Laver Leisure

MONEYSTONE PARK

Energy Strategy

June 2016

PROPOSED LEISURE DEVELOPMENT
AT MONEYSTONE PARK, WHISTON
ON BEHALF OF LAVER LEISURE
(OAKAMOOR) LIMITED

ENERGY STRATEGY

PROPOSED LEISURE DEVELOPMENT AT MONEYSTONE PARK, WHISTON ON BEHALF OF LAVER LEISURE (OAKAMOOR) LIMITED

Laver Leisure (Oakamoor) Limited

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Proposed Leisure Development at Moneystone Park, Whiston – On behalf of Laver Leisure (Oakamoor) Limited

Energy Strategy

16/06/2016

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Executive Summary

This energy strategy serves to support the outline planning application resubmission for the proposed leisure development at Moneystone Park, Whiston.

The report has been updated in June 2016 in order to reflect the outline planning application resubmission. The changes to the proposed development are set out in the Supporting Planning Statement (HOW Planning, June 2016) which accompanies the resubmission application.

The planning application is re-submitted in outline with all matters reserved except for means of access and proposes:

"The erection of a high quality leisure development comprising holiday lodges; a new central hub building (providing swimming pool, restaurant, bowling alley, spa, gym, informal screen/cinema room, children's soft play area, café, shop and sports hall); café; visitor centre with farm shop; administration building; maintenance building; archery centre; watersports centre; equipped play and adventure play areas; multi-sports area; ropewalks; car parking; and managed footpaths, cycleways and bridleways set in attractive landscaping and ecological enhancements (re-submission of Planning Application SMD/2014/0682)".

WSP | Parsons Brinckerhoff note that there have been no changes to National or Local Planning Policy in relation to energy requirements for new developments since the date of the original submission in October 2014.

The aim is to show how the development is proposed to meet local and national policies regarding carbon emissions, energy consumption, and the use of renewable energy. It has been prepared on the assumption that the lodges would be treated as dwellings under Part L of the UK Building Regulations.

The relevant policies that the energy statement considered were:

- Part L of Building Regulations 2013;
- Staffordshire Moorlands – Core Strategy Development Plan Document (Adopted 26th March 2014);
- Churnet Valley Masterplan Supplementary Planning Document (SPD) (26th March 2014).

The requirement of Part L 2013 has two main elements, relevant to this energy strategy:

1. Fabric Energy Efficiency (FEE) – Each home must demonstrate that its specification, fabric standards, air permeability and glazing does not exceed a threshold given in kWh per m^2 per year (Applicable to homes only).
2. Target Emission Rate (TER) – As well as the fabric standard a specific TER is set for the new building in terms of emissions, given as kg CO_2 per m^2 per year.

Staffordshire Moorlands Core Strategy document details two specific policies relevant to the development. SD1 "Sustainable Use of Resources" requires all development to make sustainable use of resources, and adapt to climate change. With regards to energy use it is required that "development is located and designed to minimise energy needs and to take advantage of maximised orientation to achieve energy savings in line with policy SD3". This document meets the requirement that developments with 10 or more residential units or with 1,000+ square metres floor area should be accompanied by a sustainability/energy statement addressing the energy efficiency, water conservation, sourcing of construction materials, site orientation aspects and where possible the feasibility of integrating micro renewables. This strategy document covers the energy aspects (specifically renewable energy feasibility) whilst a sustainability statement is to be provided separately. Policy DS3 covers carbon saving measures and states that the Council "will support developers proposing to exceed the thermal efficiency standards required by law at the time of the application". In the case of larger developments the Council will support measures such as 'communal' micro renewables, or District Heating installations and they will support measures designed to contribute to existing or emerging District Heating Networks.

Finally, the Moneystone Quarry development is covered within the Churnet Valley Masterplan SPD. The concept statement for the site details the "creation of a high quality, sustainable environment which will promote environmental awareness – use of sustainable building techniques, low carbon, low impact development with on-site energy generation, green technology and eco-lodges". It highlights the potential for development strategy to include a complementary renewable energy scheme and states that where feasible renewable energy and energy efficiency technologies are included.

