Energy & Sustainability Statement

Weavings farm, 101 Abingdon Rd, Standlake,

Witney, OX29 7QN

PR10548

Date: 24/04/2023

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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 properties to be built at Weavings farm, 101 Abingdon Rd, Standlake, Witney, OX29 7QN.

The proposal is for the construction of a new 3-bedroom house. This report will be focusing on implementing careful design and sustainable measures. This is so that the project creates an attractive new residential development, addressing current housing needs within the local area.

Proposed schedules of accommodation are as follows:

- 3-bedroom house

Total combined habitable floor area for dwellings: 213.88m²

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

- West Oxfordshire District Council (WODC) sustainability standards
- The National Planning Policy Framework (NPPF) July 2021

In line with WODCs sustainability targets, the dwellings would need to have a primary energy usage (DPER) of less than 35 kWh/m^2/year. The DPER metric will be calculated using Elmhurst's Design SAP 10.2, which is approved software for assessing Part L 2021 compliance. This uses Primary Energy Factors determined in the latest 2021 Building Regulations.

The primary energy metric in SAP 10.2 is new for the 2021 regulations and is a measure of the energy demand in the properties. This energy statement will demonstrate the measures taken to ensure that energy demand has been minimalized in the residential development.

The methodology used to determine and reduce the energy demand follows the GLA guidance for energy statements, which uses a Be Lean, Be Clean, Be Green approach. While this approach is not specified for use by WODC, it is the most effective and appropriate way to reduce energy demand and uses a holistic approach toward achieving this. The steps are outlined below:

Be Lean – Use less energy

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

Emphasis will be put on the buildings' fabric performance to reduce energy demand. This is because less energy 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, as well as adopting enhanced construction details for the junctions, reducing thermal bridging.

Be Clean – Supply energy efficiently

Once the demand for energy has been minimised through fabric first measurements, all remaining energy should be supplied as cleanly as possible, using systems with a low primary energy factor and a high efficiency.

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

Be Green – Use renewable energy

At this stage of the project, various low-zero carbon and renewable technologies were considered to further the reduction in energy demand. For this development, Solar Photovoltaic Panels are considered a suitable technology that reduces reliance on grid electricity.

After implementing 4.00kWp of PV on the south west facing pitched roof per unit, in addition to the high-performance fabric and highly efficient Air Source Heat Pump implemented at the previous stages of the project, **the energy demand reduces to 1832.33kWh/yr,** thus meeting the sustainability targets set by West Oxfordshire District Council.

Specification Summary

Table 1: Proposed Fabric Specifications			
Fabric Construction and Insulation			
Element	**Type**	**U-Value**	
External Floor	Ground Floor - Solid	0.12	
External Wall	Cavity Wall	0.18	
Pitched Roof, Rafter Insulation	Pitched – insulated at rafters	0.15	
Windows/Roof light	Window	Aluminium framed double glazed, argon filled, 16mm unit with low-e coating; G-Value of 63%;	1.00
Roof Windows	Roof Light	Aluminium framed double glazed, argon filled, 16mm unit with low-e coating; G-Value of 63%;	1.00
External Doors	Solid Door	Insulated composite door unit with <30% glazing;	1.00

<table>
<tr><th colspan="9">Table 2: Proposed System Specifications</th></tr>
<tr><th colspan="9">Space Heating</th></tr>
<tr><td>Main Heating System</td><td colspan="8">SAP Default Air-Source Heat-Pump supplying radiators and wet underfloor heating system;</td></tr>
<tr><td>Heating Controls</td><td colspan="8">Time and temperature zone control;</td></tr>
<tr><td>Secondary Heating</td><td colspan="8">n/a;</td></tr>
<tr><th colspan="9">Water Heating</th></tr>
<tr><td>Heat source</td><td colspan="2">From Main Heating</td><td colspan="2">Cylinder Size</td><td>250-litre</td><td>Heat Loss</td><td colspan="2">1.70kWh/day</td></tr>
<tr><td>WWHRS Instantaneous System 1</td><td colspan="2">N/A</td><td colspan="2">WWHRS Instantaneous System 2</td><td colspan="4">N/A</td></tr>
<tr><td>Water Use <=125 l/p/d</td><td colspan="2">Yes</td><td colspan="2">Cold Water Source</td><td colspan="4">From Mains</td></tr>
<tr><td>Shower(s)</td><td colspan="2">Combination boiler or unvented hot water system</td><td colspan="2">Flow Rate [l/s]</td><td colspan="4">10.0</td></tr>
<tr><td>Bath Count</td><td colspan="2">1</td><td colspan="6">Primary pipework fully insulated;</td></tr>
<tr><td>Solar Thermal</td><td colspan="8">n/a;</td></tr>
<tr><th colspan="9">Ventilation</th></tr>
<tr><td>Mechanical Ventilation System</td><td colspan="8">Intermittent extract fans in kitchen and wet rooms (incl. utility and bath/ensuite rooms)</td></tr>
<tr><td>Cooling system</td><td colspan="8">n/a;</td></tr>
<tr><td>Pressure Test Blower Door</td><td colspan="8">5.00m³/hm² @ 50 Pa Please note ERS can provide Air Leakage Testing</td></tr>
<tr><th colspan="9">Other</th></tr>
<tr><td>Detailing (linear thermal bridging junctions – formerly ACDs)</td><td colspan="8">Enhanced construction details from Concrete Block Association, with psi values based off 150mm cavity with Knauf Dritherm 32 Full Fill insulation and a lightweight block inner leaf. Concrete Block Association Certificate number with associated detail referenced in thermal bridging. Any change to the construction should be checked through this office to ensure compliance is maintained.</td></tr>
<tr><td>Lighting</td><td>No. Fittings</td><td>20</td><td>Power [W]</td><td>2</td><td>Efficacy [lm/W]</td><td>75</td><td>Capacity [lm]</td><td>150</td></tr>
<tr><td>Tariff and Meters</td><td colspan="2">Standard</td><td colspan="2">Smart Electricity Meter</td><td>Yes</td><td>Smart Gas Meter</td><td colspan="2">Not present</td></tr>
<tr><td>PV/Renewables</td><td colspan="8">4.00kWp PV per unit mounted on the south west facing pitched roof at same gradient;
3.50 kwh battery storage</td></tr>
<tr><td colspan="9">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.</td></tr>
</table>

Introduction

Site & proposal

The site is located at Weavings farm, 101 Abingdon Rd, Standlake, Witney, OX29 7QN.

Proposed development: Construction of 3-bedroom house.

Sitewide Gross Internal Area for the proposed dwelling: 213.88m²

The approximate site location of the proposed development is shown in the site plan Fig.1.

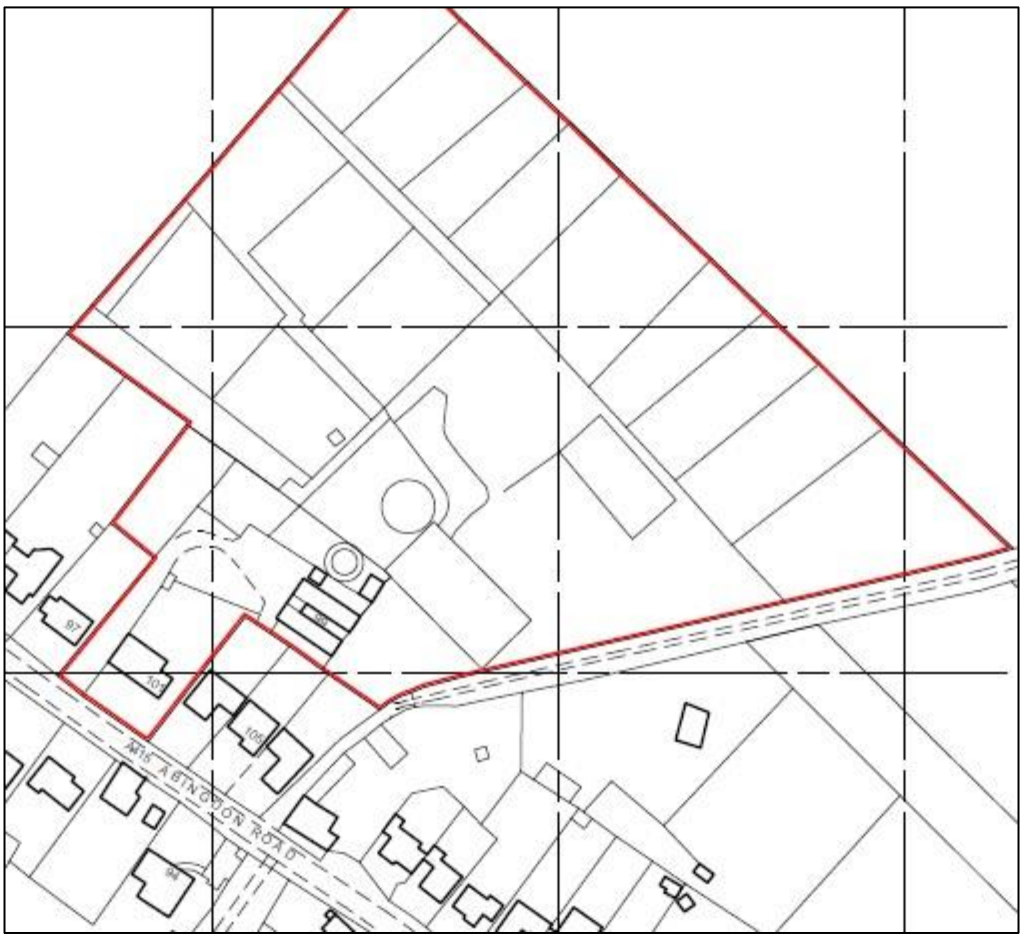


Fig.1 Site Plan

Policy context

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

- West Oxfordshire District Council (WODC) sustainability standards
- The National Planning Policy Framework (NPPF) July 2021

The WODC policy aims for a reduction in Energy Demand, so that the dwelling consumes less than 35.00 kWh/m^2/yr.

Calculation methodology

The sections below present the methodology followed in reducing the energy demand for the dwellings.

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

The energy demand is shown by the primary energy metric (DPER) in SAP 10, and is calculated using the primary energy factors in Part L 2021. SAP 10 is the approved compliance software for Part L developed by Elmhurst Energy Systems Ltd.

