



# Energy Strategy

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January 2011  
Renewal



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# Executive Summary

This document explains the findings from a detailed analysis of the Proposed Development at Surrey Canal and the ability to achieve both the current London Plan, the Draft London Plan and the Lewisham Unitary Development Plan and Draft Core Strategy energy related planning policy, as well as the likely future targets for CO<sub>2</sub> emission reductions that are expected to be included in the Building Regulations over the build programme.

Various potential technology combinations have been assessed for their ability to achieve the targets that are expected to be required over time at Surrey Canal. All final strategies will include good energy efficiency standards and incorporate a combination of:

- § Heat from SELCHP (South East London Combined Heat and Power Plant) energy from waste facility
- § Gas fired combined heat and power (CHP) generation
- § Absorption chillers
- § Photovoltaic (PV) electricity generation
- § Aquifer thermal energy storage (ATES)

The energy strategy for Surrey Canal follows the energy hierarchy set out in the London Plan for

The energy consumption and CO<sub>2</sub> emissions for a 2006 Building Regulations compliant scheme has been estimated as around 10,300 t CO<sub>2</sub>/year, and under the recent October 2010 Building Regulations revision the baseline has been estimated as around 8,600 t CO<sub>2</sub>/year.

The emissions of the Proposed Development will meet a baseline using 2010 Building Regulations through energy efficiency measures. For residential, this would require high levels of insulation and airtightness. For non-residential, the energy efficiency measures are closely related to the specific uses and due to the outline nature of the application the servicing is not fully defined. Nevertheless it has been assumed in general that thermal envelope improvements would reduce space heating demand as well as reduce cooling demand where it is used and high efficiency plant would be included.

The preferred approach is to use the waste heat from the SELCHP as the source for a community heat network connected to all buildings where appropriate. This would further reduce CO<sub>2</sub> emissions by around 29%. Renewal is currently working with SELCHP to determine the best way to take this solution forward.

The delivery of a district heating connection to SELCHP is exciting and the construction of the East London Line Phase 2 (ELL2) has acted as a catalyst to ensure the issues are mitigated with passive installation for pipes post completion of ELL2 in 2012. As a result, SELCHP, London Overground, TfL, and Network Rail have worked together in the ensuring that the construction design now incorporates a culvert chamber that facilitates the installation of district heating pipes under ELL2 post completion in 2012/2013.

In addition to the potential heat supply, SELCHP also offers the opportunity to further enhance the 'green' element through the supply of an electricity network boosted by technologies such as photovoltaic panels. Wind- turbines have also been considered but were considered difficult to integrate into the Proposed Development due to noise, flicker, visual impact and structural concerns, are therefore not currently being proposed for Surrey Canal.

The technical feasibility and economic viability of these will alter as the detailed design, policy (such as the definition of zero carbon) and financial incentives (particularly any changes to feed-in tariffs or any detailed announcement on the renewable heat incentive) evolve. Over the period of the Proposed Development these technologies will undoubtedly develop further with new options emerging. As such given the outline application nature it is suggested that the energy strategy maintain some flexibility to accommodate a range of options and leave some flexibility in approach to the inclusion of renewable system. At this stage it is proposed that renewable energy provision is to be met through a minimum of 3,000 sq m of photovoltaic panels or equivalent carbon reduction through other renewable energy systems.

In terms of reducing CO<sub>2</sub> emissions associated with comfort cooling, in addition to the demand reduction (CCHP) and ATES can provide further CO<sub>2</sub> reductions. However, the applicability of these technologies will depend on the size and profile of the cooling load and this will only be known later in the design process. It should be noted that various technical considerations such as the role of absorption chillers in adding to the urban heat island effect and the need to establish the actual yield available from the aquifer for ATES may reduce their suitability.

The strategy will also be in compliance with the Draft LBL Core Strategy Policy 8 to meet at least 20% of the total energy demand through use renewable energy, on top of savings from energy efficiency measures beyond Building Regulations Part L 2006. Also, as mentioned in Policy 8, Surrey Canal will as a minimum meet the requirements of achieving Code for Sustainable Homes Level 4 from Phase 1, of which the energy criteria requires a reduction of regulated CO<sub>2</sub> emissions by 25% on Building Regulations Part L 2010 (44% on Building Regulations Part L 2006 under versions prior to November 2010) and the equivalent for non-residential aspects of the Proposed Development. The energy strategy is also in compliance with the standards of the Draft Replacement London Plan, as well as the Lewisham Unitary Development Plan. Table 1 and Table 2 display the data to demonstrate compliance with the energy hierarchy as requested by the GLA Energy Team Guidance on Planning Energy Assessments.

**Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy**

Indicative Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)		Total
	Regulated	Unregulated	
Building Regulations 2010 Part L Compliant Development	5,600	3,000	8,600
After energy demand reduction	5,100	3,100	8,200
After SELCHP	2,200	3,100	5,300
After renewable energy	2,200	3,000	5,200

**Table 2: Carbon Dioxide Savings from each stage of the Energy Hierarchy**

	Carbon dioxide emissions (Tonnes CO <sub>2</sub> per annum)		Carbon dioxide savings (%)	
	Regulated	Total	Regulated	Total
Savings from energy demand reduction	500	400	9%	5%
Savings from CHP	2,900	2,900	57%	35%
Savings from renewable energy	0	100	0%	2%
Total Cumulative Savings			61%	40%

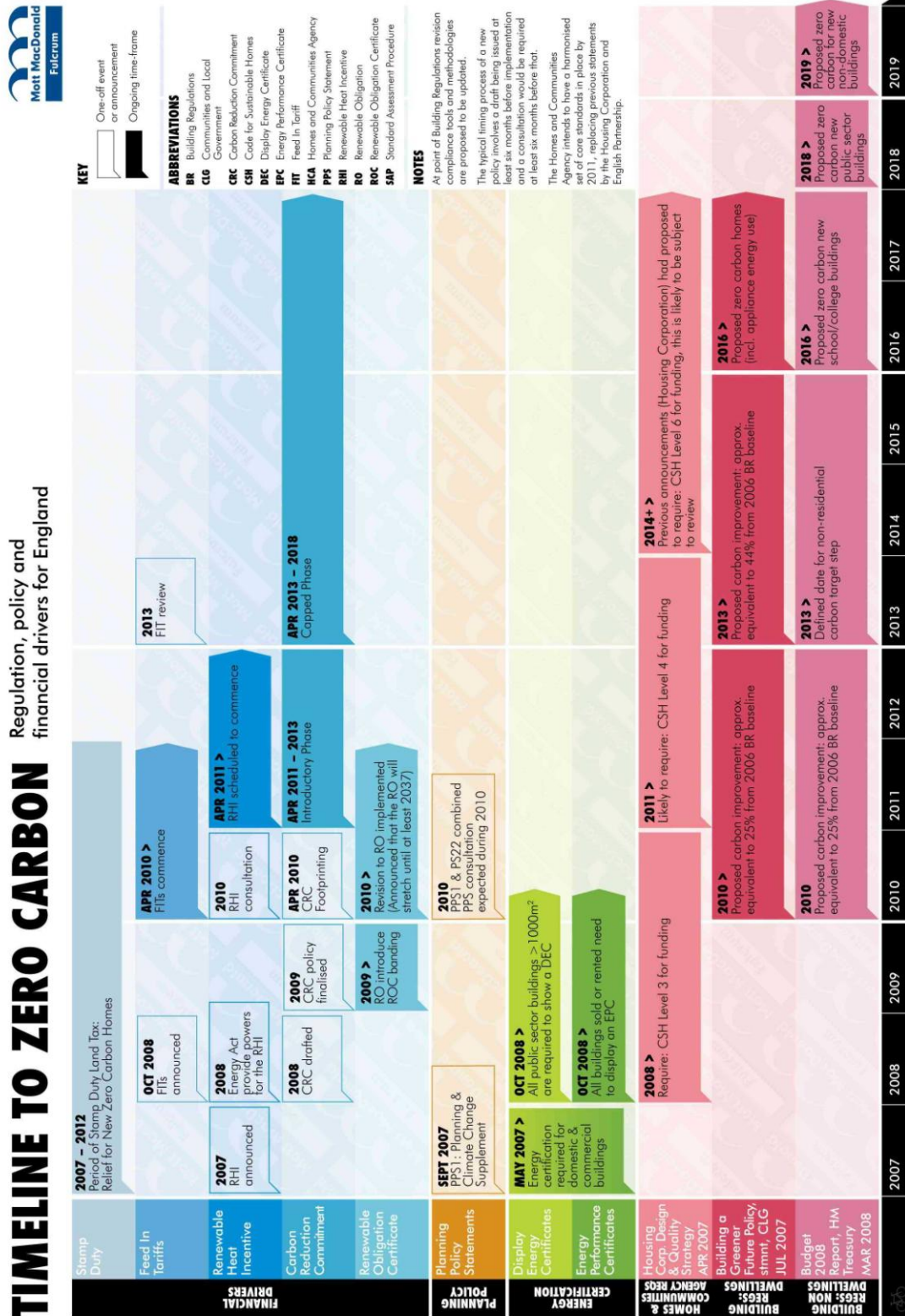
Finally, an on site gas-fired CHP plant in a single energy centre would be included to provide a back up provision if the preferred SELCHP option is not possible. It could potentially be complemented by absorption chillers or an ATES system for further carbon savings.

# 1. Introduction

Mott MacDonald Fulcrum have prepared this report to set out how the Proposed Development at Surrey Canal meets current energy related planning policy (London Plan . as adopted and draft replacement - and Lewisham UDP and Submitted Core Strategy) together with the anticipated, periodically tightening, requirements of future Building Regulations over the proposed build-  
• c æ c ^ á Á æ { à ã c ã [ } Á c @æc Á æ | | Á } ^ , Á á , ^ | | ã } \* • Á om@c building ^ Á ± : ^ following from 2019. This report is focused primarily on issues relating to energy and infrastructure, specifically in the context of incipient regulatory requirements and the wider concerns of Sustainable Development.

As an illustration of the complexity of the issue, Figure 1.1 shows the various policy targets that the Government have announced to-date.

Figure 1.1: Zero Carbon Policy Timeline



## 2. Policy Background

Energy consumption associated with the built environment is estimated to be responsible for anything up to 50% of Greenhouse Gas (GHG) emissions in industrialised countries. As such, many nations are beginning to focus on the built environment in an attempt to achieve significant emissions reductions.

### 2.1 National policy

In 2006 the Department for Communities and Local Government consulted on proposals to increase the requirements of Building Regulations in England and Wales in 3-yearly steps en route to eventually requiring all new buildings to be zero-carbon by 2016. This was announced in the 2006 White Paper on Energy and Climate Change, which was announced aimed at supporting the achievement of this target and further improving the sustainability of future development in England and Wales.

Key policies which are explained more fully in the Planning Statement that accompanies the Surrey Canal application - are outlined below:

#### 2.1.1 Planning Policy Statement 1 (PPS1), 2005

PPS1 sets out the national planning policy framework for development through the planning system and it states that:

“The purpose of the planning system is to contribute to sustainable development through the planning system and it states that:

The PPS covers areas of Social Cohesion & Inclusion; Protection & Enhancement of the Environment; Prudent use of Natural Resources; Sustainable Economic Development; and Integrating Sustainable Development in Development Plans.

It goes on to lay out how planning authorities should seek to deliver sustainable development through the various regional and local policies they develop.

#### 2.1.2 Planning and Climate Change Supplement to PPS1, 2007

The Planning and Climate Change Supplement to PPS1 outlines how planning, in delivering new development and the associated infrastructure, should help to lower greenhouse gas (GHG) emissions and improve adaptability and resilience to a changing climate. In particular, it provides regional and local planning authorities with Key Planning Objectives<sup>1</sup> and decision-making principles to be used when constructing their spatial strategies.

#### 2.1.3 Planning Policy Statement 22 (PPS22) – Renewable Energy, 2004

PPS22 outlines Government guidance for planning authorities on the use of different renewable energy generating technologies and how planning authorities should consider the opportunity for incorporating these technologies into new development.

<sup>1</sup> See PPS1:

<http://www.communities.gov.uk/documents/planningandbuilding/pdf/planningpolicystatement1.pdf>

2.1.4 Revisions to Planning Policy

A statement by the then Housing Minister John Healey in July 2009 acknowledged lowering of land values due to planning gain costs and prioritises sustainability above all other areas whilst emphasising a need for a more sustainable approach. In a subsequent statement the Minister has also stated the intention to combine the existing PPS1 and PPS22 documents into a new planning policy document.

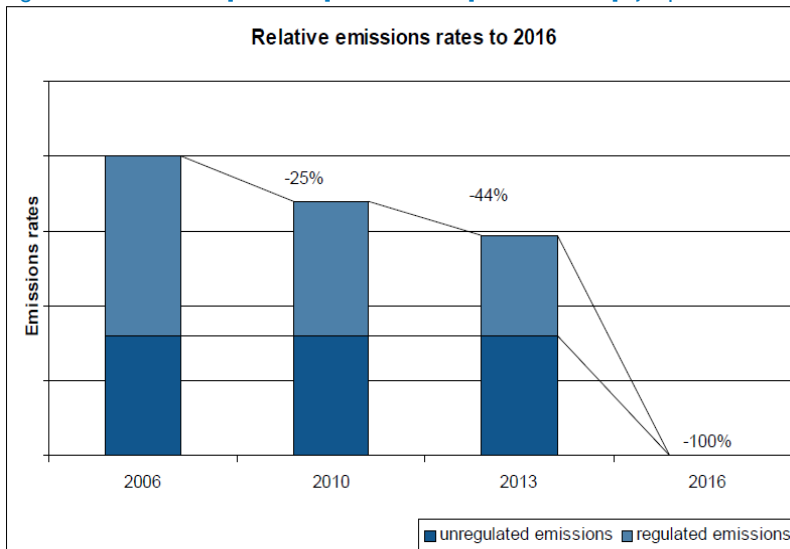
The Planning Policy Statement Consultation significantly promotes opportunities for decentralised energy systems and where possible the use of district heating systems. Further it states that due to the increasing CO<sub>2</sub> reductions coming through from Building Regulations revisions, from 2013 it may not be necessary to require planning policy targets on the percentage of energy to come from decentralised energy sources but that if Local Authorities decide to adopt a target from 2010-13 that the Secretary of State will support this. It also contains reference to the July 2009 statement and notes an intention to place an equal priority on sustainability with other cost considerations (e.g. land value).

