47 x new dwellings
Land at Bretch Hill, Balmoral Avenue, Banbury Phase 2

SUSTAINABILITY STATEMENT TO DISCHARGE PLANNING CONDITIONS 18 & 19 OF PLANNING APPROVAL REFERENCE APP/C3105/W/21/3271094

22nd August 2023

Compiled by:
Robert Atherton

Our Ref: 23173

43a St Marys Road, Market Harborough, Leicestershire LE16 7DS
Tel: 01858 322011 | Email: robert@lowcarbonbox.co.uk | Web: www.lowcarbonbox.co.uk

CONTENTS

1.0 EXECUTIVE SUMMARY

The proposed new development consisting of **47 x dwellings, Land at Bretch Hill, Balmoral Avenue, Banbury Phase 2** 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 Conditions 18 & 19** of Planning approval reference **APP/C3105/W/21/3271094**.

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.

The total predicted CO_2 emissions to comply with Part L1A 2013 of the Building Regulations are 26,775 $kgCO_2$/year.

It is proposed to install **80.20kWp photovoltaic array** between the roofs of each dwelling (excluding the mid-terrace units) to generate renewable electricity.

The **annual carbon emissions** are predicted to be **reduced by 56%%,** saving annual carbon emissions of **15.07 TonnesCO_2/year**. This meets and exceeds the target of 19% set out in Planning Condition 18.

Internal water use will be equal to or less than 110 litres/person/day. This meets the requirement set out in Planning Condition 19.

2.0 INTRODUCTION

The proposed new development consisting of **47 x dwellings, Land at Bretch Hill, Balmoral Avenue, Banbury Phase 2** 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 in accordance with planning policies ESD1, ESD2 and ESD3 of the Cherwell Local Plan (July 2015).

This report has been prepared to demonstrate compliance with **Planning Conditions 18 & 19** of Planning approval reference **APP/C3105/W/21/3271094**.

The Site plan is indicated in figure 1 below:

Figure 1: Site plan

This report will set out to summarise the following criteria:

1. Condition 18 - Outline how the scheme will achieve energy performance standards equivalent to a minimum 19% reduction in CO_2 emissions against Part L1A 2013 of the Building Regulations.
2. Condition 19 - Water conservation to achieve <110 litres/person/day and reducing the use of potable water.

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

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 – Cavity	0.19 W/m2.K	102.5mm brickwork; 150mm cavity with 150mm Knauf Supafil 34 Fill (0.034 W/mK); 100mm Fibolite Blockwork (0.28 W/mK); 12.5mm plasterboard on mortar dabs
Party wall	0.00 W/m2.K	Fully filled party wall
Roof (ceiling)	0.10 W/m2.K	12.5mm plasterboard; 400mm insulation consisting of 100mm Knauf Loft Roll 40 between ceiling joists; 150mm + 150mm Knauf Loft Roll 40 over ceiling joists; ventilated roof void
Roof (Flat)	0.18 W/m2.K	Roof finish on 110mm Kingspan TR26 insulation on VCL on timber flat roof
Ground Floor	0.11-0.12 W/m2.K	75mm screed; Vapour control layer; 150mm PIR insulation (0.022 W/mK); DPM; Beam & block Floor
Exposed floor to rooms over passage	0.17 W/m2.K	200mm mineral wool between floor joists 25mm PIR below jousts
Windows & Glazed doors	1.30 W/m2.K	Double glazed ‘g’ value = 0.66
Front door	1.00 W/m2.K	
Air test	4.50 m3/hr/m2	
Accredited Details	Concrete Block Association	Thermally broken lintels

**Please note, the constructions may vary at detail design stage.*

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

Table 2: U value comparison

Item	Proposed	Building Regs	Improvement
Walls	0.19 W/m2.K	0.30 W/m2.K	37%
Roof (ceiling)	0.10 W/m2.K	0.20 W/m2.K	50%
Ground Floor	0.11 W/m2.K	0.25 W/m2.K	56%
Windows	1.30 W/m2.K	2.00 W/m2.K	35%
Front Door	1.00 W/m2.K	2.00 W/m2.K	50%
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 37-56%.