Baseline:

The buildings baseline uses the same heating system as the as designed counterpart; therefore, in this exercise the baseline models also use an Air Source Heat Pump. 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 dwellings' 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 Tables 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. Here, we consider the most highly efficient versions of the selected heating system.

Be Green: use renewable energy

Renewable and low-zero carbon technologies are incorporated to reduce the reliance on grid electricity for the dwelling. 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 primary energy 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 3 below.

Table 3 Carbon Emission Factors for selected fuel type	
Fuel	**Primary energy factor**
Mains Gas	1.130
Bulk/Bottled LPG	1.141
Biogas	1.286
Heating Oil	1.180
Wood Pellets	1.325
Grid Electricity	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. The following is a description of the sustainable design methods under the Be Lean umbrella.

Passive design measures

Materials and Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures are 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

Regarding 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 have a long usable life and can be reclaimed/re-used in the future. It can also be recycled although it is 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 are likely to be FSC certified. It can also be recycled or down-cycled into chipboard / crushed timber.
- 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.

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 the 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 before 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 provides 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 4 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 4 Proposed Fabric U-Values		
Domestic (U-Values in W/m²k)		
Element	**Part L 2021 Building Regulation**	**Proposed**
Wall	0.26	0.18 (External Wall)
Floor	0.18	0.12(Ground floor)
Roof	0.16	0.15
Windows/Rooflights	1.60	1.00
Doors	1.60	1.00
These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure compliance and the required energy demand target.		

Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated, 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 **5.00m^3/m^2.h at 50Pa for the proposed unit**, should the air test be below 3.00m^3/m^2.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 well-being of its occupants.

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 be low energy lighting without compensating for luminance and will accommodate LED.

Water

The sustainability targets require water efficiency in the 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 110 litres per day per person.

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 the 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 prioritises demand reduction measures oversupply 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 before occupation. The calculation must demonstrate that the new dwellings will achieve a maximum water usage of 110 litres per person per day.

Rainwater harvesting

Rainwater harvesting is the collection of rainwater directly from a surface it falls on (e.g. a roof). Once collected and stored it can be used for non-potable purposes such as watering gardens, supplying washing machines and flushing toilets, thereby reducing the consumption of potable water. Potable water is produced through a purification process and is pumped over large distances, both of which require energy and result in embodied carbon that is not present in water harvested locally. In residential development, rainwater can be captured for domestic use using water butts connected to a downpipe. Larger systems can use water stored in underground water tanks.

Schemes should be designed to include space for water storage. In residential developments, down pipes should be carefully placed so that water collection and use are convenient for residents.

Greywater re-use

Water that is recycled from bathrooms and kitchens for non-potable uses is known as greywater. Greywater systems must ensure treatment regularly to prevent a build-up of bacteria, and some systems are powered, which entails an energy cost. As a result, greywater reuse is generally less preferable than water use minimisation measures.

Water recycling systems are better suited to new developments rather than retrofitting in existing buildings because of the excavation required for storage tanks and changes needed to the plumbing system, and they are generally more cost-effective for new developments and developments of a larger scale.

Recycling systems should be backed up by a mains supply or a sufficiently large reserve storage system to meet higher demands during dry spells. Storage tanks will need an overflow to allow excess water to be released which should be able to flow into a soakaway.

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 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, the 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 demonstrate that passive measures would not be adequate.

Passive measures have been considered at the design stage to minimise the risk of overheating. These include providing openable roof windows on both sides of the roof allowing the release of excess heat and effective cross ventilation. The roof windows will be fitted with motorised blackout blinds which can also be deployed to minimise heat gain when needed. This reduces the risk of physical changes to the design that may have planning implications in order to achieve Part O compliance during the building regulations stage.

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 about 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.

- Conservatories and atria can be used to assist natural ventilation in the summer by drawing warm air upward to roof vents and to collect heat during the spring and autumn.

- 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 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 the circulation of air by drawing air through windows or top floor openings and
  - passive stack ventilation (PSV) that uses pressure differences to draw in fresh air from outside to replace rising warm air which is released from the top of the building. A heat exchanger can be placed where the air escapes the building to reduce heat loss.

Be Clean – Supply energy efficiently

The Be Clean stage considers clean energy supply to the building. The following describes the possible systems considered for use in this project. The latest GLA guidance, asks developers to consider Combines heat & power (CHP) and other types of district heating. Neither of these was considered feasible for this project due to size, site constraints, and the overall cost of those systems.

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 benefits from this; therefore, this option has been considered not feasible for this development.

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 Site, therefore meaning there are no changes to the carbon reduction to be implemented to the property.

Heat Networks

All new developments should look connected, 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 the 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 not currently located within a local heat network, so therefore it is not feasible to use district heating in this project.

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, and 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 was 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 5. 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 to their storage and delivery within an urban location. These however aren't as beneficial to DPER.	20	High	High	3	☐
PV 	PV panels would generate significant energy savings, whilst having minimal impact on the appearance of the building. These are to be incorporated on the south-facing roof.	25	Low	Med	9	■
Solar Thermal 	Solar thermal array mounted on the roof may contribute to energy reductions but will reduce the amount of available roof space where Photo voltaic panels are proposed.	25	Low	Med	7	☐
Heat Pump 	Ground loops require space, additional time at the beginning of the construction process and very high capital costs. Air source heat pumps were, however, viable for this project.	20	Med	Low	0	■
Wind 	Due to insufficient open area for the installation of a stand-alone wind turbine and planning issues this option has not been considered in this development.	25	Med	High	0	☐

Detailed assessment of Photovoltaic Panels

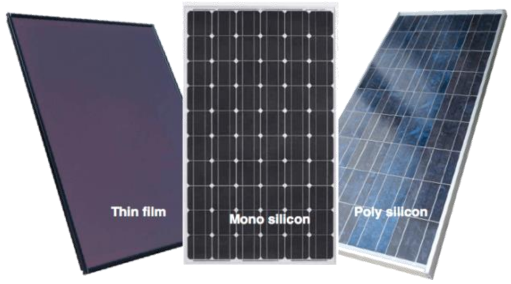


Fig 2. Photovoltaic Panels

Photovoltaic Panel is considered a suitable technology for this development 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 energy savings.

The PV shall comprise of 4.00kWp of horizontal arrays to the dwelling; Table 6 summarizes the technical data for the proposed PV array. In total, the PV installation would reduce energy demand below the target threshold, to 33.33kWh/m^2/yr.

Table 6. Proposed PV Specifications

Photovoltaic Panels	
Module Efficiency	15%
Panel Orientation	South West
Tilt	As per the sloped roof
Array Area (approximately)	~20.40m^2
Total power to be installed	4.00 kWp
Energy Savings	**2,267.05 kWh/yr**

Be Green CO_2 emissions & savings

After the Be Green Stage, with the MCS-approved installation of a highly efficient air-source heat pump, the high-performance fabric and the PV panels, the energy demand of the building now meets the sustainability targets set by WODC. This means the energy demand is **33.33kWh/m^2/yr,** below the target of 35.00 kWh/m^2/yr.

Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated energy demand of the property is **33.33kWh/m²/yr** according to a SAP 10 calculation against Part L standards, using the Primary Energy metric.

Overall, the proposed development at Weavings farm, 101 Abingdon Rd, Standlake, Witney, OX29 7QN, has been designed to meet energy policies set out by local and national planning requirements. This demonstrates that the development is committed to reducing energy demand using sustainable design measures and clean energy systems.

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 also be carefully designed to ensure the most economical operation of all equipment.

To achieve the required energy demand target, an air source heat pump will be installed by an MCS-accredited professional, with relevant certification to be provided for the as-built stage. In addition to this, levels of insulation mean the U-Values fall below the minimum notional standards of Part L reducing heat loss and therefore energy demand. After these measures, PV is added to achieve the remaining reduction needed for the target.

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 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.

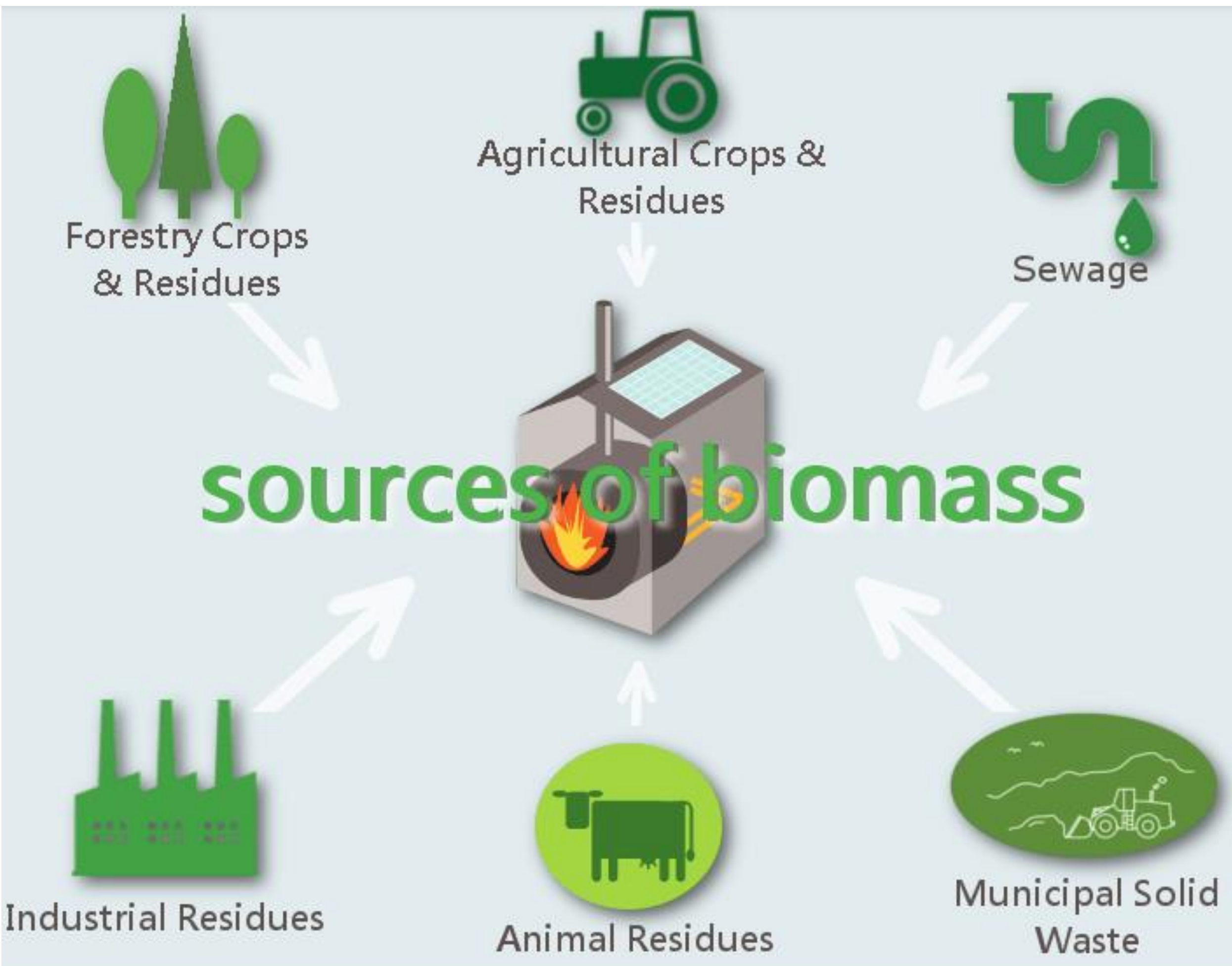
As per the West Oxfordshire District Councils' sustainability targets, residential developments are required to have an energy demand below 35.00 kWh/m²/yr. This development, after Be Lean, Be Clean and Be Green measures are implemented, consumes **33.33kWh/m²/yr,** falling below the usage targets.Post construction each building/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. These reports are to be provided 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, and electricity, be used in combined heat and power units and be used as a liquid fuel. In domestic settings, it tends to be found in the form of wood-fueled heating systems.



