Fole Dairy, Uttoxeter Road

Short Form Energy Statement

Introduction

WSP Environment and Energy were commissioned by the Co-Operative group to provide a brief energy statement for the proposed residential led development considering measures and low carbon and renewable energy sources for the purpose of achieving building regulation compliance in line with Staffordshire Moorlands Revised Submission Core Strategy, December 2011, SD2.

The proposal is for approximately 60 new homes, 2 (22No), 3 (33No) and 4 (5No) houses and a small employment unit.

The core strategy does not set a specific target but does require that major developments consider whether the scheme can provide or be a receptor for decentralised energy. In addition the strategy states:

> "*The District will strive to meet part of its future energy demand through renewable or low-carbon energy sources (which could be through a variety of technologies, for example wind power, solar energy, biomass, etc.), in line with current evidence which identifies the feasibility of these forms of energy across the District. This will be achieved by:-*
>
> 1. *Supporting small- and large- scale stand-alone renewable or low-carbon energy schemes, subject to the following considerations……..*
>
> 2. *Requiring that all new development is constructed to the highest viably possible energy efficiency/renewable energy levels of the Code for Sustainable Homes and the BREEAM office scale (and as a minimum satisfy the levels required by law at the date of approval)."*

From this the focus of the work has been to demonstrate that the new homes can achieve compliance with the present building regulations, (Part L1A 2010).

Methodology

In accordance with best practice the 'energy hierarchy' has been followed to generate a baseline to understand what, if any low and zero carbon technologies should be used.

Energy Hierarchy

The energy hierarchy is a methodology that identifies what elements of a project should be considered and at what stage to obtain maximum benefit for minimum effort.

The biggest savings should be made through energy conservation through to carbon offsetting, which should be the last consideration after all other options have been exhausted.

To attempt to reduce the energy demand of the dwellings below Building Regulation requirements this methodology has been employed:

- Reducing energy demand: measures to reduce energy consumption;

- Efficiency of supply;
- Sustainable energy: use of green energy sources.

Reducing energy demand

Energy efficient design to reduce energy demand should be the first step in any sustainable development. The energy efficiency options considered for the houses include:

- Maximise passive solar gain
- Maximise natural light
- Reduce the air permeability of the building envelope
- Increase building insulation
- Drain pipe heat recovery
- Low-energy lighting.

Efficiency of supply

- Selecting heating systems with high efficiency;
- Consider heat recovery where applicable.
- Timed and thermostatic control to hot water system;

A representative 3-bedroom dwelling has been used for the analysis. WSP have used good practice with regard to insulation and air permeability values and energy efficient services to generate energy consumption and carbon emission figures. The site is assumed not to have mains gas based on the utilities report and therefore heating has been assumed to come from oil.

Site Energy Demand

The three bedroom semi-detached representative house has been considered with 'good practice' energy efficiency measures already employed in accordance with good practice and then extrapolated for the site as a whole. The Dwelling Emission Rate (DER), as used by Standard Assessment Procedure (SAP) 9.90, (Government approved methodology for calculating dwelling carbon emissions) for the dwelling is 22.76kg CO_2 per m^2 per year or 2,048 kg, (regulated emissions only). The table below shows this for the individual dwelling and for the site as a whole.

CO_2 Emissions kg per year (Dwelling Emission Rate)		**Building Regulations CO_2 kg (Target Emissions Rate)**		**% above building regulations**
House	Whole Site	House	Building Regs	Whole Site
2,048	124,952	1,976*	120,536	3.69%

Table 1 Carbon Emissions from proposed development

*SAP Software uses fuel factors for different fuels such as oil, gas and mains electricity. This is used to reduce the disadvantage of using these fuels. Therefore the target emission rate may increase or reduce dependent on these and this has been taken into account.

From the u-values used, air permeability and efficiency of plant the house and development indicatively has emissions that are 3.69% too high.

A brief analysis of proposed methods to achieve compliance is proposed below. Each method has been analysed for its potential to deliver a compliant home however inevitably there will be variations in potential and demand for each home and therefore it is likely that a variety of technologies will be used, possibly in partnership.

- Mechanical Ventilation and Heat Recovery
- Exemplar fabric

Each of the renewable options has been considered, allowing for the fact that the development is not at detailed design yet: Renewable options considered include:

- Combined Heat & Power (CHP)
- Energy from wind
- Photovoltaic panels
- Solar water heating
- Energy from biomass
- Ground source heat pumps
- Air source heat pumps

Mechanical Ventilation and Heat Recovery (MVHR) - Mechanical Ventilation and heat recovery, (within a home which is reasonably air-tight) can save energy by recovering energy from the air used for ventilation. Assuming air permeability to be no worse than 3m per m^2 hr @50Pa then a system would indicatively allow each home to achieve building regulations compliance. The cost would indicatively be £1,500 per home.