The proposed building services are outlined in Table 3 below:

Table 3: Summary of building services

Item	Standard	Specification
Boiler	Gas fired combi boiler	Worcester Bosch Greenstar 32CDi*
Heating Controls Houses	Time & Temperature Zone Control	Via radiators
Heating Controls Flats	Programmer, Thermostat & TRVs	Via radiators
Hot Water features	Waste Water Heat recovery	Showersave QB1-21D System A (links back to boiler) connected to bath and shower unit served by showers.
Ventilation	Natural with System 3 continuous extract	Greenwood Unity CV2 dMEV
Lighting	100% low energy lighting	Bulbs to have efficacy greater than 85 lumens/circuit watt
Renewable Energy	Photovoltaic Panels	Not included in this stage, see section 3.2

***To be confirmed by heating engineer*

The proposed integration of the low carbon technologies delivers direct savings to the building occupants. This provides an economic benefit as well as reducing annual carbon emissions.

In the next section, we will review renewable energy 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: Woodchip pellets

It is also not uncommon for clients to require a standard gas boiler to provide back-up. Good practice for a 50KW log boiler would be to provide 3000 litres hot water buffer storage. The additional capital cost for biomass over gas is minimal when considered in the terms of the whole project value for new buildings, but the transportation and storage of fuel requires detailed consideration from the outset of any project.

Biomass has not been considered as a feasible option for this development due to issues associated with supply and storage of fuel; but the units have the potential to connect into a future system if it were to be constructed off site. **This option is NOT considered.**

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.

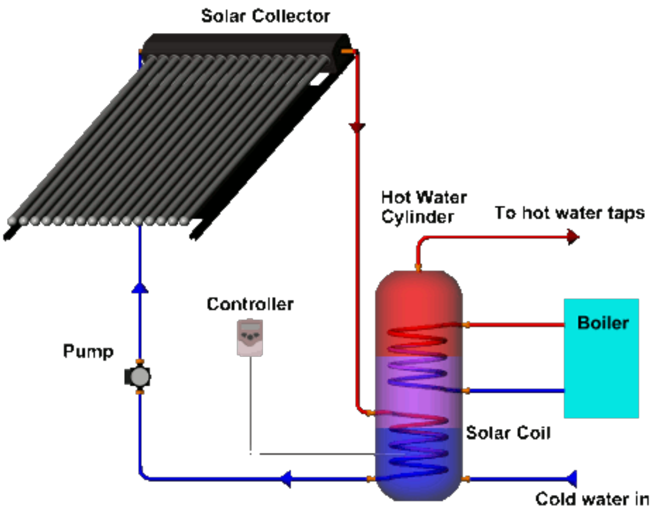

Figure 7: Solar thermal system diagram

A typical 3-4m^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.

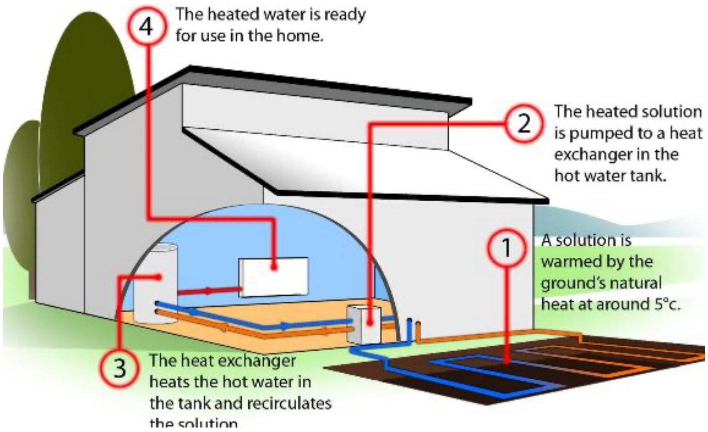

Figure 8: Ground Source Heat Pump system diagram

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.

The developer is very conscious of the need to reduce energy bills and photovoltaic panels can provide a proportion of free energy.

It is proposed to install a minimum of **80.20 kWp** peak photovoltaic panel array distributed across the optimal roofs for each dwelling excluding the mid-terrace units as the roofs are not suitable.

This is to meet the requirements to reduce CO2 emissions by a minimum of 19% and comply with Part L1A 2021.

3.2.6 Renewable Energy Summary

The installation of PV's to each dwelling (apart from mid-terraces) provides the future occupants with free energy generation which will significantly lower their energy bills. This is the most cost effective, efficient and appropriate technology for this development to meet the planning requirements and new Part L1A 2021 Building Regulations.

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 photovoltaic panels as outlined in Section 3.2.

