Energy Strategy
Kay Court,
368 – 372 Finchley Road,
NW3

Prepared by

metropolis green

On behalf of

Jewish Care

August 2011

Ref: 5091/ES - 1108SK.00

Prepared by Metropolis Green

On behalf of Jewish Care

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EXECUTIVE SUMMARY

i. This energy strategy has been prepared on behalf of Jewish Care for the proposed scheme at Kay Court, in support of a full planning application.

ii. This document demonstrates how the development will progress to achieving the London Borough of Camden’s core policy.

iii. The development will specify low carbon as well as renewable energy technologies in order to achieve the London Plan renewables targets and the Code for Sustainable Homes (Code) Level 3 standard required in local policy.

iv. The site is situated on Finchley Road and was until recently a care home operated by Jewish Care.

v. Positioned near a main distributor road (Hendon Way/Finchley Road) and priority bus route to Finchley Road Station while within walking distance of Cricklewood National Rail Station, with a PTAL rating of 4, surrounded by residential properties, the site is well served and appropriate for residential use.

vi. The site is surrounded to the north, south and east by existing 3-storey semi-detached housing, and to the west with a mix of 4-5 storey housing and Commercial on Finchley Road. The wider surrounding area provides access to a variety of facilities, shops and convenience stores within the area.

vii. The site is adjacent to Redington and Frognal Conservation area, which has predominantly early 20th century modest Arts and Crafts houses designed by the Architect Charles Quennell and developer George Hart. The existing buildings on the site are neither listed nor locally listed.

viii. The proposal includes demolition of the existing buildings and provide a new high quality residential scheme incorporating a mix of both private and affordable residential unit sizes all with private or communal amenity space. The private units will be a mix of 11 x 2 bed and 18 x 3 bed units, while the affordable consists of 3 x 1 bed, 2 x 2 bed and 1 x 3 bed units.

ix. The scheme consists of two separate blocks, the south block being the larger of the two to accommodate the private residential. The perimeter of the blocks follows the line of the existing footprint with a basement car park for the private block.

x. In addition to integrating low and zero carbon technologies on the site, the design team have worked to ensure that Kay Court has been designed to high sustainability standards by implementing a range of measures to ensure that the site is sustainable in construction and operation/occupation. These measures are set out in the Sustainable

Design and Construction Statement (ref: 5091/SDCS-1108TP.00) produced by Metropolis Green.

xi. This energy strategy follows the energy hierarchy: Be Lean, Be Clean, and Be Green. A range of low carbon and renewable energy technologies have been assessed in this energy appraisal in order to establish the most suitable energy solution for the site.

xii. The results of calculations which have been undertaken in line with the 'energy hierarchy' have enabled significant carbon reductions to be achieved. These reductions can be summarised as follows;

- A 11.62% (15,435 kgCO_2/yr) reduction associated with proposed energy efficiency measures.
- A 4.75% (5,581 kgCO_2/yr) reduction associated with proposed low carbon measures.
- Photovoltaics have been determined to be the preferred renewable energy technology for to the site, resulting in a further reduction of 11.07% (12,349 kgCO_2/yr).

xiii. This report demonstrates that an overall total carbon emission reduction of 25.12% can be achieved from the Notional Baseline as a result of this energy strategy as well as contributing to the 11.07% carbon reduction from on-site renewables.

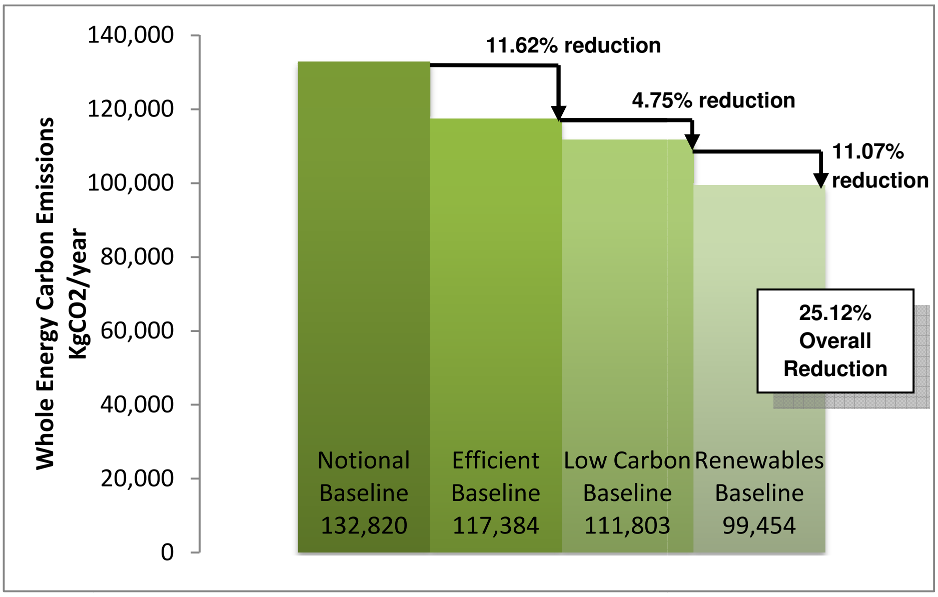
xiv. This report shows that the new units achieve a 43.77% Dwelling Emission Rate (DER) over Target Emission Rate (TER) improvement which exceeds the mandatory requirements of the Code, Ene 1 – Dwelling Emission Rate issue, contributing to the achievement of Code Level 3.

xv. Additionally, in the context of the London Plan 2011, the DER over TER improvements of 43.77% which significantly exceed the 25% improvement on 2010 Building Regulations target set for the 2010 – 2013 period.

xvi. Figure 1 shows an 'at a glance' summary of the 'Be Lean, Be Clean and Be Green' CO_2 reductions for the modelled solutions. A more detailed breakdown of emissions by category stage and emissions reductions for each stage of the 'energy hierarchy' can be found in Table 10: Energy Hierarchy Summary on page 59.

xvii. The scope for CO_2 reduction using renewables is limited by the amount of available roof space, nonetheless, the size and output of the PV array has been maximised. Although the modelled PV array utilises the entire roof space, the London Plan and London Borough of Camden policy requirements for a 20% reduction in CO_2 emissions through the specification of renewables has not been met, although an 11.07% carbon reduction from on-site renewables has been acheived. It should be noted that it is possible to achieve a total 'whole energy' CO_2 reduction from the Notional Baseline of 25.12%.

Figure 1: Whole Energy Carbon Emission Reductions



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CONTENTS

1.0 INTRODUCTION

1.1 Metropolis Green has been appointed by Jewish Care to prepare an energy strategy for the proposed scheme at Kay Court, demonstrating how the relevant planning policies will be achieved.

1.2 This report firstly assesses the energy efficiency measures of the proposed scheme, and then examines low carbon options for supplying energy to the development, before examining the potential for renewable energy technologies to reduce carbon emissions.

1.3 This document should be read alongside the Sustainable Design and Construction Statement report also produced by Metropolis Green.

2.0 SITE AND DEVELOPMENT DESCRIPTION

2.1 The site is situated on Finchley Road and was until recently a care home operated by Jewish Care.

2.2 Positioned near a main distributor road (Hendon Way/Finchley Road) and priority bus route to Finchley Road Station while within walking distance of Cricklewood National Rail Station, with a PTAL rating of 4, surrounded by residential properties, the site is well served and appropriate for residential use.

2.3 The site is surrounded to the north, south and east by existing 3-storey semi-detached housing, and to the west with a mix of 4-5 storey housing and Commercial on Finchley Road. The wider surrounding area provides access to a variety of facilities, shops and convenience stores within the area.

2.4 The site is adjacent to Redington and Frognal Conservation area, which has predominantly early 20th century modest Arts and Crafts houses designed by the Architect Charles Quennell and developer George Hart. The existing buildings on the site are neither listed nor locally listed.

2.5 The proposal includes demolition of the existing buildings and provide a new high quality residential scheme incorporating a mix of both private and affordable residential unit sizes all with private or communal amenity space. The private units will be a mix of 11 x 2 bed and 18 x 3 bed units, while the affordable consists of 3 x 1 bed, 2 x 2 bed and 1 x 3 bed units.

2.6 The scheme consists of two separate blocks, the south block being the larger of the two to accommodate the private residential. The perimeter of the blocks follows the line of the existing footprint with a basement car park for the private block.

3.0 POLICY CONTEXT

3.0.1 Increased development of renewable energy resources and improvements in energy efficiency are vital to facilitating the delivery of the European, National, Regional and Local commitments on climate change. The relevant policy drivers applicable to new developments are as follows.

3.1 European Policy

European Union Energy Performance in Buildings Directive (2002)

3.1.1. The European Parliament passed the Energy Performance in Buildings Directive in December 2002, requiring member states to promote improved energy use in all buildings.

3.1.2. Article 5: requires minimum standards for energy performance and consideration of low/zero-carbon technologies in new buildings. This requirement is to be met through Part L of the 2006 Building Regulations.

3.2 National Policy

3.2.1 Planning Policy Statement notes (PPS's) set out the Government's national land use planning policies for England. Three of these notes, PPS 1 'Delivering Sustainable Development', PPS 22 'Renewable Energy', and the recently published PPS on Planning and Climate Change (supplement to PPS1) are particularly relevant to the development.

PPS1 Delivering Sustainable Development

3.2.2 Promotion of renewables is covered by the following statement: “Development plan policies should seek to minimise the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources, rather than making new demands on the environment; and should seek to promote and encourage, rather than restrict the use of renewable resources (for example, by the development of renewable energy).”

PPS Planning and Climate Change (supplement to PPS1)

3.2.3 Paragraph 20 states that: “Planning Authorities should: expect a proportion of the energy supply of new development to be secured from decentralized and renewable or low-carbon energy sources.”

3.2.4 Decentralized is defined as a diverse range of technologies, including micro-renewables, which can locally serve an individual building, development or wider community and includes heating and cooling energy.

PPS22 Renewable Energy

3.2.5 Paragraph 8 states that: “Local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments. Such policies:

(i) should ensure that requirement to generate on-site renewable energy is only applied to developments where the installation of renewable energy generation equipment is viable given the type of development proposed, its location, and design;

(ii) should not be framed in such a way as to place an undue burden on developers, for example, by specifying that all energy to be used in a development should come from on-site renewable generation.”

3.3 Building Regulations

3.3.1 Building Regulations exist to ensure the health, safety, welfare and convenience of people in and around buildings, and the energy efficiency of buildings. The regulations apply to most new buildings and many alterations of existing buildings in England and Wales, whether new, commercial or industrial.

3.3.2 The Building Act 1984 is the enabling Act under which the Building Regulations have been made. The Secretary of State, under the power given in the Building Act 1984, may for any purposes of:

- securing the health, safety, welfare and convenience of persons in or about buildings and of others who may be affected by buildings or matters connected with buildings;
- furthering the conservation of fuel and power
- preventing waste, undue consumption, misuse or contamination of water
- furthering the protection or enhancement of the environment
- facilitating sustainable development, or
- furthering the prevention or detection of crime
- make regulations with respect to the design and construction of buildings, demolition of buildings, and the provision of services, fittings and equipment in or in connection with buildings.

3.3.3 Approved Document Guidance on how to meet the functional 'requirements' of the Building Regulations, are contained in the Building Regulations - "Approved Documents"

3.3.4 Building Regulations 2010 Approved Documents Part L1A: “Conservation of Fuel and Power in Existing Dwellings” and Part L2A “Conservation of Fuel and Power in New Buildings Other Than Dwellings” require that the minimum energy performance requirement for new buildings are exceeded, however they do not currently require the installation of renewable energy technologies.

3.3.5 Approved Documents Part L1A and L2A also require that fabric performance and services comply with minimum standards.

3.4 Regional Policy

3.4.1 In London, the Mayor has established policies and strategies relating to renewable energy use in London.

London Plan

3.4.2 The London Plan (2011) is the Spatial Development Strategy for London. Section 5 of the Plan covers the mitigation of, and adaptation to climate change and the management of natural resources. The London Plan supports the Mayor's Energy Strategy. The key policies regarding energy efficiency and renewables in new developments are summarised below.

Policy 5.1 - Climate Change Mitigation

3.4.3 The Mayor seeks to achieve an overall reduction in London's carbon dioxide emissions of 60 per cent (below 1990 levels) by 2025. It is expected that the GLA Group, London boroughs and other organisations will contribute to meeting this strategic reduction target, and the GLA will monitor progress towards its achievement annually

Policy 5.2 - Minimising CO_2 Emissions

3.4.4 A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

3.4.5 B. The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Policy 5.5 - Decentralised Energy Networks

3.4.6 A. The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralized energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

3.4.7 D. As a minimum boroughs should require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

Policy 5.6 - Decentralised Energy In Development Proposals

3.4.8 A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

3.4.9 B. Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks

2. Site wide CHP network

3. Communal heating and cooling.

3.4.10 C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7 - Renewable Energy

3.4.11 A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

3.4.12 B. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

3.4.13 Individual development proposals will also help to achieve these targets by applying the energy hierarchy in Policy 5.2. There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps.

3.4.14 The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal.

Policy 5.9 - Overheating and Cooling

3.4.15 A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

3.4.16 B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design

2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls

3. manage the heat within the building through exposed internal thermal mass and high ceilings

4. passive ventilation

5. mechanical ventilation

6. active cooling systems (ensuring they are the lowest carbon options).

3.4.17 C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

3.5 Local Policy

3.5.1 Camden's Core Strategy sets out the key elements of the Council's planning vision and strategy for the borough. It is the central part of Local Development Framework (LDF) and was adopted in November 2010. The LDF is a group of documents setting out the boroughs planning strategy and policies.

