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part of the WYG group

Energy & Renewables
Preliminary Discussion Document
Sandleford Park, Newbury

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CONTENTS

GLOSSARY

AD – Anaerobic Digestion

AGL – Above Ground Level

ASHP – Air Source Heat Pump

CHP - Combined heat and power

CCHP - Combined cooling, heat and power

CIBSE - Chartered Institute of Building Services Engineers

CO_2 - Carbon Dioxide

CoP - Co-efficient of performance

CSH – Code for Sustainable Homes

DE – Decentralised Energy

DHW – Domestic Hot Water

EPBD - Energy Performance of Buildings Directive (EU)

ESCo - Energy services Company

EST – Energy Saving Trust

LZC – Low to Zero Carbon

MUSCo – Multi Utility Services Company

NOx – Nitrogen Oxides

GFA - Gross floor area

GSHP - Ground Source Heat Pump

kV - kilovolt, measure of voltage used in transmission and distribution systems

Kyoto - Kyoto Protocol agreement to reduce greenhouse gas emissions, UNFCCC 1997

kWh – Kilo watt hour, unit of energy consisting of 1000 watt hours

MWh - Mega watt hour, unit of energy consisting of 1000 kilowatt hours

Part L –Building Regulations 2006, Part L2A conservation of fuel and power in new buildings

PV – Photovoltaic Cells

SAP – Standard Assessment Procedure

1.0 Executive Summary

This preliminary Energy and Renewables Discussion Document, produced by WYG Engineering on behalf of the Sandleford Partnership, provides an initial assessment of potential low to zero carbon and renewable energy options which may be appropriate for Sandleford Park, a new primarily residential development site with some business use, located South of Newbury.

The purpose of the document is to provide a general overview of what technologies and techniques may have potential for incorporate in this development to mitigate carbon emissions and meet local regional and national targets for sustainability and climate change, this will enable discussions around the potential and benefits of developing this site.

It is an indicative review and assumes that in later stages of the project all suggestions will be verified and thoroughly tested through detailed calculation and analysis to determine technical and commercial viability. As such, at this stage of the development this high level review has no basis in calculation, carbon analysis, modelling, consumption estimates, utilisation profile or payback analysis etc.

Development at Sandleford will need to adopt, as a minimum, Best and Advanced Practice standards of energy efficiency to reduce annual energy consumption for the benefit of occupants, reduce the burden on low carbon and renewable energy generation technologies, achieve the local and regional aspirations and deliver Zero Carbon homes[1] from 2016.

A number of different low carbon and renewable energy generation technologies have been considered for the site including building integrated, site wide decentralised and offsite solutions. These concepts are described in general, in the following document but more visually summarised in the Sustainability and Renewable Energy Summary Assessment Sheet in Appendix A, the key element of this review. This summary gives an indicative suitability for this scheme as low, medium and high and the LZT/Renewable technologies can be summarised as follows;

[1] [1]Defining Zero Carbon: Have your Say Report 2009 http://www.zerocarbonhub.org/downloads/ZCH-HaveYourSay.pdf

Low Suitability	Medium Suitability	High Suitability
Solar Collectors - Air	Photovoltaic Cells	Gas Fired CHP
Small Scale Wind	Ground Source Heating/Cooling	Solar Thermal Collectors
Fuel Cells	Air Source Heating/Cooling	Biomass Heating
On site Micro-Hydro	Large/Medium Scale Wind	
Energy from Waste	Bio-fuel Fired CHP	
	Off-site Generation	

The Summary sheet itself includes various other sustainable techniques aswell as LZT/Renewables, please see Appendix A.

1.1 General Discussion Points, Comment and Considerations

1.0 A building integrated micro generation approach would allow developers to utilise individual dwelling and building renewable solutions in accordance with mandated development standards without significant initial energy infrastructure investment. However this is likely to represent an increased capital cost for achievement of Zero Carbon standards across the life of the development.

2.0 A district heat network would enable flexibility to adapt to changing fuel supply markets and advancing technologies and usually represents lowest overall capital cost strategy. Such a network would still be anticipated to require connection to traditional energy networks (gas and electricity) to ensure security of supply, meet peak demand and initial phase development demand.

3.0 Connection to existing 'neighbours' e.g. offsite consumers with existing high constant thermal demand, could improve the performance of a CHP led district energy strategy, however there are likely to be a number of barriers to extending any DE network beyond the site boundary.

4.0 The commercial availability of locally sourced biomass promotes this as a renewable fuel source, aswell as supporting regional guidelines.

5.0 District energy will likely require the investment of an energy services company (ESCo) either independently or in partnership with the land owner or developer as part of a joint venture to operate assets and sell heat (and possibly power) over a fixed term contract normally >25years, this will require some degree of cultural shift and a level of risk in the absence of heat regulation. Building integrated renewable and micro generation may also necessitate a degree of cultural shift in operation and maintenance of renewable technologies.

6.0 The inclusion of a large onsite wind turbine(s) at Sandleford is considered to have considerable issues and possible land sterilisation impacts, although there is potential space in and around the site. However, the current consultation on the definition of zero-carbon is anticipated to permit a wider spectrum of 'Allowable Solutions' including offsite wind turbines.

7.0 More than one alternative energy strategy might be considered for Sandleford Park, at this stage, and an approach that retains the flexibility to select the most appropriate solution as part of the developments detail design, adapting to technology and policy changes over the development build programme.

1.2 Next Steps

All proposals should be thoroughly analysed at the next stage of development to determine technical and commercial viability. This analysis would be based against detailed calculations assessing carbon emissions over time in light of emerging policy and changes in regulation.

Such analysis would occur alongside and educate the masterplanning process in terms of infrastructure and would result in statements of intent appropriate for an Outline Planning Submission.

2.0 Introduction

This preliminary Energy and Renewables Discussion Document, produced by WYG Engineering on behalf of the Sandleford Partnership, provides an initial assessment of potential low to zero carbon and renewable energy options which may be appropriate for Sandleford Park, a new primarily residential development site with some business use, located to the South of Newbury.

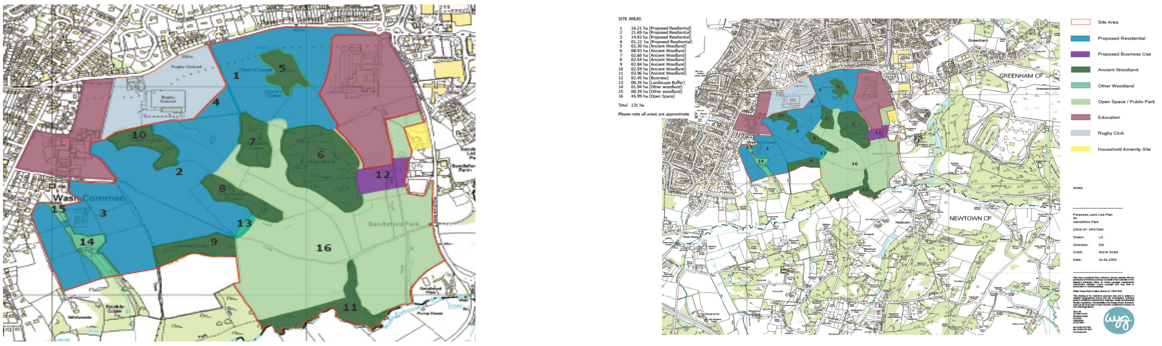


Figure 1: Sandleford Park Newbury

2.1 Sandleford Park Development Details

Development	Sandleford Park
Location	South Newbury
No of Dwellings	Up to 2000
Total Residential Area (Hectare)	54.04
Total Development Area (Hectare)	56.49

Table 2: Sandleford Park Development Details

The masterplan for Sandleford Park is currently being defined and requires a high level preliminary assessment of what energy strategy and renewable technologies may be appropriate, or not, to support discussions regarding the promotion of the site through the LDF process.

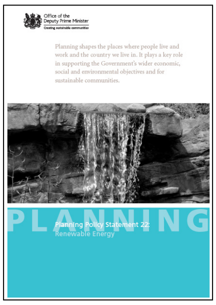
Specifically this report presents an initial desktop assessment of what carbon reduction techniques and technologies may be suitable for incorporation on the site. At this stage of the process it is not appropriate, nor is there sufficient data, to base this analysis on detailed calculation and so the following report and Sustainability and Renewable Energy Summary Assessment Sheet is based on an overview of the site compared against current technologies, strategies and best practice. It should be noted that the conclusions are not based on any form of modelling, calculation, consumption estimates, utilisation profile or payback analysis etc.

The Sustainability and Renewable Energy Summary Assessment Sheet (Appendix A) is the key part of the assessment which reviews and summarises some of the currently available sustainable techniques and low carbon and renewable technologies which may be appropriate for Sandleford Park. The list is by no means exhaustive but includes most methods which are currently considered economically viable or are becoming best practice. The table also includes techniques which will typically contribute towards relevant targets and aspirations e.g. BREEAM, Code for Sustainable Homes etc, assist in compliance with Building Regulations (Part L) or applicable to any West Berkshire Council development and sustainability targets e.g. 10% onsite energy generation as suggested in the South East Plan and appropriate to the Options for the Future document 'to reduce energy use and promote the development and use of sustainable/renewable energy technologies'.

The table indicates the general advantages and disadvantages of each application and its likely relevance/application to the scheme and is intended to give an overall appreciation of the potential techniques which could be incorporated in the scheme, or may have been used on other similar developments with similar aspirations, but in no way precludes the application of any, should there be a particular requirement. It may be that the client requires to show-case or demonstrate a particular technology due to the specific use of one or more of the buildings, which would make the economic viability and payback of the system irrelevant.

It should be noted, however, that the ease of implementation of any of the above depends greatly on the budget allocation, programme, procurement methods and attitude to sustainability etc. but particularly the required level of flexibility to be incorporated in the buildings and the level of knowledge regarding how the buildings are to be utilised.

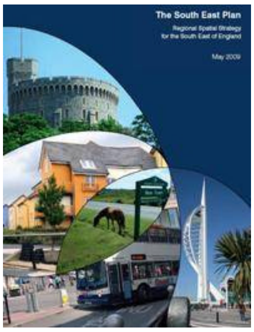
3.0 <u>Carbon Reduction and Renewable Energy Policy</u>



Planning Policy Statement (PPS) 22 sets out the Government's national policies for Renewable Energy in England. Its policies inform local planning authorities in the preparation of local development planning policy documents and states that local planning authorities should specifically encourage low carbon and renewable energy schemes through positively expressed policies in local development documents[2].