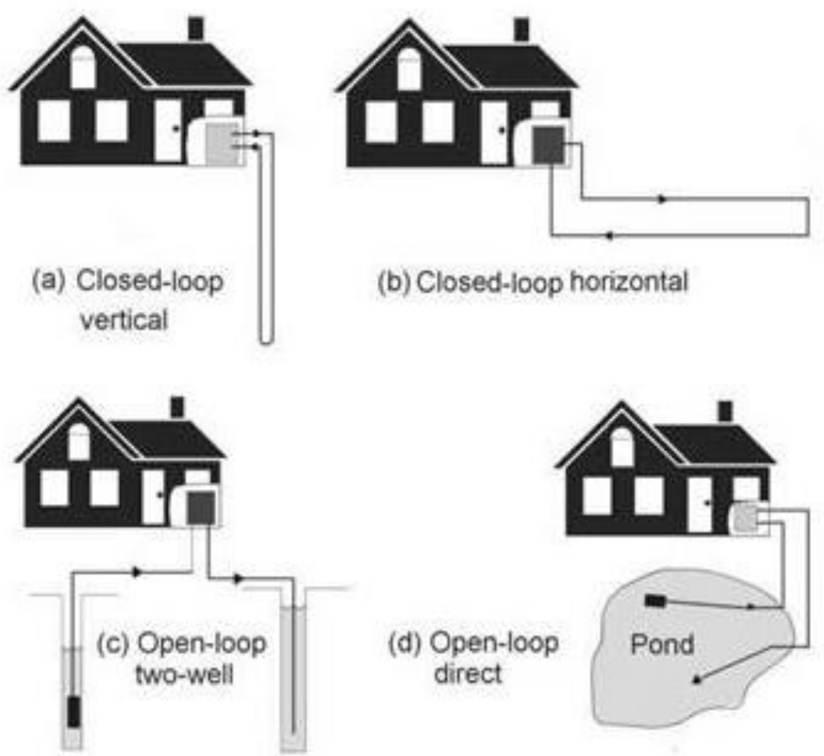
Geothermal Energy:

Geothermal energy technologies use the heat energy stored in the ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or 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 groundwater to a higher-grade heat, which 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 the 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 vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethene 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

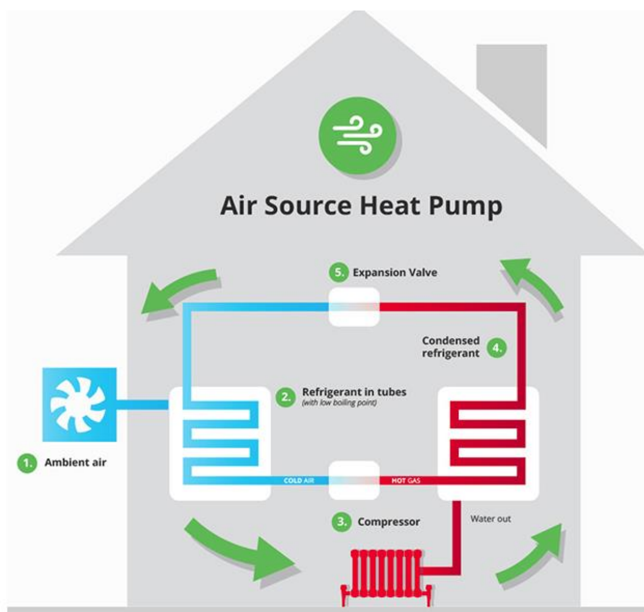
- good capacity
- low installation cost
- extensive ground excavation work

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.

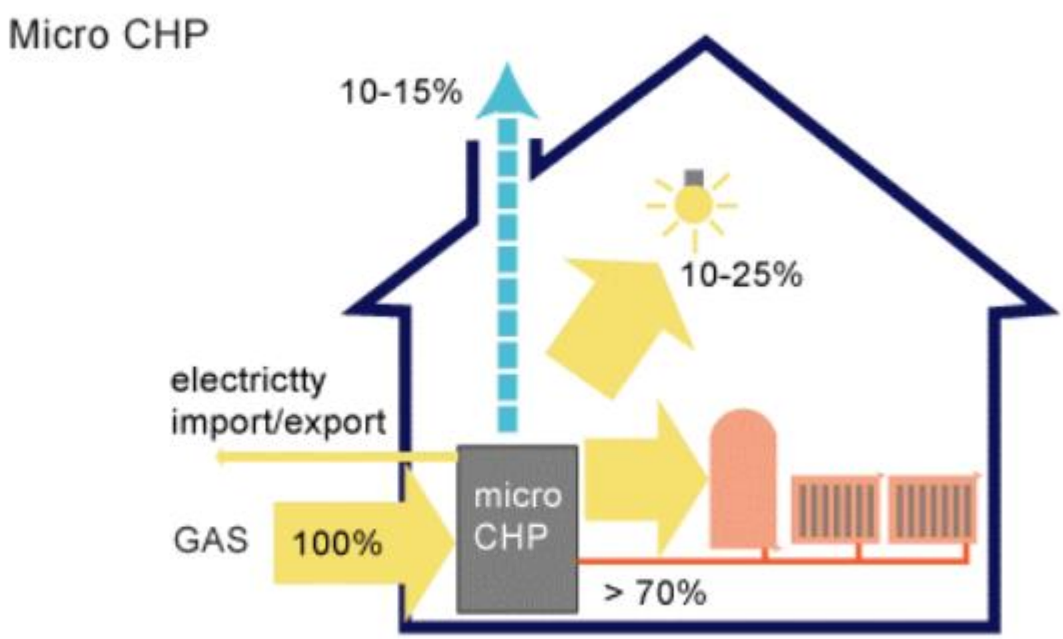
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.



CHP

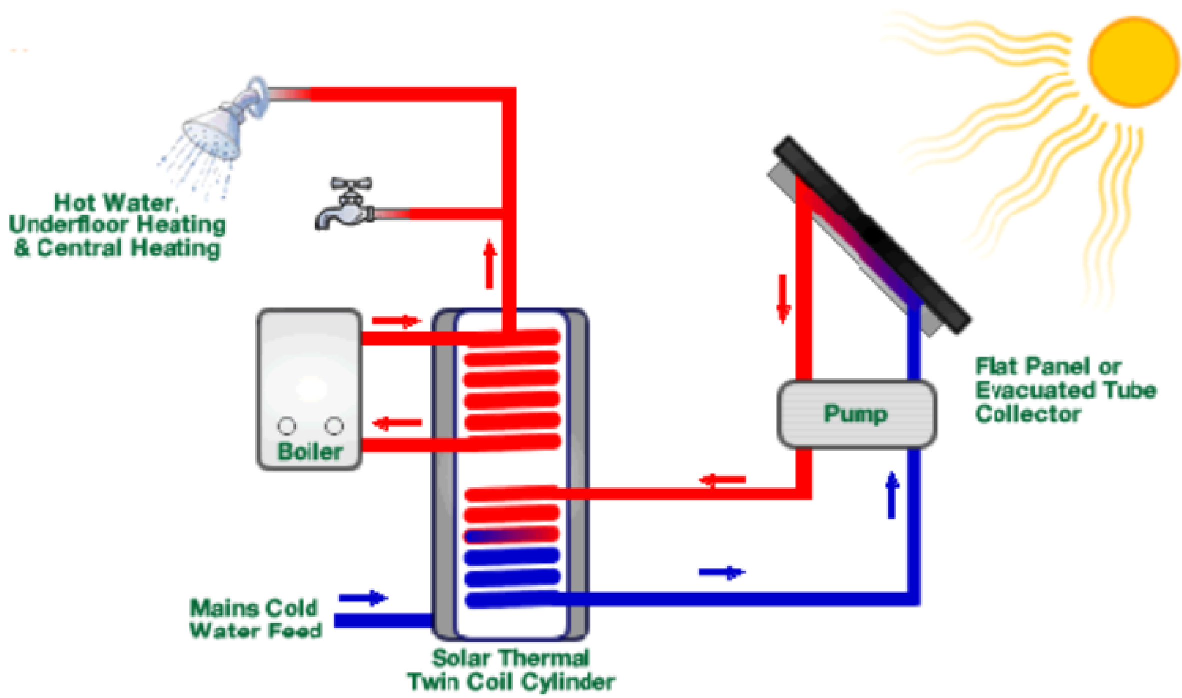
Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity 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 Charge £	Unit Price p/kWh	Emission Kg CO2 p/kWh	PE Factor	Fuel Code
Gas fuels:					
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 58	0.018	1.180
heat from boilers - B30D 0)	4.44 55	0.269	1.090
heat from boilers - coal	4.44 54	0.375	1.064
heat from electric heat pump	4.44 41	0.136 (s)	1.501 0)
heat recovered from waste combustion	4.44 42	0.015 0')	0.063
heat from boilers - biomass	4.44 43	0.029	1.037
heat from boilers - biogas (landfill or sewage gas)	4.44 44	0.024	1.286
heat recovered from power station	3.77 45	0.015 0')	0.063
high grade heat recovered from process (Appendix C4.3)	3.77 47	0.011	0.051
low grade heat recovered from process (Appendix C4.4)	3.77 49	0.136 001)	1.501 (001)
heat recovered from geothermal or other natural processes	3.77 46	0.011	0.051
heat from **CHP**	3.77 48	as above0D	as above0D

