



Energy Efficiency and Low Carbon Technologies Appraisal

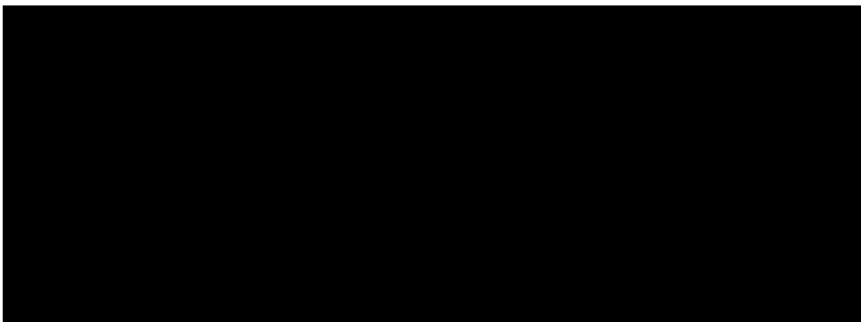
Site at Woodgate Centre, Westergate,
West Sussex



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Report produced by -

Ian Bacon
Director
Blewburton Limited
23 St. Martin's Street
Wallingford
Oxon
OX10 0AL



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1 Blewburton Limited

- 1.1 Blewburton Limited (BBL) was established in April 2016 and are the follow on company to The Blewburton Partnership (BBP) which was established in 2008 to provide energy and sustainability consultancy to clients in both the private and public sectors. We have been involved in the project management, assessment and consulting on projects involving renewable and sustainable energy for over twenty years, both with BBL, BBP and in former employment.
- 1.2 BBL is well placed to analyse and assess the potential for energy efficiency and low and zero carbon energy technologies to meet the energy demand for new developments and to determine the most cost effective and technically appropriate means of meeting the sustainable energy requirements relating to planning conditions. BBL are also licensed Elmhurst SAP, BREEAM & Home Quality Mark assessors.

2 Executive Summary

2.1 Introduction

- 2.1.1 Blewburton Limited has been commissioned by Terence O'Rourke Limited on behalf of Pye Homes to prepare a report to demonstrate how a proposed development at the Westgate Centre, Westergate, West Sussex will meet Local Planning Authority (LPA) requirements with regards energy efficiency and the provision of low and zero carbon technologies (LZCs).
- 2.1.2 The proposed development will see the construction of 180 new residential properties consisting of 15 one-bed flats, 22 two-bed flats, 49 two-bed houses, 64 three-bed houses, 3 three-bed bungalows and 27 four-bed houses. Designs will vary across the site and feature short terraces, semi-detached and detached houses, two storey, three storey and chalet style houses, bungalows and three storey apartment blocks.
- 2.1.3 The development site is located in the Local Planning Authority (LPA) area of Arun District Council and the Local Plan Policy ECC SP2: Energy and climate change mitigation states that all new residential and commercial development will be expected to be energy efficient and to demonstrate how they will produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.

2.2 Energy demand calculations

- 2.2.1 The proposed dwellings for this site can be broken down into a number of different design types, such as 1-bedroom ground floor flat, 2-bedroom semi-detached house or four bedroom detached house, as examples. We have therefore taken a sample of typical Pye Homes house type designs to match the design types for this site, undertaken SAP calculations for these designs and then extrapolated based on these results for the overall energy requirements of the site.
- 2.2.2 It is from the extrapolated figures that the amount of on-site energy generation is then calculated. Finally, the typical performance of LZC technologies are added into the calculations to allow for the calculation of minimum installation required to comply with the LPA energy policy.

2.3 Conclusion

- 2.3.1 The proposed approach to energy reduction is already good practice, in that it complies with Part L requirements even before the addition of LZC technology and as the scheme is further developed, additional options for improved energy efficiency will be explored.
- 2.3.2 The design of the dwellings and layout of the site has been reviewed to ensure benefits accrue from access to good daylighting and natural heating. The site is also laid out with a view to allowing for a wide roll out of solar PV technology, as required.

