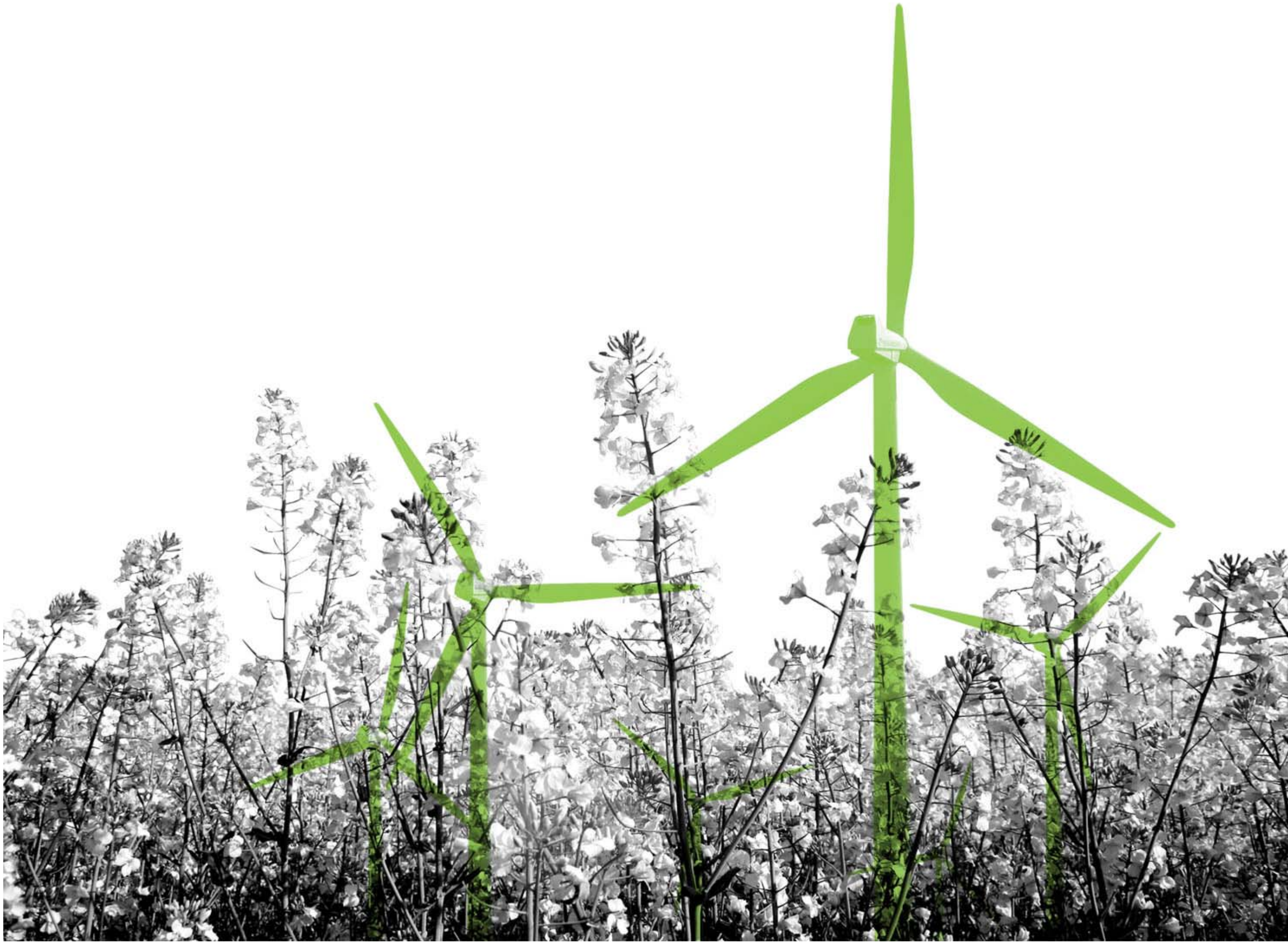

Climate Change, Site Development and Energy Infrastructure Study for Haringey

London Borough of Haringey

March 2010

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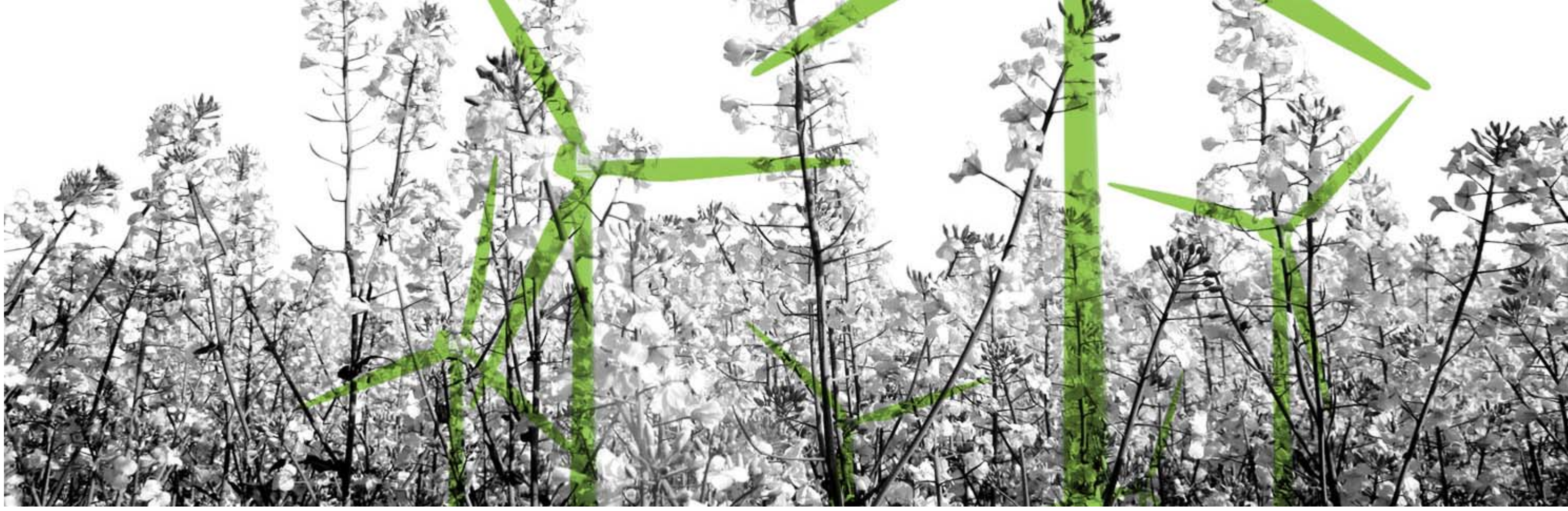


Executive Summary

1 Executive Summary

This study was undertaken to provide evidence base for policy development for the emerging Core Strategy of the Local Development Framework. The aim of the study is to assess the capacity for the incorporation of low and zero carbon technologies and decentralised energy generation within new developments in Haringey. Four potential policy options were reviewed, these covered targets percentage reductions in CO_2 emissions, Code for Sustainable Homes (CSH) and BREEAM targets, requirements for connection to district energy networks and contribution into CO_2 offset funds. From these a number of possible policy's, including percentage reductions in CO_2 emissions from renewable energy, improvements above building regulations (in line with the CSH) and the promotion of decentralised energy solutions, were selected for testing on a range of development sites in the Borough to assess the technical and financial implications.

The sites selected for testing were chosen on the basis of their representative nature as well as the range of different scales, uses, opportunities and constraints that they presented. Using a Microsoft Excel©-based tool the energy demands, CO_2 emissions, possible energy efficiency improvements, potential to incorporate CHP or district energy and the opportunities and implications of the application of different low and zero carbon technologies were analysed.

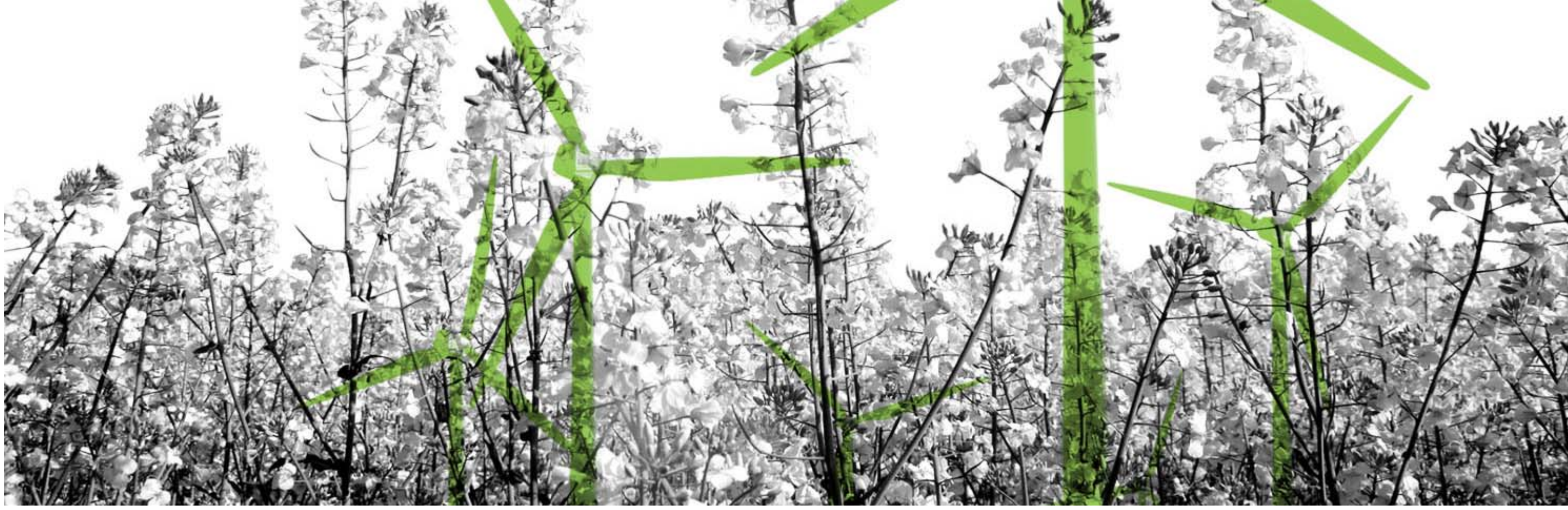
The results of the study suggest that adherence to the London plan policies enforcing the use of energy efficiency measures, the hierarchy of heat delivery favouring decentralised energy generation and supply and the implementation of a 20% or higher CO_2 reduction target to be met from on-site renewable technologies would deliver significant CO_2 savings and low carbon energy infrastructure to the Borough.

Targets relating to the Code for Sustainable Homes or BREEAM (either focussing only on the energy requirements or on the entire assessment criteria) could also be implemented and would be compatible with this approach. The Code for Sustainable Homes mandatory energy standards for both Level 3 (25% reduction in regulated emissions from Building Regulations 2006) and Level 4 (44% reduction), delivered from on-site measures, were found to be exceeded in most cases where the scheme met the London Plan energy policies and delivered at least a 20% reduction from on-site renewable energy generation. The mandatory energy standard for Code Level 5 (as it is currently defined), which requires a 100% reduction in regulated emissions achieved through measures on-site, was found to be difficult to achieve on some of the sites.

For future policy directions and capacity, it is important to note that proposed changes to Building Regulations and the definition of Zero Carbon may result in a change to the methodology of compliance with a 70% required from on-site measures and the remainder achieved through approved measures off-site ('allowable solutions'). It is envisioned that the

Code for Sustainable Homes will be revised to align with the approach taken in the updated Building Regulations although this is unlikely to be confirmed until the final proposals are confirmed.

One of the key recommendations resulting from the study is that the implementation of district heating systems and the use of combined heat and power systems should be enforced for all suitable sites. This will be crucial in the long term strategy (recommended in the SEA/RENUE Carbon Reductions Scenarios) for the development of wider district heating networks across the Borough and those extending beyond the Borough. Where this is not technically feasible, communal systems should be implemented to enable future connection as energy networks develop. To enable and support wider networks to be created the Council should engage with developers to provide information on nearby buildings (particularly schools and other public buildings with high heat demands) which could be connected when networks are installed within new developments, thereby increasing its viability and beginning the process of wider network expansion. The London Borough of Haringey has been selected by the London Development Agency for support for a feasibility study for development of decentralised energy networks which should identify more specific opportunities for delivering district energy systems and will therefore strengthen the evidence basis to support this policy approach. The analysis presented in the study suggests that PV and biomass are likely to be the favoured solutions for achieving compliance with the low and zero carbon generation targets (along with gas-CHP where feasible) due to the fact that they are likely to offer the most significant CO_2 savings for the lowest cost, however other technologies may be suitable. However, PV and Biomass but both could be limited by constraints on their use. The entire Borough is designated as an air quality management area (AQMA) and as such there needs to be clear guidance on how developers must demonstrate that a proposed biomass system does not result in exceedences of air quality limits, and address the impacts of vehicle movements for the delivery of fuel. The use of photovoltaics (and solar hot water) may be constrained by Conservation Area designations, of which there are a number across the Borough. Again, clear guidance and dialogue will be important to inform developers on the use of photovoltaics (and solar hot water), enabling and encouraging this resource to be maximised without adversely affecting the local area.



Introduction

2 Introduction

Haringey Borough Council is currently developing the Core Strategy of its Local Development Framework, which will guide development in the Borough for the next 20 years. Haringey is also in the process of identifying new development sites within the Borough that will deliver the growth and change that will be required over this period. Mitigating the CO_2 emissions arising from new development is a key planning policy objective at the national and regional level and Haringey are seeking to implement local policy to address this issue within the Core Strategy, through a policy requirement for all new developments to incorporate energy efficiency, low and zero carbon measures and Decentralised energy solutions.

The Climate Change Act was approved by Parliament on 26 November 2008 and establishes a legally binding target for the UK to cuts its CO_2 emissions by 26% by 2020 and 80% by 2050. The Planning Policy Statement 1 (PPS1) supplement on Planning and Climate Change, published in December 2007, sets out how regional and local planning policies should contribute to delivering these emission reductions. It specifically states that planning authorities should consider opportunities within their core strategies to add to the policies and proposals set out with the regional spatial strategy, where local circumstances may allow further progress to be made towards delivering this key planning objective. The London Plan is strong in the area of energy policy, ensuring that proposals follow a hierarchical approach to first reduce energy demand, then ensure efficient supply and finally incorporate renewable energy technologies. For developments which are referable to the GLA, a 20% reduction on CO_2 emissions from renewable energy technologies is required. Under the Haringey's saved UDP policies (July 2009), this target is also applicable to major development proposals determined by the Local planning authority. The most recent update to the London Plan (consolidated with alterations since 2004, adopted 2008) provides further support for the incorporation of stretching targets at local level.

Early consultation of Haringey's Core Strategy options included questions on climate change and decentralised energy generation. In general the public and stakeholders responded positively in favour of setting targets to encourage investment in decentralised and low and zero carbon energy infrastructure.

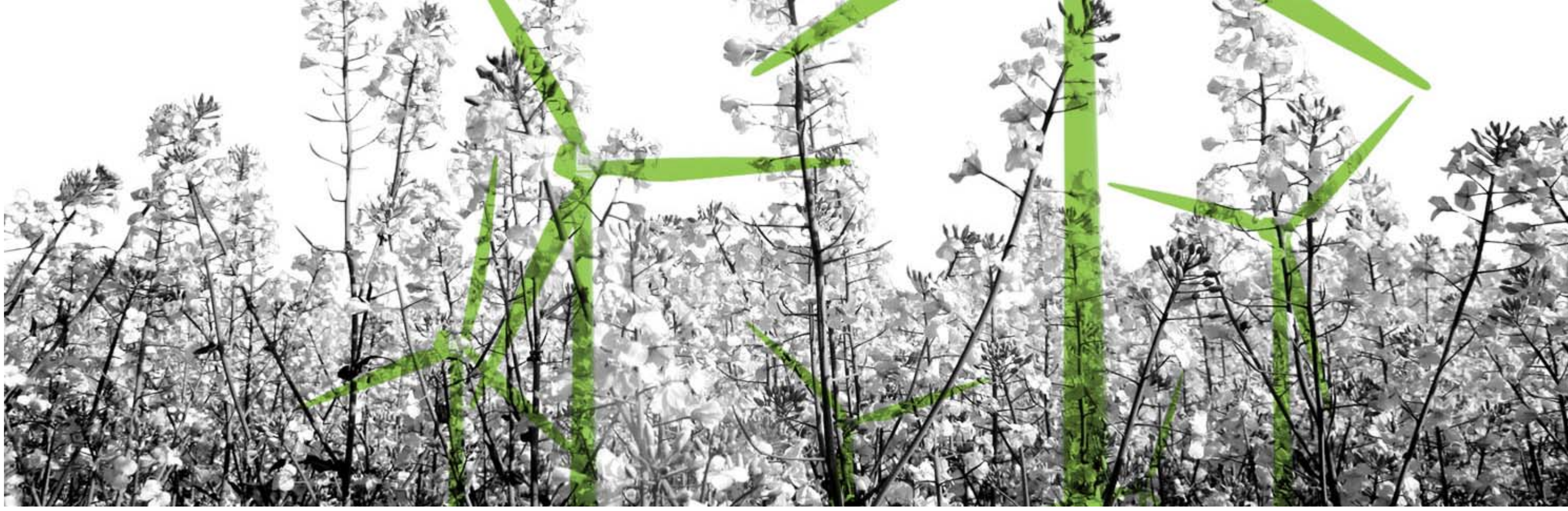
The Council's Greenest Borough Strategy (adopted in 2008) also promotes sustainable design and construction of new developments, and low and zero carbon technologies.

To ensure that policy is set at a level that delivers the objective of reducing the CO_2 emissions from the Borough but is achievable without significant implications on the delivery of other policies and objectives, it needs to be tested. A robust evidence base supporting the policy is required to identify the technical and financial implications and to ensure that the policy can be justified if an objection is raised.

AECOM were commissioned by Haringey Borough Council to undertake a study to assess the impacts, technical feasibility and indicative costs of implementing policies within the upcoming Core Strategy of the Local Development Framework to require the incorporation of low and zero carbon technologies and decentralised energy generation within new developments in the Borough.

The approach taken in this study was to select a representative but diverse sample of potential housing and mixed use sites within the Borough, for which there is a rough indication of the potential development scenarios, and to assess both the feasibility and potential implications of implementing possible policies. The full methodology for the study is outlined in Chapter 6.

This study only looks at the individual sites selected and does not cover the wider potential across the Borough for implementing decentralised or low and zero carbon technologies, however it builds upon previous studies commissioned by Haringey which do have a more Borough-wide focus. These include the Carbon Reduction Scenarios produced by SEA Renue, which has already investigated the wider potential for large scale community heating networks serving the sites such as Haringey Heartlands, St Ann’s General Hospital, Tottenham Hale and Central Leeside as well as Heat Mapping studies that have been carried out across London.



Policy Review

3 Policy Review

There is now a comprehensive range of legislation and policy at various scales which supports the development and implementation of decentralised low carbon and renewable energy policy and targets.

3.1 National

3.1.1 The Climate Change Act (2008)

The Climate Change Act sets a legally binding target for reducing UK carbon dioxide (CO_2) emissions by at least 26% on 1990 levels by 2020 and at least 80% by 2050. To deliver this act, planning policy in future years is likely to introduce further measures to support development of a low carbon and renewable energy supply.

3.1.2 UK Renewable Energy Strategy (July 2009)

The UK Renewable Energy Strategy (White Paper)[1] describes how the UK will meet its legally binding target to supply 15% of all of the energy it uses from renewable sources by 2020. This target is anticipated to be achieved by using renewable energy technologies to supply:

- Over 30% of our electricity
- 12% of the heat we use
- 10% of energy for transport

The strategy includes the following actions to help achieve these targets:

- *Planning process:* establishing a new planning process for nationally significant infrastructure projects (as introduced in the Planning Act 2008, see below); support for English regions to develop evidence-based strategies for achieving 2020 renewable energy targets; developing skills and providing resources to support swifter development and implementation of regional and local energy planning policy; helping to resolve environmental impacts of renewable energy technologies and address spatial conflicts with other uses such as radar and navigation.
- *Establishing the Office of Renewable Energy Deployment*, to work with other Government departments and stakeholders to remove barriers in the planning system, strengthen the supply chain and stimulate investment.

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[1] The UK Renewable Energy Strategy (DECC, July 2009)

- *Financial mechanisms:* extended Renewables Obligation for large scale renewable electricity generation; amended Renewable Transport Fuel Obligation; Renewable Heat Incentive and Feed-In-Tariffs to pay a guaranteed premium for each unit of renewable heat or small-scale renewable electricity generation.
- Investing in emerging technologies: supporting offshore wind, marine energy and advanced biofuels; investing in the Severn Estuary tidal power project.

3.1.3 Draft Heat and Energy Saving Strategy

The Draft Heat and Energy Saving Strategy was published for consultation in February 2009. It aims to ensure that emissions from all existing buildings are approaching zero by 2050.

The draft strategy proposes a new focus on district heating in suitable communities, removal of barriers to the development of networks, and encouragement of combined heat and power and better use of surplus heat through carbon pricing mechanisms. It also refers to extending the Building Regulations to require energy saving measures to be carried out alongside certain types of building work on existing buildings, and proposed a new voluntary code of practice with the building trade on energy efficiency and low carbon energy.

It also suggests a new way of coordinating improvements to homes and communities, house-by-house and street-by-street. This would take the form of a ‘whole house’ package for all existing homes by 2030, which would provide energy saving measures such as insulation, and renewable heat and electricity as appropriate. It would also offer information and advice to help people make changes to save energy and money, and new means of financial support to allow the cost of investing in energy savings and renewable energy for homes to be offset by future savings on energy bills.

The summary of responses to the consultation indicates broad support for the draft strategy, with emphasis on the need to support those in fuel poverty, coordinate measures targeted at householders and ensure that financing mechanisms are clear and easy to use. Some of the proposals in the Drafts Heat and Energy Saving Strategy have been taken forward in the Low Carbon Transition Plan and related documents, while DECC has announced an intention to publish further proposals by the end of 2009.

3.1.4 Zero Carbon Homes and Non-Domestic Buildings Consultation (2008) and subsequent

The Zero Carbon Homes and Non-Domestic Buildings consultation seeks to clarify the definition of zero carbon that will be applied to new homes and buildings through the building regulations.

The government announced in July 2009 that the Zero Carbon Definition will follow the methodology outlined in the 2008 consultation. Currently, the proposed residential Building Regulations correspond to the Dwelling Emission Rate (DER) targets set out in the Code for Sustainable Homes, for levels 3, 4 and 6 (see Figure 2):

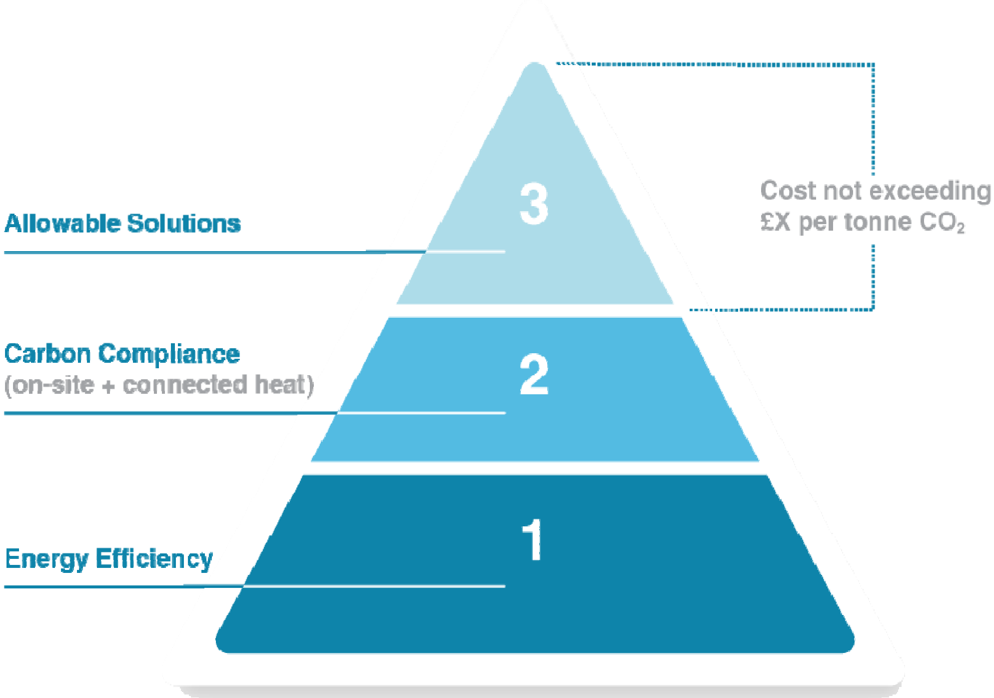


Figure 1: The Government's proposed methodology for delivering Zero Carbon buildings

This approach proposes that zero carbon should be achieved through three steps, Energy Efficiency (covering the building fabric), Carbon Compliance and Allowable Solutions. The energy efficient requirements are not yet fully defined but a Task Group from the Zero Carbon Hub has proposed that this cover only space heating and cooling from building fabric elements using a energy consumption metric (kWh/m^2/year).

The Carbon Compliance requirement has been set so that, in combination with the Energy Efficiency improvements (Step 1), it will deliver a total reduction of 70% compared to the 2006 Building Regulations Target Emission Rate (TER). This will require either more fabric or other energy efficiency measures, onsite low or zero carbon energy technologies or connection to low carbon sources of heat or electricity.

Allowable Solutions will cover the remaining carbon emitted from home for 30 years. These have been listed to include:

- Additional Carbon Compliance
- Energy efficient appliances
- Advanced building control systems
- Exports of low carbon or renewable heat
- Investments in community heat infrastructure

3.1.5 *PPS: Planning and Climate Change – Supplement to PPS1: Delivering Sustainable Development (2007)*

The Climate Change PPS requires regional planning bodies to:

- Consider how the spatial strategy will support any regional targets on climate change (paragraph 12);
- Consider the potential to build more efficient energy supply and increasing contributions from renewable and low-carbon energy sources into new and existing development (paragraph 13);
- Provide a framework for sub-regional and local planning to focus substantial new development on locations where energy can be gained from decentralised energy supply systems, or where there is clear potential for this to be realised (paragraph 13); and
- Ensure opportunities for renewable and low-carbon sources of energy supply and supporting infrastructure, including decentralised energy supply systems, are maximised (paragraph 13).

As part of Local Development Framework Core Strategies, the Climate Change PPS states that planning authorities should:

- Consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure. Care should be taken to avoid stifling innovation including by rejecting proposals solely because they are outside areas identified for energy generation (paragraph 20); and
- Expect a proportion of the energy supply of new development to be secured from decentralised and renewable or low-carbon energy sources (paragraph 20).

The PPS presents further opportunities at the local level. Local Development Orders (LDO) can be applied by planning authorities to extend permitted development rights across whole local authority areas or to grant permission for certain types of development. Although there is little experience of local planning authorities having used LDOs the PPS suggests that the Government is keen on them being used stating that: “planning authorities should give positive consideration to the use of Local Developments Orders to secure renewable and low-carbon energy supply systems” (paragraph 21).

In selecting the suitability of sites, the PPS adds that planning authorities should take into account the extent to which existing or planned opportunities for decentralised and renewable or low-carbon energy could contribute to the energy supply of development (paragraph 24).

Planning authorities should have an evidence-based understanding of the feasibility and viability of low-carbon technologies to supply new developments (paragraph 26). They may need to work with industry to make their own assessments. The PPS requires development plans to set out a target percentage of energy to be used in new developments to come from decentralised, low carbon energy sources (paragraph 26). These targets should consider the low-carbon energy potential of particular development areas, but also potential within the existing stock. They should also consider the potential for other existing or proposed decentralised energy networks to connect to a wider network (paragraph 27). This should be discussed with relevant stakeholders, including the local planning authorities.

3.1.6 The Planning and Energy Act (2008)

The Planning and Energy Act came into force in 13th November 2008 and enables local planning authorities to set requirements for energy use and energy efficiency in local plans. While adding little to the provisions of the Climate Change PPS, the Act sets in statute the role of planning bodies in setting energy targets.

3.1.7 The Recent Planning Acts (1990, 1991, 2004 and 2008)

Planning and Compulsory Purchase Act 2004 places sustainable development at the heart of the planning system. Implementation of the Act is guided by Planning Policy Statements (PPS) covering a range of issues. In addition to the Climate Change PPS outlined above, those of particular relevance are:

- PPS3 (housing) sets out policies on increasing housing supply and density.
- PPS11 (Regional Spatial Strategies).
- PPS12 (Local Spatial Planning)
- PPS22 (Renewable Energy)

More recently, the Planning Act 2008 received Royal Assent on 26th November 2008. This has introduced a new planning approval process for “nationally significant infrastructure projects”, which for energy projects would mean schemes over 50MW. Such projects will be required to obtain development consent from the new “Infrastructure Planning Commission”, but will be exempt from the current requirements to obtain planning permission and other statutory approvals defined by section 33(1) of the Planning Act. Policy for the purposes of the Planning Act will be set out in National Policy Statements (section 5 (1-2)). No national Policy Statement have yet been published, however, once they are in place, decisions will be made by the Infrastructure Planning Commission (IPC).

Projects within the scope of “nationally significant infrastructure project” are defined in section 14 and include the construction of or extension of a generation station (section 14(1) (a)) and the installation of electricity lines above ground (section 14(1) (b)). District heating networks are not currently within this scope although other types of pipeline are included.

The Act also introduced the Community Infrastructure Levy (CIL). Section 205(2) of the Act details that the overall purpose of CIL is to ensure that costs incurred in providing infrastructure to support the development of an area can be funded (wholly or partly) by owners or developers of land.

3.1.8 *Additional national policy and legislation*

In addition, the following specific policy and legislation may be used to support the development of sustainable energy infrastructure:

- Local Government Act, 2000, introduced the power of wellbeing which enables local authorities to "*do anything which they consider is likely to achieve*" improvement of the economic, social or environmental well-being of their area. This could include public sector participation in special purpose vehicles to deliver sustainable energy services (such as ESCo), co-ordinate investment and property investment;
- Strong and Prosperous Communities – The Local Government White Paper, 2006, emphasises the role of local authorities as '*strategic leaders and place-shapers'*, making better use of Local Strategic Partnerships (LSP), Local Area Agreements (LAA) and the new performance framework to tackle climate change;

The changes to national and subsequently local policy and decision-making processes that new legislation and draft strategies will undoubtedly bring, will serve to strengthen the role for planners and local authorities in delivering decentralised low carbon and renewable energy. A clear and important direction of travel has been defined, which provides useful context for the following chapters.

3.2 Regional

The following policy and guidance documents have informed the regional policy review:

- The London Plan: Spatial Development Strategy for Greater London (Consolidated with Alterations since 2004), February 2008;
- London Plan Supplementary Planning Guidance on Sustainable Design and Construction, May 2006;
- Climate Change Action Plan (2007);
- A New Plan for London: Proposals for the Mayor's London Plan (2009).

3.2.1 The London Plan

3.2.1.1 Policy 4A.3 Sustainable design and construction

'The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in DPD policies. These will include measures to:

- Reduce carbon dioxide and other emissions that contribute to climate change
- Supply energy efficiently and incorporate decentralised energy systems (Policy 4A.6), and use renewable energy where feasible (Policy 4A.7)'

3.2.1.2 Policy 4A.1 Tackling climate change

'The Mayor will, and boroughs should, in their DPDs require developments to make the fullest contribution to the mitigation of, and adaptation to climate change and to minimise emissions of carbon dioxide.

The following hierarchy will be used to assess applications:

- Using less energy, in particular by adopting sustainable design and construction measures (Policy 4A.3)
- Supplying energy efficiently, in particular by prioritising decentralised energy generation (Policy 4A.6), and
- Using renewable energy (Policy 4A.7).

Integration of adaptation measures with mitigation to tackle climate change will be sought through the approach set out in Policy 4A.9.

These contributions should most effectively reflect the context of each development – for example, its nature, size, location, accessibility and operation. The Mayor will and boroughs should ensure that development is located, designed and built for the climate that it will experience over its intended lifetime'.

3.2.1.3 Policy 4A.4 Energy assessment

'The Mayor will, and boroughs should, support the Mayor's Energy Strategy and its objectives of improving energy efficiency and increasing the proportion of energy used generated from renewable sources.

The Mayor will, and boroughs should, require an assessment of the energy demand and carbon dioxide emissions from proposed major2 developments, which should demonstrate the expected energy and carbon dioxide emission savings from the energy efficiency and renewable energy measures incorporated in the development, including the feasibility of CHP/CCHP and community heating systems. The assessment should include:

- Calculation of baseline energy demand and carbon dioxide emissions
- Proposals for the reduction of energy demand and carbon dioxide emissions from heating, cooling and electrical power (Policy 4A.6)
- Proposals for meeting residual energy demands through sustainable energy measures (Policies 4A.7 and 4A.8)
- Calculation of the remaining energy demand and carbon dioxide emissions.'

3.2.1.4 Policy 4A.5 Provision of heating and cooling networks

'Boroughs should ensure that all DPDs identify and safeguard existing heating and cooling networks and maximise the opportunities for providing new networks that are supplied by decentralised energy.

Boroughs should ensure that all new development is designed to connect to the heating and cooling network. The Mayor will and boroughs should work in partnership to identify and to establish network opportunities, to ensure the delivery of these networks and to maximise the potential for existing developments to connect to them.'

3.2.1.5 Policy 4A.6 Decentralised Energy: Heating, Cooling and Power

'The Mayor will and boroughs should in their DPDs require all developments to demonstrate that their heating, cooling and power systems have been selected to minimise carbon dioxide emissions.

The need for active cooling systems should be reduced as far as possible through passive design including ventilation, appropriate use of thermal mass, external summer shading and vegetation on and adjacent to developments. The heating and cooling infrastructure should be designed to allow the use of decentralised energy (including renewable generation) and for it to be maximised in the future.

Developments should evaluate combined cooling, heat, and power (CCHP) and combined heat and power (CHP) systems and where a new CCHP/CHP system is installed as part of a new development, examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

[2] 'Major development'as defined by the London Plan includes all schemes with more than 150 dwellings or 15,000sqm non-domestic outside Central London or 20,000sqm inside Central London or 100,000 inside the City of London.

The Mayor will expect all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:

- Connection to existing CCHP/CHP distribution networks
- Site-wide CCHP/CHP powered by renewable energy
- Gas-fired CCHP/CHP or hydrogen fuel cells, both accompanied by renewables
- Communal heating and cooling fuelled by renewable sources of energy
- Gas fired communal heating and cooling.'

3.2.1.6 Policy 4A.7 Renewable Energy

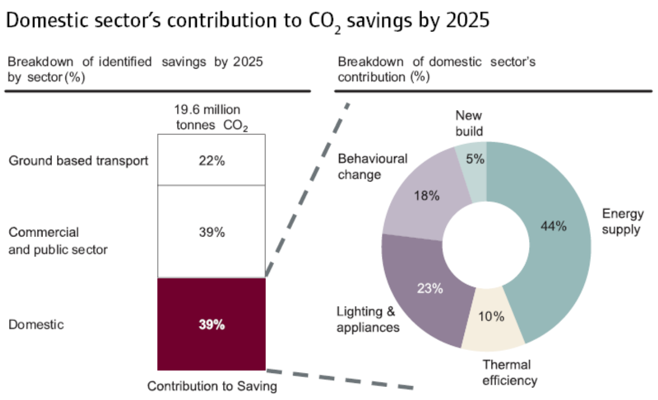
'The Mayor will, and boroughs should, in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from on site renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible.'

3.2.2 London Plan Supplementary Planning Guidance on Sustainable Design and Construction (2006)

Further guidance on the standards expected by the Mayor of London is provided in the London Plan Supplementary Planning Guidance on Sustainable Design and Construction (2006), however much of this document is superseded by the requirements of the more recent London Plan.

3.2.3 Climate Change Action Plan (2007)

The Mayor of London has committed to "work with national and local government towards a target to reduce the capital's emissions by 60 per cent from their 1990 levels by 2025". This target was established by the Mayor's Climate Change Action Plan (2007), which set out actions to contribute to achieving this target for existing homes, existing commercial and public sector buildings, new development, transport and energy supply.



The following actions are of particular relevance to this study:

- Improving energy efficiency in housing, via the Green Homes Programme. Specific initiatives include an offer of subsidised loft and cavity wall insulation, free advice on energy saving measures, energy audits and project management services, training for installers and upgrades to existing social housing.
- Improving energy efficiency in the commercial and public sector, through the Better Buildings Partnership aimed at encouraging commercial landlords to upgrade their buildings, and a green organisations 'badging' scheme for tenants to encourage and recognise efforts to reduce emissions by changing staff behaviour and improving building management.
- Requiring high standards of energy efficiency and renewable energy use in new developments, through the London Plan and the Mayor's role in planning (see below), and setting an example in public sector led developments including London Development Agency projects. Emissions savings achieved through new build are included in the figures for housing and the commercial and public sector, above.
- Reducing emissions from transport. Some of the actions proposed in this area are relevant to this study, including planning developments and providing the infrastructure to reduce car use and enable travel by public transport, walking and cycling, and providing refuelling infrastructure for alternative fuelled vehicles.
- Increasing the proportion of London's energy supplied from decentralised, renewable and low carbon sources to a quarter by 2025 and a majority by 2050. The plan focuses particularly on combined cooling, heat and power, energy from waste, promoting on-site small and medium renewable energy, and pursuing large scale renewable energy installations, including wind, wave and tidal power in the Thames Estuary. It also supports carbon sequestration.

3.2.4 Proposals for a new London Plan

The current Mayor of London has published A New Plan for London: Proposals for the Mayor's London Plan (2009)[3]. This describes initial proposals for a new London Plan, which will be prepared for adoption during the winter of 2011-2012 and is intended to set the framework for development in London over the next 20-25 years. It reiterates the commitment to reduce emissions by 60% by 2025 and states that the London Plan can contribute to this by ensuring that emissions from new developments are minimised and enabling development of sustainable energy sources. It proposes to retain, but strengthen, many of the climate change and energy policies of the London Plan (2008). In addition, it proposes to:

- Consider introducing a hierarchy of preferred cooling options for new developments

[3] http://www.london.gov.uk/mayor/publications/2009/05/london-plan-initial-proposals.jsp

- Stimulate the uptake of renewable energy and outline London’s potential capacity for renewable energy [generation]
- Consider requiring new development in London to achieve the highest levels of the Code for Sustainable Homes for energy performance
- Strongly support development of alternative fuel infrastructure, including for electric vehicles and hydrogen
- Support the provision of energy infrastructure to ensure a resilient, reliable and sustainable supply

3.3 Local

3.3.1 London Borough of Haringey Unitary Development Plan (adopted July 2006)

Haringey’s Unitary Development Plan was adopted in 2006. Specific policies within this Plan covered climate change mitigation, energy efficiency and renewable energy generation. The Saved Policies, published in 2009, included changes to policies on energy efficiency and renewable energy in order to reflect the London Plan (2008).