This technology is recommended for further consideration

Exemplary Fabric – By applying very high fabric standards it is possible to reduce demand further than that already achieved through 'good practice', in this case by 7.33%. The values used are realistic and may offer particular benefit on a site without mains gas where heating bills will be disproportionately high. However the values used may have implications on building design which are not achievable in all aspects and this may be considered on a house by house basis. An increase in cost for this cannot be calculated at this stage.

This technology is recommended for further consideration

Bulk LPG – Bulk liquefied Petroleum Gas will reduce overall emissions but as noted above the government approved methodology SAP reduces the target emission rate for the use of gas, making it more demanding to achieve compliance with this methodology. This is not recommended.

This technology is NOT recommended for further consideration

Low and Zero carbon technologies Review

The technology review is based on an analysis of practicality and cost to achieve compliance. The analysis used SAP 9.90 standards to analyse technologies and performance will vary depending on the particular make and model used.

Combined Heat and Power

This technology comprises installation of an electrical generator on site which uses an engine or turbine, fuelled, (normally) by natural gas as the prime mover. Low grade waste heat is recovered to generate hot water thereby increasing the overall efficiency. This can make significant reductions in carbon emissions as the heat normally lost is used and therefore need not be generated by other means. The technology can be applied on a district wide or individual dwelling basis where appropriate.

In this case the technology is not recommended as there is insufficient number of dwellings to use a district system and well insulated new homes do not have the ideal heating profile for micro-CHP. In addition there is no mains gas which would increase the cost of compliance.

This technology is NOT recommended for further consideration

Wind Turbines

Integration of wind turbines on developments requires consideration of many factors. Dependent on the scale of wind turbine considered viable they may be either stand alone or building integrated. However there are issues associated with integrating wind turbines onto buildings. Large scale trials have shown that wind speeds in urban environments are generally much lower than those predicted by the models available, the energy output from small scale (<50kW) turbines can be as low as 1% of the expected value. Consequently WSP do not generally recommend the installation of wind turbines onto buildings or in urban environments.

The site is rural and there may be land available on the south-west of the site to be used for one or more turbines. The initial assessment indicates that wind speed in the area is reasonable and the site does have a clear aspect south-west. The proximity of the development will however reduce yield. Although indicatively a turbine may reduce net carbon emissions sufficiently more detailed site monitoring would be required and the turbine is likely to face significant, possibly insurmountable planning difficulties as well as acceptance, on a now residential site in such a sensitive area.

This technology is NOT recommended for further consideration

Photovoltaic Panels

Photovoltaic panels comprise flat panels that convert sunlight into an electrical supply. They may be building or ground mounted. On this occasion only roof mounted panels have been considered as ground mounted panels would result in issues with safety and security. Photovoltaic panels (PV) can be incorporated into the design and provide an electrical power output used to offset incoming electrical energy.

When assessing the potential benefit of photovoltaic panels allowance must be made for overshadowing from adjacent buildings. Overshadowing can substantially reduce the output from photovoltaic panels. However the energy produced is at its peak at 1pm in the summer months, when domestic demand is usually low, falling off substantially through the winter. Excess electricity can be exported to the grid.

Photovoltaics are a realistic method for achieving compliance on the site in general. It is predominantly unshaded and most of the homes on the site offer at least one aspect of the roof facing south of the east-west axis which would be recommended. Indicatively a 1kWp (kilo-Watt peak) system taking approximately 8m^2 of roof area would reduce emissions by approximately 22% and may allow an easing of standards in other directions.

In addition the government policy of Feed-in Tariffs (FiTs) offers a payment per kWh generated and may offer a payback to offset the capital cost of approximately £2,000 per unit, if contracts can be organised with the home buyers.

Some individual units may be overshadowed and therefore not be applicable for this technology.

This technology is recommended for further consideration

Solar Thermal

Solar thermal collectors comprise fluid filled panels mounted at roof level that collect solar energy to heat water. In the UK these panels are conventionally used to provide hot water rather than heating.

The solar collectors need unrestricted access to sunlight without overshadowing. The area required for installation of the panels needs to be co-ordinated with the provision of other roof mounted equipment. Unlike PV technology the energy cannot generally, be exported off-site as it is in the form of hot water rather than electricity. Solar hot water is comparable in cost to PVs in terms of carbon reductions but considerably more effective in terms of kWh delivered per unit of price and area. They are limited to the amount of hot water that can be used within a reasonable time and this limit is described as the solar fraction, what percentage of the hot water demand the technology can provide. A limit of approximately 50% is standard.

The site is predominantly unshaded and most of the homes on the site offer at least one aspect of the roof facing within 45^o of south, which would be recommended. . To achieve compliance a small system of approximately 3m^2 per house. This should be within the limiting solar fraction. The capital cost would be similar to that of PVs but the existing government incentive schemes favour PVs on domestic installations where at present there is only a one-off premium payment of £400 per installation. As the conditions required for solar hot water are similar but without the same financial benefits of PVs these are not recommended.

