

Worton Grange, Reading

Energy Statement

On behalf of **Kier Reading LLP**



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0 Executive Summary

1. A hybrid application for outline planning permission for the development of 175 new homes, including affordable housing (with all matters reserved apart from access) and full planning permission for the development of 12 commercial units to be used flexibly within Classes B1(c), B2 and B8 with ancillary retail sales to accommodate trade counters; two car showrooms with provision for MOT and servicing (Sui Generis); three retail warehouse units (Class A1); 120 bed hotel (Class C1); pub with restaurant facility (Class A4); coffee shop with drive through facility (Class A1); restaurant with drive through facility (Class A3); and bank with drive through facility (Class A2).
2. A review of relevant regulations and policy has been undertaken and shows that the key targets in relation to energy and CO₂ emissions for the proposed development are as follows:
 - Comply with Part L of the Building Regulations 2013;
 - 50% of domestic properties to achieve an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties);
 - Non-residential development to achieve a BREEAM score of 62.5%;
 - Demonstrate how consideration has been given to securing energy for the development from a decentralised energy source, including Combined Heat and Power (CHP), biomass-fuelled heating or another form of decentralised energy (unless demonstrated that the scheme is not suitable or feasible for this form of energy provision);
 - Link to existing decentralised energy provision (including a CHP plant or a district energy network) within the vicinity of the site where they exist or demonstrate why this is not feasible; and
 - Maximise the use of energy-efficiency and energy conservation measures in the development's design, layout and orientation.
3. The proposed development has been (and will continue to be as detailed design progresses) designed in accordance with the Energy Hierarchy of reducing energy demand in the first instance, using energy more efficiently and, only then, supply clean renewable energy, if required. Worton Grange will seek to maximise energy efficiency through continued careful consideration of the masterplan design, high performance building fabric and efficient building services. The Energy Statement presents a series of measures to adopt in the masterplan and individual building designs to reduce energy demand and use energy more efficiently.
4. There are no existing or proposed district energy networks in the vicinity of Worton Grange that the new buildings could connect to. Furthermore, preliminary analysis shows that Worton Grange is unlikely to be suitable for the development of a new district heating network.
5. A Renewable Energy Feasibility Study has been undertaken and shows that it is possible to assign a 'suite' of renewable and low carbon energy technologies, which could be employed at the site to achieve the targets. This suite consists of: photovoltaic panels (PV), solar water heating, air/ground source heat pumps and micro-gas CHP.
6. A Masterplan Energy Model (MEM) has been developed for Worton Grange to provide an initial assessment of predicted energy demands and associated CO₂ emissions of the predicted and occupied development. Worton Grange is predicted to have an overall energy demand of 2,840 MWh of electricity (regulated and unregulated) and 2,500 of heat (space heating and hot water). The total annual CO₂ emissions associated with the predicted energy demand are 2,010 tonnes, of which 1,040 tonnes are associated with regulated use.

7. Compliance with the energy and CO₂ targets noted in **2** will be demonstrated through full SAP and NCM for Building Control at the detailed design stage, as well as through the BREEAM strategy.

1 Introduction

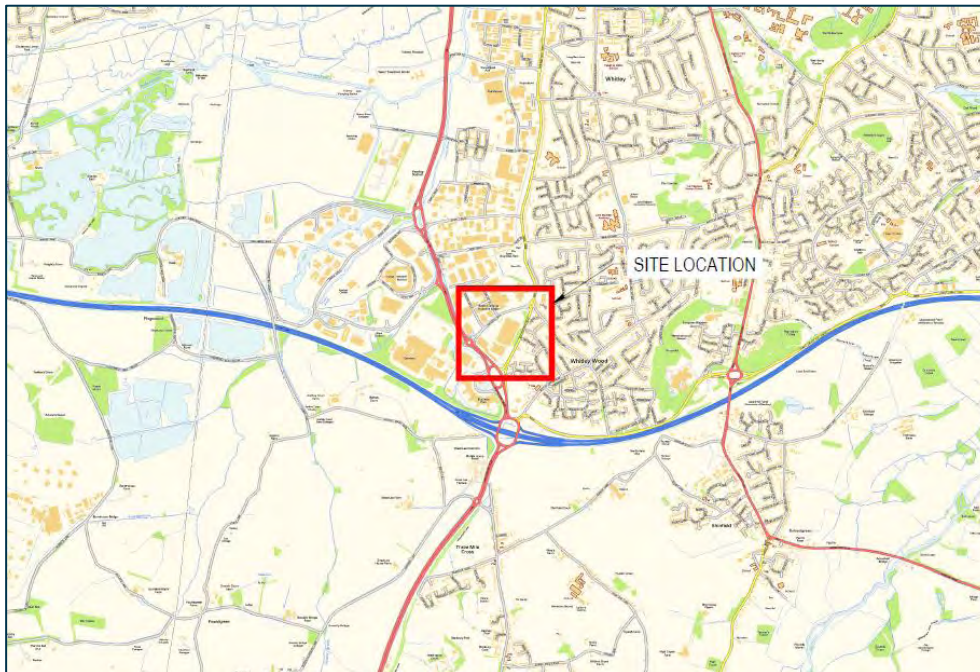
1.1 Introduction

- 1.1.1 Peter Brett Associates LLP (PBA) has been commissioned by Kier Reading LLP (Kier) to prepare an Energy Statement to support the hybrid planning application for the proposed development at Worton Grange, Reading.

1.2 Site Description

- 1.2.1 The site is approximately 8 ha in size and is located within south Reading, just north of Junction 11 of the M4 motorway.
- 1.2.2 Roads are seen to presently bound the site on all sides with Imperial Way to the north, Basingstoke Road to the south-east and the A33 (where it joins Basingstoke Road) to the south-west. The site was formally occupied by Hewlett Packard (Compaq). All buildings have since been demolished and the site is currently vacant. Landscape bunds remain in part around the perimeter of the site. There are two vehicular accesses servicing the site. The first is centrally placed on the western boundary of the site onto Imperial Way and a second is located on the southern part of the eastern boundary of the site onto Basingstoke Road.
- 1.2.3 Basingstoke Road divides the residential development of Whitley Wood and Whitley (located to the east and north-east of the site respectively) from the non-residential development (industrial, commercial, leisure and retail uses) to the west.
- 1.2.4 The site is therefore close to the strategic highway network (M4, A33 and Basingstoke Road) and within an area characterised by mixed use development including warehouses, retail, offices, leisure and residential uses. The site is well served by public transport links and there are frequent bus services to Reading Town Centre via the A33 and Basingstoke Road.
- 1.2.5 The site has an outline planning permission for two warehouse buildings (Class B8 Use) with ancillary office accommodation, granted 10 September 2014 under 131527/OUT. This permission remains extant for three years from the determination date.
- 1.2.6 Worton Grange is allocated in Reading Borough Council's (RBC) Sites and Detailed Policies Document (Adopted October 2012) as a strategic development site for residential and commercial development.
- 1.2.7 A Site Location Plan is presented in **Figure 1.1**.

Figure 1.1: Site Location Plan



1.3 Proposed Development

- 1.3.1 A hybrid application for outline planning permission for the development of 175 new homes, including affordable housing (with all matters reserved apart from access) and full planning permission for the development of 12 commercial units to be used flexibly within Classes B1(c), B2 and B8 with ancillary retail sales to accommodate trade counters; two car showrooms with provision for MOT and servicing (Sui Generis); three retail warehouse units (Class A1); 120 bed hotel (Class C1); pub with restaurant facility (Class A4); coffee shop with drive through facility (Class A1); restaurant with drive through facility (Class A3); and bank with drive through facility (Class A2).
- 1.3.2 The Proposed Site Plan is presented as **Appendix A**.

1.4 Purpose of this Energy Statement

- 1.4.1 The local planning authority, RBC, requires applicants for all major development to submit an Energy Statement with the formal planning application. This should demonstrate how the energy-related aspects of the proposed development meet the requirements of Policy CS1), and the Building Research Establishment's Environmental Assessment Method (BREEAM) standards.
- 1.4.2 The purpose of this Energy Statement is to demonstrate how Worton Grange will comply with Part L of the Building Regulations and RBC's local planning policies in relation to energy and carbon dioxide (CO₂) emissions.
- 1.4.3 It adopts an integrated approach to low carbon design principles and considers opportunities for energy efficiency in site layout, building design and contributions to CO₂ reduction from decentralised low carbon and / or renewable energy technologies.
- 1.4.4 The Energy Statement also provides a review of anticipated site energy demands and associated CO₂ emissions. Design proposals are included to achieve maximum practicable CO₂ reductions at the site.

1.5 Structure of this Energy Statement

1.5.1 The Energy Statement is structured as follows:

- Section 3: Policy and Regulation Context – Relevant local and national policy related to energy and CO₂ emissions;
- Section 4: Energy Demand Management – Proposed measures to maximise energy efficiency and reduce energy demand;
- Section 5: District Energy (including CHP) – A review of opportunities to connect to existing district energy networks in the vicinity of the site (including Combined Heat and Power (CHP) plant) or alternatively the suitability of establishing a new district energy network;
- Section 6: Clean Energy Generation – Review and identification of possible renewable and/or low carbon energy sources for Worton Grange; and
- Section 7: Development CO₂ Emissions Assessment – A prediction of site energy demands and CO₂ emissions.

1.6 Planning Submission and Design Evolution

1.6.1 This assessment has been based on our current understanding of the proposed development; and through the information set out in the following documents:

- 'Proposed Site Plan' (Drawing No. 1894-P-22 Rev P14, October 2015);
- 'Proposed Worton Grange Combined Development Layout' (Drawing no. 32618-001-SK013 Rev B, October 2015);
- 'Residential Layout-01' (Drawing No. RL-01, October 2015); and
- 'Schedule of Areas' (October 2015).

1.6.2 The Energy Statement should be reviewed and updated as necessary as the detailed design progresses or where proposals are revised.

2 Policy and Regulation Context

2.1 Introduction

- 2.1.1 Climate change has been recognised as one of the most immediate environmental challenges we currently face. Government legislation now includes numerous provisions to minimise climate change and the anticipated effects. These provisions include a reduction in the emission of greenhouse gases, including CO₂ emissions, which are to be reduced by 80% from 1990 levels by 2050. A number of interim targets have also been set.
- 2.1.2 The UK Government's international commitment (transposed into national, regional and local policy) seeks to ensure that CO₂ emissions associated with new buildings are reduced through energy demand reduction measures and the incorporation of low carbon and renewable energy technologies to deliver heat and electricity.
- 2.1.3 The need to reduce energy usage within new buildings (both residential and non-residential) is enforced through Part L of the Building Regulations (see [2.2](#)). The requirements of Part L are mandatory and should not be confused with the Code for Sustainable Homes, which stipulates mandatory CO₂ reduction requirements for certain Code 'Levels'. Furthermore, the Code has now been removed, aside from the management of legacy cases (discussed further in [2.3](#)).
- 2.1.4 Parallel to demand-side regulation, there is also a significant push in the supply of low carbon and renewable energy generation. The Energy Act 2008 provided the framework for the delivery of fiscal measures (e.g. the Renewable Obligation Order, Feed-in Tariff and Renewable Heat Incentive) to help ensure a low carbon transition for utility infrastructure.
- 2.1.5 The national policy agenda is driving both demand reduction and the generation of low carbon energy within urban developments. In addition to these substantive targets, RBC has also set planning policies to implement and shape the low carbon agenda in the area over the next eight years.
- 2.1.6 Directly relevant national policies and regulations in relation to energy and CO₂ emissions are presented in [Appendix B](#). The key aspects for this Energy Statement are summarised in the following sections.