Appendix D, E, F, G & H

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

Appendix D – Plan, elevation and section drawings used for SAP Calculation

Appendix E – BREL Worksheets for As-Designed Dwelling (i.e., Be Green Specification)

Appendix F – Be Green *SAP calculation reports for the As-Designed Dwelling*

Appendix G – Be Green PEA showing potential EPC rating using provided specification

Appendix H – Sample Water calculation showing how to achieve consumption below 110/litres/person/day

OVERVIEW 1

OVERVIEW 2

OVERVIEW 3

OVERVIEW 4

AJP design
The Studio
Ammonite Cottage
Church Road
North Leigh OX29 6TX
01993 402 993
www.ajp-design.co.uk

REV A : 09-02-2023 - PLANNING APPLICATION

NEW DWELLING AT WEAVINGS FARM, ABINGDON ROAD, STANDLAKE

S.BOOTH

3D OVERVIEWS

NOT TO SCALE

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REV: A

EYE LEVEL VIEW 1

EYE LEVEL VIEW 2

EYE LEVEL VIEW 3

EYE LEVEL VIEW 4

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3D EYE LEVEL VIEWS

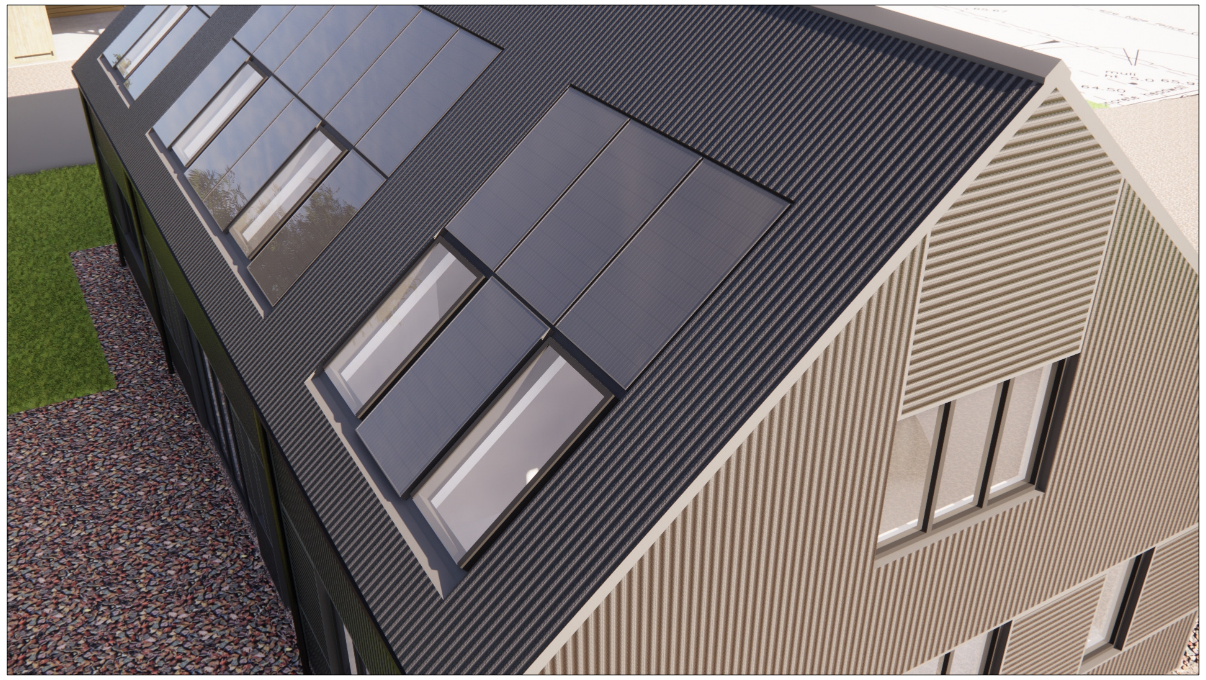
NOT TO SCALE

428 - 126

REV: A

DETAIL VIEW 1

DETAIL VIEW 2



DETAL VIEW 3

DETAIL VIEW 4

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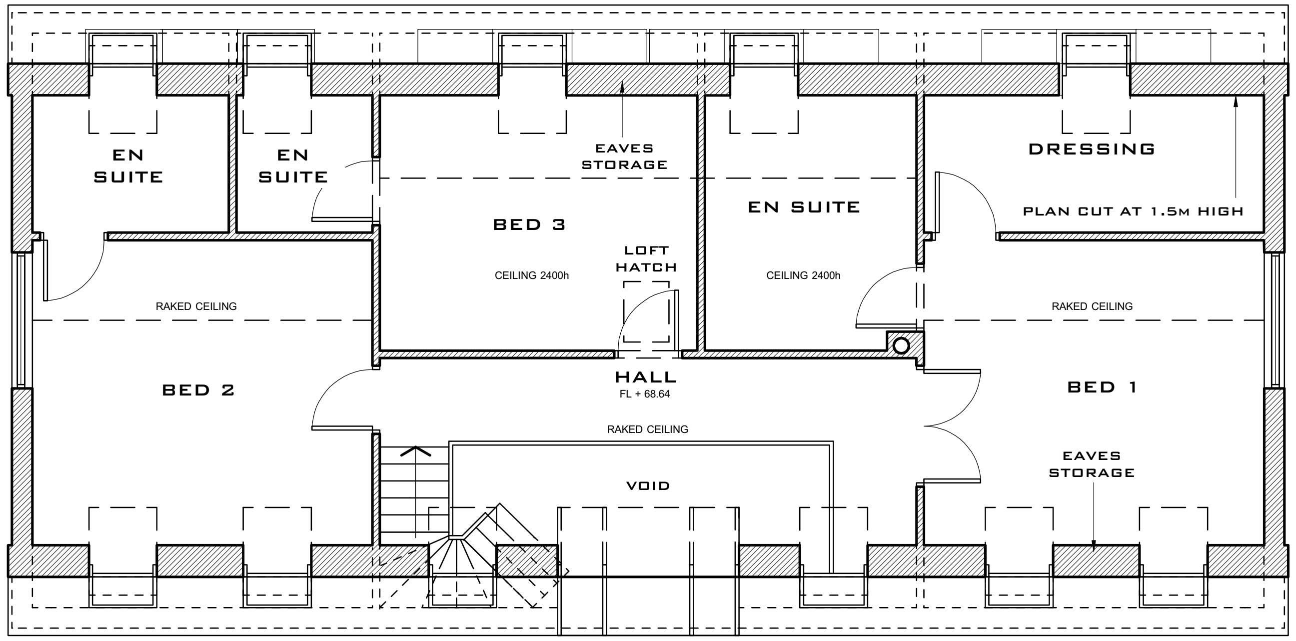
3D DETAIL VIEWS

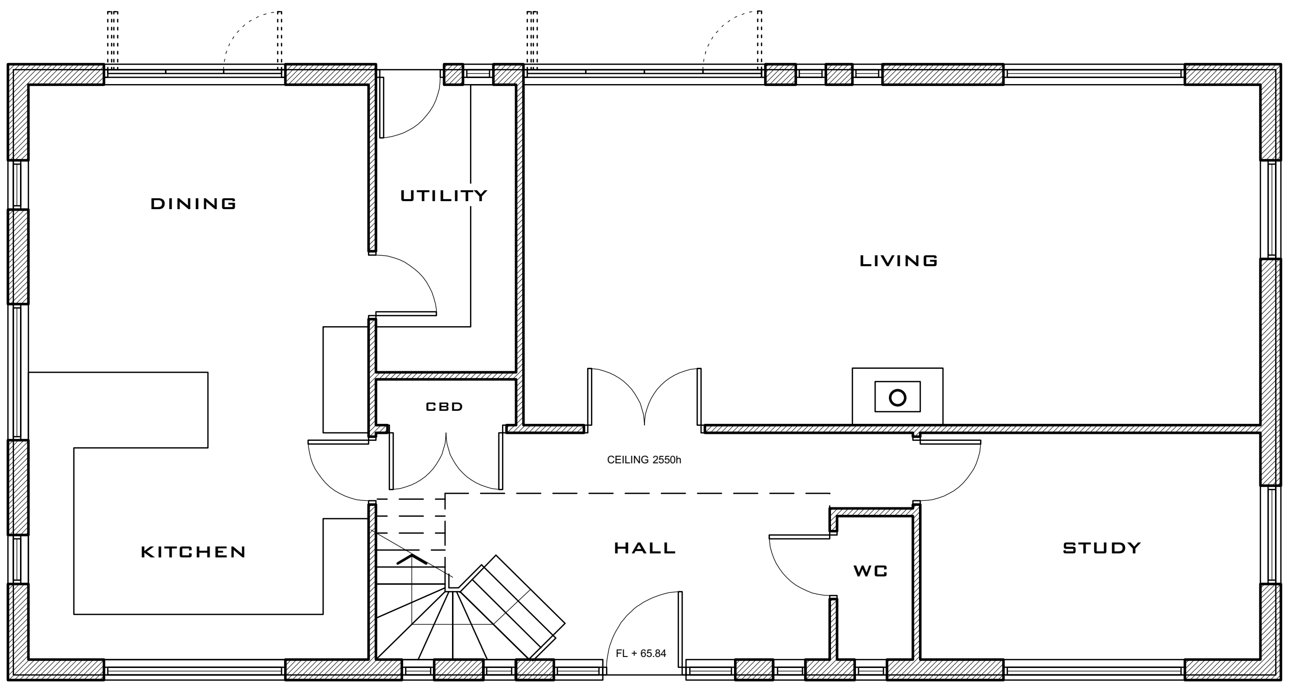
NOT TO SCALE

428 - 127

REV: A



FIRST FLOOR PLAN



GROUND FLOOR PLAN

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NEW DWELLING AT WEAVINGS FARM, ABINGDON ROAD, STANDLAKE

S.BOOTH

FLOOR PLANS (DWELLING)

