Lodge Hill

Outline Planning Application on behalf of Defence Infrastructure Organisation

Energy Statement

Prepared by Hyder Consulting (UK) Ltd

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This document forms part of a suite of documents which comprise the Lodge Hill Outline Planning Application.

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Outline Planning Application on behalf of Defence Infrastructure Organisation - Energy Statement

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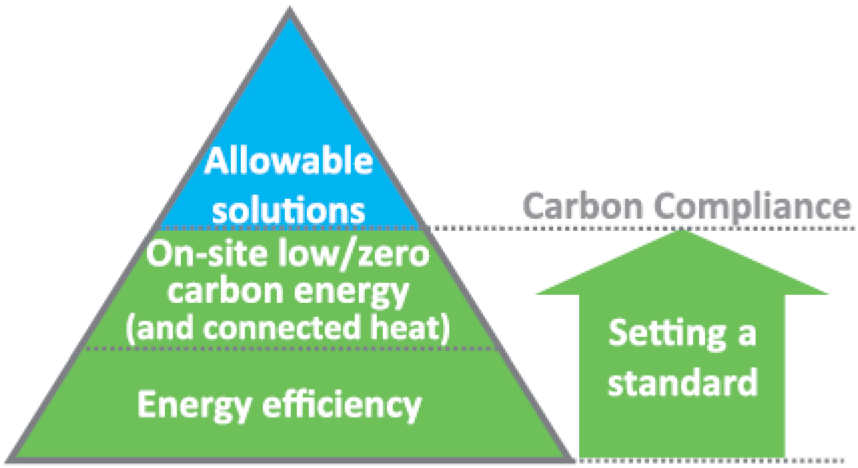
SUMMARY

This Energy Statement has been prepared by Hyder Consulting on behalf of Defence Infrastructure Organisation (DIO), and is submitted as a supporting document to the outline planning application. It focuses on how the proposed development at Lodge Hill addresses policies relating to energy and carbon dioxide emission reduction associated with buildings contained within Medway Council's adopted Local Plan and emerging Core Strategy. The Energy Statement should be read in conjunction with the comprehensive suite of documents comprised within the Outline Planning Application.

As this is an outline planning application, the main objective of this document is to describe the energy efficiency design and low and zero carbon technology options for the development and to identify the preferred strategy for reducing the carbon emissions. The final approach will be decided as the design for the development is finalised.

The following requirements emerge from national, regional and local planning policies and regulations, which should be met to achieve compliance.

- Expect to follow the zero carbon compliance hierarchy (see figure below)
- Expect to be built to Part L 2013 and higher Building Regulations.
- Domestic buildings likely to have meet Code Level 4 as a minimum
- The development likely to have to meet BREEAM Communities Excellent.
- Almost certain to have to provide district heating network which incorporates new low carbon and renewable energy systems or connects to appropriate existing waste heat, sources.



The energy hierarchy, and how it has adapted, is the starting point in establishing an appropriate strategy for the Lodge Hill development.

A number different issues need to be taken into consideration in selecting the final approach including a more detailed assessment of the energy needs (which will only be possible as the design is progressed).

By following the energy hierarchy, the primary objective is to reduce the site's energy demand by incorporating various energy efficiency measures into building design. The preliminary energy efficiency assessment shows that it is possible to reduce carbon emissions by circa 15.5% (from the baseline).

After reduction of the energy demand, appropriate low carbon and renewable energy solutions have been considered. Currently, there are many unknowns related to the near-site energy generation supplies. This makes it is difficult to assess viability of the near-site energy supply options. However, as there are potential opportunities to utilise waste heat from the nearby Damhead Creek and Kingsnorth power stations, it is logical to consider an on-site energy strategy which incorporates a district heating network. This approach will enable possible future utilisation of waste energy use from the near-site energy generation facilities should these options prove to be commercially and technologically feasible.

The adoption of a combination of on-site energy sources has the potential to meet the energy demands, provide flexibility and achieve the carbon emission reduction targets. At present, the preferred option is expected to be district heating network powered by gas-fired CHP, biomass boiler and top-up/back up gas boilers.

It is considered practical and cost effective approach to delivering low carbon and renewable energy targets in combination with other low carbon/renewable energy technologies such as solar PV and Ground Source/Air Source Heat Pumps in response to energy policy changes.

It was estimated that by applying this approach, it is possible to achieve circa 60% reduction in regulated carbon emissions. Further emission reductions can be achieved by using individual low carbon and renewable energy systems such as PV systems, abortion chillers, ground source heat pumps. It is anticipated that the remaining regulated emissions will be offset by allowable solutions.

The final approach taken to meeting the energy demands and the carbon targets will be decided as the scheme design is progressed. Further detailed design work in collaboration with the design team will be required to confirm the final strategy and determine sizes of plant, CHP engines and boilers. The approach may continuously evolve as other technologies, solutions or options may arise during the detailed design or the construction stages of the development which could be appropriate to incorporate in the design subject to their technical and commercial feasibility.

As the Government is still discussing the definition of allowable solutions, how zero carbon may be achieved and at what level carbon compliance should be set, it is recommended to review of the energy strategy for the Lodge Hill to ensure that the strategy is the most appropriate and avoiding supplementary add-on costs. It is anticipated that these areas will be controlled by way of planning conditions.

1 INTRODUCTION

1.1 Background

Hyder Consulting has been instructed to prepare this report in support of the Outline Planning Application.

This report takes into account the local, regional and national energy and sustainability policies. In particular, it considers Medway Council's energy related Local Plan policies and emerging Core Strategy which stipulates that development of this scale should reduce energy consumption, use energy efficiently and secure a minimum 20% reduction in carbon emissions from on site renewable sources.

This is an Outline Planning Application and the design is still being developed in detail; the assumptions made in predicting the energy demand and proposals to reduce the demand and carbon emissions have been tested in an energy model of the proposed development.

The main objective of this document is to describe the energy efficiency design and low and zero carbon technology options for the development and to identify the preferred strategy for reducing the carbon emissions.

The report considers the engineering aspects of the energy requirements associated with the phases of the development and the implications that this has on the capacity, location and nature of the energy infrastructure that may be required. The report considers providing power and heat via the traditional routes as well as other sustainable energy sources which could contribute to a 'sustainable infrastructure'. The respective economic, commercial and financial aspects have been considered in this report only at a strategic level. Taking these aspects into consideration is important because they can influence some or all of the engineering aspects of energy delivery.

In order to achieve the energy and sustainability objectives defined by national, regional and local policies which are noted in this report, research has been undertaken to provide the most appropriate technological and commercially viable strategic approach to energy supply in order to achieve the carbon reductions required throughout the development life cycle.

The energy strategy findings have fed into the proposed development for the Lodge Hill site, and have helped to shape the strategy with regard to the procurement and implementation of the sources of energy for the development.

1.2 Description of the Proposed Development

Lodge Hill /Chattenden is at present a Ministry of Defence site which is currently used as a training ground by the Royal Engineers and is located north of Chattenden Village, approximately 6 km to the north east of Chatham. However, the site has been declared surplus and will be released for redevelopment. It is bounded to the south by the A228 by pass, and is surrounded by woodland and open land.

Lodge Hill is emerging as a Strategic Allocation within the emerging Medway core Strategy to accommodate a new settlement. Development of a site of this magnitude provides an opportunity to achieve sustainable living that would affect not only the Lodge Hill site, but also improve that of surrounding communities, for example, by way of sustainable transport links and improved green spaces.

Table 1.1 presents the proposed land use schedule for Lodge Hill, identifying the type and use of domestic and non-domestic buildings.

Table 1.1 Land use schedule

OPA PROPOSED QUANTUM AND USE						
Land Use	**Use Class**	**OPA Quantum**				
		Hectares	**SQM GEA**	**SQM GIA**	**Units**	**Rooms**
Total OPA Area		324.66	NA	NA	NA	NA
Development Site Area		254.34	NA	NA	NA	NA
Existing Uses (existing figures are approximated)						
Military training	Sui Generis	324.66	30817	27735	NA	NA
Proposed Uses (expressed as maxima)						
Food Retail	**A1**	**NA**	**3,251**	**3,088**	**NA**	**NA**
Non-Food Retail	**A1-A5**	**NA**	**2,070**	**1,966**	**NA**	**NA**
Garden Centre	**Sui Generis**	**2.6**	**525**	**500**	**NA**	**NA**
Business Space	**B1**	**NA**	**36,750**	**35,000**	**NA**	**NA**
Business Space	**B2**	**NA**	**7,350**	**7,000**	**NA**	**NA**
Hotels	**C1**	**3.41**	**14,070**	**13,400**	**195**	**NA**
Residential Institutions (including assisted living accommodation and nursing home)	**C2**	**2.31**	**NA**	**10,000**	**120**	**NA**
Residential (including elderly accommodation)	**C3**	**NA**	**NA**	**NA**	**5,000**	**NA**
D1 Uses (assumed breakdown below):	**D1**	**NA**	**26,080**	**24,833**	**NA**	**NA**
*Education (On-Site Secondary and Primary School Provision)**	*D1*	*NA*	*23,780*	*22,648*	*NA*	*NA*
Community Centre (to include uses such as library, emergency service accommodation, place of worship)	*D1*	*NA*	*800*	*760*	*NA*	*NA*
Healthcare Centre	*D1*	*NA*	*1,500*	*1,425*	*NA*	*NA*
Servicing Compounds**	**Sui Generis**	**3.81**	**NA**	**NA**	**NA**	**NA**
Open Space** (including formal open space, playing field provision and sports pitches, excluding Category A trees)		**93**	**NA**	**NA**	**NA**	**NA**
Lakes/Water** (permanent water bodies and attenuation features)	**Sui Generis**	**9.75**	**NA**	**NA**	**NA**	**NA**

*This is the overall maximum quantum of floorspace generated by the development. In the alternative, it might be the case that primary school provision in Chattenden will take the form of an extension to the existing Chattenden primary school.

**Expressed as 'in the order of'

1.3 Development Phasing

An indicative phasing plan is illustrated within the Lodge Hill Environmental Statement, which sets out three phases of development. This has been used to inform the energy demand calculations within this report.

This energy study considers all the buildings listed in Table 1.1 Land Use Schedule. The energy demand calculations within this report are based on these land use assumptions, together with an assumption of the number of dwellings that could be developed within each phase.

