

SILVERTOWN TUNNEL

SUPPORTING TECHNICAL DOCUMENTATION

PRELIMINARY ENERGY STATEMENT

October 2015

This report assesses the opportunities for minimising CO² emissions during construction and operation of the tunnel. It considers the implementation of passive design measures, energy efficiency, and low and zero carbon technologies.

This report forms part of a suite of documents that support the statutory public consultation for Silvertown Tunnel in October – November 2015. This document should be read in conjunction with other documents in the suite that provide evidential inputs and/or rely on outputs or findings.

The suite of documents with brief descriptions is listed below:-

- **Preliminary Case for the Scheme**
 - Preliminary Monitoring and Mitigation Strategy
- **Preliminary Charging Report**
- **Preliminary Transport Assessment**
- **Preliminary Design and Access Statement**
- **Preliminary Engineering Report**
- **Preliminary Maps, Plans and Drawings**
- **Preliminary Environmental Information Report (PEIR)**
 - Preliminary Non Technical Summary
 - Preliminary Code of Construction Practice
 - Preliminary Site Waste Management Plan
 - Preliminary Energy Statement
- **Preliminary Sustainability Statement**
- **Preliminary Equality Impact Assessment**
- **Preliminary Health Impact Assessment**
- **Preliminary Outline Business Case**
 - Preliminary Distributional Impacts Appraisal
 - Preliminary Social Impacts Appraisal
 - Preliminary Economic Assessment Report
 - Preliminary Regeneration and Development Impact Assessment

SILVERTOWN TUNNEL

Preliminary Energy Statement

October 2015



Silvertown Tunnel

Preliminary Energy Statement

THIS PAGE IS LEFT INTENTIONALLY BLANK

Silvertown Tunnel

Preliminary Energy Statement



Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure)
Regulations 2009

Document Reference: ST150030-PLN-ZZZ-ZZ-RP-PC-0014

Author: Transport for London

Rev.	Date	Approved By	Signature	Description
1	02/10/2015	David Rowe (TfL Lead Sponsor)		For Consultation
		Richard De Cani (TfL MD Planning)		

Contents

SUMMARY

1.	INTRODUCTION	11
2.	THE SCHEME	15
2.1	Need for the Scheme	15
2.2	Scheme description.....	17
2.3	Construction	17
3.	POLICY CONTEXT.....	19
3.2	National policy.....	19
3.3	Regional policy.....	22
3.4	Local policy	25
3.5	Summary.....	28
4.	CONSTRUCTION ENERGY	29
4.2	Potential energy saving measures	30
5.	OPERATIONAL ENERGY	34
5.2	Baseline assessment	35
5.3	Be Lean: Reducing the need.....	38
5.4	Be Clean: Using less energy.....	45
5.5	Be Green: Renewable energy technologies.....	49
6.	OPERATIONAL ENERGY EVALUATION AND CALCULATION	57
6.1	Reducing the need	57
6.2	Using less energy.....	58
6.3	Using efficient energy supply or renewable energy	59

6.4	Summary of Operational Energy Strategy.....	59
7.	CONCLUSIONS.....	61

List of Abbreviations

AQMA	Air Quality Management Area
BMS	Building Management System
CCC	Committee on Climate Change
CCHP	Combined Cooling, Heating and Power
CEEQUAL	Civil Engineering Environmental Quality and Assessment Scheme
CEMP	Construction Environmental Management Plan
CHP	Combined Heat and Power
CIBSE	The Chartered Institute of Building Services Engineers
CO ₂	Carbon Dioxide
CoCP	Code of Construction Practice
DEN	Decentralised Energy Network
ESR	Eastern Sub-region
GLA	Greater London Authority
GHG	Greenhouse Gas
GPS	Greenwich Power Station
HGV	Heavy Goods Vehicle

Silvertown Tunnel
Preliminary Energy Statement

HPS	High Pressure Sodium
LED	Light Emitting Diode
LZC	Low and zero carbon technology
PECU	Photo Electric Control Unit
SCADA	Supervisory Control And Data Acquisition
TBM	Tunnel Boring Machine
TfL	Transport for London

Glossary of Terms

Building Regulations	Statutory instruments that seek to ensure that the policies set out in the relevant legislation are carried out. Building regulations approval is required for most building work in the United Kingdom.
Supervisory Control And Data Acquisition (SCADA)	A computer system for gathering and analysing real time data. SCADA systems are used to monitor and control plant or equipment
Tunnel Boring Machine (TBM)	A large machine used to dig a hole underground in order to start construction of a tunnel

SUMMARY

1. This Preliminary Energy Statement has been prepared to support pre-application consultation prior to an application by Transport for London (TfL) for a Development Consent Order (DCO) made under the Planning Act 2008 for the Silvertown Tunnel Scheme.
2. The Silvertown Tunnel (The Scheme) would comprise a new dual two-lane connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/A1011 Silvertown Way by means of twin tunnel bores under the River Thames and associated approach roads. The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23.
3. There are no specific carbon reduction targets relevant to the Scheme. This report therefore pays particular attention to policies 5.2 and 5.6 of the London Plan which demand that the proposed energy strategy follow the energy hierarchy (Be Lean, Be Clean, Be Green) and consider Decentralised Energy.
4. Be Lean: The proposed 'Be Lean' strategy presented in this report would allow the Scheme to achieve a 6.1 per cent reduction in CO₂ emissions over the estimated baseline through an enhanced lighting strategy. However the design of the Scheme is fully integrated with the Energy Strategy in order to identify and bring about further savings in CO₂ emissions as the Scheme progresses.
5. The key energy saving measures to consider will be:
 - enhanced fabric over and above the requirements of Part L2a of the Building Regulations,
 - high efficiency cooling systems,
 - building management system (BMS) and sub-metering strategy; and
 - energy awareness schemes and efficient asset handover.

6. **Be Clean:** There are a variety of district energy initiatives in the Greenwich area however they are not currently at a stage where they can deliver robust design principles which can be incorporated within the Scheme design as part of the 'Be Clean' stage of the hierarchy. TfL and its contractors will continue to work closely with the boroughs, developer and GLA to ensure the Scheme maximises potential for these district energy initiatives as they develop.

7. **Be Green:** Overall, there are a number of constraints associated with the Scheme when considering the installation of renewable energy technologies. There is potential for a small amount of solar photo voltaic panels at the Portal entrances and service buildings. This will need to be investigated further however it is unlikely that sufficient space will be made available to make a significant contribution to carbon emissions. It would therefore be difficult to justify the high expenditure associated with this option.

8. **Summary of Potential Savings:**

	Annual energy use (per annum)	Percentage reduction	Annual Carbon Emissions	Percentage reduction
Baseline Consumption	9,588 MWh		4,976 tCO ₂	
Savings from				
Reduce the need	9,002 MWh	6.1 %	4,672 tCO ₂	6.1 %
Using less energy	9,002 MWh	0	4,672 tCO ₂	0
Using efficient energy supply or renewable energy	9,002 MWh	0	4,672 tCO ₂	0
Total Savings	585 MWh	6.1 %	304 tCO₂	6.1 %

1. INTRODUCTION

- 1.1.1 This Preliminary Energy Statement has been prepared to support pre-application consultation prior to an application by Transport for London (TfL) for a Development Consent Order (DCO) made under the Planning Act 2008 for the Silvertown Tunnel Scheme.
- 1.1.2 TfL, has strategic environmental priorities including reducing carbon dioxide (CO₂) emissions, minimising waste and enhancing the natural and built environments.
- 1.1.3 To limit climate change, the Mayor of London has set a target to reduce London's CO₂ emissions by 60 per cent compared to 1990 levels by 2025 (Greater London Authority, 2011). TfL is expected to assist by achieving CO₂ reductions across its public transport networks. It is, accordingly, therefore committed to setting its own carbon reduction goals to 2031.
- 1.1.4 Although there are physical limitations associated with a tunnel, there remains ample opportunity to incorporate sustainability and energy efficiency measures as part of the Scheme. This report evaluates the opportunities for minimising the CO₂ emissions generated by the use of the tunnel and following these evaluations outlines the energy strategy for the Scheme.
- 1.1.5 In preparing this Preliminary Energy Statement, consideration has been given to the requirements of the following planning documentation:
- The London Plan, Spatial Development Strategy for Greater London, Greater London Authority (2015)¹;
 - Sustainable Design and Construction – The London Plan Supplementary Planning Guidance (SPG) (2014)²;

¹ Greater London Authority, 2015. The London Plan

² Greater London Authority, 2014b. Sustainable Design and Construction, Supplementary Planning Guidance, London: Greater London Authority

- GLA Guidance on Preparing Energy Assessments (2015)³;
- Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy (2011)⁴;

1.1.6 In accordance with the thrust of the policy on climate change and in the line with the above policy documents, it is sought to minimise as far as practicable the Scheme's anticipated CO₂ emissions and to mitigate any residual adverse impacts on climate change in accordance with the following the principles set out in the Mayor's Energy Hierarchy described in Policy 5.2 – Climate Change Mitigation of the London Plan.

1.1.7 TfL propose to deliver the Silvertown Tunnel through a private financed initiative and has established that a Design Build Finance and Maintain (DBFM) structure would best meet the project objectives and constraints, and achieve an appropriate risk balance. A DBFM contract would be competitively tendered in accordance with EU procurement procedures.