1:100 @ A3

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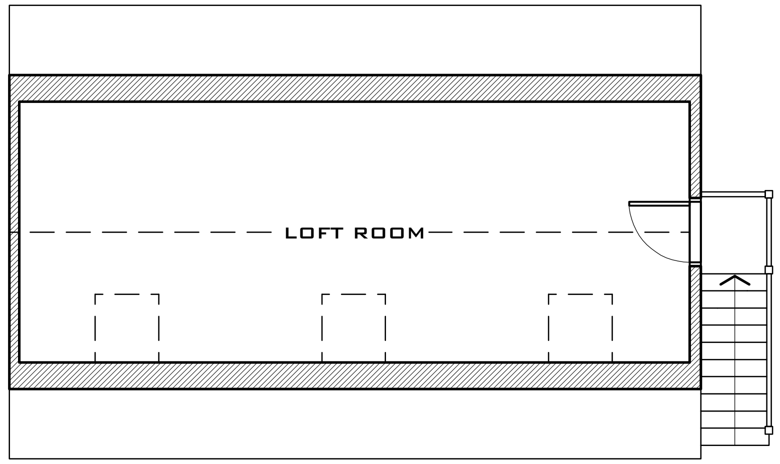
REV: A

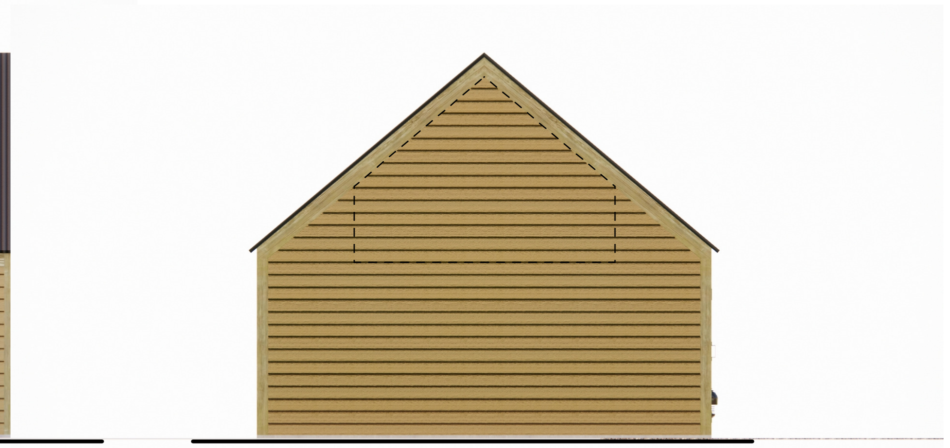
FRONT ELEVATION (SE)

SIDE ELEVATION (NE)

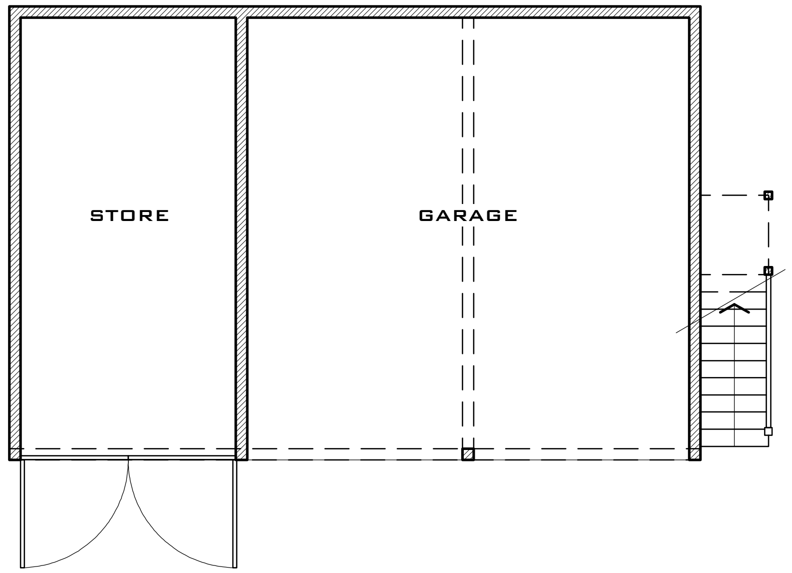


LOFT PLAN

REAR ELEVATION (NW)



SIDE ELEVATION (SW)



GROUND FLOOR PLAN

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NEW DWELLING AT WEAVINGS FARM, ABINGDON ROAD, STANDLAKE

S.BOOTH

FLOOR PLANS & ELEVATIONS (GARAGE)

1:100 @ A3

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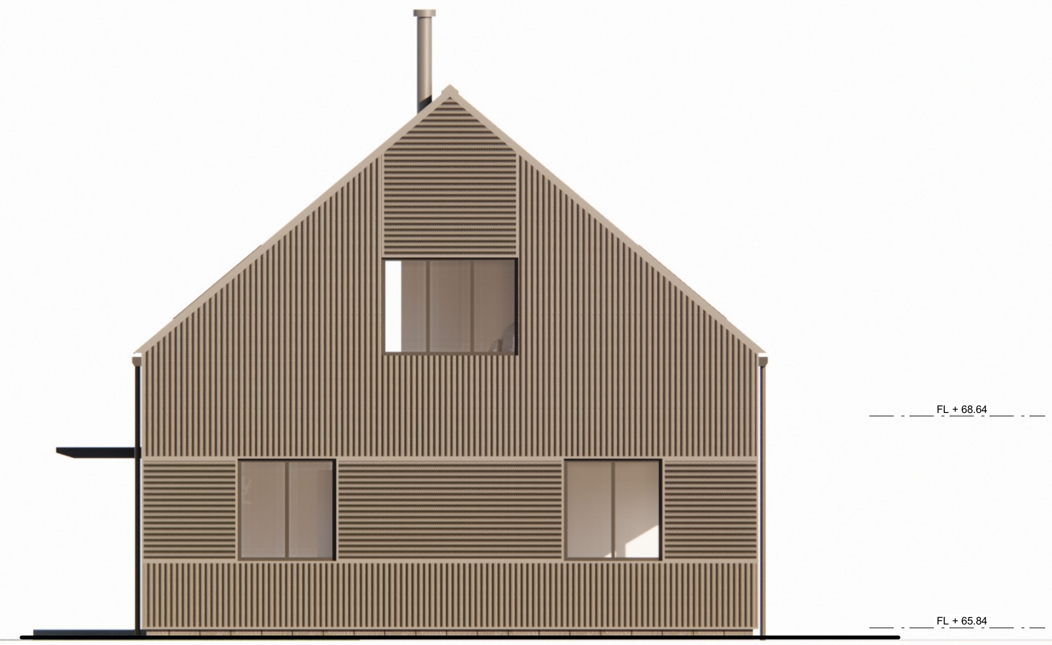
REV: A

FRONT ELEVATION (NE)



SIDE ELEVATION (NW)

REAR ELEVATION (SW)

SIDE ELEVATION (SE)

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NEW DWELLING AT WEAVINGS FARM, ABINGDON ROAD, STANDLAKE

S.BOOTH

ELEVATIONS (DWELLING)

1:100 @ A3

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REV: A

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 19 Apr 2023 15:14:58

Project Information			
Assessed By	Iraj Maghounaki	Building Type	House, Detached
OCDEA Registration	EES/015723	Assessment Date	2023-04-19

Dwelling Details			
Assessment Type	As designed	Total Floor Area	214 m^2
Site Reference	Weavings Farm	Plot Reference	001-AD
Address	weavings farm Abingdon Rd, Witney , OX29 7QN		

Client Details	
Name	AJP Design
Company	AJP Design
Address	The Studio, North Leigh, OX29 6TX

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*7.89 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.36 $kgCO_2/m^2$	**OK**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*41.9 kWh_{PE}/m^2*	
Dwelling primary energy	33.33 kWh_{PE}/m^2	**OK**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*42.8 kWh/m^2*	
Dwelling fabric energy efficiency	40.3 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heat Loss Floor 1 (0.12)	**OK**
Roofs	*0.16*	0.15	Roof (1) (0.15)	**OK**
Windows, doors, and roof windows	*1.6*	1.01	Hlaf galze door (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	143.4531	0.18
Ground floor: Heat Loss Floor 1, Heat Loss Floor 1	123.88	0.12
Exposed roof: Roof (1)	50.5285	0.15
Exposed roof: Roof (2)	68.13	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
NE windows, Windows	3.2428	North East	0.8	1 **(!)**
NE windows, Windows	0.544	North East	0.8	1 **(!)**
NE windows, Windows	0.544	North East	0.8	1 **(!)**
NE windows, Windows	0.544	North East	0.8	1 **(!)**
NE windows, Windows	0.544	North East	0.8	1 **(!)**
NE windows, Windows	1.3578	North East	0.8	1 **(!)**
NE windows, Windows	1.3578	North East	0.8	1 **(!)**
NE windows, Windows	3.2912	North East	0.8	1 **(!)**
NE windows, Windows	2.5122	North East	0.8	1 **(!)**
NE RL, Roof light	3.91	North East	0.8	1 **(!)**
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^{2}K]
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**
NE RL, Roof light	1.0965	North East	0.8	1 **(!)**
NE door, Door	2.331	North East	N/A	1 **(!)**
SW windows, Windows	3.3396	South West	0.8	1 **(!)**
SW windows, Windows	0.5168	South West	0.8	1 **(!)**
SW windows, Windows	0.5168	South West	0.8	1 **(!)**
SW windows, Windows	0.5168	South West	0.8	1 **(!)**
SW windows, Windows	7.1325	South West	0.8	1 **(!)**
SW windows, Windows	5.352	South West	0.8	1 **(!)**
Hlaf galze door, Hlaf glaze door	2.043	South West	N/A	1.2
SW RL, Roof light	1.0965	South West	0.8	1 **(!)**
SW RL, Roof light	1.0965	South West	0.8	1 **(!)**
SW RL, Roof light	1.0965	South West	0.8	1 **(!)**
SW RL, Roof light	1.0965	South West	0.8	1 **(!)**
SW RL, Roof light	1.0965	South West	0.8	1 **(!)**
NW windows, Windows	1.742	North West	0.8	1 **(!)**
NW windows, Windows	1.742	North West	0.8	1 **(!)**
NW windows, Windows	2.2606	North West	0.8	1 **(!)**
SE windows, Windows	0.91	South East	0.8	1 **(!)**
SE windows, Windows	0.91	South East	0.8	1 **(!)**
SE windows, Windows	2.448	South East	0.8	1 **(!)**
SE windows, Windows	2.448	South East	0.8	1 **(!)**