2 POLICY AND LEGISLATION

2.1 Energy White Paper (2007)

Building on policy developments outlined in the governments, The Energy Challenge (2006) document and the findings from the Energy Review, the Department for the Environment, Food and Rural Affairs (DEFRA), the Department for Trade and Industry (now Department for Business, Innovation and Skills (BIS)) and the Department for Transport (DfT) jointly published a White Paper in May 2007 – "Planning for a Sustainable Future"[1]. This includes proposals to:

> *"Streamline further the process in the town and country planning system, improve the ability of local authorities to shape their local communities, and ensure that there is a stronger approach to supporting sustainable economic development alongside work to tackle climate change in a way that is integrated with the delivery of other sustainable development objectives."*

The Energy White Paper 2007 - Meeting the Energy Challenge[2] sets out the Government's strategy to address the long term energy challenges faced by the UK. There are four key policy goals:

- To tackle climate change by reducing CO2 emissions;
- Maintain reliable energy supplies;
- Promote competitive markets; and
- Ensure that every home is adequately and affordably heated.

In November 2008 the Climate Change Act became law with a binding target of an 80% reduction in carbon dioxide emissions by 2050 compared to 1990 levels. In support of this target the Government wants new buildings to be zero carbon as soon as practically possible and has aspirations for homes and new schools to be so from 2016 with new public buildings and new non-domestic buildings from 2018 and 2019 respectively. It also wants to significantly improve the energy efficiency of all existing buildings.

2.2 National Policy

2.2.1 Planning Policy Statement 1

Planning Policy Statement - Delivering Sustainable Development[3] (PPS1) published in 2005, sets out latest Government policy on this issue. In delivering sustainable development, it expects the following objectives to be achieved:

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[1] *Planning for a Sustainable Future: White Paper*, May 2007; Department for Communities and Local Government (DCLG), the Department for the Environment, Food and Rural Affairs (DEFRA), the Department for Trade and Industry (now Department for Business, Innovation and Skills (BIS)) and the Department for Transport (DfT)

[2] *Meeting the Energy Challenge: A White Paper on Energy*; May 2007; the Department for Trade and Industry (now Department for Business, Innovation and Skills (BIS))

- Promoting regional, sub-regional and local economies;
- Promoting communities which are inclusive, healthy, safe and crime free;
- Bringing forward sufficient land of a suitable quality in the right locations;
- Giving high priority to ensuring access for all to jobs, health, education, shops, leisure and community facilities;
- Focusing developments that attract a large number of people, especially retail development, in existing centres;
- Recognising the need to enhance as well as protect biodiversity and the need to address the causes and impacts of climate change, pollution and waste and resource management impacts;
- Promoting the more efficient use of land;
- Reducing the need to travel.

This position has been clarified in relation to climate change by the publication of a supplement to PPS1, 'Planning and Climate Change' (December 2007)[4]. The supplement sets out the policies to be reflected in the preparation of regional and local planning documents, to include:

- Make a full contribution to delivering the Government's Climate Change Programme and energy policies, and in doing so contribute to global sustainability;
- Providing for the homes, jobs, services and infrastructure needed by communities, and in renewing and shaping the places where they live and work, secure the highest viable resource and energy efficiency and reduction in emissions;
- Deliver patterns of urban growth and sustainable rural developments that help secure the fullest possible use of sustainable transport for moving freight, public transport, cycling and walking; and, which overall, reduce the need to travel, especially by car;
- Secure new development and shape places that minimise vulnerability, and provide resilience, to climate change; and in ways that are consistent with social cohesion and inclusion;
- Conserve and enhance biodiversity, recognising that the distribution of habitats and species will be affected by climate change;
- Reflect the development needs and interests of communities and enable them to contribute effectively to tackling climate change; and
- Respond to the concerns of business and encourage competitiveness and technological innovation in mitigating and adapting to climate change.

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[3] *Planning Policy Statement 1: Delivering Sustainable Development*; February 2005; Office of the Deputy Prime Minister (now Department for Communities and Local Government)

[4] *Planning Policy Statement 1*: *Planning and Climate Change – Supplement to PPS1,* December 2007; Department for Communities and Local Government

2.2.2 Planning Policy Statement 22

Current policies and objectives for energy use and renewable energy consumption are explained in PPS 22: Renewable Energy5. The latter states that:

> *"Local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments."*

Local authorities are increasingly including these provisions in their new local development frameworks. This is supported by the Planning and Energy Act 2008 which enables local authorities to set requirements for energy use and efficiency in local plans.

2.2.3 Sustainable Communities Plan: Building for the Future: South East

This regional programme of action sets out proposals for maintaining and creating sustainable communities in the South East. As stated in the Sustainable Communities Plan for the South East[6].

We need to create sustainable communities in which people want to live which:

- *Are economically prosperous;*
- *Have decent homes at a price people can afford;*
- *Safeguard the countryside;*
- *Enjoy a well-designed, accessible and pleasant living and working environment;*
- *Are effectively and fairly governed with a strong sense of community.*

The programme of action does not attempt to cover all the issues of importance to communities. It highlights actions to address issues including working to improve living standards in deprived areas, providing affordable housing and developing better facilities for young people in parks and green spaces.

2.2.4 Draft National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published on 25 July and is currently undergoing a three month consultation processes. The document sets out the governments vision for development, indicating the `direction of travel' planning policy is set to take. After review, the Planning Inspectorate issued a guidance note specifying that the NPPF is 'capable of being material consideration', and therefore must be considered in the context of the proposed development at Lodge Hill.

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[5] Planning Policy Statement 22 (PPS22): Renewable Energy, August 2004; Office of the Deputy Prime Minister (now Department for Communities and Local Government)

[6] *Sustainable Communities Plan: Building for the Future: South East*, February 2003; Office of the Deputy Prime Minister (now Department for Communities and Local Government)

The NPFF is designed to consolidate all policy statements, circulars and guidance documents into a single, simpler National Planning Policy Framework, making the planning system more user friendly and transparent. The frameworks primary objective is sustainable development, therefore focussing on the 3 pillars of sustainability. The frameworks is split into three sections; planning for prosperity (Economic), panning for people (Social) and planning for places (Environmental), each of which outline guidance to tackle issues such as housing, transport infrastructure, business and economic development, climate change, etc.

The encouragement of use of renewable energy resources is indicated in the Core Planning Principles. Further, the requirement for local planning authorities to set out strategic policies to deliver renewable energy targets is referred to in plan making.

Additionally, the objectives listed under Climate change, flooding and coastal change specifically requires that policy is developed which actively supports the delivery of renewable and low-carbon infrastructure.

2.3 Regional Policy

2.3.1 South East Plan

The development falls within the South East of England and so the relevant documents to be considered are the South East Plan[7] and the Regional Sustainability Framework[8].

The South East Plan sets out a vision for the future of the South East region to 2026, outlining the need to respond to challenges facing the region such as housing, the economy, transport and protecting the environment. Some of the crosscutting issues of the South East Plan are to require sustainable development, adopt and maintain a specific climate change implementation plan and support sustainable construction by adopting efficient standards and technologies.

There is strong support in the plan for the preparation of local development documents that seek high standards of energy efficiency and which promote the inclusion of renewable energy in all development. Local planning authorities in Kent are expected to respond accordingly as they prepare local development frameworks and supplementary planning documents.

The key energy and sustainability regional policies are summarised below:

Policy NRM11 - in advance of local targets being set, those of 10 dwellings or 1000m2 of non-residential floorspace should secure at least 10% of their energy from renewable or low-carbon sources.

Policy NRM12 - encourages the integration of combined heat and power (CHP), including mini and micro–CHP, in all developments and district heating infrastructure in large scale developments in mixed use.

Policy NRM16 – reinforces the support for renewable energy, and includes criteria for consideration including the contributions a development would make to local renewable energy

[7] *The South East Plan: Regional Spatial Strategy for the South East of England*, May 2009; Department for Communities and Local Government

[8] *The South East Regional Sustainability : Towards a better quality of life*, June 2008; South East England Regional Assembly

targets and carbon dioxide savings, and the appropriateness of biomass combustion plant in terms of the proximity of fuel source and the adequacy of the local transport network.

Policy CC4 - discusses a number of ways in which developments can be designed and constructed so that they are more sustainable, contributing to a reduction in ecological footprint.

The South East Plan includes a sub-regional policy for Kent Thames Gateway that applies to Medway. It highlights the need for investment in new infrastructure, the setting of high standards for sustainability and design of any new development. The key issues are the creation of:

- A flourishing local economy;
- Effective engagement and participation of local people;
- A safe and healthy environment with well designed public and green space;
- Sufficient size and scale and density to support basic amenities;
- Good public and other transport, both locally and linking to other centres;
- A well integrated mix of decent homes;
- Good quality services including education, training and health;
- A ‘sense of place’; and
- The right links with the wider regional, national and international community

2.3.2 Regional Sustainability Framework

The Regional Sustainability Framework (RSF) aims to fulfil the sustainable development objective.

Objective 17 of the RSF seeks to address the causes of climate change through reducing emissions of greenhouse gases and ensuring that the South East is prepared for the impacts of climate change. The target is to reduce the region’s carbon dioxide emissions by at least 20% below 1990 levels by 2010 and by at least 25% below 1990 levels by 2015 (aligned with the South East Plan targets). The RSF also expresses an interest in reducing greenhouse gas emissions from activities within the region by 60% by 2050.

Objective 24 of the RSF aims to increase energy efficiency looking at both energy use per capita and the proportion of energy generated from renewable sources in the region. The target is to install the following:

- 620 MW of renewable energy (5.5% of the generation capacity) by 2010;
- 895MW of renewable energy (8% of generation capacity) by 2016; and
- 1,750MW of renewable energy (16% of generation capacity) by 2026.

The current specification for 10% of a new development’s energy demand to be met by renewable energy is increased locally to 20% or greater, following decisions by other regional bodies to do so.

2.4 Local Policy

2.4.1 Local Plan

The Medway Local Plan 2003 was adopted and became operative on 14 May 2003. The plan has two key policies directly related to energy and sustainability. These policies are presented below:

Policy BNE4: Energy Efficiency

Energy efficiency measures will be sought within development proposals, providing there is no detrimental impact on amenity. In particular, proposals should have regard to:

(i) appropriate siting, form, orientation and layout of the buildings and the appropriate size and location of windows to maximise passive solar heating, natural lighting and natural ventilation; and

(ii) the appropriate use and siting of soft landscaping to act as shading or shelterbelts; and

(iii) energy efficient technology including solar panels, combined heat and power/district heating schemes and district wind power schemes; and

(iv) high standards of insulation and other heat retaining features; and

(v) the use of building materials of the lowest possible embodied energy, except where there is an overriding need to avoid damage to the architectural or historic interest of Listed Buildings and buildings in Conservation Areas.