1.1.8 The DBFM contractor would complete the detailed design, construct the tunnel and supporting infrastructure and be responsible for maintenance during a 30 year concession period. TfL would control the day to day operation (traffic management) of the Silvertown Tunnel while Blackwall Tunnel would continue to be managed by TfL under the existing operations and maintenance arrangements.

1.1.9 This Preliminary Energy Statement takes into account environmental and spatial constraints and identifies how to minimise operational energy consumption, and running costs for the DBFM contractor through the implementation of passive design measures, energy efficiency, and low and zero carbon (LZC) technologies.

1.1.10 The Scheme will also be assessed under the Civil Engineering

³ Greater London Authority, 2014c. Energy Planning – Greater London Authority Guidance on Preparing Energy Assessments

⁴ Greater London Authority, 2011a. Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy

Environmental Quality and Assessment Scheme (CEEQUAL).

- 1.1.11 This report will be revised through each design stage and will fulfil the role of the Carbon and Energy Efficiency Plan required by TfL to:
- understand the energy consumption baseline of the proposed work and the reduction in demand that can be achieved,
 - support the Business Case,
 - meet the requirements of planning regulation and TfL energy policy;
and
 - reduce whole life costs.

THIS PAGE IS LEFT INTENTIONALLY BLANK

2. THE SCHEME

2.1 Need for the Scheme

- 2.1.1 The Silvertown tunnel scheme is proposed in response to the three transport problems which exist at the Blackwall Tunnel: congestion, frequent closures and a lack of resilience (owing to the lack of proximate alternative crossings). These issues lead to adverse effects on the economy and local environment. In the context of continued significant growth, these problems can only get worse, and in turn their secondary impacts will increase. Failing to address these problems could hamper the sustainable and optimal growth of London and the UK.
- 2.1.2 The importance of an effective river crossing in east London for national growth is recognised in the designation of the Silvertown tunnel scheme as a nationally significant infrastructure project (NSIP). The designation letter states that congestion at the Blackwall tunnel is having an impact on the national road network which the Silvertown tunnel scheme could address. Critically, it highlights why the proposal has national significance: Given the position of London as an economic driver nationally, any decrease in efficiency in London's transport network may have a consequential detrimental impact nationally.
- 2.1.3 The introduction of the Silvertown Tunnel and a user charge at both Blackwall Tunnel and Silvertown Tunnel would significantly reduce day-to-day journey time variability and deliver congestion-relief benefits during peak times on the main approach roads to the Tunnels; including the A102, the A12 and the A13. The user charge is critical in ensuring that the benefits of the scheme are locked-in for the longer-term, and also helps to pay for the scheme.
- 2.1.4 The most important impact on public transport is the opportunities the Silvertown Tunnel will create for new cross-river bus services to improve public transport links between south-east and east London, notably the growing employment areas in the Royal Docks and Canary Wharf. The Silvertown Tunnel is designed to accommodate double-deck buses, thus providing operational flexibility in the bus routes that could be extended across the Thames, as well as greater capacity.

2.1.5 The need to act become more pressing as London continues to grow and land-uses in east London have changed to reflect a developing economy and growing population. Much of the land around the safeguarded area is now high-density residential, and more development is forthcoming both on the Peninsula and at Royal Docks. Although the safeguarding means that it is feasible to build a tunnel, competing demands for space will make this more difficult in the future. There exists now a window of opportunity to construct the tunnel, but it will not stay open for long.

2.1.6 Scheme objectives were identified with reference to the need for the scheme summarised above, and also draw from the National Policy Statement for National Networks, Mayoral policy as defined in the London Plan and Mayor's Transport Strategy (MTS), and scheme development work undertaken to-date and described in more detail later in this chapter. The following scheme objectives have been adopted:

- PO1: to improve the resilience of the river crossings in the highway network in east and southeast London to cope with planned and unplanned events and incidents;
- PO2: to improve the road network performance of the Blackwall Tunnel and its approach roads;
- PO3: to support economic and population growth, in particular in east and southeast London by providing improved cross-river transport links;
- PO4: to integrate with local and strategic land use policies;
- PO5: to minimise any adverse impacts of any proposals on communities, health, safety and the environment;
- PO6: to ensure where possible that any proposals are acceptable in principle to key stakeholders, including affected boroughs;
- PO7: to achieve value for money and, through road user charging, to manage congestion.
- Appendix A of the 'Case for the Scheme' document contains an appraisal of all scheme options against the above project objectives.

2.2 Scheme description

- 2.2.1 The Scheme – known as the Silvertown Tunnel – involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (London Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.
- 2.2.2 New portal buildings would be located close to each portal to house the plant and equipment necessary to operate the tunnel, including ventilation equipment.
- 2.2.3 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and support the financing of the construction and operation of the Silvertown Tunnel.
- 2.2.4 The design of the tunnel would include a dedicated bus/coach and HGV lane, which would provide opportunities for TfL to provide additional cross-river bus routes.
- 2.2.5 Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. The main site construction compound would be located at Silvertown to utilise Thames Wharf to facilitate the removal of spoil and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich peninsula.

2.3 Construction

- 2.3.1 Through the Reference Design development, flexibility for future innovation and alternative construction proposals by the Design & Build contractor have been taken into consideration for later stages of project implementation.

- 2.3.2 The methodology proposed is not the only option available but is the methodology selected for the purposes of the Reference Design to inform parties of the scale and nature of the works involved. The selected methodology is 'typical' and based on likely methods that a competent contractor would have the capability and experience to adopt during the construction of the scheme.
- 2.3.3 Worksites to enable the Scheme to be constructed will be required at Silvertown and Greenwich. During the construction phase members of staff, operatives, sub-contractors and visitors will attend the work sites on a daily basis. The works would be phased over a total period of 4 years.
- 2.3.4 A worksite compound office will be located at Silvertown and would contain offices, stores, plant maintenance facilities, a materials testing laboratory, recycling facilities, wheel wash and potential blacktop and concrete batching plants. This site has been selected as the best location for utilising Thames Wharf for marine logistics. This will enable the efficient management of spoil removal and material delivery by river and reduce the increased demand on the local highway network.
- 2.3.5 A further worksite compound at Greenwich would contain sufficient offices and welfare to support the civil works associated with the piling, cut-and-cover and roads to be undertaken on the peninsula.

3. POLICY CONTEXT

3.1.1 This section provides an overview summary of the national, regional and local policy relating to energy and carbon emission reduction. This is intended as an overview of the key policy and regulatory requirements that need to be considered and, where necessary met, in the development of the scheme.

3.2 National policy

National Planning Policy Framework

3.2.1 The National Planning Policy Framework (NPPF) was published on 27 March 2012 and sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which to produce distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

3.2.2 As of 27 March 2013 (12 months from the day of publication), Annex 1 paragraph 215 of the NPPF says that due weight should be given to relevant policies in existing plans according to their degree of consistency with the NPPF '(the closer the policies in the plan to the policies in the framework, the greater the weight that may be given).' It also states that, from the day of publication, decision-takers may also give weight to relevant policies in emerging plans according to:

- the stage of preparation of the emerging plan (the more advanced the preparation, the greater the weight that may be given);
- the extent to which there are unresolved objections to relevant policies (the less significant the unresolved objections, the greater the weight that may be given); and
- the degree of consistency of the relevant policies in the emerging plan to the policies in the NPPF (the closer the policies in the emerging plan to the policies in the NPPF, the greater the weight that may be given).

3.2.3 The NPPF was designed to make the planning system more user friendly and transparent. The framework's primary objective is sustainable development, focussing on the 3 pillars of sustainability: planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental).

3.2.4 At the heart of the NPPF is a presumption in favour of sustainable development. Paragraph 17 identifies 12 core planning principles that should underpin both plan-making and decision taking; these include:

“support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy)”.

3.2.5 Further guidance within Section 10 paragraph 93 of the NPPF is given under the heading 'Meeting the challenge of climate change, flooding and coastal change', including:

“Planning plays a key role in helping shape places to ensure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development.”

“Paragraph 95 advises that local planning authorities should “plan for new development in locations and ways which reduce greenhouse gas emissions.”

The Climate Change Act (2008)⁵

⁵ Her Majesty's Stationery Office, 2008. Climate Change Act 2008
Page 20 of 62

- 3.2.6 The Climate Change Act 2008 introduced a legally binding target to reduce the UK's greenhouse gas (GHG) emissions to at least 80% below 1990 levels by 2050. It also provides for a Committee on Climate Change (CCC) with power to set out carbon budgets binding on the Government for 5 year periods.
- 3.2.7 In the 2009 budget the first three carbon budgets were announced which set out a binding 34% CO₂ reduction by 2020; and the Government has since proposed that the fourth carbon budget will be a 50% CO₂ reduction by 2025. The CCC also produces annual reports to monitor the progress in meeting these carbon budgets. Consequent upon the enactment of the Climate Change Act, a raft of policy at national and local level has been developed aimed at reducing carbon emissions.
- 3.2.8 The levels of the first three carbon budgets were set in fiscal budget 2009 at the 'interim' level recommended by the CCC prior to global agreement on emissions reductions. The carbon budgets require a reduction in greenhouse gas emissions of 34%, against 1990 levels, by 2020. The fourth carbon budget level was set in June 2011. The carbon budget for the 2023–2027 budgetary period is 1,950,000,000 tonnes of carbon dioxide equivalent.
- Energy Act (2013)⁶
- 3.2.9 The Energy Act makes a provision for the setting of a decarbonisation target range, duties in relation to it and for the reforming of the electricity market for the purposes of encouraging low carbon electricity generation.
- Climate Change and Sustainable Energy Act (2006)⁷
- 3.2.10 This Act enhances the contribution of the UK to combating climate change and securing a diverse and viable long-term energy supply by boosting the number of heat and electricity microgeneration installations in the United Kingdom.