Regional Energy Policy

The South East Plan – RSS for the South East of England May 2009 has specific policies related to sustainability and energy;



Policy CC1 – Sustainable Development
Policy CC2 – Climate Change
Policy CC3 – Resource Use
Policy CC4 – Sustainable Design and Construction
Policy NRM11 – Development Design for Energy Efficiency and Renewable Energy
Policy NRM12 – Combined Heat and Power
Policy NRM13 – Regional Renewable Energy Targets
Policy NRM15 – Location of Renewable Energy Development and
Policy NRM16 – Renewable Energy Development Criteria

All these policies clearly promote the use of renewable energy techniques, particularly wind and biomass, through local development frameworks and decisions.

In particular, Policy NRM11 requires new developments of more than 10 dwellings or 1,000m^2 of non-residential floor space should secure at least 10% of their energy from decentralised and renewable or low-carbon sources.

Local Planning Policy

The West Berkshire LDF - Options for the Future – Sustainability Appraisal / Strategic Environmental Assessment Report April 2009 gives several key Sustainability Assessment Objectives including 'To reduce consumption of natural resources and manage their use efficiently by reducing energy use and promoting the development and use of sustainable/renewable energy technologies'.

The West Berkshire District Local Plan 1991-2006 Saved Policies September 2007, through policies OVS.9 and OVS.10 also clearly promotes energy efficiency on all developments and the use of renewable energy technologies.

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[2] Planning Policy Statement 22: Renewable Energy, ODPM (2004)

Both of these documents are supported by the Quality Design – West Berkshire – SPD Part 4 – Sustainable Design Techniques which, in referencing other strategic documents, provides a range of methods, techniques and technologies as examples of solutions to sustainable building design for all developments which should be incorporated into new build, its purpose is to assist in maximising the opportunity for developments to be energy and resource efficient.

All documents require consideration of low to zero carbon and renewable technologies and energy efficiency measures for all sites. Sandleford Park may be appropriate for several of these strategies and systems.

Future National Policy and Zero Carbon Homes

The UK Government is committed to reducing carbon emissions from major new developments in order to combat the impact of climate change. Step changes in building regulation standards are anticipated in 2010, 2013 and from 2016 the Government is committed to the delivery of Zero Carbon homes[3].

In December 2008 the Government launched a consultation into the definition of Zero Carbon; recognizing that achieving zero carbon housing by 2016 as an extremely demanding goal and determining the best approach for achieving this aspiration. The ultimate goal of the consultation is to give developers as much flexibility as possible on achieving zero carbon standards and to embed a level of cost certainty that allows economically viable Zero Carbon homes to be built[4].

These standards will require further onsite carbon emission reductions compared to current 2006 building regulation compliance standards of 44% from 2013 and 70% from 2016 with development beyond this point also requiring all residual emissions to be mitigated via one or more allowable solutions. This system will grant developers the flexibility to adopt a number of 'offsite' or financial mechanisms that could include; offsite wind, heat export or import, installation of renewables to existing housing stock or financial contributions via the local authority as part of a Section 106 type agreement.

It will take some time for the policies that support such solutions to be established and for the costs of such infrastructure to be known with precision. Achieving Zero Carbon under a revised 70% carbon compliance and residual allowable solution would represent a much more flexible and economic

[3] Defining Zero Carbon: Have your Say Report 2009 http://www.zerocarbonhub.org/downloads/ZCH-HaveYourSay.pdf
[4] Zero Carbon Hub Event -Solihull West Midlands 12th February 2009

approach for developers and allow the opportunities offsite to be fully utilised, although the exact nature and costs of allowable solutions are subject to the final outcomes of consultation which are not anticipated until 2010 at the earliest.

Allowable solutions will cover carbon emitted from the home for 30 years after construction and at this time, a cost of £100 per tonne of CO_2 is suggested as a guideline.

4.0 Phasing

The completed Sandleford Park site may contain approximately 2000 domestic properties and several business premises, but the phasing of this build out is currently unknown.

Development phasing at Sandleford will have a significant impact on both the suitability of particular low to zero carbon technologies and any carbon emission reduction aspirations the client may have. It is important that this strategy is developed at the next stage of assessment and before energy consumption and carbon emission calculations are carried out. As can be seen in the table below if the Code for Sustainable Homes are followed, or indeed just Building Regulations requirements, changes in emission reduction are significant in a relatively short timeframe.

Code Level	Private Housing	CO2 Reduction (DER/TER)
CfSH Level 3	2010	25%
CfSH Level 4	2013	44%
Zero Carbon	2016	>70%

5.0 Energy Demand and Carbon Footprint

At this stage of the project a high level evaluation of the benefits of various Low and Zero Carbon (LZC) technologies for the development has been carried out. At the next stage the baseline energy consumption of the site should be assessed based on current building regulation compliance standards[5]. Potential reduction in consumption will then be assessed based on any aspirations to deliver improved standards of energy efficiency ahead of building regulation step changes in 2010, 2013 and 2016 and compliance with the regional spatial strategy requirements of a 10% contribution to annual energy demand from low carbon or renewable energy.

6.0 Low and Zero Carbon Technology Appraisal

Once the energy demands for the site have been established, qualitative assessment of LZC technologies can take place. Each of these technologies are typically categorised as either building integrated micro generation or site wide Decentralised Energy (DE) technologies.

WYG has undertaken a preliminary assessment of technologies for inclusion at Sandleford Park with each technology representing specific cost, planning, design and long term ownership and operation implications.

This high level assessment can be found in Appendix A.

Potential technologies have been assessed against a set of generally appropriate criteria to understand their possible suitability for inclusion at the Sandleford site including; technical and commercial viability, CO_2 savings potential, operation and maintenance, procurement and capital cost etc.

The following section of the report includes further general information applicable to considering integration of technologies as part of the development of Sandleford.

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[5] ODPM Building Regulations 2006, Part L2A conservation of fuel and power in new buildings

6.1 Wind Turbines

Wind turbines produce electricity by using the natural power of the wind to drive a generator and are capable of outputs from 100W up to 5MW. To make a significant contribution to the proposed development at Sandleford, the wind turbines would need to be large scale ground mounted wind turbines in the range of 250kW to 2MW or alternatively very large volumes of small micro-wind turbines. The wind resource at the site is potentially favourable, with anticipated average wind speeds of 4.9m/s at 10m above ground level[6]. For wind turbines to be viable the wind speeds generally need to be above 4m/s as an annual average.

Large wind turbines will have a significant impact upon the local environment with buffer distances from any existing or proposed dwellings up to 400m to mitigate the impact of noise, and a large turbine may ultimately prove very difficult to get through the planning process. There are a perceived number of environmental constraints to establishing a turbine onsite at Sandleford; including proximity to Greenham Common, main roads and any nature reserve with a potential ornithological impact. However as a cost effective and proven renewable technology and key method of offsetting punitive grid electricity it should be explored further in addition to any potential offsite wind generation.

6.2 Solar Photovoltaics

Photovoltaic (PV) systems convert solar energy directly into electricity through semiconductor cells. Photovoltaic panels can either be mounted external to the building or be integrated into the building cladding (known as Building Integrated Photovoltaic or BIPV). PV panels are probably the cleanest method of using solar energy, but the low levels of solar radiation in the UK restricts achievable power output. There are four main types of solar PV: thin-film, polycrystalline, monocrystalline, and hybrid. Monocrystalline currently tend to be the most efficient.

The cost of PV is high per kW installed but it does have the advantage of no moving parts, a long life and minimal maintenance.

The performance of PV systems at Sandleford would ultimately

[6] The DTI wind speed data base (ETSU NOABL)

depend upon the orientation of properties and roof pitch. The proportion of buildings with roofs, facades or areas for ground mounting facing due south will dictate the annual yield of energy derived from this resource and the widespread application of PV systems to buildings at Sandleford will require the consideration of their incorporation as part of the detailed masterplan and house design concept.

6.3 Solar Thermal Systems

Solar hot water heating systems (SHW) harvest energy from the sun to heat water. This is typically achieved in the UK through the use of solar heating panels positioned on the roof of a building. In the UK, two main types of solar water heating system are used: Flat plate collectors or Evacuated heat tubes. Evacuated heat tubes are more efficient and now commonly used in the UK to provide heating to domestic hot water (DHW) systems. Typically, for a single dwelling the area of solar collector required to meet summer demand would be in the region of 3 to 5m^2 (depending on building size, occupancy, panel efficiency and DHW demand), panels have lifetimes approaching 30 years with modest maintenance requirements.

SHW systems are well suited to domestic properties and can provide up to around 65% of DHW demand. To correctly situate the panels there should be sufficient roof space for their installation with a preferably open SE-SW facing roof and sufficient space for hot water cylinders close to the panels.

In the presence of a large CHP led district heating network from gas or other more renewable energy sources, the use of SHW systems may not be the optimum solution as SHW removes the summer heat load for a residential development like Sandleford, which is an essential factor for utilising CHP led district heating (Section 6.7).

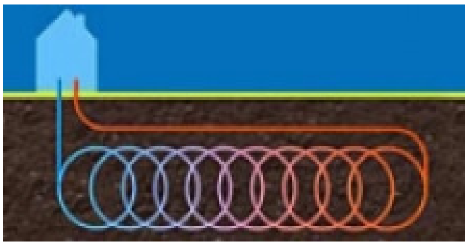
6.4 Geothermal and Ground Source Heating

Deep well Geothermal energy is used to a very limited extent in the UK, with the City of Southampton Geothermal plant the only major geothermal energy scheme currently operational. There have been geothermal projects in the UK which were abandoned in the mid 1990s[7]; a large geothermal installation to provide heating for 2,000 homes at Sandleford is unlikely to be commercially feasible and technically

[7] BERR BARRIERS TO RENEWABLE HEAT PART 1: SUPPLY SIDE May 2008

prohibited due to a number of factors including multi-million pound capital investment, and the significant element of risk in the absence of proven water extraction data.

6.4.1 Geothermal Ground Source Heating (GSHP)



Ground source heat pumps transfer heat from the ground (stored geothermal energy) into a building typically in the UK to provide space heating and, in some cases, pre-heat domestic hot water via a closed or open loop system. The coefficient of performance (COP) is the ratio of the amount of heating or cooling provided by the system to the amount of actual energy consumed. Types of ground loop are: Vertical, for use in boreholes, Horizontal, for use in trenches, Spiral or slinky, for use in trenches and pond or lake loops. Typically horizontal systems are cheaper than vertical boreholes; however require significant available land for pipe laying. Systems can deliver significant carbon savings to areas not connected to the gas network, however, where gas connection is possible offset savings are not as significant.