Policy CF11: Renewable Energy

Renewable energy schemes for the generation and consumption of electricity will be permitted when the location, scale and design of the apparatus and associated infrastructure are not detrimental to nature conservation or landscape concerns and present no significant loss of residential or countryside amenity.

2.4.2 Emerging Core Strategy

The key energy and sustainability policies of the emerging core strategy are summarised below:

Policy CS3: Mitigation and Adaptation to Climate Change – The policy requires that all new development take full account of its potential impact in terms of climate change and demonstrate that appropriate mitigation and adaptation strategies have been put in place to limit these impacts.

Residential buildings will be required to achieve at least Level 3 of the Code for Sustainable Homes and commercial buildings over 1,000 sq m will be required to meet the BREEAM 'very good' standard.

The policy also requires considering and maximising thermal efficiency of buildings and limiting the need for mechanical heating and cooling systems.

Policy CS4: Energy Efficiency and Renewable Energy – The policy requires that all new development reduce energy loads through passive design and the inclusion of energy efficiency measures. All major developments (10 dwellings or more) or over 1,000 sq m of floor space should achieve 20% of the remaining on-site energy demand through on-site renewable energy sources. The Council will support the installation of all forms of renewable energy systems if they will not have adverse effects on the environment and residential amenity.

If it the renewable energy target cannot be met economically, compensatory measures will be sought and applied to current buildings in the locality.

Where feasible, the Council will promote large scale district heating schemes that utilise waste heat from conventional power generation.

Policy CS33: Lodge Hill – The policy requires that the design solutions for the development at Lodge Hill should have due regard to the potential for a comprehensive heating grid, neighbourhood power and heat generation, SUDs and other features minimising the carbon footprint of the development as a whole.

2.5 Building Regulations

Currently, Part L 2010 requires all new buildings to calculate their carbon dioxide emissions from fixed building services (regulated emissions). It is proposed that future revisions to this regulation will use the same model, but will ask for a higher reduction in carbon dioxide emissions compared to the previous version of the building regulations.

Up until 2006 it has been possible to meet the carbon targets by using efficient conventional systems. The 2010 CO_2 emissions targets can still be largely met by an energy efficient approach to design although additional low carbon or renewable systems may be needed (or preferred) in some buildings.

The step change proposed in 2013 will make low carbon and renewable systems necessary in virtually all new buildings, however, the types of systems used are most likely to be low carbon/renewable heating and cooling systems which are reasonably affordable.

The jump to zero carbon in 2016 represents a major step change and will almost certainly require a change in approach to how Part L is implemented. The traditional approach of building regulations is to assess the performance of a building considering only the energy use of the building and only those technologies attached to it and so directly affecting its carbon performance. If this approach were taken to zero carbon buildings, around half would not be able to meet the target and many of those that could meet the target would be extremely costly. This is because if the target were implemented in this way it would rely on small scale renewable electricity generation which is very expensive.

Current thinking is that the minimum performance standards required for individual buildings will remain similar between 2013 and 2016. There will be an option for some sites to further improve their on-site carbon performance and reduce emissions but there will also be alternative approaches (referred to as allowable measures) to reducing carbon by other means including:

- Remote wind turbines (or other forms of renewable electricity generation) with some form of long-term legal association to the development
- Extension of onsite low carbon heating systems to replace high carbon heating systems in existing buildings on neighbouring sites
- Programmes of improvement works to remote buildings (e.g. insulating cavity wall and lofts or installing external insulation on hard to treat solid walled rural homes)

The next revision is expected in 2013 and is anticipated to require a further cut in carbon dioxide emissions of around 19 per cent. The tendency of carbon reduction will continue until a zero carbon target is adopted. It is anticipated that the zero carbon target will come into force in 2016 for domestic buildings and in 2019 for non-domestic buildings (2018 for public buildings).

This trajectory to zero carbon was first announced by the government in 2006 and there is still a considerable amount of work to be done to make it a reality. The current understanding of the trajectory to zero carbon from domestic and non-domestic buildings is presented in Table 2.1.

Table 2.1 Carbon reduction requirements based on Part L revisions

Buildings type	Part L 2010	Part L 2013	Part L 2016	Part L 2018	Part L 2019
Domestic	25%	44%	Zero Carbon	Zero Carbon	Zero Carbon
Non – domestic (Schools)	25%	30-44%	Zero Carbon	Zero Carbon	Zero Carbon
Non – domestic (Public buildings)	25%	30-44%	37-53%	Zero Carbon	Zero Carbon
Non – domestic (Other)	25%	30-44%	37-53%	37-53%	Zero Carbon

Note: The carbon reduction targets are presented against Building Regulations Part L 2006

2.5.1 Achieving Zero Carbon

The Government has announced its commitment to ensure that all domestic buildings should be zero carbon compliant. The Government has an ambition to make all new non-domestic buildings should be zero carbon from 2019.

Recent announcements in the 2011 Budget ‘The Plan for Growth’ document have confirmed that the government is changing the definition of “zero carbon” to include regulated energy only (i.e. exclude unregulated energy). This means that the zero carbon definition is now only to include the regulated emissions covered by Building Regulations (heating, fixed lighting, hot water and building services). Therefore, emissions from cooking or from appliances such as computers and televisions are excluded from the definition.

The Government’s commitment to achieving zero carbon is based on the following hierarchical approach to achieving zero carbon targets:

1. Ensure energy efficiency by energy efficient building design

2. Reduce carbon emissions through on-site low carbon and renewable energy technologies and near-site heat networks.

3. Mitigate the remaining carbon emissions through use of allowable solutions.

Following a study by the Zero Carbon Hub in which further consultations were undertaken with house builders, consultants and other key stakeholders, it is suggested that the 70% level initially proposed for minimum carbon compliance may be difficult to achieve for many houses and developments.

As a result, the Zero Carbon Hub have produced an Interim Report, dated December 2010, in which further amendments to the level of carbon compliance, which are considered to be more achievable, are suggested. Further, differing levels are proposed for 3 basic different dwelling types – detached house; end terrace house and low rise apartment block.

In addition, it was felt that the previous method of calculating carbon compliance level was confusing and now suggest that an absolute limit in terms of CO_2 emissions per m^2 floor area per annum is the measure used. The Zero Carbon Hub suggests the following are achievable levels of carbon compliance for these dwellings as follows:-

- Detached House – 10kg $CO_{2(eq)}$ /m^2/year
- Other houses – 11kg $CO_{2(eq)}$ /m^2/year
- Low rise apartment blocks (Four storeys and below) – 14kg $CO_{2(eq)}$ /m^2/year

In addition, the task group are set to review and establish the Carbon Compliance limit for higher apartment blocks but the work is still ongoing.

These recommendations apply to the built performance of dwellings and therefore in order to design to achieve this level, the following approximate % improvements on Part L 2006 standard should be applied as follows:-

- Detached house – 60%
- Other houses – 56%
- Low rise apartment blocks – 44%

Clearly, the carbon compliance level recommended for low rise apartment blocks is that which must be achieved overall to reach the minimum energy targets of Code level 4.

The remainder of the carbon emissions associated with the dwellings can be dealt with through the use of renewable technologies or the use of allowable solutions whereby each kg CO_2 emitted per annum must be matched by a saving in CO_2 off-site. In some instances this may not be possible, and therefore a financial contribution to either the CIL fund, Community Energy Fund (CEF) or some other energy related fund may be made. At present, a cap of £75 per tonne of CO_2 over a 30 year period is proposed for the cost of allowable solutions[9].

It is envisaged that when the Lodge Hill site is developed, most of the buildings (if not all) will have to comply with the zero carbon requirements and so construction will have to take this into consideration.

As well as complying with these Building Regulations, there are further Code for Sustainable Homes and BREEAM requirements arising from the Medway Council's policy and emerging Core Strategy. These requirements are discussed Section 2.6.

[9] *Carbon Compliance: What is the appropriate level for 2016?, Interim report, Zero Carbon Hub, December 2010*

2.6 Code for Sustainable Homes and BREEAM

2.6.1 Code for Sustainable Homes

To strengthen the sustainability requirements of new dwellings, the Government launched the Code for Sustainable Homes (CSH or ‘the Code’) in 2006 to operate in parallel to the Building Regulations for energy use for new residential development (Approved Document Part L1A). CSH sets out the national standard for sustainable design and construction of new homes. .

The Code includes sections under a number of different sustainability issues which includes; energy use in a home, materials used in the construction and the effect on biodiversity. The Code also addresses issues such as water use within each dwelling, surface water and flooding, health and wellbeing and pollution issues. This document only considers the energy/carbon aspect of the Code.

Part L of the Building Regulations (Conservation of fuel and power) will be progressively become more stringent and will eventually require all new dwellings built from 2016 onwards to achieve ”zero carbon” status.

The Code for Sustainable Homes (CSH) was introduced in April 2007 as a voluntary measure to provide a comprehensive assessment of the sustainability of a new home and replaces the Eco-Homes methodology. In terms of carbon emissions Level 3 equals a 25% carbon improvement relative to Building Regulations, 2006. New housing developments are required to achieve CSH Level 4 from 2013 (44% carbon improvement) and ”Zero carbon” from 2016). The Code Level relates to; compliance with mandatory minimum standards for waste, material, and surface water run-off as well as energy and potable water consumption.

The energy targets above are based on improvements to Part L of the Building Regulations and ”zero carbon” is be achieved by offsetting all of the CO_2 emissions associated with Part L regulated energy uses.

Different levels of the Code map exactly on to proposed Part L targets with the highest code level corresponding to zero carbon. This means the code and Part L are effectively calibrated to the same carbon scale.

Medway and some other local authorities have adopted the code as a minimum standard and publicly funded homes have to meet the code. Medway Council’s emerging Core Strategy requires new dwellings within developments to achieve at least Level 3 of the Code.

2.6.2 BREEAM

BREEAM (Building Research Establishment’s Environmental Assessment Method) is a standard assessment method established by the Building Research Establishment (BRE), used to assess the environmental impact of non-domestic buildings. Overall BREEAM is similar to the Code and covers a range of issues and credits which are awarded where a building achieves a benchmark performance. Like the Code, BREEAM is a voluntary standard although central government and some planning authorities require compliance.

BREEAM Communities will be applied to the development to assess its environmental rating. The BRE periodically updates BREEAM and the latest version of BREEAM Communities came into force in March 2011.