3.3.2 A New Plan for Haringey 2011-2026: Core Strategy - Preferred Options Consultation

Chapter 2: A Greener and Sustainable Future of the preferred options paper states that London Plan renewable energy targets will apply and the Council will expect developers operating in Haringey to consider and apply appropriate measures at appropriate levels to environmental challenges.

The paper emphasizes the importance of exploring all possibilities for site-wide or neighbourhood wide decentralised energy options, especially in parts of Haringey most likely to support them, i.e. in the growth areas of Haringey Heartlands and Tottenham Hale, and other large development sites elsewhere in the borough such as St Ann’s Hospital in the Seven Sister area of change and regeneration. It adds that opportunities for decentralised energy networks for developments elsewhere in the borough should be considered where there is a potential of exporting heat and power to existing housing, schools and community facilities.

The Council launched its Greenest Borough Strategy in 2008 which sets out how the Council will take forward actions to tackle climate change and embed environmental sustainability into all its activities. One of the key aims is to make Haringey a low carbon borough and tackle climate change by reducing carbon emissions from the development, construction and occupation of buildings and transport. The preferred policy is outlined below:

3.3.2.1 Strategic Policy 3 - Environment

To protect and enhance Haringey's strategic and local resources for current and future generations.

- Commitment to act to minimise the use of natural resources in new development by sustainable design and management.
- Ensure the potential of new development to use and generate renewable energy is maximised, with a minimum reduction in carbon dioxide of 20% from on site renewables, in line with the London Plan.
- Protection of new development from flood risk by flood protection and mitigation, working closely with the Environment Agency to support new development in areas of lower risk.
- Commitment to ensure that development does not add to flood risk in Haringey and elsewhere by consideration of Sustainable Urban Drainage Systems and Flood Risk Assessment.
- Commitment to reduce pollution of the water, air and land environment from construction and operation of new development.
- Development in Haringey will be implemented along the principles of environmental protection and sustainable design to protect and enhance local resources, reducing impact in Haringey and beyond the borough boundaries.

3.4 Other emerging and changing regulation, targets and standards

3.4.1 The Building Regulations – Part L Conservation of Fuel and Power

Building Regulations first started to turn its focus on reducing CO_2 emission in the 2002 revisions of Part L (Conservation of Fuel and Power). Revisions to Part L 2006 brought the UK Building Regulations in line with the EU's Energy Performance of Buildings Directive (EPBD). The 2006 revisions to Part L required a 23.5% saving over the 2002 standards for fully naturally ventilated spaces and 28% savings for mechanically ventilated and cooled spaces.

Following consultation, the Government's Building A Greener Future: Policy Statement announced in July 2007 that all new homes will be zero carbon from 2016. The Government indicated in their recent '*Zero Carbon for New Non-Domestic Buildings Consultation on Policy Options'* Report (November 2009) that non-domestic buildings will be required to be zero carbon by 2019, with the public sector leading the way with schools by 2016 and other central Government estate from 2018. Again this will be implemented through the Building Regulations.

The focus has now turned to the final definition of zero carbon and the suitable intermediary step changes in requirements in 2010 and 2013. Until 2013 the standard is likely to continue to be set with reference to those sources of emission (space, water heating and lighting) that are contained in the 2006 regulations and to offer the option of adopting Low and Zero Carbon (LZC) technologies. The step to zero carbon in 2016 is likely to include emissions from other sources (principally electrical appliances), which would result in the need for significant renewable generation capacity as well as other LZC systems[4].

In December 2008 the Government published Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation consulting on the definition of zero carbon homes and in particular an approach based on:

- high levels of energy efficiency in the fabric of the home
- a minimum level of carbon reduction to be achieved onsite or through directly connected heat; and
- a list of (mainly offsite) allowable solutions for dealing with the remaining emissions (including from appliances)

The following diagram sets out, with respect to carbon emissions, the improvements upon 2006 standards that are proposed for implementation in 2010, 2013 and 2016. These equate to the energy performance standards in the Code for Sustainable Homes Levels 3, 4 and 6 respectively.

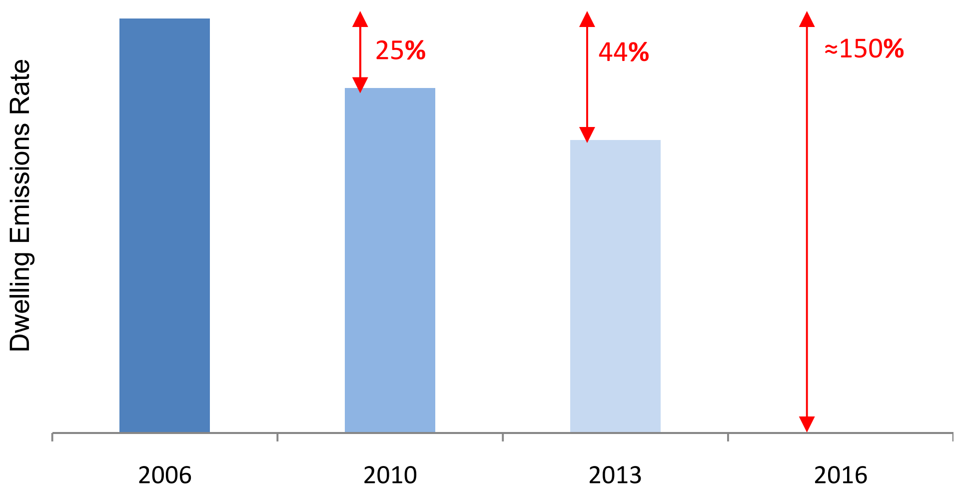


Figure 2: Relative reduction in emission rates from new domestic dwellings in the proposed Building Regulations for 2010, 2013 and 2016 compared to current (2006) Building Regulations.

Evidence demonstrating that the building complies with these criteria is required by building control both at design stage and at completion. The final “as built” calculation must be based on the building as constructed, incorporating any changes to the performance specifications that have been made during construction as well as the measured air permeability, ductwork leakage and fan performance as commissioned.

The government announced in July 2009 that the Zero Carbon Definition will follow the methodology outlined in the 2008 consultation with the Carbon Compliance element set at 70%

[4] Building Regulations Energy efficiency requirements for new dwellings. A forward look at what standards may be in 2010 and 2013, Department for Communities and Local Government, July 2007

of regulated Emissions (the DER). The energy efficient requirements are not yet defined and a Task Group it to be set up to examine and advise on the energy efficiency metrics and standards. Allowable Solutions will cover the remaining carbon emitted from home for 30 years. These have been listed to include:

- Additional Carbon Compliance
- Energy efficient appliances
- Advanced building control systems
- Exports of low carbon or renewable heat

Investments in community heat infrastructure

3.4.2 *Code for Sustainable Homes*

The Code for Sustainable Homes is an environmental assessment system for new housing in England which was introduced in April 2007 based on BRE's EcoHomes scheme. The Code assesses a development against a set of criteria under nine key categories.

The Code awards a rating to each dwelling type within the development based on a scale of Level one to six (denoted by stars) (Table 1). The rating depends on whether the dwellings meet a set of mandatory standards for each level, as well as an overall score (Table 1).

	Minimum Entry Requirements		
Code Levels	Energy Improvement over TER	Water litres/person/day	Total score out of 100
Level 1 (★)	10%	120	36
Level 2 (★★)	18%	120	48
Level 3 (★★★)	25%	105	57
Level 4 (★★★★)	44%	105	68
Level 5 (★★★★★)	100%	80	84
Level 6 (★★★★★★)	Zero Carbon	80	90

Table 1: Minimum requirements for the six levels under the Code

Mandatory requirements exist under the following credits:

- Energy (see Table 1)
- Water (see Table 1)
- Embodied Impacts of Construction Materials;
- Surface Water Runoff;
- Construction Site Waste Management;

- Household Waste Storage Space and Facilities.

The credits achieved for each dwelling type are then multiplied by the environmental weighting factor for each category to calculate the number of points achieved.

3.4.3 Changing and emerging legislation

The following emerging documents and policies which are all expected to be available or updated within the next year:

- Final South East Regional Spatial Strategy (Plan)
- Updates to the London Plan
- UKCP09 – predicted climate impacts for the UK released June 2009
- Further information from Communities and Local Government on the Code for Sustainable Homes
- A New PPS combining the PPS on Climate Change and PPS22
- Copenhagen December 2009
- Heat and Energy Saving Strategy
- Zero Carbon Strategy

3.5 Review of other Local Authority low carbon and renewable energy targets

Various local authorities have established targets for local decentralised and renewable or low carbon energy production. Some of these were developed before the supplement to PPS1 on Climate Change was published in 2007 and do not fully meet the requirements of the PPS.

As outlined below, Dover now has a robust evidence on which to base policy targets. It focuses heavily on on-site policies. By contrast, Southampton City Council's policy targets the broader energy opportunities, such as connection to District Heating.

3.5.1 Dover District Council

Faber Maunsell and EDAW (both now AECOM) were commissioned to develop an evidence base and make recommendations for decentralised and renewable and low carbon energy targets to be included in the Core Strategy (Submission Document 2009). The following recommendations have been put forward:

Core Strategy – Policy DM3 changed to:

"All new developments are required to meet Code for Sustainable Homes standards or equivalent. New developments are required to meet Code level 3 with immediate effect (from granting of permission), at least Code level 4 from 1st April 2013 and at least Code level 5 from 1st April 2016.

All new non-residential developments over 1000m^2 gross are required to meet BREEAM Very Good or equivalent with immediate effect (relevant versions cover offices, retail, industrial, education and healthcare).

Draft Development Contributions SPD (or future Community Infrastructure Levy) (2008):

For new developments that cannot meet the carbon and water reduction targets in DM3 onsite and for new non-residential developments of less than 1000m^2 gross, applicants must achieve commensurate energy and water savings elsewhere in Dover District.

The actions or sums paid must achieve the difference between the onsite performance of the development and the immediate, 2013 and 2016 energy and water standards expected for developments. Dover District will publish updates concerning details of the energy and water efficiency schemes that will be eligible and the cost per tonne of CO_2 and per m^3 of water saved. Applicants must prove they cannot meet requirements onsite through an open book accounting approach to show the development would not go ahead.

Core Strategy – new policy:

"Planning conditions will be applied to all domestic and commercial extensions and conversions to require cost effective energy and water efficiency measures to be included, aiming for no net increase in energy or water demand from the property."

There are also a number of strategic allocation policies which take into consideration particular opportunities and constraints of the site and local area.

3.5.2 *Southampton City Council*

Policy SDP13 from the City of Southampton Local Plan Review (2006) states that:

"All developments, either new build or conversion, with a floorspace of 500 m^2, or one or more residential units (based on the size of the final development footprint), will be required to incorporate decentralized and renewable or low-carbon energy equipment to reduce predicted CO_2 emissions by at least the percentage values for each type of development stated in the 'Requirements for reductions in CO_2 emissions' table'. Where specific opportunities exist, development will be required to connect to existing Combined Heat and Power (CHP) systems or make equivalent CO_2 savings through other on-site renewable or low-carbon energy measures."

Development Type	Low Rise Residential	4 Storey + Residential	Schools/ Colleges	Offices	Light Industrial
Minimum CO_2 emission reduction required	20%	15%	15%	15%	12.5%

3.5.3 *Woking Borough Council*

The key requirements of Policy SE2 from the Local Plan (1999) are:

All types of development should incorporate energy efficiency best practice measures in their design, layout and orientation;

- At least 10% of the energy that will be required by all commercial and residential development must be generated from renewable sources on site; and
- On larger developments (over 5,000m^2 floorspace) combined heat and power (CHP) should be provided.

3.5.4 *Kirklees Council*

Policy 11.3 LDF Core Strategy (Preferred Options stage 2009):

Assets supporting the production and networking of renewable energy will be protected. Public funds and developer contributions will be directed to improving the infrastructure required to deliver comprehensive renewable heat and power networks.

Policy 11.3 LDF Core Strategy (Preferred Options stage 2009):

All new developments, major refurbishments and significant extensions will be required to meet, as a minimum, either the requirements of the Code for Sustainable Homes or a BREEAM assessment, where carbon savings will be evaluated at current levels for the Code.

3.6 Lessons Learned: Ensuring the development of a robust evidence base

The data used to inform the evidence base will contain significant technical detail that may only be of limited direct interest to planners. However, a certain level of detail is necessary to underpin policy and targets so it is important that complex data is presented in such a way that planning officers can make informed decisions based upon it.

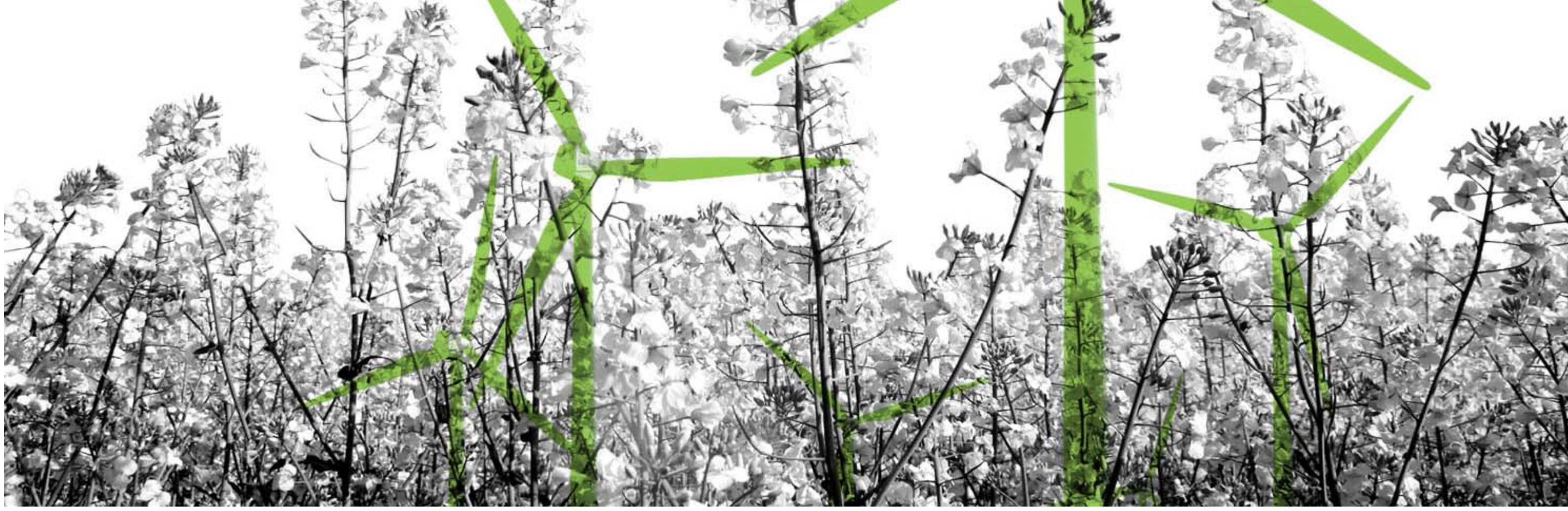
The spatial analysis undertaken as part of an evidence base will identify specific opportunities for particular energy technologies and promoting CO_2 reductions. This spatial understanding will inform the scope of planning policies and setting of targets. However, the ideal solutions may not fit neatly into the private developer led planning applications that trigger the use of these policies or targets. Delivering a town centre district heating network, for example, may begin by linking up existing civic-owned buildings as well as individual planning proposals. Planning policy and targets in the traditional sense are poorly placed to facilitate this.

A key aim of an evidence base, therefore, should be to inform wider action and investment decisions across a local authority area (or group of authorities). In terms of delivery this means identifying those stakeholders who are best placed to take each opportunity forward. Planning policy and targets will be ideal for some schemes, but local authorities and their stakeholders (including Local Strategic Partnerships) will be better placed to deliver, or facilitate the delivery of more complex proposals that cut across wider areas, particularly those that link new and existing communities (i.e. non development specific).

Developing an understanding of different character areas within an authority has helped LAs to identify both appropriate technologies and delivery partners and mechanisms. The Community Infrastructure Levy offers a significant opportunity for funding energy infrastructure. Currently, the CIL has not been fully explored in its application for energy. Other delivery mechanisms exist within the wider local authority context, which draw on the powers and duties available to authorities and their strategic partners. For example:

- Sustainable Community Strategy or a related energy or climate change strategy, including links back to development plan documents;
- Powers of Wellbeing which allow participation in special purpose vehicles to deliver sustainable energy services, co-ordinate investment and property investment;
- Local authority owned land sales;
- Procurement decisions;
- Local authority Initiatives such as affordable warmth and change management;
- Energy services, such as ESCOs; and
- Corporate strategies for development and investment of local strategic partners, including health and education.

The opportunities associated with low carbon and renewable energy targets need not be constrained to the realm of spatial planning. The Dover study (undertaken by AECOM) acknowledges the role of National Indicators in improving corporate performance. An integrated approach to these targets and related issues is needed to maximise local opportunities, which may cross geographical boundaries and require wider collaboration for effective and efficient delivery. The greater extent to which different parts of local government and other strategic partners come together to produce and manage an evidence base and to use it to influence planning and corporate level policy and target setting, the more effective the strategy's implementation is likely to be.



Existing CO_2 Emissions Data and Baseline Information

4 Existing CO_2 Emissions Data and Baseline Information

4.1 Introduction

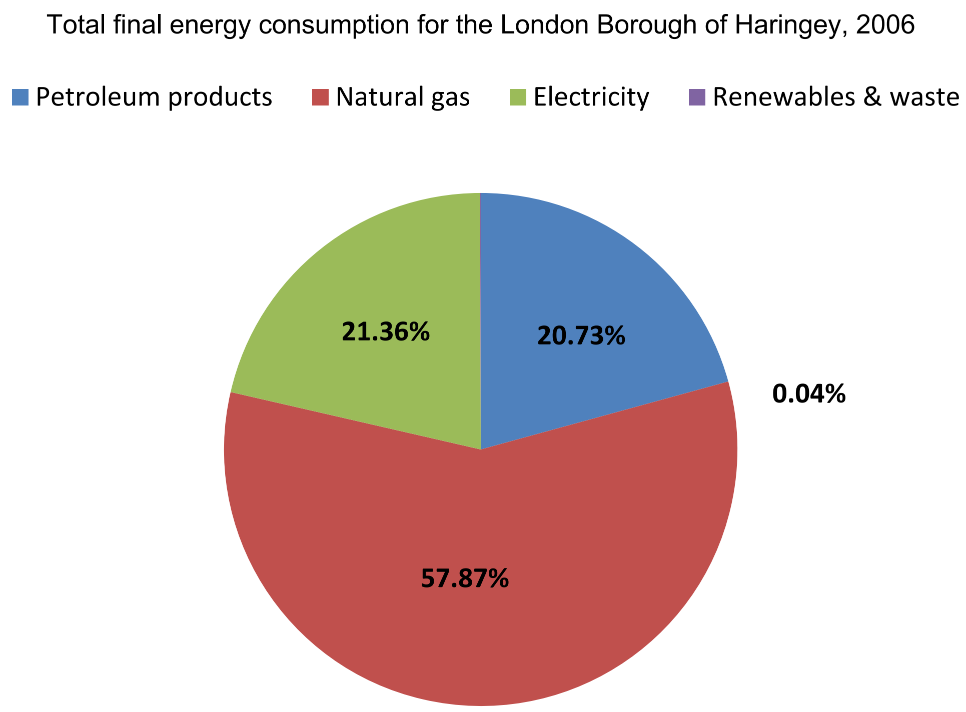
The following data sources provide the context for this study. They set out the existing energy consumption and CO_2 emissions for the London Borough of Haringey. Additional development is likely to result in increases in energy consumption and CO_2 emissions, therefore making the overall reductions targets more difficult to achieve, unless policies are implemented which seek to mitigate their impact.

4.2 Energy Consumption and CO_2 Emissions Data

4.2.1 *Total final energy consumption at regional and local authority level*

DECC hold records of total energy consumption of different fuels by sector for each region and local authority. The consumption records for 2006 for the London Borough of Haringey are shown in the following table:

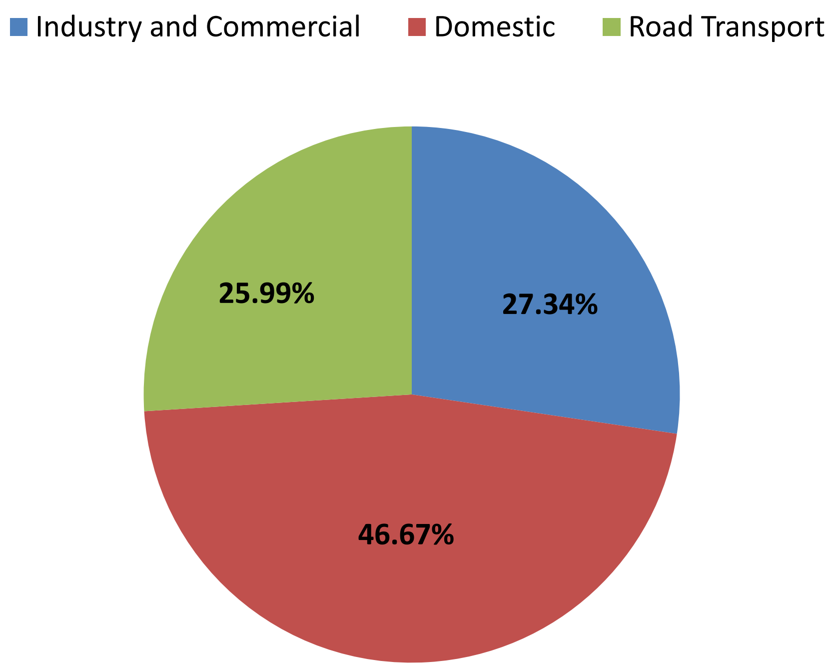
Fuel	Sector	Consumption (GWh)
Coal	Industry & Commercial	0.0
	Domestic	0.0
	Total	**0.0**
Manufactured fuels	Industry	0.0
	Domestic	0.0
	Total	**0.0**
Petroleum products	Industry & Commercial	63.3
	Domestic	5.4
	Road transport	701.8
	Rail	5.0
	Total	**775.5**
Natural gas	Industry & Commercial	446.1
	Domestic	1,718.8
	Total	**2,164.9**
Electricity	Industry & Commercial	378.1
	Domestic	421.0
	Total	**799.1**
Renewables & waste	**Total**	**1.6**
Total		**3,741.1**



4.2.2 Baseline emissions from the London Energy and CO_2 Emissions Inventory, 2005

Baseline CO_2 emissions for Haringey in 2005				
Industry & Commercial (kT per annum)	Domestic (kT per annum)	Road Transport (kT per annum)	Total Emissions (kT)	Emissions Per Capita (T)
305.3	521.1	290.2	1,116.7	5.0

London Energy and CO_2 Emissions Inventory (LECI) 2005, Defra 2007



4.3 Housing Data

The following data relates the to the nature of the housing stock within the Borough.

4.3.1 Current housing stock

Housing Tenure	Number	Percentage
LA Dwelling Stock	16,162	16.1
RSL Dwelling Stock	11,823	11.8
Other Public Sector Dwelling Stock	77	0.1
Owner Occupied & Private Rented Dwelling Stock	72,382	72.1
Total	**100,444**	

Dwelling Stock in Haringey by Tenure and Condition 2008, Office of National Statistics

4.4 Related Work

4.4.1 Heat Loss Mapping

Heat Loss data from aerial thermal imagine photography undertaken in 2000 (winter) by Horton Levi and a second survey undertaken by BlueSky International Ltd (March 2007) has been purchased by Haringey Council and is displayed on the Council Website.

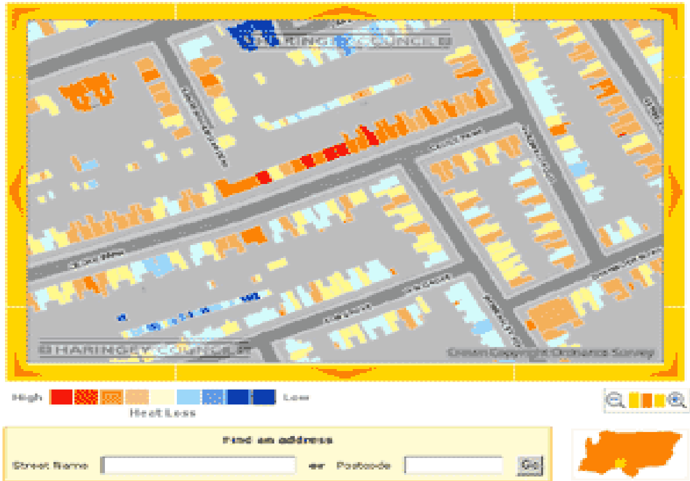


Image of data presented on the Haringey Council website

4.4.2 *Carbon Reduction Scenarios Technical Report (SEA/RENUE March 2007)*

SEA/RENUE were commissioned by Haringey to assess the carbon reduction necessary to meet the adopted target of reducing CO_2 emissions by 60% by 2050. The vision proposed for the Borough incorporates:

- Community heating network served by combined heat and power (CHP)
- Renewable energy systems, both building integrated and stand alone
- Energy efficiency improvements to the existing building stock
- Transport demand reduction and shift to sustainable transport modes

In regards to the role that planning could play in meeting the targets, the report proposes the following recommendations for the emerging planning framework:

- Communal heating systems installed within new developments to ensure compatibility with heating networks
- Use of electricity generating building integrated renewable energy systems
- Renewables requirement be on top of Building Regulations
- New developments sited to ensure close proximity to transport nodes and amenities

4.5 Haringey Aspirations

4.5.1 Climate Change

Haringey Council signed the Nottingham Declaration on Climate Change in December 2006. Haringey's Local Area Agreement (2008-2011) includes targets for reduction in per capita CO2 emissions in the Local Authority area under National Indicator 186, these are:

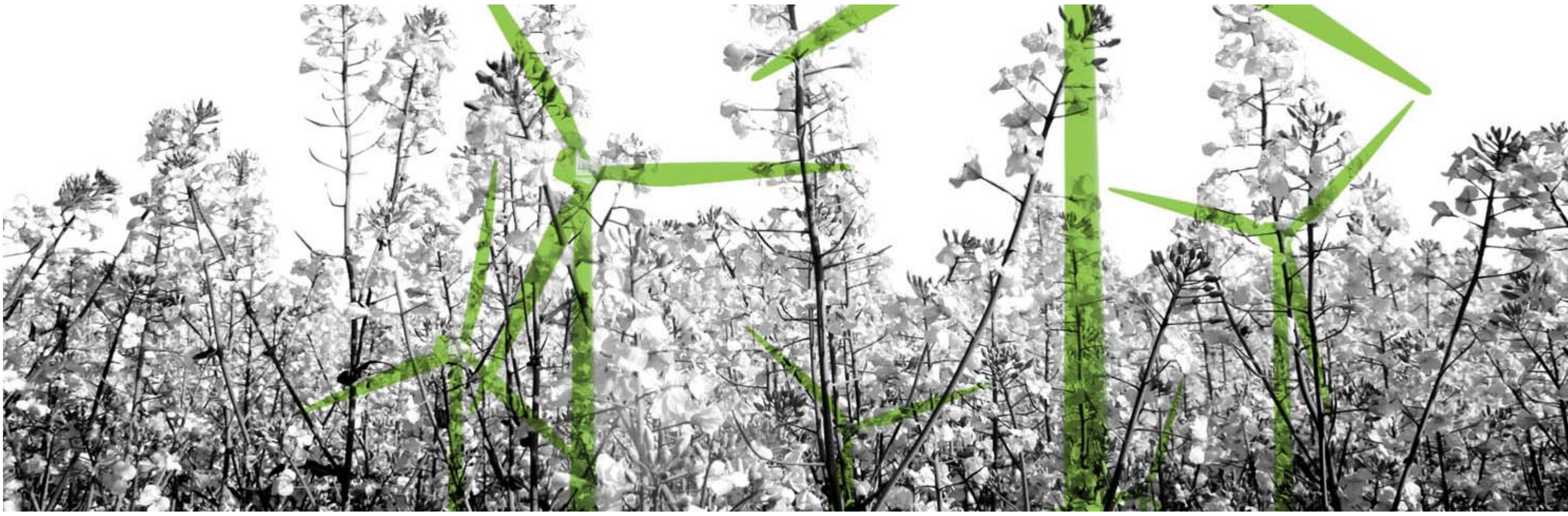
- 3.6% reduction in per capita CO2 emissions by 2008/2009 (Defra 2005 baseline)
- 7.4% reduction in per capita CO_2 emissions by 2009/2010
- 11% reduction in per capital CO_2 emissions by 2010/2011

In October 2009 Haringey Council adopted a target to reduce borough wide CO2 emissions by 40% by 2020 on a 2005 baseline and committed to developing an action plan to meet this target, fulfilling a commitment to establish a long term CO2 reduction target which was made in the Greenest Borough Strategy. A pre feasibility study identified that decentralised energy networks (i.e. district heating and CHP) together with mitigating growth in CO2 emissions from new developments and retrofitting existing housing stock will be key to delivering this target.

4.5.2 Greenest Borough Strategy

Priority Five of the Council's Greenest Borough Strategy, launched in October 2008, deals with delivering sustainable development. The plan is to achieve lower carbon emissions from homes and buildings while providing thermal comfort by "encouraging developers and home owners to adopt the highest possible standards and innovative solutions for sustainable design and construction, whilst driving forward and developing our own best practice projects through current investments in schools and social housing". The key objectives proposed are to:

- Develop sustainable and renewable energy sources in physical regeneration programmes.
- Encourage and promote best practice sustainable design and construction.
- Encourage new build to meet low or zero carbon emissions standards.

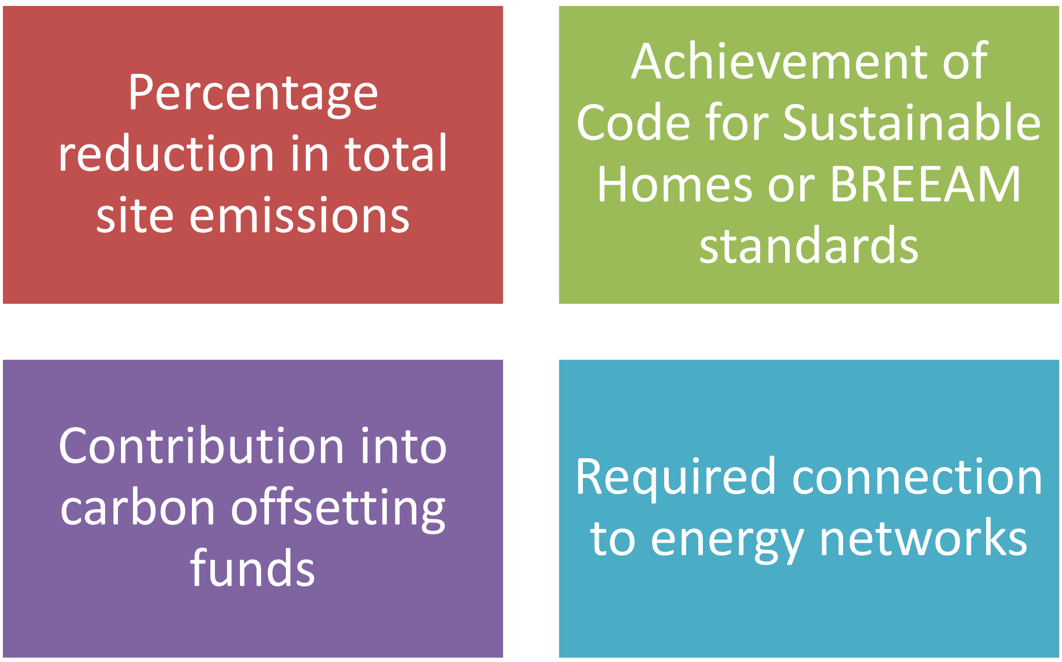


Policy Options

5 Policy Options

5.1 Policy

The following section discusses the different policy options relating to the implementation of decentralised and renewables or low-carbon energy policy that are currently in place England and the options that could be considered for implementation within Haringey's Core Strategy.



5.2 Percentage reductions in total site emissions

5.2.1 *Policy basis*

This policy approach has been widely adopted by local authorities to reduce energy demands and CO_2 emissions for proposed developments and is commonly referred to as the "Merton Rule", after the Local Authority who first adopted this style of policy. Such policies require that developments of a certain type and above a certain size reduce their CO_2 emissions by specified proportion through the use of on-site renewables. The original Merton policy wording required developments to: "*incorporate renewable energy production equipment to provide at* *least 10% of predicted energy requirements*", this was later clarified as relating to CO_2 emissions[5].

The original Merton Rule style policy is not compliant with the PPS1 Supplement which details:

"planning authorities should:

(i) set out a target percentage of the energy to be used in a new development to come from decentralised and renewable or low-carbon energy sources[6] where it is viable. The target should avoid prescription on technologies and be flexible in how carbon savings from local energy supplies are to be secured;" (Paragraph 26 (i))

It is therefore no longer appropriate to specify a specific reduction in CO_2 emissions from on site renewable energy only. Consideration should therefore be given to a policy which refers to CO_2 reduction from decentralised and renewable or low-carbon energy sources.

Although the old "Merton Rule" policy is now out dated it is worth pointing out the appeal of the policy approach. Of the 390 councils in England 325 have taken up the Merton Rule while all councils in Scotland and Wales followed their own version of the policy[7].

5.2.2 *Advantages*

- The original Merton Rule style policy was successfully implemented and enforced through planning conditions. AECOM's experience suggests that within London Boroughs and certainly within the GLA, the policy is well understood and Council's understand how to implement and enforce the Merton Rule style policy (at least at the planning stage).
- AECOM's experience suggests that the original Merton Rule policy has generally been successfully picked up by developers and addressed within planning applications, this is backed up by the review of energy strategies in the Borough. It is considered that, similar to the above benefit, the baseline knowledge gained by developers in implementing the Merton Rule puts this stakeholder in a good position to understand and implement a broader Merton Plus Policy.
- The Merton Rule has been cited[8] as leading to increased uptake of renewables. It could be assumed that a "Merton Plus" style policy could would also encourage other decentralised and low-carbon energy sources.
- As detailed in the London Plan this policy style appears to work well and be complementary with other policies such as energy hierarchies and offsetting funds.

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5 Energy should not be used as the reference unit due to the differing CO_2 emissions factors for different fuels http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule/how_is_the_policy_applied.htm
6 Decentralised and renewable or low-carbon energy is defined as "*Decentralised renewable energy or decentralised low-carbon emery or a combination of decentralised renewable energy and decentralised low-carbon energy*" (CLG (2007) *Planning Policy Statement: Planning and Climate Change* Glossary.
7http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule/building_a_zero_carbon_future.htm
8The Merton Rule: A review of the practical, environmental and economic effects (NHBC, 2009)

5.2.3 *Disadvantages*

- This policy does not directly encourage the implementation of energy efficiency measures or improved building fabric. Indirectly a reduced energy baseline is encouraged as a lower baseline means a lower level of decentralised and renewable or low carbon energy is required to meet the target percentage. These criticisms can be resolved by combining this policy with an energy hierarchy policy similar to that in the London Plan.
- Experience has demonstrated that within London, on the basis of a lack of technical and financial viability, renewables contributions have been agreed that are lower than the defined 20% target, particularly within commercial developments. The reasons that the target renewables percentage cannot be achieved have to be defined and detailed in the planning application.
- We understand that there is limited experience of policing the implementation, enforcement or monitoring of the currently Merton Rule style policies within the final constructed developments. However, the London Borough of Newham has used a condition for ongoing energy monitoring on planning applications. London Borough of Camden and Milton Keynes have also extended the enforcement to require monitoring equipment and evidence before occupation. The Milton Keynes Supplementary Planning Document (SPD) details that planning conditions will require the agreed sustainability measures to be implemented prior to occupation of the development and documentary evidence of the relevant features and measures must be submitted to the Council. In addition, site inspections will also be carried out. This experience should be drawn upon and expanded for the implementation and enforcement of a Merton Plus style policy.
- These policies are limited to new buildings with no associated / spin-off benefits to reducing CO_2 emissions in existing buildings.
- It was necessary with the Merton Rule to provide clarification of how the percentage reduction in carbon emissions is to be calculated. This can be challenging for both planners and applicants who may lack basic understanding of energy and CO_2.

5.2.4 *Example*

One of the most notable examples is in **London** where the Mayor of London implemented a 10% reduction in carbon emission requirement through its Sustainable Design and Construction Supplementary Planning Guidance, supplementing Policy 4A.9 of the London Plan[9]. Importantly the GLA combined it with their energy hierarchy set out in Policy 4A.8. This hierarchy has evolved and the target raised to 20% in the latest London Plan, Consolidated with Alterations Since 2004 (adopted in February 2008).

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9 As detailed in the introduction of the Mayor's SPG the SPG could not set new policy but can be taken into account as a further material consideration so has weight as a supplement to the London Plan. The 10% requirement added a defined target renewable contribution to Policy 4A.9 Providing for renewables energy of the London Plan which previously has not set a percentage target.

5.2.5 Conclusions

This policy is already well established in many local authorities and is included in the current London Plan and existing Council planning policy. It has been enforced in the Borough and local planners and developers understand the requirements. Retaining a similar style of policy would retain an element of consistency and support the objectives of promoting low carbon development and the uptake of renewable energy generating technologies.

5.3 Achievement of Code for Sustainable Homes or BREEAM standards

5.3.1 Policy basis

A policy requiring the achievement of specific Code for Sustainable Homes (CSH) or BREEAM ratings would indirectly impose energy targets. Section Ene 1 of both the CSH and BREEAM assessments addresses the energy consumption and resulting CO_2 emissions from a building. In the case of residential dwellings, credits are awarded on the basis of improvements over building regulations, for other buildings, credits are achieved based on the Energy Performance Certificate (EPC) rating.