6.5 Decentralised District Energy (DE) Network

The use of a community (also known as a district) heating or heat and power system, now commonly referred to as Decentralised Energy (DE), can benefit from minimal distribution losses as a result of the close proximity between supply and demand and effectively utilise technologies such as CHP and biomass. The use of a localised heating and domestic hot water system would require one or more central energy centre(s) and a distribution network to provide heat and hot water to each property within the development. In site-wide strategies the heat is typically distributed within a loop of flow and return pipes to consumer Hydraulic Interface Units (HIUs) and would connect all properties at Sandleford. Any electricity produced can be distributed in a similar manner via a private or public wire distribution system[8]. Typically for community heating system the following would be required:

- Energy centre and the installation of necessary plant and equipment
- Thermal storage (typically this is located within the energy centre)
- Site wide distribution network (heat, power or both) with connections to each property
- Property controls (HIU) for all properties.

[8] Electricity Exempt Licensing Regime http://www.lcca.co.uk/upload/pdf/EXISTING_EXEMPT_LICENCING_REGIME_3.pdf

Local utility network connection is still likely to be a fundamental part of meeting demand and ensuring security of supply and therefore local gas and electricity network capacity remains critical to servicing the needs of development. A number of potential local offsite DE connection opportunities have been identified in proximity to the Sandleford development site e.g. school, college, rugby club, commercial park etc which could be investigated.

6.6 Biomass Heating

Biomass boilers utilise energy from agricultural/forestry residues, energy crops, landfill gas and biodegradable wastes. They can be used from individual domestic properties up to district network level. The advantage of using such technology is that it can provide a significant reduction in CO_2 emissions. Typical biomass fuels used are wood pellets, wood chips and energy crops.

Biomass boilers are designed to allow modulation of the output down to about 30% of optimum output, however, for efficient and economic combustion biomass should be burned frequently at high temperature and as such it is common practice for biomass to be supported by conventional gas boilers to meet peak demand periods[9].

Up to a maximum 80% of the total heating and hot water demand at Sandleford could be effectively met by biomass boilers and their use is promoted by regional drivers and policy.

The heat distribution network, consumer connection and interface represent the most significant proportion of the capital costs for a site wide biomass system. Individual domestic biomass boilers could be considered as an alternative, but this will require a degree of cultural change for dwelling occupants used to conventional gas central heating and hot water systems in maintaining and operating more onerous biomass boilers akin to dwellings currently off the gas network using wood fuel, LPG or oil based systems.

The total site heat energy requirement will determine the amount of bio-fuel that is required to be stored on site and the frequency of delivery.

[9] BSRIA Guide to Renewable Technologies May 2008

The suitability of highway infrastructure and energy centre location for access and delivery aswell as noise and air quality impact, aesthetics and size of energy centre with associated chimney stack alongside noise and air quality are key considerations.

6.7 Combined Heat and Power

Combined Heat and Power (CHP) is an efficient form of providing heating and electricity at the same time. CHP unit's overall fuel efficiency is around 70-90% of the input fuel, much better than most power stations, which are only up to around 40-55% efficient and the heat produced in the generation of electricity can be recovered to provide hot water via a district heating network.

6.7.1 Natural Gas CHP

Natural gas CHP is not classified as a renewable technology but is categorised as low carbon as a result of the dual benefit of useful heat and power production. In order to optimise the CHP system, correct sizing is critical and any engine should typically be able to run for at least 4,000 hours. For example, it is unlikely to be cost effective to size the plant on the basis of space heating requirements when there is no space heat demand for several months of the year. Usually CHP plant is sized on the basis of the domestic hot water demand for residential development.

For the Sandleford site, gas CHP could be a potentially viable technology as part of a site wide district heating network. However, as the site is primarily residential, with little commercial/business use to make a more preferable load profile the extent of incorporation may be limited. The primarily domestic/residential energy component means that morning and evening energy peaks straddle relatively low daytime demand restricting the operational runtime of any CHP particularly in the summer period.

A detailed analysis of the combined load profile would be required at later stages of the scheme, with investigation into any other potential users who may enhance the profile and gain benefits of scale (school, college, rugby club etc).

6.7.2 Biomass CHP

A biomass CHP operates in similar manner to a Gas CHP with the exception that the fuel used to power the engine utilises renewable biomass organic matter either from dedicated energy crops, or local and national sources including commercial or agricultural products. As with biomass boilers the total site energy requirement (both heat and electricity) will determine the amount of fuel that is required to be stored on site and also the frequency of delivery of fuel to the site. Biomass CHP is a common renewable energy technology specified to achieve zero carbon development standards and is proven at a large scale (>2Mwe), however the technology at community scale is uncommon in the UK at present and their remains concerns about suitability of Biomass CHP at a community scale (<2Mwe). There are a number of Biomass CHP options:

Stirling Engines: The Stirling Engine is an external combustion engine powered by the expansion of a gas when heated, followed by the compression of the gas when cooled. There are currently a number of Biomass CHP Stirling Engine prototypes in operation but this technology is still be considered as emerging and engine prototypes range from 1 kW to 200 kW.

Steam Engines and Turbines: Steam engines are the most common approach to biomass CHP, relying on traditional technologies in the form of direct combustion heating water-tube steam boilers generating high-pressure steam that is passed through a steam turbine. Steam turbines utilise the Rankine cycle to produce power. Water is fed under pressure to the boiler where it produces superheated steam. This is fed to a turbine where it is used to produce electricity before being returned to the condenser. The steam is cooled back into hot water (which may be utilised for district heating or similar) and the water is then pumped to the boiler again.

Organic Rankine Cycle Engines: The Organic Rankine Cycle (ORC) operates in an identical way to a steam turbine except that the fluid used is an organic oil that has a lower boiling point than water. ORC generators range in size from c200 kWe to 1,500 kWe. ORC generators have a good turndown ratio and can operate at less than 50% load.

Gasification: Biomass gasification relies on the thermal degradation of biomass woodchip into gas in the absence of air. Gasification is the conversion of the combustible part in the biofuel into gases (hydrogen, CO, methane, CO_2 and nitrogen) and char by combusting the fuel via a restricted flow of oxygen. The majority of these systems use woodchips as their fuel supply. The gasification process is a proven concept and is similar to the process of producing gas from coal, however past attempts to apply it for small-scale woodchip gas production have not been fully successful. There are gasified biomass CHP systems in use in Europe but there is minimal operating data available.

While CHP itself is well established, the use of biofuels in CHP schemes presents numerous technical and commercial challenges and biomass CHP is still viewed as something of an unproven technology in the UK. However, the planned installation of several Biomass CHP systems as part of the UK renewable energy initiative and advances in technology encourages the use of biomass CHP as part of long term Zero Carbon energy strategies. A district heating scheme would serve to 'future proof' the development for the provision of new renewable technologies such as this.

Utilising energy crops and forest waste efficiently is recognised as best served by generating heat and power through a CHP plant. The size of the CHP plant should be tailored to meet the energy demands and phased to reflect the staged development of the site.

Careful consideration of the appropriate size of the plant is essential to avoid adverse impacts of waste heat production, inefficient plant operation and unsustainable consumption of biomass. If the plant is located on the development site its size will impact on the number of properties that can be built. A large scale CHP plant requires a significant amount of resource to keep it operating efficiently (over 4,000 hours per year). This will have an impact on storage facility requirements and the number of transport movements.

6.8 Energy from Waste

Energy from Waste (EfW) is a process whereby energy is created in the form of electricity or heat from a waste source. Such technologies reduce or eliminate waste that otherwise would be transferred to landfill. EfW is a form of energy recovery and most EfW processes produce electricity directly through a thermal treatment, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.

Energy from waste at incineration and gasification scales are considered inappropriate to be considered in solely meeting the energy demands of 2000 new homes at Sandleford. These technologies represent large generation and processing facilities and typically require in excess of 30,000 tonnes of waste with capital expenditure from £25m to over £100m and should only be considered as part of much wider local and regional waste management strategies. Incorporation of systems at this scale may not be feasible for Sandleford alone but further investigation could be carried out in terms of a small dedicated system linked to the Household Amenity site.

6.8.1 Anaerobic Digestion

Anaerobic digestion is an energy from waste process in which microorganisms break down biodegradable material in the absence of oxygen. The Anaerobic Digestion (AD) process creates methane gas from organic material that can be burnt to create heat and power, as well as a liquid digestate fertiliser and small amount of fibrous material. Community scale AD treatment facilities typically require a minimum of 5,000 tonnes per annum and are at 500-1000kW scale. The environmental impact in proximity to residential development as well as financial economics of AD facilities are normally the biggest barrier to development and even with subsidies and renewable energy incentives, the cost benefit of even large digesters are often unfavourable and several other significant risks and challenges include potential health hazards from pathogens and odour.

For the reasons outlined above, an Energy from Waste strategy is considered unlikely to be suitable for the Sandleford site, unless significant additional renewably classified waste streams can be identified or as part of a wider local or regional waste management strategy.

6.9 Energy Service Providers

A potential barrier to the development of this renewable energy community is the initial investment costs for developers and local authorities. One way around this is for a company to take responsibility for provide energy to the community that is willing to take on board the initial investment costs.

Decentralised district and community heating networks might be owned and operated by a private sector provider for a fixed term contract (typically >25years). Where a district energy facility is CHP led then a specialist might be preferable given the need to operate timers and other switches to ensure optimum performance power, natural gas and/or dual-fuel gas/biomass generation to satisfy daily, weekly and seasonal peaks to keep end-user bills to a minimum and maximise returns on any capital design and build contribution). The use of biomass fuels will also require dedicated short, medium and long term supply strategies and arrangements that maintain security of supply and competitively priced energy although partnerships with local biomass fuel suppliers may be explored to develop a secure long term renewable fuel supply. An Energy Service Company (ESCo) can be established to manage energy provision and contribute towards the initial capital investment need.

Increasingly fine margins mean that not all developments are well placed to attract a specialist Energy Services Provider to establish an ESCo in the delivery of onsite energy services and require a sufficient mix of commercial and residential development to ensure that the revenue stream achievable from an ESCo would be large enough to ensure financial feasibility and attractiveness. The scale of development at Sandleford may represent a commercially attractive opportunity for a private sector provider to deliver a design, fund, operate and maintain solution, early discussions would be required if this is deemed a proposal worth pursuing. Contributions to capital design and build costs provided by a private sector provider can vary significantly on the basis of the particular terms of contract, and establishing a suitable capital repayment and energy charging framework for all stakeholders. Contracting an expert provider can enable a transfer of risk away from developers and landowners to the private sector and enable a preferential financing arrangement; however it will necessitate a long term commitment for the delivery of energy services to the development.