This document consultation closed on the 1<sup>st</sup> June 2010 with the summary of consultee responses still waiting to be published.

2.1.5 Building Regulations and Zero Carbon

The document is shown below:

Figure 2.1 Relative emissions rates to 2016



Source: Building a Greener Future, 2007

Table 3: Carbon improvement as compared to Part L 2006

Date	2010	2013	2016
Carbon improvement as compared to Part L 2006	25%	44%	±
Equivalent energy/carbon standard in the Code	Code Level 3	Code Level 4	Code Level 6

Source: Building a Greener Future, 2007

Zero carbon means that over a year the net carbon emissions from the total domestic and non-domestic buildings are zero.

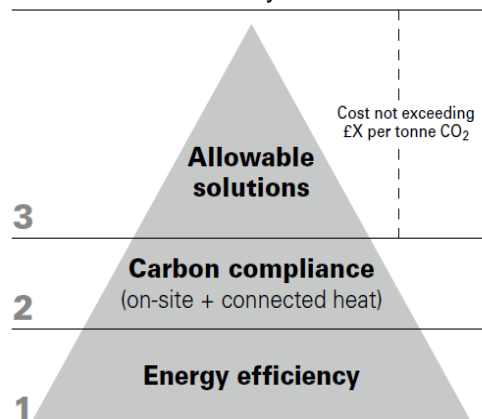
In the 2009 pre-budget report, the Government announced that domestic buildings from 2019 with schools and public buildings being zero carbon earlier, in 2016 and 2018 respectively.

The definition of Zero Carbon Homes and Non-Domestic Buildings is based on the net carbon emissions to the environment.

The proposals focused almost entirely on the domestic sector and outlined a hierarchical approach to the definition, requiring high levels of energy efficiency, followed by a degree of on-site mitigation before allowing sites that were unable to mitigate their total predicted carbon emissions on-site to utilize a variety of off-site options. This is illustrated in Figure 2.2:

Figure 2.2: Zero Carbon Hierarchy

Zero Carbon Hierarchy



- Carbon compliance beyond the minimum standard
- Energy efficient appliances / control schemes
- Export of LZC heat / cooling to surrounding developments
- S106 planning obligations
- Retrofitting of existing buildings in the locality
- Investment in LZC energy infrastructure
- Off-site renewable electricity via private wire
- Any other measures announced by Government

2.1.6 Recent Developments

In 2009, the calculation tool used to predict the carbon emissions from dwellings and judge compliance with Part L of the Building Regulations. The changes to Part L for 2010 were then announced in April, the first reduction over Part L 2006.

The recently announced changes may have a fundamental impact on the way developers achieve compliance with the Building Regulations as low-carbon technologies may be utilised in some instances. The new regulations came into force in October 2010.

2.1.7 Ministerial Statements

In July 2009, following the close of the zero carbon consultation, John Healy, previously the Minister of State for Housing and Planning, outlining further details on what will be required in the eventual definition. In May 2010, the incoming Housing Minister, Grant Shapps, restated his support for all new homes to be zero carbon from 2016 and that the new Government would bring four years of consultation to a close and get the definition of a zero carbon home nailed down within weeks. This has not in fact been the case.

The latest knowledge on the various steps to zero carbon compliance is as follows:

- § **Energy Efficiency:** In November 2009, following a 3 month study undertaken by the Zero Carbon Hub (the Hub) the Minister announced a minimum fabric energy efficiency<sup>2</sup> as 46 kWh/m<sup>2</sup>/year for detached, semi-detached and end-of-terrace dwellings and 39 kWh/m<sup>2</sup>/year for apartment blocks and mid-terrace houses.<sup>3</sup>
- § **Carbon Compliance:** In the July 2009 Ministerial statement, the *Carbon Compliance* target was announced to be 70% of regulated energy, as calculated using a bespoke calculation methodology developed for the consultation<sup>4</sup>. This was updated in July 2010 by a statement from the new minister that a study was to be undertaken by the Zero Carbon Hub into both the methodology and where the Carbon Compliance level should be, based on viability.
- § **Allowable Solutions:** The July 2009 statement gave a list of the preferred allowable solutions shown in Appendix A. To-date consultation stated for the end of 2009 has, so far, failed to materialise.

2.1.8 Implications for Surrey Canal

The current programme for delivery of the Proposed Development spans the regulatory timeline set-forth in Building a Greener Future<sup>5</sup> and beyond the target dates set for zero carbon buildings. The fact that the standards will inevitably change almost constantly as the proposals are designed and built out over the next 15 years increases the importance of long-term planning and providing a flexible solution. Decisions regarding the energy solutions for the earlier phases, where standards are lower, must be made in the

<sup>2</sup> <http://www.communities.gov.uk/news/corporate/1391989>

<sup>3</sup> These figures were calculated using cSAP . the consultation version of SAP . and will need to be updated when the final version is released (expected by the end of March 2010)

<sup>4</sup> *Definition of Zero Carbon Homes and Non-Ö* [ { ^ • c ā & Á Ó ~ ā | ā ā } \* • q

<sup>5</sup> Building a Greener Future: <http://www.communities.gov.uk/documents/planningandbuilding/pdf/153125.pdf>

knowledge that they could affect the ability of later phases to meet their currently unknown / unspecific targets in a cost effective way.

## 2.2 Regional Policy

### The London Plan 2008

The following hierarchy summarises the policies within the London Plan that will be used to assess planning applications.

Table 4: Energy Hierarchy of the London Plan

Energy Hierarchy of the London Plan	
1	<b>Using less energy</b> , particularly by adopting sustainable design and construction measures (policy 4A.3)
2	<b>Supplying energy efficiently</b> , in particular by prioritising decentralised energy generation (policy 4A.6)
3	<b>Using renewable energy</b> (policy 4A.7) . A reduction in CO2 emissions of 20% <sup>6</sup> through on-site renewable energy technologies

Source: Further Amendments to the London Plan

### The Draft Replacement London Plan

The Draft Replacement London Plan (DRLP) was issued for consultation in 2009. It also uses the energy hierarchy but goes further in its requirements. For example Policy 5.2 goes beyond the requirements expected from the Building Regulations Part L revisions, such as 44% reduction of regulated CO<sub>2</sub> emissions prior to 2013, and 55% afterwards. Table 5 compares the minimum improvements against the proposed Building Regulations changes.

Table 5: Draft Replacement London Plan

Target Reductions	Building Regulations		Draft London Plan <sup>7</sup>		
	Dates	Domestic <sup>5</sup>	Non-Domestic <sup>8</sup>	Domestic <sup>9</sup>	Non-Domestic <sup>10</sup>
	2010-2013	25%	25%	44%	44%
	2013 . 2016	44%	44%	55%	55%
	2016 . 2019	± Z ^   [ Á Ô ε	100% <sup>12</sup>	± zero carbonq	As per building regs
	2020 . 2027	± Z ^   [ Á Ô	± Z ^   [ Á Ô	± zero carbonq	± zero carbonq

The Draft Replacement London Plan has just been subject to an Examination in Public (EiP) and when this is fully finished, the EiP panel will write a report to the Mayor recommending changes to the DRLP, which the Mayor can accept or reject. Following this, the Mayor sends a final version of the plan to the Secretary of State, who decides whether any further changes are needed. Once complete, the Mayor can formally

<sup>6</sup> Stated as reduction from Building Regulations Part L 2006

<sup>7</sup> See <http://www.london.gov.uk/shaping-london/london-plan/strategy/chapter5.jsp>

<sup>8</sup> Target reduction expressed relative to a 2006 gas-fuelled base-case

<sup>9</sup> Calculated using flat 25% approach for new homes in accordance with the final 2010 Part L Building Regulations.

<sup>10</sup> Calculated using aggregate 25% approach for new non-dom buildings in accordance with the final 2010 Part L Building Regs

<sup>11</sup> %V [ c æ] Á & æ emissions from all energy uses within the building, including appliance loads

<sup>12</sup> Regulated energy only

publish the revised Plan. This is expected in late 2011. As the DRLP goes through these stages its importance increases and so has been included here for consideration.

## 2.3 Local Policy

### London Borough of Lewisham, Unitary Development Plan (UDP) (2004)

The UDP provides the land use planning framework for guiding physical change and improvement in the borough. As outlined by Chapter 4 Environmental Protection of the UDP, the Council will aim to stabilise and improved the environment by:

- § Encouraging energy and natural resource conservation and promote environmentally acceptable forms of energy generation, in particular renewable forms of energy and resource consumption. Policy STR ENV PRO 3 (Saved).
- § Using the planning system, where appropriate, to facilitate improvement and decontamination of poor quality, degraded and contaminated land. Policy STR.ENV PRO 4

Other energy related policies are:

- § ENV.PRO 18 Electricity Generation
  - ! Proposals for electricity generation facilities will be assessed against the following criteria:
    - ! (a) the sensitivity to noise and other pollution of neighbouring uses;
    - ! (b) loss of amenity that any pollution might cause to neighbouring uses;
    - ! (c) the design and appearance of the generating facility.
- § ENV.PRO 19 Energy Efficiency
  - ! Developments should have regard to the principles of energy and natural resource efficiency through their design, orientation, density and location.
- § ENV.PRO 20 Renewable Energy
  - ! The Council will consider environmentally acceptable forms of renewable energy where there is no conflict with other policies in the Plan.

### London Borough of Lewisham, Proposed Core Strategy (2010)

The Lewisham Core Strategy is a Development Plan Document and sets out the vision, objectives, strategy and policies that will guide public and private sector investment to manage development and regeneration in the borough over the next 15 years. The Core Strategy is the key planning document in the Lewisham Local Development Framework (LDF). It sets out the overall ambitions and priorities for the borough, a set of proposals, and a means for making sure that they are delivered. The consultation period for this document closed in April 2010 and was submitted to the Secretary of State in October 2010. It will now be the subject of an Examination in Public conducted by an independent Planning Inspector. This is to take place in February 2011.

Of particular relevance to the Surrey Canal is:

- § Sustainable Development
  - ! Creation of acceptable noise and air quality environments for future occupiers
  - ! Water and waste water infrastructure capability
- § Energy Use.
  - ! Include an assessment of energy to show how CO<sub>2</sub> emissions will be minimised

- ! Maximising the opportunity of supplying energy efficiently by prioritising decentralised energy generation (clean) for any existing or new developments according to the requirements of London Plan policy, and in the Regeneration and Growth Areas using SELCHP (South East London Combined Heat and Power Plant) as an energy source
- ! New residential developments to achieve levels 4 on Code for Sustainable Homes and BREEAM for non-residential elements.

## 2.4 Funding & Incentivisation

There are requirements imposed in relation to funding streams such as:

- § Homes & Communities Agency funding for social housing
- § Meeting a 60% Carbon Emissions Reduction for schools (DCSF)

The relevant policy and funding requirements have been extracted and summarised in Table 6 below:

Table 6: National funding requirements

Funding	Requirement		
Housing Corporation funding for affordable housing	2008/2011	2011/2014	2014 (to be confirmed)
	Code Level 3	Code Level 4	Code Level 6
Department for Children, Schools and Families	60% reduction from BR Part L 2002 and small power		

Source: Housing Corporation Design & Quality Strategy 2007

There are other financial incentives that could be utilised at Surrey Canal including Feed-In-Tariffs (FITs), which allow the generator to earn a regulated income from every kilowatt hour generated, and the Renewable Heat Incentive (RHI) which is a promised forthcoming piece of legislation to provide a fixed rate financial incentive for renewable heat.

Relevant incentives are discussed in Appendix B.

## 3. Energy Assessment Approach

The approach taken for site-wide energy assessment is to examine the relevant planning policies, calculate energy demand estimates for the Proposed Development and investigate the various energy scenarios to meet the policy requirements. The approach demonstrates the expected energy and carbon dioxide savings through a lean, clean and green strategy as outlined in the London Plan:

- § reduce energy demand to a minimum;
- § meet this demand as efficiently as possible; and
- § use onsite renewable and/or low carbon energy sources to supply a significant proportion of the Proposed Developments requirements.

Reducing the demand first will reduce the amount of energy that needs to be supplied by renewable or low carbon sources.

### 3.1 Accommodation Schedule

The Proposed Development at for Surrey Canal is for up to 250,000 square metres (sqm) of floor space (gross external area (GEA)). The split by floor space is as follows:

- § A1/A2 Retail: up to 3,600 sqm;
- § A3-A4: Cafes/Restaurants and Drinking Establishments up to 3,500 sqm;
- § A5 Hot Food Takeaways: up to 300 sqm;
- § B1 Business: 10,000 sq m - 15,000 sqm;
- § C1 Hotels: up to 15,000 sqm;
- § C3 Residential: 150,000 sq m - 200,000 sqm (up to 2,500 units);
- § D1 Community: 400 sqm - 10,000 sqm; and
- § D2 Leisure and Entertainment: 4,120 sq m up to 15,800 sqm.

The maximum total of the floor space by land use is more than the total quantum of development floor space. This is in order to allow flexibility in the delivery of the Proposed Development as it comes forward over time. Also, the total quantum by floor space of non-residential uses will always be no less than 37,000 sqm or 20% of the total floorspace provided, whichever is the lower, notwithstanding the minimum quantum by land use specified above.

The energy assessment has been based on the maximum floor space parameters to ensure that a worst case scenario is analysed. The floor space has been split into appropriate policy windows in order that it can be assessed against the increasing carbon abatement targets that will be required by planning and Building Regulations.

### 3.2 Policy Assumptions used for Analysis

Due to the current uncertainty regarding the future requirements of Building Regulations over the next 20 years or so, a number of assumptions have necessarily been made in order to progress this analysis. These are summarised in the following sections.

#### 3.2.1 Building Regulations and the Draft Replacement London Plan

The 2010 Part L changes are based on a 25% improvement over 2006 Part L standards. For domestic buildings, the calculation tool against which compliance with Part L 2010 is checked is SAP 2009, and the full details of this have only recently been released. With regards to the Surrey Canal outline planning

energy strategy, all steps of the assumption, for which calculations could be made. This is of particular importance regarding the non-residential element of Surrey Canal where the 2010 revision does not necessarily imply a 25% improvement over 2006 for each building and depends heavily on the assumptions surrounding the notional building. Furthermore, the planning requirements are still based on improvements from Part L 2006, so this approach allows consistency between the two sets of targets. Nevertheless, an approximation has been for the 2010 emissions to allow for comparison with the new version and future policies.

