

Strategic Land Group

**Henthorn Road,
Clitheroe**

**Energy Reduction
Report**

December 2012

Ref: 2012-156-007a

Strategic Land Group

Henthorn Road, Clitheroe

Energy Reduction Report

December 2012

Ref: 2012-156-007a

Authorised for and on behalf NJL Consulting LLP

A handwritten signature in black ink that reads "P Smith". The signature is written in a cursive, flowing style.

Paul Smith
Partner

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party. Any such party relies on this report at their own risk.

© Report copyright of NJL Consulting LLP



Adamson House
Towers Business Park
Wilmslow Road
Manchester
M20 2YY
Tel: 0845 362 8202
Fax: 0870 130 5579

info@njlconsulting.co.uk
www.njlconsulting.co.uk

Contents

1.0 Introduction..... 1

2.0 Development Proposals..... 2

3.0 Achieving Carbon Reduction..... 4

4.0 Conclusion..... 10

1.0 Introduction

1.1 Application Background

Strategic Land Group (SLG) is applying to Ribble Valley Borough Council (RVBC) for a proposed residential development of up to 120 dwellings in outline. The application includes access with all other matters reserved.

SLG has received a pre-application advice letter from RVBC dated 10th May 2012 (ref: SW/CMS/RV/2012/ENQ/00446). The letter states that:

The Council would condition that the proposal should secure at least 10% of the predicted energy requirements from decentralised and renewable or low carbon sources unless it can be demonstrated, having regard to the type of development or design, that this is not feasible or viable. We would be fairly flexible in our approach to the use of such techniques and have approved schemes which provide a mix of fabric first and 'bolt on' renewable types.

1.2 Purpose of this Document

This document is an Energy Reduction Report and has been produced by NJL Consulting (NJL). The purpose of this document is to describe the approach proposed by SLG to reduce the site-wide energy demand of the proposed development by 10% in line with the pre-application advice provided by RVBC.

2.0 Development Proposals

The proposed development is located south east of Henthorn Road, Clitheroe. The site location is shown in *Figure 1.1*.

Figure 1.1 – Pre-development Site with Orientation



The proposed development is for up to 120 residential dwellings with a single access point off Henthorn Road. An indicative layout is shown in *Figure 1.2*.

Figure 1.2 – Indicative Layout



3.0 Achieving Energy Reduction

3.1 Energy Reduction

This section describes the possible options and the proposed approach for reduction of site-wide energy demand by 10%.

The proposed approach aims to provide the most robust and cost-effective method for reducing the energy demand and CO₂ emissions associated with the proposed development over its lifetime. *Figure 3.1* presents an energy hierarchy which demonstrates the order in which the management of energy in buildings should be prioritised:

Figure 3.1 – Energy Hierarchy

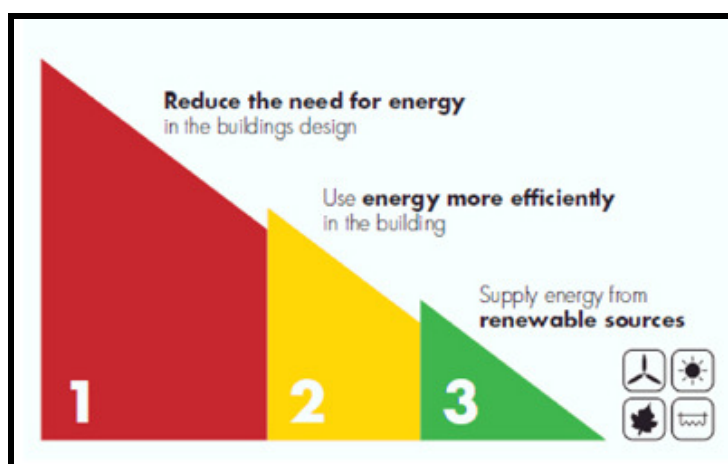


Figure 3.1 shows that energy efficiency of the building should be the priority when looking to reduce site-wide energy demand. Only once the building energy efficiency has been maximised, should the use of on-site renewable and low carbon energy sources be explored.