7.0 Conclusions

Development at Sandleford will need to adopt at minimum Best and likely Advanced Practice standards of energy efficiency to reduce annual energy consumption for the benefit of occupants and reduce the burden on low carbon and renewable energy generation technologies in achieving the local and regional aspirations and to deliver Zero Carbon homes[10] from 2016.

The first step in delivering an appropriate energy strategy is integrating energy efficiency measures to reduce energy consumption prior to considering the integration of low carbon and renewable technologies.

Assessment of appropriate technologies at this stage of any project can only be of an indicative nature as many variables which would directly affect feasibility are yet to be determined and any viability issues should be thoroughly tested before recommendations are made. However, some aspects of a site can lend themselves to the successful integration of one or more LZT/Renewable technology and the assessment has been based on some of these parameters aswell as current recognised best practices.

Therefore, a number of different low carbon and renewable energy generation technologies have been considered for the site including building integrated, site wide decentralised and offsite solutions. These are summarised in the Sustainability and Renewable Energy Summary Assessment Sheet in Appendix A, the key element of this review. This summary gives an indicative suitability for this scheme as low, medium and high and the LZT/Renewable technologies can be summarised as follows;

Low Suitability	Medium Suitability	High Suitability
Solar Collectors - Air	Photovoltaic Cells	Gas Fired CHP
Small Scale Wind	Ground Source Heating/Cooling	Solar Thermal Collectors
Fuel Cells	Air Source Heating/Cooling	Biomass Heating
On site Micro-Hydro	Large/Medium Scale Wind	
Energy from Waste	Bio-fuel Fired CHP	
	Off-site Generation	

10 Defining Zero Carbon: Have your Say Report 2009 http://www.zerocarbonhub.org/downloads/ZCH-HaveYourSay.pdf

A decentralised district energy solution may represent the most economic and fuel flexible long term approach, although potentially initial development phases establishing initial energy centre(s) and district heat and power infrastructure could represent a greater capital investment than building integrated renewables. Utilising a specialist energy services provider to establish a Sandleford Energy Services Company (ESCo) may however mitigate some of these costs. Development density, number of dwellings, mix of uses etc will need consideration to integrate CHP perhaps to meet the base hot water demand of the development.

The use of PV, whilst currently representing a very high cost per kW installed, could represent an alternative building integrated approach, particularly as revised carbon intensity figures for SAP 2009 are anticipated to increasingly favour electricity generating renewables[11].

A large wind turbine can represent an economic solution, however the perceived environmental constraints, planning and land sterilisation risks to establishing a turbine onsite can be problematic.

The cost and low carbon saving benefit generally realised by heat pumps usually indicate ground source and air source heat pumps to be less viable in new build developments on the gas network, however may be considered in tandem with other renewables, such as PV.

Any residual emissions of the development beyond 2016 are anticipated to require mitigation through a series of further 'Allowable Solutions' to achieve compliance with the Zero Carbon standard. Allowable solutions at Sandleford could include offsite wind, heat export or import, installation of renewables to existing housing stock or financial contributions via the local authority as part of a Section 106 type agreement. These solutions are required to cover carbon emitted from the site for 30 years after construction.

[11] BRE Revised SAP 2009 available at: www.bre.co.uk/sap2009/

Appendix A

Sustainability and Renewable Energy Summary Assessment Sheet

Sustainability & Renewable Energy Summary Assessment Sheet - Preliminary

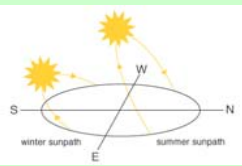
The following table reviews and summarises some of the currently available sustainable techniques and renewable technologies which may be appropriate for Sandleford Park. The list is by no means exhaustive but includes most methods which are currently economically viable or are becoming best practice. The table also includes techniques which will typically contribute towards relevant targets and aspirations e.g. BREEAM, Code for Sustainable Homes etc, assist in compliance with Building Regulations (Part L) or applicable to any West Berkshire Council development and sustainability targets e.g. 10% onsite energy generation as suggested in the South East Plan and appropriate to the Options for the Future document 'to reduce energy use and promote the development and use of sustainable/renewable energy technologies'.

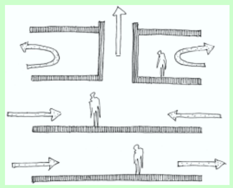
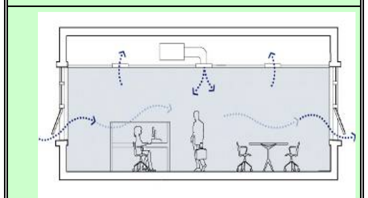
The table indicates the general advantages and disadvantages of each application and its likely relevance/application to the scheme. It should be noted that the details at this stage are not based on any form of modelling, calculation, consumption estimates, utilisation profile or payback analysis etc.

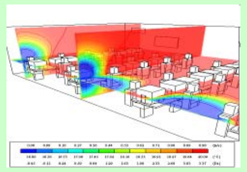
The table is intended to give an overall appreciation of the potential techniques which could be incorporated in the scheme, or may have been used on other similar developments with similar aspirations, but in no way precludes the application of any, should there be a particular requirement. It may be that the client requires to show-case or demonstrate a particular technology due to the specific use of one or more of the buildings, which would make the economic viability and payback of the system irrelevant.

It should be noted, however, that the ease of implementation of any of the above depends greatly on the budget allocation, programme, procurement methods and attitude to sustainability etc. but particularly the required level of flexibility to be incorporated in the space and the level of knowledge regarding how the space is to be utilised.

Project Title	Sandleford Park, Newbury				
Project Number	A059514	**Date**	22.09.09	**Revision**	Draft – Preliminary
Contributors	Andy Briggs - WYG				Final – Preliminary 30.09.09

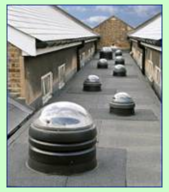
SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
Sustainable & Passive Design Options									
Design for ease of Maintenance 	Design and specification of building and plant to ensure ease and efficiency of maintenance	1. Improves ease of maintenance and extended life of plant	1. Consideration must be undertaken at early stage	Long	Low	Low	Low	Low capital expenditure and ability to incorporate from very early in the design process to all types of building. Best practice to be incorporated by the design team/developer on all buildings.	High
Orientation & Passive Solar Design 	Orientating the building to maximise passive techniques ie solar	1. Reduction in solar gains to internal spaces 2. Saving in cooling system and energy costs 3. Increases stability of internal environment 4. Should be capital cost "neutral"	1. Existing site restrictions i.e. plot size and dimensions, access, infrastructure etc. 2. Can be difficult to implement on inner city sites.	Long	Low	Low	Medium	Low capital expenditure and ability to incorporate from very early in the design process. Partially dependant on the location and configuration of buildings on the site, but where possible appropriate orientation should be incorporated to maximise natural light & beneficial heat and minimise excessive gains. At this stage of the scheme, potential can be maximised. Solar gain may be an issue with some of the buildings on the site particularly any with facades face South-East to South-West. As such consideration should be given to internal and	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								external shading devices (see below) and internal layouts and adjacencies within the building for instance location of spaces of high heat gain e.g. ICT Spaces, on the South/East to South West façade, since they will likely require cooling anyway.	
Solar Shading 	Internal and External shading devices including Brise Soleil, overhangs, blinds, louvres, reflective glass etc.	1. Reduction in solar gains to internal spaces and glare. 2. Increase heating benefit from low sun in winter. 3. Saving in cooling system and energy costs 4. Should e capital cost “neutral”	1. Façade and aesthetics of building require careful design.	Medium	Medium	High	Medium	Depending on aesthetic requirements and potential cost implications this technique could be applicable to all the buildings on the site. The incorporation of this technique is also dependant on the specific orientations of the buildings under the design as discussed above. At this stage of the scheme, potential can be maximised where necessary. Solar gain may be an issue with some of the buildings on the site particularly any with facades face South-East to South-West. As such horizontal shading should be considered for the S & SE facing facades with vertical considered for East and West facades. External shading is a more effective means or reducing solar heat gain than internal blinds, but internal blinds assist with glare. Some of the natural features around the site e.g. woodland may also be used as an effective shading method.	High
Natural Ventilation 	Natural ventilation to areas via openable windows and/or external louvres/openings.	1. Major reduction in capital, running and maintenance costs of HVAC systems.	1. External Noise. 2. Restrictions in control. 3. Unpredictable nature of external effects i.e. temperature and wind direction. 4. Restricts flexibility of internal spaces. 5. Reduces opportunity for heat recovery.	Short	Low	High	High	Natural ventilation may be applicable to some of the buildings dependant on other issues e.g. location orientation, noise, design parameters & targets etc. It may be that noise issues will prohibit natural ventilation in some of the buildings (schools) on the West to East side of the site close to the existing built out areas and roads, this would need determining through acoustical testing. Across the site particular land features may provide a level of attenuation e.g. the woodlands and school land between the business use and residential areas. The actual application on a building by building basis (particularly non-residential) will need to be determined via thermal modelling and detailed design. Clearly spaces of high internal heat gain or specific ventilation requirements will not be suitable.	High
Mixed Mode Ventilation 	A combination of natural ventilation via opening windows and/or external louvres/openings and mechanical ventilation. Usually in the form of natural supply and mechanical extract.	1. Partial reduction in capital, running and maintenance costs of HVAC systems. 2. Useful when natural ventilation is restricted but no real requirement or desire for full mechanical systems. 3. More reliability and security of natural supply requirements.	1. Some restrictions in control. 2. Unpredictable nature of external effects i.e. temperature and wind direction. 3. Restricts flexibility of internal spaces. 4. Reduces opportunity for heat recovery.	Medium	Medium	Medium	Medium	Where ventilation requirements cannot be met via natural means it may be necessary to apply mixed mode or supplementary mechanical ventilation type techniques. This is preferable to full mechanical ventilation in terms of energy consumption. The actual application will need to be determined via thermal modelling and detailed design – primarily applicable to non-residential.	Medium