⁶ Her Majesty's Stationery Office, 2013. Energy Act 2013

⁷ Her Majesty's Stationery Office, 2006. Climate Change and Sustainable Energy Act 2006

Our Energy Future – Creating a Low Carbon Economy (2003)⁸

- 3.2.11 This White Paper sets a target for 20 per cent of electricity to be produced from renewable sources nationally by 2020, with a 60 per cent reduction in CO₂ emissions by 2050 (from 2003 levels).

The Carbon Plan: Delivering Our Low Carbon Future (2011)⁹

- 3.2.12 The Carbon Plan sets out the Government's plans for achieving the emissions reductions commitment made in the Climate Change Act 2008. A pathway consistent with meeting the 2050 target is outlined.
- 3.2.13 This publication brings together the Government's strategy to curb greenhouse gas emissions and deliver climate change targets.

3.3 Regional policy

The London Plan (2015)¹⁰

- 3.3.1 The London Plan 2015, which establishes strategic planning policy for London over the next 20 – 25 years, promotes the fundamental objective of accommodating London's population and economic growth through sustainable development. This Preliminary Energy Statement has been prepared following the guidance of the following policies of the London Plan.
- 3.3.2 Policy 5.1: Includes a strategic target to achieve an overall reduction in London's CO₂ emissions of 60 per cent by 2025.
- 3.3.3 Policy 5.2: Minimising CO₂ emissions sets out that the Mayor expects that all new developments will fully contribute towards the reduction of CO₂ emissions. Specifically, Policy 5.2 (A) requires developments to make the fullest contribution to minimising emissions of CO₂ in accordance with the

⁸ Department for Transport, 2003. Our energy future - Creating a low carbon economy, Norwich: The Stationery Office

⁹ Department of Energy and Climate Change, 2011. The Carbon Plan: Delivering our low carbon future, UK: Crown Copyright

¹⁰ Greater London Authority, 2015. The London Plan

Mayor's Energy Hierarchy:

- Be Lean: use less energy;
- Be Clean: supply energy efficiently; and
- Be Green: use renewable energy.

3.3.4 Policy 5.2 (B) sets targets for CO₂ emissions reductions in London, which all major developments are expected to meet. These are as follows:

Non-domestic buildings:

Year Improvement on 2010 Building Regulations

2010 – 2013 25 per cent

2013 – 2016 40 per cent

2016 – 2019 As per building regulations requirements

2019 – 2031 Zero carbon

3.3.5 It should be noted that The London Plan CO₂ emissions targets are to be achieved in part through the requirements of the Building Regulations. The Scheme will include a limited number of structures falling within the remit of the Building Regulations. These areas would not qualify as a major development. Therefore the above targets are not directly applicable to this application.

3.3.6 Policy 5.5: Decentralised Energy Networks (DEN) prioritises connection to existing or planned DEN's where feasible.

3.3.7 Policy 5.6: 'Decentralised Energy in Development Proposals (A)' requires development proposals to demonstrate how the heating, cooling and power systems supplying the proposed development have been selected to minimise carbon emissions in accordance with the following hierarchy:

- The proposed development should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

- Major development should select energy systems in accordance with the following hierarchy:
 - connection to existing heating or cooling networks;
 - site wide CHP network;
 - communal heating and cooling.

- 3.3.8 Where design measures and the use of natural and/or mechanical ventilation will not guarantee occupant comfort, the cooling strategy should be detailed.

- 3.3.9 Where appropriate, the cooling strategy should investigate opportunities to improve cooling efficiencies through the use of locally available sources such as ground cooling, river/dock water cooling etc.

- 3.3.10 Policy 5.7: Renewable Energy expects that within the framework of the Mayor's Energy Hierarchy, major development proposals will provide a reduction in CO₂ emissions through the use of on-site renewable energy generation. However all renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets. There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible.

- 3.3.11 Policy 5.8: Innovative Energy Technologies supports the use of alternative energy technologies (e.g. the uptake of electric and hydrogen fuel cell vehicles, hydrogen supply and distribution infrastructure and the uptake of advanced conversion technologies such as anaerobic digestion, gasification and pyrolysis).

- 3.3.12 Policy 5.9: Overheating and Cooling expects major development proposals to reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the recommended cooling hierarchy.

Energy Planning – Greater London Authority Guidance on Preparing

Energy Assessment (2015)¹¹

- 3.3.13 This guidance provides details on how to address the Mayor's Energy Hierarchy through the provision of an energy assessment to accompany strategic planning applications. This Preliminary Energy Statement report follows the methodology outlined in this guidance.

Sustainable Design and Construction Supplementary Planning Guidance (2014)¹²

- 3.3.14 In April 2014 the Mayor published the Sustainable Design and Construction Supplementary Planning Guidance (SPG) to provide guidance to developers. This SPG details the Mayor's standards, covering a wide range of sustainability measures that major developments are expected and encouraged to meet.

Delivering London's Energy Future: The Mayor's Climate Change Mitigation and Energy Strategy (2011)¹³

- 3.3.15 The strategy sets out the Mayor's strategic approach to limiting further climate change and securing a low carbon energy supply for London.
- 3.3.16 To limit further climate change impacts the Mayor has set a target to reduce London's CO₂ emissions by 60% on 1990 levels by 2025. The strategy details the programmes and activities that are on-going across London to achieve this.
- 3.3.17 This strategy also details policies and activities underway to reduce CO₂ emissions from new development and transport through The London Plan and the Mayor's Transport Strategy.

3.4 Local policy

¹¹ Greater London Authority, 2014. Energy Planning – Greater London Authority Guidance on Preparing Energy Assessments

¹² Greater London Authority, 2014. Sustainable Design and Construction, Supplementary Planning Guidance, London: Greater London Authority

¹³ Greater London Authority, 2011. Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy

Newham 2027, Newham's Local Plan - The Core Strategy (Adopted Version January 2012)

3.4.1 Policy SC1: Development will respond to a changing climate through the following (relevant) mitigation and adaptation measures:

- Maximising the efficient use of energy through passive solar design and meeting the requirements of Policy SC2;

3.4.2 Policy SC2: Carbon emissions from new and existing development will be reduced by the following (relevant) measures:

- Connections to, or provision for connection to, decentralised heat networks (See Policy INF4);

3.4.3 Policy INF4: The Council supports the development and expansion of community and district heating and cooling networks within existing and new development areas and therefore:

- Applications for development of network infrastructure and related apparatus will normally be granted, subject to compliance with other relevant development plan policies and appropriate mitigation of environmental and local amenity considerations, including noise, pedestrian and vehicular traffic and appearance;
- Applications for major combined heat and power (CHP) and renewable energy developments must demonstrate how the design has made provision for connection to existing or future community or district heating and cooling networks. The local planning authority will seek where practicable to secure planning agreements to ensure that such connections are implemented;
- The use of innovative energy technologies to reduce fossil fuel use, make use of sewage waste and other waste currently processed in the borough, and reduce CO₂ emissions, will be encouraged in order to increase energy security and contribute to low carbon and waste processing development targets; and
- Applications for major development in the vicinity of an existing or a planned district heat network or other heat distribution network, should

provide for connection to that network. If that connection is not feasible at the time the development is implemented, then the development should ensure that a future connection can be made.

Royal Greenwich Local Plan: Core Strategy with Detailed Policies (July 2014)

- 3.4.4 Policy E1: Carbon emissions will be reduced in accordance with the Mayor's energy hierarchy by:
- First, requiring all development to reduce demand for energy through its design (Be Lean);
 - Second, requiring all developments, with a gross floor area greater than 500sqm, or residential developments of five or more units, to connect to an existing decentralised energy network. Where this is not available a site wide decentralised energy network is required. Where it is demonstrated that a site wide decentralised energy network is unfeasible and / or unviable, developments will be required to provide sufficient infrastructure to enable a connection to a decentralised energy network for immediate or future use (Be Clean);
 - Third, supporting the incorporation of renewable energy generation within development proposals (Be Green).

- 3.4.5 All major development proposals will require an energy assessment.

London Borough of Tower Hamlets, Local Plan: Core Strategy (2010)

- 3.4.6 Achieving a Zero Carbon Borough and Addressing Climate Change. Development will be required to be accompanied by an Energy Assessment to demonstrate its compliance with the following (non-residential development, year improvement on 2010 Building Regulations):
- 2011-2013 35% CO₂ emissions reduction
 - 2013-2016 50% CO₂ emissions reduction
 - 2016-2019 As per building regulations

- 2019-2031 Zero Carbon

3.4.7 Development will be required to connect to or demonstrate a potential connection to a decentralised energy system unless it can be demonstrated that this is not feasible or viable.

3.4.8 The sustainable retrofitting of existing development with provisions for the reduction of carbon emissions will be supported.

3.4.9 Sustainable design assessment tools will be used to ensure climate change mitigation measures are maximised within development.