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1 - Main Dwelling**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.019 **(!)**	E2 FF CBA-313
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 **(!)**	E3 FF CBA-314
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	E4 FF CBA-315
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.101	E5 FF CBA-301
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0 **(!)**	E6 FF CBA-303
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.007 **(!)**	E11 FF CBA-309
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.077	E12 FF CBA-310
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.075	E13 FF CBA-311
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.051	E16 FF CBA-316
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	
Roof	R6: Flat ceiling	SAP table default	0.12	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	**OK**
Air permeability test certificate reference		

4 Space heating		
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity		
Efficiency	170.0%	
Emitter type	Both radiators and underfloor	
Flow temperature	35°C	
System type	Air source heat pump	
Manufacturer	dfults	
Model	SAP	
Commissioning		
Secondary heating system: Closed room heater		
Fuel	Wood logs	
Efficiency	65.0%	
Commissioning		

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	250 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	75 lm/W	**OK**
External lights control	N/A	

8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	*N/A*	
Specific fan power	N/A	**N/A**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model		
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	4 kWp
Orientation	South West
Pitch	45°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed:	Assessor ID:
Name:	Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout

elmhurst energy

Property Reference	Weavings Farm	Issued on Date	19/04/2023
Assessment Reference	001-AD	Prop Type Ref	PR10548
Property	weavings farm, Abingdon Rd, Witney , OX29 7QN		

SAP Rating	84 B	DER	3.36	TER	7.89
Environmental	96 A	% DER < TER			57.41
CO_2 Emissions (t/year)	0.59	DFEE	40.29	TFEE	42.84
Compliance Check	See BREL	% DFEE < TFEE			5.94
% DPER < TPER	20.45	DPER	33.33	TPER	41.90

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

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
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-------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
-------------------------------------------------------------------------------------------------
                                                                                         Area        Storey height              Volume
                                                                                        (m2)                  (m)                (m3)
Ground floor                                                                       123.8800 (1b)    x     2.6300 (2b)    =    325.8044 (1b) -
First floor                                                                         90.0000 (1c)    x     2.4800 (2c)    =    223.2000 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              213.8800                                                   (4)
Dwelling volume                                                             (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    549.0044 (5)



-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                                                                                           m3 per hour

Number of open chimneys                                                                                            0 * 80 =      0.0000 (6a)
Number of open flues                                                                                               1 * 20 =     20.0000 (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                                                                                6 * 10 =     60.0000 (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) =        80.0000 / (5) =      0.1457 (8)
Pressure test                                                                                                                   Yes
Pressure Test Method                                                                                                    Blower Door
Measured/design AP50                                                                                                         5.0000 (17)
Infiltration rate                                                                                                            0.3957 (18)
Number of sides sheltered                                                                                                         0 (19)

Shelter factor                                                                            (20) =  1  -  [0.075 x (19)]  =      1.0000 (20)
Infiltration rate adjusted to include shelter factor                                              (21) = (18) x (20)  =      0.3957 (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
                 0.5045     0.4946     0.4848     0.4353     0.4254     0.3759     0.3759     0.3660     0.3957     0.4254     0.4452     0.4650 (22b)
Effective ac     0.6273     0.6223     0.6175     0.5947     0.5905     0.5707     0.5707     0.5670     0.5783     0.5905     0.5991     0.6081 (25)