2.2 Part L of the Building Regulations

- 2.2.1 The mandatory energy efficiency requirements of the Building Regulations are set out in Part L:
- Approved Document L1A: Conservation of fuel and power in dwellings; and
 - Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings.
- 2.2.2 The latest editions of Part L (2013) came into effect in April 2014 and require new dwellings to be on average 6% more energy-efficient than under Part L 2010, whilst new non-residential buildings need to be on average 9% more energy efficient. A new Fabric Energy Efficiency (FEE) standard was also introduced in L1A to ensure a minimum energy efficiency standard for building fabric (the longest lasting part of a home).
- 2.2.3 Planned changes to Part L in 2016 will no longer go ahead (see [7.2.3](#) in [Appendix B](#)) and therefore, at the national level, Worton Grange will be required to meet the standards of Part L 2013 only.

2.3 Removal of the Code for Sustainable Homes

- 2.3.1 The Government has now announced the conclusion of the Housing Standards Review, which aimed to simplify regulations and standards into one key set, driven by the Building Regulations. In the Deregulation Act 2015, and the accompanying Written Ministerial Statement, the Government has confirmed the following points:
- The Code has been removed, aside from the management of legacy cases;
 - Local planning authorities should no longer set policies requiring the Code in emerging local plans, neighbourhood plans or supplementary planning documents, etc.; and
 - Where there is an existing policy referencing the Code, local planning authorities may continue to apply policies that exceed the energy requirements of the Building Regulations, until the commencement of amendments to the Planning and Energy Act 2008.
- 2.3.2 This is important when considering RBC's requirement in Policy CS1 (see **Section 7.5 in Appendix B**) which requires major residential developments to achieve a minimum of 50% Code Level 4 and the remainder Code Level 3.
- 2.3.3 In accordance with the Deregulation Act, compliance with the Code for Sustainable Homes will not be pursued.

2.4 Reading Borough Council's Planning Policies

- 2.4.1 RBC's key planning documents are the Core Strategy, Sites and Detailed Policies Document and Sustainable Design and Construction Supplementary Planning Document (SPD). The relevant policies from these documents are detailed in full in **Appendix B**, including revisions to reflect the changing national policy context.
- 2.4.2 RBC's policy requirements in relation to energy and CO₂ emissions can be summarised as follows:
- Non-residential development to achieve a minimum of 50% BREEAM 'Excellent' rating and the remainder BREEAM 'Very Good';
 - Demonstrate how consideration has been given to securing energy for the development from a decentralised energy source, including Combined Heat and Power (CHP), biomass-fuelled heating or another form of decentralised energy (unless demonstrated that the scheme is not suitable or feasible for this form of energy provision);
 - Link to existing decentralised energy provision (including a CHP plant or a district energy network) within the vicinity of the site where they exist or demonstrate why this is not feasible; and
 - Maximise the use of energy-efficiency and energy conservation measures in the development's design, layout and orientation.
- 2.4.3 The Sustainable Design and Construction SPD states that, where the above split is not appropriate, major non-residential development should achieve a BREEAM score of 62.5%.
- 2.4.4 Consultation with RBC's Sustainability Team confirms that the council expects 50% of domestic properties to show an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties).

2.5 Summary of Targets for Worton Grange:

2.5.1 Based on the policy review above and in **Appendix B** the key targets for Worton Grange are as follows:

- Comply with Part L of the Building Regulations 2013;
- 50% of domestic properties to achieve an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties);
- Non-residential development to achieve a BREEAM score of 62.5%;
- Demonstrate how consideration has been given to securing energy for the development from a decentralised energy source, including CHP, biomass-fuelled heating or another form of decentralised energy (unless demonstrated that the scheme is not suitable or feasible for this form of energy provision);
- Link to existing decentralised energy provision (including a CHP plant or a district energy network) within the vicinity of the site where they exist or demonstrate why this is not feasible; and
- Maximise the use of energy-efficiency and energy conservation measures in the development's design, layout and orientation.

3 Energy Demand Management

3.1 Introduction

3.1.1 RBC's planning policies (in particular CS1: Sustainable Design and Construction and DM1: Adaption to Climate Change) state that all new development should:

- Maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
- Orientate buildings to maximise opportunities for natural heating and ventilation and to reduce exposure to wind and other elements;
- Maximise resistance and resilience to climate change (e.g. through solar shading); and
- Use trees and other planting to provide shading to amenity areas, buildings and streets.

3.1.2 This section demonstrates that Worton Grange will seek to maximise energy efficiency through careful consideration of the masterplan design, high performance fabric and efficient building services, in accordance with CS1 and DM1.

3.2 Energy Hierarchy

3.2.1 Worton Grange has been, and will continue to be, designed in accordance with following Energy Hierarchy:

- Reducing energy demand in the first instance;
- Using energy more efficiently; and
- Only then, supplying clean renewable energy where appropriate.

3.2.2 The Energy Hierarchy is illustrated in **Figure 3.1** below. **Figure 3.2** shows basic masterplan principles to reduce energy demand.

Figure 3.1: The Energy Hierarchy in Urban Development

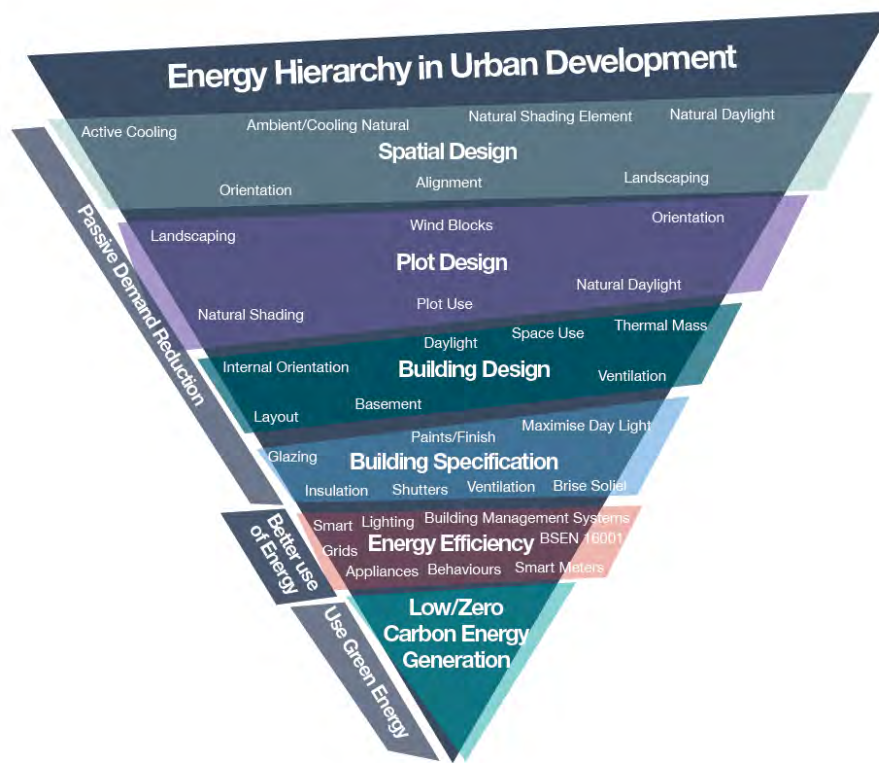
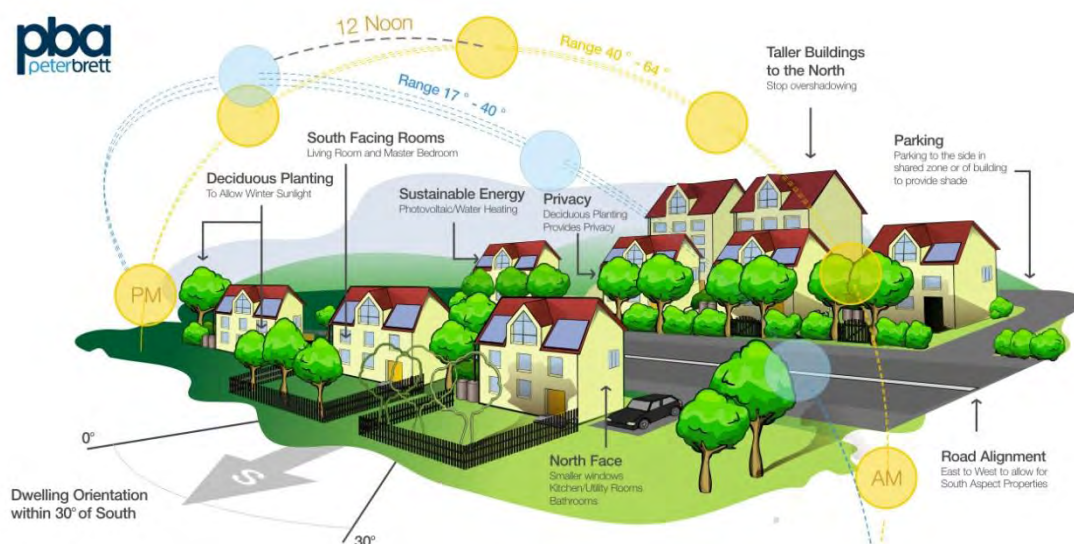


Figure 3.2: Masterplan design principles to reduce energy demand



- 3.2.3 To meet the first principles of the hierarchy (i.e. passive demand reduction) it is important to consider passive design principles within the spatial planning of the masterplan, green infrastructure provision and development context (including the anticipated impacts of climate change). These issues do not contribute to the CO₂ emissions reduction calculations under Part L of the Building Regulations, but can play an extremely large part in reducing a development's energy demands.

3.3 Masterplan Design Principles to Reduce Energy Demand

- 3.3.1 The following design principles have been considered within the masterplan. Where appropriate, these will be included in the scheme as the design progresses (especially within the residential portion):
- Optimisation of building orientation to take advantage of south-facing aspects for passive solar gains and roof-mounted renewables;
 - Selection of plot layout and building location to facilitate air movement and enhance natural ventilation;
 - Incorporation of green open spaces to provide evaporative cooling at night, helping to reduce the heat island effect; and
 - The inclusion of tree corridors throughout the site, connecting different land parcels, thus providing naturally shaded corridors.
- 3.3.2 Continued consideration of the spatial layout and plot design in this manner could bring about significant CO₂ savings.