This technology is NOT recommended for further consideration

Biomass Heating

In the context of this report biomass heating is the direct combustion of biomass wood fuels in a boiler located on site. These installations are able to reduce the net CO_2 emissions considerably as biomass, (in the form of pellets in this case) is considered to have very low net emissions. When using a district system the developer can install the plant and then recover costs from the owners through metering strategies. Although biomass boilers can be used for individual dwellings they are expensive and require considerable space. Using this technology, there are other factors such as fuel delivery traffic and NOx emissions that may make it less desirable.

The Renewable Heat Incentive (RHI) makes payments for the use of biomass per kWh generated and as with FiTs this may provide a payback against the additional capital outlay for the developer if agreement can be reached with the homeowner for a district system and for individual systems there is a one-off payment of £950 per installation available. The fuel itself is generally slightly more expensive than mains gas and slightly less than oil.

The proposed development is too small and extensive to justify a district system and therefore individual boilers to each home has been used for this analysis.

The site is rural and therefore NOx emissions and air quality issues are unlikely to be significant. An individual boiler delivers excellent results in terms of CO_2 capable of reducing carbon emissions by 74.47% compared to the baseline. However the cost of such systems is much greater than a comparable oil system, at approximately £10,000 per installation. In addition an area for the boiler, storage, and access for delivery would be required which may restrict layouts and would increase vehicle movements.

Unless the developer is seeking very large carbon emission reductions this technology is not recommended.

This technology is NOT recommended for further consideration

Ground Source Heat Pumps

Heat pumps take a resource at one temperature and increase the temperature. Ground source heat pumps (GSHPs) extract energy via a ground linked heat exchanger. Generally using electric motors, heat pumps can convert the energy supplied by a factor between 3 to 4.

Two different forms of ground loop are commonly used, vertical and horizontal. Although more cost effective horizontal loops require a large land area. Detailed design and sizing is important with this technology. It should be assumed underfloor heating will be used as this technology works better with lower temperature emitters.

Ground source heat pumps attract a one-off payment of £1,250 per installation but no on-going payment. Indicatively a system will cost £7,000 per unit, varying on size and whether a horizontal or vertical system is used. Significant ground work is being undertaken on-site and therefore it may be possible to make savings on a contract for the ground preparation.

The carbon savings from ground source heat pumps are low when compared to an efficient gas-fired boiler however are significant when compared to oil. As explained earlier due to the fuel factor for electricity in the SAP methodology compliance may be easier with these technologies. When entered into SAP modelling methodology the technology allows a carbon emission rate 40.36% better than that required for compliance.

This technology is recommended for further consideration

Air Source Heat Pumps

Air Source Heat Pumps, (ASHPs) are normally applied on a dwelling (or building) by dwelling basis, no central site management is required. District systems can be used but this would normally only take place in a block of flats or similar. They use air as the source of heat rather than the ground. Working on the same principle as ground source heat pumps ASHPs are more flexible in that they can be sited in most locations outside and even internally. At domestic scale the external unit is approximately the size of other white goods. The technology can provide cooling although this increases the overall energy consumption for the site and is not morally required for domestic installations. They are normally less efficient than GSHPs due to the more variable temperature of the air.

An indicative cost per installation would be £5,000, but no payment is available through the renewable heat incentive at present.

It should be assumed underfloor heating will be used as this technology works better with lower temperature emitters. Detailed design and sizing is important with this technology to ensure maximum efficiency. The external elements of ASHPs do make some noise but this can usually be accommodated through sensitive siting and attenuation where necessary.

The carbon savings from air source heat pumps are low when compared to an efficient gas-fired boiler however are greater when compared to oil. As explained earlier due to the fuel factor for electricity in the SAP methodology compliance may be easier with these technologies. When entered into SAP the technology allows a carbon emission rate 31.70% better than that required for compliance.

The lower efficiency and lack of premium payment upfront make this less attractive than GSHPs unless there are site specific reasons a ground source system would not be effective.

This technology is NOT recommended for further consideration

Conclusion

Reviewing the range of technologies available for an already efficient dwelling on this site, there are several methods which may allow compliance to be achieved. These offer the best combination of practicality and cost. It is likely the optimum solution will be a combination of these.

The inclusion of renewables and low and zero carbon technologies will be considered in more detail at the reserved matters stage of development, when the site layout and design details are determined. However, this statement demonstrates compliance with the local policy and building regulations on site will be achievable and as a result, there is no material reason that should prevent the granting of outline planning permission for the development.

Summary

The recommended technologies or methods which should allow compliance to be achieved are summarised below:

Technology	Indicative reduction in CO_2 emissions (%)	Cost Approx. per unit
MVHR	3.70	£1,500
Exemplary fabric	7.33	Unknown
Photovoltaics	22.00	£2,000
GSHPs	43.70*	£7,000

Table 1 Recommended Technologies

*This saving is against an altered baseline carbon emission rate due to the fuel factors in SAP and is not absolute when compared to other technologies.

FURTHER INFORMATION

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