3.5.2 The Core Strategy contributes to achieving the vision and objectives of Camden's Community Strategy and helps the Council's partners and other organisations deliver relevant parts of their programmes. It covers the physical aspects of location and land use but also addresses other factors that make places attractive, sustainable and successful, such as social and economic matters. It plays a key part in shaping the kind of place Camden will be in the future, balancing the needs of residents, businesses and future generations.

3.5.3 Within the Core Strategy there are specific policies relating to sustainability

3.5.4 The Core Strategy sets out the Council's approach to managing Camden's growth so that it is sustainable, meets our needs for homes, jobs and services, and protects and enhances quality of life and the borough's many valued and high quality places. This section focuses on delivering the key elements of our strategy relating to:

- making Camden more sustainable and tackling climate change, in particular improving the environmental performance of buildings, providing decentralised energy and heating networks, and reducing and managing our water use;
- promoting a more attractive local environment through securing high quality places, conserving our heritage, providing parks and open spaces, and encouraging biodiversity;
- improving health and well-being;
- making Camden a safer place while retaining its vibrancy; and
- dealing with our waste and increasing recycling.

3.5.5 The implications of our actions on the environment are increasingly clear and action is needed at global, national and local levels. The Core Strategy has an important role in reducing Camden's environmental impact and achieving sustainable development – meeting our social, environmental and economic needs in ways that protect the environment and do not harm our ability to meet our needs in the future. A Sustainable Camden that adapts to a growing population is one of the elements in the vision in Camden's Community Strategy.

3.5.6 The Core Strategy Policy CS13 sets out the approach that developers should take when considering energy and carbon reductions for developments.

CS13 – Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

3.5.7 The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) promoting the efficient use of land and buildings;

c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

1. ensuring developments use less energy,
2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralized energy networks;
3. generating renewable energy on-site; and

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

3.5.8 The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation

3.5.9 The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them,

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Camden Planning Guidance Sustainability (CPG 3)

3.5.10 The Core Strategy is supported by Supplementary Planning Documents (SPDs) which play an important role in planning decisions. SPDs provide detailed guidance on how planning strategy and policies will be implemented for specific topics, areas and sites.

3.5.11 CPG 3 contains advice and guidance for developers on ways to achieve carbon reductions and more sustainable developments. It also highlights the Council's requirements and guidelines which support the relevant Local LDF policies

The energy hierarchy

3.5.12 All developments are to be designed to reduce carbon dioxide emissions.

3.5.13 Energy strategies are to be designed following the steps set out by the energy hierarchy.

Energy efficiency: new buildings

3.5.14 All new developments are to be designed to minimise carbon dioxide emissions.

3.5.15 The most cost-effective ways to minimise energy demand are through good design and high levels of insulation and air tightness.

3.5.16 All new developments are to be designed to minimise carbon dioxide emissions by being as energy efficient as is feasible and viable.

3.5.17 A full model of the building should be carried out to ensure the building design optimises solar gain and daylight without resulting in overheating for developments comprising 5 dwellings or more or 500sq m or more of any floorspace.

3.5.18 Consider maximising the use of natural systems within buildings before any mechanical services are considered.

3.5.19 Any development proposing electric heating (including heat pumps) will need to demonstrate the carbon efficiency of the proposed heating system. Specifications of the electric heating system and calculations will need to be provided to demonstrate that the proposed electric heating system would result in lower carbon dioxide emissions than an efficiency gas fuelled heating system.

3.5.20 Where traditional mechanical cooling e.g. air conditioning units are proposed applicants must demonstrate that energy efficient ventilation and cooling methods have been considered first, and that they have been assessed for their carbon efficiency.

3.5.21 NB: Air source heat pumps will be considered to provide air conditioning in the summer unless it can be demonstrated that the model chosen is not capable of providing cooling.

Decentralised energy networks and combined heat and power

3.5.22 Where feasible and viable development will be required to connect to a decentralised energy network or include CHP.

3.5.23 Once a development has been designed to be as energy efficient as possible (Energy hierarchy - Stage 1), developments will be required to consider the following steps, in the order listed, to ensure energy from an efficient source is used, where possible:

1. investigating the potential for connecting into an existing or planned decentralised energy scheme and using heat

2. installing a Combined (Cooling) Heat and Power Plant (CHP or CCHP), including exporting heat, where appropriate

3. providing a contribution for the expansion of decentralised energy networks

4. strategic sites are to allow sufficient accessible space for plant equipment to support a decentralised energy network

5. designing the development to enable its connection to a decentralized energy network in the future

Renewable energy

3.5.24 There are a variety of renewable energy technologies that can be installed to supplement a development's energy needs Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies

3.5.25 All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

3.5.26 When assessing the feasibility and viability of renewable energy technology, the Council will consider the overall cost of all the measures proposed and resulting carbon savings to ensure that the most cost effective carbon reduction technologies are implemented in line with the energy hierarchy.

4.0 ENERGY/CARBON CALCULATIONS

4.0.1 The proposed development at Kay Court must comply with a number of policies and regulations, which require the calculation of energy demand and carbon emissions. The calculation of energy demand and carbon emissions for each of the policies/standards is slightly different; this is discussed in the sections below.

- Building Regulations
- London Borough of Camden CS13 requirements
- Code for Sustainable Homes (Nov 2010)
- London Plan Policies 5.2, 5.5, 5.6, 5.7, 5.9

4.1 Building Regulations

4.1.1 On the first of October 2010 a new version of Part L came into force, Part L 2010. Kay Court will be registered for compliance with Part L1A and L1B 2010 and as such CO_2 calculations are based on the 2010 requirements.

4.1.2 Calculations have been performed in order to demonstrate both Building Regulations compliance and Code achievement using the National Calculation Methodology (NCM), Standard Assessment Procedure (SAP) software. Appendix A contains a full set of SAP calculation results for the development.

4.1.3 Building Regulations 2010 Approved Document Part L1A and L1B requires that the calculated CO_2 emission rate for the building. The DER, must not be greater than the TER. Compliance is determined by SAP calculations,

4.1.4 The TER is the minimum energy performance requirement for new building. It is expressed in terms of $kgCO_2$ per m^2 of floor area per year, emitted as a result of the provision of heating, hot water, ventilation and internal fixed lighting.

4.1.5 SAP gives reference values to define the notional building of the same size and shape as the actual building that is to be built. The DER calculations for the actual dwellings are based on:

- performance of the building fabric
- ventilation characteristics of the dwelling and ventilation equipment
- efficiency and control of the heating system(s)
- solar gains through openings of the dwelling
- the fuel used to provide space and water heating, ventilation and lighting
- renewable energy technologies

4.1.6 The contribution of renewable energy in reducing carbon emissions is taken into account when calculating the DER. To comply with Building Regulations the DER must be no worse than the TER. SAP Assessments are also necessary to show compliance with the Code which is detailed in the next section.

4.2 Code for Sustainable Homes (November 2010)

4.2.1 The element of the Code that deals with the calculation of energy and carbon dioxide is the first Issue - ENE 1: Dwelling Emission Rate.

4.2.2 Credits are awarded based on the percentage improvement of the DER score over the TER as calculated by the SAP Assessments.

4.2.3 The required percentage improvement of DER over TER increases with each Code Level, as illustrated by Table 1 below. It should be noted that Part L compliance 2010 is roughly equivalent to an improvement of 25% over Part L compliance 2006

Table 1: Mandatory requirements for ENE 1 – Dwelling Emission Rate

Criteria		
% Improvement 2010 DER/TER*1	Credits*2	Mandatory Requirements
≥ 8%	1	
≥ 16%	2	
≥ 25%	**3**	**Level 4**
≥ 36%	4	
≥ 47%	5	
≥ 59%	6	
≥ 72%	7	
≥ 85%	8	
≥ 100%	**9**	**Level 5**
Zero *Net CO_2 Emissions*	**10**	**Level 6**
Default Cases		
None		

*1 Performance requirements are equivalent to those in previous scheme versions but are now measured using the AD L1A 2010 TER as the baseline.

*2 Up to nine credits are awarded on a sliding scale. The scale is based on increments of 0.1 credits, distributed equally between the benchmarks defined in this table.

4.2.4 The SAP worksheets indicating the DER are necessary evidence for the Code Assessment to prove that this criterion has been met.

4.2.5 Credits are also available within the Code standard for carbon emission reduction through the use of low or zero carbon technologies in the ENE 7 issue. There is 1 credit available for carrying out a 10% reduction and 2 credits available for a 15% reduction. Credits are awarded based on the percentage reduction in total carbon emissions that result from using Low or Zero Carbon (LZC) Energy Technologies.

4.3 2011 London Plan - Policy 5.2 - Minimising CO_2 Emissions

4.3.1 The London Plan, section 5.2, sets out the methodology and targets for the journey towards zero carbon for domestic and non domestic buildings

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

B. The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Table 2 - Domestic Targets

Residential buildings:	
Year	**Improvement on 2010 Building Regulations***
2010 – 2013	25 per cent (Code Level 4)
2013 – 2016	40 per cent
2016 – 2031	Zero carbon

Table 3 - Non Domestic Targets

Non-domestic buildings:	
Year	**Improvement on 2010 Building Regulations***
2010 – 2013	25 per cent
2013 – 2016	40 per cent
2016 – 2019	As per building regulations requirements
2019 – 2031	Zero carbon

C Major development proposals should include a detailed energy assessment to demonstrate how the minimum targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, energy assessments should include the following details:

a calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy

b Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

c Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)

d Proposals to further reduce carbon dioxide emissions through the use of onsite renewable energy technologies.

4.3.2 E The carbon dioxide reduction targets should be met onsite. Where it is clearly demonstrated that the specific targets cannot be fully achieved onsite, any shortfall may be provided offsite or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

4.5 2011 London Plan - Policy - 5.7 Renewable energy

4.5.1 A The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

4.5.2 B Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

4.5.3 There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal.

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4.6.1 A The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

4.6.2 B Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1 minimise internal heat generation through energy efficient design

2 reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls

3 manage the heat within the building through exposed internal thermal mass and high ceilings

4 passive ventilation

5 mechanical ventilation

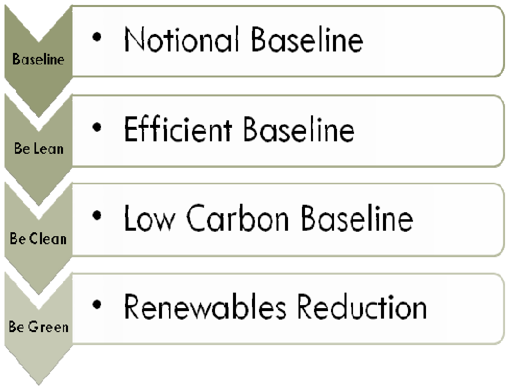
6 active cooling systems (ensuring they are the lowest carbon options).

4.6.3 C Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.

5.0 METHODOLOGY

5.1 The methodology that has been applied to this energy appraisal is in line with the Mayor's energy hierarchy of Be Lean and use energy efficiently, Be Clean and supply low carbon energy efficiently and Be Green and produce renewable energy. This is illustrated in Figure 2 below.

Figure 2: Energy Hierarchy



5.2 The Notional Baseline for the proposed development at Kay Court has been calculated using the approved national calculation methodology, SAP, as discussed in Section 4.1.

5.3 Improvements in the building fabric, lighting and performance of primary and secondary heating systems allowed for energy efficiency improvements to be achieved. These were also based on meeting best practice standards required to meet the required Code Level 3 standard. From the Notional Baseline, a new energy demand and carbon baseline is calculated, which will be referred to as the Efficient Baseline.

5.4 The London Plan requires that all new developments consider decentralised energy generation technology and communal heating systems. Combined Heat and Power technologies (CHP) and communal heating; hot water systems are examined in terms of their suitability for the site, which can reduce the Efficient Baseline further and it is to be referred to as the Low Carbon Baseline.

5.5 The reduction in carbon emissions from on-site renewables must then be investigated. This includes a feasibility appraisal of each of the approved renewable energy technologies in terms of their contribution to meeting the carbon reduction.

6.0 SITE ENERGY DEMAND & NOTIONAL BASELINE

6.1 The development at Kay Court has been modelled in compliance with the preferred approach and Metropolis Green has determined the energy and carbon data for heating and hot-water demand, lighting and fans and pumps using SAP approved software. In addition, the carbon emissions associated with appliances and cooking have also been calculated using the specified formulae in the SAP manuals. Full detailed results are provided in Appendix A of this report.

6.2 Table 4: Predicted Notional Baseline, provides a breakdown of the energy demand for Kay Court. The Notional Baseline is shown graphically in Figure 3 below.