5.3.2 Advantages

- CSH and BREEAM assessments consider the wider environmental impact of a building and therefore can achieve more holistic results in regards to delivering sustainable design and construction.
- The CSH and BREEAM assessments are regularly updated to reflect changes in the industry and feedback from developers and manufacturers. This iterative process ensures that they stay relevant and reflect measures that go beyond standard practice. It also allows adaptation to meet changing regulation, for example the definition of zero carbon.
- By simply requiring improvements over Building Regulations it provides developers with flexibility over how to meet the target as well as encouraging innovation in techniques and technologies.
- The energy elements of the CSH and BREEAM assessment methodologies are aligned to Building Regulations and therefore make it more straightforward for developers, who only need to carry out one set of calculations for the building.
- Achievement of the required target rating can be easily demonstrated through achievement of certification.
- The methodology and quality assurance for the achievement of the required rating is carried out by licensed assessors and the Building Research Establishment. The methodology is clearly specified in the technical guidance and linked to government approved software used to demonstrate Building Regulations compliance. As such, there would be greater confidence in the and there would be less implications for

- A target relating to CSH and BREEAM ratings could be combined with any of the other types of targets outlined above.

5.3.3 *Disadvantages*

- The current version of the BREEAM assessment methodology only includes mandatory targets relating to the energy performance of a building, demonstrated by the EPC rating, for the 'Excellent' rating.
- A policy focussing on improvements over building regulations would not directly encourage energy efficiency or improved building fabric.
- A policy focussing on improvements over building regulations would not necessarily result in the implementation of decentralised energy networks, particularly as these could be more costly compared to other options. If decentralised networks are a priority for the borough then such a policy in isolation may not be sufficient to ensure that site-wide systems are incorporated into strategic sites.
- A policy focussing on improvements over building regulations would not necessarily result in the incorporation of low or zero carbon energy technologies.
- The improvements to Part L of the Building Regulations will be challenging to developers, technically and financially, without additional planning requirements.

5.3.4 *Example*

Policy DC49 relating to sustainable design and construction in **Havering Borough Council**'s LDF Core Strategy (Adopted July 2008) states that:

> "Planning permission for major new developments will only be granted where they are built to a high standard of sustainable construction. Applicants for major developments will be required to produce documentation from the Building Research Establishment to confirm that the development will achieve a rating under the BREEAM rating scheme (or equivalent methodology), for non-residential developments of at least 'Very Good', or at least 'Level 3' Code for Sustainable Homes from 2008, 'Level 4' from 2010, 'Level 5' from 2013 and 'Zero Carbon' from 2016 for residential developments"

Havering have also released an SPD on Sustainable Design and Construction. The SPD states that a CSH and/or BREEAM pre-assessment must accompany the planning application to provide assurance that the design will achieve the required rating. An interim design stage certificate is required before construction can start on site and, following completion, the post-construction review (PCR) and subsequent formal certification is required.

5.3.5 *Conclusions*

A policy requiring the scheme to achieve a minimum rating against the Code for Sustainable Homes or BREEAM will deliver more benefits than purely reducing energy consumption and CO_2 emissions but will provide support for this objective. The other requirements of these assessments will support the drive for more sustainable design and construction measures in the Borough.

5.4 Contribution into carbon offsetting funds

5.4.1 Policy basis

The premise of this approach is that a developer would pay into a fund a sum of money proportional to the predicted CO_2 emissions from the proposed development. This fund would then be used by the local authority to reduce CO_2 emissions elsewhere, for example through the creation/extension of district energy schemes. This approach has been proposed as one of the possible ‘allowable solutions’ which would form for the Government’s definition of zero carbon.

Some Councils have sought to implement such a fund through use of Section 106 agreements. These are private agreements negotiated, usually in the context of planning applications, between local planning authorities and persons with an interest in a piece of land, and intended to make acceptable development which would otherwise be unacceptable in planning terms[10].

In order to be legally compliant the scheme would need to adhere to the requirements of ODPM Circular 05/2005 Office of the Deputy Prime, Annex A paragraph A2 states that:

> *“Such obligations may restrict development or use of the land; require operations or activities to be carried out in, on, under or over the land; require the land to be used in any specified way; or require payments to be made to the authority either in a single sum or periodically”.*

In setting an s.106 it must be demonstrated that it is directly related to the proposed development; necessary to make the proposed development acceptable in planning terms; fairly and reasonably related in scale and kind to the proposed development. The proximity restriction could mean that a significant number of otherwise desirable energy projects could not be funded. Also, there are many calls on s.106, such as affordable housing, meaning that the available funding ‘pot’ for energy is likely to be limited. However, the precedent set by a number of local authorities, such as Milton Keynes, demonstrate that this is a viable policy option.

The alternative funding option that may present itself is the Community Infrastructure Levy (CIL) which was introduced by the Planning Act 2008. Section 205(2) of the Act details that the overall purpose of CIL is to ensure that costs incurred in providing infrastructure to support the development of an area can be funded (wholly or partly) by owners or developers therefore providing significant opportunity for delivering decentralised low carbon energy. Regulations are currently being consulted on by government . The CIL is due to come into effect in April 2010.

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10 ODPM Circular 05/2005 Annex B

5.4.2 *Advantages*

- Opportunity to raise funds to improve the existing building stock or other low / zero carbon measures in the Borough.
- Opportunity to raise funds to provide low carbon infrastructure, such as heating networks of a district energy centre.
- Provide a method of approaching zero carbon through the use of off-setting similar to the proposed Allowable Solutions[11] thereby potentially starting the move towards zero carbon and Building Regs 2016/ 2019 standards.

Disadvantages:

- Potential pressures and balance on the s106 provisions between this and other requirements.
- Similarly, a significant number of planning applications do not have s.106 attached. The CIL may help to overcome this problem.
- Possible criticism over lack of transparency and for lengthy negotiations that tend to be associated with s106 provisions. This could be avoided by having a clear set fund amount being set in an SPD or similar.
- Potential for misuse, if developers pay into the fund rather than maximising the onsite carbon emissions. This can be resolved by combining the fund policy with a requirement for energy efficiency standards and decentralised and renewables or low-carbon energy policy.
- There is uncertainty around the legality and potential scope of funds, although the CIL may offer a solution.

5.4.3 *Example*

Milton Keynes have developed a Carbon Offset fund, supported by policy D4 of the Milton Keynes Local Plan (2005). The fund, which has been receiving payments since 2006, is detailed in MKC SPD Sustainable Construction – April 2007. The SPD states that any net increase in carbon dioxide emissions from a development must be calculated as tonnes per year. A one-off contribution is then required to the carbon offset fund, at a rate of £200 (index-linked) for each tonne carbon dioxide by means of a Section 106 agreement or unilateral undertaking. A calculation methodology is provided in the SPD12.

The Carbon Offset Fund is accompanied by a requirement for a Merton type policy for a minimum 10% CO_2 reduction to be provided from on-site renewable energy sources[13] and a requirement for energy efficiency. It is claimed that the Offset Fund, has saved nearly 570 tonnes of carbon dioxide across the Borough in the last year (April 2008- March 2009) through

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12 http://www.miltonkeynes.gov.uk/local_plan_review/displayarticle.asp?DocID=13942&ArchiveNumber
13 http://cmis.milton-keynes.gov.uk/CmisWebPublic/Meeting.aspx?meetingID=8711

improving insulation in 508 properties[14]. One of the key points raised by the Milton Keynes example was how the value of the fund was justified. The value was informed by the feasibility study undertaken at the outset by the United Sustainable Energy Agency (USEP) who now manages the fund. The fund was set at a value that enabled Milton Keynes to undertake the insulation work they wished to do.

5.4.4 *Conclusions*

A carbon offset fund is potentially a very powerful instrument for maximising the CO_2 reductions from investment in new developments. Recent Government research has highlighted that the costs of mitigating all of a building's CO_2 reductions through on-site measures can become increasingly expensive and that there are diminishing returns for the investment. An offset fund would potentially allow some of this capital to be used to deliver more cost effective CO_2 reductions.

However, to overcome some of the issues of transparency this policy would need to be supported by a well defined set of projects to demonstrate how the money would be spent and the mechanism for operating this fund. The Government's proposed methodology for delivering Zero Carbon, which will come into force in 2016 (for domestic buildings) and 2019 (for non-residential buildings), may make an offset fund possible as part of the Allowable Solutions mechanism.

This policy has significant potential but, due to the issues that would need to be addressed before it can be successfully implemented we have chosen not to explore it at this stage.

5.5 Required connection to energy networks

5.5.1 *Policy basis*

The PPS1 Supplement states that planning authorities can expect proposed development to connect to an existing decentralised energy supply systems or be designed to be compatible for future connection.

The PPS adds that any policy relating to local requirements for decentralised energy supply to new developments should be set out in a Development Plan Document, not an SPD to ensure sufficient examination by an independent Inspector.

5.5.2 *Advantages*

- Secures market and demand for the community heating systems in areas of development. This can be invaluable in securing project finance and justifying the expansion of an existing network.
- Provides good option for developments which may have a constrained site to approach zero carbon / significantly reduce their carbon emissions.

14 http://cmis.milton-keynes.gov.uk/CmisWebPublic/Binary.ashx?Document=27063

5.5.3 *Disadvantages*

- This policy can only be enforced in new developments. Although the Council can connect their own existing properties and give other existing developments the opportunity to connect.
- Arrangements for connection to existing nearby technologies such as combined heat and power (CHP) can be complex and involve a number of parties. This can result in delays to planning programmes can be deterrents to developers particularly where timescales for planning are tight. Careful consideration of the issues, good communication with the energy provider, utilities companies and other third parties such as Network Rail or a defined connection process is needed to smooth the process to avoid delay to planning and construction.

5.5.4 *Example*

A policy requiring connection to an energy network has been included in **Southampton**'s draft Core Strategy. This city has been operating a district heating system since 1986. The district heating systems are supported by Policy SDP 13: Resource Conservation of the Local Plan.

5.5.5 *Conclusions*

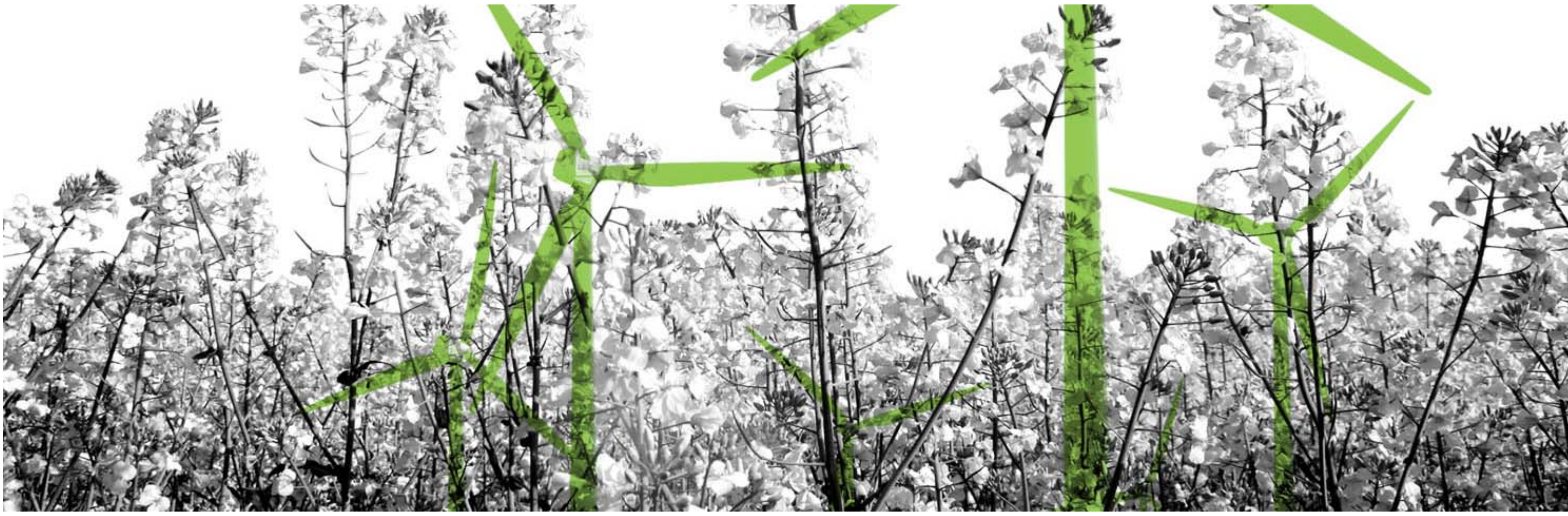
A policy to promote the use of CHP and communal heating systems will be crucial to the delivery of the Council's vision of promoting Borough-wide decentralised energy networks. This has been recognised at the London-wide level in the Mayor's Heating Hierarchy and we have employed this hierarchy in our testing; assessing the potential for using CHP in each of the sites assessed.

5.6 Policies proposed for testing

Following discussions with Haringey, the following policies have been proposed for analysis:

- Reduce total site emissions by 20% through the use of on-site renewable technologies
- Reduce total site emissions by 30% through the use of on-site renewable technologies
- Meet the mandatory energy standard required as part of Code for Sustainable Homes:
  - Level 3 - 25% improvement over Building Regulations 2006
  - Level 4 - 44% improvement over Building Regulations 2006
  - Level 5 - 100% improvement over Building Regulations 2006
- Promoting the use of CHP and communal heating systems in line with the Mayor's Energy Hierarchy

It is recognised that each of these policies has disadvantages but in combination many of these weaknesses can be resolved, therefore we will also be reviewing the potential to combine the requirements.



Site Analysis Methodology

6 Site Analysis Methodology

6.1 Site Selection

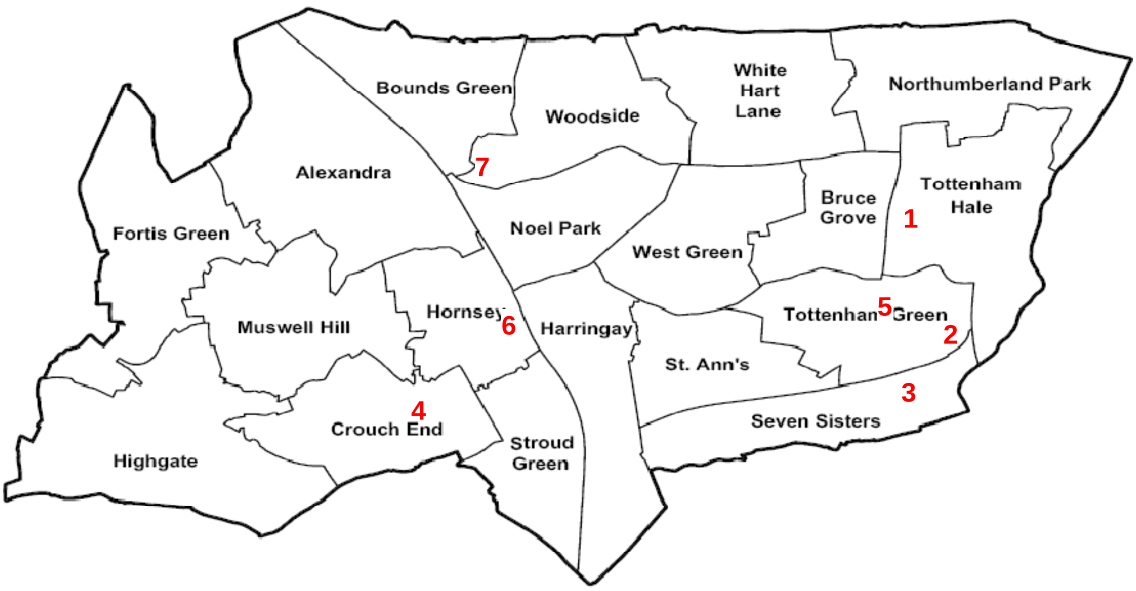
6.1.1 *Site Selection*

The sites selected for analysis have been taken from the Site Specific Proposals Schedule within the Unitary Development Plan (Appendix: Schedule 1 p178 – 182) and other sites highlighted by the Council. The selection was undertaken in discussion with Haringey Council and considered the following factors:

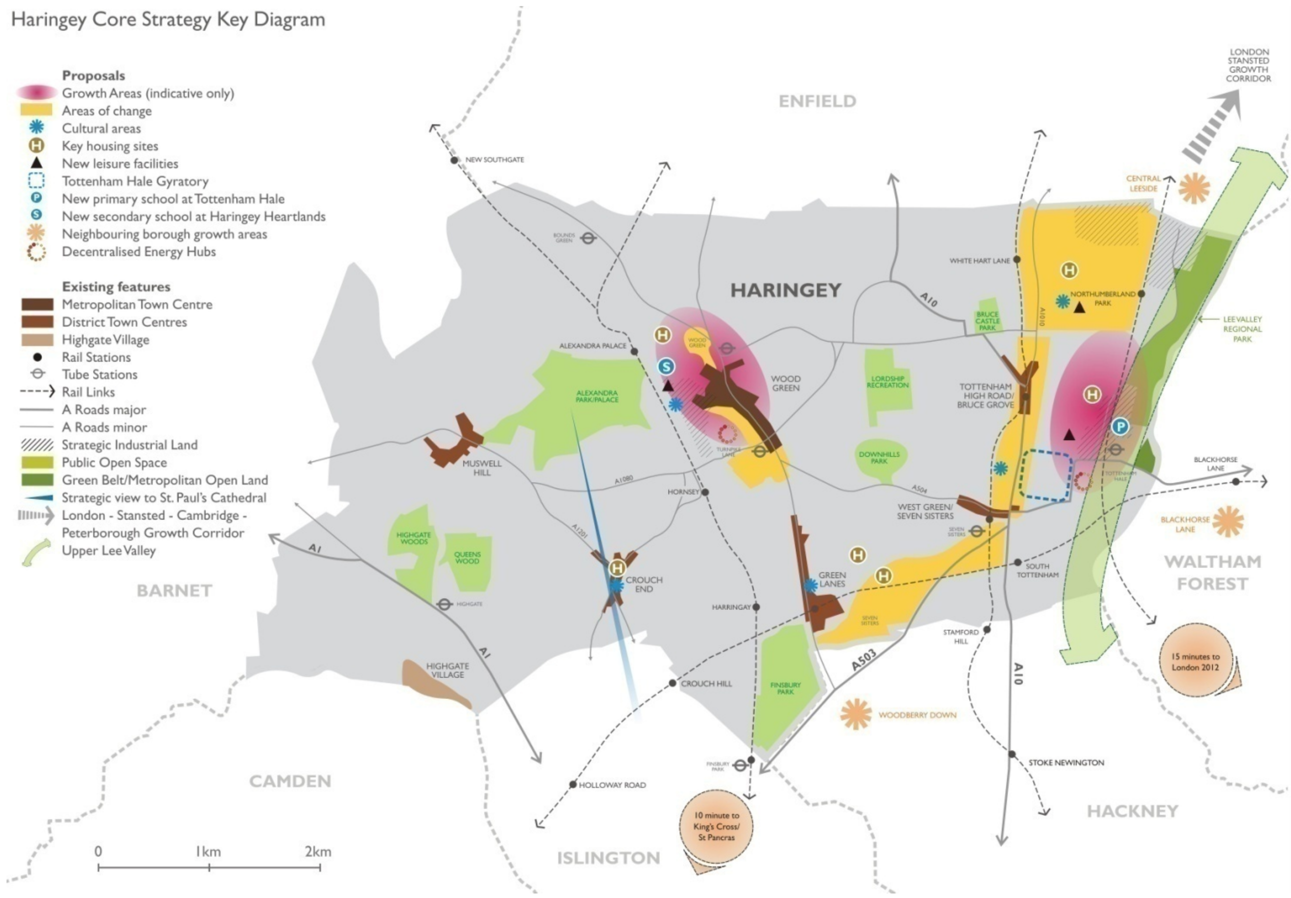
- Sites representative of typical developments in the Borough.
- A variety of development sizes.
- A variety of different uses and building types.
- Different opportunities and constraints.

6.1.2 *Summary of Sites*

	Site	Existing Use	Possible development scenario
1	596-606 Tottenham High Road - *Medium size site with access constraints*	Derelict	Mixed use, employment and residential
2	Broad Lane - *Small Site*	Car Park	Residential
3	Durnford Street - *Medium size development*	Workshops	Mixed use, employment and residential
4	Hornsey Town Hall - *Large mixed use development including refurbishment of listed building*	Council Offices	Mixed use, could include A1, A2, B1, C3, D1, D2, a theatre
5	Lawrence Road - *Large mixed use development*	Warehouses and offices	Mixed use, employment and residential
6	Hornsey Depot - *Large mixed use development with access constraints*	Utilities and employment	Mixed use
7	Civic Centre – *Large mixed use development*	Council Offices	Mixed use



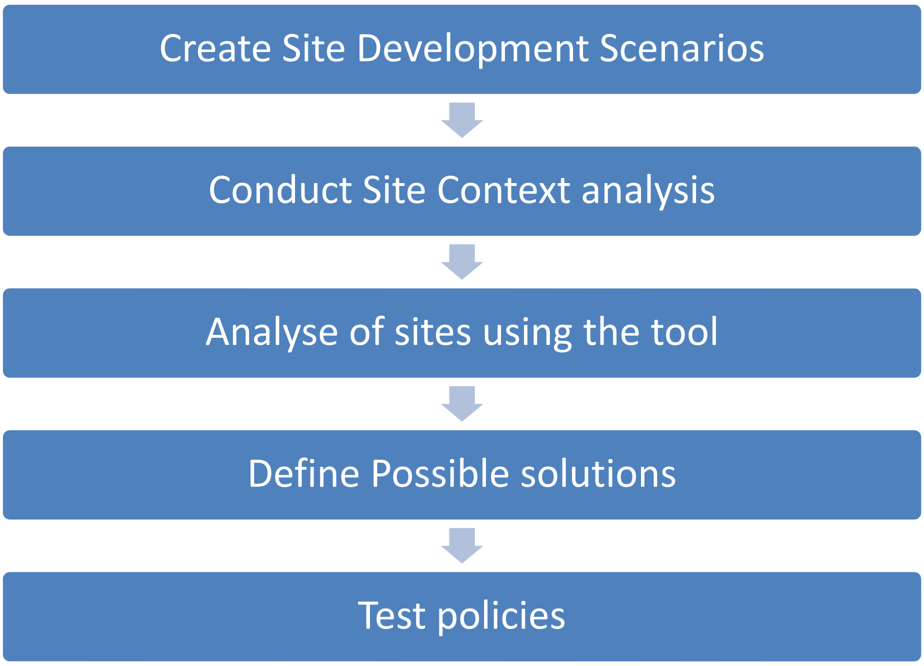
Indicative location of the seven selected sites



Haringey Core Strategy Issues and Options Consultation

Map 9.1 Areas of Renewal and Intervention

6.2 Site Analysis Methodology



6.3 Site development scenarios

The proposed development scenarios have been prepared by AECOM based on policies and Supplementary guidance from the Unitary Development Plan, information on Site Specific Proposals (UDP Appendix 1) and information derived from previous or current planning applications. The scenarios are only applicable to this study and does not constitute a planning brief or an approval by the local planning authority.

In order to further explore the impact and challenges of different types of development we have prepared two scenarios for each site. Depending on the site the scenarios vary in one or more of the following aspects:

- Density.
- Storey height.
- Proportion of different uses/building types.
- Different uses.
- Nature of development (considering new and refurbishment).

6.4 Site context assessment

For each of the development sites a desk-based context assessment has been carried out to identify the nature of the area and buildings within a radius of approximately 500m of the development.

The site context assessment aims to identify opportunities and constraints for the implementation of low and zero carbon technologies on each of the sites, these include:

- Air Quality, which could have an impact on the acceptability of the use of Biomass and/or gas-fired Combined Heat and Power Engines.
- Existing district heating systems within neighbouring premises, which could offer the potential for connection or increase the viability of networks created within the development by offering additional supply potential.
- Uses and densities of surrounding buildings (and planned development), which can have implications for the potential to develop wider energy networks in the area.
- Access, which could impact on the ability to deliver biomass fuel to the site.
- Location and height of neighbouring buildings, which may have an impact on the suitability of using the building for solar technologies (which can be severely affected by overshading) and building mounted wind turbines (which can be severely affected by turbulent wind regimes).

6.5 Tool analysis

In order to analyse the sites a toolkit was created in Microsoft Excel® which enabled the following steps to be undertaken in line with the methodology required by the London Plan policy 4A.1:

- Calculate predicted energy demands resulting from the development scenarios proposed for the site.
- Calculate predicted CO_2 emissions resulting from the proposed development scenarios.
- Calculate the potential reduction in CO_2 emissions from energy efficient fabric specifications.
- Calculate the potential for utilising CHP and the resultant reduction in CO_2 emissions.
- Calculate the potential for incorporating renewable energy generating technologies and the potential reduction in CO_2 emissions.

6.5.1 Energy Demands

The energy demands have been calculated using a combination of models and benchmark data.

For the residential elements, indicative models have been used to estimate the energy consumption for a range of standard dwelling types. The models have been created using the NHER Energy Software, which is based on SAP calculations for Building Regulations. As such these models only calculate the regulated energy demands. In order to establish the unregulated energy consumption the equation used within the Code for Sustainable Homes assessment methodology has been applied.

For the non-domestic elements benchmark data has been used to calculate the estimated energy consumption. This information has been taken from the CIBSE's TM46 – Energy Benchmarks (2008) taken from CIBSE guide TM46.

For the communal elements, which have been estimated based on the scenarios proposed, industry benchmarks of energy consumption for corridor lighting, lifts and underground car park lighting have been applied.

It should be noted that there are limitations to the calculations that result from the limited information available for the sites and therefore the limits placed on reliable extrapolation, such as the exclusion of energy consumption of water booster sets.

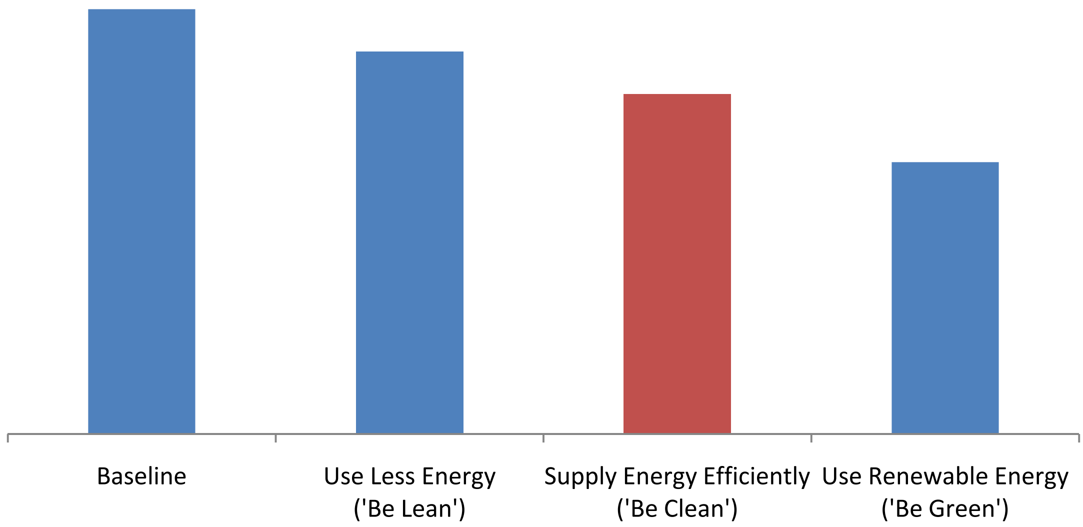
6.5.2 Predicted CO_2 emissions

The estimated CO_2 emissions have been calculated from the energy demands using the emissions factors from Building Regulations 2006:

- Gas: 0.194kgCO_2/kWh
- Electricity from grid: 0.422kgCO_2/kWh
- Electricity generated on site: 0.568kgCO_2/kWh
- Biomass: 0.025kgCO_2/kWh

Future changes to the building regulations have been proposed for April 2010 and the corresponding changes to SAP were put out for consultation in May 2009. However, because these have not yet been formally defined it has been necessary to use the Building Regulations 2006 figures for this study.

6.5.3 *Improvements from Fabric Measures*



Measures required by Policy 4A.1: Tackling climate change

The model assesses the implications of variations in fabric and energy efficiency measures associated with the residential component of the dwellings. Non-domestic fabric measures have not been included because of the difficulties in more bespoke nature of non-domestic building design and significant differences in unregulated energy consumption for different building uses. Anecdotal reports from recent research work as part of the CSH has suggested that energy consumption in buildings has stayed relatively consistent over time; the suggestion for which is that reductions in energy consumption for building services have been offset by increasing unregulated energy consumption, particularly in ICT.

The standard specification represents designs and specifications for residential dwellings that result in an improvement on the Building Regulations Dwelling Emission Rate (DER) relative to the Target Emission Rate (TER) of between 0 – 5%. The variation is the result of differences in the dwelling types, sizes and configurations. These figures are used for the baseline site CO_2 emissions.

Two alternative fabric measures have been applied to the residential dwellings to demonstrate the impact on the total site emissions and predicted energy demands. These represent:

1. A 15% improvement in the DER relative to the TER for the residential dwellings through specifications that represent improvements that can be achieved without significantly adverse technical and financial implications.

2. A 25% improvement in the DER relative to the TER for the residential dwellings, based on the EST's suggested backstop fabric specification and energy efficiency measures proposed for Code Levels 5 and 6[15].

Specification	~ 15% Improvement	~ 25% Improvement
Air Tightness ($m^3/m^2.h$) @ 50pa	5.00	3.00
Roof U-value (W/m^2K)	0.13	0.13
Walls U-value (W/m^2K)	0.17	0.15
Floors U-value (W/m^2K)	0.20	0.15
Windows U-value (W/m^2K)	1.70	1.30
Doors U-value (W/m^2K)	1.00	1.00
Thermal Bridging y-value	0.08 (accredited details)	0.04 (enhanced details)
Internal Lighting	100% Low Energy	100% Low Energy
Ventilation	MVHR*	MVHR*

**MVHR - mechanical ventilation with heat recovery assuming the backstop efficiency specifications recommended by EST which include a specific fan power (SFP) of 1W/l/s or better and a heat recovery efficiency of 85% or better.*

- Air Tightness

Building regulations sets an upper limit for the design air permeability of $10m^3/m^2hr$ at 50 Pa. Improvements beyond this standard can lead to significant reductions in the DER.

The type of construction selected by the developer can significantly affect how simple it is to achieve improvements in air tightness. In timber construction it can be easier to incorporate an air tightness barrier in to the panels so that the onsite team only need to seal joints between panels. Structurally insulated panelised systems can also achieve good standards of air tightness whereas conventional wisdom suggests that achieving this air tight membrane is more difficult in traditional masonry build. Air permeability levels of 3 or below will require mechanical ventilation in order to achieve the necessary air change rates required for good circulation.

- Insulation and U-values

The extent of fabric heat losses will depend upon the thermal transmittance of the fabric and the area of envelope through which heat loss can take place. Building Regulations

15 http://www.energysavingtrust.org.uk/business/Business/Building-Professionals/New-housing/The-Code-for-Sustainable-Homes

Approved Document Part L1A contains limiting U value standards for the individual elements. These values represent the worst case performance that is acceptable and it is necessary to improve upon these to achieve the CO_2 emissions performance required to achieve Building Regulations. Reducing U-values to the levels outlined above can have significant impact on the construction, particularly the walls and floors. Achieving lower U-values for walls can often require them to be significantly thicker than conventional specifications, although this will depend upon the insulation type that is being used. Similarly, reducing floor U-values through additional insulation will have an impact on the levels. Roof U-values are also likely to be reduced through additional insulation, which will increase the heights but is unlikely to have such a significant impact on the design.

- Thermal bridging

Thermal bridges are where elements within the construction that cross through the insulation create a path through which heat can transfer from the inside to the outside. These most commonly occur around windows and doors, as well as wall ties and concrete balconies that extend from the floor slab. The calculation methodology used in Building Regulations uses the y-value to make an assumption of the cumulative impact of thermal bridging within a building. Accredited construction details dictate a y-value of 0.08 W/m^2K, however with good detailing this can be reduced to 0.04 W/m^2K and will provide significant savings. An improved set of advanced accredited details for this reduced level of thermal bridging has been released by the Energy Saving Trust

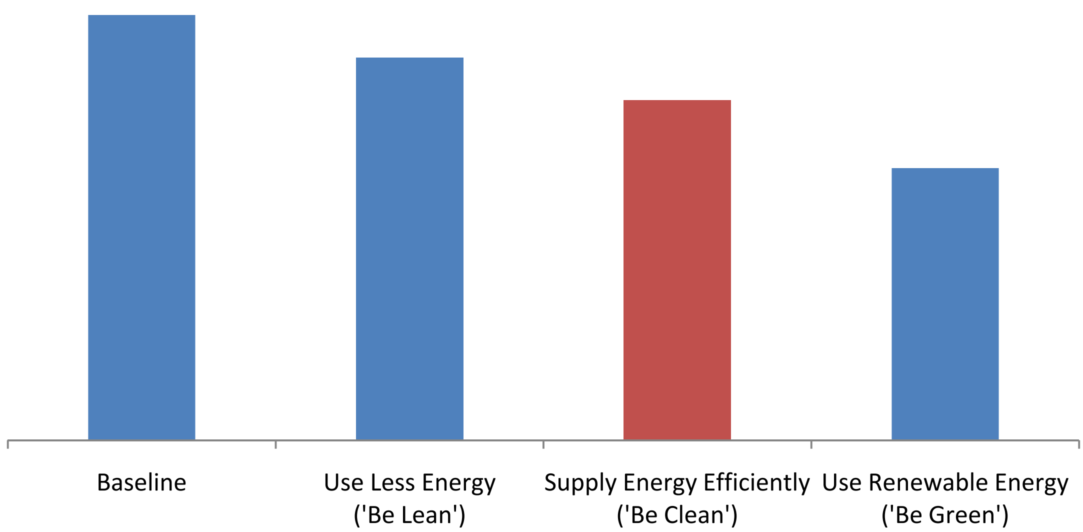
- Lighting

Improving the infiltration of natural daylight will help to reduce the use of artificial lighting within the dwellings. The masterplan layout, maximising south facing orientations and limiting overshading, internal layouts and window dimensions and specifications, all of which impinge on the levels of daylight within the dwellings, will have an effect on the lifetime energy consumption from the use of artificial lighting. To minimise energy consumption from lighting, dedicated low energy light fittings (i.e. fittings which only accept low energy lamps with luminous efficacy of greater than 40 lumens per circuit Watt) can be installed. Appropriate controls can also be employed to reduce energy consumption. Internally, smart controls can be used which enable all lights to be switched off from a single switch, thereby avoiding lights and appliances being left on during the night or periods of non-occupancy. External lighting can be controlled using daylight sensors or timers to avoid lights being switched on during daylight hours. Similarly, PIR sensors should be used for security lighting.

- Ventilation

Given the requirement for energy efficient and very air tight homes developers are beginning to use mechanical ventilation with heat recovery (MVHR) systems for dwellings. These systems recover heat from the exhaust air originating from the wet rooms within that dwelling and use this heat to warm incoming fresh air, thus reducing the energy demands for heating. They do use additional electrical energy to operate the fans but if the fan power is low and the efficiency of heat recovery is high then the system should provide a net benefit in terms of reducing CO_2 emissions over the course of a year. The additional benefit of such a system is that is allows very controlled ventilation and enables very low air permeability rates to be specified.

6.5.4 *Potential to incorporate CHP and the resulting improvements*



Measures required by Policy 4A.1: Tackling climate change

A CHP engine generates usable heat and power in a single process. The basic elements of a CHP plant comprise one or more prime movers usually driving electrical generators, where the heat generated in the process can be utilised for space and water heating.

Due to the utilisation of heat from electricity generation and the avoidance of transmission losses from electricity generated on site, the use of CHP provides a significant reduction in primary energy usage which can potentially lead to CO_2 reductions and economic savings where there is a suitable balance between the heat and power loads.

Gas fired CHP technology is a mature technology and is widely used in Europe and particularly Scandinavia. Although it uses fossil fuels, the efficiency of the system and local generation of electricity ensures that energy is generated efficiently and CO_2 emissions are therefore reduced.

A district heating network is required to deliver the heat to the dwellings. Pre-insulated flow and return pipework would be needed to be laid across the site to deliver hot water from the energy centre to each of the dwellings and commercial units. Inside the properties a hydraulic interface unit (HIU) would be used to transfer the heat across a heat exchanger to the internal heating system. Heat meters are used to record the amount of heat extracted for use within the home and would be read by the management company for billing purposes. The long-term benefits of a district heating network is that they would provide the possibility for future connection and integration with other city or area-wide heat networks and future replacement with other, renewable, energy generation technologies.

A guide to community heating produced by the Carbon Trust Guide to Community Heating (Community Heating for Planners and Developers, Carbon Trust 2004) suggests that district heating using CHP can be viable for developments of 55 dwellings per hectare or more, although this will be site dependant. An annual operational time of at least 4500 hours is commonly viewed as the requirement to provide economically viability for a scheme. This would require a demand for heat and power for at least 12.5 hours per day every day of the year. A continuous run-time is also important for the life-expectancy of the system, which can be significantly reduced if the operational times are limited and the outputs are not consistent. The systems are therefore usually sized to meet the base hot water demands, which do provide this level of consistency throughout the year.

Modelling of gas fired CHP, sized to meet hot water demands, along with good practice energy efficiency measures suggests that savings against the TER of around 35 – 40% or more can potentially be achieved, dependant on the unit type being considered.

CHP can potentially be used in combination with other technologies (see Figure 1 for a summary of the potential conflicts). If used in combination with another system providing heat to the dwellings then detailed analysis of the interaction of the two systems would need to be undertaken to adequately demonstrate that they were not adversely competing with each other for the same load and leading to either system operating at less than its optimal performance. If the CHP is sized to meet the hot water demand then the winter space heating demand can potentially be met by an alternative technology such as a biomass boiler. Renewable technologies that generate electricity work more synergistically with CHP since electricity can always be exported if more is generated than can be used on-site. CHP is not typically employed with solar water heating as the two technologies invariably compete for the same base heating load.