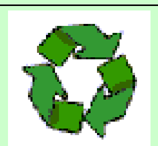
SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
Seasonal Commissioning 	Operational review/re-commissioning to be undertaken during first year of operation	1. Maximises operating efficiency of systems.	1. Additional commissioning costs	Long	Low	Low	Low	This technique should be applied where common systems (e.g. heating and ventilation) are incorporated and included in specifications to maximise running efficiencies and contribute to the Excellent BREEAM rating. Primarily applicable to non-residential buildings.	High
Minimise Construction Site Impacts 	Adopt best practice policies to all site activities	1. Minimise wastage, pollution and energy consumption from site activities	1. Possible additional construction costs	Long	Low	Low	Low	This issue largely involves educated contractors and designers with good site practise and should be incorporated to assist in achieving Excellent BREEAM targets.	High
Thermal Comfort Zoning 	Undertake thermal comfort modelling and ensure that systems are designed to provide appropriate level of zoning and occupant control	1. Provide appropriate level of occupant comfort	1. Increased design period input 2. More complex controls systems 3. Additional commissioning costs	Long	Low	Low	Low	Low capital expenditure and ability to incorporate from very early in the design process. Best practice to be incorporated by the design team/developer mainly on non-residential buildings.	High
Combined Heat and Power (CHP) (Gas) 	Gas fired CHP engines to generate electricity and heat. (Biomass could also be considered – see below)	1. Good efficiency on medium to large sites. 2. Potential to 'sell' back energy to the grid. 3. Carbon tax levy applicable.	1. Utilisation profile of building must provide adequate load requirements to achieve efficiency at all times. 2. Procurement methods have major effect on viability and costs.	Medium	High	High	Medium	Policy NRM12 in the South East Plan specifically highlights the consideration of CHP in all mixed use developments. The scale of the development gives a potential for the incorporation of local or site wide CHP, although the amount of commercial development is small in comparison with residential which may present commercial and technical viability issues in terms of extensive CHP usage. Primarily residential sites limit the incorporation of CHP due to the load profile. Viability is very much dependant on the thermal load balance of the buildings which will have to be reviewed once energy consumption models/calcs are carried out and the there is more detail to the use of the non-residential buildings. The best profile for CHP is a mix of residential and commercial/residential buildings which this site has the potential to provide on a limited scale. Where possible the incorporation of all buildings on the site should be linked to any centralized systems to enhance the load profile. If possible extending the system to include surrounding new or existing buildings to create a community scheme could be considered to enhance viability and efficiency e.g. school, college, rugby club, Newbury retail park & superstore etc. Consideration to type of fuel should be given e.g. gas or biofuel etc. This type of system can assist in reaching increasing carbon emission	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								targets.	
Grey Water Recycling 	Utilisation of basin and shower drainage water for recycling and application to WC flushing and landscape irrigation etc.	1. Saving on mains water and drainage costs 2. Reduced water consumption and operational costs	1. External Excavations for tanks 2. Additional plant and equipment to maintain. 3. Additional distribution within building.	Long	High	High	Low	This technique has relatively high capital cost, however consideration could be given to its use on a communal scale, incorporating more than one building, bringing some economy of scale. This is likely to be more applicable to the non-domestic facilities which have greater water consumption. Assessment would consider occupancy, function and use.	Low
Black Water Recycling 	Utilisation of WC, urinal and bidet drainage water for recycling and application to WC flushing and landscape irrigation etc.	1. Saving on mains water and drainage costs	1. External Excavations for tanks 2. Additional plant and equipment to maintain. 3. Additional distribution within building. 4. Risk from contamination. 5. Additional treatment required to deal with levels of contamination 5. Not yet common technology in UK.	Long	High	High	Medium	This technology is a relatively new technology in the UK with currently a high capital cost and potential environmental issues and as such it is not deemed viable at this stage.	Low
Rainwater Harvesting 	Utilisation of rainwater for recycling and application to WC flushing and landscape irrigation etc.	1. Saving on mains water and drainage costs.	1. External Excavations for tanks 2. Additional plant and equipment to maintain. 3. Additional distribution within building.	Medium	Medium	High	Low	This is a key technique for reducing water consumption and achieving any Code and BREEAM targets. Therefore consideration should be given to its use on both an individual and communal scale incorporating some or all of the buildings. Water could be used for WC flushing and irrigation to the landscape areas of the site This technique is applicable to all types of building, with more consideration required to the civil engineering works (e.g. buried tanks) if done on a commercial size or communal basis. In many scenarios, particularly educational, this technique is becoming a standard and incorporated in the site wide drainage strategy.	High
Vacuum Drainage 	A system of drainage serving sanitary appliances within a building which relies on powered vacuum rather than gravity. Useful in situations of water shortage, limited sewerage capacity, where separation of black and grey water is desired or where separation of wastewaters is desired for different treatments.	1. Low installation costs 2. Environmentally safe 3. Electrical power only required at vacuum station 4. Always self cleansing 5. No possibility of vermin in pipelines 6. Possible water saving technique if vacuum toilets are used 7. High water velocities prevent deposits in pipework 8. Minimise risk of leakage 9. Can use small diameter lightweight pipes that can be installed without a continuous fall 10. Vertical lifts are possible 11. Ability to easily separate grey and black water 12. High turn around time - no need for cistern to refill for subsequent flushes 13. Flexibility in routing of pipework	1. High component costs 2. Mechanical components - possibly for failure 3. Skilled design, installation and maintenance required 4. Regular maintenance required 5. Standby facilities may be required 6. Require area for situation of vacuum tanks and vacuum generation equipment 7. High velocity water may cause transient plumbing noise	Medium	Medium	High	Medium	This is not a commonly used technique but may be applicable to high occupancy office environments, and on a large scale could be utilised in a communal manner, however this depends on the build out proposals. Further review would be required as it would contribute to water and BREEAM targets but as it carries a relatively high capital cost, other water conserving techniques may be preferable.	Low

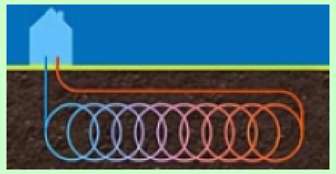
SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
Waterless Urinals 	Urinals do not require water supplies for flushing.	1. Saving on mains water and drainage.	1. Inherent high maintenance requirements and hence costs. 2. Smell problems if maintenance reduced.	Medium	Medium	Low	Low	A technique which would contribute to the water and BREEAM targets but maintenance proposals for the non-residential buildings becomes a factor with this type of system. Perhaps it could be used as a demonstration technique in one or more of the buildings.	Low
Mains Water Leak Detection 	Leak detection for all major leaks to mains water supplies to the building	1. Minimise wastage of water due to major water leaks 2. Water and cost savings	1. Additional installation costs	Long	Low	Low	Low	A good practice approach which contributes to BREEAM targets. Methods of detection should be discussed e.g. sensors – pressure, flow or tapes etc. and can be applicable on a site wide basis across most buildings but particularly non-domestic.	Medium
Sanitary Water Supply Shut-off 	Provide proximity detection shut off to water supplies to toilet blocks	1. Minimises wastage of water due to internal water leaks	1. Additional installation costs	Long	Medium	Low	Low	A good practice approach which contributes to BREEAM targets, avoiding water wastage through taps left on or vandalism etc. An easy inclusion in design specifications. Mainly applicable to public or commercial buildings.	High
Earth Tubes 	Utilisation of the earth's thermal properties to generate heat and/or cooling via ducted air systems bringing tempered fresh air into the building.	1. ''Free' non-fossil energy source. 2. Reduction in façade works e.g. louvres.	1. Usually extensive civil/structural/external works required. 2. Early consideration to built form and foundations required.	Medium	High	High	Low	A potential method of introducing air into any deep space areas which may otherwise rely on mechanical ventilation or just to pre-temper incoming fresh air. However, very early consideration is required in terms of co-ordination with structural works, possible at this stage of the project. Largely applicable to non-residential buildings.	Medium
Thermal Mass 	Utilisation of the inherent heavy thermal weight of exposed structural components to retain and release energy at appropriate times. Normally used with natural ventilation & night time cooling.	1. Free cooling/heating 2. Cost reduction to internal finishes. 3. Greater regulation of swings in internal temperature.	1. Restrictions in choice of construction techniques. 2. Limitations in control. 3. Internal aesthetics of materials. 4. Additional costs associated with exposed services installation	Long	High	Medium	Low	Mass of the construction materials and their specification should be considered in the design of all buildings on site, including residential if in multiple blocks. This will be dependant on the preferred structural solution and internal aesthetics in terms of exposed structure. The potential benefit from this passive technique should be considered and where relevant adopted into design principals. Night time cooling can be applied to exposed thermal mass to reduce energy consumption during the day and this may be applicable to some of the spaces in the non-residential buildings.	High
Occupant and/or Daylight Controlled Switching	Sensors incorporated to switch internal electric lighting in relation to occupants and levels of external daylight.	1. Maximise use of daylight. 2. Minimise use of electrical lighting 3. Contributes to Part L calculation.	1. Increase in complexity of systems	Short	Medium	Medium	Medium	Such techniques which minimise electrical consumption are key to most schemes and should be considered in	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								relation to the methods of provision of natural light and energy reduction to assist with energy and BREEAM targets. Consideration should be given to incorporation of such techniques in the specifications for non-residential buildings.	
Heat Recovery (Air Systems) 	Various methods of extracting heat energy from extract air stream and applying it to supply air streams e.g. plate exchangers, thermal wheel, run-around coil, heat pipes etc.	1. Reduces direct heating and cooling energy consumption. 2. Can reduce primary heating equipment requirements.	1. Increases capital outlay of plant. 2. Additional controls required. 3. Risk of cross contamination between air streams. 4. Large variation in efficiencies with methods. 5. Additional maintenance costs with some methods.	Short	Low	Low	Medium	This technique is standard good practice and must be considered at every opportunity where mechanical or mixed mode ventilation systems are utilised to minimise energy consumption. Applicable to non-residential and residential where whole house ventilation is used and assistance with Code compliance.	High
Sunpipes 	Reflective ducts used to transfer natural light into internal or deep plan spaces.	1. Benefits of natural light to occupants. 2. Savings energy associated with artificial lighting. 3. Reduces glare.	1. Additional structural & architectural considerations required to incorporate equipment.	High	Medium	Low	Low	Mainly applicable to non-domestic buildings but can be used in deep plan residences, blocks or for internal spaces. Given the potentially significant electrical demand of lighting and human nature in terms of natural light, maximising the potential for natural light into the spaces should be given consideration. These techniques can be used in deep plan or internal 'land locked' areas and hence depends on layouts and how they can effectively supplement electrical lighting schemes.	Medium
Lightshelves 	Reflective panel installed within the façade to direct natural light deeper into the occupied space.	1. Benefits of natural light to occupants. 2. Savings energy associated with artificial lighting. 3. Reduces glare. 4. Enhances passive solar energy. 5. Can act as a solar shading device.	1. Additional structural & architectural considerations required to incorporate equipment into facade. 2. Enhances passive solar energy. 3. Can act as a solar shading device. 4. Reduces electrical light energy consumption.	Long	Medium	Low	Low	Light-shelves are more applicable to deeper plan non-residential spaces, those with limited glazing or shaded perimeter areas and hence dependant on layouts and specific internal design.	Medium
Windcatchers & Penthouse Louvres 	A method of passive/natural ventilation reliant on the stack effect through a duct/penthouse.	1. Passive natural supply and extract ventilation to internal or deep plan spaces.	1. Additional structural & architectural considerations required to incorporate equipment. 2. Additional controls and maintenance costs.	Medium	Medium	Medium	Medium	Consideration to wind catchers should be given to naturally ventilate any deep plan areas to offset the extent of mechanical ventilation and hence energy in non-residential buildings. Such techniques can be used in many applications and can also be powered, sometimes using a PV cell, but may be prone to adverse wind direction or turbulence, so location must be considered. Dependant on the type, function and location of the building and the preferred ventilation strategy.	Medium
Non-Touch Water Appliances	Sensor operated taps and WC flush controls to give a regulated amount of	1. 40%-70% savings on cold water usage. 2. Contamination and Infection control as	1. Electrical supply required (battery or mains).	Short	Low	Low	Low	Water control appliances such as these should be considered as standard in non-residential premises in terms of	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
	water.	no physical contact with appliances.	2. Cost increase on conventional taps & cisterns.					hygiene aswell as water conservation thus contributing to water and BREEAM targets This technique has potential cost implications when compared to other water conserving techniques e.g. restrictors, cisterns and taps etc and may be prohibitive; but application would significantly improve water efficiency. Incorporation of a selection of such techniques is recommended for inclusion in fit-out specifications to meet BREEAM.	
One-Touch Water Appliances 	Single touch button or handle operated taps to give a regulated amount of water.	1. 40%-70% savings on cold water usage.	1. Marginal cost increase on conventional taps & cisterns.	Short	Low	Low	Low	These fittings can contribute towards increased water efficiency, and should be considered as part of the sanitary ware specification. Incorporation of a selection of such techniques is recommended for inclusion in fit-out specifications to meet BREEAM. Mainly applicable to non-residential buildings.	High
Urinal Flush Controls 	Ceiling or wall mounted sensors to operate and control the regular flushing of single or multiple urinals.	1. 70%-90% savings in cold water usage on unmanaged systems. 2. Compliance with current water regulations.	1. Electrical supply required (battery or mains). 2. Minor additional maintenance.	Short	Low	Low	Low	These fittings can contribute towards increased water efficiency, and should be considered as part of the sanitary ware specification. Incorporation of a selection of such techniques is recommended for inclusion in fit-out specifications to meet BREEAM. Mainly applicable to non-residential buildings.	High
Flow Restrictors 	Methods of restricting water flow in hot and cold water pipework and appliances to avoid wastage, via inline devices or outlets.	1. 20%-50% savings on cold water usage.	1. Additional pipework modifications. 2. Minor additional maintenance costs.	Short	Low	Low	Low	These fittings can contribute towards increased water efficiency, and should be considered as part of the sanitary ware specification. Incorporation of a selection of such techniques is recommended for inclusion in fit-out specifications to meet BREEAM. Applicable to residential and non-residential buildings.	High
High Performance Glazed Facades 	Glazed facades effecting heat transfer, solar gain and shading, condensation risk, occupant visual comfort and acoustic performance. Methods include multiple glazing, solar coatings, inert gas filling, solid or motorised louvres and blinds, ventilated cavity etc.	1. Improved control of solar heat gains and reduction in cooling requirements. 2. Glare reduction. 3. Increase in acoustic performance. 4. Increased insulation properties to minimise heating requirements and downdraughts. 5. Potential to incorporate solar shading.	1. Increased capital cost. 2. Complexity of installation. 3. Potential cavity condensation risk.	Medium	High	High	Low	Considerable levels of energy efficiency can be achieved in using varying levels of facade treatment to mitigate heat gains in summer and benefit from gains in winter. Lighting issues are also pertinent in a strategy to maximise natural light and minimise glare. Primarily applicable to non-residential buildings. The elevational treatment of each building will need to be reviewed in terms of the orientation to maximise the benefit where possible. Depending on the requirements of the internal environment a variety of proposals is likely from simple solar reflective glass to intelligent facades with solar tracking louvers. Such techniques can be integrated into high performing and flagship schemes	Medium

