**1 x dwelling**
**Woodlands, 5 The Cottages, The Drive, Ickenham**

**SUSTAINABILITY STATEMENT TO DISCHARGE PLANNING CONDITION 19 OF PLANNING APPROVAL REFERENCE 56190/APP/2021/2737**

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## 1.0 EXECUTIVE SUMMARY

The proposed new development consisting of **1 x dwelling, Woodlands, 5 The Cottages, The Drive, Ickenham** has been designed to incorporate low energy and sustainable building design features using a fabric-first approach with energy efficient building services.

This report has been prepared to demonstrate compliance with Planning Condition 19 of Planning approval reference 56190/APP/2021/2737 to achieve a 10% reduction in carbon emissions.

The dwellings have been designed to maximise the 'Fabric First' approach, using the geometry of the building design, combined with strategically placed glazing, orientated to maximise passive solar gains. A highly insulated building envelope provides improvements of up to 56% better than Building Regulation values.

Renewable energy has been considered and the chose low carbon technology using renewable energy is a wood burning stove using biomass to heat the living space.

The **annual carbon emissions** to comply with Part P1A 2013 of the Building Regulations for this dwelling are 6,195 kgCO2/year. Using a combination of the fabric first approach, energy efficient building services and renewable space heating via the wood burning stove, it is predicted to **reduce the annual carbon emissions by 628 kgCO2/year** which achieves a predicted **10.13% reduction in carbon emissions.** This meets the requirement of Planning Condition 19 of Planning approval reference 56190/APP/2021/2737 to achieve a 10% reduction in carbon emissions.

## 2.0 INTRODUCTION

The proposed new development consisting of **1 x dwelling, Woodlands, 5 The Cottages, The Drive, Ickenham** has been designed to incorporate low energy and sustainable building design features using a fabric-first approach with energy efficient building services and renewable energy generation.

This report has been prepared to demonstrate compliance with Planning Condition 19 of Planning approval reference 56190/APP/2021/2737 to achieve a 10% reduction in carbon emissions.

The Site plan is indicated in figure 1 below:

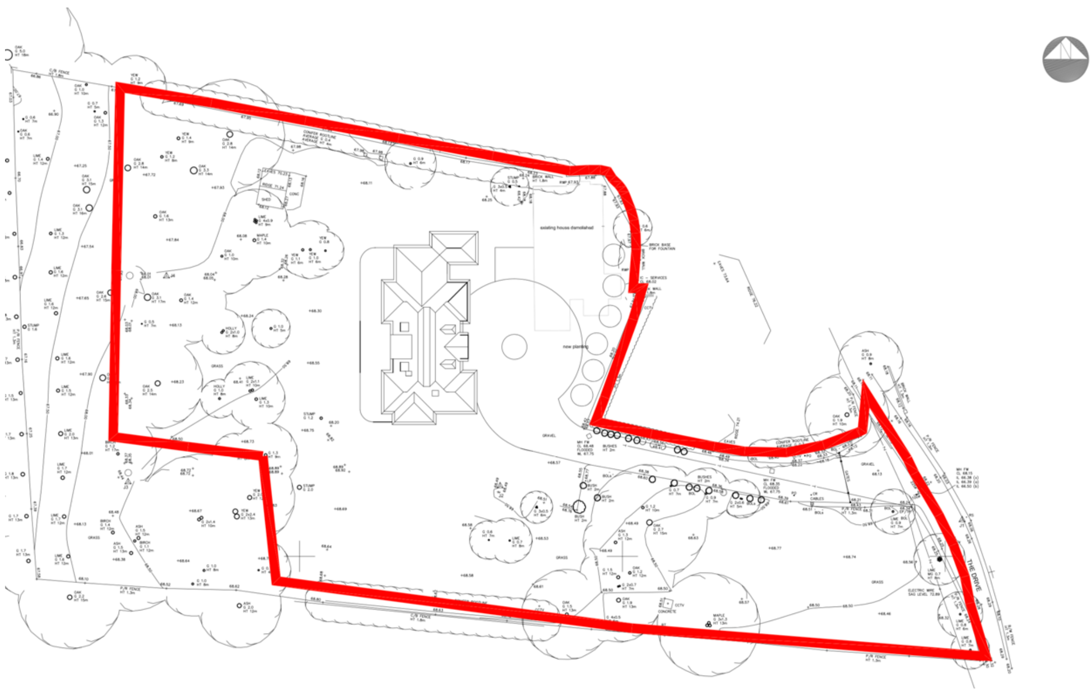

***Figure 1: Site plan***

This report will set out to summarise the following criteria

1. Determine the basecase carbon emissions to comply with current Building Regulations
2. Assess alternative renewable and low carbon technologies to provide a minimum of 10% reduction of on-site carbon reductions

The report will be carried out by an accredited On-Construction Domestic Energy Assessor, Robert Atherton, Director of Low Carbon Box. Energy assessments will be carried out using SAP 2012 using the same methodology for compliance with Part L1A 2013 of the Building Regulations.