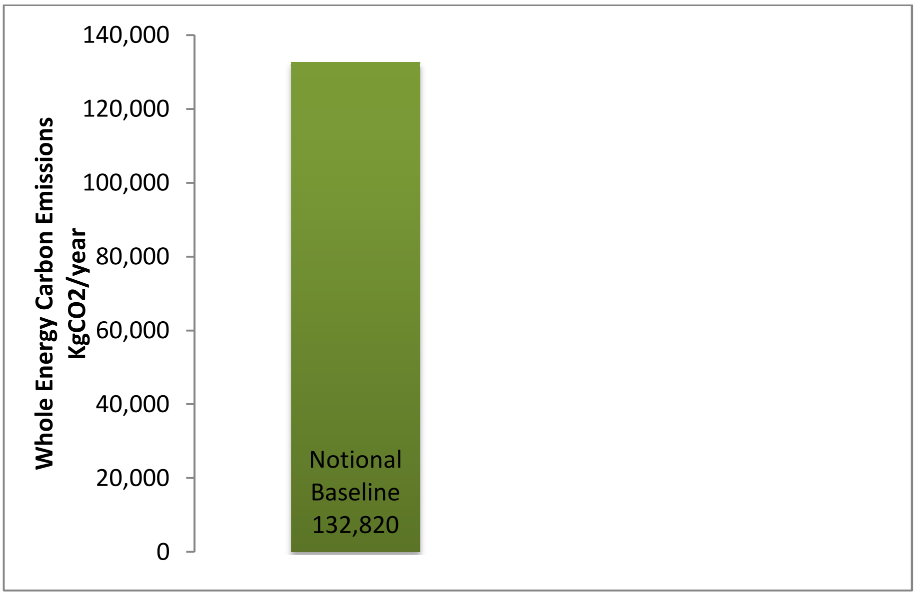
6.3 At this stage, no energy efficiency measures have been applied to this baseline. Improving the energy performance of the building is the next step, detailed in Section 7.0.

Table 4: Predicted Notional Baseline

Notional Baseline	Residential	Communal Areas
Space Heating Energy kWh/yr	143,414	0
DHW Energy kWh/yr	61,210	0
Cooling kWh/yr	0	0
Lighting Energy kWh/yr	12,660	30,372
Aux Energy kWh/yr	4,200	1,003
Un-Reg Energy kWh/yr	82,316	47,988
Carbon Emission KgCO_2/yr	91,789	41,030
Total Carbon Emission KgCO_2/yr	132,820	

6.4 Modelling of the Notional Baseline is undertaken using minimum allowable U-values and controlled system efficiencies as detailed in Part L approved documents. Values used are listed in Table 5.

Figure 3 - The Energy Hierarchy – Predicted Notional Baseline



6.5 Please note that all calculations in this report are based on drawings and information provided pre-planning approval, and as such should be considered subject to change. Modelling for the notional baseline has been undertaken using minimum allowable U-values and services as set out in Approved Document Part L1A. These results are intended to provide initial assessment of the design to ensure that planning policies, Code requirements can be achieved at this site, and to allow the client to determine the most cost effective solution(s) that will comply with all appropriate policies and standards applied to the site.. The actual energy and carbon figures will be determined at the detailed design stage by detailed SAP assessments with finalised drawings and services details.

7.0 BE LEAN – ENERGY EFFICIENCY MEASURES

7.0.1 Metropolis Green has been working with the project architects, Twenty First Architecture Ltd and the KUT Partnership to determine the most efficient and feasible way to reduce the carbon emissions of the development.

7.0.2 Minimising heat loss from the building fabric to avoid wasted energy is essential. Heat loss through walls, windows and surface areas of the building must be significantly lower than building regulations, requiring specifications with very low U-values. Heat loss through thermal bridges, where the continuity of insulation and/or the building envelope is broken, can be minimised through excellent workmanship and careful design, such as; removal of unnecessary structural elements, or insulation of structural elements, reducing window size (where appropriate), and through increased insulation.

7.0.3 The overall air tightness of the new building will meet best practice standards equating to a maximum permeability of $5m^3/hour/m^2$@50Pa. Improving the air tightness of a building results in the need for excellent ventilation which has been provided via highly efficient Mechanical Ventilation (MV) system.

7.0.4 The impact of the specified Efficient Baseline improvements have been calculated using SAP and the input parameters used to undertake these calculations are outlined in Table 5 below.

Input Parameters

7.0.5 Fabric efficiency measures are the most effective way of reducing carbon emissions from a building. Reducing the Notional Baseline DER in turn reduces the amount of low carbon technologies and renewables required to comply with regulations and policies, as well as lowering costs.

7.0.6 The U-values that have been used to achieve an improvement over the Notional Baseline to the Efficient Baseline are shown in Table 5 below.

Table 5 - Summary of Input Parameters for Notional and Efficient Baselines

Building Fabric and Services		
	Notional Baseline	**Efficient Baseline**
External Wall U-value:	0.25	0.13
Internal Heat Loss Wall U-value:	0.25	0.13
Party-Wall U-value	0.2	0.0 (Solid Party Wall)
Internal Heat Loss Floor U-value:	0.25	0.16
Ground Floor / Basement Floor U-value	0.25	0.16
Flat Roof U-value	0.20	0.16
Windows & Openings U-values	1.80	1.50
Building Regs 2010 Accredited construction details	No	Yes (As Built Stage)
Air Permeability	7.5 m3/m2.h	5.0 m3/m2.h
DHW System	Instantaneous Hot water frOm Combi Boiler.	Instantaneous Hot water from Combi Boiler.
Water Consumption	Total water use of not more than 125 litres/person/day	Total water use of not more than 125 litres/person/day
Space Heating System	LTHW Radiators heating throughout via Individual Condensing Gas Boiler. 88% Boiler Efficiency Control: Programmer + Room Stats + TRVs	LTHW Radiators heating throughout via Individual Condensing Gas Boiler. 90.3% Boiler Efficiency Control: Time and Temp Zone Control + Weather Compensator
Additional Heating System	-	-
Space Cooling System	-	-

Ventilation System	Natural Ventilation with Intermittent extract fans	Mechanical extract ventilation from all wetrooms and natural ventilation in other areas. Specific fan powers: down to 0.20 W/l/s
Windows	Fully Openable	Fully Openable
Energy Efficient Lighting (Residential):	75%	100%

7.0.7 Thermal bridging will be minimised in accordance with Accredited Construction Details, (detailed thermal bridging calculations will be performed once construction drawings are completed) and the target air permeability will be no greater than 5 $m^3/hour/m^2$

7.0.8 Further energy efficiency measures can also be applied to space heating and hot water production with mechanical ventilation, and heating system control features.

7.0.9 The design team have committed to going beyond the minimum low energy lighting requirements outlined in SAP and will specify 100% low energy space lighting.

7.0.10 As a result of the above measures and improvements, a new energy demand and carbon baseline has been calculated from the Notional Baseline which will be referred to as the Efficient Baseline and is detailed in Table 6 below.

7.0.11 This new Efficient Baseline completes the first stage of the Energy Hierarchy, to be lean and use energy efficiently, as illustrated by Figure 4 below.

7.0.12 The predicted 'Whole Energy' CO_2 reduction delivered through the efficiency measures equates to 15,435 $kgCO_2/yr$, (which is an 11.62% reduction) as a result of these efficiency measures. The improvement is illustrated in Figure 4 below. Please note this reduction is measured from the Notional Baseline and is across the 'whole energy' baseline which includes unregulated energy use. Additionally an 8.64% (3,456 $kgCO_2/yr$) reduction in CO_2 emissions can be achieved in the communal areas of Kay Court as a result of these efficiency measures.

7.0.13 Figure 5 below shows the percentage improvement of DER over TER which is the measure used to demonstrate compliance with London Plan policy 5.2 and Code Ene 1 requirements. The DER has been improved significantly by the specification of these fabric and service efficiency improvements.

7.0.14 In addition to these improvements SAP 2009 allows for a minimum of 75% energy efficient lighting in calculation of both the TER and DER, the design team have committed to going beyond this minimum and providing 100% low energy lighting, this will reduce the lighting energy demand by 21.82% (9,390 kWh/yr) when compared to the Notional Baseline.

Table 6 - Efficient Baseline Energy and Carbon Emissions

Efficient Baseline	Residential	Communal Areas
Space Heating Energy kWh/yr	94,915	0
DHW Energy kWh/yr	59,091	0
Cooling kWh/yr	0	0
Lighting Energy kWh/yr	10,128	23,514
Aux Energy kWh/yr	3,120	1,003
Un-Reg Energy kWh/yr	82,316	47,988
Carbon Emission $KgCO_2$/yr	79,900	37,485
Total Carbon Emissions $KgCO_2$/yr	117,384	
% Improvement over Notional Baseline	11.62%	
DER over TER % Improvement	7.22%	

Figure 4: Be Lean – 'Whole Energy' Efficient Baseline

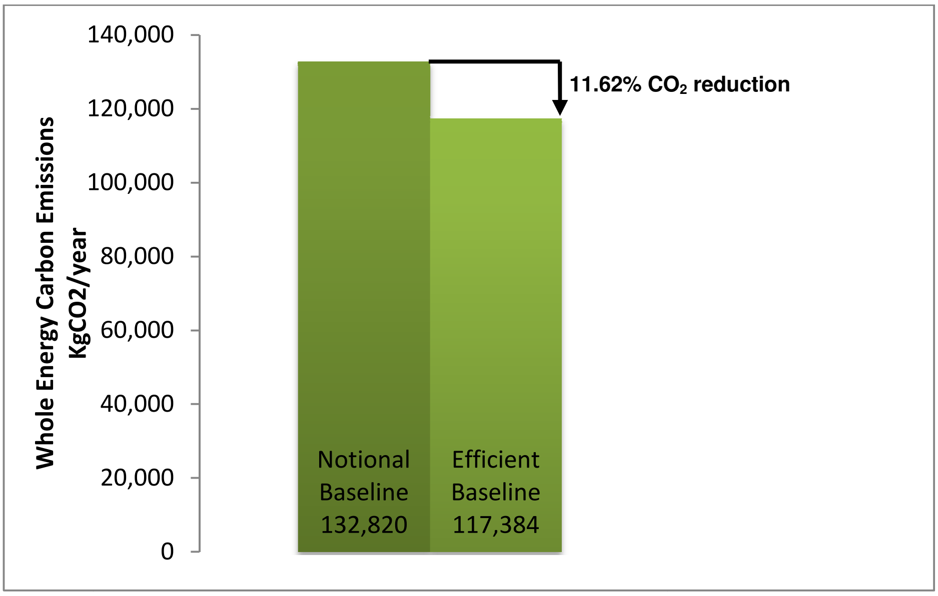
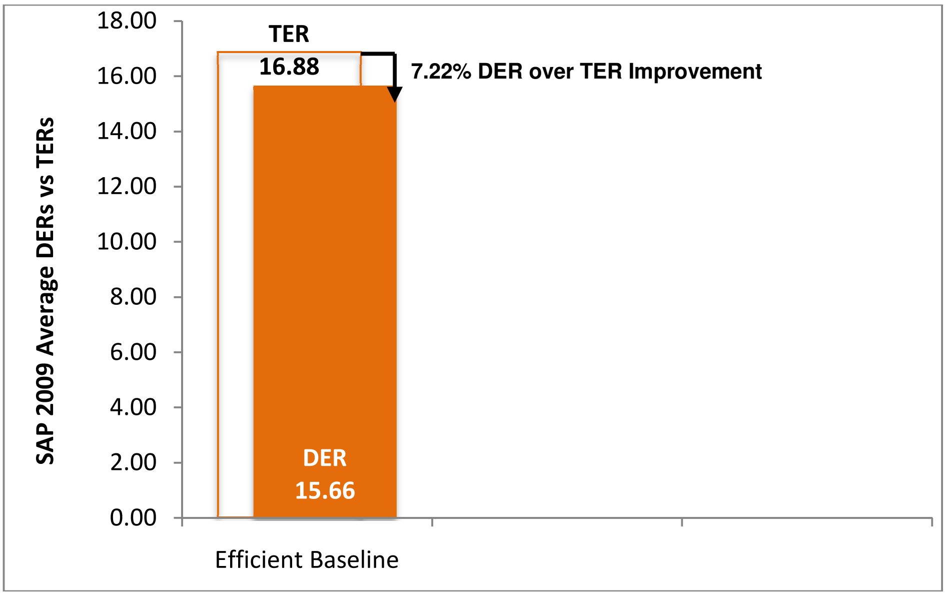


Figure 5: Efficient Baseline DER over TER Percentage Improvement



7.1 Overheating and Cooling

7.1.1 The design team have worked to ensure that the risk of summer overheating and reliance on air conditioning systems is minimised and demonstrate this in accordance with the following cooling hierarchy:

7.1.2 Internal heat generation has been minimised through energy efficient design. The proposals for Kay Court demonstrate that issues of potential overheating have been considered carefully and addressed through a combination of high levels of air-tightness and energy efficient design, with high levels of fabric performance and insulation resulting in very low U-values.

7.1.3 The amount of heat entering the buildings in summer has been reduced through taking advantage of the structure of the building and the shading that it offers as part of the design at Kay Court. The orientation of the building has been set by the existing buildings and street orientation, but the number and size of south facing windows have been minimised.

7.1.4 In terms of passive ventilation and cooling, most of the units on site have dual aspects, and will have fully openable windows, offering the opportunity for occupant control of cross ventilation. Green roofs have been specified and the proposal maintains the current garden planting which complies with London Plan policy, helping to maintain and improve the microclimatic performance of the site and helping to reduce the urban heat island effect.

7.1.5 No mechanical cooling will be specified at Kay Court, SAP 2009 calculations based on the planning drawings, performed for this energy strategy show that all dwellings comply with Appendix P: Assessment of internal temperature in summer, which assesses the likelihood of high internal temperatures during hot weather. Before any mitigation measures are applied, 13 dwellings at Kay Court fall into the 'medium' risk category and are likely to experience internal temperatures of ≥ 21.8℃ and ≤ 23.3℃ during the hottest days in July and August. When simple measures to mitigate these impacts are applied, such as specification of light-coloured internal blinds, the risk is reduced to 'slight' (internal temperatures of ≥ 21℃ and ≤ 21.7℃ during July and August).

7.1.6 Once detailed SAP calculations are performed using final construction drawings, risk of overheating will be reviewed and further measures to ensure that risks are minimised will be applied. These measures include internal blinds and solar control glazing.