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								providing good aesthetic impact. However, the glazing specification in terms of u'value and admittance should be reviewed with targets to achieve a minimum of the building Regs targets (23-28%). See Orientation & Passive Solar Design & Solar Shading.	
Green Guide to Specification 	Building Materials specified in accordance with Green Guide to Specification. Grades materials in terms of source, recycled content, recyclability etc.	1. Minimises impact on the environment of materials 2. Minimises embodied energy within buildings	1. May restrict materials available 2. May impact on cost.	Long	Medium	Low	Low	High rated construction materials which are indicated within the Green Guide to Specification should be used wherever possible, as part of an approach to sustainable construction. However, detailed analysis of the specifications and selection of materials for all building types will be required to achieve a cost effective balance of value/benefit and sustainability. Types of locally sourced materials should be reviewed as designs and specifications are developed.	High
Solar/Trombe Wall 	Provide natural ventilation in summer and tempering of air in winter using solar gains on a south facing external wall.	1. Free heating of fresh air for circulation or removal of excess heat due to buoyancy of air.	1. Provision of additional structure. 2. Fire spread precautions	Long	High	Low	Low	Incorporation of Trombe type walls are not common but can assist in any passive heating/cooling strategies for buildings of considerable façade area. Such applications would need to be integral to the operational strategy for the building and may have a significant aesthetic impact. As such this would require review in terms of the design and use of the, primarily non-domestic, buildings.	Low
Green Roof 	External roof areas covered with a 'planted' growth e.g. sedum or grass.	1. Reduces rainwater run off 2. Improves insulation of the building roof. 3. Provide free cooling to the building due to mass and materials 4. Provides habitat for wildlife.	1. Structural and building implications. 2. Maintenance of planting 3. Planning issues 4. Aesthetics	Long	Low	Medium	Low	Green, or indeed landscaped, roofs could potentially be used on each building to assist in many areas including water attenuation, energy reduction, biodiversity and ecology etc. The use of such techniques will need to be incorporated in early design proposals to meet operational requirements aswell as aesthetics but given the amount of woodland and green spaces within the site, this type of beneficial bio-mimicry could be a key aspect of the development.	Medium
Cyclists Facilities 	Provide adequate cyclists facilities	1. Encourages "green travel"	1. External location and structure required.	Long	Low	Low	Low	Adequate, covered, secure and well lit cyclist facilities should be incorporated into the design, wherever feasible and required to assist in achieving BREEAM ratings and a key part of any Travel Plan.	High
Recycling Strategy 	Demonstrate and approved and administered recycling strategy within the building and grounds, including Internal collection point and accessible external bin facilities.	1. Encourages recycling as the default approach to rubbish disposal 2. Provides learning opportunity 3. Conserves valuable resources	1. Internal and external space and structure required. 2. All parties must commit including school governors and council (or private contractor) 3. Processes and facilities must be monitored and administered	n/a	Low	Low	Low	Facilities and systems to facilitate recycling of all materials and domestic type waste (in-line with local council provision) should be incorporated into the development of each building and the entire site to assist in achieving local and regional waste targets.	High
Variable Speed Drives	Speed controlled drives on pumps and	1. Eligible for Enhanced Capital Allowances.	1. Higher initial capital costs.	Short	Medium	Low	Low	Should be considered as best practice	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
	fans where applicable.	2. Systems can be accurately commissioned.	2. Increase in system complexity.					standard where water and air systems allow incorporation to assist in energy efficiency. Primarily applicable to non-residential buildings.	
Renewable Energy Systems									
Photovoltaics 	Roof mounted solar cells used to generate electricity. Various types are available made from differing materials with different aesthetics and efficiencies.	1. Grants available. 2. Free Non-fossil fuel source. 3. Savings on roof cladding. 4. Can be Retrofit. 5. Generally simple installation procedures. 6. Large variety of types and concepts. 7. Can prolong roof life. 8. Small scale could be used as an educational demonstration programme.	1. Fairly High capital costs and long payback periods. 2. Complex manufacturing procedure and technology. 3. High embodied energy levels. 4. Generally increased roof maintenance & access concerns. 5. Current Government grant initiatives nearing end of availability period. Continuing availability of grants to be considered.	Long	High	High	Medium	Although PV cells have a relatively high capital cost they are a potential generator of electricity, and hence have a good carbon saving potential when off setting grid electricity, hence contributing to BREEAM and energy targets. Reducing costs of PV's, increasing electricity costs and changes to the carbon weighting of electricity are improving the cost per kg saving and this will increase in the future. However, currently, the capital cost is generally prohibitive with excessive payback periods and as such other renewable techniques may be preferable for consideration before PV's. Should PV's prove viable they are applicable to both residential and commercial buildings and are recognised as a technique for mitigating emissions under the Code for Sustainable Homes as a micro-generation technique. On a larger scale they should be considered for integration into the structure of the building in an attempt to offset construction costs. Appropriate areas of roof with appropriate orientation (generally South) would be required to install the cells and this should be considered when the masterplan is developed. To limit costs it may be that PV could be utilised to supplement a baseline carbon offset by a site wide heating (and power) network to reach any specific carbon targets.	Medium
Solar Collectors - Water 	Roof mounted fluid based panels generating heat to fuel domestic heating and/or hot water.	1. Grants available. 2. Free Non-fossil fuel source. 3. Savings on roof cladding.	1. Full duty boiler and associated equipment required for periods of year when little sun. 2. Increased maintenance costs. 3. Current government grant initiatives nearing end of availability period. Continuing availability of grants to be considered.	Medium	High	Medium	Medium	Consideration should be given to the provision of solar collectors to pre-heat/heat domestic hot water. Such systems would likely be applied on an individual unit basis, applicable to residential and non-residential buildings. These are a relatively common, cost effective and simple means of offsetting gas usage. Appropriate areas of roof with appropriate orientation (generally South) would be required to install the panels and this should be considered	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								when the masterplan is developed.	
Solar Collectors – Air 	Roof mounted air based panels generating heat to temper ventilation air and possibly domestic hot water.	1. Free Non-fossil fuel source. 2. Savings on roof cladding. 3. Low maintenance 4. Can be linked to domestic hot water system.	1. Currently only applicable to domestic/small scale projects. 2. Duct routes required & associated builders work.	Medium	High	Medium	Low	Utilisation of such techniques depends on the requirement for mechanical ventilation systems within individual buildings but can offer hot water and/or tempered fresh air. These systems are more applicable to domestic type situations but buildings of limited ventilation demand may be compatible. This should be considered when assessing the design and specification of the residential units/blocks.	Low
Ground Source Heating and/or Cooling 	Utilisation of the earth's thermal properties to generate heat and/or cooling via piped systems.	1. ''Free' non-fossil primary energy source. 2. Reduced maintenance costs.	1. Early site and project analysis required. 2. Unpredictability of source until drilling is carried out. 3. Additional drilling costs. 4. Supplementary heating cooling sources generally required.	Medium	High	High	Medium	Ground Source Heat Pumps have high associated cost implications in capital expenditure, design and operation. However, done on a mass basis or as part of a communal scheme, they can be cost effective. Consideration should be given to those buildings on appropriate ground conditions and which may be suitable for an appropriate low grade heating system such as underfloor – primarily commercial or educational buildings. GSHP's can assist in achieving targets but also help to future proof the facilities by providing cooling aswell as heating. However, heat pumps consume electricity and if used on a building coupling this with a form of electricity generating renewable technology would assist. Plans indicate available land around the site which could be used for sinking boreholes or laying pipe coils. Consideration should also be given to thermal piles if structural solution allows. The beck may also provide a form of heat sink or indeed an extraction source. However it is thought that flow rates are low and viability very much depends on flow rates and requires a long application process.	Medium
Air Source Heating and/or Cooling 	Utilisation of the atmospheres thermal properties to generate heat and/or cooling via piped systems.	1. 'Free' non-fossil primary energy source. 2. Reduced maintenance costs.	1. Location for external plant required with associated structural implications. 2. Supplementary heating cooling sources generally required. 3. Planning issues regarding external plant.	Medium	High	High	Medium	Air Source Heat Pumps have high associated cost implications in capital expenditure, design and operation. Consideration is also required to the location and aesthetics of external plant. Some residential or smaller units on the site may be applicable to this technology given consideration of demand and potential heating methods.	Medium
Wind Energy (Large/Med Scale)	High level wind driven blades used to generate electricity.	1. Grants/finance available. 2. Embedded renewable electrical energy	1. Planning restrictions. 2. Noise	Long	High	High	Medium	Large scale wind turbines provide a considerable opportunity to generate electrical energy. In general terms the	Medium