A representative model for the lodges was developed using National Home Energy Rating (NHER) Plan Assessor v6.0 software based on the schedule of accommodation (Appendix D) received for the proposed development. To demonstrate efficient building fabric the specification detailed in Appendix R of Standard Assessment Procedure (SAP) 2012 is used in the model as this sets out a reasonable method to comply with the fabric requirements, insulation and air permeability. However, due to the more onerous requirements for detached dwellings we have used improved levels of air permeability and improved thermal efficiency for windows. To this efficient heating and lighting was added to demonstrate a representative method of complying with the overall TER. The values used are laid out in Appendix B.

The energy demand and related CO_2 emissions of the main non-domestic element, the leisure hub, was modelled using a Simplified Building Energy Model (SBEM). The fabric and systems applied to building models were those as detailed in Part L2a of Building Regulations, which can be found in Appendix C. The SBEM does not account for process loads, such as the swimming pool, and whilst this is not relevant for consideration in relation to building regulations it is an important factor in the design of the energy provision on site.

The results of indicative SAP models (for homes) were extrapolated and added to results of SBEM model (for non-domestic buildings) to give an estimate of total site emissions and form a benchmark for the analysis of renewable energy technologies. (In this assessment the lodges have been assumed to be defined as dwellings for the purposes of Building Regulations.)

The proposals provide the required level of detail at this outline stage though will not ensure compliance with Part L of the Building Regulations which will need detailed calculations for each dwelling when finalised, however it does indicate the construction standard that will be required to achieve this.

A feasibility study was carried out in order to outline which technologies could be included in design to reduce carbon emissions and generate renewable energy to meet on site demand.

The following technologies were considered in the renewable energy study:

- ✓ Photovoltaic
- ✓ Solar Thermal
- ✓ Wind Turbines
- ✓ Biomass boilers
- ✓ Ground/Air Source Heat Pumps
- ✓ Gas Combined Heat and Power (CHP)

Wind turbines have been ruled out at the site given the location and proximity to dwellings. For the lodges, Gas CHP and Biomass boilers have both been ruled out given the requirement for both to feed a district network and the low predicted thermal demand of individual units and overall thermal density. Individual wood burning stoves may be included in the design of the lodges to provide low carbon, attractive heating in the lodges and this would not need significant alteration to standard unit design.

Whilst practical, ground source and air source heat pumps are not recommended as mains gas is available and the units are not likely to have a cooling demand. In this situation both provide for minimal carbon savings and significantly increase costs.

Photovoltaics and Solar thermal panels are considered feasible for the development given availability of roofs orientated from south-east to south-west. These technologies could be applied on the suitably orientated unshaded roofs at the development and have the potential to reduce carbon emissions significantly.

Whilst the energy demand from non-domestic units has not been modelled as being particularly high, the swimming pool will require a significant and relatively constant thermal demand and Gas CHP or biomass boilers are recommended for further consideration at the detailed design stage.

In December 2015, a 5MW solar farm on adjacent land received planning permission (Reference: SMD/2015/0220). This site is currently under construction. The applicant is investigating ways of providing a private wire connection to the site as this would allow for a significant supply of renewable energy whilst potentially protecting the development from rising energy costs. The feasibility of the private wire connection will depend on the technical (e.g. cable distances) and economic constraints of the project.

All matters related to the detailed energy strategy are reserved for future determination in the detailed design stage of the development.

1 Introduction

1.1 General

1.1.1 WSP was commissioned by Laver Leisure to develop an Energy Strategy that would consider relevant local and national policies governing energy, and provide recommendations to satisfy these policies.

1.1.2 The proposed development will comprise of 250 holiday lodges that will typically be single storey and will average 6m X 12m in dimension. Non-residential units proposed include a visitor centre, Lake Café, Leisure Hub building, water sports centre and maintenance/housekeeping building.

1.2 Site Review

1.2.1 Moneystone Quarry is located South of the village of Whiston in Staffordshire. The proposed development is spread across a wide area with Eaves Lane running through the middle of the site.

Picture 1 Redline Boundary, Source; Google

2 Current Policy Context

2.1.1 The national and local policies relevant for the Proposed Development are detailed below, along with the resulting project target.