8.0 BE CLEAN – COMMUNAL HEATING AND COMBINED HEAT & POWER

8.1 The third stage in the Mayors ‘energy hierarchy’ is to investigate the application of Combined Heat and Power (CHP) to the site, to produce energy more efficiently with the aim of reducing the carbon baseline further.

8.2 Development proposals should evaluate the feasibility of (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites. Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling.

8.1 Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

8.2 The Mayor requires that all new developments consider CHP, a decentralised energy generation technology before renewables are applied to the site. Building up a network of mini-power stations that are far more efficient than traditional centralised power stations is an important part of the Mayor’s overall strategy to move London towards its long term carbon reduction targets.

8.3 CHP is an engine which produces electricity. The process of creating the electricity produces heat as a by-product. Heat can be easily stored in a thermal storage tank and distributed across the site to provide for the hot water demands of the site. The heat can also provide for some space heating within a development.

8.4 The Mayor’s Hierarchy relating to London Plan Policies 5.5 and 5.6 expects 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 renewable energy technologies

- communal heating and cooling fuelled by renewable sources of energy
- gas fired communal heating and cooling

Application to Site – CHP – Feasible

Feasibility

8.5 A site-wide CHP solution has been investigated and found to be suitable for this site. The proposed CHP solution delivers a significant proportion of the overall savings, resulting in a 11.62% CO_2 reduction from the Notional Baseline and 4.75% from the Efficient Baseline.

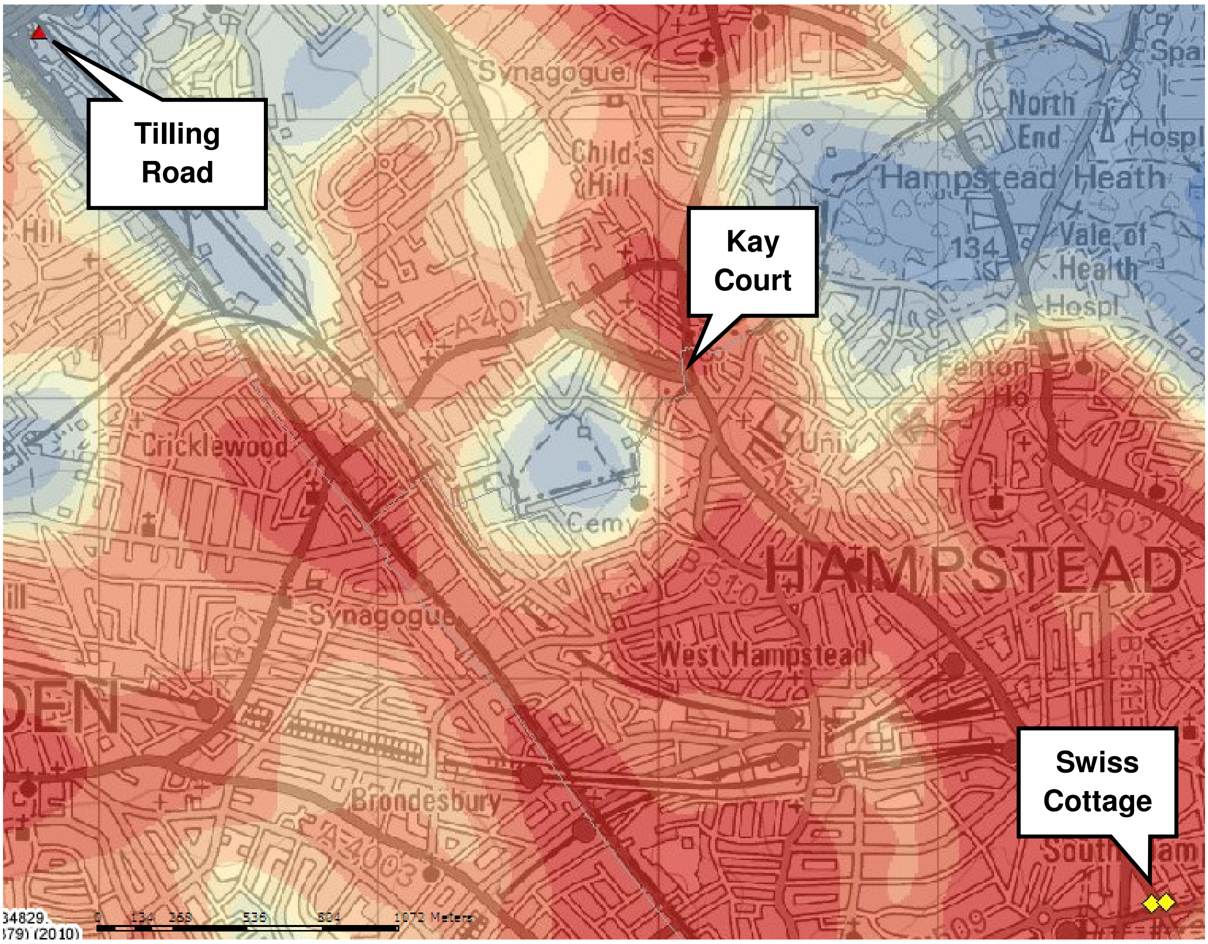
Local Connection

8.6 An investigation of the area was undertaken using the London Heat Map tool to determine opportunities to connect to existing heat infrastructure.

8.7 Investigation into existing heat networks in the area using the London Heat Map have shown that the nearest existing CHP installations are located at Swiss Cottage and there is a proposed site at BXC site at Tilling Road, both of these sites are over 2.5 km distant. Serious consideration has been given to connection to the existing CHP installations but it has been determined that connection to either of these facilities is not feasible due the distance between the sites (see Figure 6 below, CHP sites depicted by yellow diamonds, proposed by red triangles). Additionally the cost involved in infrastructure works would be extremely high and would include not only the cost of digging the roads and laying pipes but would be very disruptive to the local area in terms of road closures.

8.8 There is not currently a local heat network into which heat can be exported.

Figure 6 - London Heat Map Indicating CHP Sites and District Heat Networks



8.9 Although the research shows that there is not currently any opportunity to connect to a local heat network or CHP, calculations demonstrate that gas CHP is a feasible technology at this site and is ideal to meet the hot water demand. As such it is the preferred technology for the Low Carbon Baseline.

Energy and CO_2 Reductions

8.10 Specification of CHP reduces the CO_2 emissions by 5,581 kg per year and equates to a 11.62% CO_2 reduction from the Notional Baseline and 4.75% CO_2 reduction from the Efficient Baseline and is detailed in Table 7 below.

8.11 The CHP system helps to further reduce the average DER, as shown in Figure 8. The DER over TER improvement is now 15.82%, contributing to achieving and exceeding the mandatory minimum Code, Ene 1 requirements for Level 3.

8.12 The final Low Carbon and Renewables Baselines and related CO_2 emissions reductions will be determined at the detailed design stage by detailed SAP assessments with finalised drawings and services details.

Table 7: Energy and Carbon Emissions with CHP

Low Carbon Baseline	Residential	Communal Areas
Space Heating Energy kWh/yr	55,115	0
DHW Energy kWh/yr	34,277	0
Cooling kWh/yr	0	0
Lighting Energy kWh/yr	10,128	23,514
Aux Energy kWh/yr	1,490	1,003
Un-Reg Energy kWh/yr	82,316	47,988
Carbon Emission $KgCO_2/yr$	74,318	37,485
Total Carbon Emissions $KgCO_2/yr$	111,803	
% Improvement over Notional Baseline	11.62%	
% Improvement over Efficient Baseline	4.75%	
DER over TER % Improvement	15.82%	

Figure 7: Be Clean – Low Carbon Baseline

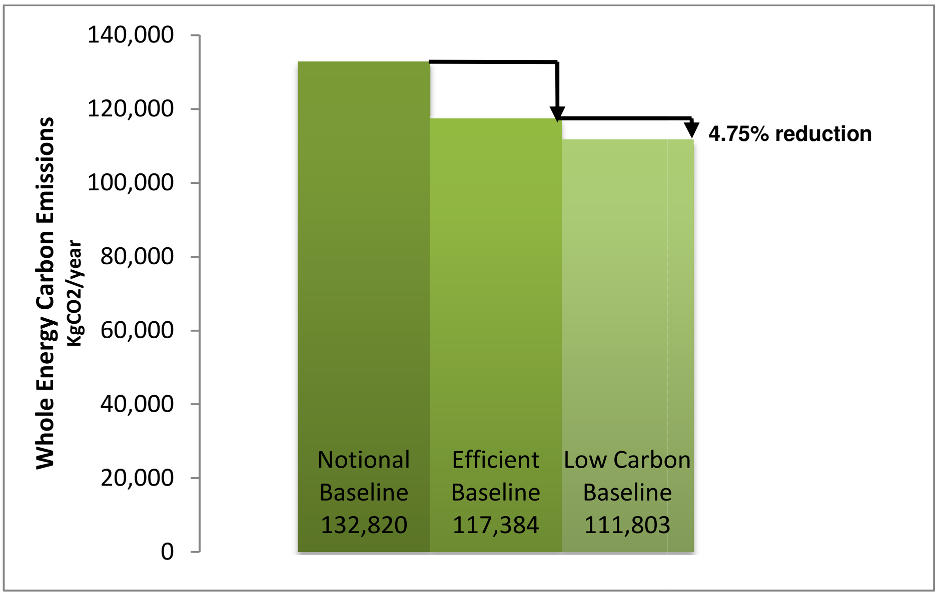
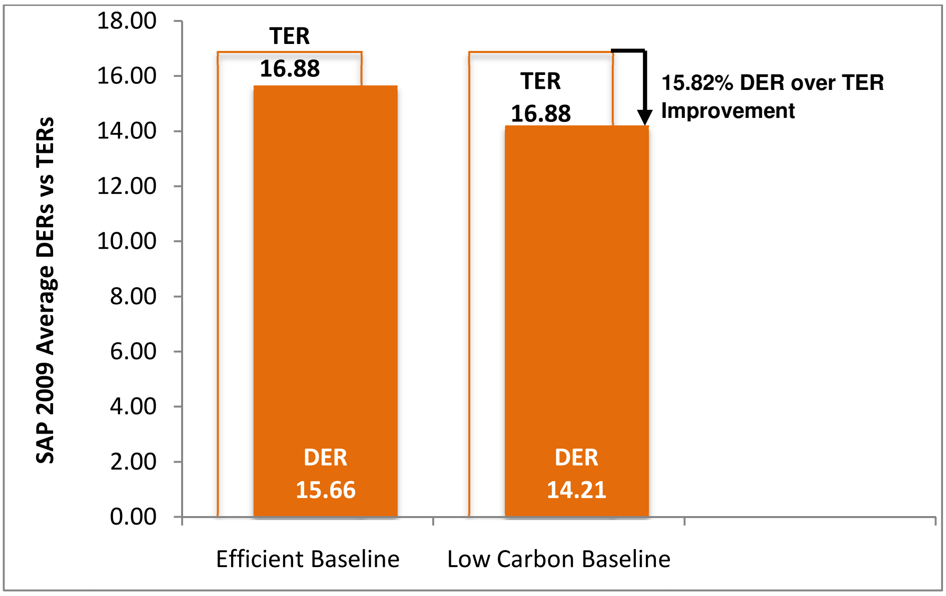


Figure 8: Low Carbon Baseline DER over TER Percentage Improvement



Plant Selection

8.13 CHP will supply heat to meet the space and hot water baseline demand of the site, a range of options are available at this site when considering CHP system specification and design which include the CHP providing part or all of the baseload heat demands of the site. Additionally a range of CHP plant and technology options are available dependant on the final load and can be modeled at detailed design stage.

8.14 The CHP electrical output will supplement the sites electricity requirement and its waste heat collected and connected to Low Temperature Hot Water (LTHW) buffer vessels for provision of space and new hot water.

8.15 Modelling for this site has been carried out based using a Baxi Dachs 5.5kWe CHP engine which is deemed suitable to meet the requirements for this development (including a buffer vessel and associated plant to store heat at periods of low demand).

8.16 The CHP engine is likely to be located in the basement plant room indicated in plans to the south east corner of the basement.

8.17 The CHP is likely to be sized to provide the base load space heating and new hot water demand.

Backup System

8.18 To ensure continuity of domestic hot water and space heating supply high efficiency gas fired condensing communal gas boilers are recommended as a backup, these will be connected to plate heat exchangers downstream of the LTHW buffer vessels and will be installed to provide back-up during times of peak demand and during periods where the CHP system is undergoing maintenance.

Other Equipment Required

8.19 Alongside the CHP engine, buffer vessels and associated pumps fans, heat interface units and meters will be required.

8.20 The heating arrangement will include boiler manifold kits, primary circulation pump and low loss header, pressurisation unit, expansion vessel, dosing pot and all associated valves and controls on the LTHW primary side. The secondary side will include a pumped landlord's heating circuit, and pumped supply to the hot water calorifiers both fed from the low loss header arrangement.

8.21 Space heating to the apartments will be served by the landlord's heating circuit, up through the service riser and onto each floor, where it will connect to an indirect community heat interface unit (HIU) in each flat, typically mounted at 750mm or greater above finished floor level in the utility cupboards.

8.22 The HIU's will provide heating to each flat in the form of wet radiator or underfloor heating circuits, using copper pipework or certified plastic pipe systems as an alternative.

Plant Location / Land Use

8.1 The CHP plant will be located in the basement plant room indicated in plans to the south east corner of the basement. As all required plant can be accommodated within the site and no additional land is required for this technology. The plant room will contain the CHP system, communal heating boilers and thermal store facilities.

