Energy Statement

Higham Lane, Dodworth

Revision A

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1. INTRODUCTION

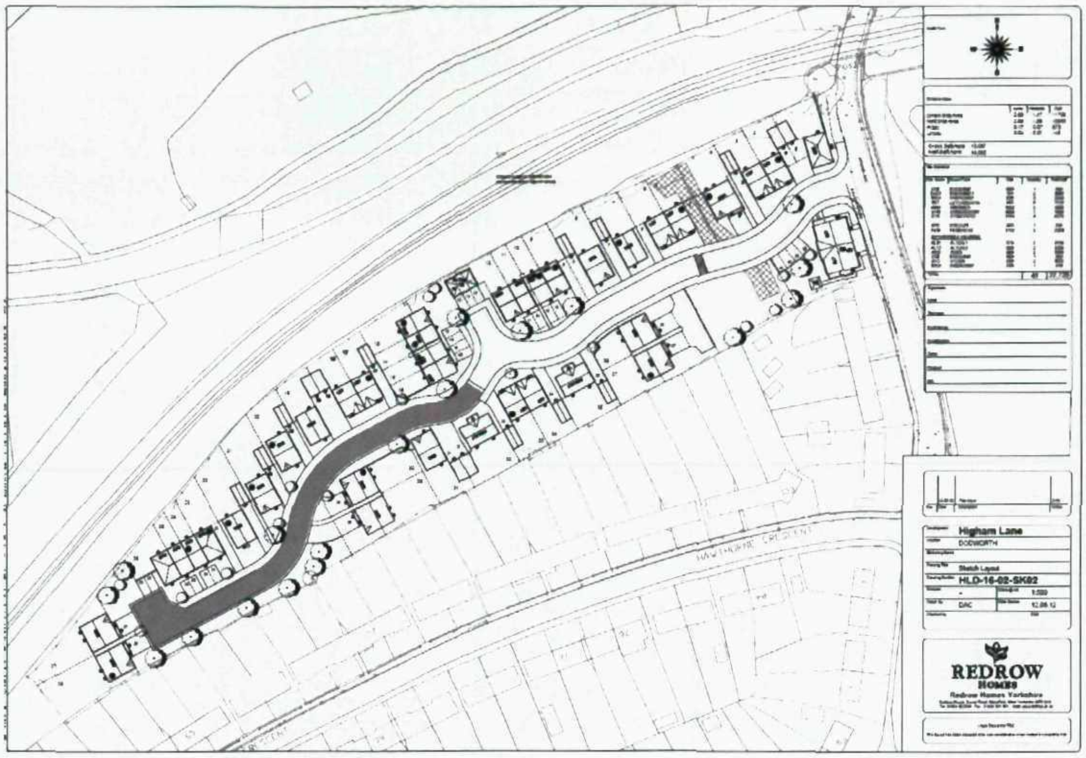
This report has been prepared specifically to address the planning application with Barnsley Metropolitan Borough Council which requires 15% of the developments predicted CO_2 to be replaced through renewable sources across 41 plots on a development referred to as Higham Lane, Dodworth.

The statement will establish the most appropriate LZC energy source for the development. In order to do so, it will cover as a minimum:

- Energy generated from LZC energy source per year
- Payback
- Noise
- Land use
- Whole life cost and lifecycle impacts of the potential specification in terms of carbon emissions
- Any available grants
- All technologies appropriate to the site
- Reasons for excluding other technologies

The following document will demonstrate how the scheme will comply with the relevant standards and policies.

Higham Lane, Dodworth, Leicester involves the construction of 41 new homes located on land off Higham Lane, Dodworth. Residential zones are surrounding the development site to the south and east boundaries. Light industrial units flank the site to the west with Silkstone golf course the North boundary. The site is located 2 miles west of Barnsley town centre.