The latest version imposes more demanding standards and energy/carbon requirements than the previous standard. Because BRE have applied previous best practice carbon standards before the government has fully decided how to address the future carbon performance of non-domestic buildings, it is likely that the requirements will need to be changed again in the future to align with Part L (2013 and 2016) requirements.

Currently, Medway Council's emerging Core Strategy requires non-domestic developments comply with the BREEAM requirements and achieve 'Very Good' standard.

However, since the BREEAM standards continue to evolve over time, there is a risk that local planning policies relating to BREEAM may become outdated.

2.7 Summary of Policy Requirements

The following requirements emerge from anticipated national, regional and local planning policies and regulations which should be met to achieve compliance.

- Expect to follow the zero carbon compliance hierarchy.
- Expect to be built to Part L 2013 and higher Building Regulations.
- Domestic buildings likely to have meet Code Level 4 as a minimum.
- The development likely to have to meet BREEAM Communities "Excellent" rating.
- Almost certain to have to provide district heating network which incorporates new low carbon and renewable energy systems or connects to appropriate existing waste heat, sources.

It is envisaged that when the Lodge Hill site is developed, the buildings will have to comply with the following carbon reduction requirements and so construction will have to take this into consideration.

Buildings type	Part L 2013	Part L 2016	Part L 2018	Part L 2019
Domestic	44%	Zero Carbon	Zero Carbon	Zero Carbon
Non – domestic (Schools)	30-44%	Zero Carbon	Zero Carbon	Zero Carbon
Non – domestic (Public buildings)	30-44%	37-53%	Zero Carbon	Zero Carbon
Non – domestic (Other)	30-44%	37-53%	37-53%	Zero Carbon

Note: The carbon reduction targets are presented against Building Regulations Part L 2006

3 STRATEGIC APPROACH

The suggested approach to energy and carbon has been developed in line with the overall approach to climate change, reflecting national, regional and local policy requirements, as well as Building Regulations Part L, the Code and BREEAM energy requirements.

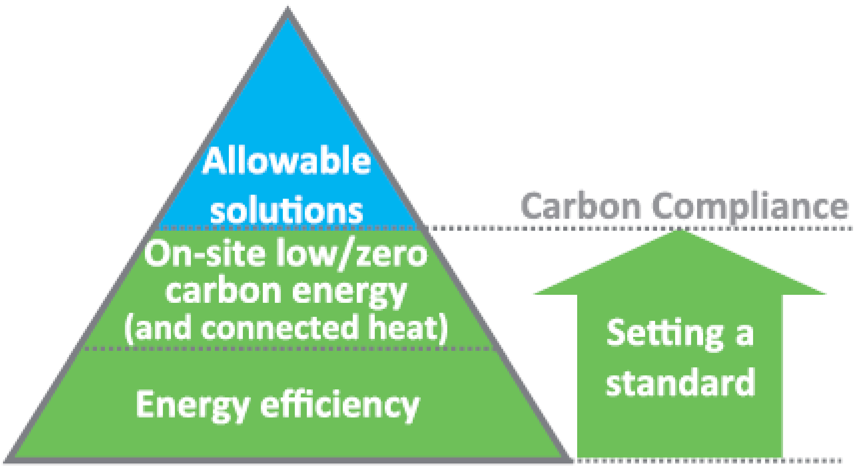
The Lodge Hill Sustainability Strategy identifies key energy related objectives within which are a series of criteria and targets. These follow the energy hierarchy and correspond to evolving best practice. The three key energy objectives are:

- Energy Efficiency (Mean)
- Efficient Supply of Energy (Lean)
- Renewable Energy (Green)

In addition to following the energy hierarchy, it is important that the strategy considers the long term viability and security of the energy solution to enable economic growth, social inclusion and prosperity. As part of this, and as recognised through the recent changes to the definition of zero carbon, this strategy considers the role that allowable solutions will have in meeting the carbon emissions targets from 2016 onwards.

The energy hierarchy, and how it has adapted, is the starting point in establishing an appropriate strategy for the Lodge Hill development (see Figure 3.1).

Figure 3.1 Hierarchy to Achieve Zero Carbon Compliance



The energy hierarchy stresses the primacy of seeking to reduce energy consumption. Within the built environment this comprises adopting energy efficiency measures in both the design and construction of new buildings.

Secondly, the promotion of a 'clean' supply of energy addresses the need to 'decarbonise' and improve efficiency in the generation and distribution of energy. Decarbonisation means reducing the amount of carbon emissions that result from generating and distributing energy.

One of the key decarbonisation mechanisms is to develop local systems of energy generation and distribution that have a reduced reliance on existing large scale remote power plants fuelled by primary fossil carbon energy (i.e. gas, oil and coal). By 'decentralising' energy supply and distribution, greater use can be made of smaller scale low and zero carbon energy sources, such as community boilers, combined heat and power systems and district heat networks. In addition, by generating energy sources close to areas of demand, increased efficiencies can be achieved by reducing the losses in energy that arise through long distance transmission and distribution. Another key decarbonisation mechanism is to utilise near-site waste heat by connecting development to the source via district heating network.

The second tier of the energy hierarchy also comprises the use of 'green' energy systems. These are renewable sources of energy with zero carbon emissions and include, amongst others, solar generated heat and power, wind energy and biomass.

The proposed energy strategy for Lodge Hill follows the energy hierarchy and focuses on the following five key factors:

1. Minimising energy demand through efficient design and incorporation of passive measures;

2. Supplying energy efficiently through use of low-carbon technology;

3. Incorporating renewable energy systems;

4. Ensuring flexibility and long term security of energy supply; and

5. Considered use of allowable solutions.

This strategy utilises Building Regulations Part L 2010 as the energy baseline and the starting point for the assessment. From this, and based upon the proposed development, a phased energy profile of the development has been generated.

In meeting the strategy it is essential that the buildings should be designed to reduce energy demand through incorporation of energy efficiency measures. The measures will include features of passive design as well as efficient plant and lighting. Opportunities for district heating and on site renewables are investigated in the following sections. The preferred technology solution put forward matches the energy profile of the proposed development ensuring effective use. The solution is also taking into consideration security of supply aspect as well as viability and flexibility of the scheme from a technical and economic point of view by suggesting an optimal combination of energy efficiency measures, decentralised energy, and renewable energy.

Implementation of energy efficiency standards and low/zero carbon systems will significantly reduce the carbon emissions. However, this still leaves a residual carbon footprint that needs to be addressed in order to meet the "zero carbon" target. It has been recognised, through the redefinition of "zero carbon", that this residual amount can be delivered by using allowable solutions.

The proposed energy strategy for the Lodge Hill development, as given in the Conclusion of this report, takes into account future developments of the Building Regulations and Code/BREEAM requirements as the requirements will become stricter in future. This is particularly relevant given the likely duration of the site development.

4 OPTIONS FOR ENERGY DEMAND REDUCTION

4.1 Baseline Energy Demand

In order to establish the approximate baseline energy demand (both thermal and electrical) for the development, an energy model has been produced. The assessment of the energy performance of the proposed design solution is based on the energy consumption of 'notional' domestic and non-domestic buildings on site which are compliant with Part L 2010 Building Regulations.

The residential energy demand was calculated using information regarding regulated energy consumption abstracted from a series of sample Standard Assessment Procedure (SAP) reports developed to provide typical residential dwelling types to develop preliminary energy benchmarks for domestic buildings. The assumptions on which the SAP calculations have been undertaken are as follows:

- All assessed dwellings are assumed to be South-West facing;
- Roof sizes are estimated as the exact roof dimensions are not available;
- Quantities and dimensions of openings (windows and doors) for each dwelling type are estimated;
- The differing types of openings and their dimensions are assumed to be the same for all dwelling types;
- Cooling is assumed not to be provided to any of the dwellings;
- Balanced whole-house mechanical ventilation system was selected from the SAP database; and
- All internal and external lighting used throughout the dwellings is energy efficient.

A conservative approach has been adopted in the assumptions made for the purposes of the SAP calculations. This approach gives a degree of comfort since neither the worst-case or best-case scenario is used and therefore incorporates an element of flexibility.

The energy consumption for space heating, hot water and electricity for lighting, pumps and fans per m^2 have been determined and derived from SAP for each typical dwelling. The average energy consumption for space heating, hot water and electricity for lighting per m^2 was calculated which is used as an energy benchmark for the energy demand assessment of each dwelling type.

Given that this is an outline planning application, there is still some uncertainty about the energy needs of the future occupants of non-domestic buildings. Without knowing the occupants or precise uses of the proposed units, it is difficult to accurately predict the energy demand.

However, standard benchmarks taken from CIBSE publication TM46 2008 and Guide F have been used to estimate as far as possible non-domestic energy use but there are a couple of issues with this approach. Firstly, there are multiple benchmarks for B1-B2 uses with wide differences between chilled and standard units and, secondly, the benchmarks are intended to be representative of the UK building stock as a whole and so tend to estimate higher heat demand than would be required for new buildings. Again, this approach will tend to over-estimate the overall energy demand and therefore inherently offer a scenario which is closer to worst-case than best-case, providing a good level of flexibility.

The non-domestic energy benchmarks which reflect Part L 2010 Building Regulations have been determined by assuming that the CIBSE TM46 and GUIDE F energy benchmarks reflect energy consumption of 2006 Part L compliant buildings and by then reducing them by 10% to obtain the energy demand for non-domestic buildings.

These benchmarks were used in the energy model to determine the baseline energy demand.

4.2 Energy Efficiency and Demand Reduction

Part L of the 2010 Building Regulations for domestic dwellings highlights the need to ensure energy efficiency in design. The introduction of the Code for Sustainable Homes and BREEAM has moved this agenda further forward and has focused on ensuring buildings are well insulated and airtight (as far as practically possible), to retain warmth and reduce the need for space heating.

The Lodge Hill development will adopt appropriate Code for Sustainable Homes and BREEAM building standards to ensure energy efficiency is the first priority in achieving its carbon and energy savings and objectives.

A range of measures to reduce carbon emissions and increase resilience to climate change can be incorporated into building design; some of these are outlined below.