Policy		
UK Government	**Local Policy**	**Project Target**
Climate Change Act 2008 The Government's renewable energy strategy aims to cut its carbon dioxide emissions by 29% against 1990 baseline levels by 2017. **Building Regulations Part L 2013.** The dwelling must achieve or better the Target Fabric Energy Efficiency (TFEE) and the Target Emissions Rate (TER). The Target Fabric Energy Efficiency is based on a notional building the same size and shape as the actual using the values detailed in SAP 2012 (Appendix B), The dwelling fabric energy efficiency must be within 15% of this. This effectively requires a minimum level of building fabric energy efficiency for compliance and is detailed as kWh/m^2/year. The Target Emissions Rate is a representation of allowable emissions per m^2 based on regulated loads of building.	**Staffordshire Moorlands – Core Strategy Development Plan Document (2014) Extracts:** **Policy SD 1**: "The Council will require all development to make sustainable use of resources, and adapt to climate change. This will be achieved by: "Requiring that development is located and designed to minimise energy needs and to take advantage of maximised orientation to achieve energy savings in line with Policy SD3". "all major-scale planning applications are accompanied by a Sustainability/Energy Statement This should address the energy efficiency, water conservation, sourcing of construction materials, and site orientation aspects of the scheme, and where possible the feasibility of integrating micro-renewables. The degree of detail expected will depend on the scale/complexity of the proposal." **Policy SD3:** "The Council will promote further carbon-saving measures in both new and existing developments (where this is consistent with other Core Strategy Policies), in the following ways: 1. Supporting developers who propose exceeding the thermal efficiency standards required by law for new buildings or extensions, at the time of the application. In the case of larger developments such as housing estates the Council will support measures such as 'communal' micro-renewables, or District Heating installations. 2. The Council will support measures by landowners/developers designed to contribute to existing or emerging District	■ This Energy Strategy addresses the energy efficiency aspects of the development and has been prepared to align with current Building Regulations 2013. ■ A low and zero carbon technology feasibility study has been carried out in order to outline which technologies could be included in design.

	Heating networks (for example by connecting 'exporters', with receptors, of heat). 3. The Council will support measures designed to improve the sustainability of existing buildings (such as improved thermal insulation, water conservation, or the installation of micro-renewables)." **Churnet Valley Masterplan Supplementary Planning Document (2014) Moneystone Quarry Concept Statement, Design Principals** "Creation of a high quality, sustainable environment which will promote environmental awareness – use of sustainable building techniques, low carbon, low impact development with on-site energy generation, green technology, eco-lodges - Ensure new development is water efficient. - Ensure that where feasible renewable energy and energy efficiency technologies are included within projects for new development."	

Table 1 Current policy

2.1.2 Whilst no specific targets are applicable (such as a minimum use of renewable energy on site) this strategy recognises the aims of local policy in that it assesses the feasibility of technologies for inclusion in design.

3 Site Energy Demand

3.1 Indicative Units, Residential (Lodges)

3.1.1 A representative model was developed for each of the building types based on the schedule of accommodation (Appendix C). A representative detached, single storey dwelling was chosen to represent the lodge development in terms of energy demand. The schedule of accommodation provided suggests that lodges will have a Gross External Area (GEA) of $72m^2$ and we have reduced this figure by 12% to calculate the likely Gross Internal Area (GIA) for the purposes of modelling energy demand. This was then extrapolated to estimate the regulated energy demand for residential elements of the proposed development.

3.1.2 The baseline model for the lodges was developed using values of a notional building as detailed in SAP2012 using the National Home Energy Assessor (NHER) Plan Assessor v6.0. Due to the more onerous requirements for detached dwellings we have used improved levels of air permeability and improved thermal efficiency for windows to ensure compliance with both the Target Emissions Rate (TER) and Target Fabric Energy Efficiency (TFEE) detailed within Part L of Building Regulations 2013. These specifications are provided in Appendix B. (In this assessment the lodges have been assumed to be defined as dwellings for the purposes of Building Regulations.)