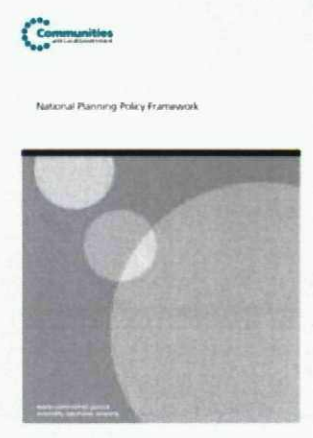
Development	Higham Lane, Dodworth
Grid Reference	431570, 405729
Landranger	SE315057
Indicative Wind speed at 10m (m/s)	5.3
Indicative Wind speed at 25m (m/s)	6.0
Indicative Wind speed at 45m (m/s)	6.4
Annual Solar Irradiation ($kWh/m^2/yr$)	1080

These proposals are based upon improvements in energy demand above that assumed for properties designed to meet current Building Regulation Part L standards and sets out the developments aspirations to comply with achieving a 15% contribution to total onsite energy demands from onsite renewable energy generation.

2. PLANNING POLICY

<u>National Policy</u>

The purpose of planning is to help achieve sustainable development. National Planning Policy Framework (NPPF) sets out the Government's planning policy for England.



There are twelve core planning principles that the planning system ought to play. To support a low carbon future, local planning authorities should:

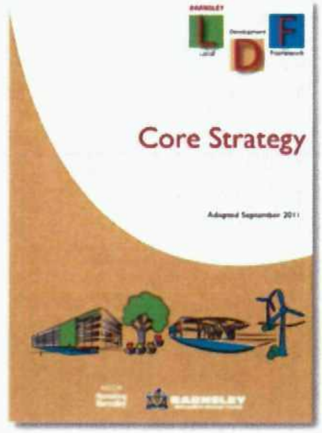
- *Support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy);*

- *When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.*

It requires that planners ensure development plans contribute to global sustainability by addressing the causes and potential impact of climate change - through policies which reduce energy use and emissions, minimise the use of new resources, and take Climate Change impacts into account in the location and design of development.

Local Planning Policy

There are two energy policies within the Barnsley Core Strategy which are to be addressed in a Sustainable Energy Statement.



Barnsley Metropolitan Borough Council
CSP5 - Including Renewable Energy in Developments

All development (either new build or conversion) of 10 or more dwellings or 1000sqm of non-residential floor space will be expected to incorporate decentralised, renewable or low carbon energy sources and other appropriate design measures sufficient to reduce the development's carbon dioxide emissions by at least 15% for applications submitted up to 2015, rising to 20% for applications submitted thereafter subject to such measures being practicable and not unacceptably prejudicing the viability of the development.

Where it is not appropriate to incorporate such provisions within the development, an off-site scheme, or contribution to such may be acceptable.

Barnsley Metropolitan Borough Council
CSP6 - Development that Produces Renewable Energy

We will allow development that produces renewable energy as long as there is no significantly harmful effect on:

- the character of the landscape and appearance of the area
- living conditions
- biodiversity, geodiversity and water quality
- heritage assets, their settings and cultural features and areas
- highway safety, and
- infrastructure including radar

Proposals must be accompanied by information that shows how the local environment will be protected, and that the site will be restored when production ends.

3. STANDARDS FOR THE ASSESSMENT

The Building Regulations

The Building Regulations set standards for the design and construction of buildings, primarily to ensure the safety and health for people in or around those buildings, but also for energy conservation and access to and about buildings.

The Building Regulations contain various sections dealing with definitions, procedures, and what is expected in terms of the technical performance of building work. The regulations are split into fourteen technical parts (A to P), which deal with individual aspects of the construction.

Part L: Conservation of Fuel and Power

Part L is the technical standard by which the energy performance of buildings is controlled. It stipulates that reasonable provision should be made for the conservation of fuel and power. This is achieved by controlling the insulation values of building elements, the allowable area of windows, doors and other openings, air permeability of the structure, the heating efficiency of boilers and the insulation and controls for heating appliances and systems together with hot water storage and lighting efficiency. It also sets out the requirements for SAP (Standard Assessment Procedure) calculations and Carbon Emission Targets for dwellings.

General guidance on how to comply with the regulations is given in a series of 'Approved Documents' issued by the Secretary of State. These are intended to provide practical guidance with respect to the technical requirements of the Building Regulations.

The current version of 'Approved Document L: Conservation of fuel and power' is split into four parts:

- Approved Document L1A: Conservation of fuel and power (New dwellings) (2010 edition)
- Approved Document L1B: Conservation of fuel and power (Existing dwellings) (2010 edition)
- Approved Document L2A: Conservation of fuel and power (New buildings other than dwellings) (2010 edition)
- Approved Document L2B: Conservation of fuel and power (Existing buildings other than dwellings) (2010 edition)

As the development at Higham Lane, Dodworth comprises only new build housing its energy performance is to be assessed in accordance with Approved Document L1A of the Building Regulations for its regulated energy.