3.5 Summary

3.5.1 There are no specific carbon reduction targets relevant to the Scheme. This report will therefore pay particular attention to policies 5.2 and 5.6 of the London Plan which requires that the Scheme develops an energy strategy following the energy hierarch (Be Lean, Be Clean, Be Green) and consider Decentralised Energy.

4. CONSTRUCTION ENERGY

- 4.1.1 This section of the statement focuses solely on the energy associated with the demolition and construction process (e.g. plant, welfare facilities and equipment).
- 4.1.2 The construction methodology, set out in the Preliminary Environmental Information Report (PEIR), has been developed to inform the assessment of the environmental impacts of the Scheme. It presents a practical and achievable approach to the construction of the Scheme, however the methodology ultimately deployed for the construction of the proposed Scheme is very dependent upon the DBFM contractor appointed to undertake these works.
- 4.1.3 A Code of Construction Practice (CoCP), will be included with the DCO application, and will set out the principles for the preparation of a Construction Environmental Management Plan (CEMP), to ensure that any construction methodologies employed are consistent with the assessments and mitigation measures set out in the Environmental Statement. The CEMP will be completed and approved by relevant stakeholders prior to the start of construction.
- 4.1.4 In line with best practice, site-wide construction emissions for all large-scale projects should be minimised where possible.
- 4.1.5 This section identifies areas of high energy consumption and with high potential to reduce it. The assumptions and recommendations of this section will be considered in further detail prior to the start of the construction works. At the current stage of design, detailed information is not available on the exact specification or operation of construction equipment. The predicted energy consumption breakdown is, therefore, based on available data and reasonable assumptions of likely plant and equipment.
- 4.1.6 A comprehensive review of construction requirements, logistics and wider considerations of the Scheme's construction was undertaken as part of the Reference Design process, including the land and access requirements, methodology, logistics, Tunnel Boring Machine (TBM) accommodation and operation consideration and programme for the

works.

- 4.1.7 In support of the project securing the necessary power requirements an assessment was undertaken as part of the Reference Design development of the temporary power supply needed during the construction phase. This was built-up using a comprehensive list of equipment required to fulfil the needs of the Scheme’s construction activities and reviewed against the construction programme.
- 4.1.8 The review concludes that the highest proportion of energy consumption is expected to be as a result of tunnelling and excavation. The two bores that form the main tunnel structures will be constructed using a segmental lining excavated through the use of an energy intensive Tunnel Boring Machine (TBM).
- 4.1.9 The power to operate the TBM and provide sufficient torque to maintain the revolution of the cutting head through varying ground conditions will vary depending upon the nature of the ground, the speed of excavation and the diameter of the TBM. The size of this machine will also mean that it will be delivered in sections which will add to the carbon emissions associated with its use.
- 4.1.10 The workforce amenity and welfare facilities have been assumed to be entirely electrically powered, including space heating, catering, auxiliary plant and hot water.

Table 4-1 Annual estimated baseline construction energy demands

Activity	Power demand (MWh)	Percentage of Total
TBM, Conveyors & General Tunnel Plant	18,752	82%
Shaft Top, Loading & General Surface Plant	3,436	15%
Piling Plant	188	1%
Site Facilities	429	2%
Total	22,805	

4.2 Potential energy saving measures

- 4.2.1 The Scheme would be registered under the Considerate Contractors Scheme’s Environmental Award. Table 4-2 Potential energy saving Table 4-2 below therefore includes measures from the Considerate Contractors Scheme. Furthermore, the Carbon Trust’s recommendations within their Action Plan to Reduce Carbon Emissions (2010)¹⁴ are included.

- 4.2.2 The DBFM contractor would address working methods that reduce energy consumption through the CoCP and will aim to continually improve energy efficiency on the work sites. The measures outlined below support this task and have been selected to bring savings in energy consumption and consequently CO₂ emissions. Particular attention would therefore be paid to those measures associated with high energy consuming activities, such as the tunnelling.

- 4.2.3 The DBFM contractor will seek to minimise both power consumption and the peak power required on all the works associated with the Scheme. This strategy will incorporate two methods – first, phasing of the works and demands to minimise the overall peak energy demand, and secondly a requirement to investigate and adopt methodology, equipment and operational practices throughout the site, including site offices and other facilities, that will minimise power consumption and make the whole construction process more energy efficient. These are listed in Table 4-2.

Table 4-2 Potential energy saving measures

Measure	Feasibility	CO ₂ saving	Notes
Minimising the use of diesel or petrol powered generators and instead using mains electricity or battery powered equipment	High	Medium	Reliance on electrical power means large mains supply connections for each work site are required. Unless this supply is available in a timely manner diesel generators will have to be used, with the associated noise, emissions and cost.

¹⁴ Carbon Trust, 2010. Action Plan to Reduce Carbon Emissions.

Measure	Feasibility	CO₂ saving	Notes
Power down of equipment/plant during periods of non-utilisation	High	Medium	Where not detrimental to the running or lifecycle of plant, switch off all engines/power during periods of non-utilisation.
Appropriate servicing	High	Low	Ensure all vehicles and machinery is serviced at recommended intervals to guarantee optimum engine efficiencies and reduce waste energy.
Energy efficient plant	High	Medium	Fuel-efficient plant, machinery and vehicles used wherever possible.
Optimised vehicle utilisation	Medium	Low	Ensuring all vehicles and plant are fully loaded before starting a cycle or trip to ensure minimum run-time and efficient use of capacity.
Energy Targets	Medium	Low	SMART targets for consumption during construction, workforce will be educated regarding the information displayed. Targets to be made visible to workforce at all times.
Energy metering/monitoring	High	Low	Monitoring of all non-plant related energy consumption. Consumption profile will enable more strategic thinking towards reduced energy demands
Smart controls	High	Low	Timers and motion sensors to reduce energy consumption when areas are not in use

Measure	Feasibility	CO ₂ saving	Notes
Energy efficient lighting	High	Medium	Lighting controls will be largely dependent on health and safety regulations within the tunnel itself however low-energy equivalents will be employed where possible
Appropriate generators	High	Medium	Deploy correctly sized generators for electrical provision on-site, where applicable. An accurate approach is to identify the processes and associated electrical equipment in use at each stage of the project, and then apply a 'diversity' factor to each item to allow for its intermittent and partial power usage. This will give a profile of the power requirement which will have a reduced peak.
Efficient site accommodation	High	Low	Provide appropriate levels of thermal insulation to the relevant areas of site accommodation to reduce energy demand for heating. Efficient heating mechanism will further reduce energy consumption.

5. OPERATIONAL ENERGY

- 5.1.1 The London Plan Energy Hierarchy strategy adopts a holistic energy saving approach to development and requires efficient use of energy, energy supply efficiency and the use of renewable energy systems where practicable. In relation to the Scheme, each stage is addressed in turn and prioritised to ensure the development is as efficient as possible.
- 5.1.2 The purpose of the energy hierarchy approach is to demonstrate that climate change mitigation measures form a fundamental part of the proposed Scheme's design and evolution. Any measures taken forward must be appropriate and feasible in the context of the overall development.
- 5.1.3 The strategy outlined within this statement follows the energy hierarchy below:
- Be Lean: Use less energy. Minimise energy demand through efficient design and the incorporation of passive measures;
 - Be Clean: Supply energy efficiently. Reduce energy consumption through use of low-carbon technology; and
 - Be Green: Use renewable energy systems.
- 5.1.4 The first principle stresses the primacy of seeking to reduce energy consumption. Within the built environment this comprises adopting energy efficiency measures in both the design and construction of new developments. The second principle addresses the 'clean' supply of energy issue. This will require 'decarbonising' and improving efficiency in the generation and distribution of energy. The third principle comprises the use of 'green' energy systems. These are renewable sources of energy with low or zero carbon emissions and include, amongst others, solar generated heat and power, wind energy and biomass.
- 5.1.5 For the purposes of this Preliminary Energy Statement, the baseline energy consumption and associated CO₂ emissions of the Scheme represent an estimate of the energy usage of the Scheme where:

-
- 'buildings' (i.e. areas covered by the energy efficiency requirements of Building Regulations ADL) meet the minimum requirements of Building Regulations ADL 2013¹⁵ in relation to CO₂ emissions; and
 - 'non-building' infrastructure (i.e. areas not covered by the Building Regulations ADL) is constructed to a typical industry standard complying with all other relevant regulations and standards.

5.1.6 Energy consumption and associated CO₂ emissions are estimated for each stage of the Mayor's Energy Hierarchy as follows:

- technical documentation and information provided by the Mechanical & Electrical (M&E) engineers (e.g. electrical outputs of the energy consuming uses such as lighting, auxiliary, heating and cooling systems, escalators, lifts, equipment etc.); and
- industrial benchmarks such as Energy Efficiency in Buildings - CIBSE Guide F (2012)¹⁶, Transportation systems in buildings - CIBSE Guide D (2010)¹⁷, Energy Benchmarks - TM46 (2008)¹⁸.

5.1.7 The expected whole energy use of the Scheme is considered in these Energy Statement calculations. This includes energy uses such as heating, cooling, lighting and auxiliary energy and extra energy uses such as appliances and computers.

5.2 Baseline assessment

5.2.1 TfL have undertaken a baseline energy demand assessment to

¹⁵ Her Majesty's Government, 2010. The Building Regulations 2013 Approved Document L2A; Conservation of fuel and power in new buildings other than dwellings, 2013 Edition edn., London: NBS.