The following sections present two options for reducing energy demand which include approaches based firstly on tier 1, then tier 3 of *Figure 3.1*:

- The *Building Fabric-led Approach* section will provide details of measures to reduce regulated energy demand (heating, lighting etc).
- The *Renewable Energy Feasibility* section appraises several options for renewable energy provision that could reduce the amount of energy provided by non-renewable sources.

3.2 'Building Fabric-led' Approach

One of the most critical environmental issues faced today is that of climate change which is a direct result of increasing CO₂ emissions and the enhanced greenhouse effect.

This low carbon 'building fabric-led' approach aims to reduce site-wide energy demand and subsequent levels of CO₂ emissions by reducing need and improving the energy efficiency of each building. This is achieved through significantly upgrading the building fabric and results in a reduction in energy demand and associated CO₂ emissions well beyond the requirements of regulatory compliance, throughout the lifetime of the building.

This will be achieved primarily by enhancing the insulation of the building fabric for all dwellings at the site, incorporating materials with high thermal performance and careful construction techniques to ensure low air permeability, thereby limiting heat loss from the buildings.

Specific details of building fabric improvements would be submitted at reserved matters stage.

3.3 Renewable Energy Feasibility Study

An alternative to the approach outlined in the previous section is the use of on-site renewable energy provision to reduce the level of energy supplied by non-renewable sources. This section reviews the feasibility of several options for renewable energy provision on the site.

Renewable energy technologies considered within this report include:

- Wind turbines;
- Solar electricity – Photovoltaic's (PV);
- Solar thermal (hot water) panels;
- Ground source heat pumps; and
- Air Source Heat Pumps.

Where a certain system has been considered inappropriate, justification for the decision is provided.

Wind Turbines

Wind turbines generate electricity by harnessing wind power through horizontal or vertical turbines and can potentially be mounted on buildings (note that roof mounting can be problematic in terms of noise and vibration and it may be preferable to mount on a separate mast). *Figure 3.2* shows average wind speeds (in yellow) at 10m, 25m and 45m above ground level (agl.) for the 1km grid square around the site (grid square 514 239, national grid

reference TL1439). The values in the squares surrounding the central yellow square correspond to wind speeds for surrounding grid squares.

Figure 3.2 Average wind speeds at three heights agl. around the site (Source: DECC, Wind Speed Database)

Wind speed at 45m agl (in m/s)

5.3	5.4	5.4
5.0	5.2	5.3
5.0	5.2	5.3

Wind speed at 25m agl (in m/s)

4.7	4.8	4.9
4.4	4.6	4.7
4.4	4.6	4.7

Wind speed at 10m agl (in m/s)

3.9	4.1	4.1
3.6	3.8	3.9
3.6	3.8	3.9

Average wind speed should be at least 6m/s for this technology to be economically attractive and to ensure efficient operation of the turbines and dependable energy generation.

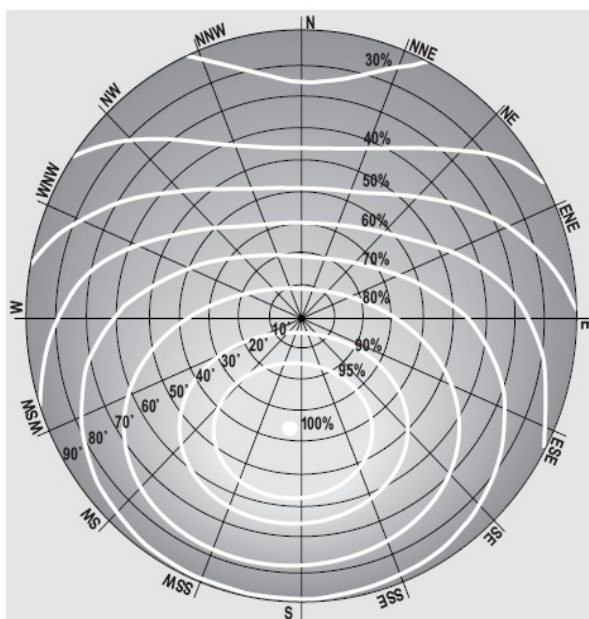
The average annual wind speeds are too low for the use of wind turbines to be feasible and therefore, wind energy is not considered further in this report.