4. ENERGY EFFICIENCY

Optimising energy efficiency is crucial to reducing energy demand and the resultant emissions of CO_2 into the atmosphere. A commitment has been met to reduce the energy demand on for the dwellings considerably through the improved specification delivered in the building fabric and through advanced building controls. 23% reduction in CO_2 across 41 plots will be achieved. Dwellings at Higham Lane will be designed to reduce energy consumption through a good quality external envelope and efficient building services.

All dwellings will aim to achieve above current standards set in Approved Document L1A of the Building Regulations (2010) and will achieve phased compliance with anticipated step changes in these regulations due in 2013 as the phased delivery of development ultimately dictates.

The summary points below outline key measures to be adopted by Redrow in achieving appropriate levels of energy efficiency improvement on this development:

- Basic passive solar design, subject to site limitations with buildings designed to maximise day lighting and displace the need for artificial lighting.
- Improved thermal performance at junctions.
- Improved Levels of insulation and air tightness.
- Improved Windows and building fabric specifications to reduce heat loss (U Values).
- Mechanical Ventilation with Heat Recovery (MVHR) or Mechanical Extract Ventilation (MEV).
- Effective heating controls.

All light fittings to have dedicated high-energy efficiency lamps with electrical appliances specified as A-rated or better.

Element U (w/m^2k)	Part L1A 2010	Typical Specification
Floor	0.25	0.18
Roof	0.20	0.14
Walls	0.30	0.28
Windows	2.0	1.5
Doors	2.0	1.0
Thermal Bridging	Y=0.15	Y=0.03
Air Permeability (@50Pa)	10	6
Low energy Lighting	75%	100%

It is assumed that all new homes on this development are to adopt this improved specification. Redrow has estimated that this will deliver a 23% reduction in CO_2 emission prior to the inclusion of LZC technologies.

5. THE REQUIREMENT

SAP is the Government's Standard Assessment Procedure for Energy Rating of Dwellings. SAP 2009 is adopted by the government as part of the UK national methodology for calculation of the energy performance of buildings. It has been used in this section to provide regulated energy ratings for the dwellings in question.

SAP calculations for each of the dwelling types were used to determine to total CO_2 usage for the site in requirement for the site in kilograms Carbon Dioxide per year ($kgCO_2$/year). The results are summarised in the table below.

House Type	CO_2 Kg CO_2/yr	Quantity	Total CO_2 Kg CO_2/yr
Avon [Mid]	1,101	2	2,203
Alton 1	1,040	2	2,081
Alton 2	1,165	2	2,330
Brecon	1,686	1	1,686
Broadway [End]	1,404	4	5,616
Evesham [Mid][G]	1,135	2	2,270
Evesham3 [Mid][G]	1,294	2	2,587
Letchworth	1,522	8	12,179
Pembroke [Cnr]	1,826	2	3,652
Shrewsbury	1,835	7	12,844
Stour [End]	1,413	2	2,825
Stratford	1,823	4	7,293
Warwick	1,703	3	5,109
Totals		**41**	**62,675**

Whichever technology is used, it will have to generate/save a total of 9,401$kgCO_2$ of regulated CO_2 per year to meet the 15% planning requirement.

6. LOW CARBON AND RENEWABLE ENERGY TECHNOLOGIES

This Section details the LZC technologies that were considered in order to enable compliance with the planning policy requirements for the Higham Lane, Dodworth development. It should be noted that the conclusions drawn within this Energy Statement are based upon planning drawings and 'Design Stage' SAP calculations informed by the following build specification:

- External wall U-value of 0.28W/m2K
- Floor U-Value of 0.18W/m2K.
- Roof U-value of 0.14W/m2K
- Window U-value of 1.50W/m2K
- Design air permeability of 5-6 m^3/m^2.h@50Pa
- Accredited thermal modelling of construction details

This Section considers all LZC technologies that could potentially be considered applicable to the site. These have been deemed to be Solar PV Panels, Solar Thermal Panels, Ground Source Heat Pumps, Air Source Heat Pumps, Combined Heat and Power, Biomass, Wind Turbines and Hydro Power.