¹⁶ The Chartered Institution of Building Services Engineers, 2012b. Energy Efficiency in Building - CIBSE Guide F, Third edition, London: The Chartered Institution of Building Services Engineers

¹⁷ The Chartered Institution of Building Services Engineers, 2010. Transportation systems in buildings - CIBSE Guide D, 4th edition, London: The Chartered Institution of Building Services Engineers

¹⁸ The Chartered Institution of Building Services Engineers, 2008. Energy Benchmarks- CIBSE TM46: 2008, London: The Chartered Institution of Building Services Engineers

understand the likely energy uses of the Scheme. The assessment includes the likely energy demand and carbon emissions of the Scheme as designed to comply with current building regulations. Where this information is not available, industry standard benchmarks are used to calculate the energy demand for the Scheme.

5.2.2 Other non-building related energy demand and carbon emissions, such as plant and equipment, are estimated using available benchmarks and product information as appropriate.

5.2.3 The Reference Design considers normal tunnel operations. Other abnormal scenarios such as congestion, emergency and fire scenarios are not included as these are unplanned and relatively infrequent events that are assumed to have a small relative impact when compared to normal tunnel operations. The figures quoted in this report are estimates only and may be subject to change.

5.2.4 The following assumptions have been made with regards to the service buildings, however these may vary as the design progresses:

- Greenwich site Building 1 – This building will be predominantly un-staffed and contains plant space for water storage for the tunnel fire suppression systems with associated pump rooms and electrical rooms. Cooling will generally be by mechanical ventilation with Direct Expansion (DX) cooling and heating for the Motor Control Centre rooms. Frost protection will be provided for the main plant areas using electric tubular heaters. Lighting will be Passive Infrared (PIR) sensor controlled.
- Greenwich site Building 2 – This building will be staffed on a permanent basis and contains welfare facilities, communications and radio rooms, uninterruptible power supplies (UPS) and battery rooms, high voltage (HV) and low voltage (LV) plant rooms, transformers and switch rooms. Cooling for the plant areas will generally be by mechanical ventilation with DX cooling and heating for the control room, offices, mess rooms and battery, UPS, communications and radio rooms. Frost protection will be provided for the main plant areas using electric tubular heaters. Lighting will be PIR controlled to un-occupied areas.

- Silvertown site Building - This building will be predominantly un-staffed and contains communications room, UPS and battery rooms, HV and LV plant rooms, isolation transformer and fire suppression room. A small back-up control room with a mess facility is also provided. Cooling for the plant areas will generally be by mechanical ventilation with DX cooling and heating for the comms room, control/mess room, battery and UPS rooms. Frost protection will be provided for the main plant areas using electric tubular heaters. Lighting will be PIR controlled to un-occupied areas. The Reference Design allows for a basic mess/control room for the purpose of a maintenance engineer having access to the plant monitoring (SCADA) system for viewing and reporting of alarms. This could be full time or part time or the contractor may choose to access the systems remotely. It will act as a base for visiting technicians to write up their report, use the washrooms etc.

5.2.5 Table 5-1 below outlines the estimated operational energy demand baseline produced using the methods outlined above.

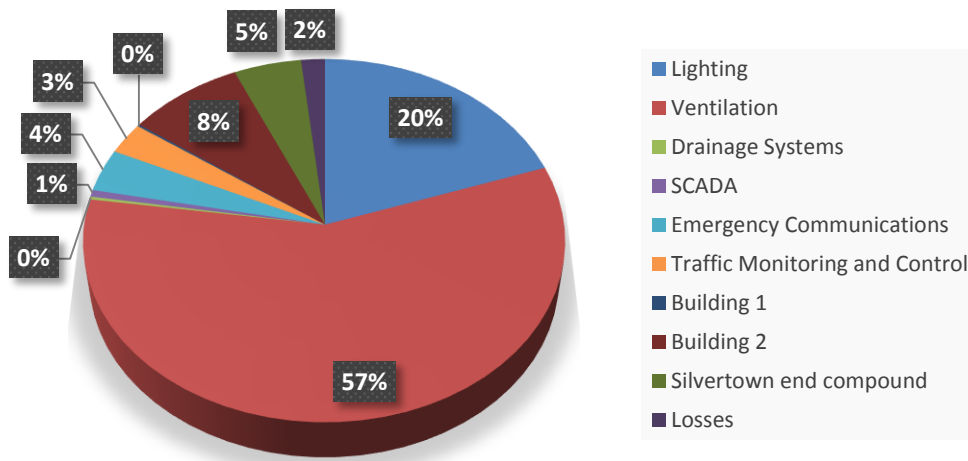
Table 5-1 Baseline energy consumption

Project deliverable	Energy System	Annual energy consumption (MWh)	Annual Carbon Emissions (tonnes CO₂)
Lighting	Electricity	1,893	983
Ventilation	Electricity	5,514	2,862
Drainage Systems	Electricity	24	13
SCADA	Electricity	58	30
Emergency Communications	Electricity	364	189
Traffic Monitoring and Control	Electricity	270	140
Service Buildings			
Building 1	Electricity	16	8
Building 2	Electricity	809	420

Project deliverable	Energy System	Annual energy consumption (MWh)	Annual Carbon Emissions (tonnes CO ₂)
Silvertown end compound	Electricity	472	245
Losses			
All Systems	Electricity	166	86
TOTAL		9,588	4,976

5.2.6 Figure 5-1 shows the breakdown of the operational energy uses.

Figure 5-1 Estimated energy consumption by energy uses



5.2.7 The largest proportion of the energy consumption is estimated to be the ventilation (57%) and lighting (20%). The smallest proportion is provided by the drainage systems, with the service buildings not far behind.

5.3 Be Lean: Reducing the need

5.3.1 The ‘Be Lean’ approach seeks to minimise energy use through demand reduction and passive measures, such as maximising insulation and use of natural ventilation, which minimise the use of energy and utilises energy more effectively (e.g. energy efficient lighting).

5.3.2 Passive design is the process of best employing the conventional elements of construction to reduce energy consumption and to maximise the use of the natural elements such as daylight, sunlight and natural ventilation. The simplest and most effective method of achieving carbon reduction on any project is often initially through the passive measures in the table below.

Table 5-2 Passive design measures

Design	Adaptation Measure	Technology
Air tightness	Green roofs	“A” rated appliances
Insulation	Water conservation	Automatic controls and monitoring
Reduce thermal bridging	Passive solar orientation	Energy management systems
Solar shading		Energy efficient lighting
Use of natural daylight		High performance glazing
Natural ventilation		Mechanical ventilation
		Energy efficient systems

5.3.3 It should be noted however that the Scheme is not well suited to the employment of many passive measures typically applied to buildings. Nonetheless, the design of the Scheme will be fully integrated with the Energy Strategy in order to identify and bring about savings in CO₂ emissions as the Scheme progresses. For this reason, no reductions against the baseline will be assumed at this stage (so as to represent a worst case scenario) with the exception of those achieved through the enhanced lighting strategy.

Fabric efficiency

5.3.4 The heat loss of building elements is dependent upon their U-value¹⁹. The

¹⁹ U-values measure how effective a material is an insulator. The lower the U-value is, the better the material is as a heat insulator

lower the U-value the better the level of insulation which will improve the thermal performance of the building and help to reduce the CO₂ emissions due to reduced space heating demands. The proposed service buildings, with areas to be permanently occupied, will therefore incorporate high levels of insulation and high efficiency glazing.

- 5.3.5 Table 5-3 below provides indicative fabric improvements over Building Regulation Part L2a. It is too early in the design process however to determine the precise fabric efficiency standards that will be achieved.

Table 5-3 Indicative enhanced fabric efficiency

Thermal element	Maximum area weighted U value (W/m²K) 2013 B'Regs	Proposed area weighted U values (W/m²K)
Main external walls	0.35	0.24 (TBC)
Roof	0.25	0.15 (TBC)
Ground floor	0.25	0.15 (TBC)
Windows	2.2	1.4 (TBC)

Potential for natural ventilation

- 5.3.6 The energy consumption associated with ventilation has been identified as the highest amongst the energy uses, particularly within the tunnel itself. Although the nature of the tunnel restricts natural ventilation, its potential within occupied areas of the portal buildings will be maximised through the design.

Promotion of daylighting

- 5.3.7 The use of daylighting will be promoted wherever feasible in order to reduce energy consumption associated with artificial lighting. However, as the scheme is situated in dense urban environment with the vast majority of areas of civil engineering below ground, the potential for utilising daylighting is limited.
- 5.3.8 The potential of utilising light tubes for transport of light to locations below ground is limited due to the nature of the tunnel beneath the River Thames.

Orientation and site layout

- 5.3.9 Portal entrances have been positioned to reduce, as far as practicable, the length of the tunnels and therefore the need for artificial lighting.

Energy Awareness Scheme for staff

- 5.3.10 To realise the potential of the design fully, a good and complete initial asset handover to operational staff is essential.
- 5.3.11 To achieve an efficient handover, the DBFM contractor will identify a schedule of training for the relevant operational staff in accordance with best practice. Training sessions will be held to the satisfaction of operational staff in each field of expertise.