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
		source.	3. 'Up front' payments required. 4. Transportation & delivery to site.					larger the provision the more cost effective they are, given the semi-rural location of the site this technique should be considered but in-line with planning requirements, proximity of residences, airports or other sensitive users e.g. military etc and ecological concerns. There appears to be land to the South of the site which may be remote enough from residential areas and clear enough to benefit from suitable wind velocities and provide appropriate buffer distances from residences. Wind analysis of the site would need to be carried out with reference to Quality Design SPD Part 4 and PPG22 etc. Large scale generation would be consistent with policies in the South East Plan etc It may be appropriate to consider the incorporation of an ESCO to supply and manage such a provision.	
Wind Energy (Small Scale) 	Packaged 'plug in' units used to generate electricity. Can be building or column mounted.	1. Grants/finance available. 2. Embedded renewable electrical energy source 3. Can be Retrofit. 4. Modular concept can be applied. 5. Can incorporate turbine to generate hot water. 6. Small scale could be used as an educational demonstration programme.	1. Planning Restriction 2. More applicable to domestic/small scale situations. 3. Easily exposed to detrimental affect of local buildings and wind turbulence, seriously reducing output and efficiency.	Short	Low	Medium	Medium	Small scale wind generation depends on many issues; largely on the prevailing climatic conditions, local structures, planning, ecology etc. Operation and quoted efficiencies of current items of equipment are questionable. On a development of largely 2/3 storey buildings application is limited, however on higher buildings without local obstructions consideration should be given.	Low
Biomass 	The utilisation of alternative non-fossil fuels e.g. Elephant grass, willow, forestry waste, husks, olive stones/pulp, bio-diesel, bio-ethanol etc to fuel boilers/engines.	1. Non-fossil fuel source. 2. Can be combined with CHP to generate electricity also. 3. Low fuel costs in comparison to fossil fuels.	1. Reliable and regular source of quality fuel required i.e coppice rotation etc. 2. Transportation costs for fuel. 3. Requirement for on-site storage in mass. 4. Additional maintenance costs for plant. 5. Consideration to products of combustion (SOx, NOx).	Medium	High	High	Low	As long as a cost effective, local and reliable source of fuel can be established, Biomass is a relatively common form of offsetting grid gas. An initial review indicates up to four suppliers of solid biomass in the locality, of particular note is TV Bioenergy in Newbury (www.tvbioenergy.co.uk). It may be that a source of fuel can be found from the management of the woodland areas around the site, managed by the community or an appointed agent. Biomass heating (and power, see below) is applicable to all types of building on micro or district scales. The more desirable scenario would be to serve all the buildings from a community scheme with central plant providing heat to all other buildings. This would carry economies of scale and would limit transport around the site in terms of fuel delivery. However a central energy centre would be required with adequate storage, and given the potential uses of the site resilience and backup would require consideration.	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
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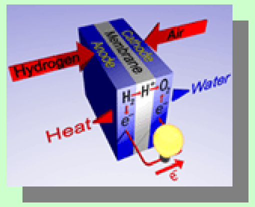
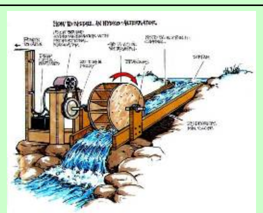
								It may be appropriate to consider the incorporation of and ESCO to supply and manage such a provision.	
Combined Heat and Power (CHP) (Biofuel) 	Biomass fired CHP engines to generate electricity and heat. (Biomass e.g. wood pellet, woodchip, bio-diesel etc)	1. Good efficiency on medium to large sites. 2. Potential to 'sell' back energy to the grid. 3. Carbon tax levy applicable.	1. Utilisation profile of building must provide adequate load requirements to achieve efficiency at all times. 2. Procurement methods have major effect on viability and costs.	Medium	High	High	High	Policy NRM12 in the South East Plan specifically highlights the consideration of CHP in all mixed use developments and biomass CHP referenced in Quality Design Part 4. Although it is currently a relatively immature, but fast developing, market, the provision of heating and electricity from biomass fuelled CHP boilers should be considered on a multiple units or site basis. Consideration needs to be given to fuel supplies in quantity and quality in all instances (see above). A communal system supplying a district heating and electrical network to each new (and existing) building may be applicable. Again, reference is drawn to the comments made in the Gas CHP section above, consideration must be given to the energy balance of heat and electricity, and other off-site but local users should be investigated to maximise the efficiency of any CHP.	Medium
Fuel Cells 	Fuel Cells produce electricity and heat by combining hydrogen and oxygen in an electrochemical process.	1. High electrical efficiency 2. Significantly lower emissions of pollutants than conventional energy conversion technologies 3. Reduced greenhouse gas emissions. 4. Quiet operation 5. Modular construction	1. High costs. 2. Many formats still in R&D stages. 3. Fuel choice - availability, storage and reliability 4. No real codes of practice, standards and regulation exist. 5. Not fully developed in building services applications.	Short	High	High	?	Fuel cells are a relatively expensive and innovative technique and as such are currently likely unfeasible for this site unless any of the functions within the commercial area lend themselves to the utilisation of a demonstration set e.g. a manufacturer of components.	Low
Micro-Hydro 	Using the inherent energy in flowing water to generate electricity by using turbines, anaconda etc.	1. Free generation of primary fuel source	1. Possible detrimental affect on water course & environment. 2. Water Authority permission. 3. Maintenance.	Long/Medium	High	High	Medium	Although there is a small beck running across part of the site and the River Eoborne runs across the South of the site, it is unlikely that there will be sufficient flow or head of water in these water courses to make micro-hydro feasible. However further investigation may be appropriate further along the masterplanning phase to eliminate this option or otherwise. See also Off-site Generation below.	Low
Energy from Waste 	Waste-to-energy (WtE) or energy-from-waste (EfW) is the process of creating energy in the form of electricity or heat from the incineration of waste source. WtE is a form of energy recovery with most WtE processes producing electricity directly through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels	1. 'Free' energy from a waste resource. 2. Suitable for community schemes. 3. Reduction in costs of landfill. 4. Can provide large scale heat and power. 5. Potential local employer. 6. Consistent waste supply if 'connected' to a specific community. 7. Limit landfill taxes.	1. Major investment with high capital costs. 2. Negative public perception. 3. Significant spatial allocation required. 4. Potential air quality and pollution issues. 5. Additional infrastructure required to facilitate. 6. Environmental impact' 7. Visual and Aesthetics	-	High	High	High	An area on the current plan has been identified as the existing Household Amenity site. It is assumed that this may be a source for some form of fuel utilising domestic waste or potentially a more industrially orientated area which may be able to accommodate plant/energy centres etc. Although, an energy from waste installation has considerable issues, in terms of ecology, aesthetics, public perception, environmental impact, planning etc, it can be a relatively cost effective means of generating energy with a consistent source of fuel from	Low

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
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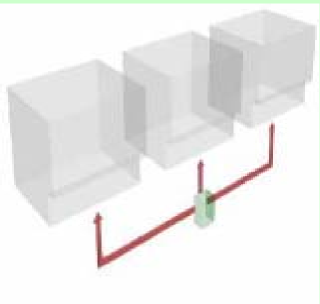
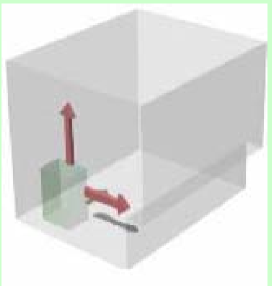
								the local community and would be consistent with all the local, regional and national drivers in terms of reduction of emissions. Detailed studies in terms of the appropriateness and viability of such a facility on the allocated footprint would be required. However, such schemes are normally on a much larger scale than the Sandleford site requiring significant investment and inclusion. It may be that a limited small scle process could be considered for perhaps just the commercial area but further research is required. In terms of location for a primary de-centralised energy centre the ideal location would be central to the site, to limit efficiency losses and pipe runs etc e.g. source nearer on average to the user. However, this can generate issues in terms of air quality, visual impact etc., particularly when amongst residences or close to schools (although this is still the case on the current plan, a buffer zone has been indicated). So, although the current location may not be the most technically appropriate location it may be better in terms of impact. The analysis of the site should address these adjacency issues against technical feasibility and possibly consider other locations and the incorporation of other potential users. It may be appropriate to consider the incorporation of and ESCO to supply and manage such a provision.	
Scale of Technology Incorporation									
Community Schemes / District Energy / De-Centralised Systems 	Incorporation of centralised systems which serve the entire development, and are administered by a central agent.	1. 3rd party administration / management 2. Benefits in terms of Code for Sustainable Homes compliance. 3. Capital cost per unit output falls with increased capacity of central plant. (Economy of Scale). 4. Convenient for some institutions. 5. Central plant tends to be better engineered, operating at higher efficiencies (where load factors are high) and more durable. 6. Some systems will naturally require central plant, e.g. heavy oil and coal burning plant. 7. Flexibility in choice of fuel. 8. Better utilisation of CHP etc.	1. Associated costs to individual unit owners for management. 2. Disruption affects whole development site. 3. Capital cost of distribution systems is high. 4. Space requirements of central plant and distribution systems are significant. 5. As the load factor falls the total system efficiency falls as distribution losses become more significant.	-	High	High	Medium	The incorporation of centralised systems which serve the entire development (or large phases/components of it), and may be administered by the developer, a central agent or an ESCO, has benefits of economy of scale and administration / management duties by a third party. It is also easier to achieve high levels of energy efficiency, potential BREEAM, CSH ratings and to meet local, regional and national targets. However it should be noted, without full backup systems, any potential breakdown may disrupt the entire site. There is a mix of uses on site which may lend itself to an element of de-centralised/community schemes incorporating a selection of one or more technology. However, recent discussions with ESCO providers have	High