8.2 The plant room will be laid out so that related plant items are located adjacent to each other. All equipment requiring maintenance or servicing will be situated in an accessible location so that they can be worked on safely.

8.3 Plant operation will be fully automatic and will run under the dictates of a control system.

Plant Maintenance

8.4 CHP plant will require regular, periodic maintenance and inspection. The unit will require a service after a predetermined number of hours. Units typically require between 6 and 10 services per annum dependant upon operation. The service procedures vary throughout the year from replacing and recalibrating components to oil and filter changes. The CHP unit uses natural gas as its fuel and is therefore subject to the Gas Safe regulations. The supplier offers two flexible maintenance packages

Additional Information

Noise / Disturbance Impact

8.5 Due to the preferred location of this technology and the manufacturers stated noise levels of 44dB, it is considered that due to location of the plant room, there will be a low risk of noise disturbance to building occupants or neighbours.

Planning Considerations

8.6 It should be noted that there are unlikely to be obstacles in obtaining planning permission for a CHP system for this site because provision of CHP is in line with London Plan requirements. As the CHP is gas fired there are unlikely to be any air quality issues associated with specification of the CHP.

Metering and Billing

8.7 Metering for functional areas within the building will be via the Heat Interface Unit (HIU) which will include M-Bus heat meters, Grundfos heating circulator, pressure differential switch, and all associated valves and controls. Heat metering will be connected back to an M-Bus monitoring system.

8.8 The HIUs should be installed to ensure easy access for reading. Billing to sub tenants will be undertaken by the management company (or ESCO, dependant upon final arrangements).

Exporting Electricity

8.9 Electricity generated through the operation of the CHP system that is not used within the landlords supply and communal areas would be sold into the local grid networks. Selling electricity via a private wire network to customers is highly regulated, and it is not current practice to allow electricity to be sold by one supplier to the consumer, therefore the clean electricity would be sold into the grid. The regulations for supplying heating and electricity are very different, and at this time it is only possible to sell heat to the communal network.

Importing/Exporting Heat

8.10 As mentioned above the option for exporting heat is not available at this site.

Enhanced Capital Allowance (ECA) and Capital Costs

8.11 The specified CHP system will qualify for ECA. To claim ECAs, a CHPQA certificate will need to be obtained. Most CHPQA Certificates record actual performance of the CHP scheme for the previous year. However, it is also possible to assess the design of new or upgraded schemes and certify their expected performance in operation.

8.12 In order to comply with Good Quality CHP scheme, two criteria will need to be met. The first criteria is the Quality Index (QI), which is an indicator for the energy efficiency and environmental performance of a scheme, relative to the generation of the same amounts of heat and power by separate, alternative means. The second criteria is the power efficiency, which governs the amount of annual power output by the CHP relative to its annual fuel input.

8.13 Based on 'The CHPQA Standard' published by the Department for the Environment, Farming and Rural Affairs (DEFRA), the threshold criteria for proposed new Good Quality CHP scheme capacity, at design, specification, tendering and approvals stages, are:

QI ≥ 105 at (Maxheat) and Power Efficiency ≥ 20%, both under Annual Operation

8.14 Qualifing CHP systems will be eligible for Enhanced Capital Tax Allowance at a corporation tax rate of 28%.

9.0 BE GREEN – RENEWABLE ENERGY TECHNOLOGY

9.0.1 The third stage of the energy hierarchy refers to the production of renewable energy, which relates to London Borough of Camden and London Plan policy.

9.0.2 Each of the approved renewable energy technologies have been appraised, examining the size and cost of each system required to maximise CO_2 reductions. The feasibility of each technology at the proposed site is also discussed in the following sections in order to determine the most suitable solution for the site.

9.0.3 London Plan approved renewable energy technologies include:

- Wind
- Photovoltaics
- Solar Water systems
- Biomass Heating / CHP
- Ground Sourced Heating / Cooling

9.0.4 The choice of technology will be dependent upon a range of factors including: orientation, height, window size, surrounding buildings and environment, site size and layout, geology, conservation and biodiversity.

9.0.5 The costs and sizing referred to in this report are approximate, based on preliminary data and market averages for fully installed systems, and are subject to change at the detailed design stage.

9.0.6 Analysis has shown that PV is the most suitable renewable technology reducing the Renewables Baseline to 99,454 by a predicted 12,349 $kgCO_2/yr$ from the Low Carbon Baseline of 111,803 $kgCO_2/yr$

9.0.7 A 11.07% reduction can be attributed to PV from the Low Carbon Baseline.

9.0.8 The total reductions equate to a 25.12% CO_2 reduction from the Notional Baseline due to Efficiency and Low Carbon measures combined with specification of PV.

9.1 Solar Photovoltaic (PV)

9.1.1 Photovoltaic systems convert solar energy directly into electricity through semiconductor cells. The panels generate electricity from both direct light and diffuse light. Photovoltaic panels can either be mounted external to the building or be integrated into the building cladding (known as Building Integrated Photovoltaic or BIPV).

Application to Site – Suitable

Feasibility

9.1.2 PV panels are the most feasible option for this site, offering the greatest CO_2 reduction in the space available.

Energy and CO_2 Reduction

9.1.3 It has been determined that PV panels can provide a total energy output of 23,344 kWh/yr at Kay Court.

9.1.4 Results of implementing the PVs are summarised in Table 9 below. The proposed solution will deliver an overall 25.12% CO_2 reduction ensuring that the site meets the Code Ene 1 – Dwelling Emission Rate issue criteria, meeting the mandatory requirements of this issue and contributing significantly to the overall achievement of a Code Level 3 rating.

9.1.5 With a total of 147 no. PV panels the electricity consumption of the development has been offset by a total of 23,344 kWh/yr, lowering the carbon emissions of the development by 12,349 $kgCO_2$/yr. The 'whole energy' carbon reduction is illustrated graphically in Figure 10 below.

Plant Selection

9.1.6 Careful consideration has been given to maximising the use of PV on site to both provide cheap renewable energy to the site and to meet London Plan and London Borough of Camden targets. Efforts have been made to ensure visual impact of PVs is minimised as well as ensuring appropriate placement for optimal orientation and functionality of the panels, and in keeping with the sensitive nature of the site. Figure 9 indicates the areas of roof that will carry PV.

9.1.7 The modelled PV system consists of 147no. 185Wp PV panels with an efficiency of 14.5%. This equates to a total PV system size of 27.20

kWp. The information shown in Table 8 below is extracted from manufacturers specification.

9.1.8 It is estimated that the PV system size of 147 PV panels will require approximately 188.16m^2 of roof space. A solar study has been undertaken for the roofs of the existing and new buildings to ensure that panels will not be overshadowed by building features of surrounding buildings, and the results of this study used to determined that there is the roof has sufficient space and is suitable for efficient placement and operation of the PV array.

Table 8 - PV system modelled

PV Make & Model	Cell Technology	Efficiency	Required area to produce 1kWp
AS-5M Amerisolar 185W	Mono-crystalline Silicon	14.5%	5.5 Panels

Plant Location / Land Use

9.1.9 Orientation and layout of the PV panels on the available roof space has been carefully investigated, and the number of PV panels has been maximised to make the best possible use of the space. As all panels will be situated on the roof of the building, there is no additional land use associated with this technology.

9.1.10 The modules should be tilted at an optimum angle of 35° in order to capture the maximum amount of solar energy. The minimum tilt angle is 10°, any less and the modules will not self clean, invalidating their warranty. The proposed PV arrangement is shown in Figure 9 below:

9.1.11 The modules will also need to be spaced at approximately 700mm to avoid over shading of neighbouring modules and to provide a walkway for safe installation and maintenance access. The diagram shown below indicates the proposed PV arrangement layout; final layout is subject to specialist sub contractor design and may differ from this layout.

9.1.12 The roof space will accommodate PV panels, at the detailed design stage, suitable PV panels and racking systems will be specified to ensure the efficient and effective use of the roof space. The roof space will be utilised to its maximum potential and will actively contribute to the carbon reduction and sustainable energy production of the proposed development.

9.1.13 Figure 9 on the following page indicates the areas of the roof that will carry PV.

Figure 9: Option for PV Panels Arrangement on Proposed Roof Layout

147 Amerisolar 185 Wp panels, tilted at 35 degrees, facing South

metropolis green

Backup Systems

9.1.14 Backup systems are not required as minimal maintenance is required to the PV panels and ancillary equipment. Should a total system failure occur, the grid will maintain the electrical supply.

Ancillary Equipment

9.1.15 PV systems require an inverter which converts the low voltage direct current electricity produced by the array of panels into 240V 50/60Hz alternating current.

9.1.16 Please also note that it is a legal requirement to use an Ofgem approved meter in order to collect revenue from the meter readings displayed or transmitted to a data collection system. In addition, for electricity supplies to new customers by a licensed supplier, an Ofgem approved and certified meter must be used. The meter will be housed inside the electrical services cupboards in the plant room and will be sited to ensure ease of access for maintenance or repair.

9.1.17 Meters will be housed inside the electrical services cupboards in the plant room.

9.1.18 All ancillary equipment will be sited to ensure ease of access for maintenance or repair.

9.1.19 Please note these arrangements are subject to change as the design progresses and will be finalised once a specialist contractor produces detailed designs at the detailed design stage.

Plant Maintenance

9.1.20 PV systems require minimal maintenance, as long as the panels are installed at or above the recommended angle they will self clean, there are no regular maintenance requirements for PV panels or the inverters. If panels are positioned at 35 degrees they will self clean, and monitoring of the system output will identify any panel problems or failures (monitoring can be remote/web based).

9.1.21 Inverters would be expected to be replaced after 12-13 years (we are working on a 25 year life based on feed in tariff incomes but PV panels will continue to provide output for up to 40 years (at a reduced level as output degrades over time)).

9.1.22 Inspection of the mechanical fixings to ensure that panels have not come loose due to fixings corroding etc will be required but does not require a specialist to undertake this and could be absorbed into the building inspection/maintenance programme.

Table 9: Energy and Carbon Emissions with PV

Renewables Baseline	Residential	Communal Areas
Space Heating Energy kWh/yr	55,115	0
DHW Energy kWh/yr	34,277	0
Cooling kWh/yr	0	0
Lighting Energy kWh/yr	10,128	23,514
Aux Energy kWh/yr	1,490	1,003
Un-Reg Energy kWh/yr	82,316	47,988
Carbon Emission $KgCO_2/yr$	61,969	37,485
Total Carbon Emission $KgCO_2/yr$	99,454	
% Improvement over Notional Baseline	25.12%	
% Improvement over Efficient Baseline	15.27%	
%Improvement over Low Carbon Baseline	11.07%	
DER over TER % Improvement	43.77%	

Figure 10: PVs Carbon Emissions Reduction

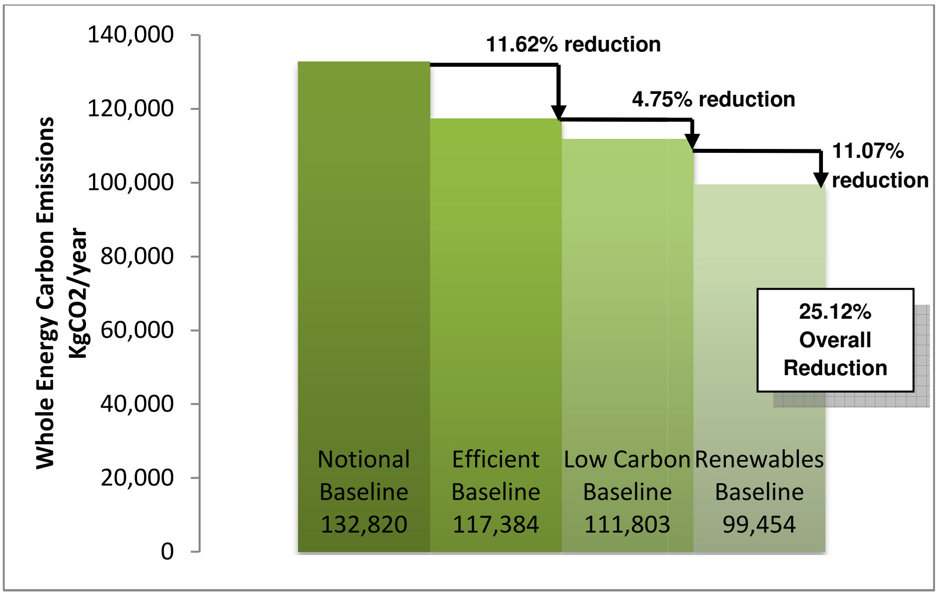
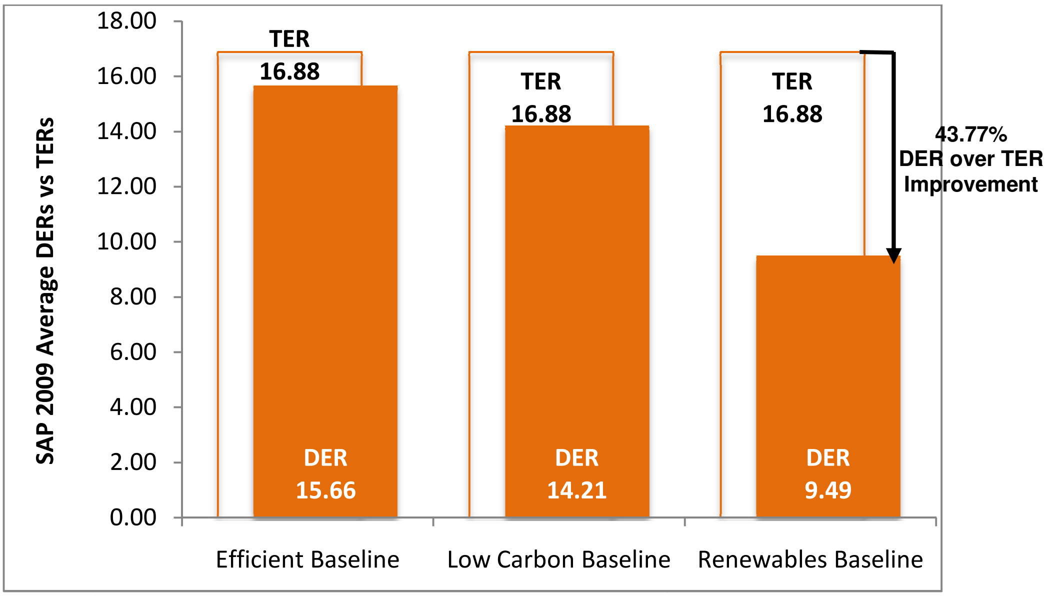


Figure 11: Renewable Baseline DER over TER Percentage Improvement



9.1.23 Figure 10 above shows the sites achievements towards the London Plan policy 5.7. Although the 20% CO_2 reduction via renewables target has not been met, the renewables provision on site has been maximised and further reductions are not available as the entire available roof space has been used for the PV array. Figure 11 above illustrates the percentage DER over TER improvement in line with the requirements of London Plan policy 5.2. The total DER over TER percentage improvement from the Notional to Renewable Baseline is

43.77% which exceeds the 25% improvement over 2010 regulations, showing that significant improvements are able to be achieved at this site.