-------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-------------------------------------------------------------------------------------------------
Element                                      Gross       Openings         NetArea        U-value          A x U       K-value          A x K
                                                m2             m2              m2          W/m2K            W/K        kJ/m2K           kJ/K
Windows (Uw = 1.00)                                                       43.7700         0.9615        42.0865                               (27)
Door                                                                       2.3300         1.0000         2.3300                               (26)
Hlaf glaze door                                                            2.0400         1.2000         2.4480                               (26a)
NE RL                                                                     10.4900         0.9615        10.0865                               (27a)
SW RL                                                                      5.4800         0.9615         5.2692                               (27a)
Heat Loss Floor 1                                                        123.8800         0.1200        14.8656      110.0000     13626.8000 (28a)
External Wall 1                           191.6000        48.1400        143.4600         0.1800        25.8228      190.0000     27257.4000 (29a)
```

Roof @ rafter	66.5000	15.9700	50.5300	0.1500	7.5795	9.0000	454.7700	(30)
Roof @ joists	68.1300		68.1300	0.1500	10.2195	9.0000	613.1700	(30)
Total net area of external elements Aum(A, m2)			450.1100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	120.7077			(33)
Internal Wall 1			298.0000			9.0000	2682.0000	(32c)
Internal Floor 1			90.0000			18.0000	1620.0000	(32d)
Internal Ceiling 1			90.0000			9.0000	810.0000	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 47064.1400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 220.0493 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	30.4100	0.0190	0.5778
E3 Sill	21.6500	0.0200	0.4330
E4 Jamb	61.8600	0.0200	1.2372
E5 Ground floor (normal)	47.8000	0.1010	4.8278
E6 Intermediate floor within a dwelling	42.2500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	32.6000	0.0070	0.2282
E12 Gable (insulation at ceiling level)	8.3600	0.0770	0.6437
E13 Gable (insulation at rafter level)	8.1600	0.0750	0.6120
E16 Corner (normal)	14.9600	0.0510	0.7630
R1 Head of roof window	11.6500	0.2400	2.7960
R2 Sill of roof window	11.6500	0.2400	2.7960
R3 Jamb of roof window	31.7800	0.2400	7.6272
R6 Flat ceiling	32.6000	0.1200	3.9120

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 26.4539 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 147.1616 (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	113.6454	112.7499	111.8722	107.7497	106.9784	103.3878	103.3878	102.7228	104.7708	106.9784	108.5387	110.1700	(38)
Heat transfer coeff	260.8069	259.9115	259.0338	254.9113	254.1399	250.5493	250.5493	249.8844	251.9324	254.1399	255.7003	257.3316	(39)
Average = Sum(39)m / 12 =												254.9076	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2194	1.2152	1.2111	1.1918	1.1882	1.1714	1.1714	1.1683	1.1779	1.1882	1.1955	1.2032	(40)
HLP (average)												1.1918	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0200 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	108.2135	106.5873	104.2176	99.6835	96.3374	92.6060	90.4850	92.8368	95.4148	99.4213	104.0528	107.7989	(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	45.5575	43.9009	42.2443	40.5876	38.9310	37.2743	37.2743	38.9310	40.5876	42.2443	43.9009	45.5575	(42c)
Average daily hot water use (litres/day)												141.1852	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.7711	150.4882	146.4618	140.2711	135.2684	129.8803	127.7593	131.7678	136.0024	141.6656	147.9537	153.3565	(44)
Energy conte	243.5358	214.2932	225.1064	192.0241	182.0973	159.7030	154.5138	163.1560	167.7046	192.2388	210.7871	240.1192	(45)
Energy content (annual)											Total = Sum(45)m =	2345.2794	
Distribution loss (46)m = 0.15 x (45)m	36.5304	32.1440	33.7660	28.8036	27.3146	23.9554	23.1771	24.4734	25.1557	28.8358	31.6181	36.0179	(46)

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	295.2562	261.0084	276.8268	242.0761	233.8177	209.7550	206.2342	214.8764	217.7566	243.9592	260.8391	291.8396	(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	295.2562	261.0084	276.8268	242.0761	233.8177	209.7550	206.2342	214.8764	217.7566	243.9592	260.8391	291.8396	(64)

Total per year (kWh/year) = Sum(64)m = 2954.2454 (64)
12Total per year (kWh/year) 2954 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	122.3520	108.6247	116.2242	103.8896	101.9237	93.1428	92.7522	95.6257	95.8034	105.2957	110.1283	121.2159	(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	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	150.9986	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	193.7106	214.4653	193.7106	200.1676	193.7106	200.1676	193.7106	193.7106	200.1676	193.7106	200.1676	193.7106	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	384.0529	388.0382	377.9955	356.6156	329.6275	304.2624	287.3170	283.3317	293.3744	314.7542	341.7424	367.1075	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	38.0999	(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)													
	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	-120.7989	(71)
Water heating gains (Table 5)													
	164.4516	161.6438	156.2153	144.2911	136.9942	129.3651	124.6669	128.5292	133.0603	141.5265	152.9560	162.9247	(72)
Total internal gains													
	813.5147	835.4469	799.2210	772.3740	731.6318	702.0947	673.9940	673.8710	694.9019	721.2910	766.1656	795.0424	(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	13.9400	11.2829	0.6300	0.8000	0.7700	54.9350	(75)
Southeast	6.7200	36.7938	0.6300	0.8000	0.7700	86.3591	(77)
Southwest	17.3700	36.7938	0.6300	0.8000	0.7700	223.2228	(79)
Northwest	5.7400	11.2829	0.6300	0.8000	0.7700	22.6203	(81)
Northeast	10.4900	16.3666	0.6300	0.8000	1.0000	77.8765	(82)
Southwest	5.4800	39.9751	0.6300	0.8000	1.0000	99.3673	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	564.3810	1028.1379	1580.2473	2242.4551	2766.7629	2857.7020	2709.0493	2301.7445	1807.4537	1183.4691	688.2556	475.0100	(83)
Total gains	1377.8957	1863.5848	2379.4682	3014.8291	3498.3947	3559.7967	3383.0434	2975.6155	2502.3556	1904.7600	1454.4213	1270.0524	(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	50.1266	50.2993	50.4698	51.2860	51.4416	52.1788	52.1788	52.3177	51.8924	51.4416	51.1277	50.8036	
alpha	4.3418	4.3533	4.3647	4.4191	4.4294	4.4786	4.4786	4.4878	4.4595	4.4294	4.4085	4.3869	
util living area													
	0.9954	0.9834	0.9453	0.8246	0.6318	0.4434	0.3244	0.3830	0.6463	0.9212	0.9884	0.9967	(86)
MIT	19.7068	19.9650	20.3111	20.6837	20.8671	20.9206	20.9289	20.9270	20.8806	20.5642	20.0589	19.6735	(87)
Th 2	19.9045	19.9078	19.9111	19.9265	19.9294	19.9429	19.9429	19.9454	19.9377	19.9294	19.9236	19.9175	(88)
util rest of house													
	0.9940	0.9786	0.9305	0.7858	0.5716	0.3731	0.2472	0.2968	0.5638	0.8928	0.9844	0.9957	(89)
MIT 2	18.3943	18.7244	19.1571	19.6034	19.7913	19.8487	19.8537	19.8555	19.8169	19.4854	18.8582	18.3615	(90)
Living area fraction									fLA = Living area / (4) =			0.2052	(91)
MIT	18.6636	18.9789	19.3938	19.8250	20.0120	20.0686	20.0743	20.0754	20.0352	19.7067	19.1046	18.6307	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6636	18.9789	19.3938	19.8250	20.0120	20.0686	20.0743	20.0754	20.0352	19.7067	19.1046	18.6307	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9917	0.9733	0.9219	0.7817	0.5764	0.3816	0.2569	0.3076	0.5718	0.8856	0.9801	0.9940	(94)
Useful gains	1366.5136	1813.7705	2193.5406	2356.8128	2016.6441	1358.3840	868.9910	915.1617	1430.8333	1686.8040	1425.4831	1262.4794	(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													
	3746.1160	3659.2810	3339.9407	2784.9051	2112.4171	1370.1596	870.4717	918.4141	1495.2632	2314.3710	3069.5718	3713.4676	(97)
Space heating kWh													
	1770.4242	1240.1830	852.9217	308.2265	71.2552	0.0000	0.0000	0.0000	0.0000	466.9099	1183.7439	1823.5353	(98a)
Space heating requirement - total per year (kWh/year)												7717.1996	
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													
	1770.4242	1240.1830	852.9217	308.2265	71.2552	0.0000	0.0000	0.0000	0.0000	466.9099	1183.7439	1823.5353	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7717.1996	
Space heating per m2										(98c) / (4) =		36.0819	(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, %	65.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1770.4242	1240.1830	852.9217	308.2265	71.2552	0.0000	0.0000	0.0000	0.0000	466.9099	1183.7439	1823.5353	(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)	1041.4260	729.5194	501.7187	181.3097	41.9148	0.0000	0.0000	0.0000	0.0000	274.6529	696.3199	1072.6678	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	295.2562	261.0084	276.8268	242.0761	233.8177	209.7550	206.2342	214.8764	217.7566	243.9592	260.8391	291.8396	(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	173.6801	153.5344	162.8393	142.3977	137.5398	123.3853	121.3143	126.3979	128.0921	143.5054	153.4348	171.6703	(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	56.4581	45.2928	40.7811	29.8780	23.0786	18.8554	21.0531	27.3656	35.5452	46.6373	52.6767	58.0273	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-90.0146	-142.5009	-223.0466	-258.0664	-274.6070	-251.8050	-248.4934	-231.4166	-199.6826	-167.4290	-103.9801	-76.0113	(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	4539.5292	(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	1737.7914	(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)	455.6493	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2267.0538	(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	4465.9162	(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	4539.5292	0.1569	712.0405	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1737.7914	0.1410	245.0315	(264)
Space and water heating			957.0720	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	455.6493	0.1443	65.7643	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2267.0538	0.1340	-303.6908	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-303.6908	(269)
Total CO2, kg/year			719.1455	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3600	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4539.5292	1.5807	7175.4184	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1737.7914	1.5214	2643.8378	(278)
Space and water heating			9819.2562	(279)

Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	455.6493	1.5338	698.8902 (282)

Energy saving/generation technologies

PV Unit electricity used in dwelling	-2267.0538	1.4951	-3389.4218
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-3389.4218 (283)
Total Primary energy kWh/year			7128.7246 (286)
Dwelling Primary energy Rate (DPER)			33.3300 (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	123.8800 (1b)	x	2.6300 (2b)	=	325.8044 (1b) -
First floor	90.0000 (1c)	x	2.4800 (2c)	=	223.2000 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 213.8800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	549.0044 (5)

2. Ventilation rate

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

		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0729 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3229 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3229 (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	0.4116	0.4036	0.3955	0.3551	0.3471	0.3067	0.3067	0.2986	0.3229	0.3471	0.3632	0.3794	(22b)
Effective ac	0.5847	0.5814	0.5782	0.5631	0.5602	0.5470	0.5470	0.5446	0.5521	0.5602	0.5660	0.5720	(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			2.3300	1.0000	2.3300			(26)
TER Semi-glazed door			2.0400	1.0000	2.0400			(26a)
TER Opening Type (Uw = 1.20)			35.9800	1.1450	41.1985			(27)
NE RL			8.6200	1.4151	12.1981			(27a)
SW RL			4.5000	1.4151	6.3679			(27a)
Heat Loss Floor 1			123.8800	0.1300	16.1044			(28a)
External Wall 1	191.6000	40.3500	151.2500	0.1800	27.2250			(29a)
Roof @ rafter	66.5000	13.1200	53.3800	0.1100	5.8718			(30)
Roof @ joists	68.1300		68.1300	0.1100	7.4943			(30)
Total net area of external elements Aum(A, m2)			450.1100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	120.8300			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 220.0493 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	30.4100	0.0500	1.5205

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        E3 Sill                                                                                  21.6500         0.0500         1.0825
        E4 Jamb                                                                                  61.8600         0.0500         3.0930
        E5 Ground floor (normal)                                                                 47.8000         0.1600         7.6480
        E6 Intermediate floor within a dwelling                                                  42.2500         0.0000         0.0000
        E11 Eaves (insulation at rafter level)                                                   32.6000         0.0400         1.3040
        E12 Gable (insulation at ceiling level)                                                   8.3600         0.0600         0.5016
        E13 Gable (insulation at rafter level)                                                    8.1600         0.0800         0.6528