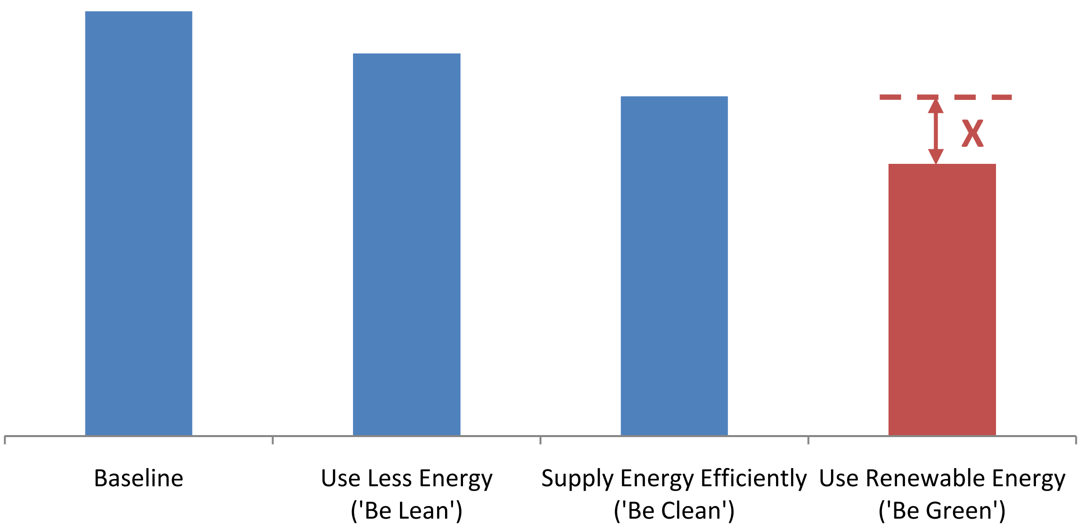
Biomass-fired CHP is an emerging technology, with few working installations currently operating within the UK. The use of this technology is seen as a route to achieving Code Level 6 and as such it is being trialled within residential schemes on some of the early schemes attempting to achieve this standard. It is likely that a better understanding of these technologies and greater confidence in their use and delivery will result from these developments.

The potential to incorporate CHP on each of the sites was assessed using the model and site context analysis. We have followed the general principle that less than 200 homes and a density of less than 55 dwellings per hectare makes it unlikely that a CHP system will be financially viable. For good financial returns and (CO_2 reduction benefits) the production of electricity needs to be maximised, which can be limited on smaller schemes for the following reasons:

- Recued heat demands result in reduced electricity production.
- The cost of maintenance relative to the returns from electricity generated are relatively higher thus reducing the financial viability.
- Smaller CHP engines tend to be less efficient and have a significantly lower ratio of electricity output to heat output.

For schemes that, according to these rules of thumb, are unlikely to support CHP and for which the site context analysis shows no immediate surrounding buildings that could be connected, we have assumed that CHP will not be installed.

6.5.5 Potential to incorporate renewable energy technologies



X represents the proportion of energy to be delivered by renewable energy

Measures required by Policy 4A.1: Tackling climate change

In exploring the potential to incorporate on-site renewable energy generation, the following renewable technologies were selected for analysis in the tool on the basis that they are readily available on the market and which are recognised by the government's low carbon building's program:

- **Solar Water Heating**

  Solar water heating systems circulate a fluid through solar collectors mounted on the roof or façade of a building to preheat the building's domestic hot water supply. Ideally the collectors should be mounted in a south-facing location, although south-east/south-west orientations are suitable with some reduction in performance. Peak levels of solar irradiation occur in the summer months when 100% of a dwelling's hot water demand can be supplied from the solar panel. Solar irradiation decreases substantially in winter but over a year a solar water heating system will typically meet around 50% of a home's total annual hot water demand.

There are two standard types of collectors used - flat plate collectors and evacuated tube collectors. Historically flat plate collectors have been the predominant type used for water heating in domestic systems due to their lower unit cost per unit of energy saved. However, recent advances in evacuated tube collector design have achieved near parity in terms of cost per $kgCO_2$ saved. Generally per m^2 evacuated tubes are more expensive to manufacture and therefore purchase, but achieve higher conversion efficiencies and are more flexible in terms of the locations they can be used

If individual systems are specified, these would comprise a flat plate panel on the roof with pipework to circulate water between the panel and an individual water cylinder within each dwelling. Communal systems would require a single array of panels connected in parallel to a main flow and return pipe to unvented calorifiers in a plant room. The first acts as a buffer vessel which then heats the main hot water calorifier which in turn feeds preheated water to a dual coil calorifier where it can be topped up from either condensing gas boilers serving the communal systems in each block or heated from a district heating main.

- **Solar Photovoltaics**

All PV cells have at least two layers of semiconductors, one that is positively charged and one that is negatively charged. When light shines on the semi-conductor, the electric field across the junction between these two layers causes electricity to flow - the greater the intensity of the light, the greater the flow of electricity.

PV systems consist of semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) in to alternating current (AC). PV panels supply electricity which can either be used directly by the buildings they are attached to or, when the building demand is insufficient, it can be exported to the grid. PV cells are available in a number of forms including monocrystalline, polycrystalline, amorphous silicon (thin film) and hybrid panels. Panels can be mounted or integrated onto the roof or facades of buildings.

Different PV types have different efficiencies which is usually expressed as kWh per kWp (kilowatt peak) and require different areas of panel to constitute one kWp.

PV technology is incorporated into SAP 2005 with a number of standard assumptions for outputs. Developers should base calculations for their proposed energy strategy on assumptions included within SAP, which assumes that on average 1kWp generates 800kWh/kWp. In reality PV can produce more energy than this, as can be seen from manufacturer' quoted data however SAP provides a common basis for calculations.

Onsite electrical generation not only avoids the need to use electricity from the grid which is primarily generated using fossil fuels but also avoid transmission losses and therefore provides significant CO_2 savings. The emission factor for grid displaced electricity is 0.568kgCO_2/kWh and this value should be used when calculating CO_2 savings from PV (as well as wind and CHP options).

- **Ground Source Heat Pumps**

Heat pump systems take advantage of the fact that the ground, air or bodies of water stay at a fairly constant temperature throughout the year. They use the refrigeration cycle to take low grade heat from theses sources (which are renewable since they derive this heat from the sun) and deliver it as higher grade heat to a building.

The ground temperature is not necessarily higher than ambient air temperature throughout the entire winter but the ground temperature is more stable than the air temperature which tends to fluctuate more. A ground sourced heating system uses a network of pipes either horizontally or vertically positioned within the ground to circulate the heat transfer fluid, collecting heat which is then delivered to the heat pump. The length of pipe work required is determined by the heat output required. Heat pump systems are generally plumbed to underfloor heating, but can also be used (at lower efficiency) to deliver higher temperature domestic hot water.

The technology, typically delivers around 3 units of heat for every 1 unit of electrical power consumed. The measure of efficiency of a heat pump is given by the Coefficient of Performance (COP), which is defined as the ratio of the output (kW), divided by quantity of input energy (kW). Annual seasonal COPs of 3 or more are achievable with ground source heat pump systems, giving good energy savings. Limiting factors are the rate at which energy can be drawn out of the ground and the maximum temperatures at which heat can be delivered to the building (typically 50-55^{o}C).

Ground source heating systems fall into two broad categories, open loop systems or closed loop systems. Open loop systems typically use a pair of wells to pump water from the ground, pass it through a heat exchanger linked to a heat pump and then pass it back into the ground via a return well. A water-bearing ground strata needs to be accessible to ensure this type of system can be installed. Closed loop systems use flexible plastic pipes buried in the ground to circulate a heat transfer fluid. There are three main types of closed loop system, horizontal systems with coils of pipe buried at around 1.5 to 2m beneath the ground, vertical borehole systems with vertical loops of pipe buried in purpose drilled boreholes, and energy piles where pipes are embedded in the piled foundations of buildings.

Whilst a ground source heat pump is clearly not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat extracted from the ground, measured as the difference between the heat output, less the primary electrical energy input.

For heating systems, the thermal energy extracted from the ground via heat transfer fluid is then raised to a higher temperature, suitable for heating purposes by the heat pump. While the average temperature to be found in the ground is in the region of 12°C, the heat pump increases the temperature between 25°C and 40°C in the heat transfer medium (water or a mixture of water and anti-freeze), which is suitable for underfloor heating.

Air-source heat pump systems work in the same way as ground source systems but extract heat from air drawn into the system. Systems which work on external air are usually attached on the external wall of a property. As previously noted, external air temperatures are less stable than ground temperatures and as such air-source heat pumps have reduced COPs. However, due to their relatively easy installation and avoidance of ground work, they could offer a straightforward solution. Internal systems are available which link to mechanical ventilation systems (MVHR). By taking air from within the dwelling more heat is available for extraction and the temperatures are less variable that external air. These systems also avoid the need for significant immersion top up because the risk of freezing is greatly reduced. As a result heat pumps connected to an MVHR system tend to be more efficient.

- **Biomass boilers**

Biomass heating is based on the use of a boiler just as standard heating technologies; however it uses wood fuel instead of fossil fuel as the source of energy. Wood fuel comes in various different forms, with varying characteristics. Chips can be obtained from arboricultural waste or other wood waste are often cheap and locally available but can often be of variable size, shape and moisture content. Pellets made from compressed saw dust usually have much lower moisture contents and higher calorific value than chip but tend to have higher processing and transportation requirements. Logs can also be used but are very rarely used for systems of capacities greater than for individual dwellings.

Biomass boilers come in a variety of capacities (rated in kW). The main difference between biomass boilers and conventional gas boilers is their considerably larger size and thermal inertia. Because of this they are normally designed to meet the base heat load for space and hot water with gas back-up to cover the peak loads. This arrangement means that the majority (around 80%) of energy use for heating and hot water can be met using biomass. Although wood fuel does have a CO_2 emission factor of $0.025kgCO_2/m^2$ to account for processing and transportation, this is much less than the factor associated with gas ($0.194kgCO_2/m^2$) and therefore the use of biomass can achieve considerable CO_2 savings.

- **Wind turbines**

Wind turbines capture energy from the wind to produce electricity. The capacity of turbines used on land range from a few Watts to 2-3 MW. Small scale turbines can be installed on buildings but tend to provide relatively small outputs, whereas larger, free standing turbines provide significant electrical outputs but need to be installed at a considerable distance from buildings and other obstacles.

Building mounted turbines or micro turbines are still relatively unproven in urban locations where wind regimes are very unpredictable and there is much debate about what can realistically be assumed in terms of their annual electrical.

Wind turbines do offer a number of significant advantages however. The cost of the electricity to the end user is likely to be comparable to current tariffs. In addition, if the turbine produces more than the electricity required by the development, the surplus can be sold, providing revenue that can either be distributed to the residents or discounted from the service charges. Wind turbines are usually a highly visible element in the landscape, which can be a powerful symbol of environmental credentials, provided the development is carried out with the relevant consultations to ensure that local residents and businesses are in favour of the project.

Appendix M of SAP provides an estimate of the likely outputs that can be expected from wind turbines located in urban, semi-urban and rural locations. Calculations of wind turbine outputs should use the SAP calculations to determine outputs of the systems selected.

Recent studies suggest that building mounted turbines located in urban areas suffer from lower and much more disrupted wind speeds than larger turbines mounted in open sites and this obviously has a significant impact on their energy generation potential. This is not necessarily a problem if the turbines can be designed to operate at low wind speeds and if their costs can be reduced to a level where their reduced performance is balanced by their low cost. There is, however, limited data on real energy generation from building mounted wind turbines in urban locations. Early examples notably generated significantly less than was predicted by manufacturers of the turbines.

Although not specifically covered in the model, air-source heat pumps could be expected to have a similar output and cost to ground-source heat pumps.

Other technologies are available on the market but which we have not reviewed because they are unlikely to be possible in Haringey or they still in the early stages of development and therefore represent an unlikely choice for developers compared to the more proven technologies listed above including:

- Hydro
- Large Wind
- Biomass CHP
- Fuel Cells

6.5.6 *Assumptions used in the model*

The Appendix contains a list and references for the assumptions made.

6.6 Testing Policies

6.6.1 *Policy options tested*

As detailed in the previous chapter, the following policy options have been tested

- Reduce total site emissions by 20% through the use of on-site renewable energy generation
- Reduce total site emissions by 30% through the use of on-site renewable energy generation
- Meet the mandatory energy standard required as part of Code for Sustainable Homes. The following levels have been looked at :
    - Level 3 (25% improvement over Building Regulations 2006)
    - Level 4 (44% improvement over Building Regulations 2006)
    - Level 5 (44% improvement over Building Regulations 2006)

6.6.2 *Reducing the total site emissions through the use of on-site renewable energy generation*

Using the outputs from the model, a number of possible solutions of meeting the target through on-site low and zero carbon technologies have been prepared. In determining the possible solutions the following implications for combining technologies have been considered:

- Technical Feasibility

  Combinations of technologies can be employed to meet the targets but it is important to note that some combinations can lead to competition between systems and therefore non-optimal performance, which will affect both output and maintenance. Generally competition occurs where multiple technologies are meeting the heat loads since this will be limited, as opposed to electricity which can be exported if excess is generated. Some technologies, such as CHP engines and, to a lesser extent, biomass boilers require continual operating periods and loads in order to operate efficiently. CHP also requires a good annual run-time to ensure financial viability so tends to be sized to meet the annual base-load hot water demands.

Deleterious effects of competition can potentially be avoided through appropriate sizing and design of the energy strategy. For example, two heat supplying technologies could work effectively together if one is sized to meet the annual hot water demand while the other is sized and operated to meet only the winter space heating demands. Therefore, if utilising combinations where conflict may occur it will be important to demonstrate that the proposed strategy will not result in any of the systems not working at their optimum efficiencies. The following table shows potential combinations of high conflict (red), no conflict (green) and conflict that can be avoided through attention to designing an appropriate strategy (pink) for residential dwellings:

	Solar Water Heating					
Biomass		Biomass				
Gas CHP			CHP			
Biomass CHP				Biomass CHP		
PV					PV	
Wind						Wind
Heat Pumps						

- Site Constraints

The ability to combine technologies may also be limited by site constraints. The roof area will have an implication on the use of PV, Solar Water Heating and building mounted wind turbines.

Both PV and Solar Water Heating will also be limited by the suitability of the roof space, which will depend on a number of factors including orientation, pitch and especially overshading.

Access to the site will have an implication on the potential to use biomass heating systems, which will require regular deliveries of biomass chips or pellets in trucks or lorries.

- Operational Issues

  The implications of energy systems on the utility costs passed on to the residents may constrain the choice of technologies. Depending on the fuel type and supply arrangements, the cost of biomass can be higher than gas and therefore residents will pay more for such a system. This may not be acceptable for social housing projects funded by RSLs, which need to address fuel poverty issues. Similarly, costs for CHP systems may also be higher than for individual gas systems and customers would be tied-in to long-term utility contracts.

6.6.3 Meeting the mandatory energy levels of the Code for Sustainable Homes

Ysing a set of generic models, the following solutions that could potentially be used to meet the mandatory energy targets for each of the Levels of the Code for Sustainable Homes have been identified:

Code Level 3

1. Fabric specification and energy efficiency measures to deliver a 15% improvement on the TER [15% EE]
2. Fabric specification and energy efficiency measures to deliver a 15% improvement on the TER [15% EE] combined with Solar Water Heating [SWH]
3. Photovoltaic array of around 1kWp [PV ~1kWp]
4. Fabric specification and energy efficiency measures to deliver a 15% improvement on the TER [15% EE] combined with Photovoltaic array of around 0.5kWp [PV ~0.5kWp]
5. Ground Source Heat Pump [GSHP]

Code Level 4

1. Communal heating system served by a gas-fired Combined Heat and Power engine [Gas CHP]
2. Communal heating system served by a biomass boiler [Biomass
3. Fabric specification and energy efficiency measures to deliver a 15% improvement on the TER [15% EE] combined with Photovoltaic array of around 1.3kWp [PV ~1.3kWp]
4. Fabric specification and energy efficiency measures to deliver a 25% improvement on the TER [25% EE] combined with Photovoltaic array of around 0.8kWp [PV ~0.8kWp]
5. Fabric specification and energy efficiency measures to deliver a 15% improvement on the TER [15% EE] combined with solar Water Heating [SWH] and a Photovoltaic array of around 0.8kWp [PV ~0.5kWp]

Code Level 5

1. Communal heating system served by a biomass-fired Combined Heat and Power engine [Biomass CHP] and a Photovoltaic array of around 0.6kWp [PV ~0.6kWp] per unit
2. Fabric specification and energy efficiency measures to deliver a 25% improvement on the TER [25% EE] combined with a Photovoltaic array of around 3kWp [PV ~3kWp]
3. Communal heating system served by a gas-fired Combined Heat and Power engine [Biomass CHP] and a Photovoltaic array of around 2kWp [PV 2kWp] per unit
4. Communal heating system served by a biomass boiler [Biomass] and a Photovoltaic array of around 1.7kWp [PV ~1.7kWp] per unit

Code Level	Solution			Potential Improvement	Cost per unit* (low end)	Cost per unit* (high end)
3	25% EE			25%	£3,000	£4,000
	15% EE	SWH		25%	£4,000	£6,000
	PV (~1kWp)			25%	£4,500	£5,500
	15% EE	PV (~0.5kWp)		25%	£4,750	£5,750
	GSHP			25%	£6,000	£8,000
4	Gas CHP			40-50%	£8,000	£12,000
	Biomass			60%	£6,000	£10,000
	15% EE	PV (~1.3kWp)		44%	£7,850	£10,150
	25% EE	PV (~0.8kWp)		44%	£6,600	£8,400
	15% EE	SWH	PV (~0.8kWp)	44%	£7,600	£10,400
5	Biomass CHP	PV (~0.6kWp)		100%	£11,700	£15,300
	25% EE	PV (~3kWp)		100%	£16,500	£20,500
	Gas CHP	PV (~2KwP)		100%	£17,000	£23,000
	Biomass	PV (~1.7KwP)		100%	£13,650	£19,350

*The costs are indicative and are likely to vary greatly depending on a number of factors including the site, density, design, market prices, size of system etc.

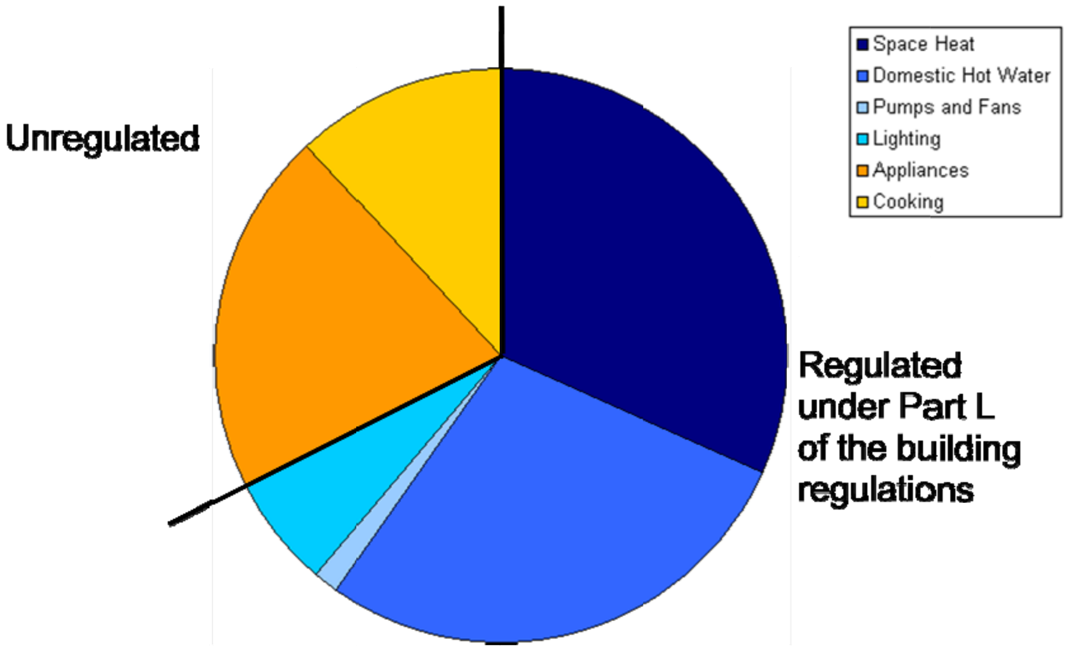
6.6.4 *Relationship between the two policy options proposed*

Improvements on building regulations and the specification of on-site renewable energy generation are not mutually exclusive. If used in tandem, measures taken to meet one will affect the other, for example the specification of renewable technologies will deliver on-site renewable energy generation as well as leading to an improvement over the Building Regulations requirements.

However, the methodology of the two requirements are fundamentally different. The percentage on-site renewable energy generation is based on total site emissions, which includes the following:

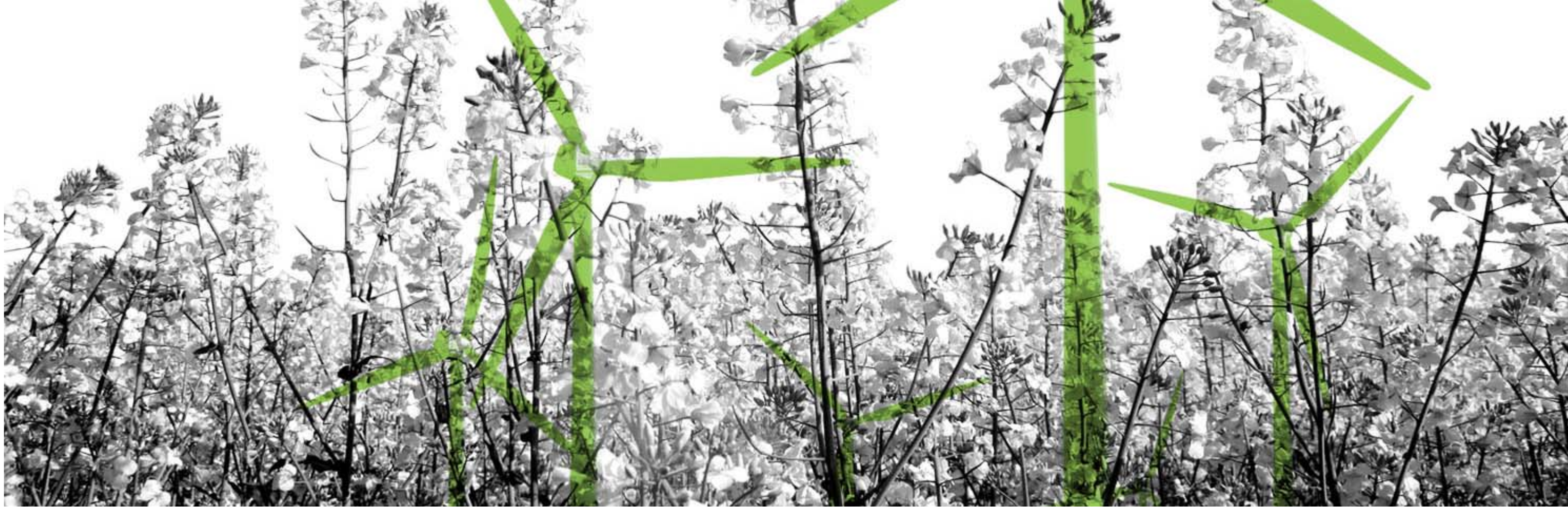
- Regulated emissions covered by Building Regulations (space heating, hot water, lights, pumps and fans)
- Unregulated emissions (cooking, appliances, process loads etc)
- Additional energy uses on-site (including lifts and lighting for communal areas)

In contrast, the methodology for improvements over building regulations is based on regulated emissions only. To show the scale of the distinction, the following Figure illustrates the proportions of the regulated and unregulated emissions for a typical dwelling.



Regulated and Unregulated emissions for a typical dwelling

Due to the different methodologies the proportions of savings in the two targets are not directly comparable. Indeed as described above, measures undertaken to deliver a level of energy efficiency and meet the target of 20% reduction in *total emissions* from on-site generation of renewable energy will commonly achieve the 44% reduction on *regulated emissions* from dwellings as required for the mandatory energy standard of the Code for Sustainable Homes.

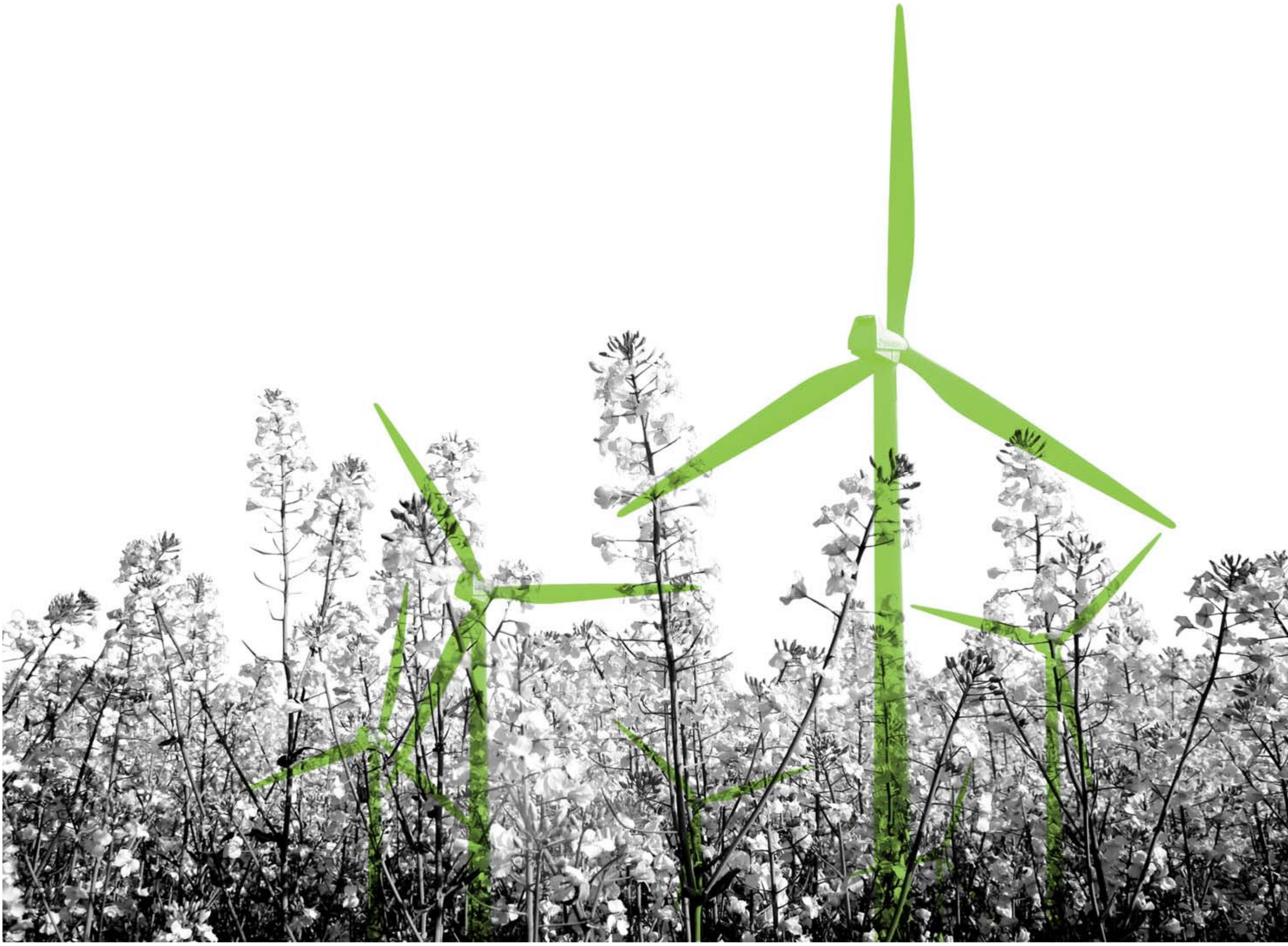


Site Analysis Results

7 Site Analysis Results

The following pages comprise the reports produced following the analysis of the selected seven sites following the method outlined in the previous chapter.

The results are discussed in the following chapter.



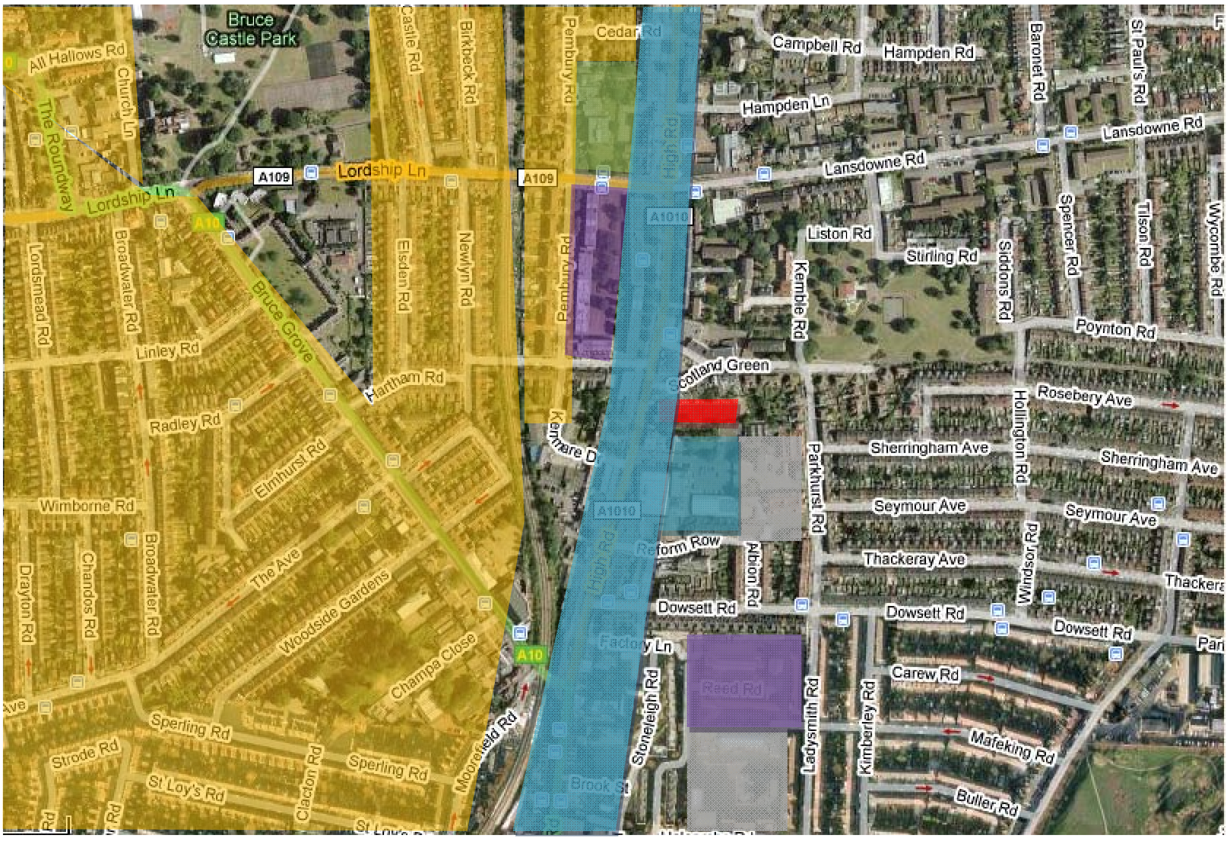
Site Analysis – Site 1: 596 – 606 Tottenham High Road

Site 1: 596 – 606 Tottenham High Road

1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	38 Flats, Retail unit	25 Flats, Retail unit
Mix of residential units	16 x 1B, 12 x 2B, 7 x3B, 4 x 4B	20 x 1B, 10 x 2B, 8 x 3B, 4 x 4B
Density	307 hr/ha (100 d/ha)	202 hr/ha (66 d/ha)
Storeys	4	3
Lifts	1	1
Area of underground car parking	0	0

2. Analysis of surrounding area



KEY: Red – Site; Orange – Medium density residential; Purple – High density residential; Grey – School; Blue - Commercial corridor; Green – Town Hall;

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	No potential adverse shading from existing buildings (that cannot be addressed by orientation/design)
Connection to existing district heating network	No existing networks near to the site
Conservation Area	The site lies within a conservation area that extends along most of High Road. This may have implications on the design of the development and use of efficient design measures and low and zero carbon technologies, particularly solar technologies.
Potential to incorporate CHP	The limited number and density of residential units and the limited non-residential component means that the development is unlikely to support the use of CHP
Potential to incorporate a communal/site wide heating system	The site could support a communal heating system thus making it compatible with future district heating systems
Future potential district heating network	The area has a high proportion of medium-density terraced housing and some high density housing including the Millicent Fawcett Court opposite (highlighted purple). Future potential for district heating in the area may be possible and therefore a communal system would enable the development to be connected in future.
Site access	Access to the site for the delivery of fuel such as biomass may be limited
Wind regime	The dense urban environment around the site would reduce the outputs from building–mounted wind turbines (this is accounted for in the modelling).

3. Baseline Demands and Emissions

	Scenario 1					Scenario 2				
	Residential					**Residential**				
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
1B Flat	16	34,248	69,464	35,595	27,929	11	23,546	47,757	24,472	19,201
2B Flat	11	34,326	54,572	31,201	25,073	7	21,844	34,728	19,855	15,955
3B Flat	7	22,827	37,121	20,893	16,835	4	13,044	21,212	11,939	9,620
4B Flat	4	15,324	23,069	13,566	10,942	3	11,493	17,302	10,175	8,207
Total	38	106,726	184,227	101,255	80,778	25	69,927	120,999	66,440	52,983
Occupancy	75					49				

	Scenario 1				Scenario 2			
	Communal				**Communal**			
	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting	342		3,121	1,317	225		2,053	866
Lifts		1	5,840	2,464		1	5,840	2,464
Car Park Lighting	0		0	0	0		0	0
Total			8,961	3,781			7,893	3,331

	Scenario 1					Scenario 2				
	Commercial					**Commercial**				
	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
General Retail	186	30,690	0	0	12,951	186	30,690	0	0	12,951
Total					12.951					12,951

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	97.51	69.26
Total Heat Demand (kWh/year)	82,972	54,559
Total Hot Water Demand (kWh/year)	101,255	66,440
Total Electricity Demand (kWh/year)	146,376	108,510

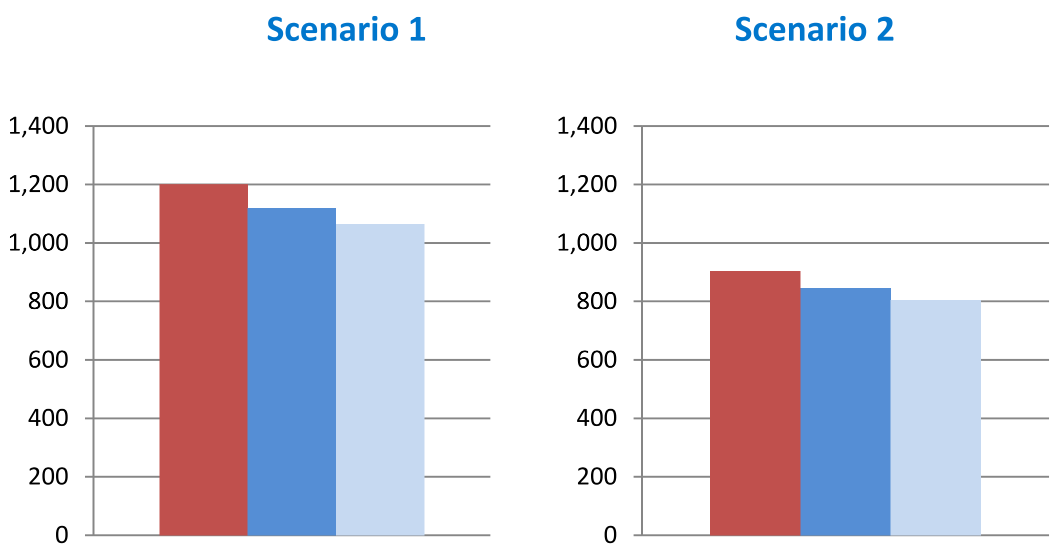
4. 'Be Lean' - Implications of Fabric Improvements

Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	91.23	65.12
Reduction on Total Site Emissions (tonnes/year)	6.28	4.14
% Reduction on Total Site Emissions	6.4%	6.0%

Measures to deliver around a 25% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	88.36	63.23
Reduction on Total Site Emissions (tonnes/year)	9.15	6.03
% Reduction on Total Site Emissions	9.4%	8.0%



Key: Red = no improvement over building regulations; Dark Blue = 15% improvement; Dark Blue = 25%improvement

5. 'Be Clean' - Potential for CHP

The use of CHP is unlikely to be technically or financially viable for this site due to the size and density of the proposed development scenarios.

The use of CHP is therefore not considered in this energy assessment.