- 2.3.3 The projected annual energy demand for the site based on a review of standard Pye Homes property design types and then extrapolated to reflect unit numbers for this site is 1,044,409kWhs of energy per annum.
- 2.3.4 To generate a minimum of 10% of annual energy requirements on site through LZC technologies, an offset of at least 104,441kWhs per annum is required.
- 2.3.5 It is proposed to deliver this through the installation of 65, 2.0kWp rated PV arrays at locations facing south-east or south west and there are 147 proposed properties that could be selected for this roll out.
- 2.3.6 Therefore, the energy efficiency design proposals outlined, along with the inclusion of the PV arrays, will comply with the Arun District Council requirements for onsite energy generation for new, major developments.

3 Introduction

- 3.1 BBL has been commissioned by Terence O'Rourke Limited on behalf of Pye Homes to prepare a report to demonstrate how a proposed development at the Westgate Centre, Westergate, West Sussex will meet Local Planning Authority (LPA) requirements with regards energy efficiency and the provision of low and zero carbon technologies (LZCs).
- 3.2 The proposed development will see the construction of 180 new residential properties consisting of 15 one-bed flats, 22 two-bed flats, 49 two-bed houses, 64 three-bed houses, 3 three-bed bungalows and 27 four-bed houses. Designs will vary across the site and feature short terraces, semi-detached and detached houses, two storey, three storey and chalet style houses, bungalows and three storey apartment blocks.
- 3.3 The development site and proposed layout are shown in the images below.



Figure 1: Aerial photo of site location

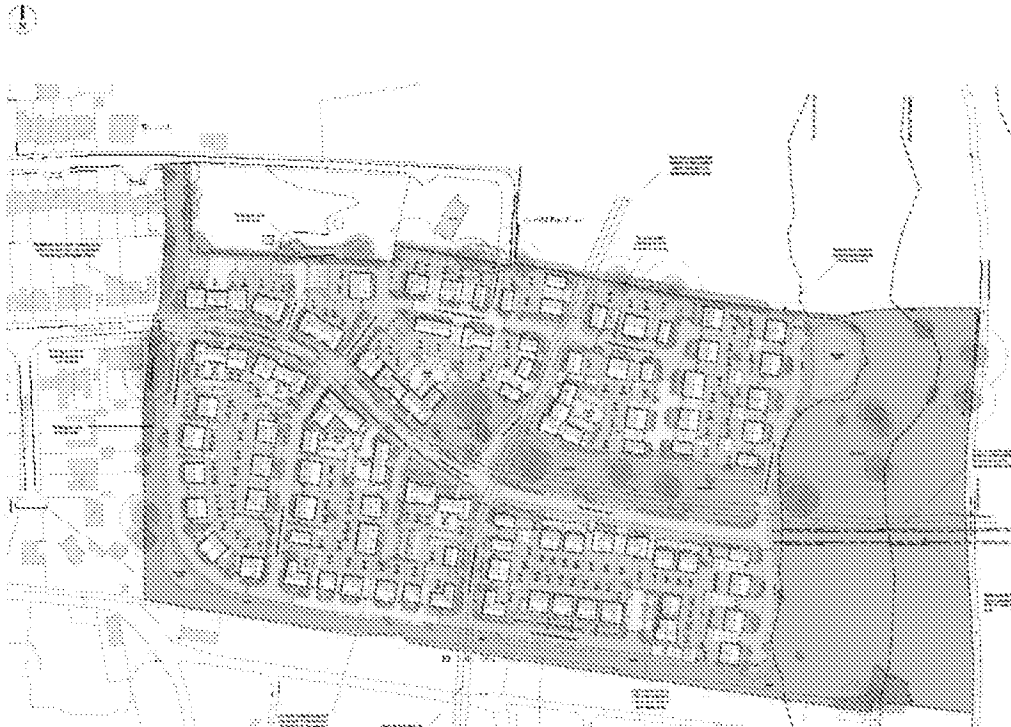


Figure 2: Plan of proposed site location and layout

- 3.4 The development site is located in the LPA of Arun District Council and the Local Plan Policy ECC SP2: Energy and climate change mitigation states,

All new residential and commercial development will be expected to be energy efficient and to demonstrate how they will:

- a. Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
- b. Use design and layout to promote energy efficiency; and
- c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

- 3.5 Accordingly, this report will assess the estimated annual energy demand for this proposed development and present the preferred to show that at least 10% of this will be generated on site using low or zero carbon energy technologies.