3.4 Building Design Principles to Reduce Energy Demand and Use Energy More Efficiently

- 3.4.1 The Energy Hierarchy requires that measures are adopted in building design to reduce energy demand requirements from the use of buildings. These measures can be split into two categories as 'passive' and 'active' measures.
- 3.4.2 The passive measures are design features, which can include building orientation, appropriate internal layouts and building fabric selection, that inherently reduce the buildings' energy requirements. The active measures are building services design features that will increase the efficiency of the energy used, and therefore also reduce the energy demand requirements.
- 3.4.3 The following passive design measures will be incorporated into building designs, where appropriate:
- Careful selection of building fabric parameters to limit internal heat gains and reduce cooling demands;
 - Use of thermal mass to support "free cooling" in summer months using night-time air purging;
 - Optimising glazed areas to take advantage of natural daylight and passive solar gains, whilst managing overheating;
 - Roof lights for natural daylighting;
 - Providing passive shading to avoid overheating (e.g. strategic planting of trees and brise soleil);

- Locating plant rooms away from southern elevations to avoid excessive heat gain and to allow maximum plant efficiency; and
 - Knowledge transfer to residents and site users through training, building user guides and home user guides.
- 3.4.4 It is anticipated that trickle vents will be used in dwellings, instead of openable windows, for acoustic reasons.
- 3.4.5 The following active building services design measures will be considered in building design:
- Mechanical Ventilation with Heat Recovery (MVHR) systems;
 - Fitting of water-efficient devices, including flow restrictors on taps;
 - All pumps and fans fitted with variable speed drives;
 - Use of hydraulic lifts where possible;
 - Selection of energy efficient equipment and white goods;
 - Commissioning process to adhere to CIBSE requirements with training provided to facilities management teams and building operatives;
 - Use of energy display devices to encourage behavioural change;
 - Time and thermostat control of hot water;
 - Controls to optimise and compensate for heat variations; and
 - Zonal control of heating supply (e.g. via a Building Management System (BMS)).
- 3.4.6 The above lists of passive and active measures are not exhaustive, and will be considered in more detail as the design of the development progresses.
- 3.4.7 A combination of passive and active measures will give very well insulated, airtight buildings with appropriate and efficient building services. It is important to emphasise the benefits of optimising the long-lasting energy performance of buildings through fabric improvements, before employing low carbon and renewable energy technologies on site.

3.5 BREEAM Requirements

- 3.5.1 In accordance with the BREEAM strategy for the site, the following energy efficiency measures will be adopted:

Energy Efficient Lighting

- 3.5.2 All internal lighting will be low energy (e.g. LED, T5 etc.). Where possible, the buildings will be designed to operate without the need for external lighting. Where external lighting is provided the fittings will be energy efficient (e.g. not less than 60 luminaire lumens per circuit Watt). External lighting will be automatically controlled to prevent operation during daylight hours and use presence detection systems in areas of intermittent pedestrian traffic (e.g. Passive Infra-red (PIR) and daylight cut-off sensors).

Energy Monitoring

- 3.5.3 Energy metering systems will be installed in commercial buildings to monitor major energy consuming systems. The energy consuming systems in buildings with a total floor area of 1000 m² will be metered using an appropriate energy monitoring and management system. The systems in smaller buildings will be metered with either an energy monitoring and management system or with separate accessible energy sub-meters with pulsed or other open protocol communications outputs. This is to enable future connection to an energy monitoring and management system. The end energy consuming uses will be identifiable to the building users (e.g. through labelling or data outputs).
- 3.5.4 Monitoring systems covering a significant majority of the energy supply to tenanted areas or, in the case of single occupancy buildings, relevant function areas or departments within the buildings/units, will also be provided.

Energy Efficient Cold Storage

- 3.5.5 Refrigeration systems in food retail buildings will be designed, installed and commissioned as follows:
- In accordance with the Code of Conduct for carbon reduction in the refrigeration retail sector and BS EN 378-2 Refrigeration systems and heat pumps – Safety and environmental requirements; and
 - Using robust and tested refrigeration systems/components (e.g. those included in the Enhanced Capital Allowance Energy Technology Product List).
- 3.5.6 The installed refrigeration systems will demonstrate a saving in indirect greenhouse gas emissions (CO₂ eq.) over the course of the operational life.

Energy Efficient Transportation Systems

- 3.5.7 In the hotel and large retail units, an analysis of the transportation demand and usage patterns for the buildings will be carried out to determine the optimum number and size of lifts and escalators. The transportation systems with the lowest energy consumption will be specified.
- 3.5.8 Lifts will be fitted with the following energy efficient features:
- The lifts operate in standby condition during off-peak periods;
 - The lift car lighting and display lighting provides an average lamp efficacy (across all fittings) of > 55 lumens/circuit Watt; and
 - The lift uses a drive controller capable of variable speed, variable-voltage, and variable-frequency control of the motor drive.
- 3.5.9 Escalators (or moving walkways) where provided will comply with at least one of the following:
- It is fitted with a load-sensing device that synchronises motor output to passenger demand through a variable speed drive; or
 - It is fitted with passenger-sensitive device for automated operation (auto walk), so the escalator operates in standby mode when there is no passenger demand.

4 District Energy (including CHP)

4.1 Introduction

- 4.1.1 This section provides a review of opportunities to connect to existing district energy networks in the vicinity of the site (including CHP plant) or alternatively the suitability of establishing a new district energy network to serve Worton Grange. This is in accordance with *Policy DM2: Decentralised Energy* contained in the Sites and Detailed Policies Document (see **Appendix B**).

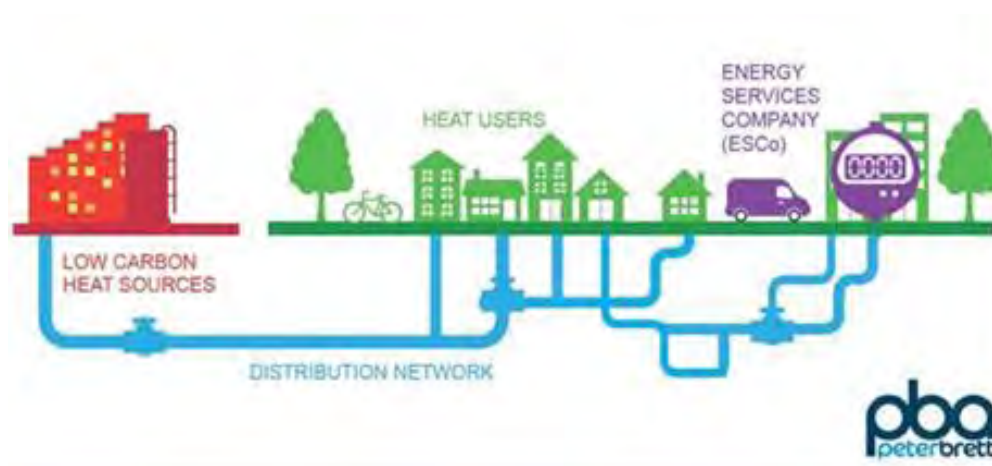
4.2 Background to District Energy

- 4.2.1 District energy (more widely referred to as district heating) is a means of delivering heat, in the form of hot water or steam, to multiple buildings from a central energy centre. There are three basic elements in a district heating system:

- Production – An energy centre containing the heat sources;
- Delivery – A hydraulic interface for each end-user; and
- Distribution – An insulated pipe network connecting the energy centre with the end-users' hydraulic interface units (HIU).

- 4.2.2 The energy centre houses the heating plant, which can include a range of technologies and fuels such as gas boilers, biomass boilers and CHP. Hot water from the energy centre is pumped through the pipe network to the individual buildings. In each building, heat is conveyed via the HIU to the central heating system and to the hot water taps. Sometimes an Energy Services Company (ESCo) is established to manage the distribution and sale of heat. District heating scheme components are illustrated in **Figure 4.1** below:

Figure 4.1: District heating scheme components



- 4.2.3 When considering a district heating approach, it is important to consider the balance between building energy efficient buildings (with a very low heat demand), and establishing a utility that is dependent on selling high volumes of heat in order to be viable.
- 4.2.4 District heating is most resource-efficient in developments with high baseload heat demands. Typically this means residential developments of very high densities (in excess of 200

dwellings/ha) or other heat-intensive uses such as industrial manufacturing, hospitals or swimming pools. Modern, energy-efficient and low density developments built to Part L 2013 standards usually have a very limited heat demand.

- 4.2.5 Heat losses from distribution pipes are also an important environmental consideration (heat losses tend to be higher in low density developments with longer heat main runs).
- 4.2.6 Establishing a district heating network requires major capital investment, but the costs vary considerably depending on the project. A major driver of the high costs of district heating is the network of hot pipes – this is quoted as up to £510 per metre¹. This is another reason why district heating is best suited to high density developments with shorter heat main runs.
- 4.2.7 Heat network viability is established through the relationship of capital infrastructure costs and returns from heat sales (including standing charges and a price/kWh of heat). District heat networks are not regulated by the Office of Gas and Electricity Markets (OFGEM). Therefore, there is a risk of end-users experiencing higher prices compared to a standard gas boiler approach, in order for the developer to recover the high capital costs of installation. However, it is the intention of the emerging Heat Trust to establish a framework to protect consumers connected to heat networks.

4.3 Connection to Existing District Energy Networks

- 4.3.1 There are no existing or proposed district energy networks in the vicinity of the Worton Grange site that the new buildings could connect to.

4.4 Site-Wide District Energy Network at Worton Grange

- 4.4.1 The proposed development at Worton Grange does not include any heat-intensive uses (such as industrial manufacturing) that could act as ‘anchor loads’ to facilitate the development of a heat network.
- 4.4.2 At this stage, there is limited information about the design of the residential portion of the site for the outline application. However, there is unlikely to be sufficient dwelling densities to create a suitable heat demand for a resource-efficient district heating scheme.
- 4.4.3 Furthermore, in accordance with the Energy Hierarchy (**Figure 3.1**), all buildings will be designed to a high fabric energy efficiency standard to comply with Part L 2013. Therefore, there is likely to be a very low heat demand across the site.
- 4.4.4 In 2010, TV Energy carried out a feasibility study on behalf of RBC as part of the Climate Berkshire initiative. This provided an economic assessment of district energy for significant proposed redevelopment sites within the Reading borough (including Worton Grange). This showed that the total capital costs of a district heating scheme for the site (as well as the Berkshire Brewery) would be in the region of £6.5 m. The feasibility study concluded that, in order to be financially viable, 60 – 75% of total capital costs would need to be funded by a body external to the EScO (e.g. grant funding). No such funding is available at present.
- 4.4.5 Therefore, at this stage, it is not considered viable to develop a new district heat network at Worton Grange.

¹ DECC (2015) *Assessment of the costs, performance, and characteristics of UK heat networks*.

5 Clean Energy Generation

5.1 Introduction

- 5.1.1 This section provides a review of possible renewable and low carbon energy sources for Worton Grange in accordance with *Policy DM2: Decentralised Energy* of the Sites and Detailed Policies Document.
- 5.1.2 A full Renewable Energy Feasibility Study has been undertaken and is presented in **Appendix D**.

5.2 Summary of Renewable Energy Feasibility Study

- 5.2.1 A summary of the Renewable Energy Feasibility Study is presented in **Table 5.1** below:

Table 5.1: Renewable Energy Feasibility Study Summary

Technology	Technological risk	Energy availability	Potential contribution	Suitable?	Comment
Photovoltaic panels (PV)	Low	Intermittent	kW (site total to MW)	Potential	Subject to the availability of suitable roof space, landscape/visual impacts and structural engineering calculations.
Solar water heating (or solar thermal)	Low	Intermittent	kW	Potential	Could be used as part of a 'suite' of effective solutions on suitable roof spaces. Subject to visual impacts and structural engineering calculations.
Air source heat pumps	Low	Baseload	kW	Potential	Could be used as part of a 'suite' of effective solutions, subject to detailed building design and noise/visual impacts.

Ground source heat pumps	Low	Baseload	kW	Potential	Subject to space for infrastructure, final building design and suitability of site geology. Potential to utilise building piles.
Wind turbines (MW-scale)	Low	Intermittent	MW	No	Inappropriate in an urban residential setting due to significant visual (and noise) impacts.
Wind turbines (micro kW-scale)	Medium	Intermittent	kW	No	Performance affected by high turbulence in built-up areas. Structural vibration challenges.
Hydropower	Low	Baseload	kW	No	No suitable watercourse
Biomass boilers (individual building scale)	Low	As required	kW	No	Adverse air quality impacts.
Biomass heat, power and CHP through a district heat network	Low	Baseload	kW to MW	No	Adverse air quality impacts. Also see Section 4 .
Fossil fuel CHP in a district heat network	Low	Baseload	kW to MW	No	See Section 4 .