6. ‘Be Green’ - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	5.84	5.99%	53,200	9,500	3.84	5.55%	35,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	5.75	5.90%	57,000	10,000	3.78	5.46%	37,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	28.90	29.64%	323,500	11,500	25.35	36.60%	283,800	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	24.82	25.46%	323,500	13,500	23.54	33.99%	283,800	12,500
GSHP	Communal System serving whole site	7.17	7.35%	88,400	12,500	4.71	6.80%	58,100	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.61%	28,000	47,000	0.60	0.86%	28,000	47,000
BIOMASS	Communal System for whole site	23.60	24.20%	296,400	13,000	15.50	22.38%	229,200	15,000

Option 2: No CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	5.84	6.40%	53,200	9,500	3.84	5.90%	35,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	5.75	6.30%	57,000	10,000	3.78	5.81%	37,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	28.90	31.68%	323,500	11,500	25.35	38.93%	283,800	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	24.82	27.21%	323,500	13,500	23.54	36.15%	283,800	12,500
GSHP	Communal System serving whole site	5.78	6.33%	88,400	12,500	3.80	5.83%	58,100	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.65%	28,000	47,000	0.60	0.92%	28,000	47,000
BIOMASS	Communal System for whole site	19.02	20.85%	296,400	16,000	12.49	19.19%	229,200	18,500

Option 3: No CHP & 25% Improvement on Building Regs for residential dwellings

LZC	System	Scenario 1				Scenario 2			
		CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	5.84	6.61%	53,200	9,500	3.84	6.07%	35,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	5.75	6.51%	76,000	10,000	3.78	5.98%	37,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	28.90	32.71%	323,500	11,500	25.35	40.10%	283,800	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	24.82	28.09%	323,500	13,500	23.54	37.23%	283,800	12,500
GSHP	Communal System serving whole site	5.06	5.72%	88,400	12,500	3.32	5.25%	58,100	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.68%	28,000	47,000	0.60	0.94%	28,000	47,000
BIOMASS	Communal System for whole site	16.65	18.84%	294,509	18,000	10.93	17.29%	227,962	21,000

7. Policy Test

1. 20% renewables

a. Based on Option 1

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£218,300	£155,100	20.0	20.0
2	PV (Mono Crystalline) scaled	£254,200	£167,000	20.0	20.0
3	Biomass	£296,400	£229,200	24.2	22.4

b. Based on Option 2

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£204,200	£145,800	20.0	20.0
2	PV (Mono Crystalline) scaled	£237,800	£157,000	20.0	20.0
3	Biomass	£294,500	£228,000	20.1	19.2

c. Based on Option 3

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£197,800	£141,600	20.0	20.0
2	PV (Mono Crystalline) scaled	£230,300	£152,500	20.0	20.0

2. 30% renewables

a. Based on Option 1

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£323,500	£232,600	29.6	30.0
2	Biomass + PV (Hybrid) scaled	£359,700	£288,300	30.0	30.0

b. Based on Option 2

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£306,400	£218,700	30.0	30.0
2	Biomass + PV (Hybrid) scaled	£388,800	£307,200	30.0	30.0

c. Based on Option 3

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	PV (Hybrid) scaled	£296,700	£212,400	30.0	30.0
2	Biomass + PV (Hybrid) scaled	£404,900	£317,900	30.0	30.0

3. Mandatory Code for Sustainable Homes Energy Standards

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			25%		
	15% EE	SWH		25%		
	PV (~1kWp)			25%		
	15% EE	PV (~0.5kWp)		25%		
	GSHP			25%		
4	Gas CHP			40-50%		
	Biomass			60%		
	15% EE	PV (~1.3kWp)		44%		
	25% EE	PV (~0.8kWp)		44%		
	15% EE	SWH	PV (~0.8kWp)	44%		
5	Biomass CHP	PV (~0.6kWp)		100%		
	25% EE	PV (~3kWp)		100%		
	Gas CHP	PV (~2KwP)		100%		
	Biomass	PV (~1.7KwP)		100%		

8. Recommendations and Conclusions

Energy Efficiency

- Approximately 6% reduction in total site CO_2 emissions depending on the relative scale of the commercial element could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 8-9% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

Efficient delivery of heat

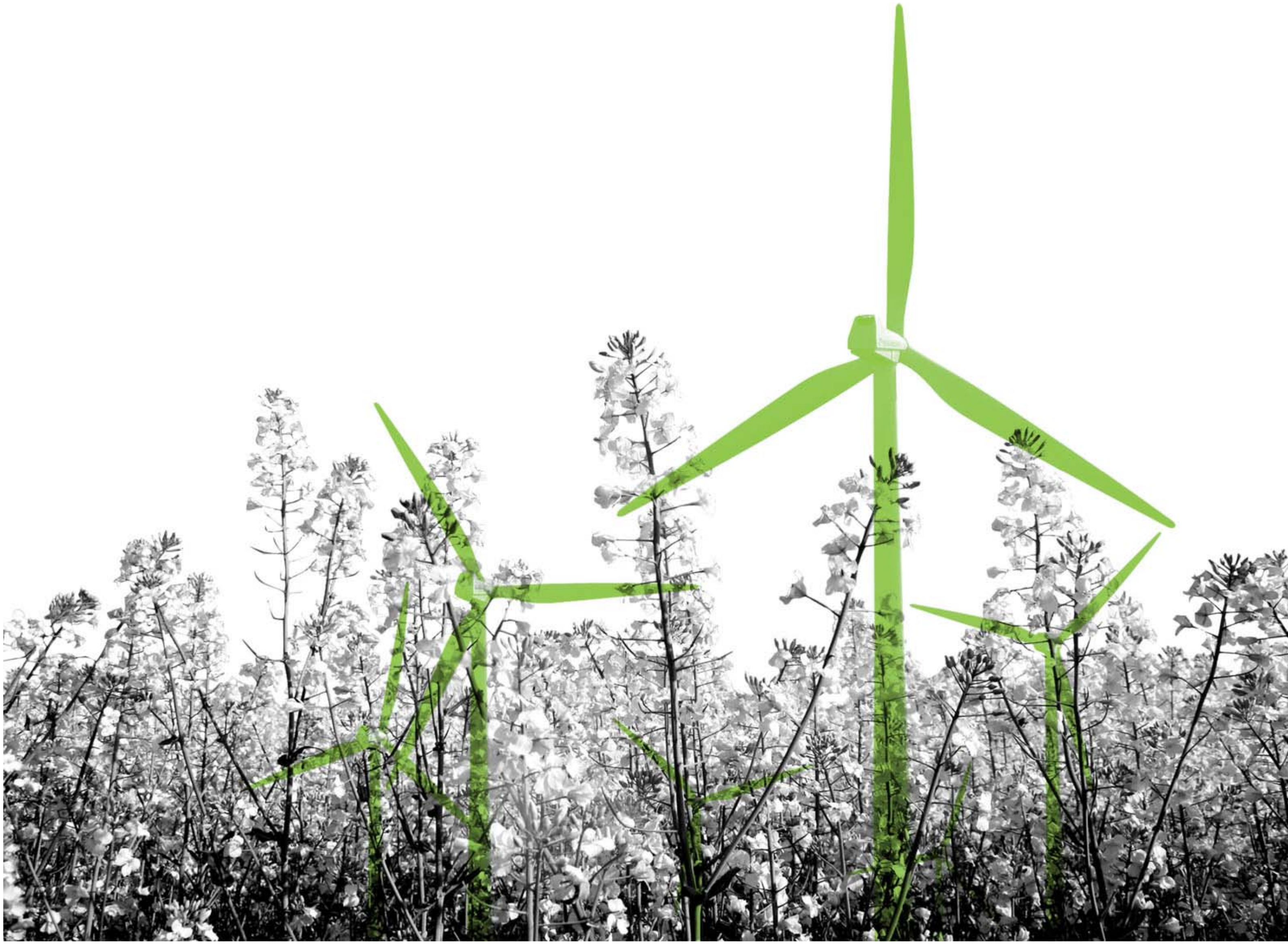
- There is a limited potential to incorporate CHP on the site due to the small scale and density of the proposed development.
- A communal heating system could be incorporated and would make the development compatible with future networks. The site is located roughly equidistant between Tottenham Hale, which has a CHP system installed and represents a large development site likely to include the installation of a district heating network, and the Tottenham Hotspur Football Ground, which is currently the subject of a planning application which proposes the use of a district heating system. Any future connection between the sites may run past this site and therefore the ability to connect would be advantageous.

Potential to meet proposed policy options

- The possible options for meeting the renewables target are likely to involve SWH, PV and/or biomass, providing a degree of flexibility to the developer.
- The use of PV or SWH may be constrained by the Conservation Area designation. This may impact on the area of roof space suitable for PV which could reduce the potential reductions that could be achieved.
- The use of biomass would have the following implications:
  - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
  - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:

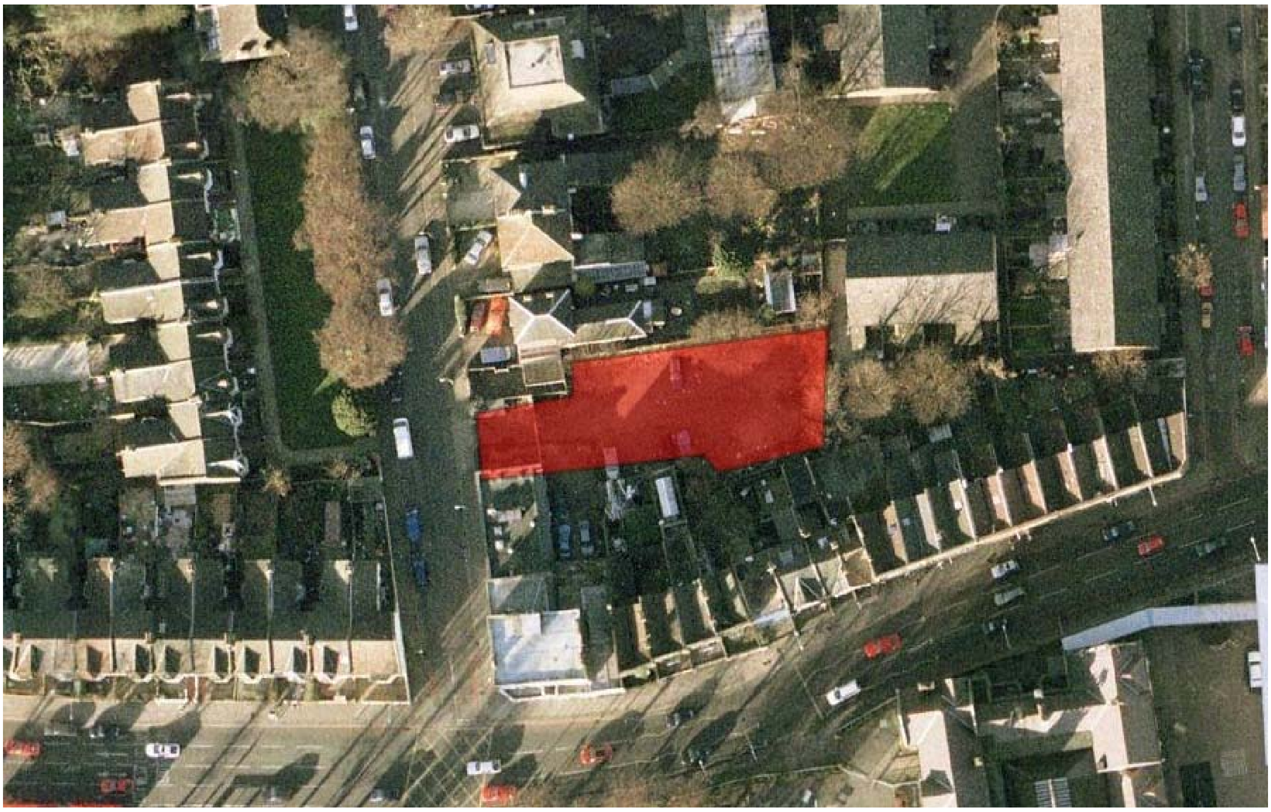
- 20% improvement in total site emissions from on-site renewables: £4,000 to £10,000
- 30% improvement in total site emissions from on-site renewables: £5,500 to £11,000
- CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
- CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.



Site Analysis – Site 1: Broad Lane

Site 2: Broad Lane



1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	4 houses	7 Flats
Mix of residential units	2 End-terrace & 2 Mid-terrace	2 x 1-Bed; 2 x 2-Bed; 2 x 3-Bed & 1 x 4-bed
Density	353hr/ha (59 d/ha)	353hr/ha (103 d/ha)
Storeys	2	3
Lifts	0	0
Area of underground car parking	0	0

2. Analysis of surrounding area

KEY: Red – Site; Orange – Residential Low rise; Purple – Residential High Rise; Grey – Education; Green – Health Centre; Dark Blue – Large Supermarket; Light Blue – Commercial Corridor; Pink – Industrial Area;

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	No significant over-shading as current plans indicate that roof height is similar to surrounding buildings
Connection to existing district heating network	No existing networks near to the site
Potential to incorporate CHP	The limited number and density of residential units means that the development is unlikely to support the use of CHP.
Potential to incorporate a communal/site wide heating system	The limited number of units planned means that the development is unlikely to support the use of a site wide heating system.
Future potential district heating network	Area has a high proportion of medium-density terraced housing but is close to a school. Future potential for district heating may be possible but would rely on the development of
Site access	The delivery and storage of biomass fuel is limited due to the density of the surrounding area. However, it may be possible for fuel to be stored in nearby industrial area and transported by train.
Wind regime	The dense urban environment around the site would reduce the outputs from building–mounted wind turbines (this is accounted for in the modelling).

3. Baseline Demands and Emissions

	Scenario 1					Scenario 2				
	Residential					**Residential**				
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
End Terrace	2	6,782	13,253	6,586	5,433	0	0	0	0	0
Mid Terrace	2	6,846	11,742	6,586	5,167	0	0	0	0	0
1B Flat	0	0	0	0	0	2	4,281	8,683	4,449	3,491
2B Flat	0	0	0	0	0	2	6,241	9,922	5,673	4,559
3B Flat	0	0	0	0	0	2	6,522	10,606	5,969	4,810
4B Flat	0	0	0	0	0	1	3,831	5,767	3,392	2,736
Total Residential	4	13,628	24,995	13,172	10,600	7	20,875	34,979	19,483	15,595
Assumed Occupancy	12					15				
	Communal					Communal				
		Area (m2)	Number	Electricity *(kWh)*	CO2 *(kg/yr)*		Area (m2)	Number	Electricity *(kWh)*	CO2 (kg/yr)
Corridor lighting		0		0	0		63		575	243
Lifts			0	0	0			0	0	0
Car Park Lighting		0		0	0		0		0	0
Total				0	0				575	243
	Commercial					**Commercial**				
	None present					**None present**				

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	10.60	15.84
Total Heat Demand (kWh/year)	11,823	15,495
Total Hot Water Demand (kWh/year)	13,172	19,483
Total Electricity Demand (kWh/year)	13,628	21,450

4. 'Be Lean' - Implications of Fabric Improvements

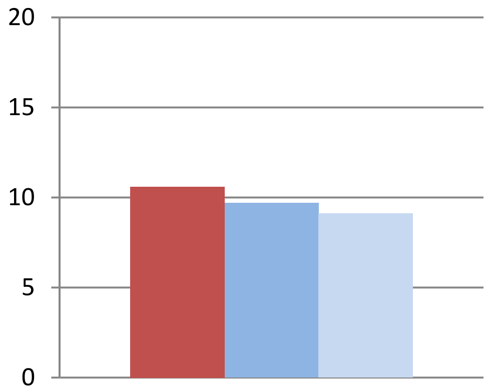
Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	9.69	14.68
Reduction on Total Site Emissions (tonnes/year)	0.91	1.16
% Reduction on Total Site Emissions	8.6%	7.3%

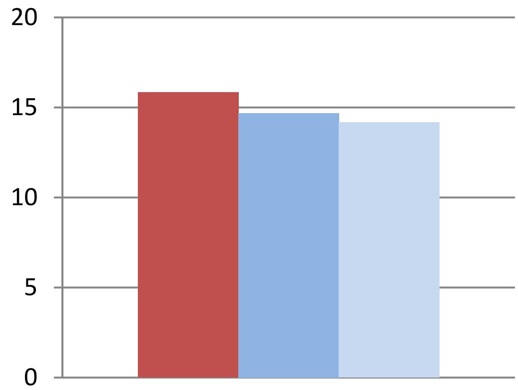
Measures to deliver around a 25% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	9.11	14.16
Reduction on Total Site Emissions (tonnes/year)	1.49	1.68
Reduction on Total Site Emissions	14.1%	10.6%

Scenario 1



Scenario 2



Key: Red = no improvement over building regulations; Dark Blue = 5% improvement; Medium Blue = 15% improvement; Light Blue = 25%improvement

5. 'Be Clean' - Potential for CHP

The use of CHP is unlikely to be technically or financially viable for this site due to the size and density of the proposed development scenarios.

The use of CHP is therefore not considered in this energy assessment.

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	-	-	-	-	1.08	6.79%	9,800	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	-	-	-	-	1.06	6.69%	10,500	10,000
SWH	Residential - Individual Systems (Houses) [Flat Plate]	1.23	11.60%	11,200	9,500	-	-	-	-
SWH	Residential - Individual Systems (Houses) [Evacuated Tube]	1.61	15.23%	16,000	10,000	-	-	-	-
PV	Residential - Communal Systems for Flats [Hybrid Panels]	-	-	-	-	7.10	44.82%	79,468	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	-	-	-	-	6.59	41.62%	79,468	12,500
PV	Residential - Individual Systems for Houses[Hybrid Panels]	2.88	27.21%	32,289	11,500	-	-	-	-
PV	Residential - Individual Systems for Houses [C21]	2.34	22.11%	28,620	12,500	-	-	-	-
GSHP	Communal System serving whole site	-	-	-	-	1.36	8.60%	16,790	12,500
GSHP	Residential - Individual Systems for houses	0.97	9.18%	11,997	12,500	-	-	-	-
WIND	Building Mounted 6kW Turbine	0.60	5.64%	28,000	47,000	0.60	3.77%	28,000	47,000
BIOMASS	Residential - Individual Systems for Houses	3.35	31.61%	40,000	12,000	-	-	-	-

Option 2: No CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	-	-	-	-	1.08	7.33%	14,000	13,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	-	-	-	-	1.06	7.22%	10,500	10,000
SWH	Residential - Individual Systems (Houses) [Flat Plate]	1.23	12.69%	11,200	9,500	-	-	-	-
SWH	Residential - Individual Systems (Houses) [Evacuated Tube]	1.61	16.66%	16,000	10,000	-	-	-	-
PV	Residential - Communal Systems for Flats [Hybrid Panels]	-	-	-	-	7.10	48.37%	79,468	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	-	-	-	-	6.59	44.91%	79,468	12,500
PV	Residential - Individual Systems for Houses[Hybrid Panels]	2.88	29.77%	32,289	11,500	-	-	-	-
PV	Residential - Individual Systems for Houses [C21]	2.34	24.19%	28,620	12,500	-	-	-	-
GSHP	Communal System serving whole site	-	-	-	-	1.10	7.47%	13,516	12,500
GSHP	Residential - Individual Systems for houses	0.80	8.22%	9,817	12,500	-	-	-	-
WIND	Building Mounted 6kW Turbine	0.60	6.17%	28,000	47,000	0.60	4.07%	28,000	47,000
BIOMASS	Residential - Individual Systems for Houses	2.74	28.29%	40,000	15,000	-	-	-	-

Option 3: No CHP & 25% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	**System**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**
SWH	Residential - Communal Systems serving flats [Flat Plate]	-	-	-	-	1.08	7.60%	14,000	13,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	-	-	-	-	1.06	7.48%	10,500	10,000
SWH	Residential - Individual Systems (Houses) [Flat Plate]	1.23	13.49%	11,200	9,500	-	-	-	-
SWH	Residential - Individual Systems (Houses) [Evacuated Tube]	1.61	17.71%	16,000	10,000	-	-	-	-
PV	Residential - Communal Systems for Flats [Hybrid Panels]	-	-	-	-	7.10	50.15%	79,468	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	-	-	-	-	6.59	46.57%	79,468	12,500
PV	Residential - Individual Systems for Houses[Hybrid Panels]	2.88	31.66%	32,289	11,500	-	-	-	-
PV	Residential - Individual Systems for Houses [C21]	2.34	25.72%	28,620	12,500	-	-	-	-
GSHP	Communal System serving whole site	-	-	-	-	0.96	6.80%	11,869	12,500
GSHP	Residential - Individual Systems for houses	0.68	7.41%	8,327	12,500	-	-	-	-
WIND	Building Mounted 6kW Turbine	0.60	6.56%	28,000	47,000	0.60	4.22%	28,000	47,000
BIOMASS	Residential - Individual Systems for Houses	2.33	25.52%	40,000	17,500	-	-	-	-

7. Policy Test

1. 20% renewables

a. Based on Option 1

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass	£40,000 Individual systems	£36,600 Communal System	31.6% Individual systems	28.3% Communal System
2	PV	£23,700 Individual systems	£35,500 Communal System	20.0% Individual systems	20.0% Communal System
3	PV + SWH	£21,700 Individual systems	£33,200 Individual SWH and Communal PV	20.0% Individual systems	20.0% Communal System

b. Based on Option 2

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass	£40,000 Individual systems	£36,600 Communal System	28.3% Individual systems	24.6% Communal System
2	PV	£21,700 Individual systems	£32,900 Communal System	20.0% Individual systems	20.0% Communal System
3	PV + SWH	£19,600 Individual systems	£30,600 Individual SWH and Communal PV	20.0% Individual systems	20.0% Communal System

c. Based on Option 3

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass	£40,000 Individual systems	£36,600 Communal System	25.5%	22.4%
2	PV	£20,400 Individual systems	£31,700 Communal System	20.0%	20.0%
3	PV + SWH	£18,300 Individual systems	£29,400 Individual SWH and Communal PV	20.0%	20.0%

2. 30% renewables

a. Based on Option 1

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass	£40,000 Individual systems	£36,600 Communal System	31.6%	28.3%
2	PV	£35,600 Individual systems	£53,200 Communal System	30.0%	30.0%
3	PV + SWH	£33,530 Individual systems	£50,900 Individual SWH and Communal PV	30.0%	30.0%

b. Based on Option 2

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass + PV	£41,851 Individual systems	£45,553 Communal System	30.0%	30.0%
2	PV	£32,500 Individual systems	£49,300 Communal System	30.0%	30.0%
3	PV + SWH	£30,500 Individual systems	£47,000 Individual SWH and Communal PV	30.0%	30.0%

c. Based on Option 3

Option	Possible Solution	Total Cost		% site reduction	
		S1	S2	S1	S2
1	Biomass + PV	£44,600 Individual systems	£48,500 Communal System	30.0%	30.0%
2	PV	£30,600 Individual systems	£47,500 Communal System	30.0%	30.0%
3	PV + SWH	£28,500 Individual systems	£45,300 Individual SWH and Communal PV	30.0%	30.0%

3. Mandatory Code for Sustainable Homes Energy Standards

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			25%		
	15% EE	SWH		25%		
	PV (~1kWp)			25%		
	15% EE	PV (~0.5kWp)		25%		
	GSHP			25%		
4	Gas CHP			40-50%		
	Biomass			60%		
	15% EE	PV (~1.3kWp)		44%		
	25% EE	PV (~0.8kWp)		44%		
	15% EE	SWH	PV (~0.8kWp)	44%		
5	Biomass CHP	PV (~0.6kWp)		100%		
	25% EE	PV (~3kWp)		100%		
	Gas CHP	PV (~2KwP)		100%		
	Biomass	PV (~1.7KwP)		100%		

8. Policy Test

Energy Efficiency

- Approximately 7-8% reduction in total site CO_2 emissions could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 10-14% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

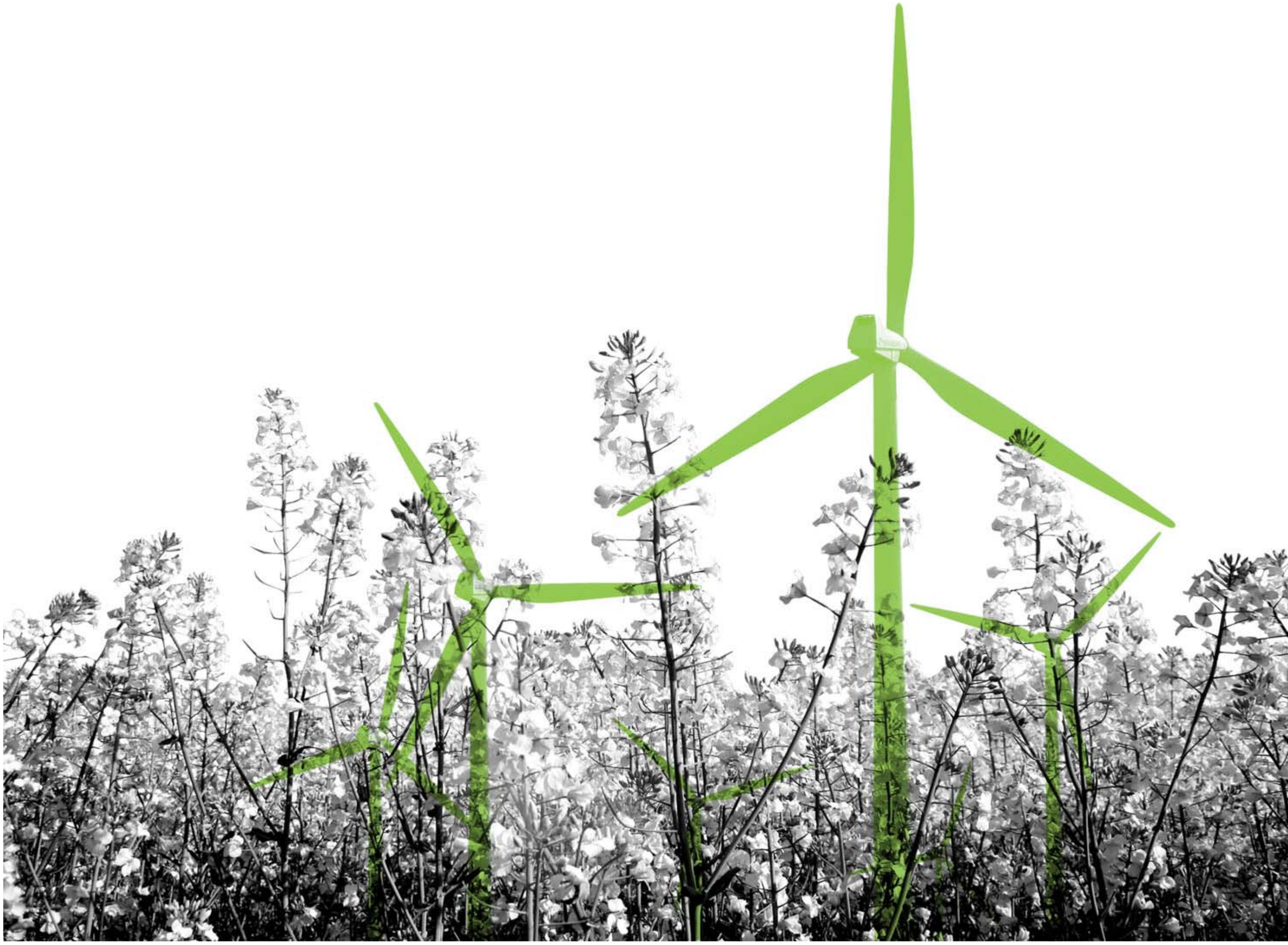
Efficient delivery of heat

- There is a limited potential to incorporate CHP on the site due to the small scale and density of the proposed development.
- The likelihood of implementing a communal heating system is likely to be limited unless a communal biomass or ground-sourced system is favoured for meeting the renewables target.

Potential to meet proposed policy options

- The possible options for meeting the renewables target are likely to involve SWH, PV and/or biomass, or systems are also possible. A site such as this would provide a degree of flexibility to the developer.
- The use of biomass would have the following implications:
    - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
    - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:
    - 20% improvement in total site emissions from on-site renewables: £4,000 to £10,000
    - 30% improvement in total site emissions from on-site renewables: £5,500 to £11,000
    - CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
    - CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.



Site Analysis – Site 3: Durnford Street & Gourley Place

Site 3: Durnford Street & Gourley Place

1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	125 dwellings, 400sqm retail	101 dwellings, 300sqm retail
Mix of residential units	35 1-bed, 35 2-bed, 31 3-bed, 24 4-bed	28 1-bed, 28 2-bed, 25 3-bed, 20 4-bed
Density	431 hrh (121dph)	345 hrh (98 dph)
Storeys	4	3
Lifts	2	2
Area of underground car parking	None	None

2. Analysis of surrounding area

KEY: Red – Site; Orange - Medium density residential; Purple – High density residential; Light Blue – Retail/commercial buildings; Green – St Anne's Hospital (also a future development site), Grey – School

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	Surrounding buildings are unlikely to have significant shading implications
Connection to existing district heating network	There are no existing networks near to the site
Potential to incorporate CHP	Although there may be less than 200 units, the density of the development will be high and the mixed use of the site would provide load diversity however the potential is limited unless the density or numbers are increased.
Potential to incorporate a communal/site wide heating system	A communal heating system would be possible on the site and would enable connection to a future district heating system.
Future potential district heating network	Developments at Lawrence Road and St Anne's hospital are likely to result in the use of CHP and the creation of heat networks. The location of these sites and the Broadwater Farm Estate suggest there is the potential to create a wider energy network in the West Green area – see the Site 5 Assessment Report for more details.
Site access	The delivery and storage of biomass fuel is limited due to the density of the surrounding area. However, it may be possible for fuel to be stored in nearby industrial area and transported by train.

3. Baseline Demands and Emissions

Residential

	Scenario 1					Scenario 2				
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
Detached	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
End Terrace	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
Mid Terrace	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
1B Flat	**35**	74,918	151,953	*77,865*	**61,094**	**28**	59,935	121,562	*62,292*	**48,876**
2B Flat	**35**	109,220	173,639	*99,275*	**79,777**	**28**	87,376	138,911	*79,420*	**63,822**
3B Flat	**31**	101,091	164,395	*92,526*	**74,553**	**25**	81,525	132,576	*74,618*	**60,124**
4B Flat	**24**	91,942	138,416	*81,396*	**65,652**	**20**	76,619	115,347	*67,830*	**54,710**
Total Residential	**125**	**377,173**	**628,403**	***351,062***	**281,077**	**101**	**305,455**	**508,397**	***284,160***	**227,531**
Assumed Occupancy	**270**					**219**				

Communal

	Scenario 1				Scenario 2			
	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting	**1,125**		**10,266**	**4,332**	**909**		**8,295**	**3,500**
Lifts		**2**	**11,680**	**4,929**		**2**	**11,680**	**4,929**
Car Park Lighting	**0**		**0**	**0**	**0**		**0**	**0**
Total			**21,946**	**9,261**			**19,975**	**8,429**

Commercial

	Scenario 1					Scenario 2				
	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
General Retail	**400**	66,000	0	0	**27,852**	**300**	49,500	0	0	**20,889**
Total	**400**	**66,000**	**0**	**0**	**27,852**	**300**	**49,500**	**0**	**0**	**20,889**

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	318.19	256.85
Total Heat Demand (kWh/year)	277,341	224,237
Total Hot Water Demand (kWh/year)	351,062	284,160
Total Electricity Demand (kWh/year)	465,118	374,930

4. 'Be Lean' - Implications of Fabric Improvements

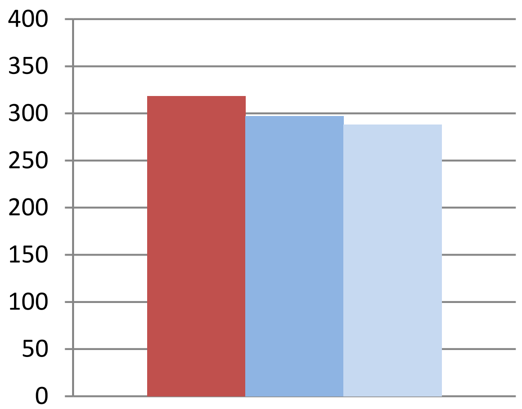
Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	297.23	239.90
Reduction on Total Site Emissions (tonnes/year)	20.96	16.95
% Reduction on Total Site Emissions	6.59%	6.60%

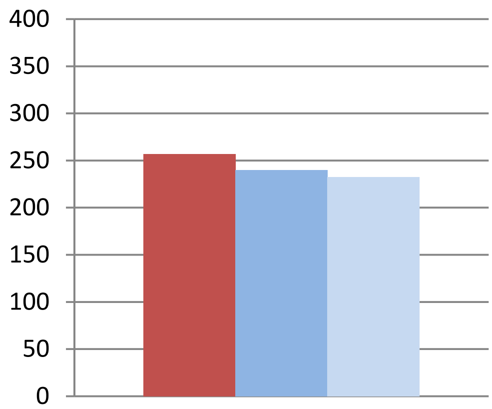
Measures to deliver around a 25% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	288.05	232.49
Reduction on Total Site Emissions (tonnes/year)	30.14	24.36
% Reduction on Total Site Emissions	9.47%	9.48%

Scenario 1



Scenario 2



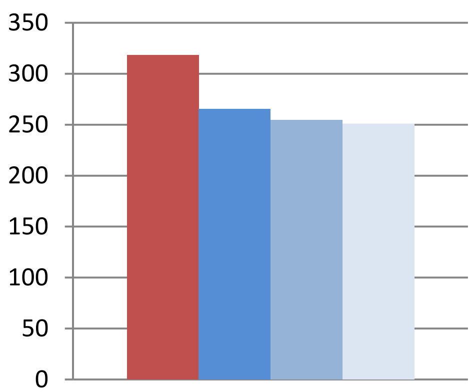
Key: Red = no improvement over building regulations; Dark Blue = 15% improvement; Light Blue = 25%improvement

5. 'Be Clean' - Potential for CHP

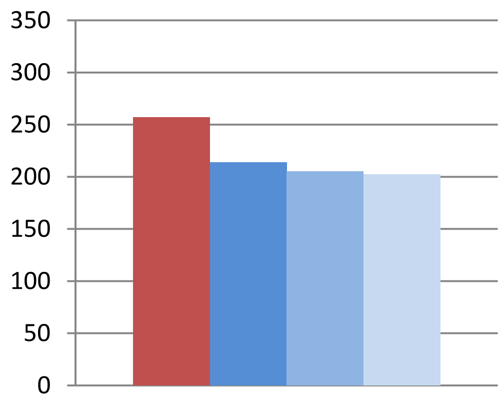
The use of CHP is unlikely to be financially or technically viable on the site due to the limited numbers, density and demand profile. The numbers presented below are therefore only intended for comparative analysis.

	Scenario 1	Scenario 2
Site density (dwellings/hectare)	121	98
Number of dwellings	125	101
CHP electrical capacity (kW)	33	27
CHP electricity generated (MWh p.a.)	187	151
Electricity imported (MWh p.a.)	279	224
CHP heat produced (useful) (MWh p.a.)	229	185
Boiler heat produced (MWh p.a.)	324	262
CHP fuel used (MWh p.a.)	533	431
Boiler fuel used (MWh p.a.)	368	298
CHP electrical efficiency	35	35
CHP overall efficiency	78	78
Running Hours	5,585	5,585
CHP engine capital cost (£)	33,407	27,028
Reduction in CO_2 emissions (tonnes)	53.09	42.95
Total Site CO_2 Emissions (tonnes/year)	265.10	213.90
% Reduction on Total Site Emissions	16.68%	16.72%

Scenario 1



Scenario 2



Key: Red = baseline total site emissions; Dark Blue = baseline + CHP; Medium Blue = 15% DER improvement + CHP; Light Blue = 25% DER improvement + CHP

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Energy Efficiency Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	19.21	6.04%	175,000	9,500	15.52	6.04%	141,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	18.92	5.94%	187,500	10,000	15.28	5.95%	151,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	95.08	29.88%	1,064,300	11,500	102.43	39.88%	1,146,600	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	81.65	25.66%	1,064,300	13,500	95.11	37.03%	1,146,600	12,500
GSHP	Communal System serving whole site	24.46	7.69%	301,600	12,500	19.79	7.70%	244,030	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.19%	28,000	47,000	0.60	0.23%	28,000	47,000
BIOMASS	Communal System for whole site	80.50	25.30%	746,800	9,500	65.13	25.36%	622,600	10,000

Option 2: No CHP & 15% Energy Efficiency improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	19.21	6.46%	175,000	9,500	15.52	6.47%	141,400	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	18.92	6.36%	187,500	10,000	15.28	6.37%	151,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	95.08	31.99%	1,064,303	11,500	102.43	42.70%	1,146,609	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	81.65	27.47%	1,064,303	13,500	95.11	39.65%	1,146,609	12,500
GSHP	Communal System serving whole site	19.68	6.62%	242,666	12,500	15.92	6.64%	196,315	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.20%	28,000	47,000	0.60	0.25%	28,000	47,000
BIOMASS	Communal System for whole site	64.76	21.79%	742,544	11,500	52.39	21.84%	619,193	12,000

Option 3: No CHP & 25% Energy Efficiency Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	19.21	6.67%	175,000	9,500	15.52	6.67%	141,400	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	18.92	6.57%	187,500	10,000	15.28	6.57%	151,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	95.08	33.01%	1,064,303	11,500	102.43	44.06%	1,146,609	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	81.65	28.35%	1,064,303	13,500	95.11	40.91%	1,146,609	12,500
GSHP	Communal System serving whole site	17.31	6.01%	213,424	12,500	14.00	6.02%	176,692	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.21%	28,000	47,000	0.60	0.26%	28,000	47,000
BIOMASS	Communal System for whole site	56.96	19.77%	740,430	13,000	46.09	19.82%	617,485	13,500

7. Policy Test

1. 20% renewables

a. Based on Option 1: No CHP & 0% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass	£746,800	£622,600	25.3%	25.4%
2	PV	£712,400	£575,100	20.0%	20.0%
3	PV + SWH	£688,100	£555,500	20.0%	20.0%

b. Based on Option 2: No CHP & 15% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass	£742,500	£620,200	21.8% (26.4)	21.8% (26.4
2	PV	£665,500	£537,100	20.0% (25.3)	20.0% (25.3)
3	PV + SWH	£641,200	£517,500	20.0% (25.3)	20.0% (25.3)

c. Based on Option 3: No CHP & 25% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass	£740,400	£617,500	19.8% (27.5)	19.8% (27.5)
2	PV	£644,900	£520,500	20.0% (27.6)	20.0% (27.6)
3	PV + SWH	£620,700	£500,900	20.0% (27.6)	20.0% (27.6)

2. 30% renewables

a. Based on Option 1: No CHP & 0% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass & PV	£914,200	£756,100	30.0%	30.0%
2	PV	£1,068,600	£862,600	29.9%	30.0%
3	PV + SWH	£1,044,300	£843,000	30.0%	30.0%

b. Based on Option 2: No CHP & 15% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass & PV	£1,015,700	£838,300	30.0% (34.7)	30.0% (34.7)
2	PV	£998,200	£805,600	30.0% (34.7)	30.0% (34.7)
3	PV + SWH	£973,900	£786,100	30.0% (34.7)	30.0% (34.7)

c. Based on Option 3: No CHP & 25% Energy Efficiency Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass & PV	£1,070,200	£882,300	30.0% (36.6)	30.0% (36.6)
2	PV	£967,400	£780,800	30.0% (36.6)	30.0% (36.6)
3	PV + SWH	£943,100	£761,200	30.0% (36.6)	30.0% (36.6)

3. Mandatory Code for Sustainable Homes Energy Standards

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			25%		
	15% EE	SWH		25%		
	PV (~1kWp)			25%		
	15% EE	PV (~0.5kWp)		25%		
	GSHP			25%		
4	Gas CHP			40-50%		
	Biomass			60%		
	15% EE	PV (~1.3kWp)		44%		
	25% EE	PV (~0.8kWp)		44%		
	15% EE	SWH	PV (~0.8kWp)	44%		
5	Biomass CHP	PV (~0.6kWp)		100%		
	25% EE	PV (~3kWp)		100%		
	Gas CHP	PV (~2KwP)		100%		
	Biomass	PV (~1.7KwP)		100%		

8. Conclusions and Recommendations

Energy Efficiency

- Approximately 6.5% reduction in total site CO_2 emissions depending on the relative scale of the commercial element could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 9.5% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

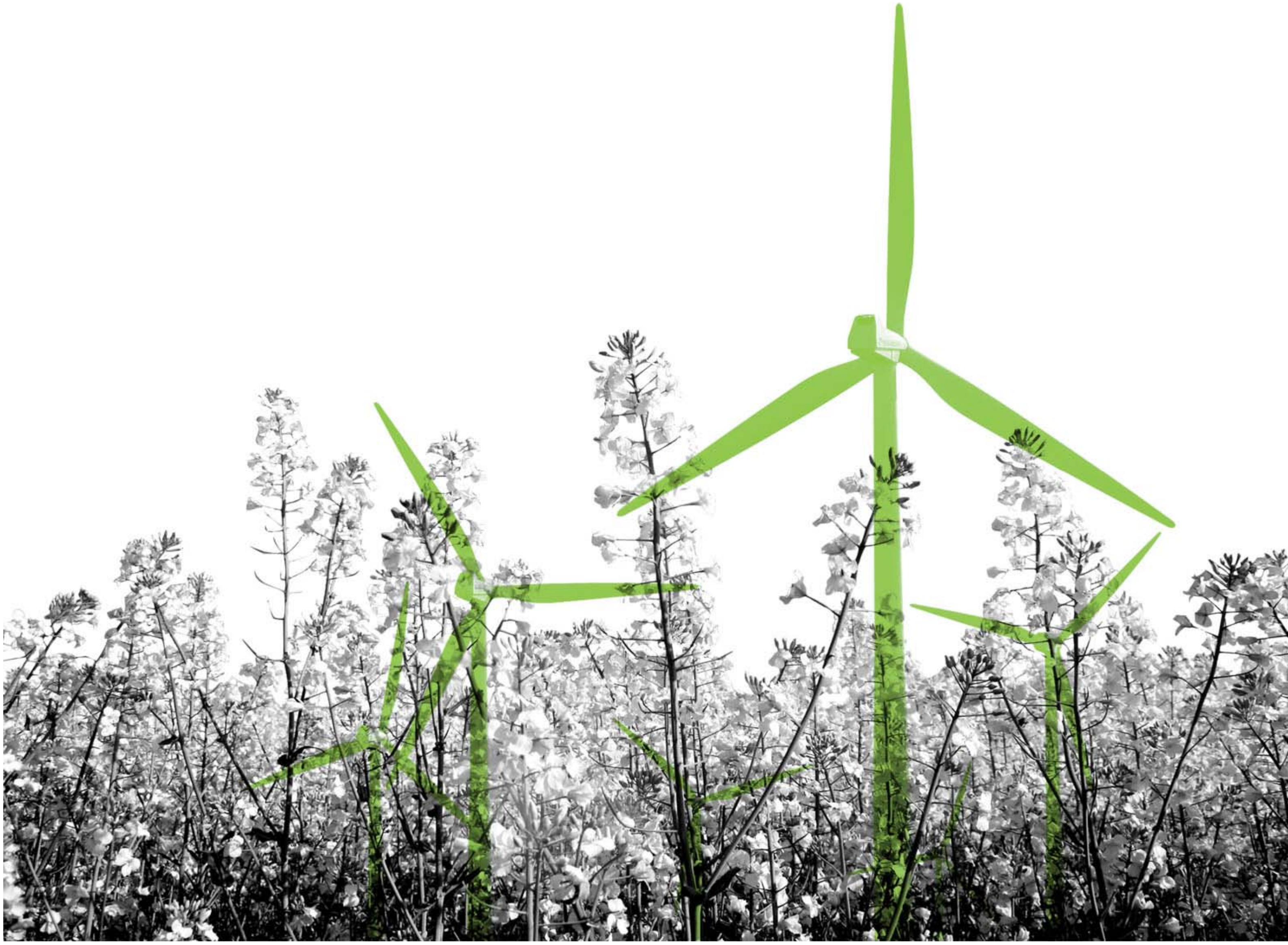
Efficient delivery of heat

- There is a limited potential to incorporate CHP on the site due to the small scale and density of the proposed development.
- The implementation of a communal heating system should be encouraged to make the scheme compatible with a future district energy network. The potential for a network in the West Green area is outlined in the Site 5 assessment later in this report.