Table 4.1 – Building Energy Efficiency Measures

Design Feature	Adaptation Measure	Technology
Air tightness	Green roofs	A rated appliances
Insulation	Grey water recycling	Automatic controls and monitoring
Reduce thermal bridging	Rainwater harvesting	Energy management systems
Passive solar orientation	Water conservation	Energy efficient lighting
Solar shading	Passive cooling	High performance glazing
Use of natural daylight		Mechanical ventilation (with heat recovery)
Natural ventilation		Energy efficient systems

In order to estimate potential energy efficiency savings for domestic buildings, it was assumed that some of the passive design features such as passive solar orientation and use of natural light can be implemented. Other assumed energy efficiency measures for domestic buildings are based on the Energy Saving Trust's (EST) standards, which are suggested in the CE292 Energy Efficiency and the Code for Sustainable Homes guidance for Level 6. The standards were simulated using SAP software and the average energy consumption for space heating, hot water and electricity for lighting per m^2 was extracted and used as energy benchmark for the energy demand assessment of each dwelling type.

It is assumed that by implementing some of the energy efficiency measures in non-domestic buildings such as use of energy efficient lighting and energy efficient M&E systems to comply with more demanding energy standards (after each change of Part L) can reduce energy demand by 5%. Using this assumption, non-domestic energy benchmarks have then been adjusted to predict energy consumption of non-domestic buildings in 2013, 2016 and 2019. The 2019 energy benchmarks are used for all the non-domestic buildings which would be constructed post 2019.

4.3 Summary

The initial baseline energy demands and carbon emissions associated with the regulated energy use as well as predicted energy and carbon reductions for the entire development are summarised in Table 4.2. The second and the forth columns of the table indicate the level of energy and carbon reductions that can be anticipated across the entire development by implementing energy efficiency measures.

Table 4.2 Summary of Annual Regulated Energy Demands and Carbon Emissions for the Development

Utility	Baseline energy demand (MWh/year)	Predicted energy demand (MWh/year)	Baseline carbon emissions (tCO_2/year)	Predicted carbon emissions (tCO_2/year)
Electricity	8,754	9,114	4,526	4,712
Gas (annual)	49,040	36,930	9,710	7,312

The table gives details of the carbon performance of the proposed development in the absence of low carbon and renewable energy technologies.

The baseline energy demand (and associated carbon emissions) indicates the level required to meet Part L 2010 Building Regulations compliance. The assessment of the baseline energy demand is based on conservative assumptions.

The predicted energy demand indicates the energy demand after energy efficiency measures have been applied to the baseline levels (such as improved insulation levels, energy efficient lighting throughout, etc.)

From Table 4.2 it can be seen that there is a slight increase in overall predicted electrical energy demand in comparison with the baseline electricity demand. This is mainly because the electrical energy demands for fans and pumps increase due to increase in electricity demands for pumping district heating water and using mechanical ventilation systems. This increase is partially compensated by use of 100% energy efficient lighting.

The preliminary assessment of energy efficiency and demand reduction shows that the proposed energy efficiency measures could result in a reduction of approximately 2,212 tCO_2 per annum equivalent to a reduction in total regulated carbon emissions of approximately 15.5%.

5 OPTIONS FOR DECENTRALISED, LOW CARBON AND RENEWABLE ENERGY SYSTEMS

This section outlines the potential for different decentralised, renewable and low carbon systems to be applied to the development, taking into account the expected policy requirements and likely demand from the site.

5.1 General

Utilising energy generated locally reduces energy lost through transmission and distribution, and can often take advantage of more advanced generating technologies that combine to provide both power and heat more efficiently. Local generation, or decentralised generation, is produced on a smaller scale nearer to the point of consumption and can offer a number of benefits, including:

- Using generated energy more efficiently by reducing distribution losses
- Contributing to security of energy supply by increasing local energy production
- Increasing reliability of supply providing the opportunity to operate ‘on’ or ‘off’ grid
- Reducing carbon emissions through more efficient use of fossil fuels and greater use of locally generated renewable energy
- Provides the opportunity to create stronger links between energy production and consumption.
- Provides a visible message of commitment to sustainable energy
- Improves security of energy supply

5.2 Site Wide Systems vs. Building Level Systems

One of the primary issues to consider is whether to link buildings to common energy infrastructure or to maintain independent operation of each building. The primary issues are that:

- Some energy technologies (e.g. CHP, biomass boiler) may not be viable or practical at a building level.
- Some low carbon systems (e.g. biomass boiler, CHP) require operational management that benefit from a shared system where centralised management can be more readily provided or is given over to a third party.
- Shared site-wide systems can introduce complexities for design, ownership, ongoing operation and allocation of costs and so are likely to require more involved management from a third party. As one of the options, a specialist Energy Service Company (ESCo) could act as a third party, which could also take on some of the wider estate management. However, centralised operation of shared systems can help to achieve higher carbon savings with less operating costs.

- Shared systems can potentially provide more energy options and flexibility to achieve higher carbon savings.

- Shared systems can be combined with some building level systems (e.g. CHP or biomass boiler with photovoltaics). Use of a combination of shared and building level systems can help to further improve flexibility and increase carbon savings.

- Any electricity generation would benefit from private electricity distribution infrastructure. This would require more involved management which could be provided by a third party.

- The density of the development has impact on system costs. Overall, this is expected to have less impact on building/development scale systems than on district scale systems. Some of the proposed energy solutions will be easier and less expensive with higher densities (e.g. biomass and gas CHP) whereas approaches using GSHPs and solar thermal/photovoltaic will become technically more difficult and more expensive as a result of increased density. Lodge Hill is a large development which has low, medium and high density areas which enables a combination of building and district scale systems to be economically and technically viable.

In summary, there is a possibility to combine site-wide systems with building level systems. This could help to meet the anticipated energy demand and achieve the required carbon savings in the most practical and cost effective way.

5.3 Meeting Anticipated Energy Demand

In meeting the anticipated energy demand and the carbon targets, the technical solution must recognise the practical implications of the demand profile, construction phasing and compatibility of technologies.

There are several different types of energy demand to consider. Different types of energy demand can be met by different energy systems and the significance of the demand will help to determine which systems are most appropriate. The patterns of energy demand also help to determine the suitability of different decentralised/low carbon/renewable systems.

In the Lodge Hill development, there are two distinct types of energy demand which must be met;

- Thermal, and
- Electrical.

Based on the assessment of the Masterplan and the proposed phasing plan, the energy demand is broken down into three main areas:

- Eastgate (includes circa 50% of Lodge Hill Central Hub)
- Westgate (includes circa 50% of Lodge Hill Central Hub)
- Chattenden

5.3.1 Thermal Demand

This type of energy is provided by thermal (hot or cold) systems which must be located on or near the site and designed to meet the load on the site (because heat is rarely distributed over great distances). Thermal systems include gas, oil and biomass fuelled combustion systems (which can also provide cooling), solar thermal or electrically powered heating and cooling.

Thermal demand can be divided into four main areas:

- Space Heating
- Other Heating
- Hot Water
- Cooling

Space Heating

Space heating is strongly seasonal. It can be provided in the form of warm air or water from a variety of systems including gas-fired and electrically powered heating. There are a variety of alternative low carbon/decentralised/renewable systems available to replace conventional warm water/air heating systems. Alternatively radiant heating may be required for which there are no ready low carbon replacements and so effectively requires gas or electrical heating.

Other Heating

Other heating, which some industrial processes require year round, will be strongly dependant on future occupant of requirements of B2 units and so is difficult to anticipate at this stage.

Water Heating

Water heating is typically a year round energy demand. As the development is largely residential, the hot water demand is expected to be high enough to justify use of district heating and CHP systems.

Cooling

Comfort cooling is a highly seasonal energy use. There are expected to be some comfort cooling requirements as there are a number of B1 type units. However, this will very much dependant on the future occupant requirements and detailed building design.

Close control cooling is typically associated with ICT equipment and results in a year round demand for cooling; this is anticipated to be relatively low. However, the ultimate demand is strongly dependant on future occupant requirements and is difficult to anticipate. If the energy demand is low as anticipated, we would expect the energy to be provided by conventional cooling systems.

Other cooling (e.g. for refrigerated storage), if applicable, is likely to be a year round demand; the requirement will be strongly dependant on future occupancy of B2 units and so is difficult to anticipate at this stage.

At this stage, as there is great uncertainty related to cooling energy demand, the overall anticipated energy demand has been broken down only into hot water and space heating energy demand. This will help to identify suitable energy technologies which could supply this demand.

Hot water and space heating energy demands for each of these areas are presented in Table 5.1.

Table 5.1 Summary of Annual Hot Water and Space Heating Demands for the Development

Area	Hot Water Energy Demand (MWh/year)	Space Heating Energy Demand (kWh/year)
Eastgate	4,170	7,254
Westgate	5,153	7,710
Chattenden	3,199	5,752

Figures 5.1, 5.2 and 5.3 present average annual hot water and space heating demand profiles for each of the aforementioned areas of the development.

Figure 5.1 Average Annual Hot Water and Space Heating Energy De mand Profile for Eastgate

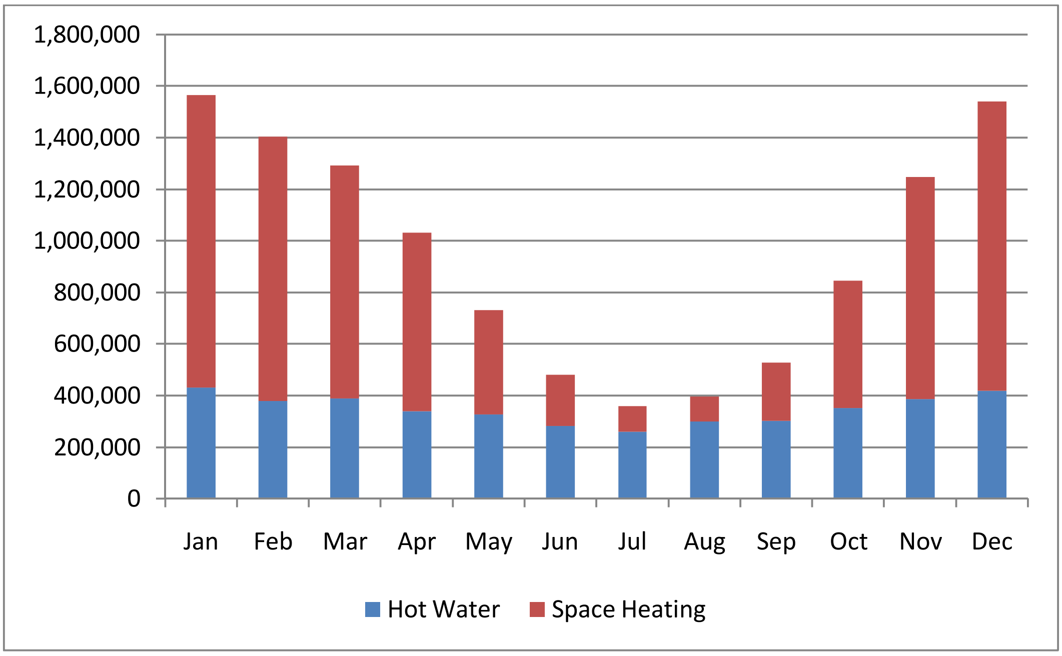


Figure 5.2 Average Annual Hot Water and Space Heating Energy Demand Profile for Westgate