## 3.0 SUSTAINABILITY STATEMENT

### 3.1 ENERGY EFFICIENCY – BUILDING FABRIC

The proposed dwelling will be constructed under Part L 2013. Below is the proposed specification for the new dwellings in tables 1 and 2.:

**Table 1: Input data used for the SAP Calculations**

| Item | Standard | Specification |
|---|---|---|
| **Walls - Brick** | 0.26 W/m2.K<br>Kappa = 77.91 kJ/m2.K | 102.5mm brickwork or blockwork; 100mm cavity with 100mm Knauf Dritherm 32 Full Fill (0.032 W/mK); 100mm lightweight Blockwork (0.28 W/mK 950 kg/m3); 13mm plaster |
| **Dormer Cheek/Attic walls** | 0.21 W/m2.K | External finish; 12mm WBP plywood; 100mm timber studs; 100mm PIR insulation (0.022 W/mK) between studs; 37.5mm insulated plasterboard (25mm PIR (0.022 W/mK) + VCL + 12.5mm Plasterboard) |
| **Attic wall/Ceiling** | 0.12 W/m2.K | Roof U value = 0.16 x 0.72 sheltering factor |
| **Roof (sloping)** | 0.16 W/m2.K | Roof construction incorporating 35mm Actis Boost Hybrid over rafters and 155mm Actis Hybris insulation between rafters at 600mm centres. |
| **Roof (Flat)** | 0.16 W/m2.K | Roof finish; 140mm PIR insulation (0.024 W/mK); VCL; 18mm WBP Plywood; Joists; Plasterboard |
| **Ground Floor** | 0.11 W/m2.K | 75mm screed; Vapour control layer; 150mm PIR Insulation (0.022 W/mK); DPM; Beam & block Floor |
| **Windows & Glazed doors & Rooflights** | 1.40 W/m2.K | Double glazed<br>'g' value = 0.66 |
| **Front door** | 1.20 W/m2.K | |
| **Air test** | 4.50 m3/hr/m2 | |
| **Accredited Details** | ACD, Concrete Block Association | See Table 3 |

Table 2 below compares the building fabric to current Building Regulation Standards.

### Table 2: U value comparison

| Item | Standard | Building Regs | Improvement |
|---|---|---|---|
| **Walls (cavity)** | 0.26 W/m2.K | 0.30 W/m2.K | 13% |
| **Roof (Ceiling)** | 0.12 W/m2.K | 0.20 W/m2.K | 40% |
| **Roof (Slope)** | 0.16 W/m2.K | 0.20 W/m2.K | 20% |
| **Roof (Flat)** | 0.16 W/m2.K | 0.20 W/m2.K | 20% |
| **Ground Floor** | 0.11 W/m2.K | 0.25 W/m2.K | 56% |
| **Windows** | 1.40 W/m2.K | 2.00 W/m2.K | 30% |
| **Front Door** | 1.20 W/m2.K | 2.00 W/m2.K | 40% |
| **Air test** | 4.50 $m^3/hr/m^2$ | 10 $m^3/hr/m^2$ | 55% |

The proposed building fabric indicated in Table 1 is proposed to have improvements of between 13-56%.

The proposed building services are outline in Table 3 below.

### Table 3: Summary of building services for SAP

| Item | Standard | Specification |
|---|---|---|
| **Heating** | Gas fired system boiler | Assumed at this stage:<br>Allowed for 2 x Worcester Bosch Greenstar 8000 50kW |
| **Heating Controls** | Time & Temperature Zone Control | Delayed start thermostat |
| **Heating Features** | Via Underfloor & radiators | |
| **Hot Water (Cylinder)** | Hot water cylinder connected to system boiler | 300 litres with 2.17 kWh/day losses**<br>Fully insulated primary pipework |
| **Hot water features** | None | |
| **Secondary Heating** | See section 3.20 | |
| **Ventilation** | Natural with System 1 intermittent extract | |
| **Lighting** | 100% low energy lighting | Bulbs to have efficacy greater than 45 lumens/circuit watt |
| **Renewable Energy** | See Section 3.20 | |

***To be confirmed by heating engineer*

The proposed specification achieves compliance with Part L1A 2013 of the Building Regulations.