Solar Photovoltaic (PV) Panels

Solar PV cells generate electricity by harnessing the power of the sun. They convert solar radiation into electricity which can be used on site or exported to the grid in times of excess generation. PV cells can be either mounted on panels or tiles and are a feasible technology for the development to achieve the required 15% CO_2 reduction required by planning. They lend themselves well to the financial benefits which can be derived from the Feed-in Tariff.

Energy generated from LZC source per year
The best PV array operates with an efficiency approaching 14%. Approximately $7m^2$ of PV cells will produce 1kWp of electricity. PV cells operate best on south facing roofs angled at 30-45 degrees. PV orientated east/west suffers from a loss in performance of 15-20% depending upon the angle of installation. PV cells should be located in areas free from potential shading. The electricity produced displaces grid electricity which has a carbon intensity of 0.529kg CO_2 per kWh_1.
In order to meet the required target of producing 9,401kgCO_2; an installation equalling approximately 21kWp would be required at an estimated cost of £42,000. Site layout in Appendix B identifies the suitably orientated plots that could receive the PV cells. This coverage equates to 56% of all plots. Distribution across the site is at the developer's discretion as potential customers may not wish to have PV yet others may want more.

Payback
The Feed-In-Tariff could greatly reduce the payback period for Solar PV. The installation cost of the panels has come down drastically in recent years and payback times are in the region of 9 years.

1 Table 12 SAP 2009v2.20 (March 2010)

Noise

A noise emission of operating PV is zero.

Land

There is no need for any external ground works. An opportunity for incorporating PV is limited by available roof space rather than land.

Whole Life Cost and Lifecycle Impacts

The capital outlay is in the region of £2,000 per kWp depending on the performance of the tile/panels. PV reduces occupants' reliance on grid electricity and therefore reduces running costs. PV tile/panels produce virtually free fuel and have very low maintenance costs. For maximum financial benefit from the installation of PV, the Feed-in-Tariff payments need to be utilised.

Available Grants

The Department of Energy and Climate Change (DECC) has used powers in the Energy Act 2008 to introduce a system of feed-in tariffs to incentivize small scale (less than 5MW), low carbon electricity generation.

As of March 2012 PV installations with a total installed capacity of less than 4kW where installed on new buildings are entitled to receive 21 pence per kwh generated and 3 pence per kwh exported.

Solar Thermal Panels

Solar thermal heating panels contribute to the hot water demand of a dwelling or building. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. Due to the seasonal availability of heat, solar thermal panels should be scaled to provide no more than 50% of the hot water load. Solar thermal panels are not a feasible technology for the houses at the Higham Lane, Dodworth development to achieve the CO_2 saving required to meet the policy.

Energy generated from LZC source per year

Evacuated tube collectors have an efficiency of approximately 60%; flat plate collectors have an efficiency of approximately 50%. Total energy generated for solar thermal panels is in excess of that for PV panels and reductions in CO_2 emissions are comparable to PV per m^2. The greatest reductions in CO_2 emissions are achieved by occupants who operate their hot water system with consideration of the panels.

Assuming $4m^2$ solar hot water panels are installed on all dwellings, the CO_2 target of 9,401kgCO_2 would be achieved from 43 installations to hit this target. An estimated cost of 43 installations is £107,500.

Solar hot water is not a suitable renewable to achieve the planning requirement as 43 installations are required on only 41 plots.

Payback

Current payback periods are in the region of 20 years per dwelling.

Noise

Noise emissions of operating solar thermal panels are zero.

Land

There is no need for any external ground works. Opportunities for incorporating solar thermal panels are limited by available roof space rather than land.

Whole Life Cost and Lifecycle Impacts

The capital outlay for solar thermal panels is in the region of £2,500 per $4m^2$ plus installation costs. Costs are higher for evacuated tubes than flat plate collectors. Solar thermal panels reduce occupants' reliance on gas and thus reduce costs. Solar thermal panels produce virtually free fuel and have very low maintenance costs. Solar thermal panels are installed on the roof so have no impact on land use.