For future updates of Building Regulations the following targets have been assumed in relation to determining the likely load profile of the Proposed Development, based on the Building a Greener Future c 3.2.2 - domestic buildings. In addition, the DRLP has indicated targets that are a material consideration in the derivation of eventual energy solutions.

Table 7: Future policy assumptions

Policy Window	Dates	Building Regulations		Draft Replacement London Plan <sup>13</sup>	
		Domestic <sup>5</sup>	Non-Domestic <sup>14</sup>	Domestic <sup>15</sup>	Non-Domestic <sup>16</sup>
1	2013 . 2016	44%	44%	55%	55%
2	2016 . 2019	± Z ^   [ Á Ö ε	100% <sup>18</sup>	± 0 to carbonq	As per building regs
3	2020 . 2027	± Z ^   [ Á Ô	± Z ^   [ Á Ô	± 0 to carbonq	± 0 to carbonq

3.2.2 Energy Efficiency

The detailed requirements for each step of the hierarchy (see Figure 2.2) are not expected to be announced until at least the New Year.

In the absence of detailed requirements the following assumptions will be used:

§ Energy Efficiency

It is assumed that all dwellings will employ Very Good practice measures to take advantage of supply chain improvement driven by ever tighter national standards, minimising carbon emissions. The specifications referred to throughout this report are shown in Table 8:

Table 8: Energy efficiency standards used for analysis

Case Study Building Fabric and Efficiency Values	EE1 Good EE	EE2 Very Good EE
Wall U-value (W/m <sup>2</sup> K)	0.20	0.15
Roof U-value (W/m <sup>2</sup> K)	0.15	0.15
Floor U-value (W/m <sup>2</sup> K)	0.2	0.15
Window & Door U-value (W/m <sup>2</sup> K)	1.6	1
Airtightness (m <sup>3</sup> /hr/m <sup>2</sup> )	7	3

<sup>13</sup> See <http://www.london.gov.uk/shaping-london/london-plan/strategy/chapter5.jsp>

<sup>14</sup> Target reduction expressed relative to a 2006 gas-fuelled base-case

<sup>15</sup> Calculated using flat 25% approach for new homes in accordance with the final 2010 Part L Building Regulations.

<sup>16</sup> Calculated using aggregate 25% approach for new non-dom buildings in accordance with the final 2010 Part L Building Regs

<sup>17</sup> %V [ c æ] Á & æmissions for Á Æ energy uses within the building, including appliance loads

<sup>18</sup> Regulated energy only

Case Study Building Fabric and Efficiency Values	EE1 Good EE	EE2 Very Good EE
Heat Loss Parameter (W/m <sup>2</sup> K)	1.2	0.8
Thermal Bridging (y-value)	0.08	0.08
% Low Energy Lighting	75%	100%
Ventilation Type	Natural	MVHR AppQ
Window Type	Double low-e	Triple low-e
Reduction in non-regulated electricity Demand	-	15% <sup>19</sup>

§ **Carbon Compliance**

Assessing a 70% reduction based on the calculation methodology used in the consultation document bespoke energy assessment model to be created which is beyond the scope of this stage of assessment. Therefore, for the purposes of this report it has been assumed that the carbon compliance target is 70% of the regulated energy as defined under the Building Regulations 2006 calculated using SAP 2005.

§ **Allowable Solutions**

The consultation is not intended to be capped & the intention that the allowable solutions scheme should be structured such that this is, on average, the maximum price paid by developers in order to mitigate emissions via allowable solutions. For this reason, the maximum price assumed in the impact assessment<sup>20</sup> of £100kgCO<sub>2</sub>/a for 30 years has been used for the purposes of this analysis.

3.3 Baseline Energy Demand

The baseline used to compare the CO<sub>2</sub> emissions savings for the energy strategy assumes that individual gas-fired boilers are used and electricity is supplied via the Grid. Residential demand is based on the Target CO<sub>2</sub> Emissions Rate (TER) derived from SAP, whereas for the non-residential provision, baseline demands were determined by type using a combination of CIBSE Guide F for annual demand data, and the ESC (which provides information on demand profiles.<sup>21</sup> Being at an outline application stage with all matters reserved the results of detailed modelling would be subject to considerable variation and so are not used at this stage of the assessment.

Using this method the baseline CO<sub>2</sub> emission is estimated to be 10,300 tCO<sub>2</sub>/year using 2006 Building Regulations or 8,600 t CO<sub>2</sub>/year under the recent October 2010 Building Regulations revision.

<sup>19</sup> This number is based upon implementing measures such as behavioural change, smart meters and demand side management. <http://www.energysavingtrust.org.uk/Resources/Features/Features-archive/Smart-meters-your-questions-answered>. As well as manufacturers data on stand-by power mitigation.

<sup>20</sup> Definition of zero carbon homes impact assessment: <http://www.communities.gov.uk/documents/planningandbuilding/pdf/1101260.pdf>

<sup>21</sup> For instances when this information was unavailable, other official data was used where available

## 4. Energy Efficient Baseline Scheme

The energy efficiency standards used for analysis are shown in Table 8. In this case, Very Good energy efficiency standards have been used for throughout all phases, illustrating a commitment for improvement beyond Building Regulations.

Table 9: Assumed Build Specification

Case Study Building Fabric and Efficiency Values	BR 2010 Minimum Requirements	Surrey Canal Assumed Energy Efficiency
Wall U-value (W/m <sup>2</sup> K)	0.30	0.15
Roof U-value (W/m <sup>2</sup> K)	0.20	0.15
Floor U-value (W/m <sup>2</sup> K)	0.25	0.15
Window & Door U-value (W/m <sup>2</sup> K)	2	1
Airtightness (m <sup>3</sup> /hr/m <sup>2</sup> )	10	3
Heat Loss Parameter (W/m <sup>2</sup> k)	-	0.8
Thermal Bridging (y-value)	-	0.08
% Low Energy Lighting	-	100%
Ventilation Type	-	MVHR AppQ
Window Type	-	Triple low-e

These lower U-values require the use of thicker fabric material which has been taken into account in the building design. For residential uses the specification also includes the use of mechanical ventilation and heat recovery (MVHR) units to supply fresh air to living spaces and recover air from hallway / kitchen. A dwelling utilising MVHR may require slightly higher storey heights to facilitate ducts running within ceiling void of flats.

For non-residential, the energy efficiency measures are closely related to the specific uses and, the servicing is not fully defined as yet. Nevertheless, it has been assumed in general that thermal envelope improvements would reduce space heating demand as well as reduce cooling demand where it is used. It is also proposed that high efficiency plant such as variable speed pumps, efficient fans, demand controlled ventilation with heat recovery and improved chiller co-efficient of performance (COP) would be included where applicable.

To reduce the proposed non-regulated energy associated with appliances, a 15% reduction has been assumed based on the anticipated use of smart-metering and other energy saving technologies like stand-by power management. The follow table represents the predicted baseline carbon emissions from the Proposed Development.

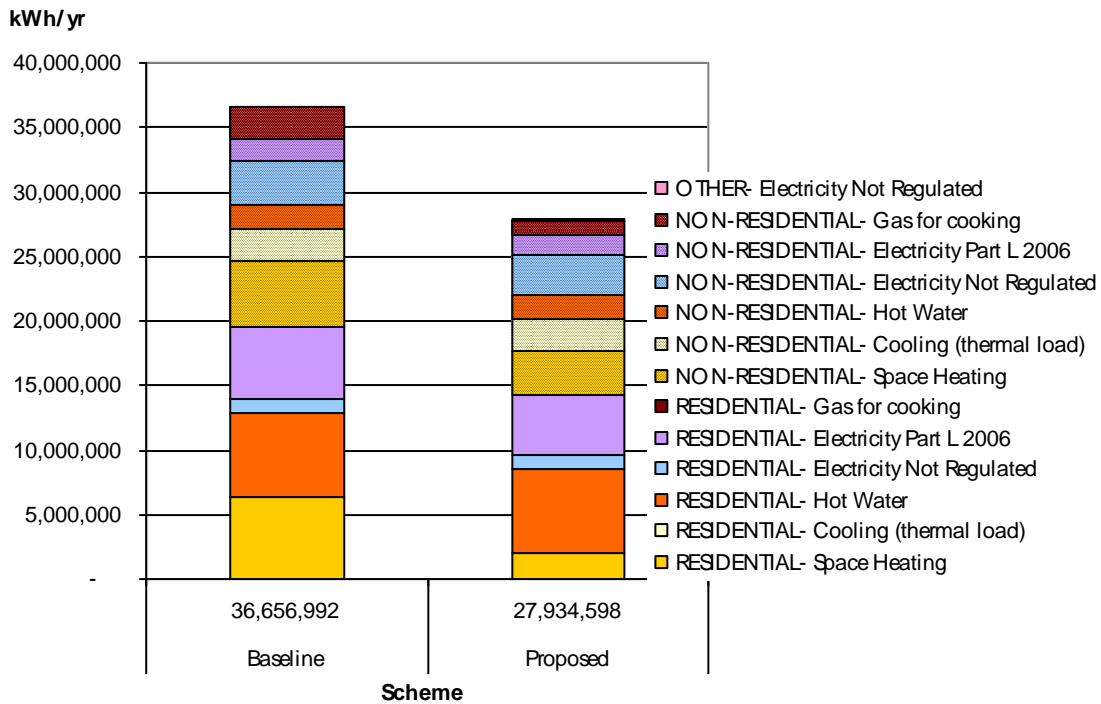
Table 10: CO<sub>2</sub> Emissions

Energy efficient scheme	
Site baseline CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	10,300
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	8,200
Reductions beyond baseline	~20%

The established baseline CO<sub>2</sub> emissions for the Proposed Development and the proposed emissions taking into account energy efficiency measures are shown in Figure 4.1, Note that under the recent

October 2010 Building Regulations revision the baseline has been estimated as around 8,600 t CO<sub>2</sub>/year, which would correspond to approximately a 5% reduction due to energy efficiency.

Figure 4.1: Total predicted energy demand . Baseline vs. Proposed



## 5. Energy Efficient Scheme with CHP and Communal Heating Network

### 5.1 Combined Heat and Power (CHP)

Combined Heat and Power units are essentially small electricity power stations. They generate electricity and are more efficient than power stations because the heat generated as a by product of electricity generation is used to provide heating and hot water to buildings.

To gain the maximum efficiency from a CHP system it is desirable to use 100% of its electrical and heat output for more than 4000 hours a year. CHP units are therefore usually sized to meet base heat provision loads with additional top up provided from supplementary sources, such as gas or biomass/biofuel fired boilers.

Typically, CHP units would be integrated into a heating network or serve large buildings with significant base heat loads in order to be most effective.

### 5.2 Communal Energy Networks

By utilising a communal heating network, efficiencies can be made as generally larger energy systems use fuel more efficiently than smaller energy systems. Centralised energy systems can supply a combination of hot water, space heating, space cooling, and power to a site through an energy network. Although central to the development, such systems are considered to be decentralised in relation to grid energy generation and distribution.

The most common form of centralised energy supply is community heating. This is where space heating and hot water is delivered to multiple buildings/dwellings by centralised plant via a network of insulated pipes buried in the ground. The pipe network would generally be installed at the same time as other services (water, drainage, etc) to minimise costs.

Most heat generation technologies discussed in this report can be used for centralised generation and some (such as CHP) only become commercially viable if used in this way.

In order for centralised heat generation plant to be sized cost-effectively, a thermal store is often needed in which to hold the heat until it is required. This could be in the form of a large central store, plot-based stores, or individual stores (such as a hot water cylinder in every dwelling), or a combination of the three, depending on the specific requirements of the development.

One further benefit of centralised energy systems is that the means of energy generation can be easily modified and added to in the future. This means that they can more effectively future-proof a development because as new more efficient and environmentally friendly heating/cooling/electricity generation technologies are proven and become cost effective, a system with minimal disruption, and therefore reduce the risk associated with changing fuel economies.

For any communal system, such as one that requires an ESCo (Energy Services Company), the influence of revenue streams will affect the choice of energy strategy. Recent and likely future changes to the regulatory environment mean that this is a complicated and evolving area.

### 5.3 SELCHP

#### 5.3.1 Background

The nearby SELCHP (South East London Combined Heat and Power Plant) energy from waste facility (EfW) is currently only providing power not CHP as there is no heat network. Nevertheless, its steam turbine can provide extraction of heat at useful temperatures and approximately 40 MW of heat could be available. On average this could supply heat demands of around 10,000 standard UK homes. Various studies<sup>22</sup> have been performed to investigate connecting it to a heat network and have shown the carbon emission reduction benefit it could bring. The GLA, LB Southwark and LB Lewisham are keen to promote the connection to SELCHP.

To further this promotion in March 2010, LB Southwark and Veolia have, through a Section 106 agreement accompanying a new waste facility<sup>23</sup> in the London Borough of Southwark, committed to using reasonable endeavours to connect SELCHP to a district heating network. This is proposed to be connected to the Southwark Park Estate to the North West which should provide the necessary momentum to begin the enabling work required for a district heating system from SELCHP.

The primary energy strategy for Surrey Canal is to connect to SELCHP and supply heat throughout the Site over a district heating network. Discussions on connecting Surrey Canal to SELCHP have been held with Steve Brown, general manager at SELCHP and have been positive, and a Statement of Intent has been received. Both Renewal and SELCHP have agreed to pursue a connection further including the possibility of also taking power as well. SELCHP have been given the potential energy demands for Surrey Canal and are assessing the beneficial addition of this to their model for the LB Southwark scheme.

#### 5.3.2 Carbon Emission Reductions

Energy from waste is a low carbon / renewable technology. In SAP 2009 waste has a carbon emissions factor of 0.04 kgCO<sub>2</sub>/kWh. This compares to 0.198 kgCO<sub>2</sub>/kWh for natural gas or 0.517 kgCO<sub>2</sub>/kWh for electricity from the national grid. Furthermore, the Renewables Obligation states 50% of Municipal Solid

The carbon emissions reduction potential of SELCHP supplying heat to Surrey Canal has been analysed with other energy provision as listed in Table 11.