4 Energy demand for the site

4.1 Methodology

- 4.1.1 All new residential buildings are required to meet certain standards in terms of energy efficiency in order to meet Part L of the Building Regulations. This is demonstrated through a SAP calculation.
- 4.1.2 The proposed dwellings for this site can be broken down into a number of different design types, such as 1-bedroom ground floor flat, 2-bedroom semi-detached house or four bedroom detached house, as examples. We have therefore taken a sample of typical Pye Homes house type designs to match the design types for this site, undertaken SAP calculations for these designs and then extrapolated based on these results for the overall energy requirements of the site.
- 4.1.3 It is from the extrapolated figures that the amount of on-site energy generation is then calculated. Finally, the typical performance of LZC technologies are added into the calculations to allow for the calculation of minimum installation required to comply with the LPA energy policy.

4.2 Energy efficiency proposals

- 4.2.1 Pye Homes recognises the need to improve the fabric and overall efficiency of the dwellings and supplied services as the first steps in achieving a sustainable energy solution for the site and proposes the following which is a strong uplift over the base Part L 1A requirements:

- ø External cavity wall U-value of 0.20 (Part L minimum standard is 0.30);
- ø Ground floor U-value of 0.12 (Part L minimum standard is 0.25);
- ø Loft/pitched roof U-values of 0.11/0.17 (Part L minimum standard is 0.20);
- ø High specification windows, doors and roof lights with U-values of 1.4, 1.4 & 1.3 respectively or better (Part L minimum standard is 2.0);
- ø Specification of high efficiency (89.7% Worcester Greenstar 24iSystem ErP model used as example in the calculation) gas fired boiler (Part L minimum standard is 88%), heating a radiator system;
- ø Best practice heating control system – time and temperature zone control and delayed start thermostat;
- ø Use of Accredited Construction Details (ACD) to deal with issues around non-repeat thermal bridging at external wall junctions with sills, jambs, corners, ground floor and roof;
- ø Hi-therm insulated lintels;

- ø Air pressure testing results of 4.50mE/hm² (@ 50Pa) or lower (Part L allows for a result of up to 10.0mE/hm² (@ 50Pa);
- ø All new lights installed will be of the low energy variety;
- ø Standard extract ventilation to kitchen and bathrooms.

4.2.2 This proposed approach is already good practice, in that it complies with Part L requirements even before the addition of LZC technology and as the scheme is further developed, additional options for improved energy efficiency will be explored.

4.3 Energy demand calculations

4.3.1 As can be seen in Table 1 below, the energy data for the properties is broken down into what are considered to be the four main areas of domestic usage – space heating, water heating, lights & appliances and cooking. It should be noted that cooking and appliances do not feature under Part L 1A of the Building Regulations, so the data is more inclusive of potential annual energy demand and reflects average usage patterns and occupancy levels.

Design Type	No.	Space Heating (kWh/yr)	Domestic Hot Water (kWh/yr)	Electricity (lights & appliances) (kWh/yr)	Electricity (pumps and fans) (kWh/yr)	Total Energy Consumption (kWh/yr)
Apts	37	87,212	72,624	12,168	2,775	174,779
2-bed hses	49	127,125	75,245	18,901	3,675	224,946
3-bed hses	67	225,240	108,985	26,215	5,025	365,465
4-bed hses	27	201,562	58,853	16,779	2,025	279,219
TOTAL	180	641,139	315,707	74,063	13,500	1,044,409

Table 1: Initial extrapolated assessment of site energy demand from all dwellings

- 4.3.2 The total extrapolated annual energy requirement for the development as a whole is 1,044,409kWhs of energy per annum.
- 4.3.3 The following sections of this study will now detail how a minimum of 10% of this requirement will be met through the installation of onsite LZC technology. This is equivalent to 104,441kWh/yr. This figure reflects the planning policy of the LPA, Arun District Council.

4.4 LZC technology options

4.4.1 The technical viability of LZC technologies has been assessed. Preferred options have then been identified and taken forward to determine how best to meet the targets and this is further covered in the following Section 5.