Micro-gas CHP	Low	Baseload	kW	Potential	Potential to use in certain buildings (e.g. apartment blocks), subject to further detailed building design.
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- 5.2.2 Based upon the location of the site and the information currently available regarding the proposed development, it is possible at this stage to assign a 'suite' of potential renewable and low carbon energy sources to meet the targets noted in 2.5. This suite is comprised of PV, solar water heating, air/ground source heat pumps and micro-gas CHP.
- 5.2.3 The options presented here are based upon current planning requirements and Building Regulations, as well as a prediction of the Government's requirements over the next ten years. As this is a large development that will progress over many years, the energy strategy needs to be flexible and able to respond to regulatory changes, market forces and technological advances.
- 5.2.4 The suitability of the various technologies should continue to be reviewed as the detailed design progresses. This is to ensure compatibility with detailed building designs and the mechanical and electricity strategy.

6 Development CO₂ Emissions Assessment

6.1 Assessment Methodology

- 6.1.1 The Government-approved methodologies for assessing CO₂ emissions in order to demonstrate compliance with Part L of the Building Regulations in England are:
- The Standard Assessment Procedure (SAP) for the energy rating of dwellings; and
 - The National Calculation Methodology (NCM) for buildings other than dwellings.
- 6.1.2 At this stage in the development process it is not possible to undertake SAP or NCM calculations because detailed design information is not available.
- 6.1.3 Instead, a Masterplan Energy Model (MEM) model has been developed to establish the predicted energy demand of Worton Grange, using PBA's in-house software and the development schedule detailed in 1.3. The model uses Chartered Institute of Building Services Engineers (CIBSE) benchmark data and the Building Research Establishment's (BRE) Domestic Energy Model (BREDEM) methodology.
- 6.1.4 Energy demand is split into regulated and unregulated demand where:
- Regulated energy is heat or power for hot water, space heating/cooling, lighting and associated pumps and fans (this energy is regulated through Part L); and
 - Unregulated energy is all other energy uses such as cooking, electrical appliances and other small power.
- 6.1.5 The MEM model predicts the regulated and unregulated energy demands of the site by month of year and hour of day, as well as the associated CO₂ emissions. All buildings have been modelled to Part L 2013 standards.
- 6.1.6 The methodology and results of MEM are provided in full in **Appendix E** and summarised in the sections below.

6.2 Results for Non-residential Buildings (Full Application)

- 6.2.1 The MEM shows that the predicted energy demand of the non-residential portion of Worton Grange (full application) is approximately 2,260 MWh of electricity (regulated and unregulated) and 1,510 MWh of heat (space heating and hot water).
- 6.2.2 The total annual CO₂ emissions associated with the predicted energy demand are approximately 1,500 tonnes, of which 760 tonnes are associated with regulated use.

6.3 Results for Residential Buildings (Outline Application)

- 6.3.1 The preliminary MEM for the residential development (outline application) shows that the predicted energy demand is approximately 580 MWh of electricity (regulated and unregulated) and 990 MWh of heat (space heating and hot water).
- 6.3.2 The total annual CO₂ emissions associated with the predicted energy demand are approximately 510 tonnes, of which 280 tonnes are associated with regulated use.

6.4 Compliance with the Energy and CO₂ Targets

- 6.4.1 Compliance with the energy and CO₂ targets noted in 2.5 will be demonstrated through full SAP and NCM for Building Control at the detailed design stage, as well as through the BREEAM assessment processes, as applicable.
- 6.4.2 As noted in 2.5, RBC requires 50% of domestic properties to achieve an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties).
- 6.4.3 Preliminary analysis of the site plan shows that approximately 85% of detached, semi-detached and terrace houses are currently designed with south facing roof space or roof space facing within 45° east/west of south. It is not yet known if the flat blocks will have pitched or flat roofs, so they have been excluded from this assessment.
- 6.4.4 Assuming each house with suitable roof space is specified with a 2 kWp array, the PV GIS online solar electricity database² shows that each system would generate approximately 1,860 kWh/year. This would produce a total site-wide generation of 139,500 kWh/year (or 139.5 MWh/year). Using the emissions factor of 0.519 kg CO₂/kWh from SAP 2012, this gives a total CO₂ saving of 72 tonnes CO₂/year.
- 6.4.5 The estimated total regulated carbon emissions of the residential scheme have been predicted as 280 tonnes of CO₂/year. There is therefore potential for the residential development to contribute approximately a 25% saving of regulated CO₂ emissions. Details of the deployment of solar PV cells will be provided with the reserved matters application for each dwelling and associated SAP assessments for building control.

² <http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php>

7 Conclusions

- 7.1.1 A hybrid application for outline planning permission for the development of 175 new homes, including affordable housing (with all matters reserved apart from access) and full planning permission for the development of 12 commercial units to be used flexibly within Classes B1(c), B2 and B8 with ancillary retail sales to accommodate trade counters; two car showrooms with provision for MOT and servicing (Sui Generis); three retail warehouse units (Class A1); 120 bed hotel (Class C1); pub with restaurant facility (Class A4); coffee shop with drive through facility (Class A1); restaurant with drive through facility (Class A3); and bank with drive through facility (Class A2).
- 7.1.2 The key policy targets for Worton Grange in relation to energy and CO₂ emissions are:
- Comply with Part L of the Building Regulations 2013;
 - 50% of domestic properties to achieve an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties);
 - Non-residential development to achieve a BREEAM score of 62.5%;
 - Demonstrate how consideration has been given to securing energy for the development from a decentralised energy source, including Combined Heat and Power (CHP), biomass-fuelled heating or another form of decentralised energy (unless demonstrated that the scheme is not suitable or feasible for this form of energy provision);
 - Link to existing decentralised energy provision (including a CHP plant or a district energy network) within the vicinity of the site where they exist or demonstrate why this is not feasible; and
 - Maximise the use of energy-efficiency and energy conservation measures in the development's design, layout and orientation.
- 7.1.3 In order to meet the above targets, Worton Grange will be developed in accordance with the Energy Hierarchy and will seek to maximise energy efficiency through careful consideration of the masterplan design, high performance fabric and efficient building services.
- 7.1.4 There are no existing or proposed district energy networks in the vicinity of Worton Grange that the new buildings could connect to. Furthermore, preliminary analysis shows that Worton Grange is unlikely to be suitable for the development of a new district heating network.
- 7.1.5 Based upon the site's location and the current development proposals, it is possible to assign a 'suite' of potential renewable and low carbon energy sources which could be employed at the site to meet the targets, if required. This includes photovoltaic panels, solar water heating, air/ground source heat pumps and micro-gas CHP.
- 7.1.6 The suitability of these energy technologies, including district heating, should continue to be reviewed as the detailed design progresses, to ensure compatibility with detailed building designs and the mechanical and electrical strategy.
- 7.1.7 Compliance with the energy and CO₂ targets noted in 7.1.2 will be demonstrated through full SAP and NCM for Building Control at the detailed design stage, as well as through the BREEAM assessment processes, as applicable.

Appendix A Proposed Site Plan



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the Architect.
Where applicable this drawing is to be read in conjunction with the
Consultants' drawings.

REV	DESCRIPTION	DATE	AUTHOR	CHK'D
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- KEY**
- Site Boundary
 - Built Form
 - Public open Space
 - Gardens
 - Pond / Swale
 - Residential Parking Courts
 - Commercial Parking Courts
 - Commercial Driveways
 - Clear zone to accommodate future MRT



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PROJECT
Worton Grange
Reading

DRAWING
Illustrative Masterplan - 01

SCALE	DATE	AUTHOR	CHK'D
1:500 @ A0	29/10/15	CW/hm	CW

JOB NO.	DRAWING NO.	REV
PERS150509	MP-01	-



Clear zone to accommodate future MRT shown dashed.

Site Under Development

Residential Site

For details of outline proposals refer to drawings prepared by
Thrive Architects Ltd

- NOTES
1. Saunders Architects LLP
 2. Figured dimensions must be taken in preference to scaled dimensions and site dimensions are to be checked before work is put in hand.
 3. This drawing has been compiled from Ordnance Survey data © Crown Copyright, information from Peter Brett Associates LLP, Reading Drawing No.'s 28791/001/002, dated 06.01.14 & 326818-001-003, dated 18.08.15. Topographical Survey data provided by Greenhatch Group, Derby Drawing No. 21122OGL Rev. 0, dated 06.14.11.
 4. Landscape proposals shown are indicative only for full details see Peter Brett Associates LLP drawings.

- 16.10.15
Imperial Way Island exit to Worton Drive adjusted following information received from PBA, and Valet Building added and minor parking adjustments to Car Showroom 2 layout.
- 07.10.15
Trade City parking and road markings revised following information received from PBA, 07.10.15.
- 06.10.15
Red Line revised to suit additional proposed highway works as PBA dwg. 32618-001-004 Rev. C.
- 02.10.15
Road layout to Residential Site amended following receipt of PBA dwg. 32618-001-004 Rev. C. Hotel layout and car park revised following Tenant comments. Unit E layout and car park revised following design development. Indicative trees removed pending confirmation of final landscaping scheme.
- 18.09.15
P8 PRELIMINARY ISSUE 8 Red line boundary revised.
- 17.09.15
P7 PRELIMINARY ISSUE 7 Red line boundary revised.
- 11.09.15
P6 PRELIMINARY ISSUE 6 Commercial plot cycle parking provision added and Trade City parking amended following information received from Transport Consultant. Revised Hotel layout added. Indicative sub-stations added for confirmation.
- 09.09.15
P5 PRELIMINARY ISSUE 5 Car Showroom & Trade City Plots revised following Client confirmation of Sketch Scheme layout and tenant drawing.
- 03.09.15
P4 PRELIMINARY ISSUE 4 Indicative tree planting added.
- 02.09.15
P3 PRELIMINARY ISSUE 3 Additional colour and detail added.
- 28.08.15
P2 PRELIMINARY ISSUE 2 Car Showroom & Trade City Plots added following Client confirmation of Scheme layout and dwg. 1894 - SK - 189.
- 25.08.15
P1 PRELIMINARY ISSUE 1

- P14 PRELIMINARY ISSUE 14 28.10.15
Minor amendment to Coffee Shop refuse enclosure following comments received from Tenant. Drainage ditch revised following information received from P.C.S., 28.10.15.
- P13 PRELIMINARY ISSUE 13 27.10.15
Coffee Shop layout revised following information received from Tenant. New footpath to Basingstoke Road added following receipt of information from PBA.

AMENDMENTS CONTINUED



**SAUNDERS
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Saunders Architects is a trading name of Saunders Architects LLP
Registered in England & Wales Registered No. OC307146

PROPOSED SITE PLAN

Proposed Development at
Worton Grange, Imperial Way
READING
for Kier Reading LLP

SCALE 1:500 @ A0
Drawn: RC Date: Aug. 2015
Drawing No. 1894 - P - 22 Revision: P14

NOTES

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Where applicable this drawing is to be read in conjunction with the Consultants' drawings.