Table 11: Energy Provision

Energy Demand	Energy delivery technology
Hot water	SELCHP
Space heating	SELCHP
Space cooling	Electric chiller
Electricity	Grid

22 [Community Heating Development Study Summary Report \(May 2005\)](#) and [Surrey Canal District Heating Study \(2009\)](#)  
 23 Application no. 08/AP/2209

The resulting emission reductions are listed in Table 12.

Table 12: CO<sub>2</sub> Emissions

Energy efficient scheme with SELCHP and communal heating	
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	5,300
Reductions beyond Energy Efficient baseline	~28%

Whilst SELCHP offers good potential for carbon emission reductions, there are a number of important matters that need to be addressed to enable a district heating connection to SELCHP for Surrey Canal:

- § Requirement for standby / backup and peak load boilers;
- § Routing of district heating network connection; and
- § Future of SELCHP.

These are discussed in more detail in the following sections.

#### 5.3.3 Standby / Backup and Peak Load Boilers

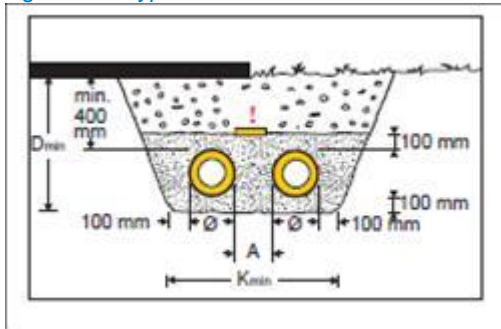
Facilities would be required for any backup plant to guarantee an uninterrupted supply of heat in the event of any unplanned or planned outage at SELCHP. Although it has to be noted that SELCHP has 2 boiler units, and so some resilience already exists. Backup boilers would also be able to produce additional heat to meet any peak load demands that are in excess of the total SELCHP output. The requirement for this would depend on the actual heat load on SELCHP, which at the moment is zero. Large heat accumulators or thermal stores could also be used to assist in smoothing out peak demands and providing immediate heat backup.

For convenience and cost reasons it is likely that large floor mounted natural gas fired boilers would be the most appropriate choice for backup. These could be operated reasonably quickly and would not have the fuel storage requirements of heating oil. Although fossil fuel based these would only be operated very infrequently and thus have negligible impacts on carbon emissions. It is envisaged that one single energy centre would be located in Plot Orion to provide backup for Surrey Canal.

#### 5.3.4 Routing of SELCHP Connection

District heating networks normally consist of 2 pipes one for flow and one for return. Pre-insulated pipes are normally used for external networks and these are buried within purposely built trenches. The pipes consist of an inner carrier pipe, insulation and then an outer protective casing. The carrier pipe material can be steel or plastic depending on size and temperature requirements, and the outer casing is normally plastic. The effect of the extra size due to the insulation and the need for 2 pipes means that the trench width is not insignificant. In particular, large diameter steel pipes (Outside diameter - OD ~400mm) may be needed to handle the quantity of heat for the connection to SELCHP, hence a wide trench (~1.2m) and works access (~3m) will be necessary, see Figure 5.1 and Figure 5.2 below.

Figure 5.1: Typical Trench Detail



Source: Logstor

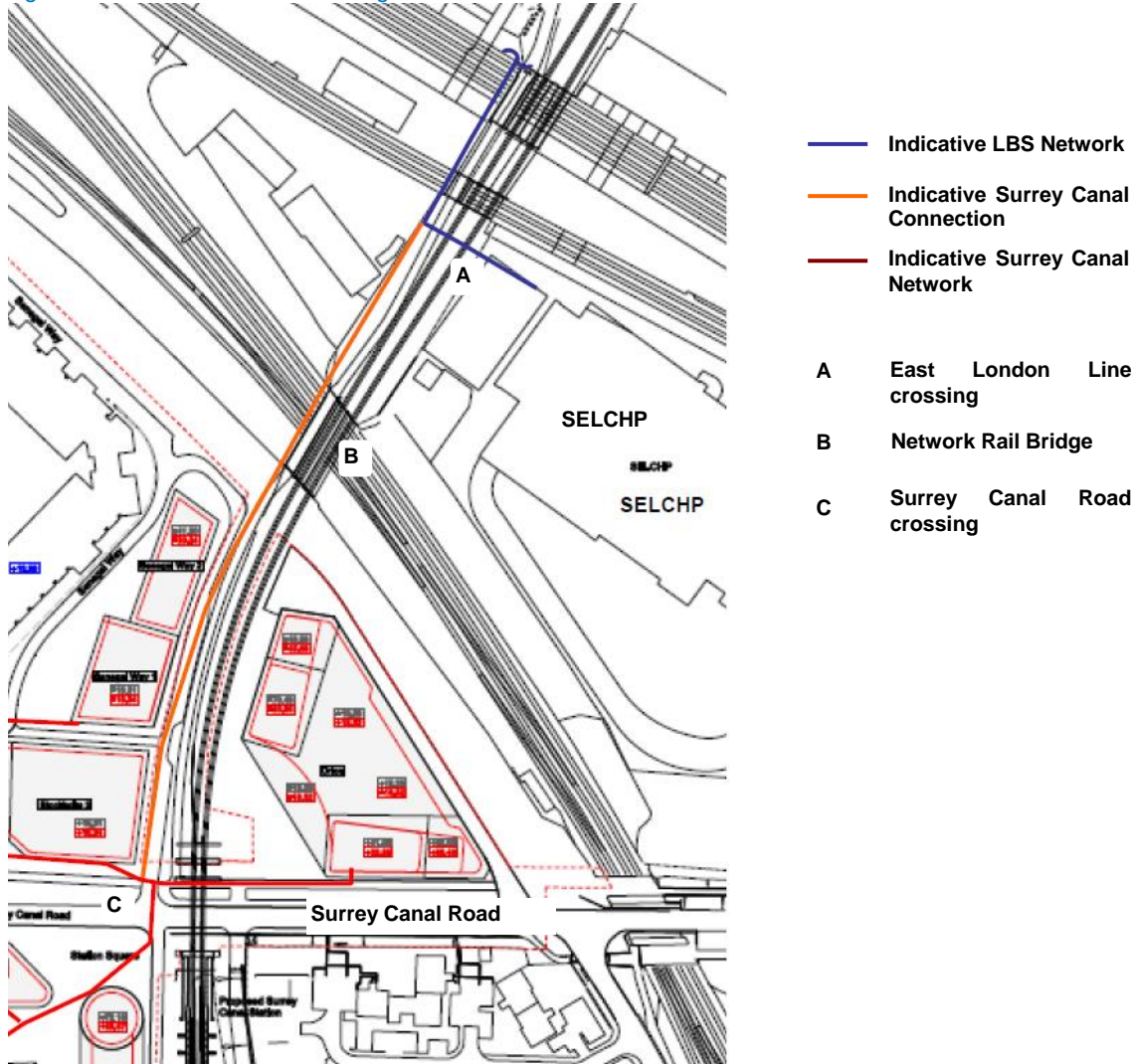
Figure 5.2: Installation of large diameter pipe



Source: Danish District Heating Association

Indicative plans for the proposed LBS heat network show that the pipes would exit the rear of the plant on to the footpath at its western edge and head north to the Southwark Park Estate. To connect to Surrey Canal it is anticipated that a branch could run south along the footpath at the western edge of SELCHP to connect to a network around Surrey Canal, see Figure 5.3. This connection would be around 250m in length.

Figure 5.3: SELCHP District Heating Connection



It has to be noted that by autumn 2012 the footpath at the western edge of SELCHP will also be the alignment for the East London Line (ELL) Phase 2 and current plans, Figure 5.4, indicate that the footpath will be retained.

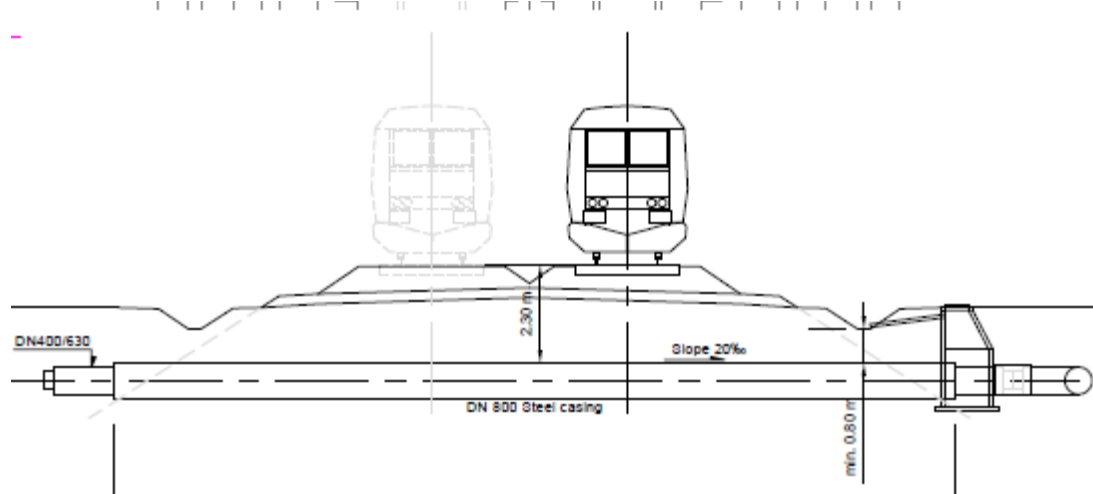
Figure 5.4: East London Line Phase 2 . new rail link



Source: <http://www.tfl.gov.uk/corporate/projectsandschemes/16240.aspx>

The heat network will need an under track crossing (UTC) to reach the above mentioned footpath from SELCHP (point A on Figure 5.3). For example this can be achieved by placing two steel casings under tracks to house the flow and return district heating pipes, see Figure 5.5. The passive provision of ducting has now been designed into the ELL Phase 2 works to avoid the potential high costs of installation post completion of the works. TfL have now had these works fully costed and provided a budgetary quote to SELCHP for the inclusion of passive provision of ducting to enable future installation of pipe work.

Figure 5.5: UTC for district heating pipes



Source: PPSL District Energy

The connection would then run along under the above mentioned footpath and permission would be needed from the owners of this land (ELL) to either allow a wayleave or easement for the pipes. Further south the footpath passes under a Network Rail bridge for the track to New Cross Gate (point B on Figure 5.3). This bridge has three arches (Figure 5.6, Figure 5.7), two of which would be required for the ELL tracks with the remaining arch able to facilitate the route of the pipes which would be laid beneath a cycle and pedestrian route being retained as part of the ELL2 works.

Figure 5.6: Network Rail Bridge . Arch for pipes



Source: Photo April 2010

Figure 5.7: Network Rail Bridge . Arches for ELL



Source: Photo April 2010

Permission will be required from Network Rail to use this arch and it is understood that the bridge will undergo strengthening work. Mott MacDonald Fulcrum are in the process of obtaining drawings from Network Rail to understand the issues for pipe installation under the arch. Further discussion will then be required with SELCHP, TfL and Network Rail in relation to the installation of the pipes.

Pipes will need to cross Surrey Canal Road to reach the southern half of Surrey Canal. The road is lower than the surrounding ground level and was formed from the filling in of Surrey Canal. The footpath crosses this via a bridge, Figure 5.8. Investigation of utility records shows that this road is congested with services and contains some major strategic ones including 2no. extra high voltage (EHV) 132 kV EDF electricity cables and a 600mm intermediate pressure (IP) Southern Gas Networks gas main. To traverse the road district heating pipes would need to avoid existing utilities; this could be achieved by going underneath them and district heating pipes can be installed via trenchless techniques such as tunnelling or pipe-jacking. Nevertheless, this could be expensive. Another option may be to take the pipes above ground and cross over the road using a pipe bridge, Figure 5.9. This structure could be integrated with the rail bridge required for the ELL.

Figure 5.8: Current Footbridge Across Surrey Canal Rd



Source: Photo taken April 2010

Figure 5.9: Example Pipe Bridge



Source: Logstor

If SELCHP is to supply district heating to other new and existing sites to the south, such as the estates south of Rollins Street, crossing Surrey Canal Road will be necessary.

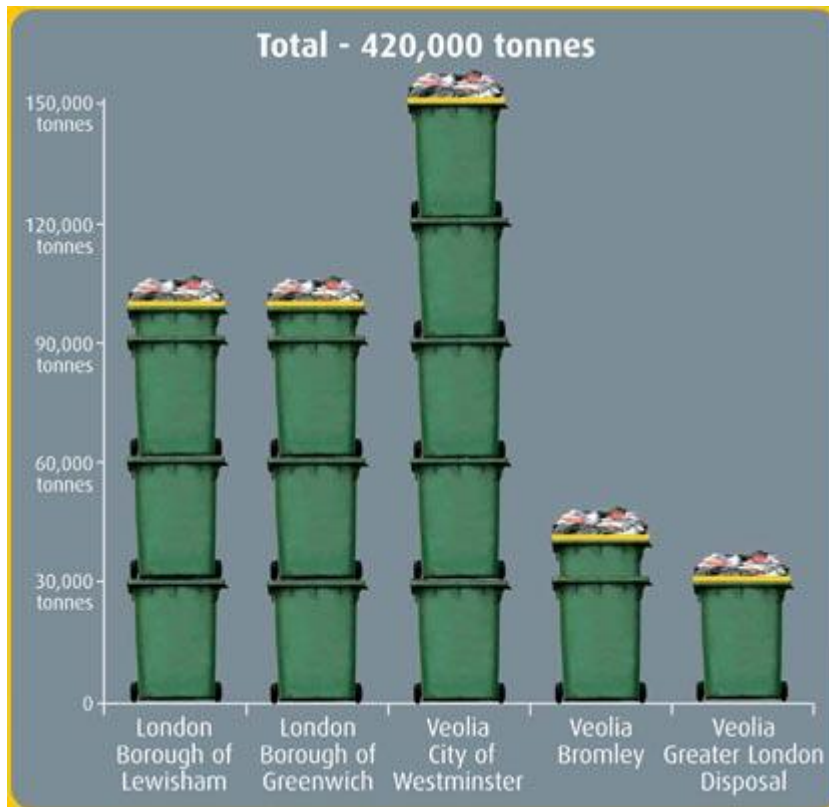
#### 5.3.5 Future of SELCHP

SELCHP opened in 1994 and is scheduled to close around 2032 as the plant reaches the end of its operating life. Also, although SELCHP meets current pollution regulations such as the Waste Incineration Directive (WID), it could be the case that future legislation may force expensive retrofitting that could lead to earlier closure.