3.1.3 The modelled TER was found to be 21.16 $kgCO_2/m^2/yr$. with total site emissions therefore at 335 **tCO_2**.

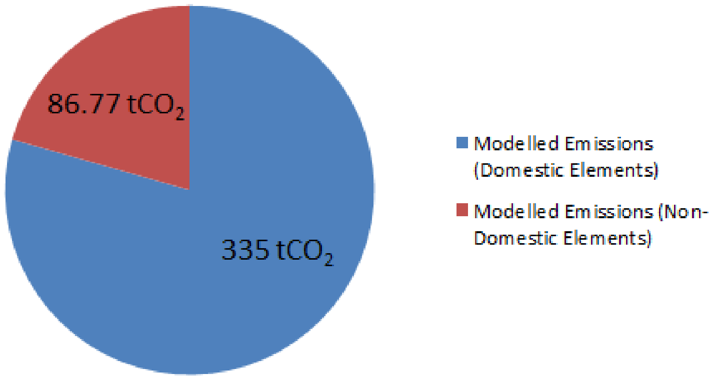
3.2 Indicative Units, Non Domestic

3.2.1 A representative "Simplified Building Energy Model" (SBEM) was created based on the schedule received for non-domestic elements, such as the leisure hub (Appendix C). The values used in models include those detailed for notional building within Part L2A of Building Regulations 2013.

3.2.2 The Target Emissions Rate for the non-domestic notional building was found to be 18.5 $kgCO_2/m^2/yr$ with total emissions of 86.77 tCO_2. These calculations account for energy use from building services such as heating, hot water, cooling and lighting but do not include energy use from other proposed elements such as the swimming pool.

3.3 Total Site Emissions

3.3.1 The total site emissions have been modelled as 421.77 tCO_2/yr.



4 Low and Zero Carbon Technologies

4.1.1 Low and zero carbon technologies have been assessed with a view to determine their applicability to the site in order to optimise generation potential.

4.1.2 Table 2 below indicates the zero & low carbon resources that are available and the technology that can provide either heat or electricity or both.

	Resources	Electricity	Thermal
Zero Carbon	Solar	Photovoltaic panels	Solar thermal collectors
	Wind	Wind turbines	-
	Biomass	CHP	Biomass boilers / CHP
Low Carbon	Ground	-	Ground source heat pumps
	Air	-	Air source heat pumps
	Gas	CHP	CHP

Table 2 Low and zero carbon resources

4.1.3 Potential renewable energy sources at the site include solar, wind and biomass. There is no hydro-power resource on the site. Low carbon resources include the use of a mains gas connection for CHP, (Combined Heat and Power) or connection to mains electricity for heat pump applications.

4.2 Solar resource

4.2.1 The solar resource present in the UK can be used for both solar thermal and photovoltaic panels which are technologies that convert sunlight into electricity and hot water, respectively. The irradiance map (Figure 1) illustrates the relative available resource. The priority when including either technology in design is to maximise the level of sunlight received, this is achieved by ensuring panels are orientated towards south and are un-shaded. Solar hot water is generally limited to providing 50% of the hot water demand but PVs are generally not limited as they can export any electricity not used on-site.

<u>Photovoltaic & Solar Thermal Panels Criteria</u>

- ✓ Orientated between south-west and south-east;
- ✓ Tilted at approx. 30^{O};
- ✓ Unshaded by trees or buildings; and
- ✓ Hot water demand (Thermal).

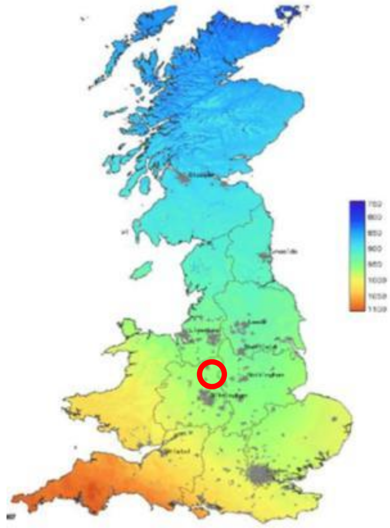


Figure 1 Irradiance Map

Commentary & Viability of Photovoltaics

4.2.2 Photovoltaics are considered feasible for the proposed development as they can be installed on roofs. Should panels be desired for inclusion in design they can be installed on buildings orientated from south-east to south-west although consideration should be given to over shading from trees and other obstacles. The PV GIS solar resource map suggests that a roof mounted system at the site could produce 842 kWh/kWp.

4.2.3 Individual domestic PV arrays are typically up to 4 kWp or equivalent to around 16 panels. A system of this size applied to each lodge, on the appropriate aspect at Moneystone would generate approximately 3,368 kWh of electricity each, saving 1,748 $KgCO_2$/year and providing significant cost savings. Given the modular nature of this technology, smaller systems can be deployed to suit design requirements.