In order to calculate the Baseline carbon emissions and the predicted carbon emissions, we used SAP 2012 and assessed each different dwelling type 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 47 x dwellings

Plot	No. Types	Baseline	Proposed	Saving	Saving
		kgCO2/yr	kgCO2/yr	kgCO2/yr	%
Cypress	6	1,539	870	668	43.44%
Elder	10	1,488	635	854	57.36%
Elm	1	1,982	800	1,182	59.65%
Fern semi	2	1,384	557	826	59.72%
Fern End	4	1,381	549	833	60.28%
Fern Mid	2	1,287	1,012	275	21.40%
Fir & Teak FF	1	1,054	302	752	71.36%
Fir & Teak GF	1	1,000	406	594	59.41%
Gorse	2	1,254	-117	1,371	109.34%
Huckleberry Det	2	1,727	736	990	57.36%
Huckleberry End	2	1,611	233	1,378	85.56%
Huckleberry Mid	1	1,514	1,276	238	15.73%
Poplar V1	1	1,688	610	1,077	63.83%
Poplar V2	3	1,738	644	1,094	62.94%
Roseberry	2	1,776	556	1,219	68.67%
Rowan Semi	4	1,519	854	666	43.81%
Rowan End	2	1,473	671	802	54.46%
Rowan Mid	1	1,361	1,111	250	18.35%
TOTAL	**47**	**26,775**	**11,704**	**15,071**	**56.29%**

The total predicted annual carbon emissions for the Baseline are 26,775 kgCO2/year. Using the proposed designs and specification, the revised predicted carbon emissions are 11,704 kgCO2/year for the whole development.

This is an **annual saving of 15,071 kgCO2/year (15.07 TonnesCO2/year)** resulting in a **56.29% reduction in annual carbon emissions** (against Part L1A 2013).

3.4 WATER CONSERVATION

INDOOR WATER USE

Under Part G of Building Regulations, indoor water use is restricted to 125 litres/person/day.

The target for Planning Condition 19 is 110 litres/person/day.

It is proposed to meet this standard with the following flow rates, batch capacity and flush volumes:

Table 7: indoor Water Calculation

Installation Type	Unit of Measure	Capacity/Flow Rate	Use Factor	Fixed Use (Litres/person/day)	Litres/person/day
WC (Single Flush)	Flush Volume (litres)		4.42	0	0.00
WC (Dual Flush)	Full Flush Volume (litres)	4	1.46	0	5.84
	Part Flush Volume (litres)	2.6	2.96	0	7.70
Taps (exluding kitchen utility)	Flow rate (litres/min)	6	1.58	1.58	11.06
Bath (where shower present)	Capacity to overflow (litres)	180	0.11	0	19.80
Shower (where bath present)	Flow rate (litres/min)	8	4.37	0	34.96
Bath only	Capacity to overflow (litres)		0.5	0	0.00
Shower only	Flow rate (litres/min)		5.6	0	0.00
Kitchen/Utility taps	Flow rate (litres/min)	6	0.44	10.36	13.00
Washing Machine	Litres/kg dry load	8.17	2.1	0	17.16
Dishwasher	Litres/Place Setting	1.25	3.6	0	4.50
Waster Disposal	Litres/use (1 = present, 0 - absent)	0	3.08	0	0.00
Water Softener	Litres/person/day	0	1	0	0.00
	5			Total Calculated	114.01
	6			Contribution Greywater	0.00
	7			Contribution Tainwater	0.00
	8			Normalisation factor	0.91
	9			Total water consumption	103.75
	10			External water use	5.00
	11			**Total Water Consumption**	**108.75**

The total predicted indoor water use is therefore 108.75 litres/person/day.

This meets the target of 110 litres/person/day set out in Planning Condition 19.

5 SUMMARY

The proposed new development consisting of **47 x dwellings, Land at Bretch Hill, Balmoral Avenue, Banbury Phase 2** 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 Conditions 18 & 19** of Planning approval reference **APP/C3105/W/21/3271094**.

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.

The total predicted CO2 emissions to comply with Part L1A 2013 of the Building Regulations are 26,775 kgCO2/year.

It is proposed to install **80.20kWp photovoltaic array** between the roofs of each dwelling (excluding the mid-terrace units) to generate renewable electricity.

The **annual carbon emissions** are predicted to be **reduced by 56%%,** saving annual carbon emissions of **15.07 TonnesCO2/year**. This meets and exceeds the target of 19% set out in Planning Condition 18.

Internal water use will be equal to or less than 110 litres/person/day. This meets the requirement set out in Planning Condition 19.

Report by	Report date:	Signature:
Robert Atherton Msc Energy & Sustainable Building Design OCDEA and CfSH Assessor Of Low Carbon Box	22.08.2023	[redacted]