Potential to meet proposed policy options

- The possible options for meeting the renewables target are likely to involve SWH, PV and/or biomass, providing a degree of flexibility to the developer.
- The use of biomass would have the following implications:
    - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
    - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:
    - 20% improvement in total site emissions from on-site renewables: £5,000 to £6,000
    - 30% improvement in total site emissions from on-site renewables: £7,500 to £8.5,000
    - CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
    - CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.



Site Analysis – Site 4: Hornsey Town Hall

Site 4: Hornsey Town Hall

1. Potential Development Scenarios

	Scenario 1	Scenario 2
Schedule	116 Flats, 5000sqm cultural, 1200sqm retail	90 Flats, 5000sqm cultural, 1200sqm retail
Mix of residential units	32 x 1B, 32 x 2B, 28 x 3B, 23 x 4B	25 x 1B, 25 x 2B, 22 x 3B, 18 x 4B
Density	515hrh (145dph)	399hrh (113 dph)
Storeys	4	4
Lifts	9	8
Area of underground car parking	0	0

2. Analysis of surrounding area

KEY: Red = Site; Orange = Medium density residential; Purple = High density residential; Grey = School; Blue = Commercial corridor; Green = Library

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	Library building and the Town Hall Tower may have adverse impacts on potential roof space
Roof Use	Conservation area and listed building status could limit the use of the roof for renewable energy generation.
Connection to existing district heating network	No existing networks near to the site
Potential to incorporate CHP	Although there may be less than 200 units, the density of the development will be high and the mixed use of the site would ensure load diversity, the potential would be enhanced by a more dense scheme.
Potential to incorporate a communal/site wide heating system	The site could support a communal heating system
Future potential district heating network	Area has a high proportion of medium-density terraced housing and is close to other commercial and public uses (library, supermarkets etc.). Could act as a hub for future energy network.
Site access	Access to the site for the delivery of fuel such as biomass may be limited
Wind regime	The dense urban environment around the site would reduce the outputs from building–mounted wind turbines (this is accounted for in the modelling).

3. Baseline Demands and Emissions

Scenario 1

Residential					
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
1B Flat	32	68,497	138,928	71,190	55,858
2B Flat	32	99,859	158,756	90,765	72,939
3B Flat	28	91,308	148,485	83,572	67,338
4B Flat	23	88,112	132,649	78,005	62,917
Total Residential	115	347,775	578,818	323,533	259,052
Assumed Occupancy	272				
Communal					
		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting		1035		9,444	3,986
Lifts			1	5,840	2,464
Car Park Lighting		0		0	0
Total				15,284	6,450
Commercial					
	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
General Retail	1200	198,000	0	0	83,556
Cultural/Public Buildings	5000	350,000	1,000,000	200,000	341,700
Total	6200	548,000	1,000,000	200,000	425,256

Scenario 2

Residential					
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
1B Flat	25	53,513	108,538	55,618	43,639
2B Flat	25	78,014	124,028	70,911	56,984
3B Flat	22	71,742	116,667	65,664	52,909
4B Flat	18	68,957	103,812	61,047	49,239
Total Residential	90	272,227	453,045	253,239	202,770
Assumed Occupancy	213				
Communal					
		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting		810		7,391	3,119
Lifts			1	5,840	2,464
Car Park Lighting		0		0	0
Total				13,231	5,584
Commercial					
	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
General Retail	1200	198,000	0	0	83,556
Cultural/Public Buildings	5000	350,000	1,000,000	200,000	341,700
Total	6200	548,000	1,000,000	200,000	425,256

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	690.76	633.61
Total Heat Demand (kWh/year)	1,055,28	999,806
Total Hot Water Demand (kWh/year)	523,533	453,239
Total Electricity Demand (kWh/year)	911,060	833,458

4. 'Be Lean' - Implications of Fabric Improvements

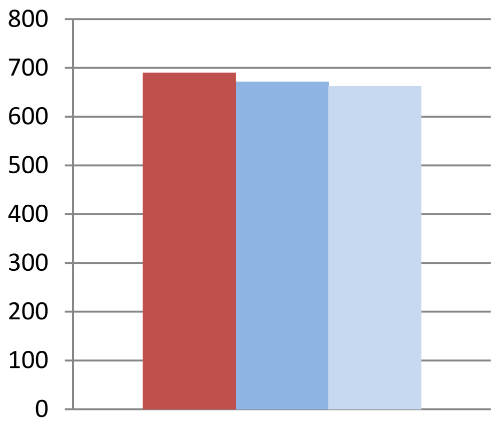
Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	671.44	618.49
Reduction in Total Site Emissions (tonnes/year)	19.32	15.12
% Reduction on Total Site Emissions	2.8%	2.4%

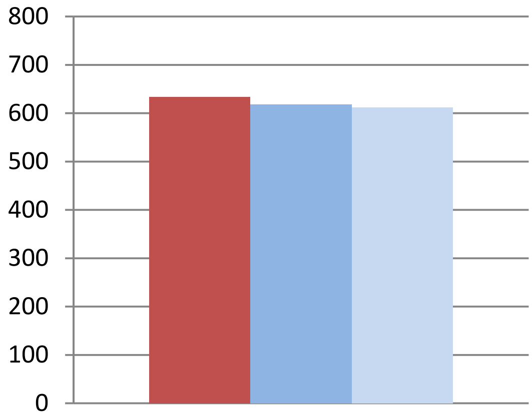
Measures to deliver around a 25% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	663.02	611.9
Reduction in Total Site Emissions (tonnes/year)	27.74	21.71
%Reduction on Total Site Emissions	4.0%	3.4%

Scenario 1



Scenario 2

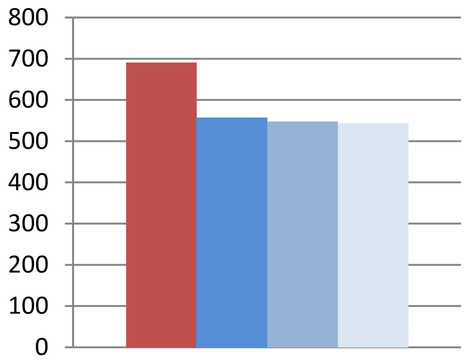


Key: Red = no improvement over building regulations; Dark Blue = 15% improvement; Light Blue = 25%improvement

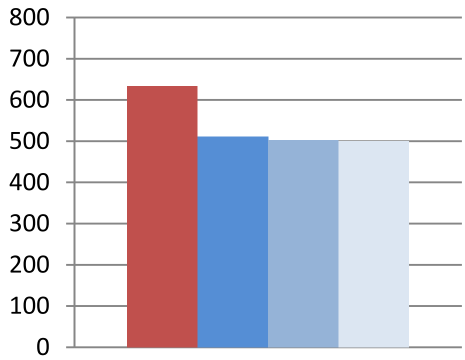
5. 'Be Clean' - Potential for CHP

	Scenario 1	Scenario 2
Site density (dwellings/hectare)	145	113
Number of dwellings	116	90
CHP electrical capacity (kW)	84	77
CHP electricity generated (MWh p.a.)	469	431
Electricity imported (MWh p.a.)	442	402
CHP heat produced (useful) (MWh p.a.)	576	530
Boiler heat produced (MWh p.a.)	813	749
CHP fuel used (MWh p.a.)	1,339	1,233
Boiler fuel used (MWh p.a.)	924	851
CHP electrical efficiency	35	35
CHP overall efficiency	78	78
Running Hours	5,585	5,585
CHP engine capital cost (£)	83,934	77,247
Reduction in CO_2 emissions (tonnes)	133.38	122.75
Total Site CO_2 Emissions (tonnes/year)	557.38	510.86
% Reduction on Total Site Emissions	19.31	19.37

Scenario 1



Scenario 2



Key: Red = Baseline Total Site Emissions; Dark Blue = Baseline + CHP; Medium Blue = 15% improvement + CHP; Light Blue = 25% improvement + CHP improvement.

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	17.67	2.56%	161,000	9,500	13.83	2.18%	126,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	17.40	2.52%	172,500	10,000	13.62	2.15%	135,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	87.47	12.66%	979,200	11,500	68.45	10.80%	766,300	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	75.12	10.87%	979,200	13,500	63.56	10.03%	766,300	12,500
PV	Total – Residential + Commercial	132.82	19.23%	1,486,900	11,500	128.92	20.35%	1,443,200	11,500
GSHP	Communal System serving whole site	61.45	8.90%	757,800	12,500	56.56	8.93%	697,500	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.09%	28,000	47,000	0.60	0.09%	28,000	47,000
BIOMASS	Communal System for whole site	202.26	29.28%	734,800	4,000	186.14	29.38%	600,400	3,500

Option 2: CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	17.67	3.23%	161,000	9,500	13.83	2.75%	126,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	17.40	3.18%	172,500	10,000	13.62	2.71%	135,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	87.47	15.97%	979,159	11,500	68.45	13.60%	766,298	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	75.12	13.72%	979,159	13,500	63.56	12.63%	766,298	12,500
PV	Total – Residential + Commercial	132.82	24.25%	1,486,851	11,500	128.92	25.62%	1,443,221	11,500
GSHP	Communal System serving whole site	57.05	10.42%	703,498	12,500	53.11	10.55%	654,935	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.11%	28,000	47,000	0.60	0.12%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	187.76	34.29%	730,862	4,000	174.80	34.74%	597,351	3,500

Option 3: CHP & 25% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO_2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO_2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	17.67	3.25%	161,000	9,500	13.83	2.76%	126,000	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	17.40	3.20%	172,500	10,000	13.62	2.72%	135,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	87.47	16.08%	979,159	11,500	68.45	13.68%	766,298	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	75.12	13.81%	979,159	13,500	63.56	12.70%	766,298	12,500
GSHP	Communal System serving whole site	54.87	10.09%	676,616	12,500	51.40	10.27%	633,894	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.11%	28,000	47,000	0.60	0.12%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	100.06	18.39%	37,221	372	93.74	18.73%	34,871	372

7. Policy Test

1. 20% renewables

a. Based on Option 1 – No CHP & No Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass communal system [whole site]	£734,800	£600,400	29.3	29.4
2	PV	£1,546,515	£1,418,568	19.2	20.0
3	GSHP + PV	£1,616,400	£1,482,900	20.0	20.0

b. Based on Option 2 – CHP & 15% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass [top-up] + PV	£1,194,200	£938,500	20.0 (36.6)	20.0 (36.5)
2	CHP + PV	£2,270,100	£1,936,700	20.0 (36.6)	20.0 (36.5)

c. Based on Option 3 – CHP & 25% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass [top-up] + PV	£1,229,000	£965,700	20.0 (37.0)	20.0 (36.8)
2	CHP + PV	£2,261,800	£1,930,200	20.0 (37.0)	20.0 (36.8)

*Options 2 and 3 have higher total CO_2 reductions due to the incorporation of energy efficiency measures and CHP

2. 30% renewables

d. Based on Option 1 – No CHP & No Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass communal system [whole site] + PV	£790,400	£644,500	30.0	30.0
2	PV + GSHP	£2,244,700	£2,140,700	28.1	29.3

e. Based on Option 2 - CHP & 15% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV	£2,530,900	£2,253,200	24.3 (40.0)	25.6 (40.9)
2	CHP + Biomass [top-up] + PV	£1,807,240	£1,501,800	30.0 (44.5)	30.0 (44.4)

f. Based on Option 3 - CHP & 25% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV	£2,530,900	£2,253,200	24.4 (40.5)	25.8 (41.4)
2	CHP + Biomass [top-up] + PV	£1,837,900	£1,525,800	30.0 (44.9)	30.0 (44.7)

*Options 2 and 3 have higher total CO_2 reductions due to the incorporation of energy efficiency measures and CHP

3. Mandatory Code for Sustainable Homes Energy Standards

Code Level	Solution			Potential Improvement	Scenario 1 Potential Feasibility	Scenario 2 Potential Feasibility
3	25% EE			≈25%		
	15% EE	SWH		≈25%		
	PV (~1kWp)			≈25%		
	15% EE	PV (~0.5kWp)		≈25%		
	GSHP			≈25%		
4	Gas CHP			≈40-50%		
	Biomass			≈60%		
	15% EE	PV (~1.3kWp)		≈44%		
	25% EE	PV (~0.8kWp)		≈44%		
	15% EE	SWH	PV (~0.8kWp)	≈44%		
5	Biomass CHP	PV (~0.6kWp)		≈100%		
	25% EE	PV (~3kWp)		≈100%		
	Gas CHP	PV (~2KwP)		≈100%		
	Biomass	PV (~1.7KwP)		≈100%		

8. Conclusions and Recommendations

Energy Efficiency

- Approximately 2-3% reduction in total site CO_2 emissions depending on the relative scale of the commercial element could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 3-4% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

Efficient delivery of heat

- There is a strong potential to incorporate CHP on the site due to the scale, density and the proposed mix of uses planned for the site.
- There are schools in the nearby area and some existing Council operated building such as the library. The potential for connecting to neighbouring buildings should be encouraged by the Council.

Potential to meet proposed policy options

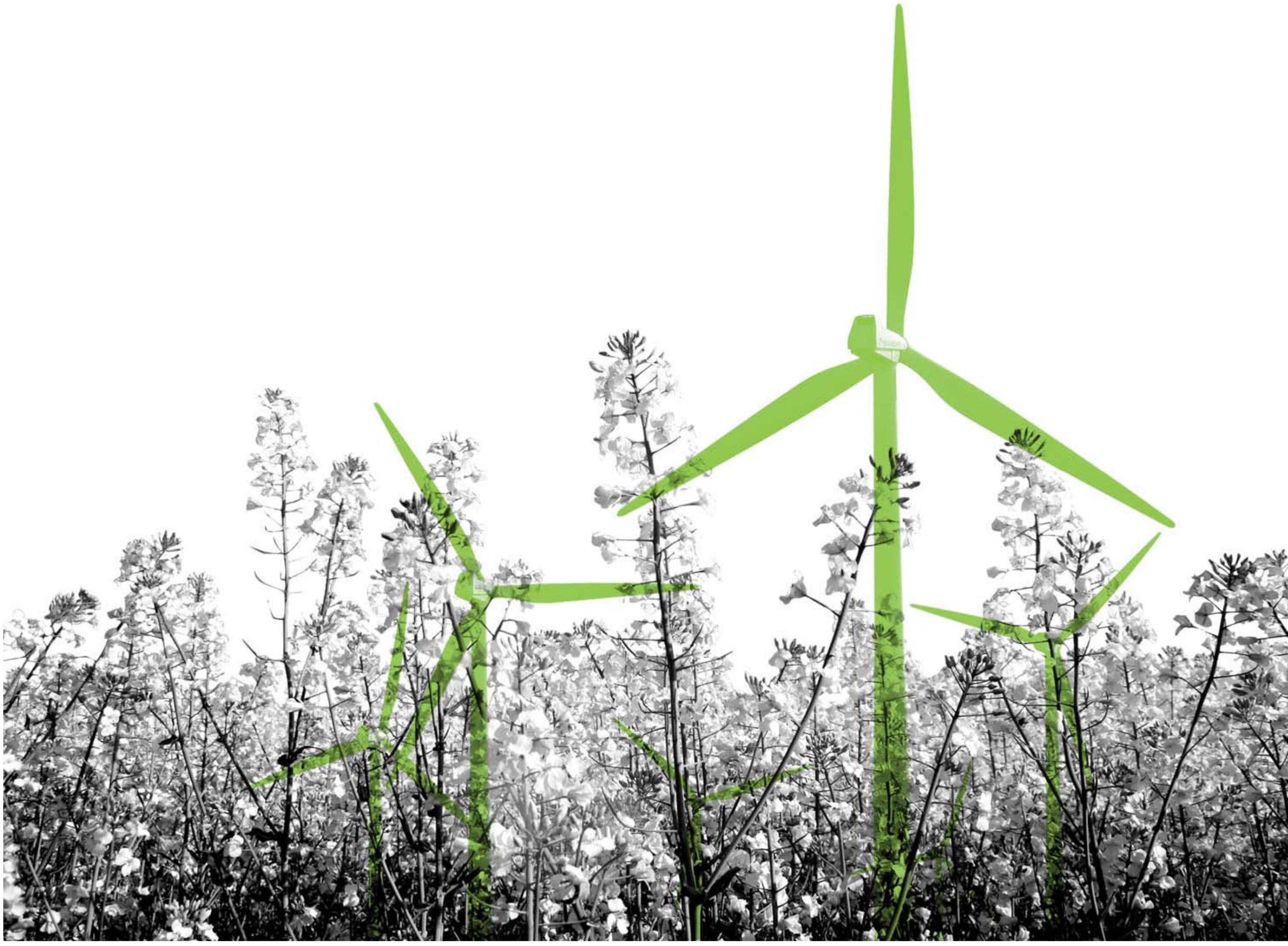
- PV and/or biomass are likely to be required options for meeting the renewable energy targets. The site is potentially constrained for both of these options and may have implications for the site:
  - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
  - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.
  - The use of PV could be constrained by the conservation area designation. The Council should provide guidance on the incorporation of PV without impacting on the Conservation Area designation so that the developers can design the building appropriately to maximise the potential for PV within the constraints
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:
  - 20% improvement in total site emissions from on-site renewables: £6,300 – £19,600 (Options 2 and 3 include the cost of CHP of around £9000 per unit)

- 30% improvement in total site emissions from on-site renewables: £7,000 – £22,000* (Options 2 and 3 include the cost of CHP of around £9000 per unit) (*limited options)
- CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
- CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.

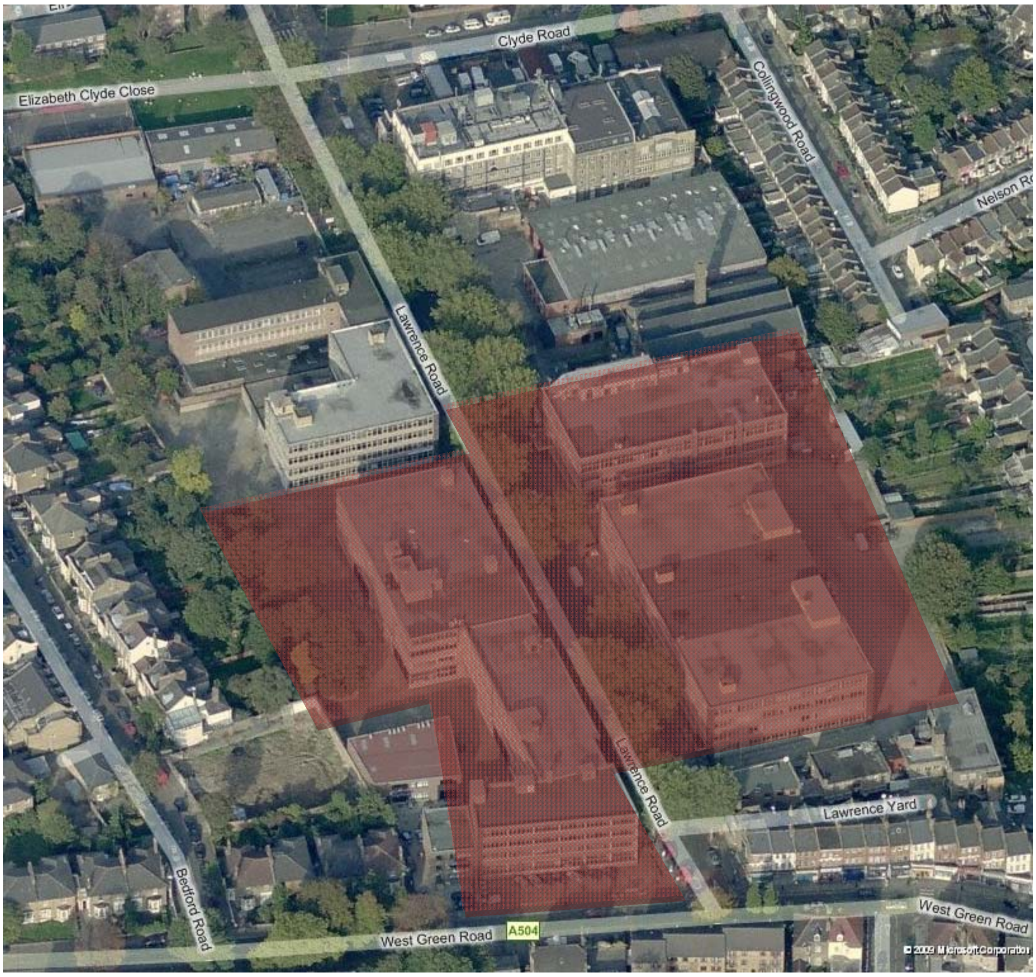
To assist potential development to achieve the proposed policy targets the Council should assist developers by:

- Providing information on the extent of PV or SWH that can be applied to the roof of the development without affecting the Conservation Area designation



Site Analysis – Site 5: Lawrence Road

Site 5 – Lawrence Road



1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	400 residential dwellings, 3000sqm offices, 500sqm restaurant	301 residential dwellings, 2000sqm offices, 500sqm restaurant
Mix of residential units	All flats 112 x 1B, 112 x 2B, 98 x 3B, 78 x 4B	All flats 84 x 1B, 84 x 2B, 74 x 3B, 59 x 4B
Density	973hrh	729hrh
Storeys	6	5
Lifts	8	6
Area of underground car parking	1500 m^2	1500 m^2

2. Analysis of surrounding area

KEY: Red – Site; Orange – Medium density residential; Purple – High density residential; Grey – School/college; Blue - Commercial corridor; Yellow – Future development site (mixed use), Green – Library and Leisure Centre with Swimming Pool

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	Surrounding buildings are unlikely to have shading implications
Conservation	Surrounded by Clyde Circus Conservation Area which could limit the use of the roof for renewable energy generation.
Connection to existing district heating network	The only existing district heating network in the Borough is located in the Broadwater Farm Estate which is approximately 1km north of the site.
Potential to incorporate CHP	The number of units, the density of the development and the proposed mix of units mean that the proposed development is likely to support the use of CHP and the development of a communal heating system.
Potential to incorporate a site wide heating system	The density of the site and possible development scenarios would make the incorporation of a site-wide energy network a viable option for the site.
Future potential district heating network	There will be more development adjacent to this site which could make the start of a district heating system. The network could then potentially act as a hub for future connection to existing uses (residential and commercial) in the surrounding area with possible links up to Broadwater Farm and future development planned at St Anne's Hospital (1km south-west of the site).
Site access	Access to the site for the delivery of fuel such as biomass could be possible subject to the location and design of an energy centre.
Wind regime	The dense urban environment around the site would reduce the outputs from building–mounted wind turbines (accounted for in the modelling).

3. Baseline Demands and Emissions

	Scenario 1					Scenario 2				
	Residential					**Residential**				
	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
Detached	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
End Terrace	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
Mid Terrace	**0**	0	0	*0*	**0**	**0**	0	0	*0*	**0**
1B Flat	**112**	239,739	486,249	*249,166*	**195,502**	**84**	179,804	364,687	*186,875*	**146,627**
2B Flat	**112**	349,505	555,644	*317,679*	**255,286**	**84**	262,129	416,733	*238,259*	**191,465**
3B Flat	**98**	319,579	519,699	*292,503*	**235,684**	**74**	241,315	392,426	*220,869*	**177,966**
4B Flat	**78**	298,813	449,853	*264,539*	**213,371**	**59**	226,025	340,274	*200,100*	**161,396**
Total Residential	**400**	**1,207,636**	**2,011,446**	***1,123,887***	**899,843**	**301**	**909,273**	**1,514,119**	***846,103***	**677,452**
Assumed Occupancy	**864**					**651**				

	Scenario 1					Scenario 2				
	Communal					**Communal**				
		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting		**3600**		**32,850**	**13,863**		**2709**		**24,720**	**10,432**
Lifts			**8**	**46,720**	**19,716**			**6**	**35,040**	**14,787**
Car Park Lighting		**1500**		**30,000**	**12,660**		**1500**		**30,000**	**12,660**
Total				**109,570**	**46,239**				**89,760**	**37,879**

	Scenario 1					Scenario 2				
	Commercial					**Commercial**				
	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
General Offices	**3000**	285,000	360,000	36,000	**190,110**	**2000**	190,000	240,000	24,000	**126,740**
Restaurant	**500**	45,000	185,000	18,500	**54,880**	**500**	45,000	185,000	18,500	**54,880**
Total	**3500**	**330,000**	**545,000**	**54,500**	**244,990**		**235,000**	**425,000**	**42,500**	**181,620**

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,197.07	896.95
Total Heat Demand (kWh/year)	1,378,059	1,050,516
Total Hot Water Demand (kWh/year)	1,178,387	888,603
Total Electricity Demand (kWh/year)	1,647,206	1,234,033

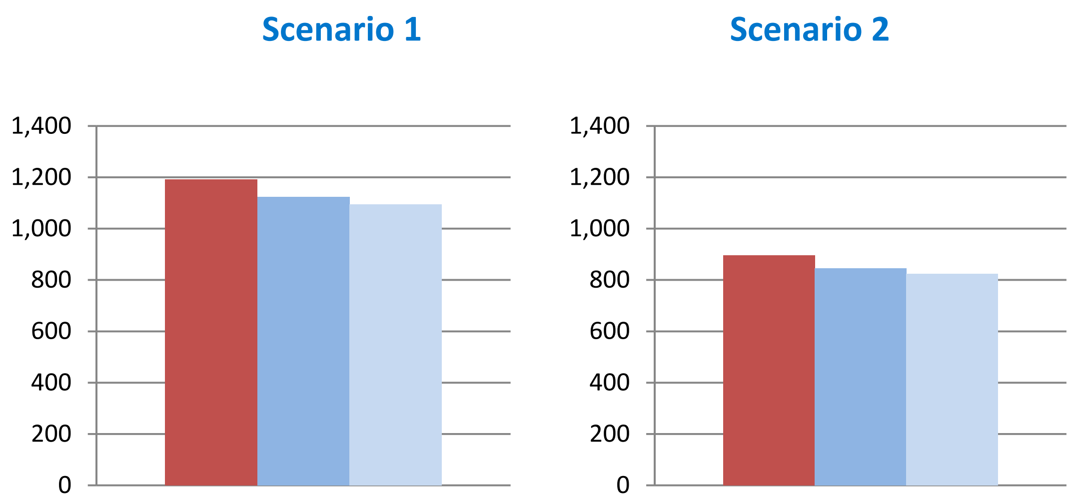
4. ‘Be Lean’ - Implications of Fabric Improvements

Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,123.95	846.44
Reduction on Total Site Emissions (tonnes/year)	67.12	50.51
% Reduction on Total Site Emissions	5.64%	5.63%

Measures to deliver around a 25% improvement on the DER for residential dwellings

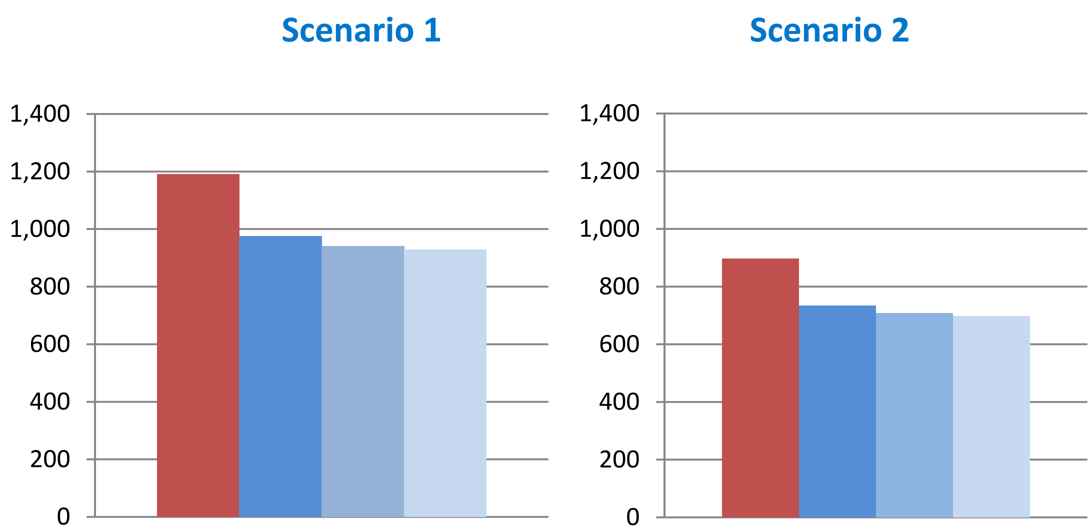
	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,094.61	824.36
Reduction on Total Site Emissions (tonnes/year)	96.46	72.59
% Reduction on Total Site Emissions	8.10%	8.09%



Key: Red = no improvement over building regulations; Dark Blue = 5% improvement; Medium Blue = 15% improvement; Light Blue = 25%improvement

5. 'Be Clean' - Potential for CHP

	Scenario 1	Scenario 2
Site density (dwellings/hectare)	274	206
Number of dwellings	400	301
CHP electrical capacity (kW)	136	103
CHP electricity generated (MWh p.a.)	759	576
Electricity imported (MWh p.a.)	888	658
CHP heat produced (useful) (MWh p.a.)	932	707
Boiler heat produced (MWh p.a.)	1,317	999
CHP fuel used (MWh p.a.)	2,168	1,645
Boiler fuel used (MWh p.a.)	1,497	1,135
CHP electrical efficiency	35	35
CHP overall efficiency	78	78
Running Hours	5,585	5,585
CHP engine capital cost (£)	135,907	103,088
Reduction in CO_2 emissions (tonnes)	215.97	163.82
Total Site CO_2 Emissions (tonnes/year)	975.10	733.13
% Reduction on Total Site Emissions	18.13	18.26



Key: Red = baseline total site emissions; Dark Blue = baseline + CHP; Medium Blue = 15% DER improvement + CHP; Light Blue = 25% DER improvement + CHP

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	61.46	5.16%	800,000	13,500	46.25	5.16%	602,000	13,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	80.70	6.78%	800,000	10,000	45.55	5.08%	451,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	202.83	17.03%	2,270,513	11,500	183.15	20.42%	2,050,273	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	174.19	14.62%	2,270,513	13,500	170.07	18.96%	2,050,273	12,500
GSHP	Communal System serving whole site	99.50	8.35%	1,227,094	12,500	75.48	8.41%	930,777	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.05%	28,000	47,000	0.60	0.07%	28,000	47,000
BIOMASS	Communal System for whole site	327.50	27.50%	2,188,717	7,000	248.41	27.70%	1,672,294	7,000

Option 2: CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	61.46	6.53%	800,000	13,500	46.25	6.54%	602,000	13,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	80.70	8.57%	800,000	10,000	45.55	6.44%	451,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	202.83	21.55%	2,270,513	11,500	183.15	25.88%	2,050,273	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	174.19	18.51%	2,270,513	13,500	170.07	24.03%	2,050,273	12,500
GSHP	Communal System serving whole site	84.20	8.95%	1,038,313	12,500	63.95	9.04%	788,672	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.06%	28,000	47,000	0.60	0.08%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	153.54	16.31%	107,119	372	116.63	16.48%	93,386	372

Option 3: CHP & 25% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	**System**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**
SWH	Residential - Communal Systems serving flats [Flat Plate]	61.46	6.62%	800,000	13,500	46.25	6.63%	602,000	13,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	80.70	8.69%	800,000	10,000	45.55	6.53%	451,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	202.83	21.85%	2,270,513	11,500	183.15	26.24%	2,050,273	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	174.19	18.76%	2,270,513	13,500	170.07	24.37%	2,050,273	12,500
GSHP	Communal System serving whole site	76.61	8.25%	944,781	12,500	58.24	8.35%	718,283	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.06%	28,000	47,000	0.60	0.09%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	139.71	15.05%	101,973	372	106.22	15.22%	89,513	372

7. Policy Test

1. 20% renewables

a. Based on Option 1 - No CHP & No Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass	£2,188,700	£1,672,300	27.5 (27.5)	27.7 (27.7)
2	PV	£2,270,500	£2,050,300	17.0 (17.0)	20.4 (20.4)
3	PV + GSHP	£2,671,400	£2,012,900	20.0 (20.0)	20.0 (20.0)
4	PV + SWH	£2,563,200	£1,930,300	20.0 (20.0)	20.0 (20.0)

b. Based on Option 2 – CHP & 15% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV	£5,707,200	£4,293,300	20.0 (36.8)	20.0 (36.9)
2	CHP + Biomass [top-up] + PV	£4,095,600	£3,081,100	20.0 (36.8)	20.0 (36.9)

c. Based on Option 3 - CHP & 25% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV	£5,678,400	£4,271,600	20.0 (37.7)	20.0 (37.8)
2	CHP + Biomass [top-up] + PV	£4,216,400	£3,172,100	20.0 (37.7)	20.0 (37.8)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

2. 30% renewables

a. Based on Option 1 - No CHP & No Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass + PV	£2,522,600	£1,903,700	30.0 (30.0)	30.0 (30.0)
3	PV + GSHP	£3,497,600	£2,981,100	25.8 (25.8)	28.4 (28.4)

b. Based on Option 2 - CHP & 15% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV	£5,149,200	£3,873,300	30.0 (44.7)	30.0 (44.8)

c. Based on Option 3 - CHP & 25% Improvement on Building Regs for residential dwellings

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV	£5,255,600	£3,953,400	30.0 (45.4)	30.0 (45.5)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

3. Mandatory Code for Sustainable Homes Energy Standards

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			≈25%		
	15% EE	SWH		≈25%		
	PV (~1kWp)			≈25%		
	15% EE	PV (~0.5kWp)		≈25%		
	GSHP			≈25%		
4	Gas CHP			≈40-50%		
	Biomass			≈60%		
	15% EE	PV (~1.3kWp)		≈44%		
	25% EE	PV (~0.8kWp)		≈44%		
	15% EE	SWH	PV (~0.8kWp)	≈44%		
5	Biomass CHP	PV (~0.6kWp)		≈100%		
	25% EE	PV (~3kWp)		≈100%		
	Gas CHP	PV (~2KwP)		≈100%		
	Biomass	PV (~1.7KwP)		≈100%		

8. Conclusions and Recommendations

Energy Efficiency

- Approximately 5.5% reduction in total site CO_2 emissions depending on the relative scale of the commercial element could be achieve through ‘best practice’ energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 8% reduction in total site CO_2 emissions (or more) could be achieve through a set of ‘advanced practice’ energy efficiency measures but may result in significant cost increases

Efficient delivery of heat

- There is a strong potential to incorporate CHP on the site due to the scale, density and the proposed mix of uses planned for the site.
- The site is part of a wider redevelopment proposal and therefore the potential exists to link a district energy network to the future phases of the redevelopment.
- There is a significant potential to look at developing a district heating system in the West Green area. The site at could be part of such a system, linking with 2 or 3 other networks in the vicinity to provide a hub for future expansion. The other networks are within 500m of the site, these are:
    - An existing district heating system is located at Broadwater Farm Estate, around 500m north of the site.
    - To the south-east of the site is St Anne’s Hospital, for which there are redevelopment proposals of a size that would support a district heating system.
    - There are also some schools and a sports centre in the vicinity which could be linked together and joined to a future network.