Energy efficient lighting and controls

- 5.3.12 For the tunnel approach a worst case scenario has been assumed with all lighting operating at 100% output from dusk to dawn, and with Photo Electric Control Units (PECU) operating at 70 lux on and 35 lux off.
- 5.3.13 As part of the Mayor's pledge to cut CO₂ emissions, TfL has begun implementing the energy saving plan which will be delivered over the next three years. By 2016, the programme aims to reduce associated CO₂ by around 9,700 tonnes a year and contribute towards approximately £1.85m of savings for TfL a year. The programme will also reduce energy consumption by more than 40 per cent by 2016, compared to the current levels.
- 5.3.14 The programme includes the introduction of Central Management Systems (CMS) for street lighting on the TLRN. This allows TfL to remotely monitor and manage street lighting and dynamically control levels of lighting depending on use. By adjusting the lighting levels to be aligned better with traffic flows and road usage at different times of night TfL can significantly reduce its energy consumption and carbon emissions, without compromising road user safety or security. The system remotely records lighting failures, enabling maintenance crews to ensure that lighting levels are restored without delay
- 5.3.15 Under normal operations the lighting within the tunnel approaches will be

fully automated and will be controlled dependant on the time of day and the luminance values being read from the portal photometers. The lighting will automatically switch to night mode at dusk and return to photometer control at dawn.

- 5.3.16 The lighting system is designed to encourage energy conservation. Luminaires will be fixed to the soffit of the tunnel in each bore via a supporting framework to achieve a uniform light level across the full width of the roadway including walkways.
- 5.3.17 It is proposed for the Scheme to incorporate high intensity LED lighting for the threshold, transition, interior and exit zones to meet all the required lighting levels. This lighting system is an improvement from conventional fluorescent, stepped scheme. This is in accordance with TfL's new energy efficient lighting programme to help reduce the cost of lighting the TfL Road Network (TLRN) and to reduce CO₂ emissions across London.
- 5.3.18 The baseline scenario assumes Fluorescent T5 (HO) and high pressure sodium (HPS) for Threshold and Transition Zones. The proposed LED scheme offers an estimated base comparison saving of 29% of electrical consumption.
- 5.3.19 There will be additional energy savings based on the improved control that LED gives over HPS for the transition and threshold zones. The active controls savings will be detailed at later project stages. They could represent a further saving in the order of 15-20% of the threshold and transition lighting consumption.

Heat recovery

- 5.3.20 The expected heat demand associated with the portal buildings is very low and therefore heat recovery from the significant plant and equipment or the tunnel ventilation system could bring only a marginal reduction in overall CO₂ emissions. Mechanical Ventilation Heat Recovery is therefore not proposed.

Efficient heating

- 5.3.21 The heat profile of the Scheme will be restricted to occupied areas of the portal buildings and will be characterised by negligible loads in summer

and relatively low loads in winter. A number of options have been considered to supply this demand.

- 5.3.22 Heating will be provided only within the staff areas with thermostatic control to reduce energy consumption. In this analysis, it has been assumed that electrical heating will be provided to the staff areas.

Efficient Cooling

- 5.3.23 There is potential to install High efficiency Variable Refrigerant Flow (VRF) systems. VRF systems benefit from better efficiencies and offer greater benefits in terms of space utilisation for central plant compared to dedicated splits systems. Most areas identified for Direct Expansion (DX) cooling would be suitable for VRF excluding the UPS and battery room which will be critical systems and too small for VRF.

Building Management Systems

- 5.3.24 The tunnel will be designed for routine operation as a fully automatic facility, with minimum intervention for planned maintenance.
- 5.3.25 The operational status of the Monitoring and Evaluation (M&E) systems installed in the tunnel and associated tunnel services buildings will be monitored via a comprehensive Plant Monitoring and Control System (SCADA system) which operate at all times to optimise efficient management.

Efficient staff equipment

- 5.3.26 Where provided, preference will be given to selecting staff equipment that is energy efficient, e.g. low energy computers and screens.
- 5.3.27 A number of small power uses will be outside of the control of TfL. However, where possible, TfL will encourage the use of low energy consuming technologies.

Table 5-4 Reducing the need

Reducing the need	Overview	Feasibility	Further action
Orientation and site layout	Tunnel entrances positioned to reduce need for lighting and ventilation services	Low	None
Lighting	LED lighting throughout. Automated controls (within the remit of safety requirements)	High	Lighting strategy to be progressed through design stages with reduced energy demand a key consideration
Potential for Natural Ventilation	Very little opportunity to provide natural ventilation on scheme	Low	Promote natural ventilation wherever feasible. Small potential within portal buildings.
Thermal Mass	Thermal mass increased within portal buildings utilised by staff to reduce heat losses	Low	Materials with high thermal mass to be used where feasible
Efficient Cooling	There is potential to install High efficiency Variable Refrigerant Flow (VRF) systems. VRF systems benefit from better efficiencies and offer greater benefits in terms of space utilisation for central plant compared to dedicated splits systems.	High	Most areas identified for Direct Expansion (DX) cooling would be suitable for VRF excluding the UPS and battery room which will be critical systems and too small for VRF

Reducing the need	Overview	Feasibility	Further action
Efficient Envelope	Thermally efficient fabric with reduced air permeability	Low	Limited to staff areas within portal buildings. Opportunity to be assessed at later design stages

5.4 Be Clean: Using less energy

5.4.1 Once demand for energy has been minimised, the hierarchy requires that all planning applications must demonstrate how their energy systems have been selected in accordance with the order of preference in Policy 5.6b of the London Plan. Energy assessments will need to explicitly work through the order of preference and where an approach is not appropriate for the development the assessment must provide reasoned justification for a departure from the hierarchy, as set out in the Sustainable Design and Construction – The London Plan Supplementary Planning Guidance.

5.4.2 The order of preference outlined in Policy 5.6b is as follows:

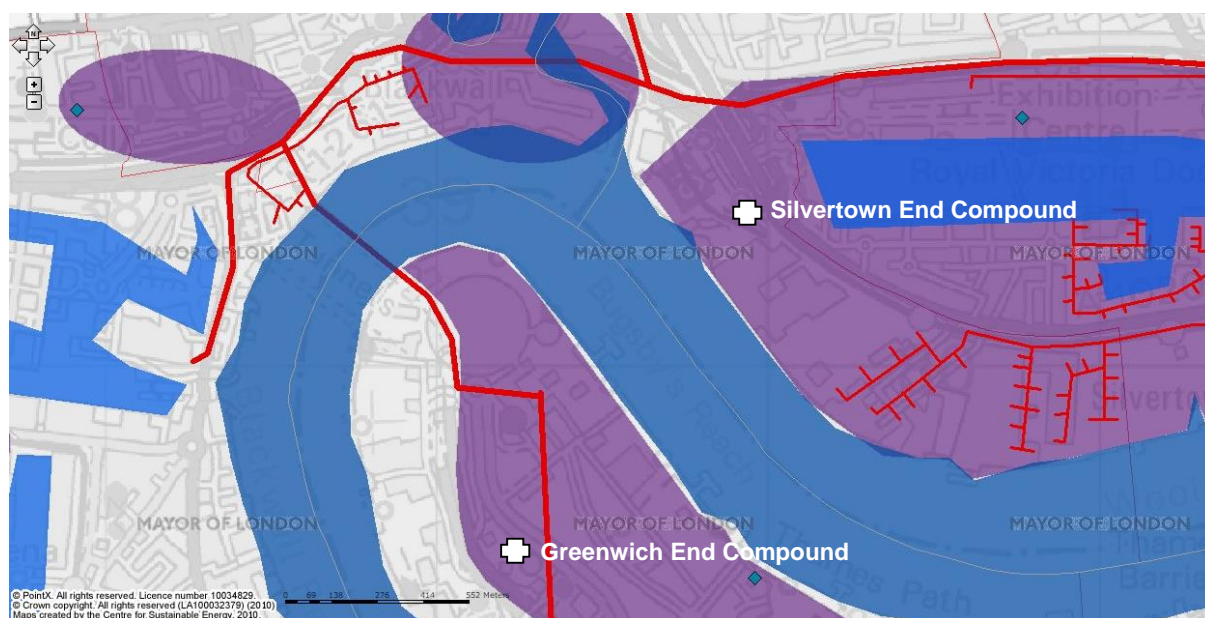
- connection to existing heating or cooling networks;
- site wide CHP network; and
- communal heating and cooling.

Connection to existing heating or cooling networks

5.4.3 A District Energy Network (DEN) is the process of heating and/or cooling a group of buildings from a central thermal energy generation plant(s) via a network of fluid distribution pipes. It is widely used for urban environments including residential, commercial, local authority, government, and industrial buildings. It is also used extensively for universities and hospitals where there are a variety of discrete buildings located around a campus. District energy is an alternative to the more traditional installation of individual heating or cooling plants in each building.

- 5.4.4 The energy centre serving the area often includes a CHP plant. A DEN with CHP is considered one of the most cost-effective ways of cutting CO₂ emissions for multi-building applications, and has one of the lowest CO₂ footprints of all fossil generation plants. Additionally, DENs are prioritised by regional and local planning authorities. Specifically, Policy 5.5 of The London Plan expects 25% of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025.
- 5.4.5 The London Heat Map below demonstrates that neither set of portal buildings are in close proximity to an 'existing' heat or cooling network (yellow pipelines).