4.2.4 A total level of deployment of 350.6 kWp across the whole development would offset over 421 tCO_2/yr. – enough for the site to become zero carbon. Using basic modelling this level of deployment would require approximately 8,430 m^2 of roof space oriented between South East and South West. This would likely be slightly higher than the area available on the lodges alone but it is anticipated that the non-domestic buildings could provide the extra roof space required.

4.2.5 This technology is recommended for the lodges and may be applicable no some non-domestic aspects of the development. It benefits from the fact that energy can be exported to the grid at times of low demand.

4.2.6 In December 2015, a 5MW solar farm on adjacent land received planning permission (Reference: SMD/2015/0220). This site is currently under construction. The applicant is investigating ways of providing a private wire connection to the site as this would allow for a significant supply of renewable energy whilst potentially protecting the development from rising energy costs. The feasibility of the private wire connection will depend on the technical (e.g. cable distances) and economic constraints of the project.

4.2.7 All matters related to the detailed energy strategy are reserved for future determination in the detailed design stage of the development.

Commentary & Viability Solar Thermal

4.2.8 Solar thermal is also suitable for inclusion at the proposed development given requirements for deployment are the same as those for photovoltaics and given demand for hot water at each of the lodges.

4.2.9 Crucially, limitations on the development of this technology would be available roof area and that solar thermal is generally sized to meet 50% of domestic hot water demand. This technology would also compete for roofspace with photovoltaics should both technologies be desired.

4.2.10 This technology though applicable given availability of roofspace and domestic hot water demand would require alteration to the standard servicing strategy of dwelling design used by builders as a thermal store would be required.

4.2.11 Solar thermal equipment could be underutilised if there are periods when the lodges are not being used. This differs from solar PV as the energy produced cannot be exported to the grid.

4.3 Ground & Air resource

4.3.1 Ground & Air Source Heat Pumps (GSHP & ASHP) take a low grade heat resource (ground / air) and increase the temperature through a vapour compression cycle. Heat pumps can deliver this heat source typically at a co-efficient of performance of 2 to 4.5, meaning that for each kiloWatt hour of electricity consumed by heat pump 2 - 4.5 kWh of useable heat is delivered. To use the air temperature as the heat source, single or communal units are installed outside of a building, while ground source heat pumps involve boreholes or horizontal collectors, which circulate a carrier fluid that absorbs heat. In both cases following compression heat is transferred to heat distribution system. This technology suits steady low temperature applications and is therefore suited to underfloor heating and well insulated buildings. A key advantage is that the cycle can be reversed to provide cooling negating the requirement for additional cooling equipment. The benefit of heat pumps is greatest when mains gas is not available as the carbon emission savings are typically greater.

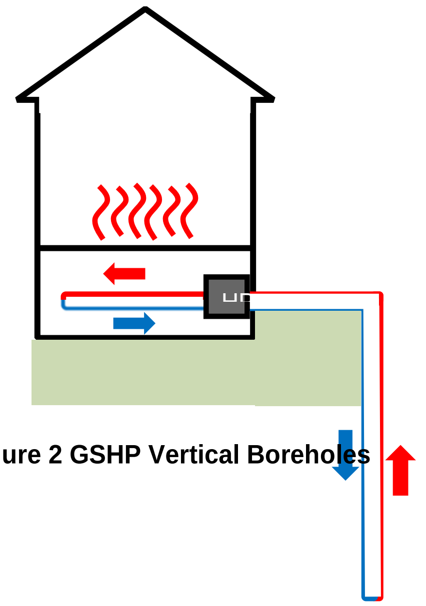


Figure 2 GSHP Vertical Boreholes

Criteria for GSHP & ASHP

- ✓ Requirement for heating and cooling;
- ✓ Ability to use low temperature heat distribution for space heating; and
- ✓ Lack of mains gas available on the site.

Commentary & viability Ground Source Heat Pumps

4.3.2 Although the technology is feasible at the site, the availability of mains gas and expected lack of cooling demand will make the technology not economically viable and unlikely to offer significant carbon savings.

Commentary & viability Air Source Heat Pumps

4.3.3 This technology is a more cost effective approach than ground source heat pumps and could provide the majority of heating and hot water demands. This technology however, only provides for minimal (if any) carbon savings compared to mains gas where this is available because technologies will consume grid electricity that has a higher emissions factor than gas. In addition, the lodges are not anticipated to have any cooling demands.