Potential to meet proposed policy options

- PV and/or biomass are likely to be required options for meeting the renewable energy targets. The site is potentially constrained for both of these options and may have implications for the site:
    - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
    - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.

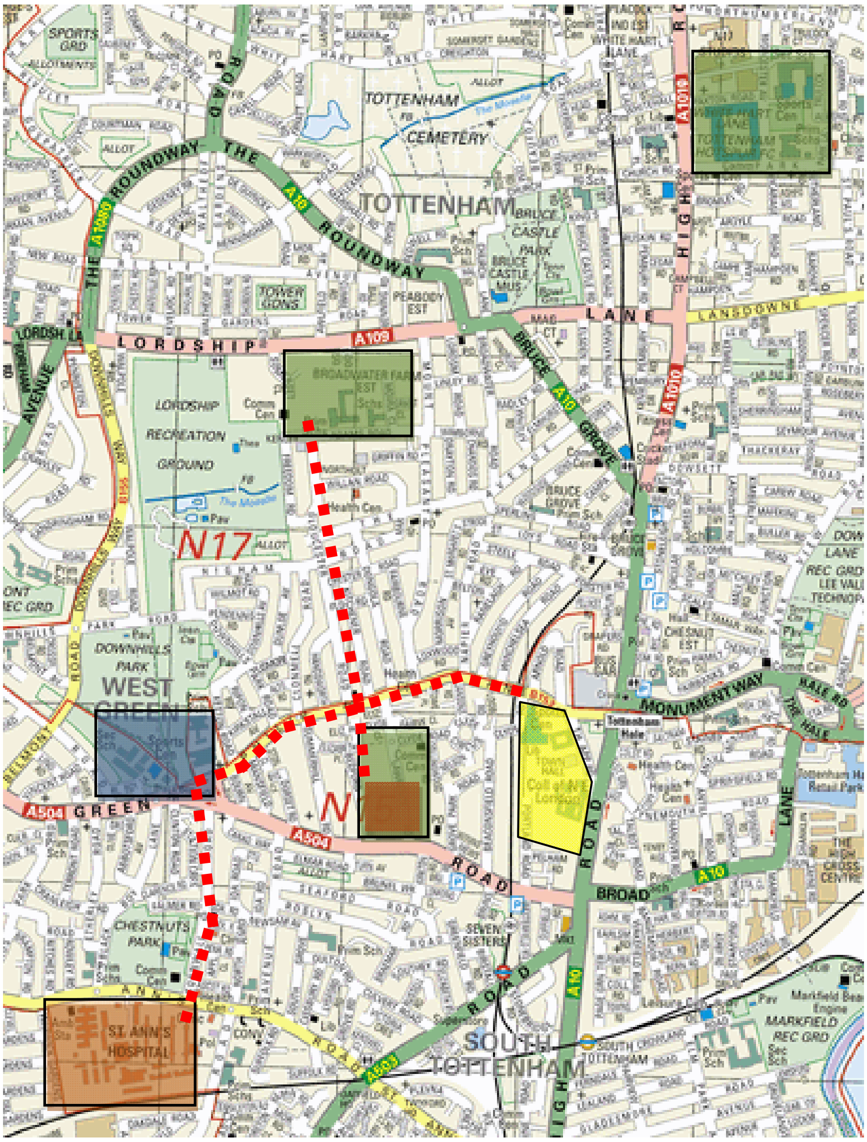
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:
    - o 20% improvement in total site emissions from on-site renewables: £5,500 – £14,000 (Options 2 and 3 include the cost of CHP of around £9000 per unit)
    - o 30% improvement in total site emissions from on-site renewables: £6,500 – £13,200* (Options 2 and 3 include the cost of CHP of around £9000 per unit) (*limited options)
    - o CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
    - o CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

  Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.

To assist potential development to achieve the proposed policy targets the Council should assist developers by:

- Provide (or help developer to obtain) information on the district heating system at Broadwater Farm
- Look at the potential to provide support for the connection of a district heating system to the system already installed at Broadwater Farm through funding under the CIL or negotiations on s106 provisions.

As previously highlighted, the Lawrence Road site is located in an area which, on the basis of a very broad overview, would appear to have some of the building blocks (public buildings with high heat demand and existing or proposed CHP systems) that could make the establishment of a wider decentralised energy network feasible. The following page shows an indicative map of the area around Lawrence Road highlighting some of these opportunities and the scale of a potential network. Taking this forward would require a full feasibility study to be undertaken to assess the financial and technical viability of the individual schemes as well as the expanded scheme. However, this exercise aims to highlight the importance of taking the wider context into view when considering development sites to ensure that long term visions are supported and the need to establish a plan



Red – Lawrence Road site

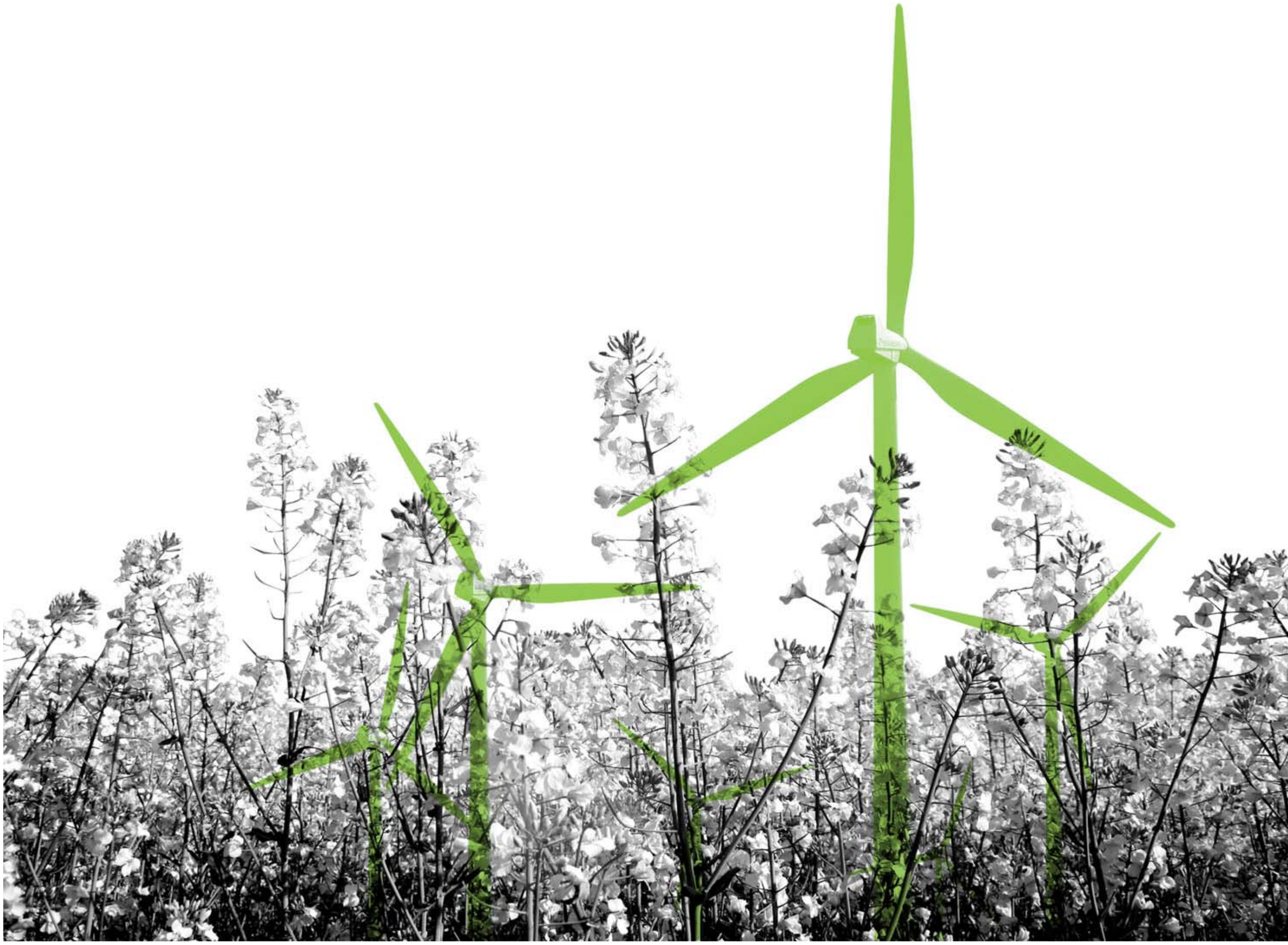
Green – represent locations where district systems already exist (Broadwater Farm) or where they are proposed as part of new development schemes (Northumberland Development Project and the wider development adjacent to the assessed site)

Blue – Location of a significant heat load comprising two schools and a sports centre at West Green

Orange – Site of a proposed new development at St Anne's Hospital. This development is likely to be of a density that would make a site-wide CHP system viable, particularly if connected to the parts of the hospital that are being retained.

Yellow – Location of Tottenham Green Swimming Pool and North London College Campus plus the site of proposed new mixed-use development.

Red Line – represents a very indicative route for a district heating pipe to connect the existing, planned and potential systems identified. The resulting network could be the basis of further expansion to the existing buildings in the surrounding area.



Site Analysis – Site 6: Hornsey Depot

Site 6: Hornsey Depot

1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	400 residential units, 2,500m^2 Non-Domestic (Supermarket)	230 residential units, 3,790m^2 Non-Domestic (Supermarket)
Mix of residential units	34 Houses, 365 flats	17 Houses, 213 flats
Density	Not given	Not given
Storeys	5	5
Lifts	8	8
Area of underground car parking	4,125	4,125

2. Analysis of surrounding area

KEY: Red = Site; Orange = Medium density residential; Purple = High density residential; Grey = School; Blue = Commercial corridor; grey – community centre; Yellow – future development site

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass and CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	No significant over-shading
Conservation Area	The site is adjacent to a conservation that extends along High Street, this may have implications for the design and use of low and zero carbon technologies that have a visual impact.
Connection to existing district heating network	No existing networks near to the site
Potential to incorporate CHP	The number and density of residential units and the proposed commercial uses means that the development could support the use of CHP
Potential to incorporate a communal/site wide heating system	The mix and density of the proposed development suggest that it is likely to support the use of a site wide heating system.
Future potential district heating network	The proximity of a number of schools and a large future development area (Haringey Heartlands) mean that there is a significant potential to develop a wider district heating network.
Site access	The delivery and storage of biomass fuel is limited due to the density of the surrounding area. However, it may be possible for fuel to be stored in nearby industrial area and transported by train.
Wind regime	The dense urban environment around the site would reduce the outputs from building–mounted wind turbines (this is accounted for in the modelling).

3. Baseline Demands and Emissions

Scenario 1

Residential

	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
End Terrace	23	77,995	152,407	75,738	62,481
Mid Terrace	11	37,653	64,581	36,223	28,418
1B Flat	102	218,334	442,834	226,919	178,047
2B Flat	102	318,299	506,033	289,315	232,493
3B Flat	90	293,491	477,275	268,625	216,445
4B Flat	71	271,996	409,482	240,798	194,222
Total Residential	399	1,217,768	2,052,611	1,137,618	912,105
Assumed Occupancy	891				

Communal

		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting		3285		29,976	12,650
Lifts			8	46,720	19,716
Car Park Lighting		4125		82,500	34,815
Total				159,196	67,181

Commercial

	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
Supermarket	**2,500**	1,000,000	262,500	26,250	**472,925**
Total		1,000,000	262,500	26,250	**472,925**

Scenario 2

Residential

	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
End Terrace	2	6,782	13,253	6,586	5,433
Mid Terrace	15	51,344	88,064	49,394	38,752
1B Flat	63	134,853	273,515	140,156	109,970
2B Flat	88	274,611	436,578	249,605	200,582
3B Flat	44	143,485	233,334	131,328	105,817
4B Flat	18	68,957	103,812	61,047	49,239
Total Residential	230	680,032	1,148,556	638,116	509,794
Assumed Occupancy	476				

Communal

		Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting		1917		17,493	7,382
Lifts			8	46,720	19,716
Car Park Lighting		4125		82,500	34,815
Total				146,713	61,913

Commercial

	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
Supermarket	**3790**	1,516,000	397,950	39,795	**716,954**
Total	**3790**	1,516,000	397,950	39,795	**716,954**

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,452.21	1,288.66
Total Heat Demand (kWh/year)	1,151,243	868,595
Total Hot Water Demand (kWh/year)	1,163,868	677,911
Total Electricity Demand (kWh/year)	2,376,964	2,342,745

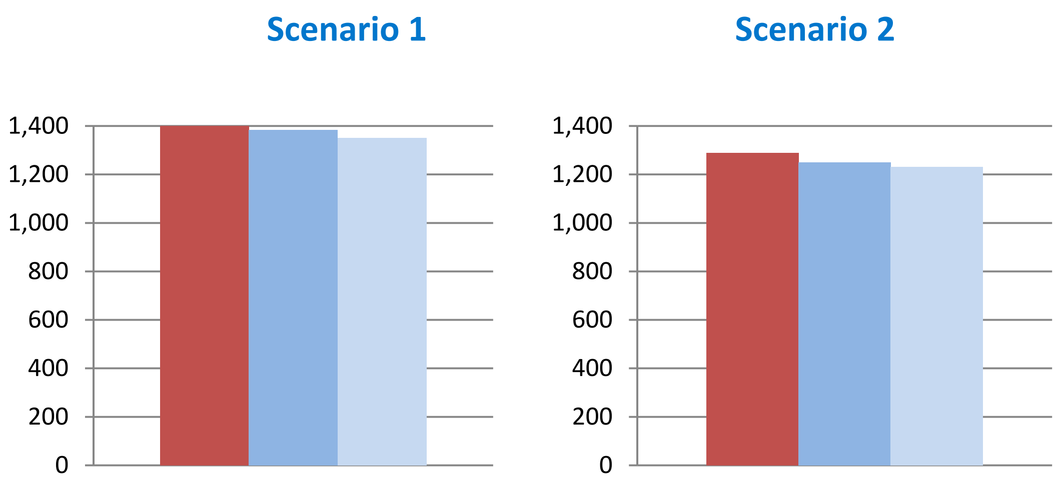
4. 'Be Lean' - Implications of Fabric Improvements

Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,383.04	1,249.65
Reduction on Total Site Emissions (tonnes/year)	69.17	39.01
% Reduction on Total Site Emissions	4.76%	3.03%

Measures to deliver around a 25% improvement on the DER for residential dwellings

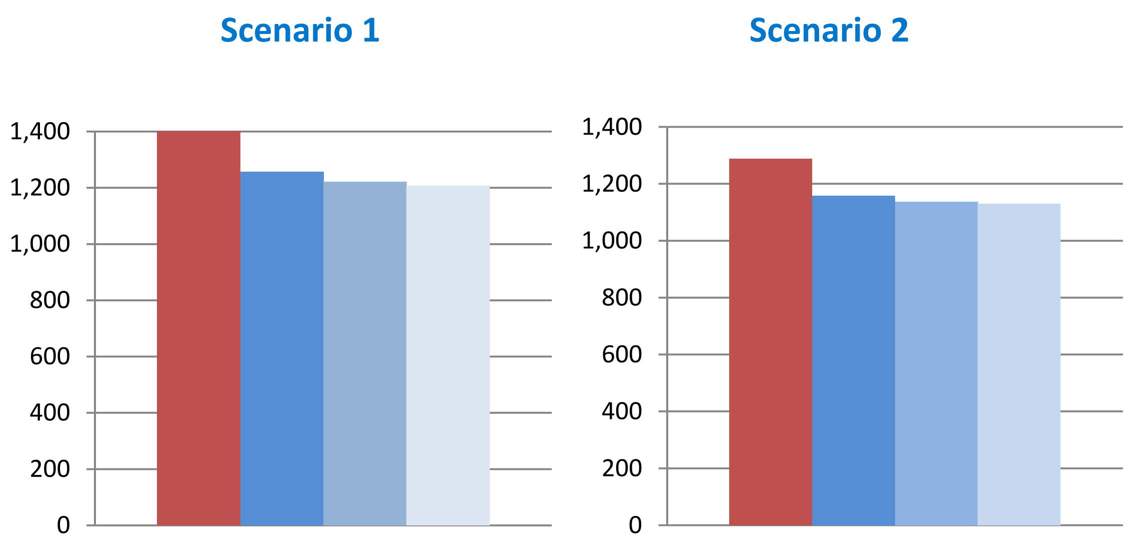
	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	1,351.14	1,231.73
Reduction on Total Site Emissions (tonnes/year)	101.07	56.93
% Reduction on Total Site Emissions	6.96%	4.42%



Key: Red = no improvement over building regulations; Dark Blue = 5% improvement; Medium Blue = 15% improvement; Light Blue = 25%improvement

5. 'Be Clean' - Potential for CHP

	Scenario 1	Scenario 2
Site density (dwellings/hectare)	Not given	Not given
Number of dwellings	400	300
CHP electrical capacity (kW)	123	82
CHP electricity generated (MWh p.a.)	687	459
Electricity imported (MWh p.a.)	1,690	1,884
CHP heat produced (useful) (MWh p.a.)	844	564
Boiler heat produced (MWh p.a.)	1,193	797
CHP fuel used (MWh p.a.)	1,964	1,312
Boiler fuel used (MWh p.a.)	1,356	906
CHP electrical efficiency	35	35
CHP overall efficiency	78	78
Running Hours	5,585	5,585
CHP engine capital cost (£)	123,077	82,216
Reduction in CO_2 emissions (tonnes)	195.58	130.65
Total Site CO_2 Emissions (tonnes/year)	1,256.63	1,158.01
% Reduction on Total Site Emissions	13.47	10.14



Key: Red = baseline total site emissions; Dark Blue = baseline + CHP; Medium Blue = 15% DER improvement + CHP; Light Blue = 25% DER improvement + CHP

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	56.08	3.86%	511,000	9,500	32.73	2.54%	298,200	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	55.23	3.80%	547,500	10,000	32.23	2.50%	319,500	10,000
PV	Residential – Total for Flats and Houses [Hybrid Panels]	163.33	11.25%	1,828,341	11,500	141.87	11.01%	1,588,087	11,500
PV	Residential – Total for Flats and Houses [Monocrystalline Panels]	139.13	9.58%	1,797,152	13,000	130.31	10.11%	1,572,493	12,500
GSHP	Communal System serving whole site	90.11	6.21%	1,111,253	12,500	60.19	4.67%	742,323	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.04%	28,000	47,000	0.60	0.05%	28,000	47,000
BIOMASS	Communal System for whole site	296.58	20.42%	2,180,342	7,500	198.12	15.37%	1,653,669	8,500

Option 2: CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	56.08	4.59%	511,000	9,500	32.73	2.88%	298,200	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	55.23	4.25%	547,500	10,000	32.23	2.83%	319,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	163.33	13.38%	1,828,341	11,500	141.87	12.47%	1,588,087	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	139.13	11.39%	1,797,152	13,000	130.31	11.45%	1,572,493	12,500
GSHP	Communal System serving whole site	74.59	6.11%	919,894	12,500	51.49	4.53%	634,977	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.05%	28,000	47,000	0.60	0.05%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	136.03	11.14%	100,604	740	93.90	8.25%	84,931	905

Option 3: CHP & 25% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO_2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO_2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	56.08	4.65%	511,000	9,500	32.73	2.90%	298,200	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	55.23	4.58%	547,500	10,000	32.23	2.85%	319,500	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	163.33	13.54%	1,828,341	11,500	141.87	12.56%	1,588,087	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	139.13	11.53%	1,797,152	13,000	130.31	11.54%	1,572,493	12,500
GSHP	Communal System serving whole site	66.60	5.52%	821,339	12,500	47.02	4.16%	579,870	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.05%	28,000	47,000	0.60	0.05%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	121.46	10.07%	95,183	784	85.75	7.59%	81,899	955

7. Policy Test

1. **20% renewables**
   a. Based on Option 1 – No CHP & No improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Communal Biomass System for whole site	£2,175,300	£1,303,669	20.4	15.4
2	PV	£2,886,000	£2,885,100	17.8	20.0
3	PV +SHW	£3,180,500	£2,843,800	20.0	20.0
4	PV + GSHP	£3,353,830	£3,162,800	20.0	20.0

   b. Based on Option 2 - CHP & 15% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV scaled	£4,902,800	£3,651,400	20.0 (32.7)	20.0 (29.4)
2	CHP + PV scaled	£6,325,000	£4,617,600	20.0 (32.7)	20.0 (29.4)

   c. Based on Option 3 - CHP & 25% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV scaled	£5,027,900	£3,721,400	20.0 (33.5)	20.0 (29.9)
2	CHP + PV scaled	£6,292,400	£4,599,178	20.0 (33.5)	20.0 (29.9)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

2. 30% renewables

a. Based on Option 1 – No CHP & No improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Communal Biomass System for whole site + PV	£3,732,300	£3,413,600	30.0 (30.0)	30.0 (30.0)
2	GSHP + PV	£3,997,300	£3,933,900	24.0 (24.0)	26.8 (26.8)

b. Based on Option 2 - CHP & 15% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV scaled	£6,269,800	£4,925,200	30.0 (41.4)	30.0 (38.2)
2	CHP + PV scaled	£6,477,000	£5,261,500	21.1 (33.7)	25.1 (33.9)

c. Based on Option 3 - CHP & 25% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + Biomass top-up + PV scaled	£6,378,600	£4,985,800	30.0 (41.8)	30.0 (38.6)
2	CHP + PV scaled	£6,477,000	£5,261,500	21.4 (34.7)	25.2 (34.4)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

3. 30% renewables

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			≈25%		
	15% EE	SWH		≈25%		
	PV (~1kWp)			≈25%		
	15% EE	PV (~0.5kWp)		≈25%		
	GSHP			≈25%		
4	Gas CHP			≈40-50%		
	Biomass			≈60%		
	15% EE	PV (~1.3kWp)		≈44%		
	25% EE	PV (~0.8kWp)		≈44%		
	15% EE	SWH	PV (~0.8kWp)	≈44%		
5	Biomass CHP	PV (~0.6kWp)		≈100%		
	25% EE	PV (~3kWp)		≈100%		
	Gas CHP	PV (~2KwP)		≈100%		
	Biomass	PV (~1.7KwP)		≈100%		

8. Conclusions and Recommendations

Energy Efficiency

- Approximately 3-5% reduction in total site CO_2 emissions depending on the relative scale of the commercial element could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 5-7% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

Efficient delivery of heat

- There is a strong potential to incorporate CHP on the site due to the scale, density and the proposed mix of uses planned for the site.
- The site is located in close to a major redevelopment area ' Haringey Heartlands' which has the potential to develop a district heating system, and therefore the incorporation of CHP should be strongly encouraged to allow future linkage and expansion.
- A number of schools are located in close proximity to the development. These could be connected and would improve the viability of a CHP district heating system and the potential to provide an extended network should be explored. This could potentially provide some of the 'allowable solutions' requirement for future building regulations compliance.

Potential to meet proposed policy options

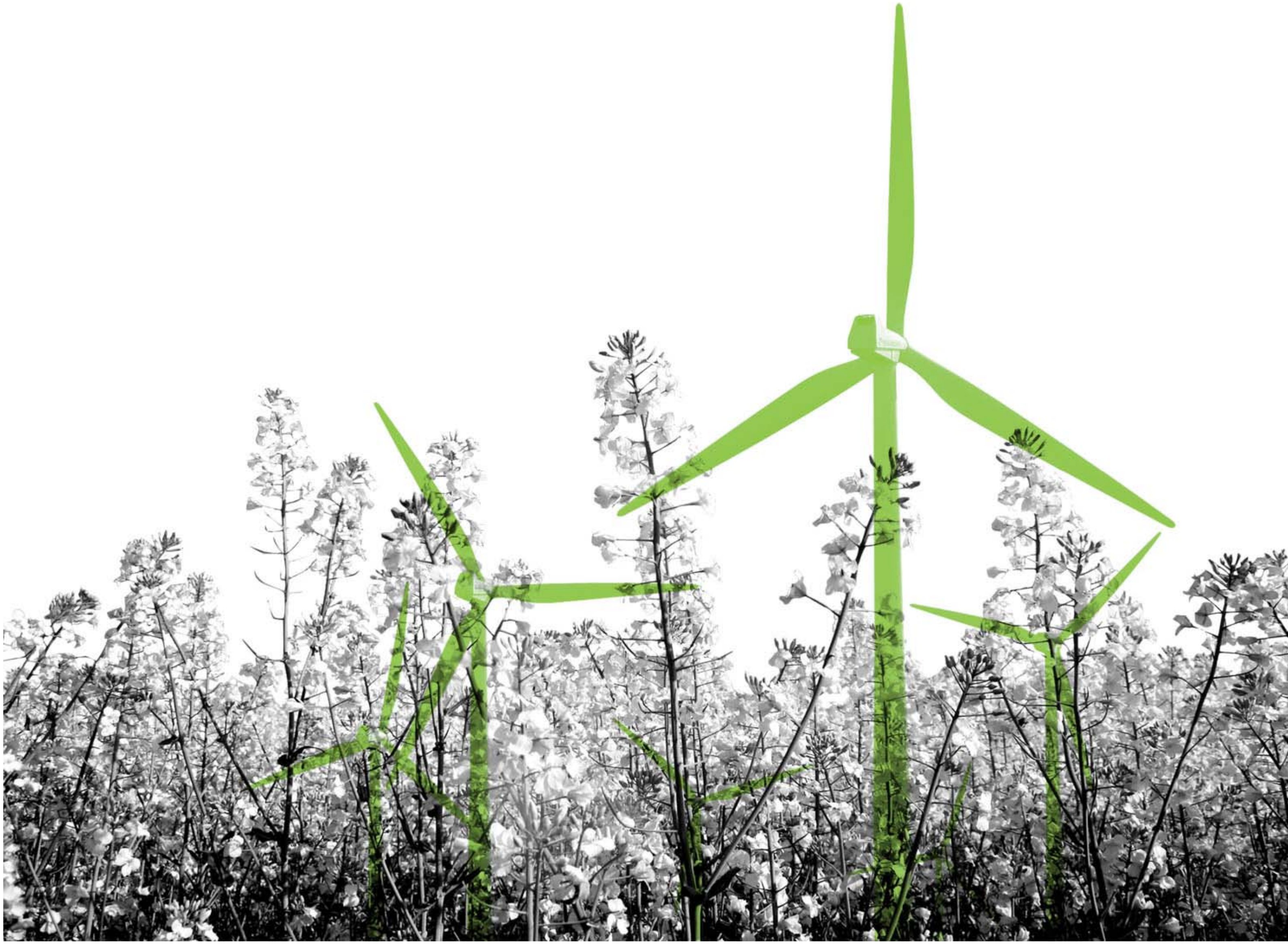
- PV and/or biomass are likely to be required options for meeting the renewable energy targets. The site is potentially constrained for both of these options and may have implications for the site:
    - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
    - Implementation of biomass heating would result in regular deliveries of fuel to the site, the frequency would depend on a number of factors but could require two per week in the winter months.
    - The nearby conservation area designation may impact on the roof area available for PV which could reduce the potential reductions that could be achieved.
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:

- 20% improvement in total site emissions from on-site renewables: £5,500 – £15,900 (Options 2 and 3 include the cost of CHP of around £9000 per unit)
- 30% improvement in total site emissions from on-site renewables: £9,400 – £22,900* (Options 2 and 3 include the cost of CHP of around £9000 per unit) (*limited options)
- CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000
- CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.

To assist potential development to achieve the proposed policy targets the Council should assist developers by:

- Provide (or help developer to obtain) information on the energy demands and plant replacement for the nearby schools to enable the potential to connect to a district heating system to be explored.
- Look at the potential to provide support for the connection of a district heating system to the nearby school(s) through funding under the CIL or negotiations on s106 provisions.
- Providing information on the extent of PV or SWH that can be applied to the roof of the development without affecting the Conservation Area designation



Site Analysis – Site 7: Civic Centre

Site 7: Civic Centre

1. Potential Development Scenarios Proposed

	Scenario 1	Scenario 2
Schedule	200 Flats, 500sqm Office, 200sqm Retail, 300sqm Restaurant	12 Houses, 108 Flats, 1000sqm Office
Mix of residential units	56 1-bed, 56 2-bed, 49 3-bed, 39 4-bed	8 mid-terrace, 4 end-terrace, 52 1-bed, 30 2-bed, 22 3-bed
Density	550hrh (164dph)	291hrh (98dph)
Storeys	5	4
Lifts	4	3
Area of underground car parking	none	none

2. Analysis of surrounding area

KEY: Red – Site; Orange – Medium density residential; Purple – High density residential; Blue – Commercial/Retail, Grey – Schools, Green – offices; Navy – Bus Depot

Issue	Implications
Air quality	The area is within an AQMA and therefore the use of Biomass or CHP would need to be assessed to ensure that it has no adverse implications for local air quality.
Roof shading	Surrounding buildings are unlikely to have shading implications
Conservation Area	The site is within a conservation area which may have an implication on the incorporation of design measures or technologies (such as PV or SWH) that have a visual impact.
Connection to existing district heating network	No existing networks near to the site
Potential to incorporate CHP	The number of units, the density of the development and the proposed mix of units mean that the proposed development is likely to support the use of CHP.
Potential to incorporate a communal/site wide heating system	The number of units, the density of the development and the proposed mix of units mean that the proposed development may support a district heating system.
Future potential district heating network	A number of schools, offices and high density housing sites are in the vicinity of the site. A network created on the site could potentially act as a hub for future expansion of a district network in the area.
Site access	Access to the site for the delivery of fuel such as biomass could be possible
Wind regime	The dense nature of the surrounding urban environment is unlikely to make the site suitable for wind

3. Baseline Demands and Emissions

Scenario 1

Residential

	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
End Terrace	0	0	0	*0*	0
Mid Terrace	0	0	0	*0*	0
1B Flat	56	119,869	243,125	*124,583*	97,751
2B Flat	56	174,752	277,822	*158,840*	127,643
3B Flat	49	159,790	259,849	*146,251*	117,842
4B Flat	39	149,406	224,927	*132,269*	106,685
Total Residential	200	603,818	1,005,723	*561,943*	449,921
Assumed Occupancy	432				

Communal

	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting	1800		16,425	6,931
Lifts		4	23,360	9,858
Car Park Lighting	0			
Total			39,785	16,789

Commercial

	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
General Office	500	47,500	60,000	6,000	31,685
General Retail	200	33,000	0	0	13,926
Restaurant	300	27,000	111,000	11,100	32,928
Total		107,500	171,000	17,100	78,539

Scenario 2

Residential

	Number	Electric (kWh)	Heat (kWh)	*of which DHW (kWh)*	CO_2 (kg/yr)
End Terrace	4	13,564	26,506	*13,172*	10,866
Mid Terrace	8	27,384	46,968	*26,344*	20,668
1B Flat	52	111,307	225,759	*115,684*	90,769
2B Flat	30	93,617	148,833	*85,093*	68,380
3B Flat	22	71,742	116,667	*65,664*	52,909
4B Flat	0	0	0	*0*	0
Total Residential	116	317,615	564,732	*305,956*	243,592
Assumed Occupancy	214				

Communal

	Area (m2)	Number	Electricity (kWh)	CO_2 (kg/yr)
Corridor lighting	936		8,541	3,604
Lifts		3	17,520	7,393
Car Park Lighting	0			0
Total			26,061	10,998

Commercial

	Area (m^2)	Electric (kWh)	Heat (Fossil) (kWh)	of which DHW (kWh)	CO_2 (kg/yr)
General Office	1000	95,000	120,000	12,000	63,370
General Retail	0	0	0	0	0
Restaurant	0	0	0	0	0
Total		95,000	120,000	12,000	63,370

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	545.25	317.96
Total Heat Demand (kWh/year)	597,680	366,776
Total Hot Water Demand (kWh/year)	579,043	317,956
Total Electricity Demand (kWh/year)	751,103	438,676

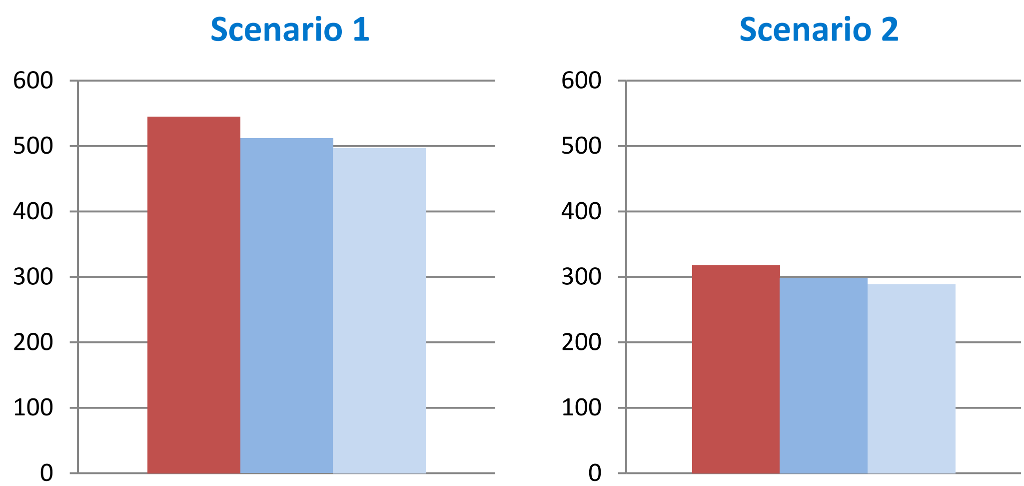
4. 'Be Lean' - Implications of Fabric Improvements

Measures to deliver around a 15% improvement on the DER for residential dwellings

	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	511.69	298.48
Reduction on Total Site Emissions(tonnes/year)	33.76	19.48
% Reduction on Total Site Emissions	6.15%	6.13%

Measures to deliver around a 25% improvement on the DER for residential dwellings

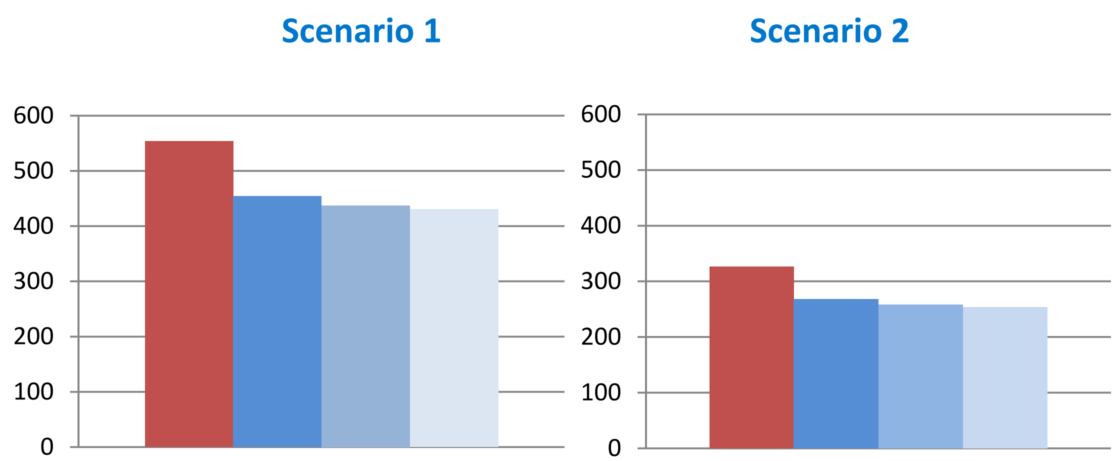
	Scenario 1	Scenario 2
Total Site CO_2 Emissions (tonnes/year)	497.02	288.70
Reduction on Total Site Emissions(tonnes/year)	48.23	29.26
% Reduction on Total Site Emissions	8.85%	9.20%



Key: Red = no improvement over building regulations; Dark Blue = 15% improvement; Light Blue = 25% improvement

5. 'Be Clean' - Potential for CHP

	Scenario 1	Scenario 2
Site density (dwellings/hectare)	164	95
Number of dwellings	200	116
CHP electrical capacity (kW)	63	36
CHP electricity generated (MWh p.a.)	349	203
Electricity imported (MWh p.a.)	422	255
CHP heat produced (useful) (MWh p.a.)	429	250
Boiler heat produced (MWh p.a.)	606	353
CHP fuel used (MWh p.a.)	998	581
Boiler fuel used (MWh p.a.)	689	401
CHP electrical efficiency	35	35
CHP overall efficiency	78	78
Running Hours	5,585	5,585
CHP engine capital cost (£)	62,557	36,402
Estimated Overall Cost	£1,800,000	£1,044,000
Reduction in CO_2 emissions (tonnes)	99.41	57.85
Total Site CO_2 Emissions (tonnes/year)	454.28	268.55
% Reduction on Total Site Emissions	18.23%	18.19%



Key: Red = baseline total site emissions; Dark Blue = baseline + CHP; Medium Blue = 15% DER improvement + CHP; Light Blue = 25% DER improvement + CHP

6. 'Be Green' - Renewable Energy Potential

Option 1: No CHP & 0% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	30.73	5.64%	280,000	9,500	15.98	5.03%	145,600	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	30.26	5.55%	300,000	10,000	15.74	4.95%	156,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	121.70	22.32%	1,362,300	11,500	79.10	24.88%	885,500	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	104.51	19.17%	1,362,300	13,500	73.45	23.10%	885,500	12,500
GSHP	Communal System serving whole site	45.80	8.40%	564,800	12,500	26.65	8.38%	328,700	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.11%	28,000	47,000	0.60	0.19%	28,000	47,000
BIOMASS	Communal System for whole site	150.75	27.65%	1,140,800	8,000	87.72	27.59%	703,800	8,500

Option 2: CHP & 15% improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	System	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)	CO2 saving (tonnes)	% of Total Site	Cost (£)	Cost per tonne (£)
SWH	Residential - Communal Systems serving flats [Flat Plate]	30.73	7.16%	280,000	9,500	15.98	6.40%	145,600	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	40.35	7.06%	300,000	10,000	15.74	6.30%	156,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	121.70	28.37%	1,362,308	11,500	79.10	31.67%	885,500	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	104.51	24.37%	1,362,308	13,500	73.45	29.41%	885,500	12,500
GSHP	Communal System serving whole site	38.15	8.89%	470,436	12,500	22.46	8.99%	276,951	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.14%	28,000	47,000	0.60	0.24%	28,000	47,000
BIOMASS	Combined with CHP system serving winter space heating demands	69.57	16.22%	75,900	1,100	49.95	16.40%	65,235	1,600

Option 3: CHP & 25% Improvement on Building Regs for residential dwellings

		Scenario 1				Scenario 2			
LZC	**System**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**	**CO2 saving (tonnes)**	**% of Total Site**	**Cost (£)**	**Cost per tonne (£)**
SWH	Residential - Communal Systems serving flats [Flat Plate]	30.73	7.27%	280,000	9,500	15.98	6.52%	145,600	9,500
SWH	Residential - Communal Systems serving flats [Evacuated Tube]	40.35	7.16%	300,000	10,000	15.74	6.42%	156,000	10,000
PV	Residential - Communal Systems for Flats [Hybrid Panels]	121.70	28.81%	1,362,308	11,500	79.10	32.28%	885,500	11,500
PV	Residential - Communal Systems for Flats [Monocrystalline Panels]	104.51	24.74%	1,362,308	13,500	73.45	29.98%	885,500	12,500
GSHP	Communal System serving whole site	34.36	8.13%	423,671	12,500	20.12	8.21%	248,062	12,500
WIND	Building Mounted 6kW Turbine	0.60	0.14%	28,000	47,000	0.60	0.24%	28,000	47,000
BIOMASS	Boiler attached to district heating system working alongside CHP	62.65	14.83%	73,307	1,200	36.68	14.97%	63,646	1,700

7. Policy Test

1. 20% renewables

a. Based on Option 1 – No CHP & No improvement over Building Regulations

Possible Solution		Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass	£1,140,800	£703,800	27.7 (27.7)	27.6 (27.6)
2	PV (scaled)	£1,220,700	£711,900	20.0 (20.0)	20.0 (20.0)
3	SWH + PV (scaled)	£1,182,000	£691,700	20.0 (20.0)	20.0 (20.0)

b. Based on Option 2 – CHP & 15% improvement over Building Regulations

Possible Solution		Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV (scaled)	£2,760,200	£1,603,100	20.0 (36.8)	20.0 (36.7)
2	CHP + Biomass top-up + PV (scaled)	£2,057,400	£1,200,000	20.0 (36.8)	20.0 (36.7)

c. Based on Option 3 –CHP & 25% improvement over Building Regulations

Possible Solution		Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV (scaled)	£2,745,800	£1,592,600	20.0 (37.7)	20.0 (37.9)
2	CHP + Biomass top-up + PV (scaled)	£2,117,800	£1,232,000	20.0 (37.7)	20.0 (37.9)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

2. 30% renewables

a. Based on Option 1 – No CHP & No improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	Biomass + PV (scaled)	£1,299,000	£798,300	30.0 (30.0)	30.0 (30.0)
2	SWH + PV (scaled)	£1,662,300	£1,041,500	27.9 (27.9)	29.8 (29.8)
3	GSHP + PV (scaled)	£1,883,200	£1,182,300	30.0 (30.0)	30.0 (30.0)

b. Based on Option 2 –CHP & 15% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV (scaled)	£3,162,300	£1,882,700	28.4 (43.4)	30.0 (44.6)
2	CHP + Biomass top-up + PV (scaled)	£2,604,700	£1,528,100	30.0 (44.7)	30.0 (44.6)

c. Based on Option 3 – CHP & 25% improvement over Building Regulations

Option	Possible Solution	Total Cost		% site reduction from renewables (and total % reduction on baseline)*	
		S1	S2	S1	S2
1	CHP + PV (scaled)	£3,162,300	£1,866,900	28.8 (43.8)	30.0 (44.6)
2	CHP + Biomass top-up + PV (scaled)	£2,663,600	£1,561,800	30.0 (44.7)	30.0 (45.6)

*Higher total % savings are realised where CHP and/or fabric improvement measures are implemented

3. 30% renewables

Code Level	Solution			Potential Improvement	Scenario 1	Scenario 2
					Potential Feasibility	Potential Feasibility
3	25% EE			≈25%		
	15% EE	SWH		≈25%		
	PV (~1kWp)			≈25%		
	15% EE	PV (~0.5kWp)		≈25%		
	GSHP			≈25%		
4	Gas CHP			≈40-50%		
	Biomass			≈60%		
	15% EE	PV (~1.3kWp)		≈44%		
	25% EE	PV (~0.8kWp)		≈44%		
	15% EE	SWH	PV (~0.8kWp)	≈44%		
5	Biomass CHP	PV (~0.6kWp)		≈100%		
	25% EE	PV (~3kWp)		≈100%		
	Gas CHP	PV (~2KwP)		≈100%		
	Biomass	PV (~1.7KwP)		≈100%		

8. Conclusions and Recommendations

Energy Efficiency

- Approximately 6% reduction in total site CO_2 emissions could be achieve through 'best practice' energy efficiency measures that are unlikely to result in significant cost increases
- Approximately 9% reduction in total site CO_2 emissions (or more) could be achieve through a set of 'advanced practice' energy efficiency measures but may result in significant cost increases

Efficient delivery of heat

- There is the potential to incorporate CHP on the site but the proposed density is towards the lower end of technical and financial viability, however the site is located in a strategic location close to a major redevelopment area ' Haringey Heartlands' which has the potential to develop a district heating system, and therefore the incorporation of CHP should be strongly encouraged to allow the expansion of wider networks.
- A number of schools and some commercial buildings are located in close proximity to the development. These could be connected and would improve the viability of a CHP district heating system and the potential to provide an extended network should be explored. This could potentially provide some of the 'allowable solutions' requirement for future building regulations compliance.