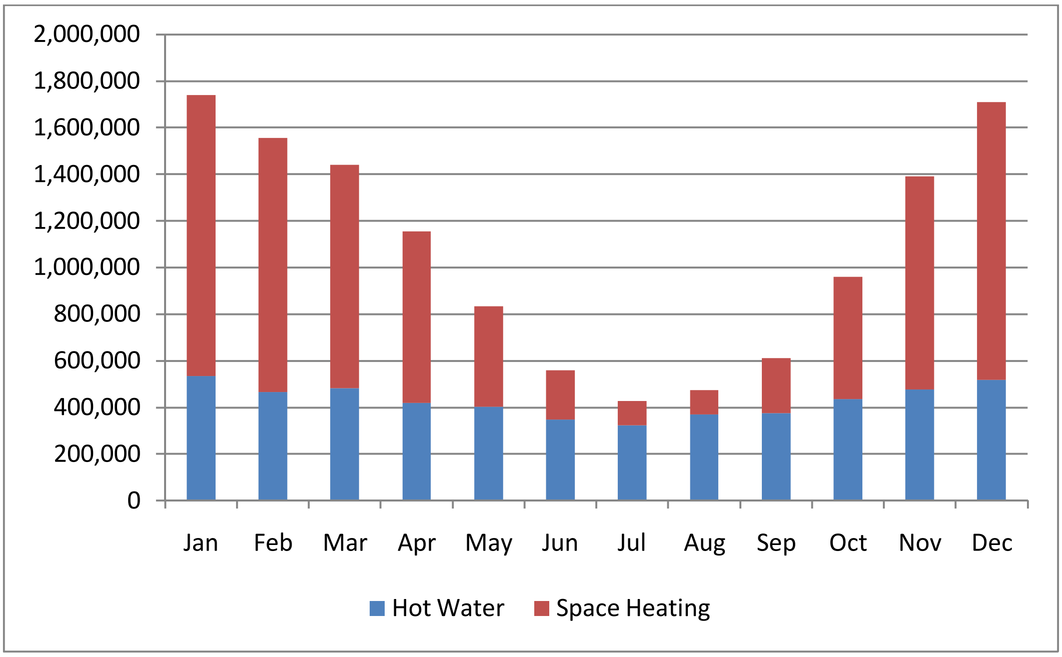
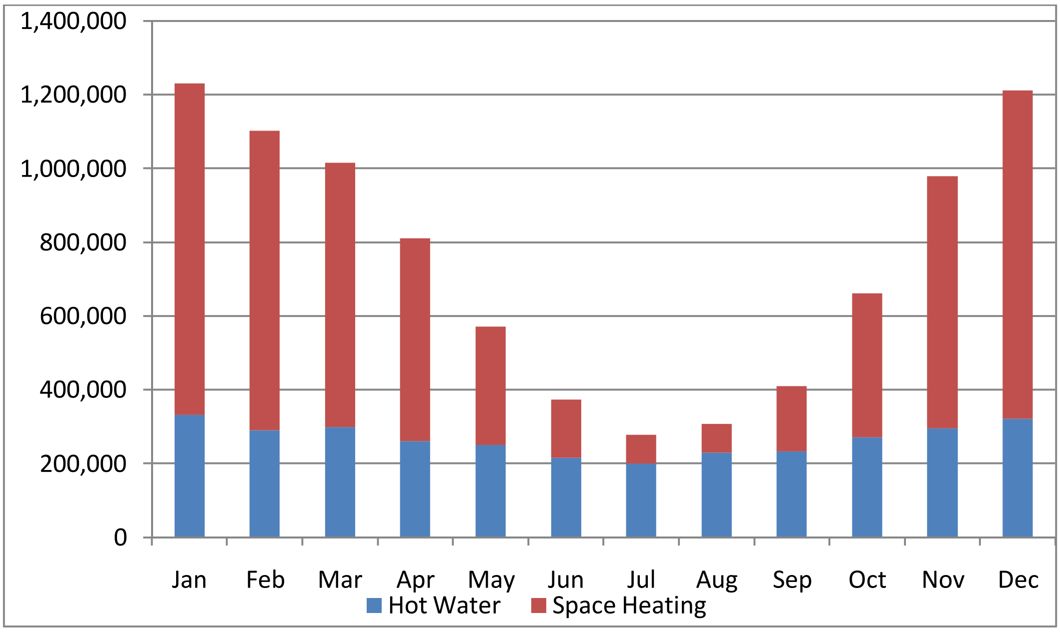


Figure 5.3 Average Annual Hot Water and Space Heating Energy Demand Profile for Chattenden



By assessing these thermal energy patterns for each area, some conclusions can be drawn regarding thermal energy supply. The assessment shows that hot water and space heating energy demand can be effectively provided by either centralised on-site or near-site energy generation connected to a district heating network.

Suitability of different on-site and near site options is discussed in the following sections of this document.

5.3.2 Electrical Demand

Electrical demand of the site could be provided by either electricity generated on-site, near site or via national electricity grid. It is preferable to produce as much electricity as possible on-site to maximise the value of electricity generated and minimise transmission losses (electricity supply companies currently sell electricity to consumers at a considerably higher rate than they pay to purchase excess generation). Hence, electricity generation also needs to take into account the likely load factors and consumption profiles.

At this stage, given that the details of the proposed development will be determined at a later stage, there is uncertainty around the precise electricity use, electricity demand profile has not been broken down and analysed in detail. This is usual and appropriate for an outline planning application. However, the total estimated electricity demands associated with regulated energy use for the three areas identified in 5.3 above, Eastgate, Westgate and Chattenden are summarised in Table 5.2.

Table 5.2 Summary of Estimated Annual Electricity Demands for the Development

Area	Estimated Electricity Demand (MWh/year)
Eastgate	3,752
Westgate	2,982
Chattenden	2,380

Electricity generation on the site from a technology selection point of view is less of a concern as any excess electricity generated on-site could be exported via the grid. If on-site electricity generation is not sufficient to cover energy demand, electricity from the grid will be utilised, as indicated in the Outline Planning Application Supporting Infrastructure Report.

5.4 Near-site Energy Generation Options

The development is approximately 8km away from an existing coal-fired power station at Kingsnorth which has low grade heat, some of which is currently wasted during the steam cycle in order to maintain efficiency.

In October 2006, E.ON announced to build two new cleaner coal units at Kingsnorth. It is understood that a new more efficient 1600 MWe coal-fired power station is planned comprising 2 No. 800MWe units, forming Kingsnorth 5 and 6. These are to replace an existing coal-fired power station which will come to the end of its useful life by 2015. It is anticipated that the new station will include carbon capture and storage technology and that district heating, up to 400MW (200MW from each unit) at a temperature of up to about 120ºC could be available.

It is believed that E.ON would be prepared to fund the offsite district heating infrastructure (from power station to the site boundary) if they are granted consent by the government to improve their coal fired power station. The consent has not yet been granted therefore this option cannot be progressed at present. However, this option should be investigated if the consent is granted in the future. An indication of how this option can be implemented in the future is summarised in the Outline Planning Application Supporting Infrastructure Report.

In addition, the development is approximately 8km away from an existing 792 MW Damhead Creek gas-fired power station, which has low grade heat which is currently wasted. The power station is located next to the Kingsnorth power station.

On 9 March 2009 Scottish Power announced plans to develop a second 1,000MW gas-fired power station adjacent to the current power station. In January 2011, the government has given consent for construction of the power station.

Scottish Power has advised they can provide sufficient waste heat energy from their power station with or without the extension to generating capacity. Scottish Power would expect the developer or an ESCo to fund infrastructure pipe work from the power station to the site boundary.

It is anticipated that the construction of the power station will commence in 2013 and finish in October 2016 which potentially can work well with the phasing of the development.

With the future potential for offsite waste heat being made available, it is considered advantageous to have an on-site district heating network that is able to be connected (subject to technical and commercial agreements) to either power station. This waste heat would be able to meet all domestic hot water and space heating demands for the development. However, it would not contribute to the 20% renewable target and carbon targets during later stages of the project. Therefore, on-site renewable energy sources would still be required to further reduce carbon emissions from the development and meet the renewable target as a minimum

Furthermore, if the waste heat is supplied from the Kingsnorth and/or Dam Head Creek power stations, it would avoid the need for any generation on site. In this instance, a pumping station with control and metering for the respective area will be required.

The development may have to sign a long-term contract to purchase heat from the power stations, although this could prove to be advantageous given potential fluctuations in future energy prices.

At this outline stage in the development process, legal structures and operation of the district heating network are still to be determined. Similarly, practicalities of connection, connection charges to the scheme, heat costs, carbon emission factor, maintenance procedures, etc will be established upon appointment of the district heating system operator. The level of detail provided in this report is considered to be appropriate for this stage in the planning and development process.

Further, it is intended that this report, alongside the Outline Planning Application Sustainability Report will be used to inform the design process in subsequent stages of the development, ensuring that the underlying objectives are maintained and targets delivered in an appropriate manner.

As there are many unknowns related to the near-site energy generation supplies, and their potential waste heat exports, it is difficult to assess viability of these near-site options. Therefore, it is necessary to identify and consider alternative on-site energy generation strategies which can achieve the required carbon and renewable energy targets if the near-site options are unfeasible. However, the potential opportunities to utilise waste heat from the nearby power stations, means that it is logical to consider an on-site energy strategy which incorporates a district heating network which can be connected to the power stations should the near-site energy supply options prove to be feasible in the future.

5.5 On-Site Energy Generation Options

There are a number of energy technologies which may be regarded as suitable for this development, and a combination of these can help to meet the energy demand and achieve the carbon emission reduction targets required. These technologies include:

- Gas-fired CHP
- Biomass fired CHP
- Biomass heating
- Ground Source Heat Pumps
- Solar Thermal
- Solar Photovoltaic
- Wind

5.5.1 Combined Heat and Power (CHP)

Cogeneration or Combined Heat and Power (CHP) systems are well established in the UK. The plant effectively operates as a boiler but whereas a boiler only produces heat, a CHP unit also produces electricity and it is this that provides displacement of grid electricity and brings CO_2 and running cost savings.