4.4.2 Table 2 below shows the results of the feasibility study.

Technology	Feasible	Reason
Wind turbines (stand-alone)	r	Insufficient open area or commercially viable wind speeds for installation of a stand-alone wind turbine(s).
Solar photovoltaics (PV)	P	Appropriately angled, unshaded roof space is available on most units and install costs deemed to be reasonable. Public generally supportive of technology.
Solar thermal	P	Appropriately angled, unshaded roof space is available on most units and install costs deemed to be reasonable. Public generally supportive of technology, but prefer PV.
Wood-fuel heating	r	Biomass boilers are potentially feasible for the larger properties, however, when compared to other heating options this would be expensive to run and space for a plant room and fuel store would need to be considered. Public not familiar with the technology and there may also be issues with local air quality.
Ground source heat pumps (GSHP)	r	Ground source heat pumps maybe feasible, however, they would be expensive to install and ground tests would be required. They require oversized radiators or underfloor heating as a result of low flow temperatures. They best suit larger properties and are potentially an expensive install.
Air source heat pumps (ASHP)	P	ASHPs are a feasible option and they require oversized radiators or underfloor heating as a result of low flow temperatures. They are also best suited to larger dwellings.
District heating and Combined Heat & Power (CHP)	r	Small, individual CHP units are not currently available and a district heating scheme would require significantly higher heat loads than those associated with a development of this size to be economically viable.

Table 2 - Technical feasibility of LZC technologies

5 Preferred LZC Technology

5.0 The preferred LZC technology to meet the 10% on-site generation requirement is solar photovoltaics, otherwise known as PV, as this will be the easiest option to install, fits the projected costings for the development and is readily accepted by the house buying public. This section will now offer some background to this technology, how it will be used on this site and the amount required to meet the LPA requirements.

5.1 Background

5.1.1 Solar generated electricity is created by the technology of photovoltaics (PV) – solid state semi-conductors that convert light into electricity. When light (a photon) is incident on a PV cell it gives energy to an electron. The electron moves away from the cell into an electrical circuit. The electricity created is direct current (DC). This can either be used to charge batteries or power DC devices; however, in the UK it would normally be converted to alternating current (AC) via an inverter to meet the electrical demands of the site/building and tied into the grid.

5.1.2 Systems are easily retrofitted or incorporated into new and existing roofs, facades and glazing, the technology being extremely versatile. The panels themselves when arranged and connected together form an array with electrical generating capacity measured in kilowatts peak (kW_p - a rating calculated using a defined theoretical set of conditions rather than maximum or typical output).



Figure 4: Standard PV panels installed on a houses in Berkshire and Oxfordshire

5.1.3 Solar PV panels are available in a variety of different forms including;

- ¿ Mono-crystalline
- ¿ Poly-crystalline
- ¿ Thin film
- ¿ Hybrid

5.1.4 Mono-crystalline and hybrid panels are the most efficient at turning daylight into energy, but it may be easier to install thin film panels in the form of solar roof tiles rather than fitting a standard roof and then retrofitting panels. This is, however, more costly and whilst solar roof tiles come in a variety of different physical sizes and capacities, they do not currently vary much from a grey/blue/black colour.

- 5.1.5 Other mounting options exist for flat roof applications, such as using weighted cassettes or roof integration kits, as shown in the images below. Installation of these options relies on adequate load factors for the host roof being available.