Available Grants

On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy to revolutionise the way heat is generated and used in buildings and homes. The second phase of the RHI scheme will see households moved to the same form of long-term tariff support offered to the non-domestic sector in the first phase. Consultation on the RHI for domestic installations is expected in autumn 2012. The outcome and level of support for renewable heat will be determined after this period.

Ground Source Heat Pumps

Ground Source Heat Pumps (GSHP) work in much the same way as a refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input in a smaller space. Electricity drives the pump which circulates a fluid (water/anti-freeze mix or refrigerant) through a closed loop of underground pipe. This fluid absorbs the solar energy that is stored in the earth (which in the UK remains at a near constant temperature of 12 degrees Celsius throughout the year) and carries it to a pump. A compressor in the heat pump upgrades the temperature of the fluid which can then be used for space heating and hot water.

GSHPs are able to provide substantial reductions in energy and would, in theory, be able to meet the energy target. However, GSHPs require ground excavation works to bury the coils. The proposed site layout does not include sufficient space within each private garden to bury the coils. Thus it has been concluded that GSHPs are not feasible.

Energy generated from LZC source per year

GSHPS reduce energy demand significantly but do replace gas as the heating fuel with electricity which is more carbon intensive (gas = 0.198; electricity = 0.517). As GSHPs are upgrading heat energy from the earth, GSHPs operate at 'efficiencies' in excess of 350%, although this is not currently represented by SAP. The percentage reductions achievable in terms of CO_2 emissions are comparable to solar thermal panels in SAP. Due to the lower temperature of the output of GSHPs compared to traditional gas boilers, GSHPs work best in well insulated buildings and with underfloor heating.

Payback

Current payback periods are in the region of 20 years per dwelling.

Noise

Noise emissions of operating GSHPs are zero.

Land

GSHPs require extensive ground works to bury the coils that extract the low grade heat from the earth. They therefore require a large area for horizontal burial (40-100m long trench) or a vertical bore (50-100m).

Whole Life Cost and Lifecycle Impacts

The capital outlay is in the region of £11,000 per house. Additional costs will be accrued if underfloor heating is to be installed. Electricity is a more expensive fuel than gas and thus fuel bills are not reduced as much as energy is reduced.

Available Grants

On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy to revolutionise the way heat is generated and used in buildings and homes. The second phase of the RHI scheme will see households moved to the same form of long-term tariff support offered to the non-domestic sector in the first phase. Consultation on the RHI for domestic installations is expected in autumn 2012. The outcome and level of support for renewable heat will be determined after this period.

Air Source Heat Pumps

Air Source Heat Pumps (ASHP) operate in much the same way as a refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input into a smaller space. Electricity drives the pump which extracts heat from the air as it flows over the coils in the heat pump unit. A compressor in the heat pump upgrades the temperature of the extracted energy which can then be used for space heating and hot water. As there is no need for any external ground works for ASHP and the heat pump unit will not be visible to the general public, this technology is feasible for the Higham Lane, Dodworth development.

Energy generated from LZC source per year

ASHPs require electricity to drive the pump, and therefore displace gas heating with electricity, which has a higher carbon intensity (gas = 0.198; electricity = 0.517). As ASHPs are upgrading heat energy from the air, they operate at efficiencies in excess of 250%. However, this is currently limited by SAP. ASHPs can achieve large reductions in energy demand, albeit less so than GSHPs.

However, as the target is in terms of CO_2 generation or mitigation; ASHPs fail to make any impact as the energy used to power the units is grid electricity and although there is an energy reduction the CO_2 intensive grid makes the technology incompatible with the policy.

Combined Heat and Power (CHP) and Micro-CHP (mCHP)

CHP is a form of decentralised energy generation that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high CO_2 emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. As both the electricity and heat from the generator is used, the efficiency of the system is increased above that of a conventional power plant where the heat is not utilised. However, the overall efficiency of approximately 75% is still lower than the 90% efficiency of a heat only gas boiler. CHP is suitable for dense developments where there is a high, constant and varied heat demand. This is not the case for the Higham Lane, Dodworth development which is of relatively low density is entirely residential and energy efficient measures have limited the heating load. Furthermore, a site-wide distribution network would be required which would not be economically feasible for a development of this size and nature.

mCHP, however, would be a feasible technology for the larger houses within the development. mCHP systems operate in homes or small commercial buildings and are driven by heat-demand, delivering electricity as the by-product. Due to this operating model and because of the fluctuating electrical demand of homes and commercial buildings, mCHP systems will often generate more electricity than is instantly being demanded. A mCHP unit resembles a gas-fired boiler and produces electricity from fossil or renewable fuels. Currently mCHP systems are best suited to either larger homes with high heating demand or older homes where it is hard to improve insulation, like houses with solid brick walls. Policy requires that the load is to be reduced through fabric improvements first. This strategy eliminates this technology.