Figure 5-2 London Heat Map²⁰



- 5.4.6 Greenwich Power Station (GPS) is owned by TfL and is used to house the Central Emergency Power Supply for the London Underground. The gas turbines used for this do not require the full space of the station so there is

²⁰ Centre for Sustainable Energy, 2010. London Heat Map,[online] Available at: <http://www.londonheatmap.org.uk/Mapping/> [Accessed: 21 August 2015]

a large amount of under-utilised space. TfL have developed a proposal to make use of the empty space by installing Combined Heat and Power (CHP) engines which would supply low carbon, cheaper electricity than is currently available from most energy suppliers.

- 5.4.7 Greenwich Council has been in discussions with TfL about the potential to build a heat network that would use the waste heat from the engines to serve the area surrounding the Power Station. The Council commissioned a feasibility study in April 2015, which involves a detailed review of the potential for a heat network, the business case and a potential network route. Once the feasibility study is completed in November 2015, a decision will be made as to the council's potential involvement in the project and the process that would be required.
- 5.4.8 In addition to this, Cofely District Energy have signed a 40 year energy services contract with ExCeL to supply heat, chilled water and CHP-generated electricity to the venue. There are plans to link this system to Cofely's existing district energy schemes in Stratford and Queen Elizabeth Olympic Park, creating greater opportunities for end users to benefit from low carbon, green energy.
- 5.4.9 The ExCeL energy centre currently has the capacity for 18MW of heating and 5MW of cooling, but the envelope of the building can contain significantly more plant and was built to supply energy to the wider area. Cofely will initially be installing a 2.6MWe of CHP, as well as additional cooling plant.
- 5.4.10 When the ExCeL network is connected to the existing network owned and operated by Cofely in East London, the resulting 230MW of heating capacity will be sufficient to heat the equivalent of 45,000 homes, This will enable the network to serve additional hotels, offices and homes as the area is regenerated over the next 20 years.
- 5.4.11 TfL are working closely with Arup via the GLA's "Decentralised Energy for London" programme to ensure the Schemes maximise synergies and potentials from the local plans. Discussions will continue around making passive provision for the heat network to use the tunnel to connect across the river as well as reviewing potential for the Scheme to contribute waste heat to the network. However, given the negligible heating demands of the

Scheme, the potential for carbon savings through connection to a heat network will be minimal. The cost and embodied energy associated with the infrastructure required to allow this connection would therefore likely exceed the benefits of the connection.

5.4.12 In contrast, the extensive electrical requirements expected warrants further investigation into implementing a private wire to Greenwich Power Station. This could result in significant carbon reductions and a cheaper electricity supply. At the time of writing this report, Pinnacle Power, who will own and operate the District Energy scheme on the Greenwich Peninsula, have designed the proposed building to take 10 MW of CHP. This is very much in the early design processes and therefore there are no performance figures available in order to accurately estimate potential carbon reductions for the Scheme. There may also be significant technical and legal constraints/risks relative to any requirement to ensure continuous operation of the tunnel independent of the status of the private wire to GPS.

5.4.13 Pinnacle Power is also looking into a cooling network, however this will be largely driven by how much load can be achieved and is therefore some way from coming into fruition. It has therefore been discounted for the time being however warrants further consideration, as the design progresses, as a means to meeting a proportion of the significant cooling demands for the Scheme. Consideration will also need to be given to the ability to ensure passive provision of cooling where practicable.

Site wide CHP network

5.4.14 Combined Heat and Power (CHP) technology converts gas into electrical power. The utilisation of the waste heat by-product of this electricity generation process combined with minimal distribution losses, due to its close proximity to the load, results in significant CO₂ emissions savings and potential utility cost benefits comparative to grid electricity.

5.4.15 CHP is an important technology for efficient fuel use and can use biomass or gas as the fuel source. A gas-fired CHP is regarded as a low carbon technology, not a true renewable. Should the supply of fuel to the CHP be biomass then the system can be considered as a true renewable system.

- 5.4.16 CHP primarily offers carbon emission reductions by reducing the amount of carbon heavy electricity imported from the national grid.
- 5.4.17 The system produces electricity that can be used in the building or exported to the grid, and heat for space, water and even process heating. Systems must therefore be 'heat lead' for high efficiency, which best suits applications to situations where there is a significant demand for heat for long periods of time (especially through the winter period), such as residential developments, hospitals, hotels and leisure centres (swimming pools being ideal).
- 5.4.18 Given the nature of the development conventional CHP is therefore not considered suitable.
- 5.4.19 A Combined Cooling, Heat and Power (CCHP) system incorporates an absorption chiller (i.e. a chiller driven by heat) to provide space cooling from the CHP waste heat recovery system. This potentially allows the system to function effectively when space heating requirements are low.
- 5.4.20 However, due to the high capital costs for CCHP, limited expected site heating and cooling loads and therefore limited improvement in CO₂ savings offered by the CCHP system, the level of additional plant space and system complexity, CCHP is not proposed for the Scheme.

5.5 Be Green: Renewable energy technologies

- 5.5.1 After the initial savings through energy efficiency measures, the next step in a sustainable energy strategy is the consideration of 'onsite' low carbon (be clean) and renewable energy (be green); referred to as low and zero carbon (LZC) technology.
- 5.5.2 Utilising energy generated locally (on-site) reduces energy lost through transmission and distribution, and can often take advantage of more advanced generating technologies that combine to provide energy more efficiently. Local generation, or decentralised generation, is produced on a smaller scale nearer to the point of consumption and can offer a number of benefits, including:
- using generated energy more efficiently by reducing distribution losses;

- contributing to security of energy supply by increasing local energy production;
- increasing reliability of supply providing the opportunity to operate 'on or off grid';
- reducing carbon emissions through more efficient use of fossil fuels and greater use of locally generated renewable energy;
- provides the opportunity to create stronger links between energy production and consumption;
- can be linked to fund complementary programmes of work, such as retrofitting microgeneration equipment in existing housing stock; and
- provides a visible message of commitment to sustainable energy.

5.5.3 Zero carbon or renewable energy comes from harnessing natural energy flows from the sun, wind, or rain. Many such as solar, wind and hydro, directly produce energy and do not emit any carbon dioxide in the process. Others such as biomass, use solar energy to grow renewable plant material that can subsequently be used for energy. Examples here are wood, straw, etc. However, biomass use still generates carbon dioxide when it is burnt. The difference being that this carbon is only that taken from the atmosphere when the plant grew. This is unlike carbon emissions from fossil fuels that are essentially new to the atmosphere, causing increases in atmospheric carbon dioxide levels and climate change. Therefore, when used to replace fossil fuels, biomass leads to a net reduction in carbon emissions; particularly where local supply chains can provide a sustainable supply of biomass.

5.5.4 Of the available renewable energy technologies, some are 'intermittent' in nature, such as solar and wind. Others such as biomass, ground source heat pumps and anaerobic digestion can service baseload duties.

5.5.5 Table 5-5 below provides an overview of potential LZC technologies and their feasibility relative to incorporation within the Scheme.

Table 5-5 LZC technology review

LZC Technology	Overview	Feasibility	Further action
Solar hot water panels	<p>Solar hot water panels harvest energy from the sun to warm water.</p> <p>However the requirements for hot water on the Scheme will be minimal.</p>	Low	None
Wind	<p>Wind turbines harvest the kinetic energy from the wind to drive a turbine and produce electricity. This can then be used on site and/ or transferred to the grid.</p> <p>The location of wind turbines is critical to their performance. They are typically situated in regions that frequently develop strong winds. London does not generally have a good wind climate for power generation – the high density of buildings considerably slows the wind as it passes across the city. Compared to open spaces with uninterrupted laminar air movement, the highly turbulent air movement in built up urban areas makes this technology poorly suited for this location.</p> <p>Alongside undesirable visual impacts of wind turbines and space constraints the reasons outlined above make wind</p>	Low	None

LZC Technology	Overview	Feasibility	Further action
	technology impractical for this scheme.		
Solar Photovoltaic Panels	<p>Photovoltaic panels harvest energy from the sun to produce electricity.</p> <p>Opportunities to place panels on the portal roofs is limited however they may well be a means to introduce some form of structure at the portal entrances to house solar panels.</p> <p>Use of photovoltaic panels reduces the need to source energy from the National Grid. This reduces the amount of carbon associated with the project.</p>	Low	Design team to discuss scope for introducing structure above portal entrances to house panels through design process
Ground Source Heat Pump Technology (GSHP)	<p>A ground source heat pump is formed of a loop of pipe buried underground with a fluid pumped around it. This fluid absorbs the heat from the ground and then passes through a compressor to raise the temperature. This heat can be used in a building's heating system.</p> <p>The heat demands on the Scheme will be insufficient to</p>	Low	None

LZC Technology	Overview	Feasibility	Further action
	<p>make ground source heat pumps commercially viable.</p> <p>The available ground for the installation of GSHP loops is limited. Therefore, GSHP is therefore not proposed for the Scheme.</p>		
<p>Air Source Heat Pump (ASHP)</p>	<p>An air source heat pump absorbs the heat from outside and distributes it into the building's heating system.</p> <p>The minimal heating requirements mean that the savings associated with the ASHP in a heating mode would be negligible...</p> <p>ASHPs would also require additional plant space and would add to the complexity of the M&E services. ASHPs are therefore not proposed.</p>	<p>Low</p>	<p>None</p>
<p>Biomass Boiler</p>	<p>A biomass boiler uses wood or peat based fuel to power a building's heating system.</p> <p>In addition to the lack of heating requirements at Silvertown the implementation of biomass has issues related to space constraints, transport, supply chain and air quality:</p>	<p>Low</p>	<p>None</p>