REV	DESCRIPTION	DATE	AUTHOR	CHK'D

KEY

- Site Boundary
- Residential Buildings
- Public open Space
- Gardens
- Parking Courts
- Tarmac





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PROJECT

Worton Grange
Reading

DRAWING

Residential Layout -01

SCALE	DATE	AUTHOR	CHK'D
1:500 @ A1	29/10/15	CW/hm	-

JOB NO.	DRAWING NO.	REV
PERS150509	RL-01	-

Appendix B Energy Policy and Regulation

7.2 Building Regulations Approved Document L: Conservation of Fuel and Power

- 7.2.1 The energy efficiency requirements of the Building Regulations are set out in Part L of Schedule 1 of the Building Regulations and in a number of specific building regulations. Approved Document L1A sets out the requirements for conservation of fuel and power in new residential buildings, and L2A for new non-residential buildings.
- 7.2.2 The current edition of L1A (2013) came into effect on 6 April 2014. This strengthens the requirements of Part L1A to deliver 6% CO₂ savings across the new-build home mix relative to Part L 2010 and also introduces a Fabric Energy Efficiency (FEE) target to ensure a minimum energy efficiency standard for building fabric (the longest-lasting part of a dwelling). The current edition of L2A 2013 strengthens the previous requirements to deliver 9% CO₂ savings across the new non-residential building mix.
- 7.2.3 In their Productivity Plan 'Fixing the foundations: Creating a more prosperous nation' (July 2015) has confirmed that the planned changes to Part L in 2016 will not go ahead. It does not intend to proceed with the proposed increase in on-site energy efficiency standards, 'Zero Carbon Homes' or the 'Allowable Solutions' carbon offsetting scheme.

7.3 Code for Sustainable Homes

- 7.3.1 The Code for Sustainable Homes (Code) (established in 2007) is an environmental assessment method for rating and certifying the performance of new homes. It is a Government owned national standard intended to encourage continuous improvement in sustainable home building. The Code uses a one to six star rating system to communicate the overall sustainability performance, and sets minimum standards for energy and water use at each level.
- 7.3.2 The Deregulation Act (March 2015) and accompanying Written Ministerial Statement confirmed that:

"Local planning authorities should not set in their emerging Local Plans, neighbourhood plans, or supplementary planning documents, any additional local technical standards or requirements relating to the construction, internal layout or performance of new dwellings. This includes any policy requiring any level of the Code for Sustainable Homes to be achieved by new development; the government has now withdrawn the code, aside from the management of legacy cases."

"Where there is an existing plan policy which references the Code for Sustainable Homes, authorities may continue to apply a requirement for a water efficiency standard equivalent to the new national technical standard, or in the case of energy . . . [local planning authorities] will continue to be able to set and apply policies in their local area which require compliance with energy performance standards that exceed the energy requirements of Building Regulations, until commencement of amendments to the Planning and Energy Act 2008".

- 7.3.3 Therefore, the Code is no longer applicable to Worton Grange, Reading.

7.4 Building Research Establishment's Environmental Assessment Method (BREEAM)

- 7.4.1 The Building Research Establishment's Environmental Assessment Method (BREEAM) is the world's first sustainability rating scheme for the built environment. The latest version,

BREEAM UK New Construction 2014, opened for new construction project registrations on 27 May 2014. The aims of BREEAM are to:

- Mitigate the life cycle impacts of buildings on the environment;
- Enable buildings to be recognised according to their environmental benefits;
- Provide a credible environmental label for buildings; and
- To stimulate demand and create value for sustainable buildings, building products and supply chains.

7.4.2 BREEAM assesses the sustainability of a building under ten sustainability topics as follows: Management, Health and Well-being, Energy, Transport, Water, Materials, Waste, Land Use and Ecology, Pollution and Innovation. A building is given a rating ranging from 'Pass' to 'Outstanding'.

7.5 Reading Borough Council's Planning Policies

Adopted Core Strategy (January 2008, Altered January 2015)

7.5.1 Policy CS1: Sustainable Construction and Design is the key policy in relation to energy and carbon dioxide (CO₂) emissions in the Adopted Core Strategy. The Sustainable Design and Construction Supplementary Planning Document (SPD) has amended the requirements of CS1 to reflect the changing national policy context. This includes removal of the former requirement to offset at least 20% of predicted CO₂ emissions from the estimated energy usage of the completed and occupied development.

7.5.2 The amended requirements of CS1, directly relevant to this Energy Statement, are summarised as follows:

- Major residential development, including flats, to achieve a minimum of 50% Code Level 4 and the remainder Code Level 3 (note: the Code has been removed);
- Major non-residential development to achieve a minimum of 50% BREEAM 'Excellent' rating and the remainder BREEAM 'Very Good'; and
- All development to maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand.

7.5.3 The Sustainable Design and Construction SPD states that, where the above split is not appropriate, major non-residential developments should achieve a BREEAM score of 62.5%.

Adopted Sites and Detailed Policies Document (October 2012, Altered January 2015)

7.5.4 Policy DM1: Adaption to Climate Change requires all developments to demonstrate how they will be designed to incorporate measures to adopt to climate change, including:

- New buildings shall be orientated to maximise the opportunities for both for natural heating and ventilation and reducing exposure to wind and other elements;
- Proposals involving new buildings shall demonstrate how they have been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, etc.; and

- Use of trees and other planting, where appropriate as part of the landscaping scheme, to provide shading to amenity areas, buildings and streets.
- 7.5.5 Policy DM2: Decentralised Energy requires major developments (any development of more than 20 dwellings and/or non-residential development of over 1,000 m²) to demonstrate how consideration has been given to securing energy for the development from a decentralised energy source, including Combined Heat and Power (CHP), a biomass-fuelled heating scheme or another form of decentralised energy provision within the site, unless it can be demonstrated that the scheme is not suitable or feasible for this form of energy provision.
- 7.5.6 Furthermore, DM2 states that where there is existing decentralised energy provision, including a CHP plant or a district energy network, within the vicinity of the application site, further developments of over 10 dwellings or non-residential development of 1,000 m² will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.
- 7.5.7 Policy SA2a: Worton Grange allocates Worton Grange as a strategic development site. It states that proposals at the site must secure energy from a decentralised energy source.

Consultation with RBC Sustainability Team

- 7.5.8 Consultation with RBC's Sustainability Team confirms that the council expects 50% of domestic properties to show an improvement of at least 19% over Part L 2013 (or a 9.5% improvement across all domestic properties).

Appendix C BREEAM Low and Zero Carbon Feasibility Study

Worton Grange, Reading

Low and Zero Carbon (LZC) Feasibility
Study for Worton Grange, Reading

On behalf of **Kier Reading LLP**



Project Ref: 32618-LZC | V2 | Date: October 2015



Document Control Sheet

Project Name: Worton Grange, Reading

Project Ref: 32618

Report Title: Low and Zero Carbon (LZC) Feasibility Study for Worton Grange, Reading

Doc Ref: 2618-LZC V2

Date: October 2015

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Approved by:	-	-	-	-
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
V1	07/09/2015	For BREEAM	MD	JR	-
V2	30/10/2015	Final	MD	JR	

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1 Executive Summary

- 1.1.1 This Low and Zero Carbon (LZC) Feasibility Study has been produced in relation to criteria contained within BREEAM New Construction 2014 Ene 4. The purpose of this report is to establish which LZC technologies are feasible for incorporation at Worton Grange, Reading.
- 1.1.2 A review of all potentially available energy generation technologies has been undertaken and is presented in **Section 3**. A summary of these findings are provided below in **Table 1.1**.

Table 1.1: Summary Review of LZC Energy Technology Options for Worton Grange, Reading

Technology	Comment	Feasibility
Solar photovoltaics (PV)	The development should offer opportunity for solar PV installation, if required. Where possible, panels should be optimally positioned to face south with no shading. A frame system can be used to optimise PV performance on flat roofs, by adjusting tilt/orientation.	Yes
Solar hot water	Feasible, though depends on other LZC technologies, in particular solar PV which would compete with PV for roof space. Solar water heating is not compatible with district heating, as it requires a hot water cylinder within the building.	Yes
Air source heat pumps	Air source heat pumps are likely to be feasible, subject to detailed building designs.	Yes
Fossil CHP (including micro-gas CHP)	No heat-intensive uses (such as industrial manufacturing) that could act as 'anchor loads' to facilitate the development of a heat network. Site-wide heat demand not sufficient for district heating. Micro-gas CHP may be suitable in certain buildings, subject to detailed design.	Yes – micro-gas CHP only
Ground source heat pumps	The masterplan must allow space for the installation of horizontal collector loops or a network of boreholes. Potential to utilise building piles for collector loops (subject to structural design).	Yes
Biomass heating	Biomass plant is deemed impractical for this development due to a combination of high emissions, the large amount of space required for plant and fuel storage, and the high number of vehicle movements required to supply sufficient fuel volumes. It is also likely to be problematic in terms of air quality impacts. Site-wide heat demand not sufficient for district heating.	No
Wind Energy	Wind turbines are not considered appropriate within an inner-city, urban residential setting due to visual and noise impacts. Building-mounted turbines are yet to deliver long-term reliable performance due to high turbulence in built-up areas and structure vibration issues.	No
Hydropower	There is no suitable watercourse in the vicinity of the site.	No

- 1.1.3 A number of technologies are considered not feasible due to reasons of site location, space, environmental impact or economics, generally related to this being an urban site. These include large-scale fossil fuel CHP, biomass heating, wind energy and hydropower.
- 1.1.4 The study shows the following technologies are feasible at the site, subject to detailed building design: solar PV, solar water heating, air/ground source heat pumps and micro-gas CHP.

2 Introduction

2.1 Background

2.1.1 This Low and Zero Carbon (LZC) Feasibility Study has been produced in relation to criteria contained within BREEAM New Construction 2014 Ene 4.

2.1.2 The purpose of this report is to establish which LZC technologies are feasible for incorporation at Worton Grange, Reading. This feasibility will be based on the following criteria:

- Energy generated from LZC energy source per year;
- Carbon dioxide (CO₂) savings from LZC energy source per year;
- Life cycle cost of the potential specification, accounting for payback;
- Local planning criteria, including land use and noise;
- Feasibility of exporting heat/electricity from the system;
- Any available grants;
- All technologies appropriate to the site and energy demand of the development;
- Reasons for excluding other technologies; and
- Where appropriate to the building type, connecting the proposed building to an existing local community CHP system or source of waste heat or power OR specifying a building/site CHP.

2.2 Site Description

2.2.1 The site is approximately 8 ha in size and is located within south Reading, just north of Junction 11 of the M4 motorway.

2.2.2 Roads are seen to presently bound the site on all sides with Imperial Way to the north, Basingstoke Road to the south-east and the A33 (where it joins Basingstoke Road) to the south-west. The site was formally occupied by Hewlett Packard (Compaq). All buildings have since been demolished and the site is currently vacant. Landscape bunds remain in part around the perimeter of the site. There are two vehicular accesses servicing the site. The first is centrally placed on the western boundary of the site onto Imperial Way and a second is located on the southern part of the eastern boundary of the site onto Basingstoke Road.

2.2.3 Basingstoke Road divides the residential development of Whitley Wood and Whitley (located to the east and north-east of the site respectively) from the non-residential development (industrial, commercial, leisure and retail uses) to the west.

2.2.4 The site is therefore close to the strategic highway network (M4, A33 and Basingstoke Road) and within an area characterised by mixed use development including warehouses, retail, offices, leisure and residential uses. The site is well served by public transport links and there are frequent bus services to Reading Town Centre via the A33 and Basingstoke Road.

2.2.5 The site has an outline planning permission for two warehouse buildings (Class B8 Use) with ancillary office accommodation, granted 10 September 2014 under 131527/OUT. This permission remains extant for three years from the determination date.

- 2.2.6 Worton Grange is allocated in Reading Borough Council's (RBC) Sites and Detailed Policies Document (Adopted October 2012) as a strategic development site for residential and commercial development.