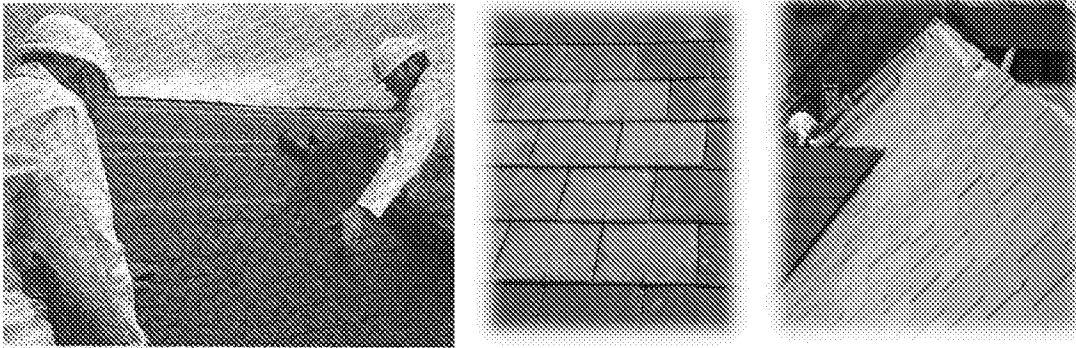


Figure 5: PV roof tiles and slates

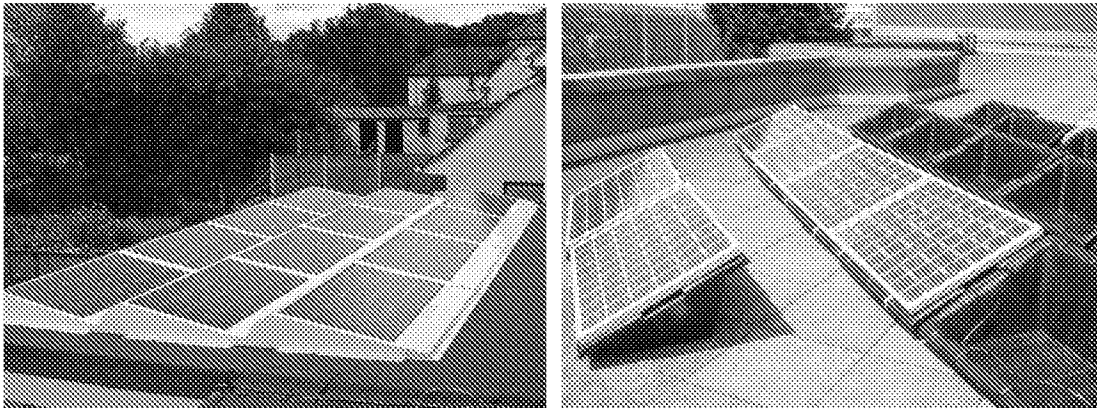


Figure 6: PV mounting options for flat roofs

- 5.1.6 The key locational requirements for a PV array are to avoid shading and to face within 45° of south, although they will work at a reduced efficiency facing east/west. A tilt of between 30-45° is also preferable, but not essential.

5.2 Generation and tariffs

- 5.2.1 In terms of generation capability, 1kWp installed PV should produce between 900 - 950 units/kWhs of electricity per annum situated in a southerly-facing, un-shaded location in the south of England. This will drop by 25% for east or west facing arrays. A 1kWp array made up of conventional 250Wp rated panels will need around 6m² of space on a roof, with around 1m² of internal wall space required for the inverter and associated equipment.
- 5.2.2 The host building will have first call on any electricity generated and this will offset electrical requirements, leading to savings for the occupiers. In addition to this, payment can be received from utilities for the export of unused generated electricity.

5.3 Solar PV at the Woodgate Centre site

- 5.3.1 The use of a PV at the Woodgate Centre site is considered a technically viable option, as most of the dwellings have a large enough area of un-shaded, southerly facing, pitched roof space available on to which a system can be installed at a 45° angle.
- 5.3.2 In order to generate 10% of the onsite annual energy requirements of the dwellings proposed, the combined PV arrays need to generate 104,441kWhs of energy per annum.
- 5.3.3 The majority of dwellings have a roof facing to south-east or south west, so this will see a 5% drop off in the production figure of between 900 - 950 units/kWhs of electricity per annum discussed above in section 5.2.1, so 1.0kWp of PV is taken to deliver 810kWhs per annum for the site.
- 5.3.4 Therefore, 128.94kWp of PV is required at this site as a minimum to meet the LPA 10% on site generation requirements.
- 5.3.5 Accordingly, if 65 of the dwellings were to install a 2.0kWp PV array on a south-east or south-west facing roof, the site would be in compliance with the energy requirements of Arun District Council Local Plan policy.
- 3.5.5 Typical Pye Homes house type designs show that there is easily enough room on the roofs to install a PV array of 2.0kWp and an assessment of the site layout, which has been designed to maximize energy efficiency and the solar resource, suggests that 147 of the properties could have a PV array installed to meet the requirements.

6 Conclusions

- 6.1 The proposed approach to energy reduction is already good practice, in that it complies with Part L requirements even before the addition of LZC technology and as the scheme is further developed, additional options for improved energy efficiency will be explored.
- 6.2 The design of the dwellings and layout of the site has been reviewed to ensure benefits accrue from access to good daylighting and natural heating. The site is also laid out with a view to allowing for a wide roll out of solar PV technology, as required.
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