Potential to meet proposed policy options

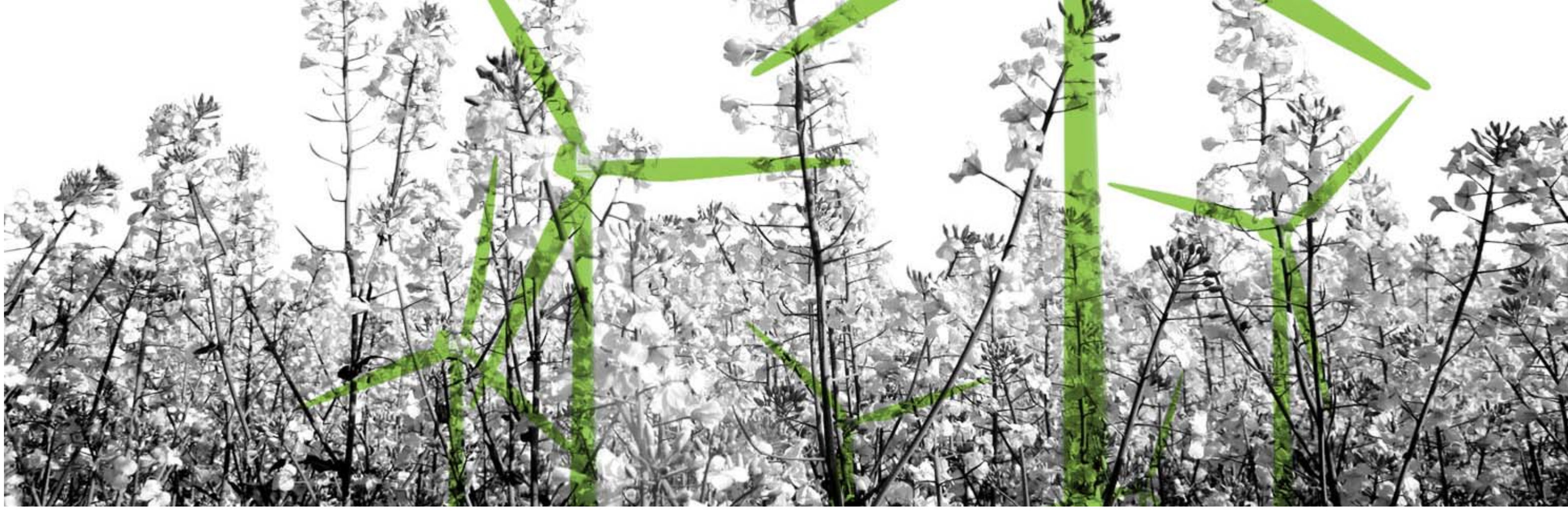
- PV and/or biomass are likely to be required options for meeting the renewable energy targets. The site is potentially constrained for both of these options:
  - Air quality issues may have an impact on the extent or potential to incorporate biomass systems and would limit the possible solutions for the site or increase the costs of meeting the target
  - The conservation area designation may impact on the roof area available for PV which could reduce the potential reductions that could be achieved.
- Estimated capital costs for the different solutions are presented in section 7. For comparison, indicative cost ranges for meeting the tested policy options, presented in terms of cost per residential dwelling are:
  - 20% improvement in total site emissions from on-site renewables: £5,700 – £13,800 (Options 2 and 3 include the cost of CHP of around £9000 per unit)
  - 30% improvement in total site emissions from on-site renewables: £6,500 – £15,800 (Options 2 and 3 include the cost of CHP of around £9000 per unit)
  - CSH Level 3 energy standard (25% improvement on building regs): £4,000 to £8,000

- CSH Level 4 energy standard (44% improvement on building regs): £8,000 to £12,000

Please note these costs are not mutually exclusive, as previously highlighted, meeting the 20% renewables target is likely to meet the energy standards for Code Levels 3 and 4. Also, as these costs are presented in terms of cost per residential dwelling they are affected by the proportion of the non-residential element.

To assist potential development to achieve the proposed policy targets the Council should assist developers by:

- Provide (or help developer to obtain) information on the energy demands and plant replacement for the nearby schools to enable the potential to connect to a district heating system to be explored.
- Look at the potential to provide support for the connection of a district heating system to the nearby school(s) through funding under the CIL or negotiations on s106 provisions.
- Providing information on the extent of PV or SWH that can be applied to the roof of the development without affecting the Conservation Area designation



Conclusions

8 Findings & Conclusions

8.1 Summary of Results

Site	Scenario	Potential to install CHP	Solution(s) identified to achieve 20% renewables target	Solution(s) Identified to achieve 30% renewables target	Solution(s) Identified to achieve CSH Level 4 mandatory energy standard	Solution(s) Identified to achieve CSH Level 5 mandatory energy standard
Site 1	1					
Site 1	2					
Site 2	1					
Site 2	2					
Site 3	1					
Site 3	2					
Site 4	1					
Site 4	2					
Site 5	1					
Site 5	2					
Site 6	1					
Site 6	2					
Site 7	1					
Site 7	2					

8.2 Key Findings

- Although this study incorporates a number of significant assumptions and, because no scheme designs have been prepared for the site is to a large extent a hypothetical exercise, the findings suggest that there is the potential that all of the polices proposed could be achieved with the exception of Code Level 5 on some of the smaller sites. However this assumes that the scheme can be designed in a way that mitigates any potential constraints to the use of the technologies proposed.
- Solutions for delivering energy efficiency measures, implementing CHP systems where feasible and achieving 20% (or greater) reduction in CO_2 emissions through on-site renewable energy generation are likely to result in the achievement of the mandatory

energy standards required for Code for Sustainable Homes Levels 3 and 4 for residential dwellings. This target would also help to reduce the EPC rating of non-domestic buildings, which would help to improve the BREEAM score and rating.

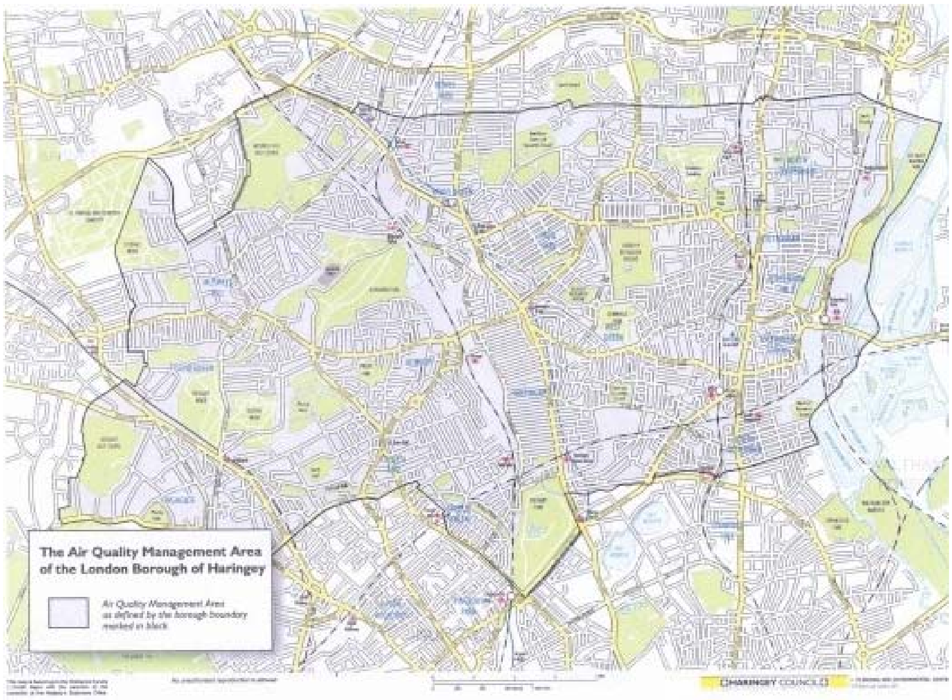
- The costs for delivering a 20% reduction in total site emissions from the use of on-site renewable energy technologies (which is also likely to meet the requirements for Code Levels 3 and 4 for the residential dwellings on the site) was found to be in the range of £5,000 to £19,000 depending on the development and solution adopted. Although it was not in the remit of this study to consider the implications of the Code it can be compared to work undertaken by Cyril Sweet on behalf of CLG looking at the costs of delivering the Code for Sustainable Homes, which is available at: http://www.communities.gov.uk/publications/planningandbuilding/codecostanalysis. This study found the costs of delivering Level 4 (both the mandatory energy standard as well as the other requirements) to be between £5,500 and £13,500 depending on the type of development and the environmental constraints associated with the site.
- Solutions that include the use of CHP are significantly more expensive than those that do not. Although the incorporation of CHP reduces the overall total site CO_2 emissions by around 15-20% (thereby reducing the renewables target), the cost of the district heating network and plant are significant. If gas CHP is used then the 'saving' resulting from the decreased renewable energy provision required to meet the target is greatly outweighed by the costs required to install the CHP and district heating system. It is therefore likely that developers may seek to avoid incorporating a district CHP system if they can achieve the 20% renewables target through another less expensive solution. However, this would contravene policy 4A.7 of the London Plan and if the scheme was referable it would be likely that, unless sufficient technical justification could be provided, the GLA would not accept the proposals. The compromise, which has been made on other applications in London, could be a reduction in the 20% requirement.
- Schemes that incorporate CHP are likely to favour the use of biomass boilers to meet the renewable energy target. This is because after the installation of the communal/district heating system infrastructure and energy centre, adding a biomass boiler is the most cost sensitive option to meet the target as they make use of the same infrastructure. However, modelling shows that if the CHP is maximised and the Biomass sized to avoid competition with the CHP, then the maximum reduction in CO_2 emissions is likely to be around 10-15%. Additional renewables provision of an alternative form will therefore be required in order to meet the 20% target.
- Schemes that are not sufficiently large or dense to support the incorporation of CHP are likely to rely on biomass heating and/or photovoltaics as these two options have the capacity to deliver large reductions in CO_2 emissions for the lowest cost.
- The scale of PV that can be utilised on the site is primarily dependent on the available roof area, assuming that the design can be adapted to maximise the orientation and pitch of the roofscape and limit the shading. This will be affected by the massing of the

building since the ratio of floor area to roof space decreases as the storey height increases. Achieving sufficient PV to meet the target is therefore more difficult for taller buildings.

- A constraint on the application of PV that may impact upon some of the development sires in the Borough will be the Conservation Area designations. The analysis shows that PV is likely to be an important component of the solutions proposed to meet the targets. If the implications of the Conservation Area designations have a significant impact on the available roof area for PV then this could potentially affect the ability to achieve the renewable energy targets.
- The analysis shows that the use of Biomass is likely to be a possible and potentially a preferred option for meeting the renewable energy target. However, the entire borough of Haringey has been declared an air quality management area (AQMA) for Nitrogen Dioxide (NO_2) and Particulate Matter (PM_{10}) as demonstrated in the following diagrams:

Haringey AQMA

From the UK National Air Quality Archive

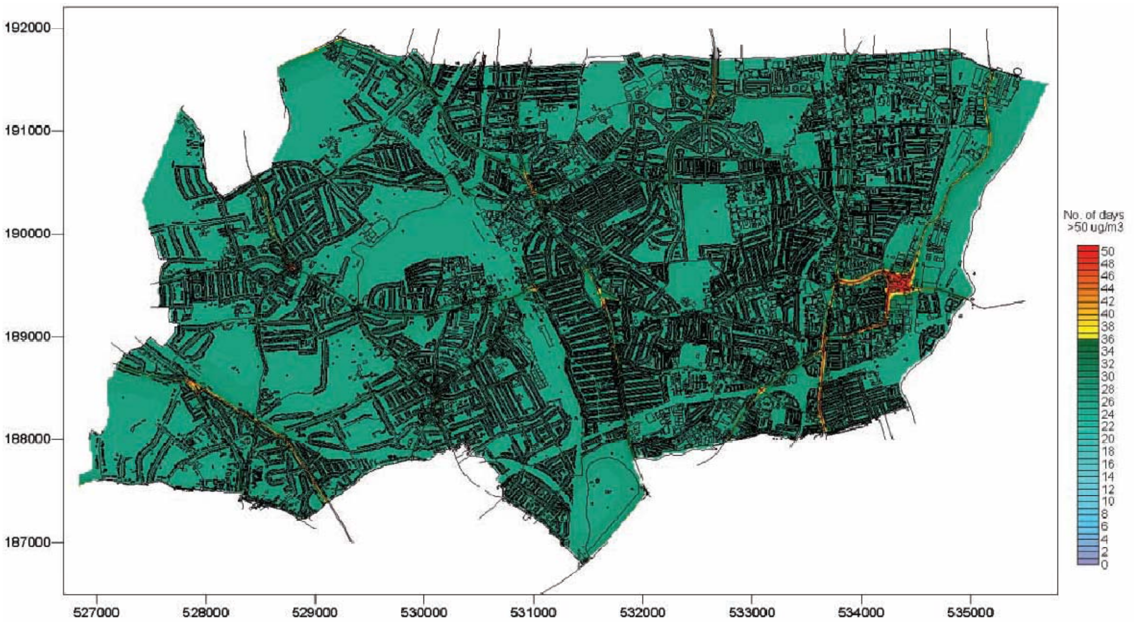


Description: The whole borough

Pollutants Declared: Nitrogen dioxide (NO_2), Particulate Matter < 10 μm (PM_{10})

Predicted Annual Mean Nitrogen Dioxide Levels for 2005 Concentration for Haringey, based on 1999 Met Data (Kings College London 2004)

The areas coloured yellow to red are those that exceed the air quality objective of 40 µg/m3 (21ppb). NO_2 pollution is concentrated around the borough's major roads with a greater concentration in the area around Tottenham Hale.



Predicted Daily Mean PM10 Objective for Haringey in 2005, based on 1999 Met Data (Kings College London 2004)

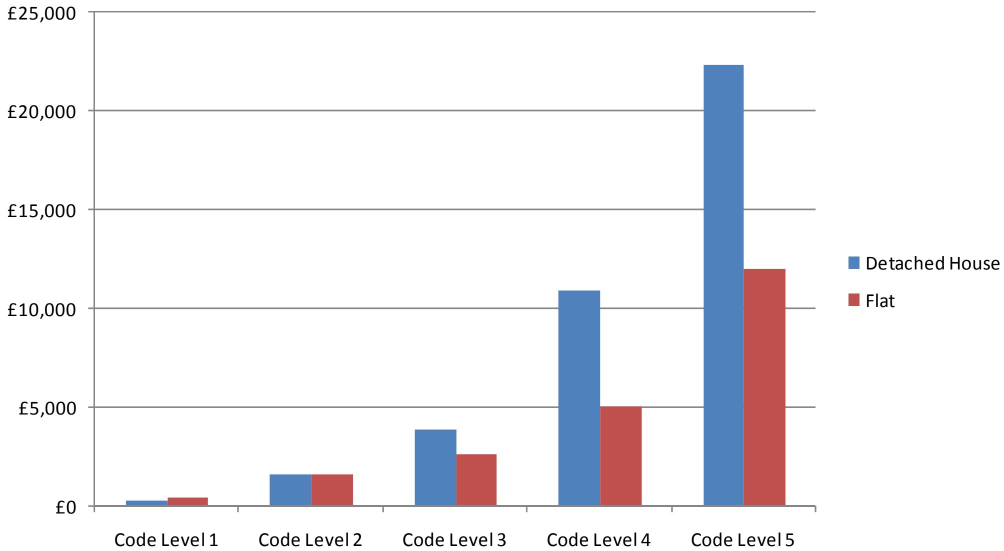
The areas coloured yellow to red were predicted to exceed the National Air Quality objectives. PM10 is concentrated around some of the major roads but appears to be a significant problem in the area around Tottenham Hale.

This could have a potentially significant impact on the use of biomass in the Borough but, in determining the implications, a holistic and comprehensive view should be taken in recognition of the role that biomass can play in reducing CO_2 emissions. It is therefore recommended that investigations in the medium term be undertaken to determine the impacts of increased biomass in the Borough, taking account of future decreases improvements in air quality from improved vehicle performance. It will also be necessary for developers proposing to use biomass to demonstrate, using Screening assessments and Dispersion Modelling, that its use will not have an adverse impact on the local air quality.

- Another potential implication of the use of biomass in new developments will be the delivery of fuel. Biomass is normally delivered in trucks, roughly the same size as refuse vehicles. The fuel requirement will vary greatly depending on a number of different factors (boiler size, storage size, vehicle size etc) but during the winter, when the demand for heat is at its highest two deliveries a week could be expected. This may have implications on traffic movements, air quality and noise.
- The analysis suggests that the use of Solar Water Heating (SWH) to meet the proposed targets for new developments may be limited because it delivers lower CO_2 savings compared to other technology options and, for larger sites with residential components, would not be compatible with CHP systems. The reason for the relatively small CO_2 reduction is because the system is only able to offset half of the domestic hot water demands, which account for only a small proportion of the total CO2 emissions from domestic and most non-domestic buildings. Also the CO_2 emissions factor associated with gas is much lower than that associated with electricity. Where used in new developments SWH systems are likely to be most commonly applied to houses or non-domestic properties with high hot water demands. However, the greatest potential is likely to be retrofitting to existing properties.
- Based on the assessments carried out the use of Ground Source (or Air Source) Heat Pumps (GSHP/ASHP) are likely to be limited due the relatively high costs, space requirements and limited CO_2 savings. The CO_2 savings are limited when the systems are used for heating because the efficiencies are larger offset by the higher emissions factor associated with the electricity that they use compared to the gas that they offset.
- Our analysis of the benefits of using on-site small scale wind turbines has been based on the assumptions in SAP Appendix M, which applies factors for turbines in urban locations to reflect the reduced outputs resulting from adverse turbulence. Based on this approach the outputs from such systems are low and consequently they do not represent an attractive choice relative to the other technology options. However, this is a relatively conservative and, when well sited, wind turbines have the potential to deliver very cost effective CO_2 savings, particularly larger scale systems. As such more it may be viable to use wind turbines as part of an energy strategy for developments in

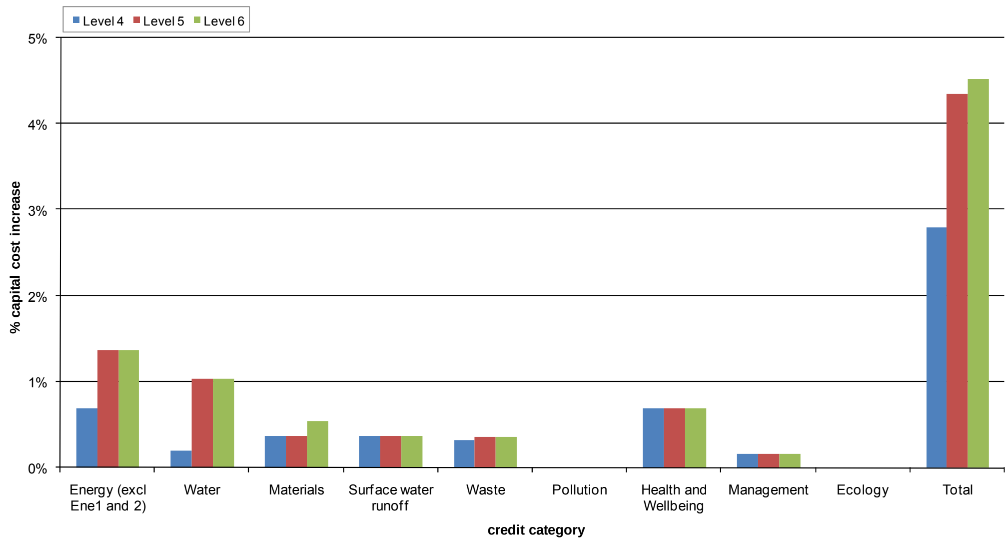
the borough, although data from a year of anemometer recordings would probably be required.

- Overall, the implications of meeting the required energy standard of Code Level 4 (44% improvement over Building Regulations 2006) are relatively minor given the policy requirements to deliver a good standard of energy efficiency and CHP where viable. The Code has wider cost implications associated with the other requirements which are outside the scope of this study but there are other studies that have investigated this area including a recent AECOM and Cyril Sweet study for CLG to show the financial implications of achieving different levels of the Code. However, the costs are predicted and are not yet fully supported by the development industry and there is not yet sufficient published data on the actual costs of achieving the higher Code levels to establish robust cost benchmarks. The results demonstrate that the costs associated with meeting advanced Code levels are relatively modest for most elements other than the standards for CO_2 emissions, which has been covered in this study. The results show a marked increase in costs associated with meeting Code Levels 5 & 6.



Cost of meeting the mandatory Energy criteria in the Code for a detached house and a flat. Code Level 6 has been excluded (Source: Cost Analysis of The Code for Sustainable Homes, Faber Maunsell AECOM and Cyril Sweett, 2008)

Percentage cost increase (over base construction cost) for Code credits (exc. Ene 1, 2 & 7) - Flat.



Costs (over base construction cost) for delivering Code credits as required to levels 4, 5 & 6 for a flat. (Source: Cost Analysis of The Code for Sustainable Homes, Faber Maunsell AECOM and Cyril Sweett, 2008).

Percentage cost increase (over base construction cost) for Code credits (exc. Ene 1, 2 & 7) - House.

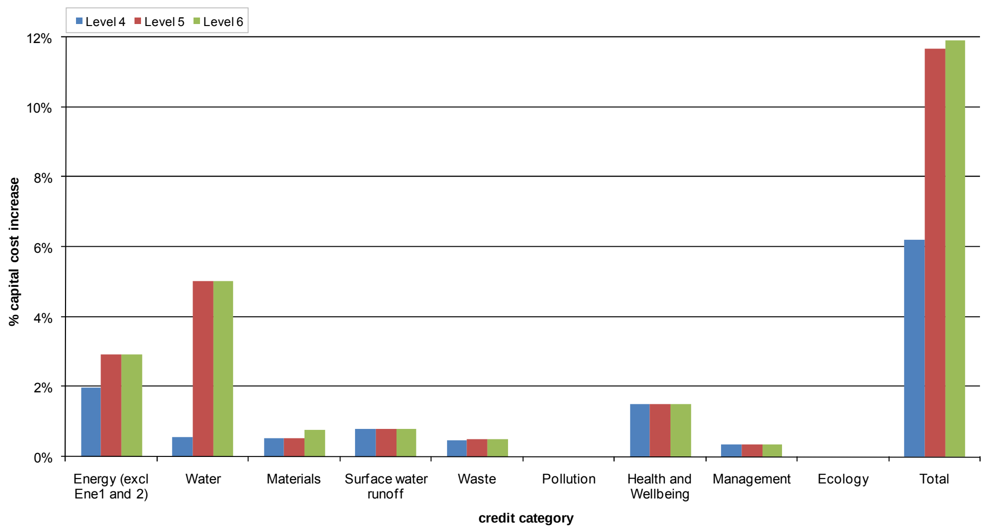


Figure 3: Costs (over base construction cost) for delivering Code credits as required to levels 4, 5 & 6 for a house. (Source: Cost Analysis of The Code for Sustainable Homes, Faber Maunsell AECOM and Cyril Sweett, 2008).

- This study has not considered the costs of BREEAM because there are no specific standards for energy except for meeting the Excellent and Outstanding ratings and the other elements are outside the scope of this project. However, the figure below shows data from a previous cost analysis of BREEAM and gives the percentage increase on the base build cost to deliver 'Good', 'Very Good' and 'Excellent' ratings under BREEAM Offices (2004) and BREEAM Schools[16,17].The cost analysis shows that the

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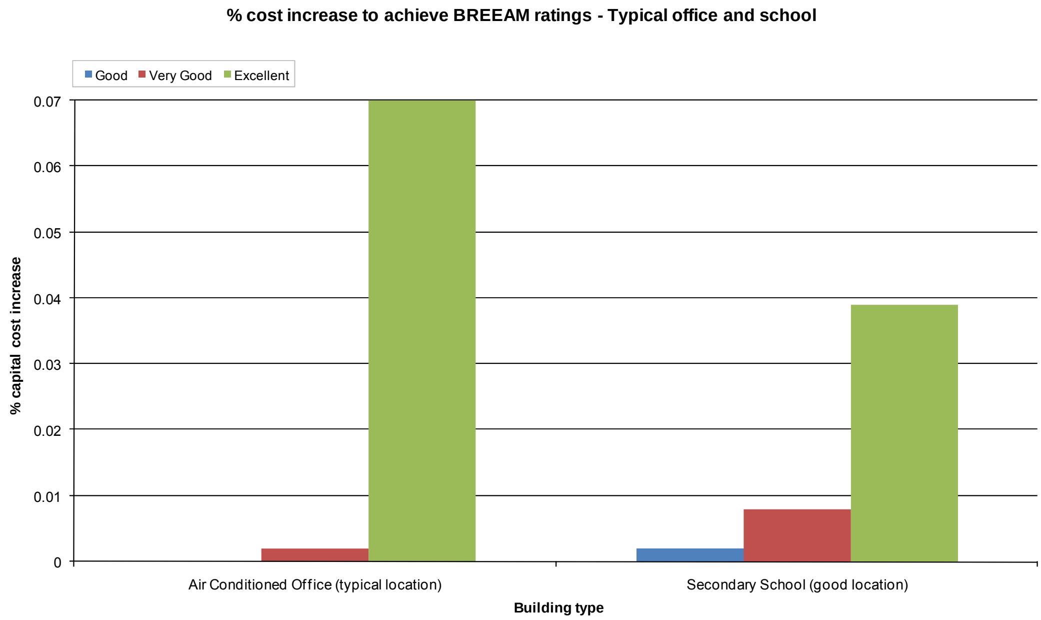
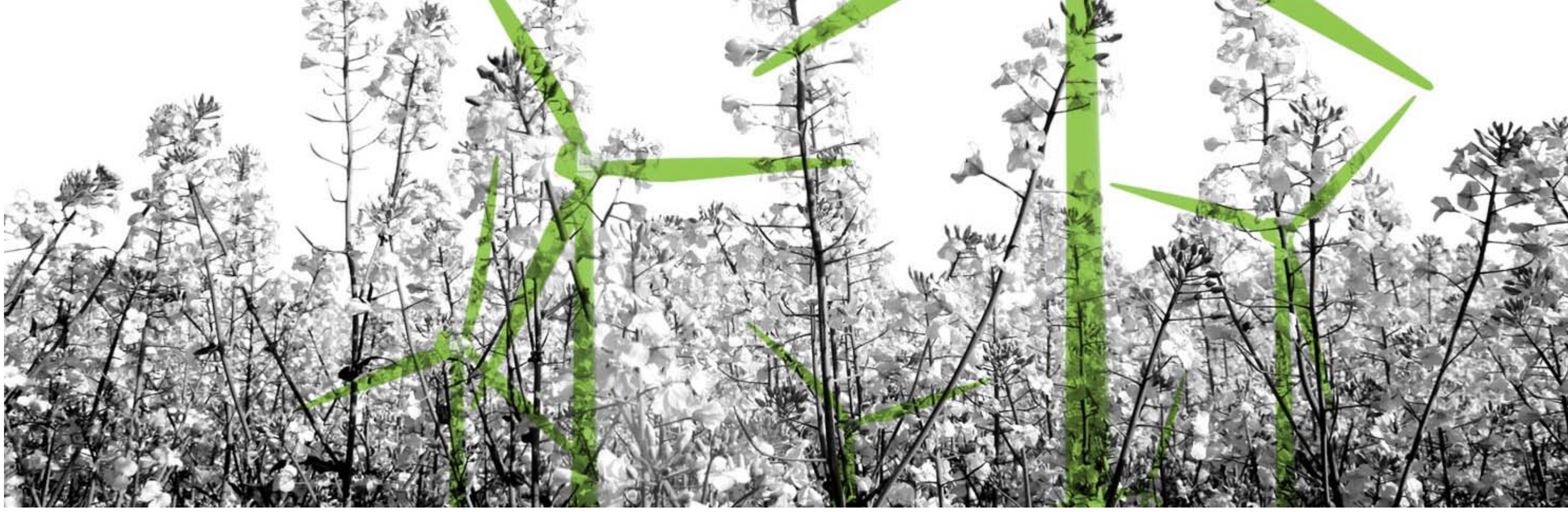
[16] Putting a price on sustainability (BRE Trust and Cyril Sweett, 2005)
[17] Putting a price on sustainable schools (BRE Trust and Faithful & Gould, 2008

‘Very Good’ level of BREEAM is achievable with a small increase to build costs, while the costs associated with BREEAM ‘Excellent’ are much more significant. We are not aware of any published cost data on meeting BREEAM office targets since 2004, certainly none is yet available showing the costs of delivering BREEAM Offices 2008, which contains a number of fairly significant changes, compared with earlier BREEAM versions.



Costs (over base construction cost) for delivering BREEAM Offices (2004) and BREEAM schools ratings. (Source: Putting a price on sustainable schools (BRE Trust and Faithful & Gould, 2008)



Recommendations

9 Recommendations

9.1 Suggested Policy

- All developments should maximise energy efficiency as the first step in minimising CO_2 emissions, in line with London Plan policy 4A.3.
- The Council will seek to maximise the opportunities for creating and expanding decentralised energy networks and will expect all major schemes (residential developments over 10 dwellings or other developments with a total floor space of over 1,000m^2) to support this by following the hierarchy of energy delivery set out in the London Plan policy 4A.6.
- All major developments should aim to reduce predicted CO_2 emissions by 20% through the use on on-site renewable energy generation, in line with London Plan policy 4A.7.
- Non-domestic schemes of greater than 1000sqm will be required to achieve a BREEAM rating of at least 'Very Good'
- Residential developments will be required to achieve the mandatory energy requirement for 'Level 3' of the Code for Sustainable Homes up to 2010 (equivalent to a 25% improvement over Building Regulations 2006) and 'Level 4' from 2010 (equivalent to a 44% improvement over Building Regulations 2006).

It should be noted that for the last two policy options, this study has only looked at the energy criteria of the assessment methodologies.

The policy in the Core Strategy should be supported by detailed policies in Development Management Documents (DPDs) and a Sustainability Planning Document (SPD) on Sustainable Design and Construction providing more details of each of these policies and outlining the methodology required for applicants to demonstrate that proposed development will meet the requirements and targets.

9.2 Broader Recommendations

- Energy efficiency should be promoted as the first step in line with London Plan policy. It is important that, by implementing a policy to deliver low and zero carbon energy generation, the potential to implement energy efficiency measures should be maximised. This will reduce the energy consumption of the dwelling and thereby reduce CO_2 emissions and fuel costs for consumers. Developers should be instructed to demonstrate that reasonable measures have been taken to reduce energy through efficiency and passive design.

- Sites where CHP is possible are key to the creation of wider district energy networks within the Borough and therefore planning requirements, specifically the hierarchy of heat delivery outlined in London Plan Policy 4A.5, should be enforced. Developments which do not propose to include CHP should be required to demonstrate the technical reasons for non-compliance with the policy.
- Sites where decentralised energy networks are being installed should consider the potential to make connections to nearby buildings where there is sufficient load to make it economically viable. The Council should seek to facilitate this, either by:
    - Highlighting the potential neighbouring sites to developers and, where they are council-owned, assess the current energy systems and provide the required information on energy demands to allow feasibility assessments to be undertaken.
    - Providing economic incentives, either financial contributions through the CIL or negotiations on a s106 agreement, to make such connections viable in terms of the initial capital expenditure.
- Sites where future decentralised energy networks are possible, but which for technical reasons cannot support CHP in isolation, should be developed with communal heating systems to make them compatible with future networks in line with London Plan Policy 4A.5.
- Sites within conservation areas should be assessed by planning officers to provide developers with clear guidance on ways of maximising the potential to incorporate energy efficient design measures and low and zero carbon technologies, particularly solar, without compromising the local conservation designation.
- The Council should assess or seek guidance on the implications of an increase in biomass heating within the Borough and provide clear guidance to the steps that developers must take and requirements they must meet if seeking to incorporate such technology. Issues that will need to be considered are:
    - Implications on air quality and clarification on the appropriate methodology for scoping and modelling studies to assess the implications of a proposed installation.
    - Standards required for the installation and details that must be provided with the planning application covering issues such as system specification, fuel source, delivery arrangements and flue height.
    - If considered necessary, clear designation of areas where such technologies would not be appropriate.
- The scope of this study has been limited to strategic sites and the planning approaches appropriate to these. However, in order to take advantage of wider opportunities in the Borough the Council should continue to explore and refine the potential for district

networks and appropriate delivery mechanisms as part of a further, borough-wide study. This should consider:

- The relationship with and opportunities presented by activities in neighbouring boroughs and by pan-London bodies, including the GLA and LDA.
- The role of corporate and other strategic policies, such as the Sustainable Community Strategy, in supporting planning policy.
- The full range of delivery mechanisms available to the Council, both planning and non-planning, including: powers to establish and fund energy companies; Local Development Orders; the Community Infrastructure Levy; and community ownership and delivery.
- The role of planning in helping developers to meet their 2016 zero carbon homes obligations by identifying appropriate ‘allowable solutions’.