The next section reviews low and zero carbon technologies.

## 3.2 RENEWABLE ENERGY

This section of the report conducts an appraisal of potential low carbon or renewable technologies which could be utilised at the site.

### 3.2.1 Wind Turbines

Wind turbines convert the power in the wind into electrical energy using rotating wing-like blades which drive a generator. Similar to PV, they can either be grid connected or used to charge batteries or on site use.

Wind turbines can range from small domestic turbines producing hundreds of watts to large offshore turbines with capacities of 3MW and diameters of 100m. A detailed study for urban deployment should take into account wind speed and turbulence and potential noise pollution issues.

There are two main types of turbine available, horizontal or vertical axis. Horizontal axis turbines, (sometimes referred to a propeller type) range in scale from 0.5m to 100m diameter. Vertical-axis turbines rotate around a vertical axis, resulting in lower rotor tip speed and reduced noise and vibration issues.

In both cases, the output of the turbine will be dependent upon both the start-up speed of the blades and the specific gearing and generator design.

The efficiency and performance of small scale, and in particular, domestic scale wind turbines can vary, however, the most common cause of poor performance is poor sitting of the turbine. The turbulent wind conditions often found in urban locations undermines the performance of horizontal scale turbines as they have to regularly rotate Yaw to face the oncoming wind.

This process reduces the proportion of energy that the turbine can capture. Vertical axis turbines are designed to avoid this issue by always having blades facing the wind.

These performance issues mean that as a general rule, horizontal turbines are better suited to less turbulent wind regimes, whilst vertical axis turbines offer potential for installation in urban environments.

**Figure 3: Wind turbine**

In either case, the turbine must be mounted at a reasonable height to ensure that it can 'see' the wind. For urban deployment this means that roof mounted turbines still require a mast and the structural design of the building must be developed to incorporate the additional loads and stresses.

While the site is semi-exposed, the wind turbine would not be favorable for the development and local area due to noise and biodiversity issues. **This option is NOT considered.**

### 3.2.2 Biomass Heating

In the context of energy generation, the term 'biomass'· can refer to any organic substance that can be processed to produce energy, either solid matter or liquid biofuel. Biomass fuels are an alternative to conventional fossil fuels and are often considered to be near carbon neutral. This is because the growing plant or tree absorbs the same quantity of $CO_2$ in its lifetime as is released upon energy conversion.

Biomass is a renewable form of energy as it can be replaced over a short period of time. Biomass or biofuels are currently being produced from plantations of a variety of plant types, as well as from waste materials like cooking oil and waste wood. If waste wood is used, care must be taken to maintain fuel standards and exclude wood treatments such as preservatives and paint. Biomass heating is simple and proven technology, widely used in mainland Europe, and which compares well in running cost with mains gas. It can be implemented on a variety of scales from systems for small buildings up to systems of several MW capacities, with the capital cost of larger installations decreasing per unit of heat output.

A key issue for any site considering biomass is the need for substantial storage space allocation for the fuel stock. Although not impossible, the storage requirement and the need for regular fuel deliveries can create significant complications in the development of large scale urban biomass heating systems.

Biomass boilers can achieve similar efficiencies as good quality gas boilers, providing a significantly more efficient fuel burn than open fires or wood burning stoves. Large scale biomass boilers are particularly suitable for rural use such as farms or warehousing where space constraints are less onerous.

The capital costs of biomass boilers are greater than their gas equivalents. For example the purchase price of a 50KW log boiler alone is in the region of £4,000-£5,000 and there is a requirement for additional 'buffer' storage compared to conventional gas systems. Note however that the extra over cost compared to gas for a 15KW output can be as high as £8,000-£12,000.

**Figure 4: Biomass Boiler diagram**

**Figure 5: Wood burning stove**

Another form of biomass heating is a wood burning stove. Using seasoned wood to generate local heat to the main living space reduces the need for whole house heating and uses renewable energy via wood. **This is the chosen method of providing renewable energy for this project.**

### 3.2.3 Solar thermal hot water heating

Solar thermal panels collect solar radiation to heat water that can then be used for either space heating or domestic hot water. There are two types of competing solar thermal technologies; flat- plate and evacuated tube. In summary, evacuated tube collectors are more efficient and therefore require less active collector array than the equivalent output of a flat plate system. However, in general, capital costs for the two technologies are comparable.