Additional Information

Noise / Disturbance Impact

9.1.24 Due to the nature of this technology there will be no noise disturbance to occupants or neighbours caused by PV panels. Manufacturers information for inverters indicates operational noise levels of 33dB if installed correctly. This noise level in combination with the siting of inverters which will be housed inside the electrical services cupboards in the plant room will ensure no noise disturbance to occupants or neighbours.

Planning Considerations

9.1.25 Although there is a clear policy objective for provision of renewable technologies for new build projects to help reduce carbon emissions, visual impact of the panels is not considered to be an issue at this site as the roof is not overlooked by any neighbouring buildings. It should be noted that this benefit has been considered in balance with any impacts on the adjacent conservation areas.

Capital and Life Cycle Costs

9.1.26 It is estimated that the total capital cost of the PV panels, including inverters, installation, miscellaneous electrical components etc, has been estimated by the KUT Partnership to be approximately £28,000, (please note, all figures are indicative and based on an generic system price range provided by a single PV provider/installer, Metropolis Green takes no responsibility for the accuracy of these figures as final costs will depend on detailed design of the PV array, ancillary equipment and site constraints. All prices should be considered subject to change at any time due to market forces and are dependent on the supplier/installer. Once detailed designs have been prepared quotes should be obtained from PV suppliers/installers for accurate system costs). PV panels have a long lifetime with low maintenance and replacement requirements.

Carbon Life Cycle Costs

9.1.27 PV panels and inverters have relatively high embodied energy, but studies show that appropriately sited systems will recuperate their embodied carbon within a few years.

Exporting Electricity

9.1.28 The annual income generated by the PV panels includes a Feed-In Tariff (FIT) generation tariff rate of 32.9p/kWh (subject to change). Tariffs will be linked to the Retail Price Index (RPI) which ensures that each year they follow the rate of inflation. The rate payable is set at the year of entering the FIT and the entrance rate will reduce annually. In addition to the generation tariff a micro generation export rate of 3p/kWh for the electricity exported to the grid, this rate is payable by the electricity provider and will also be RPI linked. The electricity export rate is collected from electricity utility provider.

9.2 Other Appraised Technologies

9.3 Solar Thermal

9.3.1 Solar Thermal hot water heating systems harvest energy from the sun to heat water. The solar heating collectors are generally positioned on the roof of a building, they can also be wall mounted, although with reduced efficiency. A fluid within the panels, heats up by absorbing solar radiation. The fluid is then used to heat up new water which is stored in a separate water cylinder.

9.3.2 As an alternative to PVs, implementing Solar Water Heating (SWH) can deliver carbon saving to new hot water generation for space heating as well as for new hot water production.

Application to Site – Not Feasible

Feasibility

9.3.3 CHP and solar thermal both provide hot water as all or a proportion of the base load hot water demand. CHP and solar thermal would therefore be competing for the same base load. As the CHP system modelled is sized to provide the base load new hot water demand for the development, to run the CHP system in conjunction with solar thermal would result in lower efficiencies for both systems and lower carbon reductions than are available with the CHP/PV option. Therefore, it is determined that the solar thermal water heating option is not a feasible solution for the development at Kay Court.

Land Use

9.3.4 With regard to land use, Solar Thermal panels are installed in or on the building and do not require use of any space or land that is not within the footprint of the building.

Noise

9.3.5 Solar Thermal panels have no impact in terms of noise, although the pumps (equivalent to central heating pumps) may emit negligible noise levels the siting of the pumps, low levels of noise and the proximity of neighbours mean that there will be no impact on building users or neighbours through specification of Solar Thermal and related pumps.

Life Cycle Costs and Carbon

9.3.6 In terms of lifecycle costs of Solar Thermal, the panels have a long lifetime (up to 30 years) with low maintenance requirements and although the initial capital costs are high, the system modelled will pay back in a relatively few years. Maintenance and replacement of system components must be taken into account when considering life cycle costs, but these technologies will both still return a profit when factoring in the energy savings, RHI payments.

9.3.7 Solar Thermal systems have low embodied energy which is repaid within a few years (faster than PVs).

9.4 Wind Turbines

9.4.1 Wind is one of the most cost-effective methods or generating renewable electricity. However wind is more suited to low density areas where there is more space necessary for maintenance, less turbulent wind patterns, and they are less likely to be the cause of noise and vibration to nearby properties. High density areas are not ideal with current wind turbine technology.

Application to Site – Not Feasible

Feasibility

9.4.2 Modelling indicates wind turbines at this site will not able to achieve the level of carbon emission reductions associated with the PV solution.

9.4.3 Installation of wind turbines are neither feasible or suitable for Kay Court, there are a number of concerns with wind turbines in an urban environment including; visual impact, noise, cost, maintenance, space, as well as mechanical loading implications for installation of turbines ‘on building’. Although calculations for the modelled systems indicate that wind systems contribute to carbon reductions, it must be noted that under dense urban environments the energy outputs generated by wind turbines can be quite unpredictable. This is mainly due to the neighbouring buildings acting as obstructions causing turbulence to the incoming wind flow. The site would need to be evaluated appropriately (over a period of 12 months) using wind speed monitoring & recording devices in order to give an accurate prediction in terms of energy output derived by the real wind speed measurements recorded on site.

9.4.4 In addition to these concerns, the actual energy output of any turbines installed is likely to be much lower than the modelled outputs due to turbulence created in the urban environment. Turbulence can be overcome by installing turbines on minimum 30m high towers but this will exacerbate the concerns/impacts listed above.

9.4.5 Life cycle assessment of wind turbines shows that they can repay embodied energy within a few years if suitably sited. Additionally wind turbines have a long lifetime with relatively little maintenance required, and when considering life cycle costs, even with the feed in tariff and energy savings considered they have a longer payback time than other renewable technologies

9.4.6 In comparison to PV panels, the energy output is much less predictable, as the annual sun path remains the same year on year whereas wind is unpredictable. In addition, roof structures at Kay Court would need to be properly assessed in order to determine whether it will be able to withstand the loading on the building caused by the turbines.

9.4.7 Therefore, wind turbines have been determined to be unsuitable for the development at Kay Court.

9.5 Biomass Heating

9.5.1 Wood is the most commonly used form of biomass fuel, and can either be burned in solid fuel boilers for central heating applications, or for raising steam for power generation in large installations.

9.5.2 Typically, biomass installations are sized to meet a base heat load with peak load and load variations to be met from gas-fired boilers. Biomass boilers operate most efficiently and are therefore most cost effective when working continuously at full load, they do not respond well to rapidly fluctuating demand. When assessing the feasibility of a biomass installation, storage space and biomass delivery requirements need to be taken into account.

Application to Site – Not Feasible

Feasibility

9.5.3 Although SAP calculations show that a Biomass Boiler operating for no less than 8320 hours could provide a higher level of carbon reductions than Gas CHP (from the Efficient Baseline). The main operational concerns are raised in relation to air quality, storage capacity and logistics of parking for delivery of wood pellets/chips etc.

9.5.4 Air quality is another major concern with biomass heating due to NOx (Nitrogen Oxides) and Particulate Matter (PM10) emissions.

9.5.5 The entire London Borough of Camden is designated as an Air Quality Management Area (AQMA), with current technology, biomass fuelled CHP may negatively impact on air quality which is deemed inappropriate in an Air Quality Management Area unless abatement technology can provide sufficient mitigation.

9.5.6 Biomass systems also require space for storage and delivery of fuel, additionally, fuel delivery carries implications for parking, increased emissions and pressure from transport. The proposed plant room is situated on the first floor of the development at Kay Court. In the context of the current layout, there is insufficient space able to be allocated for the biomass storage facility. Therefore, it is determined that biomass heating solution cannot be practically implemented and it is not a suitable renewable energy technology for the site.

9.5.7 Life cycle assessment of biomass boilers shows that the embodied energy is usually repaid within a few years.

9.5.8 When considering life cycle costs, there are higher maintenance requirements than other forms of renewable energy, fuel costs are predicted to rise and the value of net lettable space required for storage must be considered.

9.5.9 When considering noise impact, the impact of fuel deliveries must be considered, otherwise, the impact is similar to conventional plant.

9.5.10 Therefore, it is determined that a biomass heating solution cannot be practically implemented in addition energy modelling, site and technology assessment have determined that biomass heating is not suitable for the development at Kay Court.

9.6 Ground Source Heat Pump (GSHP)

9.6.1 In the UK, soil temperatures stay at a constant temperature of around 11-12℃, throughout the year. Ground source heat pumps take this low temperature energy and concentrate it into more useful, higher temperatures, to provide space heating and water heating. The process is similar to that used in refrigerators. A fluid is circulated through pipes in the ground absorbing the heat from the soil, the fluid is passed through a heat exchanger in the pump which extracts the heat from the fluid and increases it via a compression cycle. This is then used to provide underfloor heating and heat new hot water.

Application to Site – Not Feasible

Feasibility

9.6.2 It has been determined that connection to existing or installation of new Ground Source Heat Pump plant is not a feasible option for the Kay Court scheme, this is due to the existing transport and utility infrastructure beneath the site and the large area required for boreholes exterior to the building. Boreholes are required to be 5 metres apart per 100kW of duty.

9.6.3 Energy modelling and cost analysis show that installation of a GSHP, is one of the most costly options for this site and would require further detailed analysis of conflicts with existing systems, ground conditions and soil conductivity before determining whether or not the required levels of carbon savings could be achieved.

9.6.4 Land use, plant space and physical security for the ground collectors and the heat pump units also needs to be taken into consideration. For horizontal collector systems, a potentially large area is required for the collector pipework. This area should be free of trees which will cause problems for installation of the pipework. It can be beneath the building but it is most effective in an open area. For borehole or vertical collectors, land requirements are reduced but still significant as the boreholes must be a minimum of five metres apart.

9.6.5 Noise impact of heat pumps is considered to be negligible although concerns have been raised where older systems are poorly maintained and become noisy.

9.6.6 Life cycle assessment shows that this technology has a low embodied energy and carbon which is repaid within a few years.

9.6.7 The capital cost of a heat pump system, the collector system and the heat distribution system compromises this technology as a cost effective solution. The cost of the heat pump itself is directly proportional to the output, so over-sizing should be avoided. A large proportion of the total cost is the cost of installing the collector, with vertical systems working out at around 25-50% more expensive owing to the need for borehole drilling. Larger systems will require major ground works to install a large horizontal collector or several boreholes. Installation costs can be reduced if the collector is installed as part of the ground works. The associated energy savings and RHI will reduce the lifecycle costs

9.6.8 Studies have raised concerns over operational efficiencies matching manufacturers stated efficiencies and costs of maintenance required. Taking all of these considerations into account, it is judged that GSHP is not a suitable or affordable technology for Kay Court.

9.7 Renewables Summary

9.7.1 Each of the London Plan approved renewable technologies have been appraised in terms of their suitability for the proposed development at Kay Court.

9.7.2 The implementation of a PV system has been found to be the most feasible solution for the site.

9.7.3 A 27.20 kWp photovoltaic system (requiring 188.16m^2 of 185Wp panels) in conjunction with a 5.5kWe gas fired CHP system has been found to be the most suitable energy solution to achieve an overall 25.12% carbon reduction at the site.

9.7.4 Air Source Heat Pumps are a feasible alternative to CHP at the site. Calculations show that a 7.45% reduction in 'whole energy' CO_2 emissions can be achieved from the Notional Baseline if this technology is specified.

9.7.5 Wind is not a feasible renewable technology for the site, due to space constraints, perceived planning issues and uncertainty surrounding expected energy output, roof loading, height restrictions and conservation sensitivity issues.

9.7.6 A solar thermal system is not feasible for the development, as there is limited suitable roof space, distances for pipe runs to storage vessels are significant and it is not appropriate to specify solar thermal in conjunction with CHP. A solar thermal system alone could not achieve significant carbon reductions across the site.