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
				PAYBACK PERIOD	CAPITAL	DESIGN	OPERATION		
								indicated they would consider managing systems with as little as 300-500 domestic residences connected. The technical and commercial viability is not only dependant on the number of connected users but, in terms of residences, the density and layout of the site (50 dwellings per Hectare or above is the preferred limit but systems can work with less) and this should be considered in Masterplanning. Consideration of the phasing and build out of the site is also important when reviewing district schemes as a critical mass of demand is required to justify the incorporation of the large scale central plant. It may be that temporary plant connected to district infrastructure is utilised or micro-generation techniques for a initial number of buildings. However, the balance and type of energy provision and hence the viability of the ESCO's commercial model may effect the capital cost of the project.	
Dedicated / Individual Units 	Incorporation of technologies on a unit by unit basis, with ownership and responsibilities for maintenance being incumbent on the individual units owner.	1. Individual ownership. 2. No management costs to 3rd party agent. 3. Failure does not impact whole site, only area served. 4. Low overall capital cost, savings made on minimising the use of air and water distribution systems. 5. Zoning of the systems can be matched more easily to occupancy patterns. 6. Maintenance less specialised. 7. Can be readily altered and extended. 8. Energy performance in buildings with diverse patterns of use is usually better.	1. Potential increased individual service costs in the event of failure. 2. Higher unit cost for technology on a house-by-house basis. 3. Equipment tends to be less robust with shorter operational life. 4. Flueing arrangements can be more difficult with combustion systems. 5. Fuel needs to be supplied throughout the site. 6. May require more control systems.	-	Medium	Medium	High	The individual application of technologies such as solar thermal, wind, biomass etc on a building-by-building basis should also be given serious consideration with regards to the proposed development targets, particularly in consideration of phasing and any build-out programme e.g. it may be that micro-generation techniques need to be employed to meet targets from the start of a project until a critical mass of buildings is built out which could justify a district scheme. A detailed analysis will be required to determine the most appropriate mix of communal and individual applications to deliver the regulatory and target criteria. This will need to consider and correspond with any forthcoming changes in regulatory requirements over the design and construction period (e.g. the changes in the Building Regulations).	High
Offsite Generation									
Remote / Offsite Generation	Generation of energy offsite which can be attributed to and offset against the	1. Substantial CO_2 emission offset & assistance towards UK zero carbon	1. Land or facilities required elsewhere. 2. Significant capital cost.	-	High	High	-	Significant contributions to the overall carbon profile of an area or applied to	Medium

SUSTAINABLE TECHNIQUE	APPLICATION	ADVANTAGES	DISADVANTAGES	COSTS				COMMENT	SUITABILITY for SCHEME
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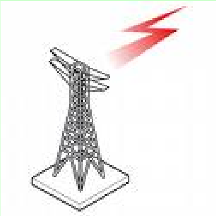
	energy consumed on site. This can be via a 'direct wire' concept or an overall contribution into the local/regional grid.	requirements. 2. Possible ESCO capital cost assistance. 3. Appropriate for current national and regional policy drivers. 4. Less complex and costly implications for site.	3. Contractual issues with other landowners.					a specific site can be achieved through various means of off site generation. A review of the local area has suggested the following may be appropriate for initial investigation; • A local wind farm • A micro-hydro scheme in the weir to the East of the site at Browns Pond. • A micro-hydro scheme on the Kennett and Avon canal in Newbury. • Energy from Waste (see above)	

Payback Period Definition		
Short	0 – 5	years approximately
Medium	5 – 20	years approximately
Long	20	years or over

Documents Reviewed	
1	WYG Proposed Land Use Plan for Sandleford Park Dwg. No. HP07098
2	The South East Plan – RSS for the South East of England May 2009
3	West Berkshire District Local Plan 1991-2006 Saved Policies September 2007
4	West Berkshire LDF - Options for the Future – Sustainability Appraisal / Strategic Environmental Assessment Report April 2009
5	Quality Design – West Berkshire – SPD Part 4 – Sustainable Design Techniques

Assumptions	
1	Some form of sustainable aspirations and targets shall be applied to the site assessed through vehicles such as BREEAM and Code for Sustainable Homes etc.

Appendix B

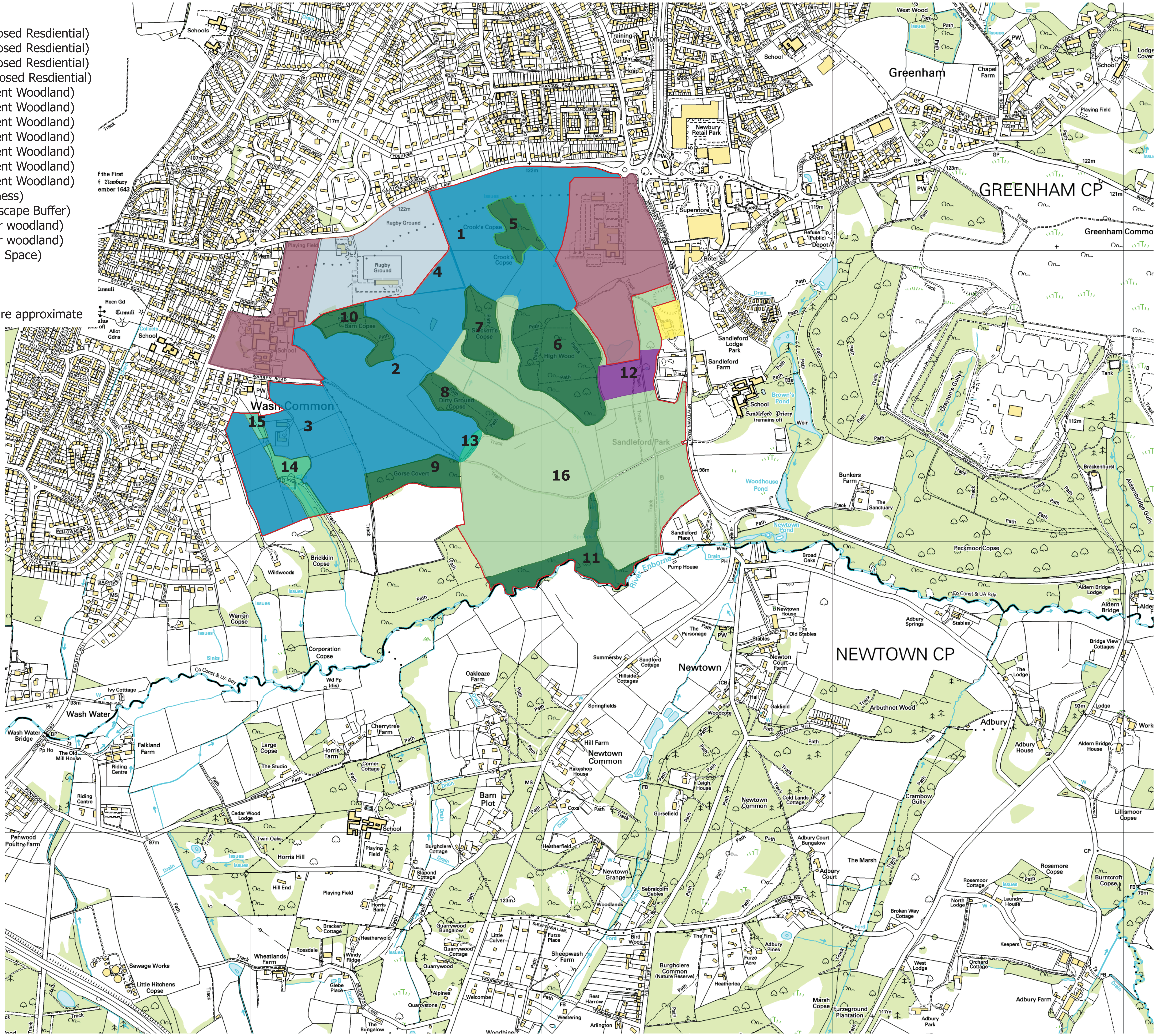
Land Use Plan

SITE AREAS

1	16.21 ha (Proposed Resdiential)
2	21.69 ha (Proposed Resdiential)
3	14.92 ha (Proposed Resdiential)
4	01.22 ha (Proposed Resdiential)
5	02.30 ha (Ancient Woodland)
6	08.93 ha (Ancient Woodland)
7	02.68 ha (Ancient Woodland)
8	02.54 ha (Ancient Woodland)
9	02.84 ha (Ancient Woodland)
10	02.59 ha (Ancient Woodland)
11	03.96 ha (Ancient Woodland)
12	02.45 ha (Business)
13	00.35 ha (Landscape Buffer)
14	01.94 ha (Other woodland)
15	00.39 ha (Other woodland)
16	45.99 ha (Open Space)

Total 131 ha

Please note all areas are approximate



- Site Area
- Proposed Residential
- Proposed Business Use
- Ancient Woodland
- Other Woodland
- Open Space / Public Park
- Education
- Rugby Club
- Household Amenity Site

Notes:

Porposed Land Use Plan
for
Sandleford Park

DWG Nº: HP07098

Drawn: LA

Checked: SG

Scale: Not to Scale

Date: 24.06.2009

This drawing is for illustrative purposes only and is subject to detailed topographical survey and site investigation, including ground conditions/ contaminents, drainage, design and planning/ density negotiation. The feasibility of the design shown, therefore, must not be relied upon. It has not been considered in respect of the CDM Regulations.

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Appendix C

Report Conditions

WYG ENGINEERING LTD

REPORT CONDITIONS

Energy & Renewables

Preliminary Discussion Document

Sandleford Park

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