However, it is assumed that the SELCHP site could still be the location for an energy facility and SELCHP would be replaced with future technologies, such as smaller scale pyrolysis or gasification using solid recovered fuel (SRF) or fuel cells with hydrogen. Furthermore, any contract to supply Surrey Canal with heat would be long term (in the region of 20 years plus) regardless of the future of the current SELCHP plant and carbon emission reductions would form a key condition of this.

In addition to the lifetime of the plant, the security of the waste fuel source is another area to consider. SELCHP receives waste from a number of London authorities, see Figure 5.10.

Figure 5.10: SELCHP Waste Contract Details



Source: <http://www.selchp.com/commercial.html> accessed August 2010

The major contracts are detailed in Table 13 below. As can be seen about 350 kilotonnes per annum (ktpa) of the 420 ktpa maximum capacity is contracted till at least 2016.

Table 13: Major SELCHP Waste Contracts

Contract	Quantity	Length	Data Source
City of Westminster	150 ktpa	Disposal contract expire in 2016/17 (Also waste collection)	City Management Services and Finances June 2010 <sup>24</sup>
LBs Lewisham / Greenwich	Min 100 ktpa each (renegotiated every 5 yrs)	2024	LBL Municipal Waste Management Strategy <sup>25</sup>

Also management companies and may have access to other waste streams if necessary. In 2008 they secured

24 [http://www3.westminster.gov.uk/newcsu/Policy\\_and\\_Scrutiny\\_Committees/Current\\_P\\_and\\_S\\_Committees\\_and\\_Task\\_Groups/Finance\\_and\\_Resources/2010/22%20June2010/item\\_5\\_City%20Management%20Finances%20report.doc](http://www3.westminster.gov.uk/newcsu/Policy_and_Scrutiny_Committees/Current_P_and_S_Committees_and_Task_Groups/Finance_and_Resources/2010/22%20June2010/item_5_City%20Management%20Finances%20report.doc)

25 [http://www.lewisham.gov.uk/NR/rdoonlyres/60F7EBE2-1A5D-43FA-8C78-E6173359278B/0/WasteStrategyv5\\_Draft.pdf](http://www.lewisham.gov.uk/NR/rdoonlyres/60F7EBE2-1A5D-43FA-8C78-E6173359278B/0/WasteStrategyv5_Draft.pdf)

a waste management PFI contract with LB Southwark<sup>26</sup>; this included the integrated waste management facility mentioned earlier. Waste-derived fuel from the facility will be sent to SELCHP.

Thus in the short term the availability of fuel and availability of SELCHP may not be a major issue. The longer term is greatly influenced by EU and UK waste policy. The Landfill Directive through measures such as the Landfill Tax escalator and Landfill Allowance Trading Scheme (LATS) is steering waste disposal away from landfill and towards energy recovery. However, the new UK Government, through its fundamental Review of Waste Policies<sup>27</sup>, may have an impact on the economics or regulatory burden on waste combustion. Also, the 2008 revision of the EU Directive on Waste is still yet to feed through to UK policy. This is expected to have a significant impact on the economics of waste-to-energy plants and 65% for new plants. This might have some affect on the future business planning of SELCHP, as a CHP system linked to a district heating system will generally have higher overall efficiencies.

Given the areas discussed above in regards to the future of SELCHP, it is expected that in the near and long terms low carbon heat would be guaranteed for Surrey Canal.

5.3.6 SELCHP Next Steps

As highlighted by the above sections, progress has begun on enabling a district heating connection from SELCHP to Surrey Canal and this is the subject of discussions with SELCHP and ELL designers; as a result Table 5.14 displays some of the actions arising. The most urgent are being pursued immediately, whereas others will be investigated further to planning permission being secured. These can be incorporated into a Heads of Terms for the SELCHP Energy Supply or a Section 106 Agreement. Please refer to the Appendix for further records of discussions.

Table 5.14: SELCHP Next Steps

Issue	Detail	Action	Timeframe
Pipe route . ELL Crossing	UTX to be included	SELCHP to arrange.	Now
Pipe route . ELL Footpath	Permission for DH pipe to be laid under path.	SELCHP to arrange	Now
Pipe route . NR Bridge	Verification required from NR that DH pipe can go under arch	MMF obtaining further information from NR and follow up with SELCHP.	Early as possible
Pipe route . Surrey Canal Road crossing	Solution required for crossing road	To be further investigated	After permission has been secured
Future of SELCHP	Issue of energy supply and long term future of SELCHP	Heads of terms and contract agreements to be for long term supply	Contract negotiations to begin in detail once permission has been secured

26 [http://www.veoliaenvironmentalservices.co.uk/pages/media\\_pressReleasesDirect.asp?articleId=1410&highlight=SELCHP](http://www.veoliaenvironmentalservices.co.uk/pages/media_pressReleasesDirect.asp?articleId=1410&highlight=SELCHP)  
 27 <http://www.defra.gov.uk/corporate/consult/waste-review/>

## 5.4 Onsite Gas fired CHP

The use of onsite gas fired CHP has been considered as an alternative option if the SELCHP connection is not possible. It is envisaged that the energy centre would be located in Plot Orion, and this would house a large gas fired CHP unit (in the region of over 1 MW electrical) alongside large floor mounted natural gas fired boilers for peak demands. The CHP would utilise a large thermal store and supply a portion of space heating demand to maximise operational hours. A linked heating network would distribute the heat around the Site.

The carbon emissions reduction potential of this gas CHP option has been analysed with other energy provision as listed in Table 15.

Table 15: Energy Provision

Energy Demand	Energy delivery technology
Hot water	Gas fired CHP
Space heating	Gas fired CHP with peak gas boilers
Space cooling	Electric chiller
Electricity	Gas fired CHP + Grid

The resulting emission reductions are listed in Table 16.

Table 16: CO<sub>2</sub> Emissions

Energy efficient scheme with Gas CHP and communal heating	
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	5,600
Reductions beyond Energy Efficient baseline	~25%

Whilst gas CHP offers reasonable potential for carbon emission reductions it is less than the SELCHP option due to the higher carbon intensity of the fuel. Also although the use of a large single engine should achieve higher efficiencies, there will be implications due to phasing which would mean that the unit would not operate effectively until a certain level of build out.

## 5.5 Trigeneration or CCHP

Trigeneration is combined cooling, heat, and power (CCHP), usually this involves the production of cooling from CHP heat via absorption chillers. The greater heat demand can increase the viability of the CHP operation as well as its size. This can lead to greater potential carbon emission reductions as it removes the need for cooling from electrical chillers depending on relative carbon efficiencies of the heat source and the chillers.

The feasibility of CCHP depends on the size, type and profile of the cooling load as well as the nature of the heat source. Absorption chillers tend to have large capacities and operate better when producing a steady, constant output. At this outline stage the cooling demands of Surrey Canal can only be approximately estimated as discussion on details such as particular design conditions will start once permission is secured and reserved matters designs begin. Nevertheless, the primary emphasis would be on to remove or reduce the need for mechanical cooling rather than use CCHP.

Nevertheless, the proposed uses of B1 (Business), C1 (Hotels), D1 (Non-residential institutions) and D2 (Assembly & Leisure) can have space cooling demand and in total this has been estimated to be in the region of ~ 3MW. Whilst in total this might be of a size suited to absorption chillers (an absorption chiller<sup>28</sup> is around 300kW) the cooling loads are not all in the same plot and may not be concurrent. There would be a choice between either decentralising the absorption chillers in blocks of high cooling demand or having a centralised chiller with a cooling network. The preferred option would depend on future detailed design. However, there are three important points to note. Firstly, absorption chillers generally require hot water at around 90°C or more, the supplying heat system would need to provide this and often modern district heating systems do not necessarily do this whilst optimising electrical generation efficiency. Secondly, a site wide cooling network would require further external infrastructure (in addition to the heat network) and pipe sizes tend to be quite large due to the small temperature difference in cooling systems. Finally, absorption chillers require roughly twice the amount of heat rejection compared to conventional chillers, and normally these are large roof mounted wet cooling towers which have operation and maintenance (O&M) and large space requirements.

The heat source for the absorption chiller(s) could either be SELCHP or gas fired CHP. It should be noted that if a gas fired CHP is used, this additional heat rejection would also increase any local heat island effect, which is contrary to the London Plan Policy 4A.10 Overheating that encourages avoiding excessive heat generation. The carbon emissions reduction potential of both options has been analysed with other energy provision as listed in Table 17.

Table 17: Energy Provision

Energy Demand	SELCHP CCHP Option Energy delivery technology	Gas CCHP Option Energy delivery technology
Hot water	SELCHP	Gas fired CHP
Space heating	SELCHP	Gas fired CHP with peak gas boilers
Space cooling	Absorption chiller(s)	Absorption chiller(s)
Electricity	Grid	Gas fired CHP + Grid

The resulting emission reductions are listed in Table 18.

Table 18: CO<sub>2</sub> Emissions

Energy efficient scheme with	SELCHP CCHP Option	Gas CCHP Option
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	4,900	5,000
Reductions beyond Energy Efficient baseline due to CHP	~28%	~25%
Reductions beyond Energy Efficient baseline due to Absorption Chillers	~6%	~6%
Total reductions beyond Energy Efficient baseline	~34%	~31%

Although these may represent some benefit over the SELCHP / CHP heat only options, the various technical considerations discussed above may prevent these reductions from being possible. For this

<sup>28</sup> [http://www.carrieraircon.co.uk/index.php/chillers/product/16lj\\_11\\_53\\_single\\_effect\\_hot\\_water\\_fired\\_absorption\\_chillers/](http://www.carrieraircon.co.uk/index.php/chillers/product/16lj_11_53_single_effect_hot_water_fired_absorption_chillers/)

reason, it is proposed that the decision to include CCHP would need to be made at the next design stage where a better understanding of cooling requirements and consequent loads can be made.

#### 5.5.1 Spatial Requirements for Community Technologies

Spatial requirements for plant room (both internal requirements (e.g. heat exchangers, solar hot water cylinders) and external (e.g. district heating sub-stations) have been discussed with the design team for incorporation with the dwelling designs should a community system be chosen.

For a community approach, each dwelling will require a Heat Interface Unit (HIU) which is comparable in size to a traditional gas boiler, which it would replace in the design.

Due to its nature, spatial requirements for a community approach extend beyond the immediate dwelling area. The plans have allowed for a district heating network including suitable road widths for piping and a location for centralised plant in the Energy Centre. The plant size accommodates the necessary boilers, pumps, and CHP equipment to operate such a heat network.

Appendix C contains an indicative heat network for Surrey Canal.

## 6. Renewable Options

In this section options are investigated for further reducing the predicted CO<sub>2</sub> emissions of Surrey Canal through renewable energy technologies.

These reductions will be measured against the Energy Efficient Baseline with SELCHP established in section 5.

The technology combinations have been selected taking into account the energy profiles for the Site, the building service requirements for the particular type of energy being generated and the compatibility with preferred energy option of using heat from SELCHP. Table 19 below displays the selection process.

Table 19: Compatible Green Supply Options

Energy	Use	ST	PV	Wood	Wind	ASHP	GSHP / ATES
Heat	Hot water supply	J	I	J	I	I	I
Heat	Space heating (or for cooling)	I	I	J	I	J	J
Electricity	Lights, pumps and fans (Part L regulated); small power and appliances (Non-regulated under Part L)	I	J	I	J	I	I
<b>Compatible with using SELCHP</b>		I	J	I	J	I	?

Note that only technologies which produce electricity are easily compatible with SELCHP. Whilst the heat producing technologies may possibly be technically compatible, they would add extra complexity and reduce the economic case for creating a district heat network to supply the heat from SELCHP<sup>29</sup>. ATES technologies are considered compatible here if they are sized to meet the cooling demand, their resulting heat output is assumed to be balanced to this and will reduce the space heating supplied by SELCHP. Therefore only three of these technologies have been selected for further analysis: PV, ATES and wind.

<sup>29</sup> A similar result would occur for the backup option of using onsite gas fired CHP.

## 6.1 Energy Efficient Scheme with SEL CHP and Photovoltaic Panels (PV)

### 6.1.1 Energy supply options

This scenario looks at the option of adding Photovoltaic panels to supply electricity.

Table 20: Energy Provision

Energy Demand	Energy delivery technology
Hot water	SELCHP
Space heating	SELCHP
Space cooling	Electric chiller
Electricity	Photovoltaic panels and grid electricity

The main physical limitation to the amount of PV that can be installed is the roof space available, as discussed further below.

### 6.1.2 Roof availability

When assessing the available roof space that can be utilised for Photovoltaic panels, an area is desired where safe access can be guaranteed for installation and on-going maintenance of the panels. In the case of safe access to the panels not being available, a moveable access platform (hoist) will need to be utilised. This needs to be taken into consideration in later design.

At Surrey Canal, photovoltaic panels could be located on the higher parts of most plots. The total area of roof taken as technically suitable for photovoltaic panels is approximately 7,500m<sup>2</sup>. The panels should ideally be angled at 30 degrees to the horizontal and facing south for maximum output. For flat roofs spacing of rows of panels should minimise overshadowing of each other and also account for maintenance space required. Taking into account overshadowing, maintenance space and the frames, the roof area allocated should be approximately 3 times the active panel area required. Therefore the total area of possible active photovoltaic panel would be approximately 3,000m<sup>2</sup>.

Competition with other roof uses needs also to be considered and much of the space at roof level in Surrey Canal is identified for specific uses. For health and safety and vandalism reasons it is assumed that systems would not be compatible with areas designated as accessible open space and thus only areas that are not generally accessible are considered as suitable. This would generally be in areas used for brown roofs and there are examples of this roof type where PV systems have been successfully included. As a result of using only this space, the PV area is further reduced. The impacts of panels on surface drainage and biodiversity may further reduce the possible area; at this stage it has been considered that if a small area is included the impact will not be significant.

As well as technical feasibility there also needs to be a consideration of economic viability. Currently the feed-in tariff for PV provides a payback period that is within the predicted lifetime of the system, however, the October 2010 spending review stated that the tariff will be reviewed in 2013 or earlier. This brings into question whether PV may be viable after this date and so as a worst case situation it is assumed that only PV installed prior to this date can be included. This would mean that panels would only be installed on the taller parts of the earlier indicative phases such as Excelsior, Timber Wharf and possibly Orion. This further reduces the area to around 900m<sup>2</sup>.