9.7.7 A biomass fuelled CHP system providing hot-water and electricity has been deemed not to be feasible. This is due to efficiency management and plant space availability issues. Additionally, as the London Borough of Camden is within an Air Quality Management Area, concerns are raised relating to the impact on local air quality without costly abatement technologies were biomass CHP to be considered. Also due to concerns relating to parking, fuel deliveries and plant room space constraints limiting fuel storage capacity at the site, it was determined that this option cannot be practically implemented.

9.7.8 A Ground Source Heat Pump System is not feasible due to site constraints and existing transport and utility infrastructure beneath the site.

9.7.9 Table 10 below provides a summary of the overall carbon reductions and improvement of DER over TER for the modelled technologies. A CHP and PV system is determined to be the most suitable low carbon and renewable energy technology solution for the development at Kay Court.

Table 10: Energy Hierarchy Summary

	Notional Baseline	Efficient Baseline	Low Carbon Baseline	Renewable Baseline
Space Heating Energy kWh/yr	143,414	94,915	55,115	55,115
DHW Energy kWh/yr	61,210	59,091	34,277	34,277
Cooling kWh/yr	0	0	0	0
Lighting Energy kWh/yr	43,032	33,642	33,642	33,642
Aux Energy kWh/yr	5,203	4,123	2,493	2,493
Un-Regulated Energy kWh/yr	130,304	130,304	130,304	130,304
Renewables Contribution kWh/yr	-	-	-	23,344
Actual CO_2 Emissions $KgCO_2$/yr	**132,820**	**117,384**	**111,803**	**99,454**
CO_2 Reduction $kgCO_2$/yr	-	15,435	5,581	12,349
Percentage CO_2 Reduction	**-**	**11.62%**	**4.75%**	**11.07%**
Total CO_2 Reduction $kgCO_2$/yr	-	15,435	21,017	33,366
Total Percentage CO_2 Reduction	**-**	**11.62%**	**11.62%**	**25.12%**
DER over TER % Improvement	**-**	**7.22%**	**15.82%**	**43.77%**

9.7.10 An overall total carbon emissions reduction of 25.12% from the Notional Baseline can be achieved as a result of this energy strategy. The proposal meets the minimum requirements of the Code Ene 1 issue, and contributes significantly to the development achieving a Code Level 3 rating, as well as contributing to the 11.07% carbon reduction from on-site renewables.

9.7.11 This strategy also achieves a 43.77% improvement in DER over TER for the dwellings on the site, ensuring that the dwellings meet and exceed the criteria for the Code Ene 1 mandatory requirements and London Plan targets set for the 2010 – 2013 period.

9.7.12 London Plan and London Borough of Camden policy requirements are for a 20% reduction in CO_2 emissions due to the specification of renewables. Clearly this target has not been met with the 11.07% carbon reduction from on-site renewables, although it should be noted that it is possible to achieve a total ‘whole energy’ CO_2 reduction from the Notional Baseline of 25.12% and the energy hierarchy methodology was followed in determining the most appropriate energy solution for the site.

10.0 CONCLUSION

10.1 Following the energy hierarchy has enabled significant carbon reductions to be calculated for the proposed development at Kay Court. The total overall carbon reduction is predicted to be approximately 25.12% with renewables contributing 11.07%. These calculations demonstrate that the development will meet the mandatory Code Ene 1 requirements and that the development is on track to achieve certification at the required minimum level of Code Level 3. See Figure 12 for a graphical summary of CO_2 reductions.

10.2 In accordance with the London Plan requirements and the energy hierarchy, 'whole energy' figures produced using SAP calculations have been used in this energy strategy, including: heating, hot-water, lighting, pumps and fans and un-regulated energy. The proposed development at Kay Court is calculated to have a 'whole energy' Notional Baseline of 132,820 $kgCO_2$/yr.

10.3 In the first stage of the energy hierarchy (Be Lean), calculations to determine the Efficient Baseline predict a 11.62% carbon reduction through the proposed energy efficiency measures. This results in a reduction of 15,435 $kgCO_2$/yr from the Notional baseline to the Efficient Baseline. The risk of summer overheating in the dwellings on site has been addressed with a range of passive measures, and there will be no requirement for active cooling for this site.

10.4 The second stage (Be Clean) calculations to determine the Low Carbon Baseline predict that specification of CHP can deliver a further carbon reduction of 5,581 kg/CO_2,which equates to a 4.75% reduction from the Efficient to Low Carbon Baseline, and can be expressed as a total 11.62% carbon emission reduction from the Notional Baseline.

10.5 Finally, calculations to determine the Renewable Baseline have determined PV to be the most suitable renewable energy technology for to the site. The modelled PV panel array contributing a further carbon reduction of reduction of 12,349 $kgCO_2$/yr, which is a 11.07% reduction from the Low Carbon Baseline. These reductions are achieved utilising 188.16m^2 of 185Wp PV panels. The calculations show that the fabric efficiency measures, specification of CHP and PV can achieve an overall total 25.12% CO_2 reduction from the Notional Baseline

10.6 The scope for CO_2 reduction using renewables is limited by the available roof space. Nonetheless, the size and output of the PV array has been maximised using all available roof space on the existing and new buildings. The London Plan policy 5.7 and London Borough of Camden policy requirements are for a 20% reduction in CO_2 emissions due to the specification of renewables. Clearly this target has not been met with the 11.07% carbon reduction from on-site renewables. However, it should be noted that it is possible to achieve a total 'whole energy' CO_2 reduction from the Notional Baseline of 25.12%.

10.7 Additionally in the context of the London Plan policy 5.2, the site achieves significant DER over TER improvements of 43.77% which exceeds the 25% improvement over the 2010 Building Regulations. This achievement contributes a significant number of credits to the Code Ene 1 issue.

Figure 12: Whole Energy Carbon Emission Reductions

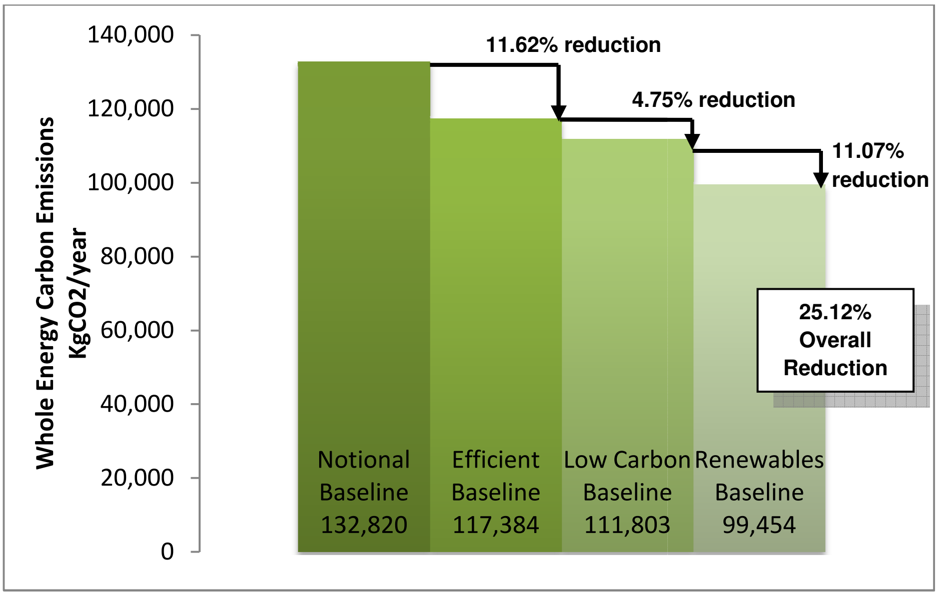
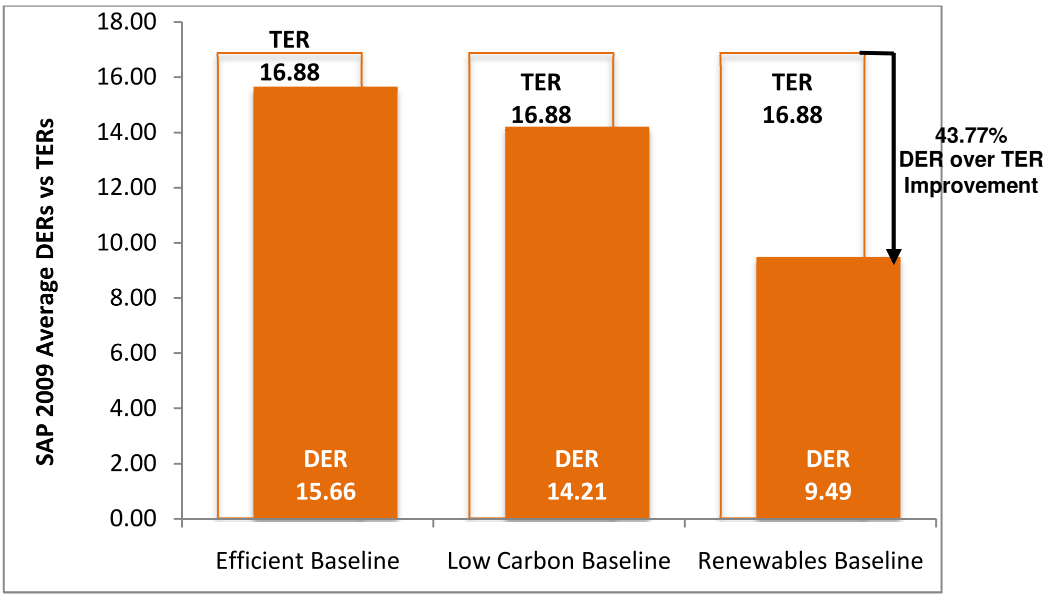


Figure 13: Renewable Baseline DER over TER Percentage Improvement



APPENDIX A – SAP RESULTS

APPENDIX B – RENEWABLE TECHNOLOGIES

B1.0 Combined Heat and Power –CHP

B1.1 CHP is an engine which produces electricity. The process of creating the electricity produces heat as a by-product. Heat can be easily stored in a thermal storage tank and distributed to across the site to provide for the hot water demands of the site. The heat can also provide for some space heating within a development.

B1.2 CHP systems are far more efficient than traditional centralised power plants. The CHP plant reduces losses such that for the same energy output, CHP requires 100 input units to the centralised plants 180 units, a result of the high losses associated with traditional centralised power stations.

B1.3 CHP engines operate most efficiently at a constant output. Demand profiling is therefore an important factor in the sizing of a CHP system. For example, it is unlikely to be cost effective to size the plant on the basis of space heating requirements when there are no space heat requirements for several months of the year. Therefore, CHP plant is usually sized on the basis of a steady hot water demand which provides electricity which can either be used on-site or exported to assist in decarbonising the grid.

B1.4 Combined heat and power (CHP) is not a renewable source, unless it is powered by bio-fuels.

B2.0 Solar Photovoltaic (PV)

B2.1 Photovoltaic systems convert solar energy directly into electricity through semiconductor cells. The panels generate electricity from both direct light and diffuse light. Photovoltaic panels can either be mounted external to the building or be integrated into the building cladding (known as Building Integrated Photovoltaic or BIPV).

B2.2 PV panels are arguably the cleanest method of using solar energy, but the lower levels of solar radiation which occur within the United Kingdom limits the achievable power output of the panels. However, panels come with a guarantee of 25 years and will work efficiently for at least 40 years. They are cleaned naturally by rainfall, and as there are no moving parts they are virtually maintenance free. The power output levels from PV are well documented and developers can be confident that they will generally perform to manufacturers specifications.

B2.3 They come in a wide range of types and are often integrated into the buildings structure as an alternative to conventional tiling, as façade, shading features, or as flat roofing systems It is possible to get combined PV/solar thermal tiles such as the c21e which can be an ideal solution for low rise housing.

B2.4 PV inverters are required to change the direct current (DC) electricity from the PV panels into alternating current (AC) for use with home appliances and electricity grid.

B2.5 Grid-tied inverters use high-frequency transformers, to convert DC current directly to 240 volts AC. Most PV inverters on the market will include a maximum power point tracker that enables the inverter to extract an optimal amount of power from the solar array by tracking the array’s maximum power point.

B3.0 Solar Thermal

B3.1 Solar Thermal hot water heating systems harvest energy from the sun to heat water. The solar heating collectors are generally positioned on the roof of a building, they can also be wall mounted, although with reduced efficiency. A fluid within the panels, heats up by absorbing solar radiation. The fluid is then used to heat up new water which is stored in a separate water cylinder.

B3.2 There are two types of collectors – flat plate and evacuated tube. Evacuated tube collectors are generally more expensive because they are more complex but are considered to be more efficient saving approximately 582 kWh per m^2 per year. Flat plate collectors save approximately 454 kWh per m^2 per year.

B3.3 A fewer number of more efficient panels may achieve the same heat output, but the cost of panels increases significantly as efficiency is increased.

B3.4 The majority of heat output from solar hot water systems is achieved during the summer and mid seasons, with the least heat energy obtained during the winter.

B3.5 The best location for solar thermal collectors is on a south-east/south-west facing roof, and positioned at an elevation of between 10 and 60°. Depending on the angle of the roof, the collectors can potentially be roof integrated, otherwise the collectors will require frame mounting at the appropriate angle.

B3.6 A solar thermal system can provide between 50 and 70% of annual hot water needs. Savings from solar hot water are difficult to predict and will depend on how much water is used and at what time of day.

B3.7 Solar Thermal systems are most effective when combined with water efficient fixtures and fittings and the hot water can be used during the day and early afternoon, this may require the provision of additional information to the user in order to understand the system.

B3.8 When a series of collectors are frame mounted, space will be required surrounding each collector to prevent each panel from shading the next, as the sun moves through the sky and when there is low sun in winter.