2.3 Proposed Development

- 2.3.1 A hybrid application for outline planning permission for the development of 175 new homes, including affordable housing (with all matters reserved apart from access) and full planning permission for the development of 12 commercial units to be used flexibly within Classes B1(c), B2 and B8 with ancillary retail sales to accommodate trade counters; two car showrooms with provision for MOT and servicing (Sui Generis); three retail warehouse units (Class A1); 120 bed hotel (Class C1); pub with restaurant facility (Class A4); coffee shop with drive through facility (Class A1); restaurant with drive through facility (Class A3); and bank with drive through facility (Class A2). This LZC Feasibility Study relates to the non-residential uses only.

2.4 Summary of Technology Feasibility for Worton Grange, Reading

- 2.4.1 A review of all potentially available energy generation technologies has been undertaken and is presented in **Section 3**.

3 Low and Zero Carbon Technology Review

3.1 Solar Photovoltaic (PV) Arrays

#	Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size but typically limited by available roof space and intended Feed In Tariff thresholds.
2	Carbon dioxide savings per year	Dependant on system size but typically limited by available roof space and intended Feed In Tariff thresholds
3	Life cycle costs and potential payback	Minimal maintenance. Panels designed to operate for at least 25 years. Inverter replacement may be required after 10-15 yrs. Typical payback should be 8-10 years.
4	Local planning criteria, including land use and noise	No planning issues. Roof-mounted classed as permitted development. May need visual/landscape impact assessment.
5	Feasibility of exporting heat/electricity	Yes. Connection to grid can be provided.
6	Any available grants	None. System should be eligible for Feed in Tariff.
7	Specific considerations	Available roof area. Check for shading from adjacent buildings, trees etc which would impact on system efficiency. Need sufficient space for inverter. Subject to structural engineering calculations.
8	Suitability for proposed development	Where possible, optimally positioned to face south with no shading. A frame system can be used to optimise PV performance on flat roofs, by adjusting tilt/orientation.
9	Feasibility	Yes

3.2 Solar Water Heating

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size but typically sized to meet building hot water demand.
2	Carbon dioxide savings per year	Dependant on system size but typically sized to meet building hot water demand.
3	Life cycle costs and potential payback	Regular service of pumps recommended. Heat transfer fluid will need to be replaced every 12 to 15 years. Panels designed to operate for at least 25 years. Typical payback for system with standard install, the right roof orientation, eligible for the Renewable Heat Incentive should be 8-10 years.
4	Local planning criteria, including land use and noise	No planning issues. Roof mounted and classed as permitted development. May need visual/landscape impact assessment.
5	Feasibility of exporting heat/electricity	Not usually appropriate for heat export due to system size. Usually designed to serve heat needs on building to which it is installed only.
6	Any available grants	None. System should be eligible for Renewable Heat Incentive and Enhanced Capital Allowance.
7	Specific considerations	Assess available roof area. Check for shading from adjacent buildings, trees etc which would impact on system efficiency. Need sufficient space for hot water storage. Subject to structural engineering calculations.
8	Suitability for proposed development	Yes though depends on other LZC technologies, in particular solar PV which would compete with PV for roof space. Solar water heating is not compatible with district heating, as it requires a hot water cylinder within the building.
9	Feasibility	Yes

Air Source Heat Pumps (ASHP)

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size.
2	Carbon dioxide savings per year	Dependant on system size.
3	Life cycle costs and potential payback	Full annual maintenance required with full replacement on internal plant likely after 15 – 20 years depending on usage. Whilst, due to their high efficiencies, these systems are accepted as being a renewable technology their primary energy is electricity and therefore payback is unlikely when the energy costs are factored in.
4	Local planning criteria, including land use and noise	The location of the condensers would require planning consent. Some noise from the external condensers but this can be treated locally if required with attenuation / acoustic housings. Plant area for external condensers required.
5	Feasibility of exporting heat/electricity	Not applicable. Unit would be sized to maximum heating / cooling demand and only run and modulate to the required heating and cooling load.
6	Any available grants	None. But system may be eligible for Enhance Capital Allowance and Renewable Heat Incentive.
7	Specific considerations	Is heating and cooling required. Condenser space.
8	Suitability for proposed development	Air source heat pumps are likely to be feasible, subject to detailed building designs.
9	Feasibility	Yes

3.3 Fossil Fuel CHP

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size, efficiency and percentage of heating requirement delivered.
2	Carbon dioxide savings per year	Dependant on system size, efficiency and percentage of heating requirement delivered.
3	Life cycle costs and potential payback	Full annual maintenance required with full replacement likely in 10 – 15 years depending on usage. Payback dependant on system size and usage.
4	Local planning criteria, including land use and noise	Full planning submission would be required. Land-use space requirements for energy centre, if needed. Noise impacts can be managed through correct plant sizing, positioning and attenuation.
5	Feasibility of exporting heat/electricity	Yes. Grid connection can be provided along with heat input to a district heating system if available.
6	Any available grants	None. But system may be eligible for Enhance Capital Allowance and Climate change Levy reduction through CHP Quality Assurance scheme.
7	Specific considerations	Must have adequate heat load to ensure CHP operates efficiently.
8	System appropriate for this development	No. No heat-intensive uses (such as industrial manufacturing) that could act as 'anchor loads' to facilitate the development of a heat network. Site-wide heat demand not sufficient for district heating. Micro-gas CHP may be suitable in certain buildings, subject to detailed design.
9	Feasible	Yes – Micro-gas CHP only

3.4 Ground Source Heat Pumps

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size, efficiency and percentage of heating requirement delivered.
2	Carbon dioxide savings per year	Dependant on system size, efficiency and percentage of heating requirement delivered.
3	Life cycle costs and potential payback	Full annual maintenance required with full replacement on internal plant likely after 15 – 20 years depending on usage. Payback period depends on system/building type and heating it is replacing but with Renewable Heat Incentive paybacks of less than 10 years could be achieved.
4	Local planning criteria, including land use and noise	No planning requirements though open loop systems accessing watercourses/bodies may need Environment Agency consent. Significant area required particularly for the horizontal ground loop arrangement. Minimal noise from internal plant which can be controlled with attenuation etc.
5	Feasibility of exporting heat/electricity	Not Applicable. Unit would be sized to maximum heat demand and only run and modulate to the required heating load.
6	Any available grants	None. But system may be eligible for Enhance Capital Allowance and Renewable Heat Incentive.
7	Specific considerations	Ground source heat pumps perform better with underfloor heating systems or warm air heating than with radiator-based systems because of the lower water temperatures required.
8	Suitability for proposed development	The masterplan must allow space for the installation of horizontal collector loops or a network of boreholes. Potential to utilise building piles for collector loops (subject to structural design).
9	Feasibility	Yes

3.5 Biomass Heating

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Full heating duty delivered.
2	Carbon dioxide savings per year	Dependant on system size.
3	Life cycle costs and potential payback	Full annual maintenance required with full replacement of plant likely after 15 – 20 years depending on usage. Payback can be 8-10 years but depends on existing fuel source. If replacing mains gas then payback will be much longer.
4	Local planning criteria, including land use and noise	Air quality impact will need to be assessed. Minimal noise but external fuel storage required.
5	Feasibility of exporting heat/electricity	Not Applicable. Unit would be sized to maximum heating demand and only run and modulate to the required heating load.
6	Any available grants	None. But system may be eligible for Renewable Heat Incentive.
7	Specific considerations	Bulk storage location and proximity to plant room and delivery point.
8	Suitability for proposed development	Biomass plant is deemed impractical for this development due to a combination of high emissions, the large amount of space required for plant and fuel storage, and the high number of vehicle movements required to supply sufficient fuel volumes. It is also likely to be problematic in terms of air quality impacts. Site-wide heat demand not sufficient for district heating.
9	Feasibility	No

3.6 Wind Energy

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size.
2	Carbon dioxide savings per year	Dependant on system size.
3	Life cycle costs and potential payback	Full annual maintenance required with replacement of major components 10 yearly minimum. Typical payback in excess of 10 years.
4	Local planning criteria, including land use and noise	Full planning submission would be required. Noise impacts can be significant so impact on local residents will need to be considered.
5	Feasibility of exporting heat/electricity	Yes. Connection to grid can be provided.
6	Any available grants	None. But system may be eligible for Feed in Tariff.
7	Specific considerations	Appropriate wind speeds in the location. NOABL data suggests speeds for Worton Grange are moderate.
8	Suitability for proposed development	Wind turbines are not considered appropriate within an inner-city, urban residential setting due to visual and noise impacts. Building-mounted turbines are yet to deliver long-term reliable performance due to high turbulence in built-up areas and structure vibration issues.
9	Feasibility	No

3.7 Hydro Power

#	Technology Assessment Criteria	Comment
1	Energy generated per year	Dependant on system size.
2	Carbon dioxide savings per year	Dependant on system size.
3	Life cycle costs and potential payback	Once installed, most systems can last for 40-50 years, with low running and maintenance costs and could last for longer if well maintained.
4	Local planning criteria, including land use and noise	Planning applications for hydropower should normally be accompanied by a Flood Risk Assessment.
5	Feasibility of exporting heat/electricity	Yes.
6	Any available grants	None. But system may be eligible for Feed in Tariff.
7	Specific considerations	To be suitable for electricity generation, a river needs to have a combination of: flow – how much water is flowing down the river per second, and head – a difference in height over a reasonably short distance.
8	Suitability for proposed development	There is no suitable watercourse in the vicinity of the site.
9	Feasibility	No

4 Conclusion

- 4.1.1 This study has reviewed the feasibility of a range of low and zero carbon technology options for Worton Grange, Reading.
- 4.1.2 A number of technologies are considered not feasible due to reasons of site location, space, environmental impact or economics, generally related to this being an urban site. These include large-scale fossil fuel CHP, biomass heating, wind energy and hydropower.
- 4.1.3 The study shows the following technologies are feasible at the site, subject to detailed building design: solar PV, solar water heating, air/ground source heat pumps and micro-gas CHP.

Appendix D Renewable Energy Feasibility Study

7.6 Introduction

7.6.1 This Renewable Energy Feasibility Study examines a selection of well-established renewable and low carbon energy sources and reviews their suitability for Worton Grange. The variables affecting their suitability include:

- Environmental constraints (e.g. suitable geology for ground source heat pumps or the presence of protected ecological species that may be affected by the technology);
- Resource constraints (e.g. the availability and reliability of local biomass fuel supplies or the local wind resource);
- Social constraints (e.g. visual or health impacts of placing combustion-based technologies near housing); and
- Infrastructure constraints (e.g. impacts on aviation from wind turbines or the availability of suitable transport infrastructure to import fuel, plant or equipment).

7.7 Photovoltaic Panels (PV)

Figure 7.1: PV panels positioned on a south-facing roof space



- 7.7.1 Photovoltaic panels (PV) offset grid electricity and therefore provide a CO₂ saving (currently 0.519 kgCO₂/kWh). Payback periods for PV are now commercially attractive due to the Feed-in Tariff (FiT) mechanism and a significantly increased supply base.
- 7.7.2 PV arrays are connected to the electrical system of a building via inverters. The electricity generated by PV can be used onsite and, when not required, can be exported to the National Grid. This process requires no user intervention.
- 7.7.3 Sunshine in England is intermittent and often unreliable, which can significantly impact PV performance. PV also only operates in daylight hours, so cannot generate electricity

continuously. It is most efficient when it is positioned as south-facing at a pitch of 30-35° from horizontal, and in areas free from shading.