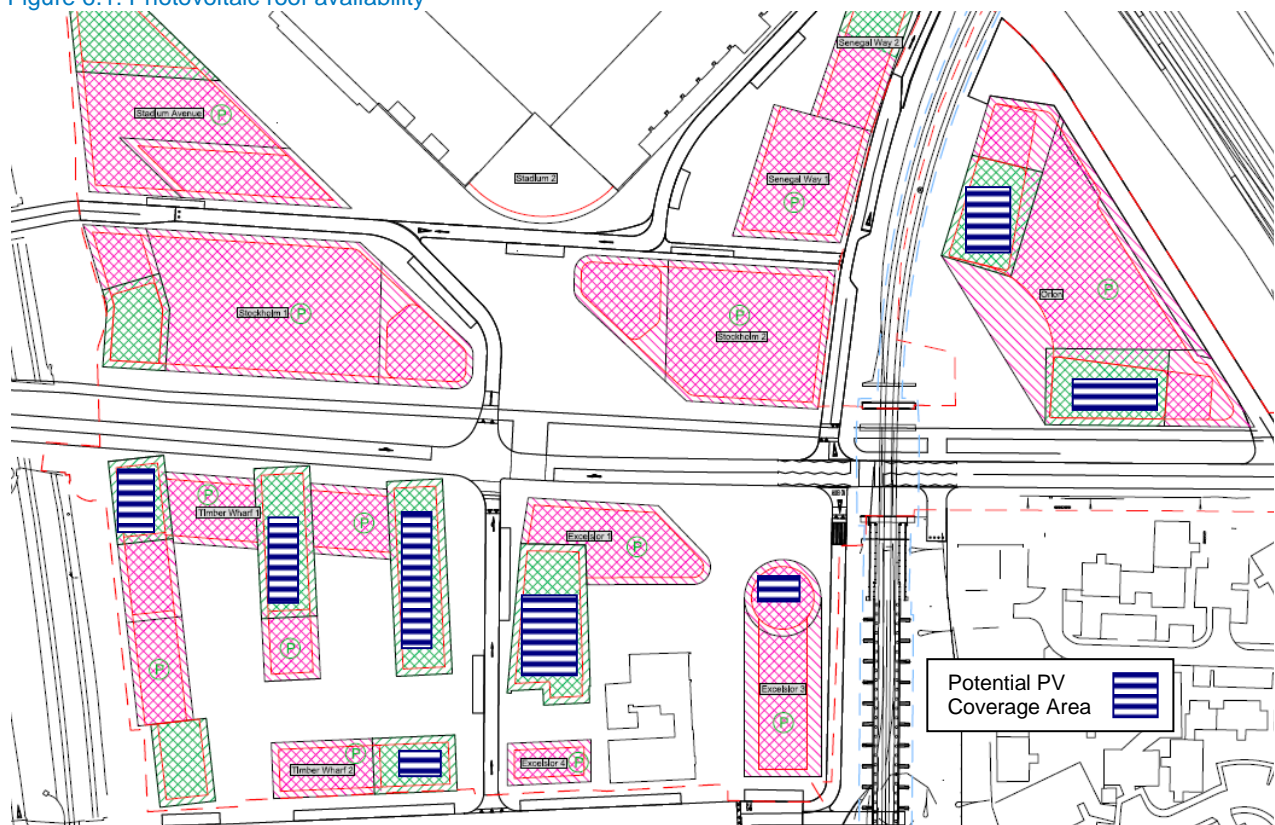
It has been estimated that a further reduction of CO<sub>2</sub> emissions by less than around 0.5% could be made by approximately 900m<sup>2</sup> of PV panels.

Table 21: CO<sub>2</sub> Emissions

Energy efficient scheme with SELCHP and PV	
Installed capacity	900m <sup>2</sup> poly-crystalline photovoltaic panels (at 30 incline, south facing and unshaded)
Site Total CO2 Emissions (tCO2/year)	5,200
Reductions beyond Energy Efficient baseline due to SELCHP	28%
% reduction due to renewables	<0.5%
Total Reductions beyond Energy Efficient baseline	>28%

It may be possible to include more panels if the review in 2013 is favourable or if the costs of systems have dramatically reduced but this will not be known for a while. Figure 6.1 displays the roof areas that are considered suitable. This may also be further reduced in size to accommodate any issue raised by surface drainage or biodiversity.

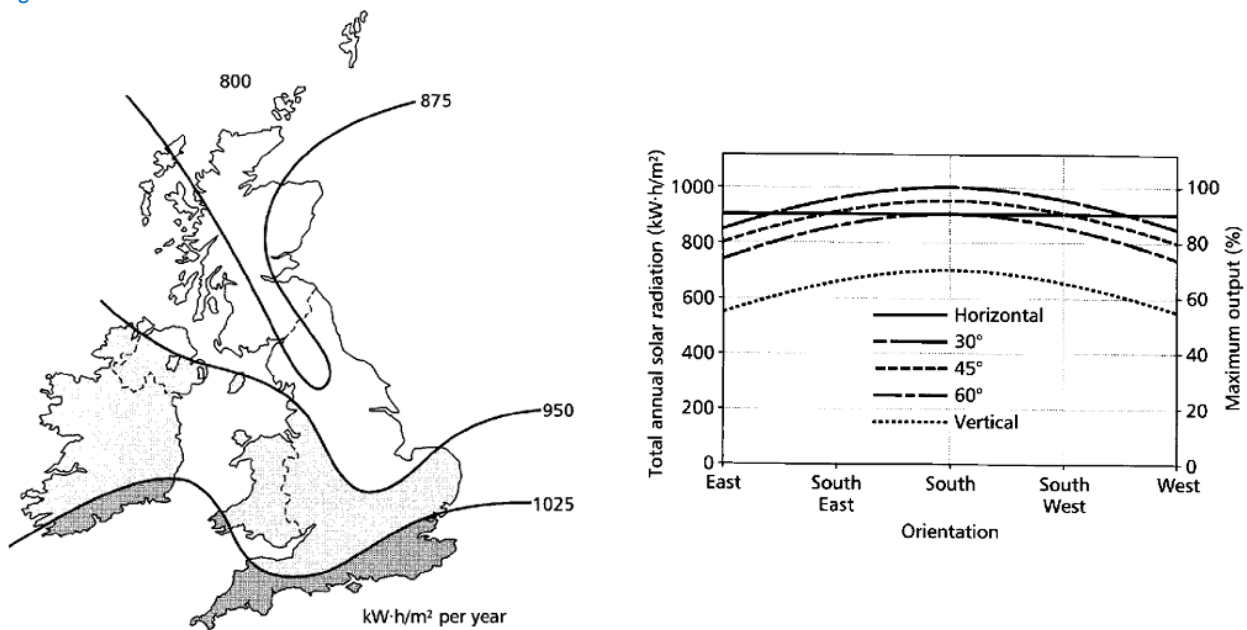
Figure 6.1: Photovoltaic roof availability



6.1.3 Solar radiation

PV panels should face between SE and SW, at an elevation of about 30° . 40°. The graph below shows the average annual total solar radiation on a horizontal surface and the relative output of PV panels mounted in orientations between East and West, as well as the relative output for different tilt angles of the panels. For flat roof areas it is not expected that orientation will be a problem, however for areas with pitched roof there will be a slight reduction in radiation.

Figure 6.2: Annual solar irradiation in the UK and Ireland & Relative electricity output for different orientations and tilt angles



Source: DTI . Photovoltaics in Buildings Design Guide, 1999

6.1.4 Risk of overshadowing

There should be no overshadowing of the PV panels, as this reduces their overall efficiency. Even shading a small part of a PV panel could significantly reduce its efficiency and the efficiency of other PV panels connected in the string. Overshadowing can be caused by trees, other buildings, roofs of adjacent buildings, dormer windows, roof furniture, etc

6.1.5 Grid connection

When connecting a new PV installation to the electricity grid, the main concerns of the Distribution Network Operator are safety and power quality. The installation needs protection to ensure the disconnection from the grid if a loss of mains condition happens. For these reasons, installations of <5kW will need to comply with Engineering Recommendation G83/1. Above 5kW, Engineering Recommendation G59 applies.

Electricity Supply Regulations 1988 requires a connection agreement between the consumer and the electricity back to the grid.

6.1.6 Operation & Maintenance

PV systems have relatively low maintenance requirements and running costs. Nevertheless, the cost of replacing inverters should be accounted for.

6.1.7 Cost and output reliability

The production of electricity through photovoltaic cells has become increasingly common in the UK. The recently started Feed-In Tariffs scheme offer significant revenue for PV. Previously, the majority of large scale projects that have utilised this technology have had significant grant funding in order to facilitate their inclusion. Nevertheless, per kWh PV is still comparatively expensive and being able to fund the installation by upfront capitalisation on the lifetime generation or low interest loans is an area that has only recently become possible and needs further work to become established. It should also be noted that the FIT scheme has a built in degression rate and is also due for review in 2013, so the timescales of the project are such that they may not be a reliable income stream.

6.2 Energy Efficient Scheme with SEL CHP and Wind Turbines

Surrey Canal is a high density scheme. A number of studies have shown that wind turbines are generally less suited to dense urban areas as their output will be affected by potentially lower and more disrupted wind speeds. Additionally, the use of larger more cost-effective machines may be undesirable due to the proximity of buildings.

6.2.1 Energy supply options

Notwithstanding, this scenario looks at the option of small scale wind turbines providing electricity mounted on the taller buildings.

Table 22: Energy Provision

Energy Demand	Energy delivery technology
Hot water	SELCHP
Space heating	SELCHP
Space cooling	Electric chiller
Electricity	Wind turbines and grid

6.2.2 Average wind speeds

The average annual wind speed for locations in the UK is provided by DECC's Wind Resource Database. For this site the following average wind speeds are shown in Figure 6.3 and wind direction in Figure 6.4.

Figure 6.3: NAOBL Wind Estimates for Surrey Canal (SE14 5RT)

for the 1km grid square 535 178 (TQ3578)

Wind speed at 45m agl (in m/s)

5.9	5.8	5.8
6	5.9	5.8
6	6	5.9

Wind speed at 25m agl (in m/s)

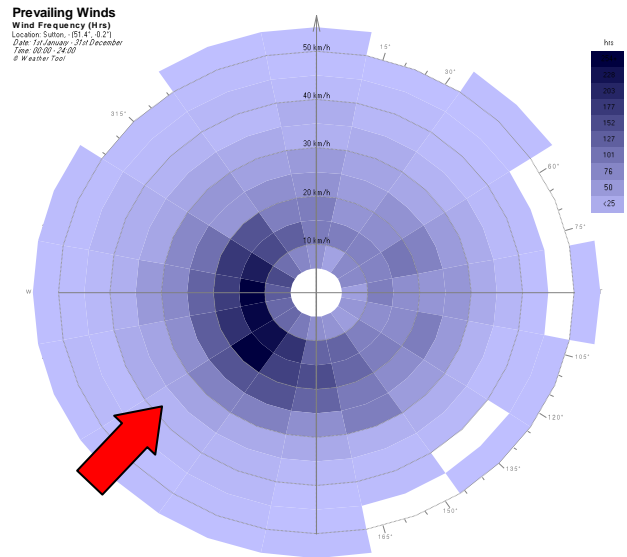
5.4	5.3	5.3
5.5	5.4	5.3
5.6	5.5	5.4

Wind speed at 10m agl (in m/s)

4.7	4.6	4.5
4.8	4.6	4.5
4.8	4.8	4.7

Source: DECC

Figure 6.4: Wind Rose



Source: Weather Tool/Ecotect using Meteornorm

It should be noted, however, that these estimates do not take into consideration landforms (e.g. hills and wood stands) and are often found to over estimate actual wind conditions.

### 6.2.3 Location

There are several issues that must be considered from the use of wind turbines. The proximity of a wind turbine to residential, institutional and commercial type properties must be considered; in relation to issues such as noise, flicker, radar interruption, visual amenity, ice throw and bat strike.

Large scale wind turbine technology does not seem to be a valid candidate as renewable energy technology for the energy strategy at Surrey Canal. Large scale application of wind technology is not suited for the Site since it requires a large expanse of land and could have several negative environmental impacts.

In theory, small scale wind turbine can be integrated on the flat roofs of the tallest buildings. 16 buildings have been identified as adequate to sit small wind turbines.

In order to estimate the potential number of turbines that can be sited, the following considerations have been made:

- § Wind turbine Proven WT1500 has been considered with a rotor diameter of 9 m.
- § The turbulence zone between two turbines has been assumed to be around 1.5 times the diameter when face on to the prevailing wind direction.



Vertical axis turbines such as Quiet Revolution may also be suitable. Based on the average wind speeds of the Site (with an adjustment for the urban terrain), and assuming the turbines are building mounted and the estimated number of turbines, the CO<sub>2</sub> emissions reductions are summarised in the table below.

Table 23: CO<sub>2</sub> Emissions

Energy efficient scheme with SELCHP and Wind Turbines	
Installed capacity	48 no. Proven Energy WT15000
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	4,900
Reductions beyond Energy Efficient baseline due to SELCHP	28%
% reduction due to renewables	5%
Total reductions beyond Energy Efficient baseline	33%

expected outputs of the various turbines, and as such should only be viewed as indicative. The wind profile of the Site would need to be ascertained to enable a more accurate prediction to be made.

Figure 6.5: Turbine Details

Turbine	Proven Energy WT15000	Quiet Revolution qr5
Manufacture	Proven Wind Turbines	XCO2
Website	<a href="http://www.provenenergy.co.uk">www.provenenergy.co.uk</a>	<a href="http://www.quietrevolution.co.uk">www.quietrevolution.co.uk</a>
Text Left	 <p>Stand alone or building mounted</p>	 <p>Stand alone or building mounted</p>
Rotor Diameter	8.5	4.2m
Pylon Height	At least 15m	9m
Approx Annual Output @ 5m/s	25,379kWh	8,000kWh

6.2.4 Issues to be aware of

Wind turbine outputs are strongly dependent on wind speed and turbulence therefore their location needs to be considered carefully. Generally, turbines should either be located away from obstructions such as buildings (ideally 10 x height of obstruction downstream) or on the top of tall buildings. There are likely to be considerable difficulties in locating the required number of the smaller turbines on the Proposed Development. There are also potential issues with noise and shadow flicker as well as the effects of the turbines on the buildings structure and the visual impact, particularly on townscape. Given these issues wind turbines are not considered as a preferable solution.