4.4 Gas Fired CHP

4.4.1 Combined Heat & Power (CHP) technology consists of an electrical generator normally in the form of a gas-fired engine or turbine. The engine or turbine exhaust gases contain heat which can be captured to provide space heating, process heat or hot water, increasing overall efficiency. Carbon emission savings can be achieved as capturing this waste heat negates the need for additional consumption while the electricity generated has significantly lower embodied carbon compared to grid electricity as it is generated solely from gas and avoids some of the efficiency losses associated with grid electricity, e.g. transmission losses. To be economically viable units should generally operate a minimum of 5,000 hours each year.

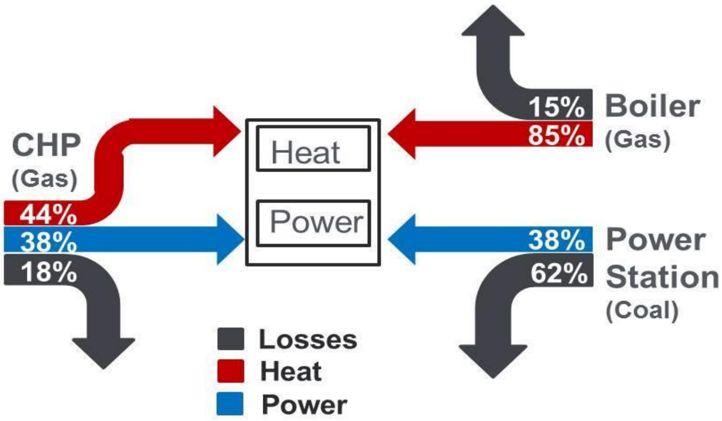


Figure 3 CHP

4.4.2 The requirements for a gas CHP include a gas supply and a larger plant area than a gas boiler. The systems are relatively noisy and require sound attenuation and/or sensitive siting.

4.4.3 Gas CHP units often serve district heating schemes which allow for greater economies of scale and consistency of thermal demand. Generally CHP units can only be applied to residential developments on a district heating scheme as they are generally not available on a domestic scale, and the units that are available do not suit new, energy-efficient dwellings. A minimum of 300 dwellings (or equivalent) with a density of greater than 60 dwellings per hectare is generally the threshold before which a district network is considered. They also benefit significantly from a balanced demand that is during the day and the evening.

Criteria for Gas CHP

- ✓ Consistent and significant thermal demand, (operate for a minimum of 5,000 hours);
- ✓ Access to mains gas; and
- ✓ Available area for plant room, equivalent to a small building depending on level of demand.

Commentary and viability

4.4.4 The development does not meet the threshold for minimum number of units and the thermal demand density will be low due to the highly insulated nature of new buildings. For the lodges, it would also involve further complexity through altering design and layout of development given the requirement for a central energy centre and as all dwellings would have to be connected to heat main network.

4.4.5 At 181,175 kWh/year, the thermal demand of non-domestic elements is not particularly large. However, as previously noted the SBEM does not account for process loads and Gas CHP is recommended for further consideration due to the expected large thermal demand arising from the proposed swimming pool where it may deliver significant CO_2 emission and cost savings.

4.5 Wind Resource

4.5.1 The UK has one of the highest wind resource potentials in Europe. Wind turbines should be sited away from sensitive buildings due to noise and visual concerns and away from other nearby obstructions so as to avoid reduced output caused by turbulence.

Wind turbine criteria

- ✓ Average wind velocity should be greater than 6m/s[1];
- ✓ An area free of obstructions such as trees and buildings; and
- ✓ Significant distance away from sensitive premises and significant obstacles; including Conservation Areas, residential areas, airports and ecologically sensitive areas.