In order to fully utilise CHP, it is essential to recover as much heat as possible from the machine and to use the heat in a heating system or to provide cooling via absorption chillers. To be economically viable, the plant should be run for over 5000 hours per annum. The application of CHP therefore requires a demand for heating and hot water to be available year round. As the development is mainly residential of mixed density, the hot water demand is expected to be high enough to justify use of centralised CHP system connected to a district heating network.

Most CHP systems in the UK run on natural gas or diesel but there are other fuels which are technically feasible at this scale including biofuel, biomass and biogas.

Natural gas CHP engines can be adapted to run on biogas with minor technical changes. However, there is unlikely to be a constant supply source of organic matter (e.g. waste, food, sewage) to make this option feasible. There are a limited number of biogas suppliers which can deliver biogas to site which raises concerns with fuel supply security.

Carbonaceous material within biomass and residual wastes can be converted into “Syngas” by pyrolysis/gasification processes. Syngas can be used to run a CHP engine. However, there are a number of technical issues with gasifiers (e.g. poor reliability, poor quality of syngas unsuitable for reliable operation of CHP engines) making them unsuitable for the application. Currently, this technology at the scale required is under development and is not yet proven to be reliable and represents too great a technical risk at this time.

Liquid biofuels can also be used to run converted diesel CHP engines, however, there are similar concerns to biogas with security of supply and concerns over the sustainability of liquid biofuels (relative to the food vs. fuel debate).

Taking into account the aforementioned issues, biomass/biofuel CHP technology is not currently considered to be appropriate for the development. If a CHP system is considered, it is recommended that this should be a gas-fuelled option only.

5.5.2 Biomass Boiler

Biomass boilers are now regarded as a conventional form of technology with a wide range sizes and types to meet renewable targets. Biomass boilers use biomass as a fuel source, which is an alternative solid fuel to the conventional fossil fuels and has carbon emissions close to zero. Various types of biomass fuel are in use, the most common being wood chips, logs and pellets.

Biomass needs to be delivered to site in large trucks and the arrangements for supply and storage of the biomass fuel should be carefully considered. Biomass delivery will require suitable vehicular access for long trucks. It will also require a suitable biomass storage space but with careful architectural planning of the site this does not need to be a problem.

Choice of fuel type is also important. Logs would not normally be used in boilers at this scale. Pellet fuels have higher energy intensity, more consistent properties and are easier to transport and store. Pellet boilers also tend to be smaller, more efficient and slightly more reliable. However, pellets are harder to source and the cost of pellet fuel is currently higher than the cost of mains gas and hence can result in unnecessarily high heating bills that may discourage its use. Pellets are also more carbon intensive than wood chips, hence their use will lead to higher carbon emissions.

Wood chips are preferred in the UK as they currently cost less that natural gas and are readily available locally. However, it is recommended that any system is designed to take both pellets and chips.

A number of local wood chip suppliers have been contacted to identify whether the required quantities of biomass can be supplied locally. LC Energy and South East Wood Fuels have replied confirming possibility of wood chip supply of the required quantities. It should be noted that the situation may change in the futures especially when the Renewable Heat Incentive (RHI) is introduced.

Modern biomass boilers can achieve efficiencies of more that 85%. They can be fed automatically by screw drives from fuel hoppers or other mechanical delivery systems. The boilers are not as responsive to changes in heat demand as gas or oil boilers but this issue can be overcome by the use of thermal stores. The overall reliability and performance of well designed biomass systems can be as good as gas or oil fired heating and biomass boilers make a suitable replacement for these systems.

A biomass based energy strategy could be applied with independent boilers in each building or the buildings served could be connected to a centralised boiler via a district heating network. A per-building biomass boiler strategy will require several times more plant room space than centralised plant and could require reasonably involved management by the occupants in terms of maintenance and fuel deliveries. Therefore, it is more practical to have a single centralised communal boiler. Operation and management of such centralised communal boiler system can be carried out by operated by a third party (e.g. ESCo) who sells heat to tenants.

Communal biomass boilers can work well with CHP systems. This can help to improve security of energy supply and reliability of the overall energy system.

5.5.3 Ground Source Heat Pumps (GSHP)

The ground can be used as both a source of heating and a source for cooling. Ground source heating involves heat pumps, drawing heat from underground, whereas ground source cooling can either use heat pumps or make use of low temperature groundwater directly. Ground-source heat pumps (GSHP) are a proven technology, which is becoming more widely used and utilise the energy in the ground through a refrigeration cycle. Where GSHP are used for both heating and cooling, depending on the season, this can be a very efficient solution. GSHP can be open loop or closed loop.

Closed loop GSHP system comprises a sealed system of buried pipes normally containing brine or water/antifreeze solution. The solution is circulated continuously around a closed system.

Open Loop GSHP system uses groundwater which is taken from an aquifer to supply heating or cooling. The water is then returned to the ground (sometimes via a borehole sometimes via storm water drainage). Open loop systems require abstraction and discharge licences from the Environment Agency (EA).

GSHP systems which provide heating are most efficient when warming water to 35-40ºC. Their performance drops off rapidly at higher operating temperatures which means they are not ideal for providing domestic hot water (which must generally be stored at >65ºC to avoid risk of Legionella) but can providing space heating and cooling. GSHP heating systems are not quite direct replacements for conventional boilers because they operate at slightly lower temperatures. This means that

- Space heating systems need to be designed to take account of the lower operating temperature, therefore requiring greater areas for dissipation of the heat to compensate. Such a system may incorporate underfloor heating.
- Any hot water systems connected to the GSHP require special consideration to ensure water is raised to temperatures to avoid legionella and other bacterial growth.

In terms of energy demands, GSHP cooling systems are direct replacements for conventional chillers/refrigeration. The principal issue is that systems are more expensive than conventional cooling although long term energy savings should mean systems pay for themselves relatively quickly.

GSHP systems which provide heat are likely to be suitable only at building level. As they operate at low temperatures they are not very compatible with higher temperature technologies and systems such as biomass boiler, CHP or waste heat supply system. At building level, either open loop or closed loop is possible. In general closed loop systems are simpler and cheaper to construct, and do not normally require EA consent.

Unless one of the tenants is a prestige office building requiring significant cooling or chilled distribution warehouse, there is not anticipated to be a significant cooling load. However, if there is a significant cooling load, a GSHP cooling system could be considered. Such a system could reduce running costs substantially. An open loop cooling system is likely to be preferred to a closed loop as it has the ability to generate a cold sink within the groundwater, although this would require abstraction and discharge licenses from the EA.

Although, GSHP systems are considered as renewable energy systems they utilise electricity to produce heat or cooling. If the electricity does not come from a renewable energy source, GSHPs will not be carbon neutral.

This issue becomes important where there is a requirement to achieve zero carbon target, which makes GSHPs to an extent less favourable over other renewable energy technologies.

It is believed that ground source cooling with or without heat pumps and with or without reversibility may have a place in the development as they can provide efficient and low carbon cooling for the development and it is recommended to investigate further the feasibility of this technology. This will require investigation of the geology and hydrology of the site and preliminary consultation with the Environment Agency.

The consideration of such a system would need to be balanced with the water needs of the site and local area, since it has been identified as an extremely water-stressed area.

5.5.4 Solar Thermal

The hot water requirements for a large scale development of this nature are not well suited to solar thermal. Solar thermal systems will not generally be capable of supplying 100% of the hot water demand of a home and so will need a top-up/back-up system of some kind. Therefore, it is unlikely to be worthwhile to install solar thermal on-site.

5.5.5 Solar Photovoltaic (PV)

Photovoltaic (PV) modules convert daylight directly into electricity. PV systems are suitable for any type of building but they require significant unshaded south facing space as even a small shadow may significantly reduce output. PV systems can be incorporated into the units in various ways: on sloped roofs and flat roofs, or in facades, atria and shading devices.

PV systems should ideally face south with an incline of 30º, although orientations within 45º of south and other angles can still generate high outputs. The panels should be ideally mounted on the roof of the units to facilitate correct orientation and minimise shading. These systems could be installed on a per-building or site-wide basis.

The technology is easily scalable which means that the required amount can be installed to meet the renewable energy requirements and the carbon reduction targets. The only technically limiting factor on the maximum size of PV system is the available south facing roof area as surplus electricity can be fed back into the grid.

PV technology tends to be the most expensive renewable technology per unit of energy generated. However, with introduction of Feed-in-Tariffs (FIT), economics of the system has significantly improved and if the system is designed correctly, reduced payback periods can be achieved.

PV technology is technically viable and will reduce running costs for tenants. As the system produces renewable electricity it can play a primary role in achieving renewable energy and carbon reduction targets.

5.5.6 Wind Power

On-shore wind technology is currently one of the most cost-effective renewable energy technologies. This statement is generally applicable to the large scale installations due to reduced cost per kW installed. Most wind turbines are installed in non-urban areas for environmental and technical reasons. The capacity of wind turbines can range from 500W to more than 2.5MW. Generally speaking, the larger the turbine, the more cost-effective but also the more complex it is to find suitable space and obtain planning permission.

Installation of large wind turbines would be a major contributor to meeting renewable energy obligations and carbon reduction targets, however there are likely to be some significant barriers to installing wind power within the site. As the development will be densely populated, issues such as development restriction, noise, telecoms interference and visual impact may restrict installation of wind turbines.

Preliminary assessment of the wind source shows that the annual wind speed is circa 6-6.5 m/s which is considered to be marginal for technical viability of wind turbines. Taking into consideration the marginal wind speeds, sterilisation of large areas of land around the wind turbines and potential planning issues including development restrictions, visibility, noise and overshadowing implications, the use of large scale wind turbines are not considered favourable for the site.

5.6 Summary of options for decentralised, low carbon and renewable energy systems

The adoption of a combination of energy generation options has the potential to meet the energy demands, provide flexibility and achieve the renewable and carbon emission reduction targets.

For the reasons discussed above, it may be appropriate to supply the domestic hot water and space heating demand of the Lodge Hill development by a district heating network. This approach can help to ensure that if feasible, the development can easily connect and utilise waste heat from the near-site power stations without a need to redesign the system. The approach can also provide flexibility to allow growth in energy demand and extension or modification of the energy supply system in response to energy policy changes.

Implementing a district heating network strategy will ensure sufficient and relatively consistent thermal demand allowing use of a combined heat and power (CHP). At present, it is considered that one of the most technically and economically feasible options would be to use a gas-fired CHP system.