The system consists of solar collectors that are often roof mounted. Liquid is passed through the solar collectors and then to a heat exchanger in a domestic hot water cylinder, which will also have a top-up heat source (gas, biomass, or electricity) to ensure reliability of supply.

**Figure 6: Typical solar thermal panel**

Solar thermal collectors can still produce energy from diffuse sunlight and are therefore less susceptible to performance reductions from orientation and angle compared to PV.

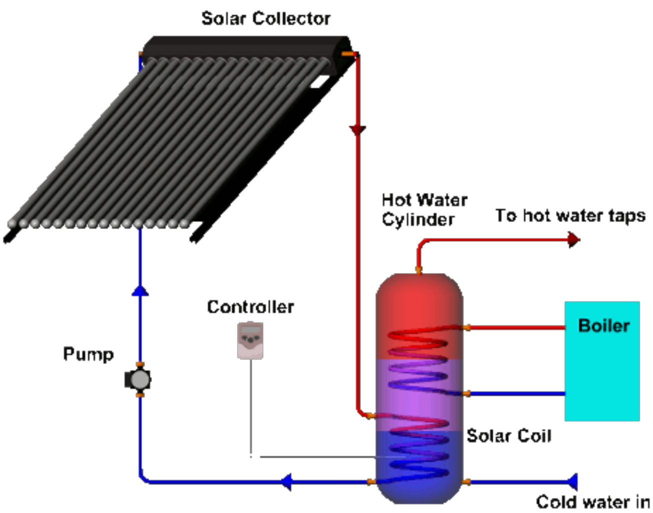


**Figure 7: Solar thermal system diagram**

A typical 3-4$m^2$ collector area system (area dependent on technology) is capable of providing 50% the annual domestic hot water demand for a typical 2-3 bed house. The proportion of hot water provided varies over the course of a year, with the system achieving 100% coverage during the summer months and 5% during the winter.

If properties are left during the day, or empty for periods over the summer, the hot water can recirculate through the system which can cause the panels to corrode and shorten their lifespan.

The advantages over this by using solar thermal are minimal and would add to the occupants' maintenance issues. It has been disregarded on this basis. **This option is NOT considered.**

### 3.2.4 Ground Source & Air Source Heat Pumps

A ground source heat pump (GSHP) harnesses the energy from the ground and upgrades it for use within buildings. Whereas ambient air temperatures can have a large swing throughout the year the temperature of the ground a few metres below the surface stays relatively stable. This makes it possible to use the heat in the ground during the winter months to meet our heating needs. In the summer months it is also possible to cool buildings using ground temperatures that are lower than ambient air.

A typical ground system consists of a ground to water heat exchanger often called the 'ground loop' or 'ground coil', a heat pump and a distribution system. Water (or other solution) is passed round the system 'absorbing' heat from the ground and upgrading this heat via the heat pump into the building.

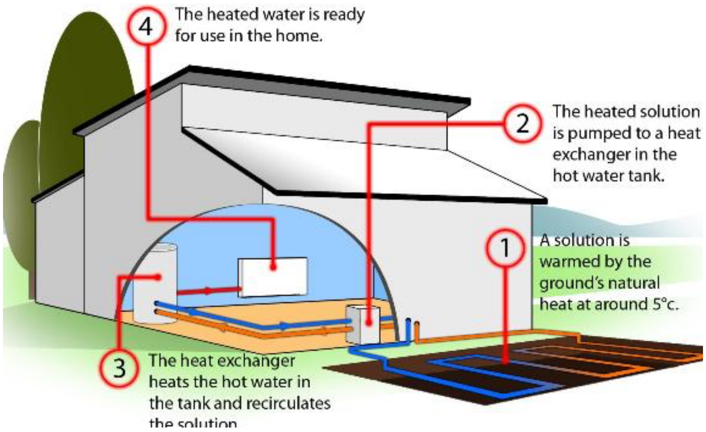


**Figure 8: Ground Source Heat Pump system diagram**

The heat exchanger can consist of either a vertical borehole system, where long pipes are driven deep into the ground or a horizontal trench system, which operates at shallower depths. The performance of a GSHP is measured using a COP (coefficient of performance). This defines the amount of useful energy output from the heat pump compared to the energy input. Typical systems can achieve a COP in the region of 350-400%.