### 6.3 Aquifer Thermal Energy Storage (ATES)

In an ATES system, in summer cold water is drawn from an aquifer (to be used as chilled water for the cooling system), with warmer water, carrying heat rejected from the cooling system, being discharged back into the aquifer.

In winter, the process is reversed. A heat pump (which, in turn, would provide the heating mains to the space heating system and to fresh air tempering coils in air handling plant), with cooler water, having had its useful heat absorbed by the heat pump, is drawn from the aquifer. This process can help mitigate the urban heat island effect and would be considered an appropriate adaption response to climate change as mentioned in the London Plan (Policy 4A.10 Overheating).

The system can also be used to allow heat sharing between buildings. This greatly increases the potential energy efficiency of the system.

The feasibility of ATES depends on the size, type and profile of the cooling load as well as the nature of the heat source. To optimise the efficiency and carbon savings associated with ATES, the system is typically sized on the Proposed Development's total cooling demand. For Surrey Canal, this has been estimated at 3MW. At this size, the ATES system supplies around 43% of the Proposed Development's total cooling load (around 13% of its total heat demand).

The supplementary heat source for the ATES could either be SELCHP or gas fired CHP. The carbon emissions reduction potential of both options has been analysed with other energy provision as listed in Table 24.

Table 24: Energy Provision

Energy Demand	SELCHP & ATES Option Energy delivery technology	Gas & ATES Option Energy delivery technology
Hot water	SELCHP	Gas fired CHP
Space heating	SELCHP + ATES	Gas fired CHP with peak gas boilers + ATES
Space cooling	ATES	ATES
Electricity	Grid	Gas fired CHP + Grid

The resulting emission reductions are listed in Table 25.

Table 25: CO<sub>2</sub> Emissions

Energy efficient scheme with	SELCHP & ATES Option	Gas CHP & ATES Option
Site Total CO <sub>2</sub> Emissions (tCO <sub>2</sub> /year)	5,100	5,000
Reductions beyond Energy Efficient baseline due to CHP	24%	25%
Reductions beyond Energy Efficient baseline due to ATES	6%	6%
Total reductions beyond Energy Efficient baseline	30%	31%

From current geological record data and desk top studies made with reference to the British Geological Survey, it would appear that the underground aquifer in Surrey Canal is likely to be suitable to allow water to be drawn from and discharged back into the aquifer.

## 7. Phasing and Management

This section discusses the approaches to the phasing and management of the energy strategy for Surrey Canal.

### 7.1 Indicative Phasing Approach

The energy strategy for Surrey Canal will need to be compatible with the eventual phasing of the Proposed Development. Based on estimated proposed phasing predominantly from south to north, the indicative envisaged approach is shown in Table 7.1 according to the preferred energy strategy of connecting to SELCHP and the backup plan of onsite gas CHP.

Table 7.1: Phasing Approach

Plots	Preferred Energy Strategy	Backup Energy Strategy
Excelsior	Energy efficiency, temporary high efficiency gas boiler for heat, PV panels if appropriate	Energy efficiency, temporary high efficiency gas boiler for heat, PV panels if appropriate
Timber Wharf	Energy efficiency, temporary high efficiency gas boiler for heat, PV panels if appropriate Towards end of phase SELCHP connection may be complete, all prior development is able to connect. Temporary boilers for backup only.	Energy efficiency, temporary high efficiency gas boiler for heat, PV panels if appropriate
Orion (including energy centre)	Energy efficiency, SELCHP for heat, PV panels if appropriate. Energy centre for backup heat.	Energy efficiency, energy centre with CHP and gas boiler for heat, PV panels if appropriate. Earlier phases connect to energy centre and CHP.
Senegal Way	Energy efficiency, SELCHP for heat. Energy centre for backup heat.	Energy efficiency, energy centre with CHP and gas boiler for heat.
Stockholm / Stadium	Energy efficiency, SELCHP for heat. Energy centre for backup heat.	Energy efficiency, energy centre with CHP and gas boiler for heat.
Bolina	Energy efficiency, SELCHP for heat. Energy centre for backup heat.	Energy efficiency, energy centre with CHP and gas boiler for heat.

In relation to the locations of and arrangements for the associated decentralised energy plant, it should be noted that key items such as energy centres cannot always be delivered upfront due to technical and economical reasons. In particular the gas CHP system, which would ideally be sized to cater for the whole of the Proposed Development in order to achieve higher efficiencies, would not then be financially viable or technically feasible to operate until a certain level of build out has been achieved. This could be in the region of 60%.

Therefore the early phases are based on the installation of temporary high efficiency gas boilers, used to provide heat and establish the viability of district heating and allow for the completion of the SELCHP connection or the installation of CHP in the energy centre. Then once a critical mass has been established the connection of the wider scale system can be progressed.

All phases will have minimum energy efficiency targets, and these are likely to form the majority of the reductions required to meet the 2010 revision of Building Regulations Part L which is roughly a 25% reduction on the 2006 revision.

In terms of renewable energy generation, it is envisaged that where appropriate PV panels can be deployed on a per phase basis and will contribute to carbon emission reductions in each phase.

The two retained buildings in the Excelsior plot (Rollins House and Guild House) will also connect to the community energy system, as their heating systems are to be renewed. Energy efficiency improvements will also be made to these buildings, although it might not be possible to achieve the same level of performance as the new build plots due to the extra constraints.

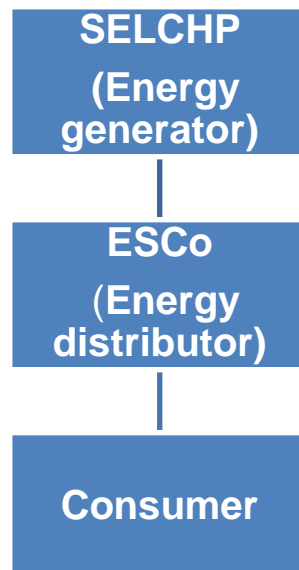
At this stage the Millwall FC Stadium itself is not included within the community energy system, however as the system becomes established it would be envisaged that it may connect if it is technically feasible and economically viable. A suitable opportunity may be when a major overhaul of the existing heating system takes place.

## 7.2 Management via ESCOs

Where a community energy system is being installed, an approach that is favoured to manage is to set up or procure a body to generate, supply and distribute energy via an Energy Services Company (ESCO). These can be (but not always) a special purpose vehicle company, set up specifically for a development, which will operate the energy facility and provide energy services on a long term contract. These can be subsidiaries of commercial ESCo companies and partially/wholly owned by community organisations or developers. In essence, they are not substantially different, in the way they operate, than the existing large utility companies.

It is envisaged that the preferred option of supplying heat (and possibly power) from SELCHP would be operated by some form of ESCo. However, this would restrict the ESCo structure, as at least the identity of the energy generator (SELCHP) is fixed. The other roles of distributor, billing, metering, local maintenance and energy sales to the end consumer would be provided by a single ESCo vehicle, see Figure 7.1.

Figure 7.1: Potential ESCo Structure



In this configuration SELCHP would sell heat to an ESCo, and they, in turn, manage the district network and sell this heat on to customers within the Surrey Canal development. The identity of this ESCo would be established through a procurement process to begin if planning permission is secured.

### 7.2.1 Procurement Process

A key area of discussion at the beginning of the procurement process is the various drivers involved. Having a clear view on these drivers helps in ensuring that the discussions do not go down a blind alley or become too protracted. Thus it is important that at the start thought is made regarding the concerns of the various parties involved. Ultimately, it is likely that assignment for the ESCo contract would be passed to the parties responsible for the long term management of Surrey Canal, such as the management company, the housing associations or the local authority. Therefore it is important that these are among the procuring parties or at least their interests are taken into account. Furthermore, it is also important to bear in mind the interests of other stakeholders such as the future consumers.

After establishing the drivers, the procurement process would involve outlining an ESCo model and methods of delivery. These would then be used to produce a list of potential suitable companies who would be invited to tender to an agreed list of requirements. From the returns and subsequent interviews a preferred bidder would be selected for detailed negotiations. One option may be work with Veolia Sheffield.

### 7.2.2 ESCo Responsibilities

The appointment of an ESCo would likely be to finance and operate the community energy system at Surrey Canal, contractually providing heat and electricity to the 2,500 homes and around 40,000m<sup>2</sup> of employment space and community services for a defined period. Long term contracts (over 25 years) are often used. Such an appointment would be ensured to work alongside the phasing of the Proposed Development.

In short, the ESCo can be responsible for the following aspects:

- § Purchase of energy from SELCHP;
- § Operation, management and ongoing maintenance of the community energy distribution system and, if necessary, any backup energy system;
- § Direct management of energy billing and development of mechanisms for managing this service and billing occupants;
- § Possible provision of partial funding to the scheme;
- § Ownership of responsibility for the risk of change in law during the contract period; and
- § Achievement of carbon targets for the project and hence potential plant arrangements in terms of low or zero carbon technologies.

In order to achieve a fair charging arrangement, there are contractual mechanisms that can ensure the prices paid by consumer are competitive compared to the market price. This can be approached through the inclusion in the contract of a clause that ensures that the energy price supplied will be at or below a certain level. It could also ensure that if electricity was supplied through private wire it would not be unfair for the consumer.

## 8. Discussion & Conclusions

This document discusses how the energy strategy for Surrey Canal follows the energy hierarchy set out in the *Building Regulations*. Reducing the demand first will reduce the amount of energy that needs to be supplied by renewable or low carbon sources.

The baseline used to compare the CO<sub>2</sub> emissions savings for the energy strategy is estimated to be 10,300 tCO<sub>2</sub>/year using 2006 Building Regulations or 8,600 tCO<sub>2</sub>/year under the recent October 2010 Building Regulations revision.

It will be used, and will reduce CO<sub>2</sub> emissions by around 20% from 2006 Building Regulations; this is in the region of 5% from a 2010 baseline. For residential this would require high levels of insulation and airtightness, this may require the use of the use of mechanical ventilation and heat recovery (MVHR) units to supply fresh air to living spaces and recover air from hallway / kitchen. For non-residential the energy efficiency measures are closely related to the specific uses and the servicing is not fully defined, nevertheless it has been assumed in general that thermal envelope improvements would reduce space heating demand as well as reduce cooling demand where it is used and high efficiency plant would be included. It is also proposed that the following high efficiency plant would be included where applicable: variable speed pumps, efficient fans, demand controlled ventilation with heat recovery and chillers with high co-efficient of performance (COP).

It will be used, and will reduce CO<sub>2</sub> emissions by around 29%. Renewal is currently working with SELCHP to take this solution forward as there are a number of important areas that need to be addressed to enable a district heating connection to SELCHP:

- § Requirement for standby / backup and peak load boilers;
- § Routing of district heating network connection; and
- § Future of SELCHP.

It is envisaged that an energy centre would be located in Plot Orion to provide backup heat for Surrey Canal. Providing a district heating connection to SELCHP is exciting and the construction of the East London Line Phase 2 (ELL2) has acted as a catalyst to ensure the issues are mitigated with passive installation for pipes post completion of ELL2 in 2012. As a result SELCHP, London Overground, TfL, and Network Rail have worked together in the ensuring that the construction design now incorporates a culvert chamber that facilitates the installation of district heating pipes under ELL2 post completion in 2012/2013.

The use of SELCHP brings restrictions on Surrey Canal such as the choice of renewable technology, for easier compatibility with the SELCHP heat supply and to not reduce its viability, t@^ Á %\* element should be met through technologies that supply electricity, not heat, such as photovoltaic panels and building mounted wind-turbines. Initial estimates have shown that these could contribute to around 0.5% (PV) . 5% (Wind) of further CO<sub>2</sub> emission reductions even assuming a maximum implementation of capacity. Building mounted wind turbines are considered particularly difficult to integrate due to the noise, flicker, visual impact and structural concerns and the lack of reliable output data, therefore they are not being proposed for Surrey Canal. The viability of PV is heavily reliant on the current feed-in tariffs which may be removed in 2013 in the feed-in tariff review. Therefore it is proposed only that PV is only included in phases prior to this and thus the potential contribution is relatively low. The area of PV may also be further reduced in size to accommodate any impacts on surface drainage or biodiversity.

The technical feasibility and economic viability of these will alter as the detailed design, policy (such as the definition of zero carbon) and financial incentives (particularly any changes to feed-in tariffs or any detailed announcement on the renewable heat incentive) evolve. Over the period of the Proposed Development these technologies will undoubtedly develop further with new options emerging. At this stage it is proposed that renewable energy provision is to be met through a minimum of 3,000 sq m of photovoltaic panels or equivalent carbon reduction through other renewable energy systems.

In terms of reducing CO<sub>2</sub> emissions associated with comfort cooling, in addition to the demand reduction { ^ æ • ~ ! ^ • Á ã } Á c @, both absorption chillers using heat from SELCHP (i.e. tri-generation or CCHP) and ATES can provide further CO<sub>2</sub> reductions. However, the applicability of these technologies will depend on the size and profile of the cooling load. It should be noted that various technical considerations such as the role of absorption chillers in adding to the urban heat island effect and the need to establish the actual yield available from the aquifer for ATES may reduce their suitability.

The strategy will also be in compliance with the Draft Core Strategy Policy 8 to meet at least 20% of the total energy demand through renewable technologies, on top of savings from energy efficiency measures beyond Building Regulations Part L 2006. Also, as mentioned in Policy 8, Surrey Canal will as a minimum meet the requirements of achieving Code for Sustainable Homes Level 4 from Phase 1, of which the energy criteria requires a reduction of regulated CO<sub>2</sub> emissions by 25% on Building Regulations Part L 2010 (44% on Building Regulations Part L 2006 under versions prior to November 2010) and the equivalent for non-residential aspects of the Proposed Development. Surrey Canal will also achieve, as a minimum, BREEAM Very Good standard for the non-residential provision. It is also expected that the energy strategy will be in compliance with the standards of the Draft London Plan, as well as the Lewisham Unitary Development Plan.

In the case that the preferred SELCHP option does not come forward, an on-site gas-fired CHP plant has been highlighted as the most likely back-up option at this stage. If determined to be technically and financially viable, further carbon savings could potentially be achieved by complementing the gas CHP with an ATES system or absorption chillers, however these would have a negative urban heat island effect.