LZC Technology	Overview	Feasibility	Further action
	<ul style="list-style-type: none"> • A biomass boiler would require additional plant room space, and fuel storage; • Transportation of biomass into central London is inherently not a sustainable activity; • Biomass boilers emit more NOX and PM10 than conventional gas boilers, which would cause air quality concerns, particularly considering the location within an Air Quality Management Area (AQMA). <p>Biomass boilers are therefore not considered to be viable.</p>		
Anaerobic Digester	<p>Anaerobic Digestion (AD) is unlikely to be able to generate significant power, relative to the sites predicted demands, due to likely limitations on organic waste feedstock; although additional feedstocks may be identified (but not necessarily guaranteed).</p> <p>There are also potential odour issues associated with this technology which would point to it being located away from residential development.</p>	Low	None

LZC Technology	Overview	Feasibility	Further action
	<p>These issues, coupled with high maintenance, space and operational restrictions suggest that this technology is not appropriate for this development.</p>		
<p>Fuel Cells</p>	<p>Gas fuelled stationary fuel cells, which could produce electricity and heat as a CHP technology.</p> <p>However, there are currently negative aspects to fuel cells, which are mainly linked to the immaturity of the technology and are may be reduced in the future.</p> <ul style="list-style-type: none"> • high capital costs; • maintenance expertise and replacement parts supply chain are not developed at the moment, and contribute to the whole life cost of the technology; • adjoining systems (water treatment, backup gas tanks, etc.) add to the plant size requirements; and • life expectancy of the fuel cells is low. The heat loads are estimated to be too low to make this option worthwhile. 	<p>Low</p>	<p>None</p>

LZC Technology	Overview	Feasibility	Further action
	Fuel cells are therefore not considered feasible.		

5.5.6 Overall, there are a number of constraints associated with the Scheme when considering the installation of renewable energy and low carbon technologies. There is potential for a small amount of Solar PV at the tunnel portal entrances. This will need to be investigated further however it is unlikely that sufficient space will be made available to make a significant contribution to carbon emissions.

6. OPERATIONAL ENERGY EVALUATION AND CALCULATION

6.1 Reducing the need

6.1.1 The proposed measures to reduce the energy demand could result in a CO₂ reduction of approximately 585 tonnes. This represents a 6.1% reduction over the baseline scenario.

6.1.2 It should be noted however that the Scheme is not well suited to the employment of many passive measures typically applied to buildings. Nonetheless, the design of the Scheme will continue to be fully integrated with the Energy Strategy in order to identify and bring about savings in CO₂ emissions as the Scheme progresses. For this reason, no reduction against the baseline will be assumed at this stage (so as to represent a worst case scenario) with the exception of those achieved through the enhanced lighting strategy.

Table 6-1 Reducing the need

Project deliverable	Energy System	Annual energy consumption (MWh)	Annual Carbon Emissions (tonnes CO₂)
Lighting	Electricity	1,308 MWh	679 tCO ₂
Ventilation	Electricity	5,514 MWh	2,862 tCO ₂
Drainage Systems	Electricity	24 MWh	13 tCO ₂
SCADA	Electricity	58 MWh	30 tCO ₂
Emergency Communications	Electricity	364 MWh	189 tCO ₂
Traffic Monitoring and Control	Electricity	270 MWh	140 tCO ₂
Service buildings			

Project deliverable	Energy System	Annual energy consumption (MWh)	Annual Carbon Emissions (tonnes CO₂)
Greenwich site Building 1	Electricity	16 MWh	8 tCO ₂
Greenwich site Building 2	Electricity	809 MWh	420 tCO ₂
Silvertown site Building	Electricity	472 MWh	245 tCO ₂
Losses			
All Systems	Electricity	166 MWh	86 tCO ₂
TOTAL		9,002 MWh	4,672 MWh
Percentage Reduction		6.1%	6.1%

6.2 Using less energy

6.2.1 There are a variety of district energy initiatives in an early planning stage in the Greenwich area however they are not currently at a stage where they can deliver robust design principles which can be incorporated within the Scheme design. The DBFM contractor will need to further explore these opportunities, so that as standards for both the technical and legal interface emerge they can be incorporated where appropriate.

6.2.2 At this stage we are able to discount district heat options and centralised CHP due to the negligible heat demands expected for the Scheme. In contrast, the extensive electrical requirements expected warrants further investigation into implementing a private wire to Greenwich Power Station. This would result in significant carbon reductions and a cheaper electricity supply. At the time of writing this report, Pinnacle Power, who will own and operate the proposed District Energy scheme on the Greenwich Peninsula, have designed the building to take 10 MW of CHP. This is very much in the early design processes and therefore there are no performance figures available in order to accurately estimate potential carbon reductions for the Scheme. There may also be significant technical and legal constraints relative any requirement to ensure continuous operation of the tunnel independent of the status of the private wire to Greenwich Power Station.

6.3 Using efficient energy supply or renewable energy

6.3.1 There are a number of constraints associated with the Scheme when considering the installation of renewable energy and low carbon technologies. There is potential for a small amount of Solar PV at the tunnel portal entrances. This will need to be investigated further however it is unlikely that sufficient space will be made available to make a significant contribution to carbon emissions. It would therefore be difficult to justify the high expenditure associated with this option.

6.4 Summary of Operational Energy Strategy

6.4.1 In line with the local and regional policy guidance, the analysis presented in this report demonstrates the initial energy and CO₂ emissions reductions achievable through the implementation of passive design and energy efficiency measures.

6.4.2 The proposed strategy presented in this report would allow the Scheme to achieve a 6.1% reduction in CO₂ emissions over the baseline through an enhanced lighting strategy. However, the design of the Scheme is fully integrated with the Energy Strategy in order to identify and bring about further savings in CO₂ emissions as the Scheme progresses.

6.4.3 The key energy saving measures to consider will be:

- enhanced fabric over and above the requirements of Part L2a of the Building Regulations,
- high efficiency cooling system,
- building Management System and sub-metering strategy, and
- energy awareness schemes and efficient asset handover.

6.4.4 The analysis has determined that there is very little opportunity for on-site low or zero carbon technologies.

6.4.5 There are a variety of district energy initiatives proposed in the Greenwich area however they are not currently at a stage where they can deliver robust design principles which can be incorporated within the Scheme design. The DBFM contractor will need to further explore these

opportunities, so that as standards for both the technical and legal interface emerge they can be incorporated where appropriate.

6.4.6 At this stage however we are able to discount district heat options and centralised CHP due to the negligible heat demands expected for the Scheme.

Table 6-2 Summary of potential energy and CO₂ reductions

	Annual energy use (MWh pa)	% reduction	Annual Carbon Emissions (tonnes CO₂)	% reduction
Baseline Consumption	9,588 MWh pa		4,976 tCO ₂	
Savings from				
Reduce the need	9,002 MWh pa	6.1%	4,672 tCO ₂	6.1%
Using less energy	9,002 MWh pa	0	4,672 tCO ₂	0
Using efficient energy supply or renewable energy	9,002 MWh pa	0	4,672 tCO ₂	0
Total Savings	585 MWh pa	6.1%	304 tCO₂	6.1%

7. CONCLUSIONS

- 7.1.1 This Preliminary Energy Statement was developed to assess the available options for providing heating, cooling and electrical demands for the Scheme, whilst minimising energy consumption and consequently overall CO₂ emissions.
- 7.1.2 Energy consumption during construction has been estimated and a number of measures identified as part of this Energy Statement to reduce the CO₂ emissions associated with construction activities.
- 7.1.3 The Mayor's Energy Hierarchy has been followed to ensure that the Scheme maximises its potential to contribute to the Mayor's and TfL's ambitions to reduce CO₂ emissions associated with transport in London.
- 7.1.4 A wide range of energy saving measures has been considered. Those measures identified as both relevant and with potential to achieve significant savings will be taken forward to the detailed design stages of the project to achieve the maximum construction and operational CO₂ emissions savings.
- 7.1.5 There are ongoing discussions around making passive provision for the heat network to use the tunnel to connect across the river as well as reviewing potential for the Scheme to contribute waste heat to the network. However, given the negligible heating demands of the Scheme, the potential for carbon savings through actual connection to any heat network will be minimal. The cost and embodied energy associated with the infrastructure required to allow this connection would therefore likely exceed the benefits of the connection.
- 7.1.6 Given the negligible heating demands of the Scheme, the potential for carbon savings through connection to a heat network will be minimal. The cost and embodied energy associated with the infrastructure required to allow this connection would therefore likely exceed the benefits of the connection.
- 7.1.7 There are a variety of future district energy initiatives proposed in the Greenwich and Newham areas however they are not currently at a stage where they can deliver robust design principles which can be incorporated

within the Scheme design. The DBFM contractor will need to further explore these opportunities, so that as standards for both the technical and legal interface emerge they can be incorporated where appropriate.

- 7.1.8 To further reduce CO₂ emissions, an analysis of the feasibility of Low Zero Carbon energy technologies has been undertaken. It has been demonstrated that opportunity for on-site low or zero carbon technologies is limited however further opportunity may be identified as the design progresses.
- 7.1.9 To ensure energy efficient operation, a comprehensive commissioning strategy and energy management system will be implemented and the relevant staff will be provided with information and guidance on how to use energy efficiently.