        E16 Corner (normal)                                                                      14.9600         0.0900         1.3464
        R1 Head of roof window                                                                   11.6500         0.0800         0.9320
        R2 Sill of roof window                                                                   11.6500         0.0600         0.6990
        R3 Jamb of roof window                                                                   31.7800         0.0800         2.5424
        R6 Flat ceiling                                                                          32.6000         0.0600         1.9560
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                     23.2782 (36)
Point Thermal bridges                                                                                                (36a) =    0.0000
Total fabric heat loss                                                                                   (33) + (36) + (36a) =   144.1082 (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          105.9357   105.3396   104.7553   102.0111   101.4977    99.1076    99.1076    98.6649   100.0282   101.4977   102.5364   103.6222 (38)
Heat transfer coeff
               250.0439   249.4478   248.8636   246.1193   245.6059   243.2158   243.2158   242.7732   244.1364   245.6059   246.6446   247.7305 (39)
Average = Sum(39)m / 12 =                                                                                                      246.1169

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             1.1691     1.1663     1.1636     1.1507     1.1483     1.1372     1.1372     1.1351     1.1415     1.1483     1.1532     1.1583 (40)
HLP (average)                                                                                                                   1.1507
Days in mont        31         28         31         30         31         30         31         31         30         31         30         31


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4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                               3.0200 (42)
Hot water usage for mixer showers
                96.1898    94.7443    92.6378    88.6075    85.6333    82.3164    80.4311    82.5216    84.8132    88.3745    92.4914    95.8213 (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
                45.5575    43.9009    42.2443    40.5876    38.9310    37.2743    37.2743    38.9310    40.5876    42.2443    43.9009    45.5575 (42c)
Average daily hot water use (litres/day)                                                                                      130.0997 (43)

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               141.7474   138.6452   134.8821   129.1952   124.5643   119.5908   117.7054   121.4526   125.4008   130.6187   136.3923   141.3788 (44)
Energy conte   224.4932   197.4289   207.3088   176.8617   167.6874   147.0508   142.3545   150.3837   154.6317   177.2484   194.3158   221.3651 (45)
Energy content (annual)                                                                              Total = Sum(45)m =      2161.1299
Distribution loss  (46)m = 0.15 x (45)m
                33.6740    29.6143    31.0963    26.5293    25.1531    22.0576    21.3532    22.5575    23.1948    26.5873    29.1474    33.2048 (46)
Water storage loss:
Store volume                                                                                                                  250.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                   1.8903 (48)
  Temperature factor from Table 2b                                                                                              0.5400 (49)
Enter (49) or (54) in (55)                                                                                                      1.0208 (55)
Total storage loss
                31.6444    28.5820    31.6444    30.6236    31.6444    30.6236    31.6444    31.6444    30.6236    31.6444    30.6236    31.6444 (56)
If cylinder contains dedicated solar storage
                31.6444    28.5820    31.6444    30.6236    31.6444    30.6236    31.6444    31.6444    30.6236    31.6444    30.6236    31.6444 (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
               279.4000   247.0221   262.2155   229.9973   222.5942   200.1864   197.2613   205.2905   207.7673   232.1552   247.4514   276.2718 (62)
WWHRS          -43.9740   -38.8909   -40.7243   -33.7214   -31.4271   -26.8924   -25.2073   -26.8055   -27.8239   -32.8013   -37.1599   -43.1596 (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
               235.4260   208.1312   221.4912   196.2759   191.1671   173.2940   172.0540   178.4850   179.9434   199.3539   210.2915   233.1122 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =     2399.0253 (64)
12Total per year (kWh/year)                                                                                                     2399 (64)
Electric shower(s)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (64a)
                                                       Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =      0.0000 (64a)
Heat gains from water heating, kWh/month
               118.5694   105.3197   112.8556   101.3150    99.6815    91.4029    91.2583    93.9280    93.9235   102.8605   107.1185   117.5293 (65)


-----------------------------------------------------------------------------------------------------
5. Internal gains (see Table 5 and 5a)
-----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986   150.9986 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               193.7106   214.4653   193.7106   200.1676   193.7106   200.1676   193.7106   193.7106   200.1676   193.7106   200.1676   193.7106 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               384.0529   388.0382   377.9955   356.6156   329.6275   304.2624   287.3170   283.3317   293.3744   314.7542   341.7424   367.1075 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999    38.0999 (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)
              -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989  -120.7989 (71)
Water heating gains (Table 5)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	159.3675	156.7257	151.6876	140.7153	133.9805	126.9484	122.6590	126.2473	130.4493	138.2534	148.7757	157.9695	(72)
Total internal gains	808.4306	830.5288	794.6933	768.7981	728.6182	699.6780	671.9862	671.5892	692.2910	718.0178	761.9853	790.0872	(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	11.4500	11.2829	0.6300	0.7000	0.7700	39.4820	(75)
Southeast	5.5300	36.7938	0.6300	0.7000	0.7700	62.1830	(77)
Southwest	14.2800	36.7938	0.6300	0.7000	0.7700	160.5739	(79)
Northwest	4.7200	11.2829	0.6300	0.7000	0.7700	16.2756	(81)
Northeast	8.6200	16.3666	0.6300	0.7000	1.0000	55.9946	(82)
Southwest	4.5000	39.9751	0.6300	0.7000	1.0000	71.3976	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	405.9068	739.4228	1136.4435	1612.6076	1989.6026	2054.9795	1948.0902	1655.2251	1299.8173	851.1213	494.9943	341.6332	(83)
Total gains	1214.3374	1569.9516	1931.1368	2381.4058	2718.2207	2754.6575	2620.0764	2326.8143	1992.1083	1569.1392	1256.9796	1131.7204	(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	52.2843	52.4092	52.5323	53.1180	53.2291	53.7522	53.7522	53.8502	53.5495	53.2291	53.0049	52.7726	
alpha	4.4856	4.4939	4.5022	4.5412	4.5486	4.5835	4.5835	4.5900	4.5700	4.5486	4.5337	4.5182	
util living area	0.9972	0.9910	0.9712	0.8978	0.7421	0.5463	0.4044	0.4712	0.7457	0.9549	0.9933	0.9980	(86)
MIT	19.3649	19.6424	20.0432	20.5350	20.8521	20.9714	20.9942	20.9887	20.8896	20.4152	19.7939	19.3239	(87)
Th 2	19.9448	19.9471	19.9493	19.9596	19.9616	19.9706	19.9706	19.9723	19.9671	19.9616	19.9576	19.9535	(88)
util rest of house	0.9964	0.9883	0.9626	0.8697	0.6841	0.4659	0.3118	0.3702	0.6658	0.9365	0.9909	0.9974	(89)
MIT 2	18.0326	18.3879	18.8950	19.4972	19.8411	19.9543	19.9686	19.9681	19.8917	19.3719	18.5904	17.9862	(90)
Living area fraction									fLA = Living area / (4) =			0.2052	(91)
MIT	18.3060	18.6453	19.1305	19.7102	20.0485	20.1630	20.1790	20.1775	20.0964	19.5860	18.8373	18.2606	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3060	18.6453	19.1305	19.7102	20.0485	20.1630	20.1790	20.1775	20.0964	19.5860	18.8373	18.2606	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9836	0.9538	0.8618	0.6893	0.4814	0.3308	0.3908	0.6767	0.9279	0.9870	0.9958	(94)
Useful gains	1207.4606	1544.1645	1841.9511	2052.3055	1873.7446	1326.0362	866.7483	909.2870	1348.1556	1455.9849	1240.6225	1126.9560	(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	3502.1029	3428.7361	3143.2823	2660.5892	2050.4432	1353.0088	870.4796	917.0702	1463.9402	2207.0050	2894.9457	3483.2452	(97)
Space heating kWh	1707.2139	1266.4321	968.1904	437.9642	131.4637	0.0000	0.0000	0.0000	0.0000	558.7590	1191.1127	1753.0792	(98a)
Space heating requirement - total per year (kWh/year)												8014.2153	
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	1707.2139	1266.4321	968.1904	437.9642	131.4637	0.0000	0.0000	0.0000	0.0000	558.7590	1191.1127	1753.0792	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8014.2153	
Space heating per m2											(98c) / (4) =	37.4706	(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	1707.2139	1266.4321	968.1904	437.9642	131.4637	0.0000	0.0000	0.0000	0.0000	558.7590	1191.1127	1753.0792	(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)	1849.6358	1372.0824	1048.9604	474.5008	142.4309	0.0000	0.0000	0.0000	0.0000	605.3727	1290.4797	1899.3274	(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													
	235.4260	208.1312	221.4912	196.2759	191.1671	173.2940	172.0540	178.4850	179.9434	199.3539	210.2915	233.1122	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.6027	87.4086	86.9738	85.8052	83.2375	79.8000	79.8000	79.8000	79.8000	86.2423	87.3222	87.6399	(217)
Fuel for water heating, kWh/month													
	268.7430	238.1131	254.6643	228.7460	229.6645	217.1604	215.6065	223.6654	225.4930	231.1556	240.8225	265.9886	(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	40.2492	32.2894	29.0731	21.3002	16.4529	13.4421	15.0088	19.5091	25.3404	33.2479	37.5534	41.3679	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-97.9380	-129.8513	-175.5783	-185.1896	-189.7593	-173.4070	-170.9092	-165.8063	-155.9437	-142.0002	-104.5356	-85.6381	(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	-83.4467	-171.3066	-333.1213	-490.2078	-638.9167	-638.9154	-631.6955	-539.2915	-401.0932	-241.8639	-110.3164	-66.3478	(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	8682.7901	(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	2839.8228	(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)	324.8344	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6123.0794	(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	5810.3680	(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	8682.7901	0.2100	1823.3859	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2839.8228	0.2100	596.3628	(264)
Space and water heating			2419.7487	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	324.8344	0.1443	46.8836	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1776.5566	0.1360	-241.5650	
PV Unit electricity exported	-4346.5228	0.1265	-549.8287	
Total			-791.3937	(269)
Total CO2, kg/year			1687.1679	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.8900	(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	8682.7901	1.1300	9811.5529	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2839.8228	1.1300	3208.9998	(278)
Space and water heating			13020.5526	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	324.8344	1.5338	498.2419	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1776.5566	1.5026	-2669.4752	
PV Unit electricity exported	-4346.5228	0.4644	-2018.3616	
Total			-4687.8369	(283)
Total Primary energy kWh/year			8961.0584	(286)
Target Primary Energy Rate (TPER)			41.9000	(287)

Predicted Energy Assessment

elmhurst energy

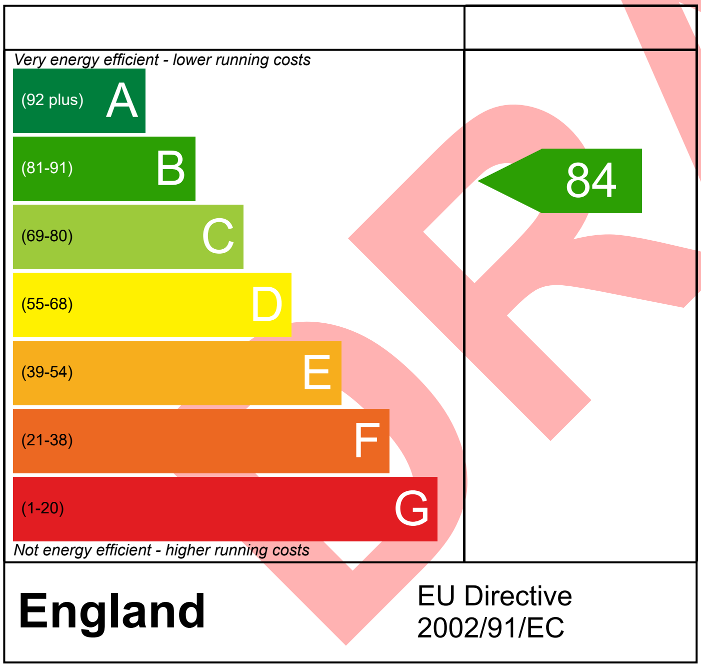
weavings farm, Abingdon Rd, Witney , OX29 7QN

Dwelling type:	House, Detached
Date of assessment:	20/04/2023
Produced by:	Iraj Maghounaki
Total floor area:	213.88 m²
DRRN:	

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

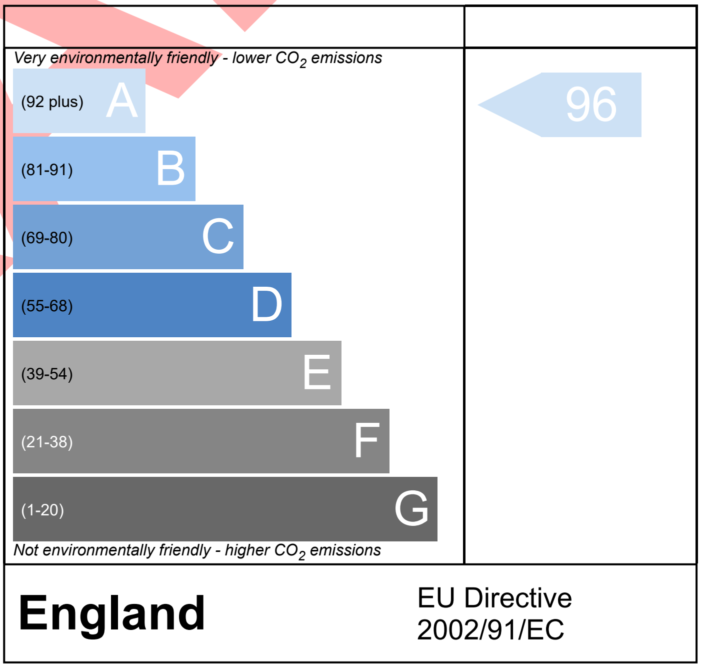
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

breglobal

Job no:	PR8908
Date:	05/07/2021
Assessor name:	Nikolas Koutsorizof
Registration no:	BRE400012
Development name:	House 1 & 2, 14 Sunderland Avenue, Oxford, OX2 8DX

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:	House 1		House 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	4	11.84	4	11.84		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)	7	12.64	7	12.64		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		**Bath & Shower**		**Bath & Shower**																	
Bath	Capacity to overflow	165	18.15	165	18.15		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	10	43.70	10	43.70		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	9	14.32	9	14.32		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		131.1		131.1		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**		**119.3**		**119.3**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	Mandatory level		**Level 1/2**		**Level 1/2**		-		-		-		-		-		-		-		-
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		**124.3**		**124.3**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	17.K Compliance?		**Yes**		**Yes**		-		-		-		-		-		-		-		-