# Appendix A. Allowable Solutions

- § Carbon compliance beyond the minimum standard up to 100% of total energy
  - ! There may be circumstances when paying carbon compliance costs less than other allowable solutions to reach zero-carbon.
- § Energy efficient appliances or advanced controls systems
  - ! This would require appliances used in the development to be of the highest possible standard at the time the home is built.
- § Exporting LDC heat/cooling to existing properties
  - ! Depending on the location, there may be potential to export excess heat to surrounding, existing homes (that would likely have a higher heat demand) or non-domestic buildings (which may have a different demand profile) in the near-by area.
- § Section 106 Planning Obligations
  - ! The Planning Policy Statement: *Planning and Climate Change* expects new developments to be planned to make good use of decentralised and renewable energy. S106 Planning Obligations provide a potential mechanism through which such infrastructure might be delivered. When such contributions are appropriate, it is right to consider them allowable solutions.
- § Retrofitting EE measures to existing stock
  - ! Many schemes exist that currently support relatively easy energy efficiency measures being installing in existing stock. This allowable solution would be the installation of more difficult measures
- § Investment in low or zero-carbon (LDC) energy
  - ! The developer buys a financial investment in LDC infrastructure and transfers this investment to the buyer of the zero-carbon home. The buyer should benefit from an income stream from this investment, so there is tangible benefit to owning a zero carbon home.
- § Off-
  - ! Currently the Government does not propose to count directly connected renewable electricity towards carbon compliance but this may be re-considered at a later date.
- § Any other measures that Government might in future announce as being eligible
  - ! No such measures are currently planned however; the review proposed for 2012 could potentially lead to further allowable solutions being announced.

# Appendix B. Financial Incentives

## B.1. Feed -In Tariffs

A Feed-In-Tariff (FIT) is a policy mechanism which is designed to encourage small scale renewable electricity generation by allowing the generator to earn a regulated income from every kilowatt hour generated. As of 2010, FIT legislation is in place in 63 countries across the world.

From April 2010 Feed-in tariffs (FIT) are available in the UK for electrical generation from renewable sources. The tariff value varies with the source and size of generation. PV panels of less than 4kW installed on new buildings will benefit from a generation tariff of 36.1 pence/kWh for electricity produced and consumed in the development. The onsite consumption would also offset the cost of imported power, offering a further benefit which, depending on the supply agreement, could be in the region of 10 - 15 pence/kWh. However if there is no onsite consumption, the electricity could be exported and would receive an additional export tariff of 3 pence/kWh. These levels incentivise consumption on site rather than export. The extent to which this is possible in typical domestic usage profiles is yet to be tested; with field trials from the BRE suggesting that the spike nature of most appliance consumption meaning it may be less than might be expected. However, it is clear that the most benefit will be to occupants with significant usage during the hours of peak sunshine.

The tariff levels remain fixed for the lifetime of a particular system, which is 25 years for PV. However to incentivise early installation a 7% annual degression rate will apply to reduce the generation tariff for new installations after 2012. For instance a scheme installed in 2012/13 would receive a generation tariff of 33 pence/kWh for its lifetime rather 36.1 pence/kWh. Only gas-fired MicroCHP units of 2kW or below will benefit from the FITs.

### B.1.1. Capitalisation of Feed -In Tariffs for PV

The Feed-In Tariffs (FITs) that are a rate of return of 5-8% should be achievable on the investment. However unless they are also social landlords it is not straightforward for the housebuilder to enjoy the return on investment.

Four companies have been contacted about their financial model for capitalising on the lifetime generation of electricity by PVs.

#### Eaga

Eaga (<http://www.eaga.com/>) said they are planning to introduce a full capitalisation model. Eaga are accustomed to delivering large scale and individualised energy savings projects for Warm Front. They have a large team of heating system and insulation installers across the country.

The full capitalisation model would still give back some benefit to the householder, particularly the fuel-poor whom Eaga have a tradition of assisting. This is because any power used as it was generated would be free of charge. This free power is only available in the daytime, when the unemployed, elderly and infirm are more likely to be home.

The full capitalisation model is unlikely to appeal to a home buyer who would presumably want some a proposal at whatever level of capitalisation the housebuilder may wish to achieve in order to get buy-in from the future purchaser and would even do install-only projects.

### Solar Technologies Installations Ltd

Solar Technologies is a British Gas company (<http://www.solartechnologies.co.uk/>). They have set aside £20m capital to begin a business capitalising PV, but the business model has not been finalised. To get a development licence they started with only the Code 4 houses seeking the installation, and only those with south facing roofs. This amounted to 29 x small 1kWp systems, and 97 x 2kWp (average) systems. They have not yet responded but in conversation they indicated they preferred a part capitalisation model, ~ 20% contribution from the housebuilder, so they can reward the houseowner more and maintain their buy-in.

### Selfenergy

Selfenergy (<http://www.selfenergy.co.uk/>) are associated with Eon. They intend to enter this market but have not finalised their financial models as yet.

### Vigor Renewables

Vigor Renewables (formally Low Carbon Finance) (<http://www.vigorrenewables.co.uk/>) are mainly concerned with larger scale installations i.e. no less than 500 kWp unless there was promise of a continuing stream of fairly large opportunities. They prefer to develop wind energy sites and in the case of a suitably windy site would be prepared to go to a much smaller scale. They would manage all the cost and installation and offer a discount on the price of electricity to the host of the installation.

## B.2. Renewable Heat Incentive

The Renewable Heat Incentive (RHI) is a forthcoming piece of legislation to provide a fixed rate financial incentive for renewable heat. In April 2011 the Government intends to introduce the Renewable Heat Incentive to encourage renewable heat generation. The full details are still under consultation and may be subject to some variation but is intended that the scheme will pay an incentive per kWh based on a fixed rate of return for heat generated from renewable technologies such as biomass, solar thermal or heat pumps. The rate of return is intended to be around 12% for all technologies except solar thermal which would be 6%. The incentivisation levels in the current model appear to favour small scale installation, i.e. those up to 500 kW. This is a consequence of the RHI that should be monitored as it will affect the scale at which the industry will respond and therefore where technology risk is mitigated and skills are developed.

## B.3. Renewable Obligation

Renewable Obligation Certificates (ROCs) are issued to operators of eligible generating stations. The Renewable Obligation Order requires Electricity suppliers to either have a certain proportion of their supply from renewables sources or to purchase the required ROCs which are auctioned quarterly. ROCs are issued to operators of eligible generating stations. ROCs are issued to operators of eligible generating stations. ROCs are issued to operators of eligible generating stations.

The Renewables Obligations Order requires Electricity suppliers to either have a certain proportion of their supply from renewables sources or to purchase the required ROCs which are auctioned quarterly.

The revision of the order<sup>30</sup> in April 2009 introduced the concept of ROC Banding, whereby a different number of ROCs are awarded per MWh of electricity according to the type of technology that is used to

<sup>30</sup> See The Renewables Obligation Order 2009 [http://www.opsi.gov.uk/si/si2009/uksi\\_20090785\\_en\\_1](http://www.opsi.gov.uk/si/si2009/uksi_20090785_en_1)

generate the electricity. Some of the generation types that are relevant to energy from MSW are given in Table 2.

Table 2: Generation Types

Generation Types	Definition
Electricity Generated from Landfill Gas	Electricity generated from gas formed by the digestion of material in a landfill;
Co-firing of Biomass	Electricity generated from regular biomass in a month in which the generating station generates electricity partly from fossil fuel and partly from renewable sources;
Energy from Waste with CHP	Electricity generated from the combustion of waste (other than a fuel produced by means of anaerobic digestion, gasification or pyrolysis) in a qualifying combined heat and power generating station in a month in which the station generates electricity only from renewable sources and those renewable sources include waste which is not biomass;
Co-firing of Biomass with CHP	Electricity generated from regular biomass by a qualifying combined heat and power generating station in a month in which it generates electricity partly from fossil fuel and partly from renewable sources, and where the fossil fuel and regular biomass have been burned in separate boilers or engines;
Standard Gasification	Electricity generated from a gaseous fuel which is produced from waste or biomass by means of gasification, and has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station which is at least 2 megajoules per metre cubed but is less than 4 megajoules per metre cubed;
Standard Pyrolysis	Electricity generated from a gaseous fuel which is produced from waste or biomass by means of pyrolysis, and has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station which is at least 2 megajoules per metre cubed but is less than 4 megajoules per metre cubed;
Advanced Gasification	Electricity generated from a gaseous fuel which is produced from waste or biomass by means of gasification, and has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 4 megajoules per metre cubed;
Advanced Pyrolysis	electricity generated from a liquid or gaseous fuel which is produced from waste or biomass by means of pyrolysis, and (a) in the case of a gaseous fuel, has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 4 megajoules per metre cubed, and (b) in the case of a liquid fuel, has a gross calorific value when measured at 25 degrees Celsius and 0.1 megapascals at the inlet to the generating station of at least 10 megajoules per kilogram;
Anaerobic Digestion	Electricity generated from gas formed by the anaerobic digestion of material which is neither sewage nor material in a landfill

Source: The Renewables Obligation Order 2009

The revision of the order<sup>31</sup> in April 2009 introduced the concept of ROC Banding, whereby a different number of ROCs are awarded per MWh of electricity according to the type of technology that is used to generate the electricity. Some of the generation types that are relevant to energy from MSW are given in Table 2.

Table 3 below gives the quantity of ROCs eligible per MWh of power for some of the relevant technologies.

Table 3: ROC Quantities

Generation Type	No. of ROCs per MWh
Landfill Gas	0.25
Co-firing of Biomass	0.5
Energy from Waste CHP	1

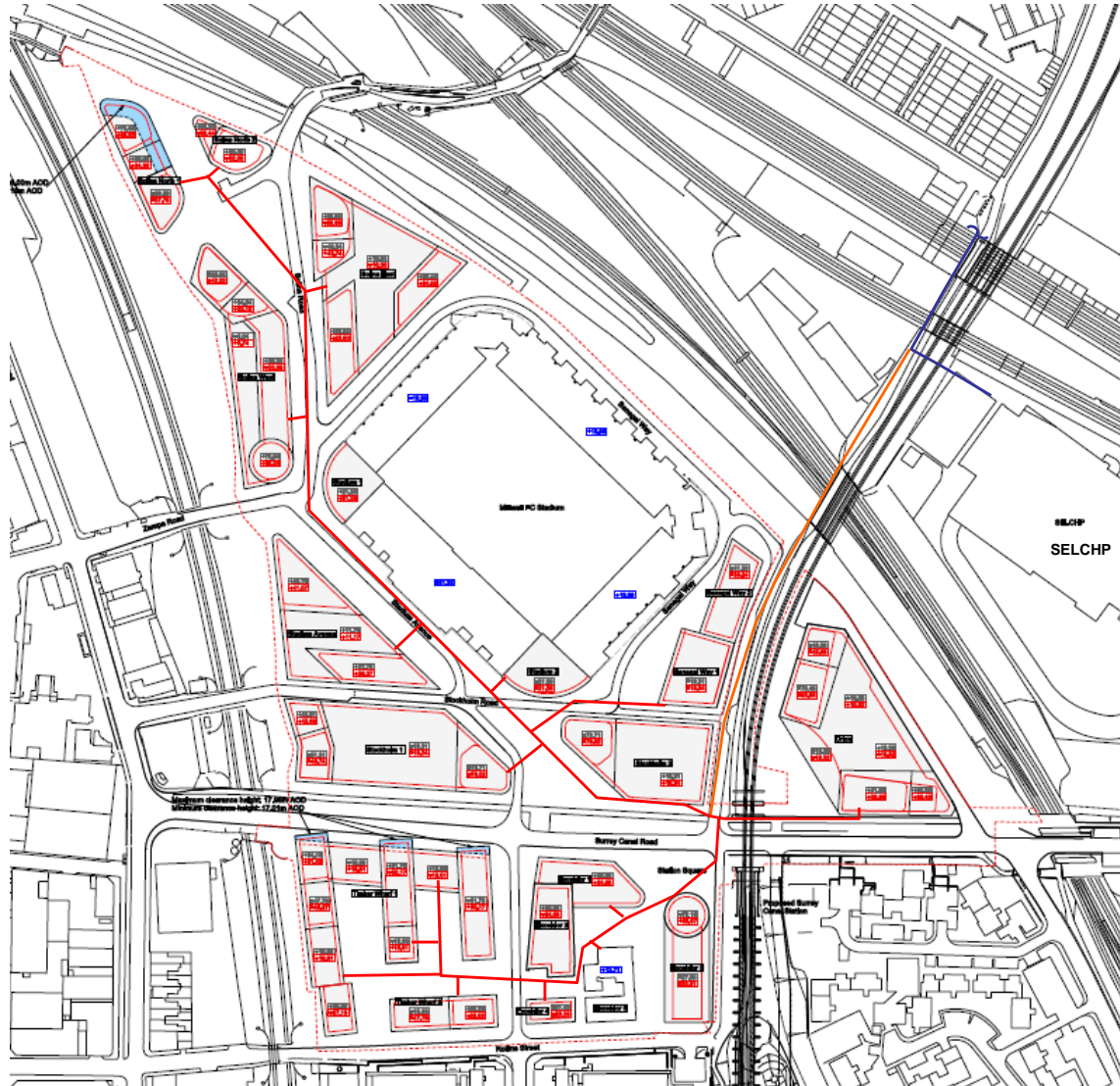
<sup>31</sup> See The Renewables Obligation Order 2009 [http://www.opsi.gov.uk/si/si2009/uksi\\_20090785\\_en\\_1](http://www.opsi.gov.uk/si/si2009/uksi_20090785_en_1)

Generation Type	No. of ROCs per MWh
Dedicated Biomass	1.5
Advanced Pyrolysis	2
Advanced Gasification	2
Dedicated Biomass CHP	2

Source: The Renewables Obligation Order

In terms of CHP, the order defines it as *combined heat and power generating station which has been accredited under the CHPQA.*

# Appendix C. Indicative Heat Network



- Indicative LBS Network
- Indicative Surrey Canal Connection
- Indicative Surrey Canal Network

NTS

## SURREY CANAL - INDICATIVE DISTRICT HEAT NETWORK

# Appendix D. SELCHP Statement of Intent