Energy generated from LZC source per year

mCHP engines can provide high reductions in primary energy and CO_2 emissions. Electricity produced by a CHP engine displaces grid electricity which has a carbon intensity of 0.529 kg per kWh.

Payback

Current payback periods for traditional CHP are in the region of 10-15 years. For mCHP this is reduced to a period of between 8 and 10 years, and the economic advantages of the Feed-in Tariff have the potential to lower these time spans further.

Noise

Low frequency noise emissions of operating a CHP engine can be high, particularly close to the plant room.

Whole Life Cost and Lifecycle Impacts

The cost reduces proportionally as the size of the engine increases. CHP engines often struggle to provide cost-effective energy to dwellings on residential schemes. Running costs and maintenance requirements are much higher than for domestic gas boilers. To get the most benefit out of installing CHP it is necessary to install heat networks, usually using piped water. These carry high costs, equivalent to between £500 and £800 to install each kW of generating capacity.

Available Grants
On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy to revolutionise the way heat is generated and used in buildings and homes. The second phase of the RHI scheme will see households moved to the same form of long-term tariff support offered to the non-domestic sector in the first phase. Consultation on the RHI for domestic installations is expected in autumn 2012. The outcome and level of support for renewable heat will be determined after this period.

Biomass Boilers

Biomass boilers generate heat on a renewable basis as they are run on biomass fuel which is carbon neutral. The fuel used is generally wood chip or wood pellets. Wood pellets are slightly more expensive than wood chips but have a much higher calorific value and enable greater automation of the system. Biomass boilers can be used with district heating networks or as individual boilers on a house-by-house basis. A district heating network is not viable for the Higham Lane, Dodworth development due to the low density nature of the development and consequent heat losses from the distribution pipes. Furthermore, all biomass boilers, although being clean burning devices do emit particulate matter and nitrous oxides which have a negative influence on air quality. For these reasons, it has been concluded that biomass boilers are not viable for the Higham Lane, Dodworth development.

Energy generated from LZC source per year
Although biomass boilers do not reduce energy demand, they can provide significant reductions in CO_2 emissions which are limited by the hot water load. Biomass boilers are best suited to providing the base heating load of a development (year round hot water demand) with conventional gas boilers responding to the peak heating demand (winter space heating).

Payback
Current payback periods are in the region of 15-20 years.

Noise
Noise emissions of operating a biomass boiler can be high, particularly close to the plant room.

Land
Biomass boilers require a plant room, and possibly an energy centre if used for larger developments with a district heating network. Biomass boilers require a flue to effectively disperse pollutants. The height of the chimney required is dependent on the size of the engine installed. A fuel store will be required and this should be sized to reduce fuel delivery frequency. Space needs to be allocated for delivery vehicles to park close to the plant room.

Whole Life Cost and Lifecycle Impacts

The capital outlay is low compared to a CHP engine. Biomass is more suitable than CHP for smaller developments as the installed cost is cheaper. Biomass fuel is more expensive than gas and as such heat being provided to dwellings is generally more expensive than the market. Running costs and maintenance requirements are much higher than for domestic gas boilers.

Available Grants

On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy to revolutionise the way heat is generated and used in buildings and homes. The second phase of the RHI scheme will see households moved to the same form of long-term tariff support offered to the non-domestic sector in the first phase. Consultation on the RHI for domestic installations is expected in autumn 2012. The outcome and level of support for renewable heat will be determined after this period.

Wind Turbines

Wind turbines can range from small domestic turbines (1kW) to large commercial turbines (150m tall, 2MW). There are also different designs and styles to suit the location. They generate clean electricity that can be provided for use on-site, or sold directly to the local electricity network. The wind speed of 4.7m/s at 10m elevation at the Higham Lane, Dodworth development is below that required for horizontal axis turbines (>6m/s to operate efficiently). As the energy generated via the turbine is proportional to the cube of the wind speed and the wind speed at the Higham Lane, Dodworth development is insufficient, it has been concluded that this technology is not feasible for this development.