- 7.7.4 PV is considered to be an effective renewable energy technology to employ at Worton Grange, in order to meet the CO₂ reduction targets noted in 2.5. At present, there is limited information about the proposed roof designs. However, it is anticipated that the majority of houses will have pitched roofs (orientated in various directions) and any apartment blocks/commercial buildings are most likely to have flat roofs. PV arrays can be installed on suitably orientated roof spaces and, on flat roofs, frame systems can be used to help optimise their performance (by adjusting their pitch and orientation). The use of PV arrays (especially on wide-spanning roofs) is subject to detailed assessment of landscape/visual impacts and structural engineering calculations.

7.8 Solar Water Heating (or Solar Thermal)

Figure 7.2: A solar water heating panel positioned on the south-facing pitched roof of a house



- 7.8.1 Solar water heating could be used to offset a portion of the hot water demand in both the domestic and commercial buildings at Worton Grange. In well-designed buildings, solar water heating can reduce the fuel consumption associated with hot water by 60-70% and the associated CO₂ emissions.
- 7.8.2 Solar water heating systems rely on solar energy and, therefore, the most effective heat production occurs during the daytime and sunny periods. The efficiency of solar water heating is greatly reduced during the winter. Therefore, their output for the 'whole year' is relatively low.
- 7.8.3 In order to accommodate solar water heating systems, buildings must be designed to allow space for hot water cylinders and flow/return pipework. As with PV, solar water heating operates most efficiently when installed on south-facing (or almost south-facing) roof space.
- 7.8.4 At Worton Grange, solar water heating systems could be employed on suitable roof spaces, subject to visual/structural impacts, as part of a 'suite' of effective technologies to meet the CO₂ reduction targets.

7.9 Air Source Heat Pumps

Figure 7.3: Discretely positioned external condensers of an air source heat pump system



- 7.9.1 Air source heat pumps absorb heat from the outside air, which can then be used to heat radiators, underfloor heating systems, or warm air convectors and hot water in a building. Heat pumps have some impact on the environment as they need electricity to run the fans and compressors for air extraction (typically in excess of 2 kW).
- 7.9.2 Air source heat pumps require the installation of external condensers, which are usually mounted on roofs or rear/side walls. They also feature moving parts (an electrically driven fan) and therefore make noise when they operate. If adopted, the external condensers will need to be positioned carefully to avoid visual/noise disturbance to site users and residents.
- 7.9.3 Keeping in mind these considerations, as part of a 'suite' of technologies to meet the CO₂ reduction targets, air source heat pumps are considered to be an effective solution for Worton Grange.

7.10 Ground Source Heat Pumps

Figure 7.4: Ground source heating horizontal collector loops being installed



- 7.10.1 Ground source heat pumps draw heat energy from the ground, concentrate it and then release it into a property. Some heat pumps are able to reverse this process in the summer, thereby providing cooling in buildings.
- 7.10.2 Ground source heat pumps systems can be either 'open loop' or 'closed loop'. Closed loop systems are typical in the UK and consist of laying a series of coiled pipes in shallow trenches (horizontal collector loops) – which requires considerable land area - or down boreholes (vertical collector loops). In open loop systems, groundwater is abstracted at ambient temperature from the ground, passed through a heat pump before being reinjected back into the ground or discharged at the surface. Open loop systems have the advantage of limited underground infrastructure, but require an environmental permit to extract and discharge water.
- 7.10.3 In order for systems to operate effectively, buildings must achieve a high standard of fabric energy efficiency and, where appropriate, an underfloor heating system (wet system) could be incorporated to optimise system performance.
- 7.10.4 The efficiency and cost-effectiveness of a ground source heat pump system is affected by underlying ground conditions and the thermal conductivity of the geology. Certain shall geological conditions (including sands, gravels and dry clays) have poor geothermal properties and therefore are not suitable.
- 7.10.5 Ground source heat pumps have the potential to be adopted as part of a 'suite' of effective solutions at Worton Grange.
- 7.10.6 If a ground source heating approach is pursued, the masterplan must allow space for the installation of horizontal collector loops or a network of boreholes. A review of the current Proposed Site Plan (**Appendix A** shows that there are large car parking areas in the commercial portion of the site (full application), and public parks and private gardens in the residential portion (outline application) which could potentially be used for horizontal collector loops. However, this approach is subject to appropriate testing of a trial borehole to determine the suitability of the ground conditions at the site.

7.11 Wind Energy

Figure 7.5: A roof-mounted wind turbine



- 7.11.1 Wind is a well-established energy source. The expertise and skills to undertake a range of wind turbine installations is extensive and the good supply base for wind energy means there is strong market competition. With this experience and knowledge behind wind energy generation, the financial risks are relatively low.
- 7.11.2 The RenSMART NOABL Wind Map³ indicates that the site has the following moderate wind speeds:
- At 10 metres: 4.7 m/s (10.5 mph);
 - At 25 metres: 5.4 m/s (12.1 mph); and
 - At 45 metres: 6 m/s (13.4 mph).
- 7.11.3 However, the accuracy of the NOABL Wind Map can vary considerable, even to the extent that it can make a site unviable. In addition, it does not consider the impact of the built environment on wind regimes, including increased turbulence and reduced speed.
- 7.11.4 There is an existing 85 metre high 2 MW wind turbine at Green Park, located approximately 700 m west of the site boundary.
- 7.11.5 There are a number of large developments around the Worton Grange site that could disrupt/alter wind regimes at the site, including the Reading International Business Park located approximately 200 m south-west of the site boundary (the direction of prevailing winds). A thorough assessment of actual on-site wind speeds would be needed before committing to a large-scale wind turbine approach.

³ RenSMART (2015) *NOABL Wind Map*^{1.01} [online] available at: <http://www.rensmart.com/Weather/BERR> [accessed 01/09/2015]

- 7.11.6 The site not considered suitable for a 'showcase' or 'flagship' wind turbine development (like Green Park) as it is likely to cause a significant visual/noise disturbance and wind flicker, which would be detrimental to the amenity of existing/new residents and other site users.
- 7.11.7 Building-mounted turbines (kW scale) are unlikely to provide long-term reliable performance at the site due to the wind turbulence from surrounding new/existing buildings. These systems also present engineering challenges as they often cause structure vibration.

7.12 Hydropower

Figure 7.6: An Archimedean screw hydropower scheme



- 7.12.1 There are no suitable watercourses in the vicinity of the site.

7.13 Biomass Heat, Power and Combined Heat and Power

Figure 7.7: Biomass fuel (wood chips) in a storage hopper



- 7.13.1 Biomass can be used as a fuel source for heat, power and Combined Heat and Power (CHP) applications. Biomass is typically burned in biomass boilers. Other potential technologies include gasification and pyrolysis, but these are yet to be commercially proven.

- 7.13.2 Biomass plants can be scaled to meet the needs of the proposed development and to reflect the availability of biomass in the area. Large biomass plants can be used to supply heat (and power) to multiple buildings (district heating – discussed further in 4) or in smaller kW-scale systems to provide warmth to a single room in a dwelling or to power central heating and hot water boilers.
- 7.13.3 The lifecycle costs of biomass systems are greater than tradition fossil fuel heating systems. However, incentive schemes such as the Renewable Heat Incentive (RHI) can reduce the costs and provide financial returns. The RHI is a government scheme set up to accelerate the uptake of renewable heat technologies among householders, communities and businesses. It has been available for the non-domestic sector since November 2011 and has recently become available for the domestic sector.
- 7.13.4 As a solid fuel, biomass often requires transportation over significant distances. However, the carbon intensity of biomass is still significantly less than traditional fossil fuels (oil and gas), even including the emissions associated with intercontinental transportation.
- 7.13.5 In high density built-up areas where air quality already presents an issue, the emissions from biomass boilers may exceed local air quality standards. In addition, biomass is a bulky product that requires additional space for infrastructure (including storage and delivery space).
- 7.13.6 The use of biomass technologies is subject to the availability of long-term contracts to ensure security of supply and sufficient generation for the site.
- 7.13.7 According the National Biofuel Supply Database⁴, there are four pellet/chip suppliers within a 20 km radius of the site:

Supplier	Address	Approximate distance from site (km)	Supplied fuel types
GV Recycling	38 Willowside, Reading, Berkshire, RG5 4HJ	7	Chip
Stickland Wood Yard	The Egg Yard, Greywell Road, Basing, Hampshire, RG24 7NH	17	Log, chip
Hampshire Woodfuel Cooperative, Odiham	The Estate Office, Herriard Park, Basingstoke, Hampshire, RG25 2PL	18	Log, chip
R.D.F. Energy	Padworth Sawmills, Aldermaston, Berkshire, RG7 4NU	12	Chip

⁴ Forestry Commission (2015) *National Biofuel Supply Database* [online] available at: <http://www.woodfueldirectory.org/> [access 01/09/2015]

- 7.13.8 Worton grange is in an area designated by Reading Borough Council as a Smoke Control Area in order to control air pollution. In this area, you can only burn smokeless fuels (such as anthracite, semi-anthracite, gas, low volatile steam coal and fuels on the DEFRA approved list). Therefore, although there are a number of pellet/chip suppliers in the area, both large- and kW- scale biomass boilers are not considered appropriate for Worton Grange due to potential adverse air quality impacts.
- 7.13.9 A district heating approach is not considered appropriate at this stage (as is discussed in 4). Furthermore, the Proposed Site Plan (**Appendix A**) indicates there is unlikely to be sufficient space for large-scale biomass infrastructure and storage.

7.14 Fossil Fuel Combined Heat and Power

- 7.14.1 The use of fossil fuels (normally gas) in CHP plants is a common and well understood technology. It works with reciprocating engines, turbines or combined cycling. High exhaust temperatures can be utilised for heating purposes and fuel availability is typically not an issue.
- 7.14.2 Fossil fuel CHP plants are usually designed to meet the heat demand rather than electrical demand. This maximises the CHP output to more favourable electricity supply markets.
- 7.14.3 Fossil fuel CHP is not a renewable energy and, therefore, does not contribute towards renewable energy production at the site. However, it does offer a significant contribution to CO₂ reduction because of improved efficiency.
- 7.14.4 Large fossil fuel CHP plants can be used to provide heat (and power) to multiple buildings through a district heat network. However, a district heating approach is not considered suitable at Worton Grange (as discussed in 4).
- 7.14.5 Micro-gas CHP systems are now available in the market. There is potential for these systems to be employed at Worton Grange (e.g. replacing conventional boilers in apartment blocks), subject to further detailed building design.

Appendix E MEM Reports

Project Name: Worton Grange (Non-residential)
Project Number: 32618
Consultant: MD



Masterplan Energy Model: Data Report

This data report provides a summary of the masterplan energy model and its results. These results are provided in line with the recommendations presented in the main body of the report and the limitations provided below.

Key Performance Indicators and Assumptions

Commercial and Industrial Use Class

Data References

Energy Efficiency in Buildings CIBSE Guide F 2004
BSRIA Rules of Thumb Fourth Edition 2003
Peter Brett Associates Industry Experience 2010
BCO Guide to Specification 2009

Methodology

The benchmark data from the above references have been adjusted to reflect a 44% reduction in carbon emissions over the 2002 Building Regulations, in order to represent Building Regulations 2010. The majority of this 44% reduction has been achieved through applying a standard reduction in regulated electricity demand of 55% and a 25% reduction in hot water demand (although this reduction changes slightly depending on use class). The remaining carbon emission reductions required in order to meet the 2013 Building Regulations were then achieved through space heating reductions.