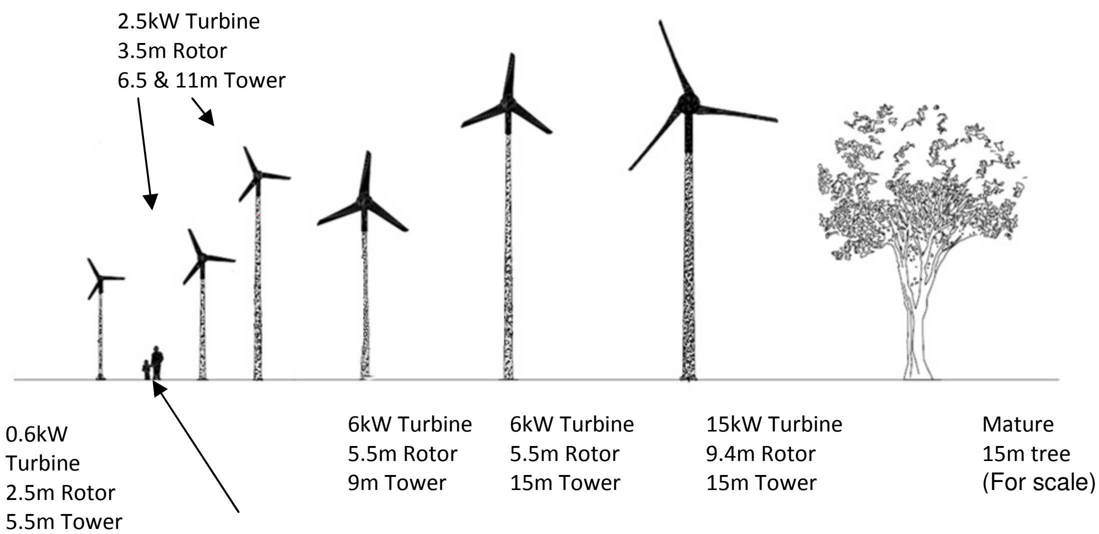
B4.0 Wind Turbines

B4.1 Wind turbines are available in a variety of shapes, sizes and duties, with the most common being a propeller blade/windmill configuration with a horizontal axis. Turbines are also available in vertical axis arrangements in a number of styles, and purpose built rooftop modules or integrated systems are emerging onto the market.

B4.2 Due the size of the wind turbines they are typically ground mounted. Vibration, noise and appearance can be issues associated with wind turbines, and must be considered early during the design if they are incorporated into the development.

B4.3 Wind is one of the most cost-effective methods or generating renewable electricity. However wind is more suited to low density areas where there is more space necessary for maintenance, less turbulent wind patterns, and they are less likely to be the cause of noise and vibration to nearby properties. High density areas are not ideal with current wind turbine technology.

Figure 14: Illustration of scale for different sized wind turbines



metropolis green

B5.0 Biomass Heating / CHP

B5.1 Wood is the most commonly used form of biomass fuel, and can either be burned in solid fuel boilers for central heating applications, or for raising steam for power generation in large installations. The wood is either burned as raw wood-chippings, or processed into pellets. Pellets have a more even temperature burn and as such are more efficient than raw chippings; however, there is a carbon factor to their manufacture so the CO_2 reduction potential is lowered.

B5.2 In considering this type of system, space for storage and the necessary feed system to supply the boilers would need to be provided. In addition, a guaranteed ongoing and dependable fuel supply would be required.

B5.3 The biomass-fired system requires more fuel handling and storage equipment than is required for typical gas or oil fired boiler systems. A large storage bin is typically provided which can be used on a rotational basis, with a regular top-up of fuel that would be delivered by lorry. The low density and calorific value of wood means that large storage volumes are required, and there must be suitable access for the fuel delivery vehicles.

B5.4 Typically, biomass installations are sized to meet a base heat load with peak load and load variations to be met from gas-fired boilers. Biomass boilers operate most efficiently and are therefore most cost effective when working continuously at full load, they do not respond well to rapidly fluctuating demand. When assessing the feasibility of a biomass installation, storage space and biomass delivery requirements need to be taken into account.

B6.0 Ground Source Heat Pump

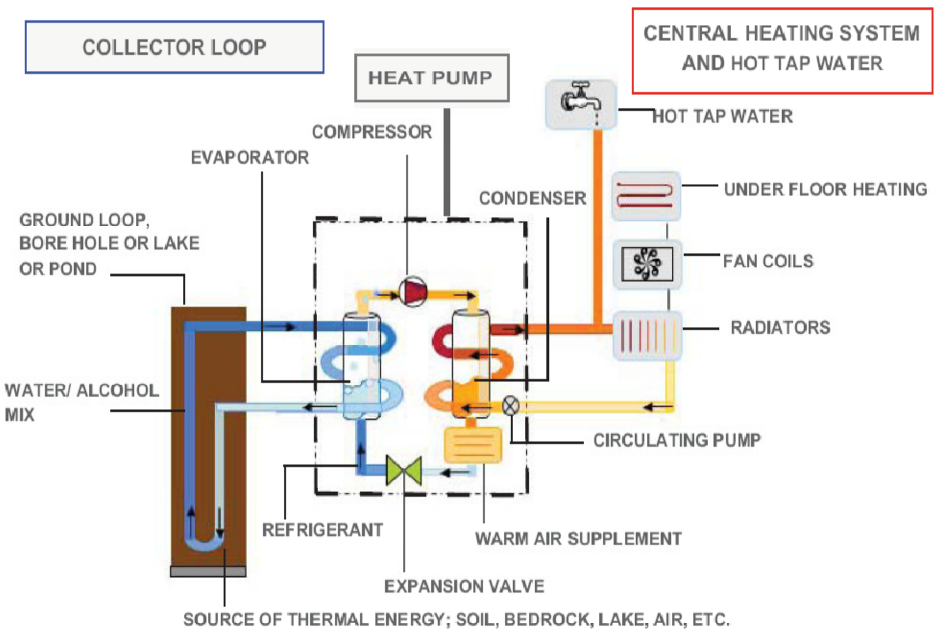
B6.1 In the UK, soil temperatures stay at a constant temperature of around 11-12°C, throughout the year. Ground source heat pumps take this low temperature energy and concentrate it into more useful, higher temperatures, to provide space heating and water heating. The process is similar to a refrigerator. A fluid is circulated through pipes in the ground absorbing the heat from the soil, the fluid is passed through a heat exchanger in the pump which extracts the heat from the fluid and increases it via a compression cycle. This is then used to provide underfloor heating and heat new hot water.

B6.2 Grid electricity is used to power the heat pumps and a Coefficient of Performance (CoP) of at least three is required for efficient energy provision and carbon savings. GSHP should be used in conjunction with underfloor heating because it requires lower temperatures than traditional radiators and maintains the efficiency of the heat pump. The CoP of the heat pump can reduce over time and so standard maintenance is importance to ensure the continued efficiency of the system. In individual houses GSHP can provide the majority of the heating and hot water demand but in larger buildings the heat pump may only provide a proportion of the heating and hot water needs.

B6.3 Ground source systems can be installed in horizontal trenches or in vertical boreholes. Horizontal trenches require access to relatively large areas of ground and are buried about 1 to 2 metres below the surface. Whereas boreholes require much less surface area, however have a higher cost attached to drilling 30m to 100m below the ground level. Boreholes need to be adequately spaced to ensure each borehole doesn't interfere with the next. This is known as thermal breakthrough, when the temperature of the soil is reduced overtime, which in turn affects the productivity of the system. Allowing more space between each borehole allows the soil temperatures to replenish. Once installed, GSHPs cannot be seen and so offer no visual impact on an area.

B6.4 Geological information is required to assess the thermal conductivity of the soil at a particular site. The soil's thermal conductivity affects the sizing of the boreholes and therefore efficiency and cost of the system. A test borehole is only recommended if there are no space constraints at the site, a GSHP system is the preferred technology, and the only uncertainty is the thermal conductivity of the soil and therefore the number of boreholes required. In this case the test borehole would become part of the ground source system and the cost would be absorbed into the total cost.

Figure 15: Ground Source Heat Pump System



APPENDIX C – GRANTS AND INCENTIVES

C1.0 Renewables Obligation

C1.1 The Renewables Obligation (RO) scheme obliges all electricity suppliers in Great Britain to ensure that a proportion of electricity supplied is produced from renewable sources of energy. Suppliers can meet this obligation either by supplying power from renewable generating stations, or by purchasing green certificates (*Renewables Obligation Certificates - "ROC's*) or by paying a buy-out price, collected by a fund and recycled to suppliers. There are value bands for the price received for a ROC produced from different types of renewable energy generation technologies. The Renewables Obligation (RO) focuses on supporting large-scale renewable electricity projects.

C2.0 Feed In Tariff

C2.1 The Energy Act 2008 established enabling powers for the introduction of FITs to supplement the RO and incentivise small-scale low-carbon electricity generation, up to a maximum limit of 5MW capacity for renewable energy and up to 50kW in the case of fossil-fuelled CHP.

C2.2 Government introduced the Feed-In Tariff (FIT) in April 2010. FiT is a new financial incentive for renewable generators with an installed capacity below 5MW. It has been developed by the Department of Energy and Climate Change (DECC) and is designed to encourage individuals and business in the UK to generate renewable energy. Under this scheme energy suppliers make regular payments to householders, communities and organisations who generate their own electricity from renewable or low carbon sources.

C2.3 The Feed-In Tariffs scheme will be reviewed by the government every five years, to coincide with the reviews of the Renewables Obligation. There is a risk that tariff levels may be reduced when the scheme is reviewed, and as such care must be taken when forecasting income over the 25 year life of the tariff scheme.

C2.4 Also note that it is a legal requirement to use an Ofgem approved meter in order to collect revenue from the meter readings displayed or transmitted to a data collection system. In addition, for electricity supplies to new customers by a licensed supplier, an Ofgem approved and certified meter must be used.

C3.0 Renewable Heat Incentive

C3.1 The counterpart to small scale electricity generation is The *Renewable Heat Incentive (RHI)* scheme. It will provide financial support for those who install renewable heating, which qualifies for support under the scheme. However, Support for RHI for residential installation does not begin until October 2012, though there will be a "RHI Premium Payment" similar to a capital grant for systems installed before then.

C3.2 At a new level, the incentive will apply to:

- solar thermal water heating
- biomass boilers
- ground and water source heat pumps
- Biogas Injection

C3.3 The RHI is to support non-residential installations from July 2011 (Phase 1), businesses, offices, public sector buildings and industrial processes in large factories. Residential support will not start until October 2012 (Phase 2).

C3.4 No Tariffs have yet been published for residential installations, apart from indicative levels for the Premium Payment:

Heat Technology	Payment per installation
Air source heat pumps	£850
Biomass boilers	£950
Ground source heat pumps	£1,250
Solar water heating	£300

C3.5 The Energy Act 2008 provides the statutory powers for a renewable heat incentive scheme to be introduced across England, Wales and Scotland. The detailed legal framework will be set out in secondary legislation.

C3.6 Each eligible installation has to be registered by the energy regulator Ofgem. There are some specific requirements. For example, systems below 45kW capacity must com-ply with the Microgeneration Certification Scheme.

C3.7 The heat cannot be wasted and must be used for a prescribed purpose; space, water or process heating (not for electricity production). There are two different approaches that can be used to measure the heat output of systems: metering and 'deeming', which implies that the level of payment would be based on a 'deemed' output based on what the installed system would be expected to deliver if the property were well insulated. However, for Phase 1 of the scheme all systems will have to be metered, the government has outlined how the metering should be configured in the system, calibrated, maintained and read.

C3.8 The exact mechanisms for deeming are still under consultation. It is not yet confirmed whether deeming of the heat output will be applicable to new installations in Phase 2.

C4.0 Enhanced Capital Allowance

C4.1 The Enhanced Capital Allowance (ECA) scheme is a key part of the Government's programme to manage climate change. It provides businesses with enhanced tax relief for investments in equipment that meets published energy-saving criteria.

C4.2 Enhanced Capital Allowances (ECAs) enable a business to claim 100% first-year capital allowances on their spending on qualifying plant and machinery.

C4.3 Enhanced Capital Allowances (ECAs) can only be claimed on energy-saving products that meet the relevant criteria for their particular technology group

C4.4 The criteria on the list are reviewed each year, to reflect technological advances and market changes. New technology groups might also be added as part of the annual review, but they must have the approval of the Department of Energy and Climate Change (DECC), Her Majesty's Revenue and Customs (HMRC) and the Treasury.

C4.5 The list of qualifying products, within each technology, is updated each month to include any new or modified products that meet the criteria.

C4.6 **Which technologies and products qualify for ECAs?**
An up-to-date list of the technologies that qualify for the allowance can be found on the Energy Technology Product List (ETPL). The groups currently on it are:

- Air-to-air energy recovery
- Automatic monitoring and targeting (AMT)
- Boiler equipment
- Combined heat and power (CHP)
- Compact heat exchangers
- Compressed air equipment
- Heat pumps for space heating
- Heating ventilation and air conditioning equipment
- Lighting
- Motors and drives
- Pipework insulation

- Radiant and Warm Air Heaters
- Refrigeration equipment
- Solar thermal systems
- Uninterruptible Power Supplies (UPS)

Within these 15 groups, there are 54 sub-technologies such as single speed motors and biomass boilers

C4.7 Businesses can write off the whole of the capital cost of their investment in these technologies against their taxable profits of the period during which they make the investment.

C4.8 This can deliver a helpful cash flow boost and a shortened payback period.