Energy generated from LZC source per year

Energy generated is proportional to the cube of the wind speed. Electricity produced displaces grid electricity which has a carbon intensity of 0.529 kg/kWh.

Payback

Current payback periods are in the region of 15-20 years. These time spans have the potential to be reduced considerably where the Feed-in Tariff has been taken advantage of.

Noise

Noise emissions of turbines vary according to size but are generally lower than the noise from road traffic, trains and construction activities.

Land

Smaller models can be roof mounted but must be higher than surrounding structures and trees. For larger turbines a more extensive area of land will be required.

Whole Life Cost and Lifecycle Impacts

The capital outlay is approximately £1,000 per kW. Smaller models are more expensive per kW. Vertical axis turbines are more expensive than horizontal. For maximum lifecycle cost benefit, it is important for Feed-in-Tariff payments to be secured. An annual service will be required. Turbines rated in excess of 5kW may require the network to be strengthened and arrangements to be made with the Local Distribution Network Operator and electricity supplier.

Available Grants

The Department of Energy and Climate Change (DECC) has used powers in the Energy Act 2008 to introduce a system of feed-in tariffs to incentivize small scale (less than 5MW), low carbon electricity generation.

As of April 2011 wind installations with a total installed capacity of ≤1.5kW where installed on new buildings are entitled to receive 35.5 pence per kilowatt hour produced.

7. CONCLUSION

This document has identified the feasible renewable option for this development as solar photovoltaic panels. Solar thermal panels are not cost effective to reduce the CO_2 target required of the policy and ASHPs will not reduce the CO_2 on the site compared even to a modern mains gas boiler.

SAP calculations have been carried out to demonstrate that PV can meet the energy demand of the planning condition. By installing a total of 21kwp on a selection of house types the 15% target for on-site CO_2 reduction can be met. However, it may be possible to achieve the 9,401kgCO_2 with a less amount of PV tiles/panels depending on type and configuration.

Details of the energy calculations for the development can be found in Appendix A of this document.

Appendix B indicates the suitable plots that can accommodate PV cells. These 23 locations have been selected to achieve maximum efficiency in electricity generation. Distribution of the PV amongst these plots may vary dependant on detailed design. Home owners may wish to increase the amount of PV installed.

Appendix A

Series	Total Energy kwh/yr	Total kg/CO2/yr
Redrow	272,530	62,675
Baseline	367,305	81,578
% Reduction	26%	23%

Reduction Table		
Chosen % Reduction	15	%
Target as shown kwh reduction	40,879	
Target as shown CO2 reduction	9,401	

PV Detail	
PV Installations kwh	48
PV Installation Cost kwh	£96,000
PV Installations CO2	21
PV Installation Cost CO2	£42,000

Solar Detail	
Solar Hot Water Installations kwh	33
Solar Hot Water Installation Cost kwh	£82,500
Solar Hot Water Installations CO2	43
Solar Hot Water Installation Cost CO2	£107,500

Dodworth		Redrow	Baseline	Redrow	Baseline
House	House Quantity	Total kg/CO2/yr	Total kg/CO2/yr	Total kwh/yr	Total kwh/yr
Avon [Mid]	2	2,203	2,717	9,309	11,907
Alton 1	2	2,081	3,156	7,577	12,659
Alton 2	2	2,330	3,455	8,511	13,846
Brecon	1	1,686	2,181	7,483	9,980
Broadway [End]	4	5,616	7,091	24,656	32,109
Evesham [Mid][G]	2	2,270	2,817	9,725	12,488
Evesham3 [Mid][G]	2	2,587	3,249	11,168	14,512
Letchworth	8	12,179	15,524	53,374	70,269
Pembroke [Cnr]	2	3,652	4,779	16,170	21,859
Shrewsbury	7	12,844	16,832	57,159	77,298
Stour [End]	2	2,825	3,555	12,250	15,936
Stratford	4	7,293	9,562	32,442	43,901
Warwick	3	5,109	6,660	22,705	30,542
Total	41	62,675	81,578	272,530	367,305

Appendix B