Use of district heating and gas-fired CHP technology will contribute significantly to the carbon emission reduction targets. As the biomass CHP technology develops and becomes technically and economically viable and biofuels supply chain matures, biomass CHP system can potentially be integrated in the district heating network, which would help meeting the 20% renewable energy target.

Failing this, there are a number of potential renewable and low carbon technologies which can be installed on-site to further reduce carbon emissions in combination with the district heating network. The technologies below should be considered in the following order of preference:

1. Biomass boiler
2. Photovoltaics
3. Ground source heat pumps (reversible or, more likely, cooling only)

Ground source heat pumps offer the potential to contribute to renewable and carbon reduction targets, although, as discussed above the conditions of application need further evaluation during the detail design phase of the development, upon finalisation of the exact heating and cooling requirements for each individual building within the development.

5.7 Allowable Solutions

Allowable solutions have been introduced to offer flexibility to developers, providing them with an option to offset remaining emissions, when other on-site options are not considered technically and commercially feasible.

Allowable solutions are central to the overall policy of ensuring that achieving zero carbon is affordable.

The Government has not yet defined the scope or price of allowable solutions. It is also unclear as to how allowable solutions may be delivered. However, Zero Carbon Hub has recently announced its proposals for a framework for allowable solutions which provide some indication of what might be expected from the final policy.

According to these proposals, the allowable solutions are split into three areas:

1. On-site allowable solutions – This might include measures such as smart appliances, site-based heat storage, electricity storage, waste management systems, LED street lights, flexible demand systems, etc
2. Near-site allowable solutions - This might include measures such as retrofitting low/zero carbon technologies to communal buildings, creation of local sustainable energy projects/infrastructure such as district heating or wind turbines, communal waste management, local energy storage, electric vehicle charging, etc.
3. Off-site allowable solutions - This might include measures such as investing in energy from waste plants, low carbon electricity generation, district heating pipe-work, low carbon cooling, energy storage, flexible demand projects to counterbalance intermittent renewable energy provision, etc.

Allowable solutions will need to deliver the residual carbon emissions equal to that emitted by any new development. It is understood that the housing developers would pay an allowable solutions provider to deliver the required reductions. There will be a cap on the carbon price which would encourage competition between allowable solution providers ensuring that money is invested in the most cost-effective solutions. At present, a cap of £75 per tonne of CO_2 over a 30 year period is proposed for the cost of allowable solutions. However, the cap has not been defined yet which can make considerable difference to the total cost of zero carbon and the final energy strategy for the development.

Based on the available information, it can be concluded that allowable solutions may be an important part in achieving the development’s zero carbon targets. Again, the extent to which allowable solutions may be implemented within the development will be determined in the detail design stage of the development, since it will then be possible to establish more accurate energy demands for the buildings.

At this stage, the option to consider the future incorporation of “Allowable Solutions” in the resulting energy strategy is consistent with the overall strategy and appropriate for this stage in the design of the development.

5.8 Preferred Option

Assuming on-site energy provision for the development, the preferred option is expected to be district heating network powered by gas-fired CHP, biomass boilers and top-up/back up gas boilers. This arrangement can help to meet the hot water space heating demand as well as some portion of electrical demand of the site. It can also provide flexibility allowing connection and utilisation of the near-site waste heat options (if these options become feasible in the future) and gradual growth in energy demand. This preferred option could be one of the most practical and cost effective approaches in delivering low carbon and renewable energy targets, in combination with other low carbon/renewable energy technologies (e.g. photovoltaic's and GSHP/ASHP) in response to current and future energy policy.

Regardless of whether the strategy uses on-site or near-site energy options, the development will need to include both a High Voltage electrical and a district heating network.

Based on the proposed development and the indicative phasing, three energy centres are considered appropriate. Three energy centres offer a strategic advantage as these may be utilised as full energy generators or as boosters and control of the offsite sources.

The energy centres will be constructed to allow modular plant and equipment to be added as the energy demands increase and they will also be linked to maximise availability and provide cover whilst allowing for routine and breakdown maintenance. They will also be sized to allow for peak demand and comprise different technologies whilst ensuring that the CO_2 reduction targets are achieved. To allow for the integration with the development and ensure energy availability, the proposed energy centres will be strategically located to supply the following areas of the development;

- Energy Centre 1 - Eastgate (includes circa 50% of Central Hub)
- Energy Centre 2 - Westgate (includes circa 50% of Central Hub)
- Energy Centre 3 - Chattenden

For the off-site waste heat supply options, a similar logic would apply.

During the development of each phase and as the demand increases, the hire or purchase of containerised generators and/or boilers could be considered in the short term. These could be relocated to the final energy centres later in the development.

Cooling load for the development can be provided either by absorption chillers located near cooling loads (which will utilise heat from the district heating network) or by ground Coupled cooling systems as described above. The cooling load can also be provided through conventional direct expansion units at a point of use, although this is less preferable since it is more carbon-intensive.

Carbon emissions from electrical demand of the site and those which will arise from the operation of the CHP unit, the biomass boiler and gas boilers can also be partially offset by roof mounted PV panels. Preliminary assessment of renewable energy generation potential which can be provided by PV panels suggests that they could offset the remaining carbon emissions. However, this approach is unlikely to be practical or cost effective.

The adoption of gas-fired CHP in combination with biomass boilers has the potential to achieve up to 70% reduction in regulated carbon emissions. Utilising PV systems, absorption chillers, ground source and air source heat pumps can further reduce regulated carbon emissions.

Allowable solutions may then be used to off-set the remaining carbon emissions to achieve zero carbon beyond 2016.

In any case, whatever overall energy strategy approach is finally selected, it should be viewed in the context of being technically and economically feasible.

5.9 Moving forward

The level of detail which is provided within this report is appropriate to the Outline stage in the planning process. The report demonstrates that an assessment of potential energy technologies and energy strategy options has been undertaken which, together with an estimate of the anticipated energy demand, indicates which technologies and energy options can be suitable for the development.

In addition to meeting the energy demand for the development, this report assesses the appropriateness of technologies in meeting the carbon dioxide emission objectives, security of supply and financial implications for the development.

This report provides an outline energy strategy approach which is both felxible and robust, without being oevrly limiting in the technologies which can be implemented, and allows further refinement in the detail design stage of the development. The proposed outline energy startegy and the proposed technical solutions are subject to technical and commercial feasibility. The strategy may change as other technologies, solutions or options may arise during the detailed design or the construction stages of the development which could be appropriate to incorporate in the design.

It is anticipated that conditions will be applied which require that subsequent detailed and reserved matters applications will provide updated Energy Strategy Reports which indicate a greater level of certainty and detail on how the development will deliver the underlying objectives outlined in this report. This will be possible since the design of the individual buildings, their use and energy requirements will be more accurately defined at that stage.

6 CONCLUSIONS

There are many issues to consider in selecting the final approach including a more detailed assessment of the energy needs (which will only be possible as the design is progressed). This will need to consider the possibility to connect the site to near-site waste heat options, identification of needs of possible tenants, potential system operators, and capital and operational costs. Issues related to allowable solutions such as availability of options and the carbon cap price will also need to be taken into account.

However, whatever final energy solution is adopted for the development, it should focus on the following key factors:

1. Minimise energy demand;
2. Supply energy efficiently;
3. Incorporate renewable energy systems;
4. Ensure flexibility and long term security of energy supply; and
5. Consider use of allowable solutions.

As a primary objective, the site's energy demand should be reduced by incorporating various passive and energy efficiency measures into building design. The preliminary energy efficiency assessment indicates that it is possible to reduce carbon emissions by circa 15.5% (from the baseline) by applying different energy efficiency measures. Based on the reduced energy demand, appropriate low carbon and renewable energy solutions have been considered.

Currently, there are many unknowns related to the near-site energy generation supplies. This makes it is difficult to assess viability of the near-site energy supply options. However, as there are potential opportunities to utilise waste heat from the nearby power stations, it is logical to consider an on-site energy strategy which incorporates a district heating network. This approach will enable possible future utilisation of waste energy use from the near-site energy generation facilities should these options prove to be feasible.

The adoption of a combination of on-site energy sources has the potential to meet the energy demands, provide flexibility and achieve the carbon emission reduction targets. At present, the preferred option is expected to be district heating network powered by gas-fired CHP, biomass boiler and top-up/back up gas boilers. This arrangement will help to meet the hot water and space heating demand as well as some portion of the electrical demand. It should also enable easy connection and utilisation of the near-site waste heat options should these options become available and feasible. It will also facilitate gradual growth in demand to be met. It is considered practical and cost effective approach to delivering low carbon and renewable energy targets in combination with other low carbon/renewable energy technologies in response to energy policy changes.

Cooling load for the development can be provided either by absorption chillers and/or by ground source heat pumps. PV systems can be installed in individual buildings as and when required to meet the carbon reduction targets.

By implementing an on-site district heating strategy powered by gas-fired CHP, biomass boilers and top-up/back up gas boilers, it is possible to achieve circa 60% reduction in regulated carbon emissions. Further emission reductions can be achieved by using individual PV systems, abortion chillers and ground source heat pumps.

Further, following the implementation of passive design and energy efficiency measures, the incorporation of PV and Biomass boilers will 20% of the remaining energy demand for the site.

It is anticipated that any remaining regulated emissions will be offset by allowable solutions.

The above approach satisfies, and often exceeds the national, regional and local policy requirements to address the following:-

- Reduction in energy demand through the incorporation of passive design to maximise the thermal efficiency of buildings and reduce the need for mechanical heating and cooling systems;
- The incorporation of energy efficiency measures to further reduce energy demand;
- Incorporate CHP in developments;
- Assisting in achieving at least Code for Sustainable Homes level 3 and BREEAM "very good"
- Achieve 20% of the remaining on-site energy demand through on-site renewable energy sources.

The final approach taken to meeting the energy demands and the carbon targets will be decided as the scheme design is progressed. Further detailed design work in collaboration with the design team will be required to confirm the final strategy and determine sizes of plant, CHP engines and boilers. The approach may continuously evolve as other technologies, solutions or options may arise during the detailed design or the construction stages of the development which could be appropriate to incorporate in the design subject to their technical and commercial feasibility.

In addition, it should also be noted that the Government is still discussing the definition of allowable solutions and how zero carbon may be achieved, through the use of allowable solutions. Outcomes of these discussions are expected to be published later in 2011.

The inherent flexibility of the strategy outlined above provides scope to take account of the finalised definition for allowable solutions, whilst ensuring that the underlying objectives are not jeopardised.