Figure 4 Site location

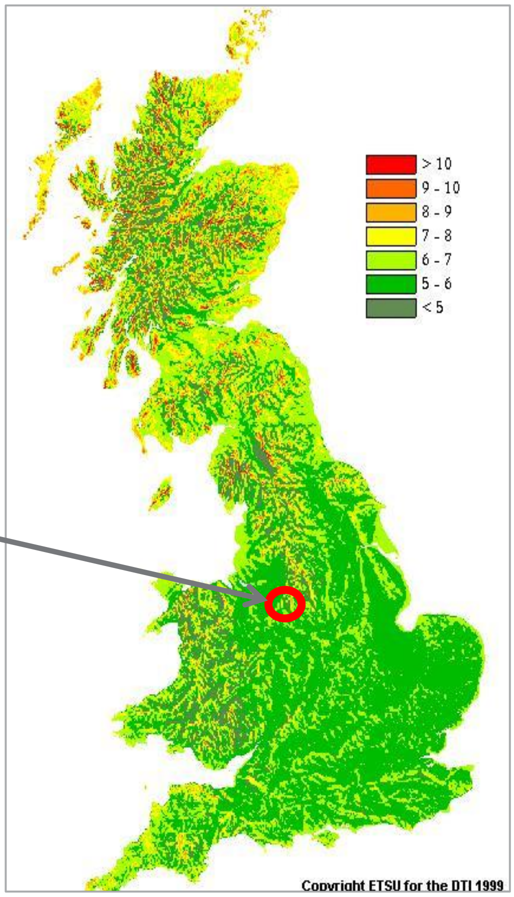


Figure 5 Wind Resource map

Commentary and viability

4.5.2 Building integrated wind turbines are generally not recommended due to turbulence and the lower efficiency of smaller units.

4.5.3 Another option would be to install stand-alone turbines to provide power to units across the site. However, the noise and visual impacts of turbines of this scale mean that they would need to be sited a significant distance from buildings, not available on the site.

4.5.4 Wind technology is therefore not considered applicable to the development due to lower wind speeds, space constraints, proximity to dwellings and proximity to a conservation area.

[1] Equal to or greater than 6m/s on NOABL database, 5m/s if measured on site over a period of months.

4.6 Biomass Resource

4.6.1 The UK has experienced significant growth in the biomass sector with biomass pellets and chip being widely available. Biomass heating can deliver large net carbon emission reductions. These are greatest where mains gas is not available and it offsets more carbon intensive fuels.

4.6.2 At the point of delivery, NOx and particulate emissions from biomass boilers are higher than that of gas fired plant and this can be an issue in urban locations.

4.6.3 Biomass heating often serves district heating schemes to benefit from economies of scale and greater thermal demand. An energy centre would be required within the Proposed Development to serve a district network.

4.6.4 Biomass CHP is applicable at larger installations but is not considered here due to the relatively small demand.

4.6.5 A minimum of 300 dwellings with a density of greater than 60 dwellings per hectare is generally the threshold before which a biomass fed district network is considered.

Figure 6 Biomass Boiler

4.6.6 Criteria for Biomass Heating

- ✓ Storage space and access available for biomass use on the Site;
- ✓ Consistent, high, heat demand density;
- ✓ Availability and security of fuel;
- ✓ Whether or not the Proposed Development is in an Air Quality Management Area (AQMA); and
- ✓ Mains gas availability

Commentary and viability

4.6.7 Biomass boilers are not suitable on an individual dwelling basis given the low expected thermal demand; rather a central boiler and district network would be required. As with the gas CHP analysis, the added cost of including a district heat network and energy centre would be disproportionate and likely to be inefficient due to the low thermal demand of each unit and the low thermal density of the development.

4.6.8 Lodges could incorporate wood burning stoves to provide space heating. This would achieve CO_2 emissions savings compared to gas or electric heating and may be considered attractive as part of the lodge “experience”.

4.6.9 Biomass boilers are also recommended for consideration for the non-domestic elements of the development due to the expected thermal demand arising from the swimming pool.

5 Conclusion

5.1.1 A representative lodge was modelled using the SAP methodology based on an average unit determined from the Schedule of Accommodation for the proposed development. It has been prepared on the assumption that the lodges would be treated as dwellings under Part L of the UK Building Regulations. The output of this software allowed the assessment of whether the building specification chosen achieved compliance with both the Target Emissions Rate (TER) and Target Fabric Energy Efficiency (TFEE) of Part L of the Building Regulations 2013. Compliance with Building Regulations was assured as specifications as detailed in Part L of Building Regulations were used as a minimum (Appendix B). The output of this software allowed for an estimate of total site energy consumption and emissions to be calculated through extrapolation.

5.1.2 A further model was developed using Simplified Building Energy Model (SBEM) software to represent the non-domestic elements. The fabric and systems applied to the building model were those as detailed in Part L2A of Building Regulations, which can be found in Appendix C.