The COP is maximised where the flow temperature of the heating circuit is between 35-40°C and therefore GSHP are ideally suited for connection to under-floor heating. The potential scale of GSHP is only limited by the availability of land for the ground loop and reasonable levels of energy abstraction. Typical costs for ground source heat pumps range from £800/kW for trench systems to £1,500/kW for vertical borehole systems.

Cheaper alternatives are the use of Air Source Heat Pumps. They have externally located condenser units that recover heat from the air and connect to the internal space heating & hot water system. They can be noisy and it is important to consider the system set up to ensure the hot water immersion is not providing the space heating, causing high bills and increased carbon emissions.

The constraints of the proposed site do not lend well to the use of ground source heat pumps and as a result, this technology has not been considered feasible. **This option is NOT considered.**

### 3.2.5 Photovoltaics (PV)

Photovoltaic panels convert solar radiation into direct current electricity. In principle, they are an ideal source of renewable energy as they harness the most abundant source of energy on the Earth, the sun, and they produce electricity which is the most useful form of energy.

PVs are silent in operation, have no moving parts and have a long life with low maintenance levels. PV systems can be connected to the grid or battery arrays in remote locations. Grid connected systems consist of PV arrays connected to the grid through a charge controller and an inverter.

***Figure 9: Typical PV installation to pitched roof***

PV cells are more efficient at lower temperatures so good ventilation should be allowed around the PV modules where possible. Overshadowing and self-shading reduce energy production and in order to maximise energy output, the modules must face due south at an angle of approximately 35 degrees. Output is measured in kWp (kilowatts peak which is the maximum output a module will have under standard test conditions.

At present typical costs start in the region of £2,000-£3,000 per kWp for medium sized orders. The cost varies between systems to reflect the overall efficiency of the modules. Higher efficiency modules cost more but require less space for installation.

At this stage, the proposed scheme does not indicate any solar panels to the roof. And the energy generated can be just put back into the grid for significant periods of the occupant are out at work all day, then they are not benefitting from the energy generated. **Based on this, this option is NOT considered.**

### 3.2.6 Renewable Energy Summary

It is proposed to use low carbon technologies as indicated in Section 3.2 to include a wood burning stove in the main living space.

### 3.3 CARBON EMISSIONS SUMMARY

To confirm, it is proposed to use a fabric first approach using the designed dwellings and the specification as outlined in Tables 1 & 3 together (Building Fabric + Building Services) together with renewable energy via a wood burning stove.

In order to calculate the Baseline carbon emissions and the predicted carbon emissions, we used SAP 2012 and assessed the working drawings by the Architect using the specifications and designs provided. A summary of the results are indicated in Table 4 below:

- Type – House Type
- TER (Target Emission Rate) Baseline carbon emissions obtained from SAP 2012
- DER (Dwelling Emission Rate) actual carbon emissions obtained from SAP 2012
- Baseline – Total carbon emissions
- Proposed – Total predicted carbon emissions with chosen specification and design

**Table 4: Carbon Emissions Summary for the 6 x dwellings**

| Plot | Area | TER | DER | Baseline | Proposed | Saving | Saving |
|---|---|---|---|---|---|---|---|
| | *m2* | *kgCO2/m2/yr* | *kgCO2/m2/yr* | *kgCO2/yr* | *kgCO2/yr* | *kgCO2/yr* | *%* |
| 1 | 424 | 14.61 | 13.13 | 6,195 | 5,567 | 628 | **10.13%** |

The total predicted annual carbon emissions for the Baseline are 6,195 kgCO2/year. Using the proposed designs and specification, the revised predicted carbon emissions are 5,567 kgCO2/year for the whole development.

This is an annual saving of 628 kgCO2/year (0.63 TonnesCO2/year**) resulting in a 10.13% reduction in annual carbon emissions** using a low-tech fabric first approach with increased levels of insulation, air tightness and energy efficiency and low carbon technologies.

## 5 SUMMARY

The proposed new development consisting of **1 x dwelling, Woodlands, 5 The Cottages, The Drive, Ickenham** has been designed to incorporate low energy and sustainable building design features using a fabric-first approach with energy efficient building services.

This report has been prepared to demonstrate compliance with Planning Condition 19 of Planning approval reference 56190/APP/2021/2737 to achieve a 10% reduction in carbon emissions.

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| Report by | Report date: | Signature: |
|---|---|---|
| **Robert Atherton**<br>Msc Energy & Sustainable Building Design<br>OCDEA and CfSH Assessor<br>Of Low Carbon Box | 06.07.2022 | R. Atherton |