Solar Electricity – Photovoltaic's (PV)

Photovoltaic systems use solar cells to convert daylight into electrical energy through semi-conductor cells. Greater light intensity falling upon the PV array increases the flow of electricity; consequently this technology is particularly reliant upon careful positioning. PV modules can be either roof mounted or free standing and can be installed on horizontal, sloping or vertical surfaces.

Optimum performance is achieved at roof pitch angles of 30° to 50° (horizontal mounting is preferable to vertical), facing due south and not overshadowed (See *Figure 3.3*).

Figure 3.3 Optimum Orientation of PV Arrays



Source: Building Integrated PV, Design Brief

As there is no definitive site layout at present, it is not possible to determine whether PV is a feasible option for the site as there is no information on roof angles and orientation.

However, PV would be straightforward to incorporate into a proposed scheme and therefore, will be considered further within this report.

Solar Thermal – Water Heaters

Solar collectors absorb the sun's energy and typically provide heat for domestic hot water (although they can also contribute to space heating in some cases, especially when coupled to under floor heating systems). The system transfers heat from the collectors to storage tanks. Such technology is suited to the UK climate and will work effectively on overcast days with diffuse sunlight. As with PV, their efficiency depends upon positioning; ensuring the panels are orientated due south and mounted between 30° and 50° will deliver good performance.

As for PV, there is no definitive site layout at present, so it is not possible to determine whether solar thermal is a feasible option for the site. However, as it would be straightforward to incorporate into a proposed scheme, it will be considered further within this report.

Ground Source Heat Pumps

Ground source heat pumps (GSHPs) extract heat from the ground and supply space heating. GSHPs can also partially heat water, however, an immersion system (electrical) is usually necessary to raise water temperature to the required levels. Heat is moved from the source (ground) to point of distribution via either horizontal or vertical loop systems. Due to their sub-terranean installation, these systems have no visual impact issues.

A GSHP is considered to be a 'low carbon' energy source, as electricity (assumed at this stage to be from standard grid electricity generated largely from fossil fuel sources) is required to drive a compressor and transform the heat up to the desired temperature. This heat is then distributed to the emitter (such as underfloor heating). GSHPs are therefore most cost effective when replacing electric heating or where the property is off the mains gas grid. The measure of useful heat energy output to electrical energy input is known as the coefficient of performance (CoP), which, for GSHPs, is typically in the region of 3.5 (i.e. for every 3.5 units of heat provided, one unit of electricity is required).

Despite the likely provision of private gardens for each dwelling, there would be limited space on the development to accommodate the necessary quantity of horizontal ground collector loops.

Slinky loops are an alternative approach to the installation of GSHPs using horizontal heating loops which require less ground works but has the potential in some situations to 'starve' the ground of heat, thereby reducing the CoP (and therefore mitigation of energy demand and associated CO₂ emissions) over time, as more electrical power is consumed by the pump to meet the heat demand.

Vertical collector loops benefit from high thermal efficiency but require boreholes up to 150m deep (or numerous boreholes of reduced depth), the borehole being no less than 6m apart to minimise thermal interference. Uncertainty about geology at this depth means that drilling could be time-consuming and technically difficult. As a consequence, this approach is an expensive option and carries additional risk. Dependent upon the geology in the area, drilling costs would be between £25 and £95 per meter depth.

Given the limited space on the development for horizontal loops and the high costs and uncertainty known to be associated with vertical systems, neither are considered technically feasible on this site and will therefore not be given further consideration.