5.1.3 An assessment was carried out in order to outline which technologies could be included in design in order to reduce carbon emissions on the site. Both Solar Photovoltaics and Solar Thermal are feasible options for the development given the likely presence of unshaded roofs orientated from south-east to south-west. These technologies could be applied to lodges with the only limiting factor being available unshaded roof space.

5.1.4 Wood burning stoves could be included to provide space heating for the lodges, enabling CO_2 emission savings. Biomass boilers, wind turbines and CHP are not feasible at this scale.

5.1.5 Given the higher levels of thermal demand for the non-domestic elements, (particularly the swimming pool) a central gas CHP or biomass boiler could be considered for inclusion in design. Both of these technologies would present good opportunities for reducing CO_2 emissions and providing significant cost savings.

5.1.6 As we have modelled the units in line with Part L of the building regulations, further energy reduction can be achieved in the use of more efficient building materials. These can be specified at the detailed design stage.

5.1.7 Connection to the adjacent Solar Farm may be possible. This is being explored. This would provide a significant contribution to the sites' overall energy demand.

5.1.8 All matters related to the detailed energy strategy are reserved for future determination in the detailed design stage of the development.

Appendix A

Assumptions

The table below shows the energy conversion factors to calculate the carbon dioxide emissions.

Energy conversion factors used in this report

Energy Source	$kgCO_2/kWh$
Electricity (mains fed)	0.519
Electricity (onsite generation offset)	0.519
Gas	0.216
Biomass (pellets)	0.039

Appendix B

Baseline Energy Efficiency Parameters Used in Modelling – Based on SAP Appendix R 2012

Building Element.	(Notional)
External Walls (W/m^2K)	0.18
Floors (W/m^2K)	0.13
Roof (W/m^2K)	0.13
Window (W/m^2K)	1.2*
Openings %	25% of floor area
Thermal Bridging (W/K)	0.05
Heating (Mains Gas)	89.5%
Controls	Time and temperature control, weather compensation, modulating boiler and interlock
Air Permeability (m_3m^2h)	3*
Ventilation	Natural

***indicates where we have included higher levels of efficiency in modelling**

Appendix C

Non Domestic Baseline Energy Efficiency Parameters (Part L2a Building Regulations 2013)

Building Element.	(Notional)
External Walls (W/m^2K)	0.26
Floors (W/m^2K)	0.22
Roof (W/m^2K)	0.18
Window (W/m^2K)	1.6
Openings %	25% of floor area
Heating (Mains Gas)	91%
Air Permeability (m_3m^2h)	3/5
Ventilation	Natural

Appendix D

Schedule of Accommodation

Accommodation	Description	Indicative Quantum of Development
Lodges	Lodges	Up to 250 units
Leisure Hub Building	Swimming Pool and toddler pool and plant	Up to 415 m^2
	Restaurant/Bar and outside terrace	Up to 500 m^2
	Bowling alley	Up to 140 m^2
	Spa	Up to 150 m^2
	Gym with studio	Up to 100 m^2
	Informal screen room	Up to 80 m^2
	Children's soft play area	Up to 145 m^2
	Café	Up to 70 m^2
	Sports Hall	Up to 320 m^2
	Reception area	Up to 145 m^2
	Shop	Up to 50 m^2
Lake Café	Café	Up to 130 m^2
Visitor Centre	Visitor Centre with farm shop	Up to 490 m^2 (including up to 400 m^2 retail use)
Archery Centre	Archery Centre	Up to 260 m^2
Administration Building	Administration Building	525 m^2 (as existing)
Maintenance Depot	Maintenance Depot	Up to 500 m^2
Substation	Substation	600 m^2 (existing compound)
Mini-sports area	Multi-Sports Area	Up to 1,400 m^2
Equipped Play Area	Equipped Play Area	Up to 500 m^2
Woodland Activity Area	Adventure Play Area	Up to 500 m^2
	Ropewalks	Up to 5,000 m^2
Car Parking	Short Stay	Up to 170 spaces
	Secure Long Stay	Up to 150 spaces
	Staff	Up to 67 spaces
	Coach	Up to 5 bays
	Watersports Centre	Up to 26 spaces
Footpaths/Cycleways	Footpaths/Cycleways/Bridleways	-
Watersports Centre	Watersports Centre	Up to 500 m^2

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