Additional carbon emission reductions required to meet standards for Building Regulations 2013 have been established through PBA's knowledge of M&E and Structural Engineering and guidance presented by the BCO.

Unregulated energy demand has not been adjusted to reflect changes in demand use since 2002. Our assumption is that whilst appliances contributing to the unregulated demand continue to have improved efficiencies and lower energy requirements, more appliances and technologies are being bought and used, hence displacing the carbon emission savings achieved.

Each commercial use class has been subdivided into a use typology to provide a range of different use scenarios. High street and local centres have taken data from a range of end uses to provide an average energy demand for the use class.

Domestic Use Classes

Data References

The Government's Standard Assessment Procedure for Energy Rating of Dwellings 2009 edition with correction, May 2010
Energy Savings Trust Information : "Energy Efficiency and the Code for Sustainable Homes" - Level 3, Level 4 and Level 6 2009
BSRIA Rules of Thumb Fourth Edition 2003
Energy Efficiency in Buildings CIBSE Guide F 2004
BRE Domestic Energy Model (BREDEM 8 & 12)
Zero Carbon Hub establishing a fabric energy efficiency standard 2012

Methodology

The baseline regulated energy demands for domestic use classes were primarily calculated using the methodology as set out in The Government's Standard Assessment Procedure (SAP). The baseline unregulated energy demand however was calculated using the methodology set out in the Code for Sustainable Homes. These methodologies enabled a 2013 baseline to be calculated for domestic units directly.

In order to calculate the predicted energy demand for 2013 and PassivHaus the percentage reduction in space heating, hot water heating and electricity that could be achieved was estimated using information set out in the Zero Carbon Hubs "Fabric Energy Efficiency Standard for Zero Carbon Homes". The information in this document enabled sample SAP calculations to be carried out on Flats, Terrace, Semi Detached and Detached Houses and thus the percentage savings in electricity, space heating and hot water heating that could be achieved through base build alone were found.

The unregulated energy demand for residential units was assumed to remain the same as the baseline for the reasons stated above, which follows the BREDEM approach to calculating unregulated supply.

RESULTS: The predicted energy demand

Description	Quantity	Total Area (m2)	Total Predicted Energy Demand (MWh)					Total CO2 Emissions (Tonnes)			
			Hot Water	Space HTG	Reg Elec	Unreg Elec	Total	Gas	Reg. Electric	Unreg. Electric	Total
Residential											
Full application	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0
Non- Residential											
Full application	22	20,964	284	1,230	829	1,430	3,773	327	430	742	1,500
Subtotal	22	20,964	284	1,230	829	1,430	3,773	327	430	742	1,500
GRAND TOTAL	22	20,964	284	1,230	829	1,430	3,773	327	430	742	1,500

Residential	kg CO2 / m2 (regulated):	#DIV/0!
Non-Residential	kg CO2 / m2 (regulated):	36.123

Daily Maximum and Minimum Peak Demands for January and June

	January		June	
	Heat (kW)	Electricity (kW)	Heat (kW)	Electricity (kW)
Max.	526	421	92	416
Min.	111	91	2	91

Energy Efficiency % reduction for Space Heating over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	8%	19%
Semi Detached	0%	8%	19%
Terrace	0%	10%	31%
Flat	0%	10%	31%

Energy Efficiency % reduction for Hot water* over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	0%	3%
Semi Detached	0%	0%	3%
Terrace	0%	0%	3%
Flat	0%	0%	3%

**2016 Reduction for Flats has been taken to be the same as 2013 reduction, as 2016 reduction using SAPs was found to be less than 2013 reduction*

Energy Efficiency % reduction for Electricity over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	0%	5%
Semi Detached	0%	0%	5%
Terrace	0%	0%	5%
Flat	0%	0%	5%

Assumptions and Limitations

1. The masterplan energy model is based on published benchmark data. PBA are not responsible for the benchmark data and its quality of collation or quality assurance.
2. The applications of rules of thumb have been used to adjust benchmark data to represent likely changes in the Building Regulations. Adjustments have been made through the use of industry guides and PBA's experience in structural engineering and M&E engineering. It is recognised that through adjustments such as these a generic approach to energy demand modelling has been created.
3. The masterplan energy model is a generic model and not building specific. The development of detailed energy infrastructure or plant should not be based on high level assessment figures.
4. The domestic energy demand is aligned to the Office of the Communities and Local Government Standard Assessment Procedure. This masterplan energy model is therefore limited by the assumption, number and calculations presented within the SAP.
5. Domestic energy demand reductions are based on Energy Saving Trust guidance as benchmark reductions. The application of energy demand reductions are therefore limited to the standards set by the Energy Savings Trust.
6. The masterplan energy model is limited by the nature of information that is present at the outline planning stage. In this respect the model is based on the masterplan development schedule broken down as use classes where available. Where use classes are not available assumptions have been made to estimate the typology.
7. Use of the Homes and Community Agency's benchmark data for occupation has been utilised to assess the likely water consumption per person within each dwelling.
8. It has been assumed that 33% of water used within a dwelling will be for hot water. Water reduction targets are taken from the CLG Code for sustainable homes standard.
9. A wide variety of factors will influence the final energy demand of a development. Many of these factors cannot be incorporated within a model without significant conjecture. It is recommended that more detailed energy demand modelling is undertaken for the development once more detailed designs are available. Detailed modelling should use both the SAP and Simplified Building Energy Model.
10. Demand profiles have been normalised to enable them to be representative of the likely total energy demand. As such these profiles provide an indication of the energy profile.

Project Name: Worton Grange (Residential)
Project Number: 32618
Consultant: MD



Masterplan Energy Model: Data Report

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Key Performance Indicators and Assumptions

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Methodology

The benchmark data from the above references have been adjusted to reflect a 44% reduction in carbon emissions over the 2002 Building Regulations, in order to represent Building Regulations 2010. The majority of this 44% reduction has been achieved through applying a standard reduction in regulated electricity demand of 55% and a 25% reduction in hot water demand (although this reduction changes slightly depending on use class). The remaining carbon emission reductions required in order to meet the 2013 Building Regulations were then achieved through space heating reductions.

Additional carbon emission reductions required to meet standards for Building Regulations 2013 have been established through PBA's knowledge of M&E and Structural Engineering and guidance presented by the BCO.

Unregulated energy demand has not been adjusted to reflect changes in demand use since 2002. Our assumption is that whilst appliances contributing to the unregulated demand continue to have improved efficiencies and lower energy requirements, more appliances and technologies are being bought and used, hence displacing the carbon emission savings achieved.

Each commercial use class has been subdivided into a use typology to provide a range of different use scenarios. High street and local centres have taken data from a range of end uses to provide an average energy demand for the use class.

Domestic Use Classes

Data References

The Government's Standard Assessment Procedure for Energy Rating of Dwellings 2009 edition with correction, May 2010
Energy Savings Trust Information : "Energy Efficiency and the Code for Sustainable Homes" - Level 3, Level 4 and Level 6 2009
BSRIA Rules of Thumb Fourth Edition 2003
Energy Efficiency in Buildings CIBSE Guide F 2004
BRE Domestic Energy Model (BREDEM 8 & 12)
Zero Carbon Hub establishing a fabric energy efficiency standard 2012

Methodology

The baseline regulated energy demands for domestic use classes were primarily calculated using the methodology as set out in The Government's Standard Assessment Procedure (SAP). The baseline unregulated energy demand however was calculated using the methodology set out in the Code for Sustainable Homes. These methodologies enabled a 2013 baseline to be calculated for domestic units directly.

In order to calculate the predicted energy demand for 2013 and PassivHaus the percentage reduction in space heating, hot water heating and electricity that could be achieved was estimated using information set out in the Zero Carbon Hubs "Fabric Energy Efficiency Standard for Zero Carbon Homes". The information in this document enabled sample SAP calculations to be carried out on Flats, Terrace, Semi Detached and Detached Houses and thus the percentage savings in electricity, space heating and hot water heating that could be achieved through base build alone were found.

The unregulated energy demand for residential units was assumed to remain the same as the baseline for the reasons stated above, which follows the BREDEM approach to calculating unregulated supply.

RESULTS: The predicted energy demand

Description	Quantity	Total Area (m2)	Total Predicted Energy Demand (MWh)					Total CO2 Emissions (Tonnes)			
			Hot Water	Space HTG	Reg Elec	Unreg Elec	Total	Gas	Reg. Electric	Unreg. Electric	Total
Residential											
Outline application	175	11,800	287	700	129	446	1,563	213	67	231	512
Subtotal	175	11,800	287	700	129	446	1,563	213	67	231	512
Non- Residential											
Outline application	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL	175	11,800	287	700	129	446	1,563	213	67	231	512

Residential	kg CO2 / m2 (regulated):	23.764
Non-Residential	kg CO2 / m2 (regulated):	#DIV/0!

Daily Maximum and Minimum Peak Demands for January and June

	January		June	
	Heat (kW)	Electricity (kW)	Heat (kW)	Electricity (kW)
Max.	622	150	158	82
Min.	34	38	5	21

Energy Efficiency % reduction for Space Heating over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	8%	19%
Semi Detached	0%	8%	19%
Terrace	0%	10%	31%
Flat	0%	10%	31%

Energy Efficiency % reduction for Hot water* over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	0%	3%
Semi Detached	0%	0%	3%
Terrace	0%	0%	3%
Flat	0%	0%	3%

**2016 Reduction for Flats has been taken to be the same as 2013 reduction, as 2016 reduction using SAPs was found to be less than 2013 reduction*

Energy Efficiency % reduction for Electricity over 2010 baseline

House Type	2010	2013	PassivHaus
Detached	0%	0%	5%
Semi Detached	0%	0%	5%
Terrace	0%	0%	5%
Flat	0%	0%	5%

Assumptions and Limitations

1. The masterplan energy model is based on published benchmark data. PBA are not responsible for the benchmark data and its quality of collation or quality assurance.
2. The applications of rules of thumb have been used to adjust benchmark data to represent likely changes in the Building Regulations. Adjustments have been made through the use of industry guides and PBA's experience in structural engineering and M&E engineering. It is recognised that through adjustments such as these a generic approach to energy demand modelling has been created.
3. The masterplan energy model is a generic model and not building specific. The development of detailed energy infrastructure or plant should not be based on high level assessment figures.
4. The domestic energy demand is aligned to the Office of the Communities and Local Government Standard Assessment Procedure. This masterplan energy model is therefore limited by the assumption, number and calculations presented within the SAP.
5. Domestic energy demand reductions are based on Energy Saving Trust guidance as benchmark reductions. The application of energy demand reductions are therefore limited to the standards set by the Energy Savings Trust.
6. The masterplan energy model is limited by the nature of information that is present at the outline planning stage. In this respect the model is based on the masterplan development schedule broken down as use classes where available. Where use classes are not available assumptions have been made to estimate the typology.
7. Use of the Homes and Community Agency's benchmark data for occupation has been utilised to assess the likely water consumption per person within each dwelling.
8. It has been assumed that 33% of water used within a dwelling will be for hot water. Water reduction targets are taken from the CLG Code for sustainable homes standard.
9. A wide variety of factors will influence the final energy demand of a development. Many of these factors cannot be incorporated within a model without significant conjecture. It is recommended that more detailed energy demand modelling is undertaken for the development once more detailed designs are available. Detailed modelling should use both the SAP and Simplified Building Energy Model.
10. Demand profiles have been normalised to enable them to be representative of the likely total energy demand. As such these profiles provide an indication of the energy profile.