Air Source Heat Pumps

Air source heat pumps (ASHPs) are based upon the same principles of operation as GSHPs, but extract ambient heat from the air, rather than the ground. Within the air-coupled heat pump, heat is moved from the outside air or exhaust air from the property to point of distribution to provide space heating. As for GSHPs, ASHPs can also meet domestic hot water demand.

Like GSHPs, ASHPs are not a 100% renewable energy source as electricity is required to run the heat exchanger, and they are therefore most cost effective when replacing electric heating or where the property is off the gas grid. ASHPs have lower CoPs than GSHPs because of lower source temperature and the lower energy density of air compared with water. The CoP reduces with outside air temperature such that if the external air

temperature is 0°C, the CoP is in the region of 1. That is, for every one unit of heat provided, one unit of electricity is required; essentially, units installed with ASHPs would have electrical heating during full winter loads, which would significantly reduce the renewable energy contribution from these systems and would potentially require additional heating provision, likely to be from electrical resistance systems which are expensive to operate and would negate the intended benefit of renewable energy provision on site. For this reason ASHPs would not generally be specified in Britain for developments whose heating demand would otherwise be supplied by gas.

An alternative application for this technology is in the form of Exhaust Air Source Heat Pumps (Exhaust ASHP), which can be installed in residential properties to provide space and water heating. These units recover embodied heat from the air within the dwelling (generated from lights, people and appliances, etc.) using mechanical ventilation, which extracts warm stale air from various parts of the building and passes it over the heat exchanger unit within the heat pump. This provides heat at a sufficient temperature for space heating and can heat water. An internal, electrical immersion heater may be required to boost water temperature to an acceptable level. These units do not suffer from the problems associated with seasonal losses of efficiency and operate with a CoP of around 3 allowing for the water heating immersion pump. That is, for every three units of heat produced one unit of electrical energy is required to drive the pump. These systems are also able to control the ventilation rate for the dwelling.

Exhaust ASHPs could be installed in every dwelling at the site to provide space and water heating, although there would be a negative impact on the floor area remaining within each unit as the exhaust ASHPs are approximately the size of a large fridge freezer with a footprint of 600mm x 600mm, allowance for equipment.

It should also be noted that these systems operate most efficiently and provide the most environmental benefit when coupled to emitters such as under floor heating or oversized radiators.

Due to the requirement for underfloor heating associated with ASHPs and the space required for Exhaust ASHPs which represent a departure from the proposed specification and layout of the dwellings, these technologies will not be considered further.

3.4 Proposed Approach at Henthorn Road, Clitheroe

The proposed development will deliver the target 10% energy demand reduction compared to a prevailing Building Regulations, Part L compliant build in accordance with RVBC's aspirations for the site.

The reduction in site-wide energy demand shall be delivered primarily through a 'building fabric-led' approach, with an additional number of appropriate dwellings fitted with either PV or solar thermal water heating systems to further reduce energy demand.

An estimation of site-wide energy demand and further details of building fabric improvements and renewable energy provision will be submitted as part of subsequent reserved matters applications.

4.0 Conclusion

Strategic Land Group (SLG) is applying to Ribble Valley Borough Council (RVBC) for a proposed residential development of up to 120 dwellings. The application is in outline with access. All other matters are reserved.

Pre-application advice from RVBC (ref: SW/CMS/RV/2012/ENQ/00446) has stated that an approach that reduces site-wide energy demand by 10% through a combination of fabric energy efficiency improvements and renewable energy provision will be acceptable.

This document is an Energy Reduction Report and has described the approach proposed in order for the development to achieve the target of a 10% site-wide energy reduction against prevailing Building Regulations, Part L.

The reduction in site-wide energy demand shall be delivered primarily through a 'building fabric-led' approach, with an additional number of appropriate dwellings fitted with either PV or solar thermal water heating systems to further reduce energy demand.

Further information on site-wide energy demand, proposed building fabric improvements and renewable energy provision will be provided through subsequent reserved matters applications.