Volume 6

SILVERTOWN TUNNEL

6.7 Energy and Carbon Statement

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APFP Regulation 5(2)(a)
Revision 0
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

April 2016

MAYOR OF LONDON

TRANSPORT FOR LONDON
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Silvertown Tunnel

Energy and Carbon Statement
6.7

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

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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
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

S.1.1 This Energy and Carbon Statement has been prepared to support the application by Transport for London (TfL) for a Development Consent Order (DCO) made under the Planning Act 2008 for the Silvertown Tunnel Scheme.

S.1.2 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 March 2019 and would last approximately 4 years with the new tunnel opening in 2022/23.

S.1.3 This report pays particular attention to the National Networks National Policy Statement (NN NPS) and policies 5.2 and 5.6 of the London Plan which outline the energy hierarchy (Be Lean, Be Clean, Be Green) this statement has accorded with.

S.1.4 The baseline construction carbon footprint for the construction of the Scheme has been calculated and a total of 153, 279 tonnes of CO_2 will be produced with the majority of embodied carbon associated with the materials required to construct the Scheme. Several key energy and carbon saving measures have been proposed during construction including:

- minimising the use of diesel or petrol powered generators and instead using mains electricity or battery powered equipment;
- powering down of equipment/plant during periods of non-utilisation;
- using energy efficient plant, where possible;
- using energy efficient lighting;
- providing appropriate levels of thermal insulation to the relevant areas of site accommodation to reduce energy demand for heating;
- providing appropriate, energy efficient generators;
- the principles of avoidance, reduction and minimisation of material use and waste production should be sought to reduce the construction

materials and waste and therefore the transport of these materials to site;

- TfL has committed to transport at least 50% by weight of all materials associated with the Scheme by River, as further described in the Code of Construction Practice (CoCP) (Document Reference: 6.10) and
- a staff travel plan will be implemented.

S.1.5 The baseline operational CO2 (excluding traffic movements) has been calculated as 1,827t CO2 per year.

S.1.6 Be Lean; The measures presented in this report will allow the Scheme to achieve a 13.50 per cent reduction in CO2 emissions over the estimated baseline through an enhanced lighting strategy

S.1.7 They key energy saving measures to consider will be:

- enhanced fabric over and above the requirements of Part L2a of the Building Regulations;
- enhanced lighting strategy;
- high efficiency cooling systems;
- building management system (BMS) and sub-metering strategy; and
- energy awareness schemes and efficient asset handover.

S.1.8 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.

S.1.9 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.

Table S-1Summary of Potential Operational Savings:

	Annual energy use (per annum)	**Percentage reduction**	**Annual Carbon Emissions**	**Percentage reduction**
Baseline Consumption	3,519 MWh		1,827 tCO_2	
Savings from				
Reduce the need	3,044 MWh	13.50%	1,580 tCO_2	13.50%
Using less energy	3,044 MWh	0	1,580 tCO_2	0
Using efficient energy supply or renewable energy	3,044 MWh	0	1,580 tCO_2	0
Total Savings	**475**	**13.50 %**	**246**	**13.50 %**

S.1.10 The annual increase in CO2 emissions from traffic using the Scheme when the tunnel is operational is less than 1% of the annual CO2 emissions projected by the London Atmospheric Emissions Inventory for the Greater London Area (GLA) in 2030.

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1. INTRODUCTION

1.1.1 This Energy and Carbon Statement has been prepared 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 (CO_2) 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 CO_2 emissions by 60 per cent compared to 1990 levels by 2025 (Greater London Authority, 2011). TfL is expected to assist by achieving CO_2 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 presents the baseline construction and operation carbon footprint and evaluates the opportunities for minimising the CO_2 emissions generated and following these evaluations outlines the energy strategy for the Scheme.

1.1.5 In preparing this Energy and Carbon Statement, consideration has been given to the requirements of the following planning documentation:

- the National Networks National Policy Statement (NN NPS) (2014)[1];
- the London Plan, Spatial Development Strategy for Greater London, Greater London Authority (2015)[2];
- Sustainable Design and Construction – The London Plan Supplementary Planning Guidance (SPG) (2014)[3];
- GLA Guidance on Preparing Energy Assessments (2015)[4]; and

[1] Department for Transport, 2014. The National Networks National Policy Statement
[2] Greater London Authority, 2015. The London Plan
[3] Greater London Authority, 2014b. Sustainable Design and Construction, Supplementary Planning Guidance, London: Greater London Authority

- delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy (2011)[5].

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 CO_2 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 This Energy and Carbon Statement takes into account environmental and spatial constraints and identifies how to minimise construction and operational energy consumption, and running costs for the Contractor through the implementation of passive design measures, energy efficiency, and low and zero carbon (LZC) technologies.

1.1.8 The Scheme will also be assessed under the Civil Engineering Environmental Quality and Assessment Scheme (CEEQUAL). It is intended that the Scheme achieves at least the target of 'Very Good' and ideally 'Excellent'.

1.1.9 This statement will be revised at the detailed 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.

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[4] Greater London Authority, 2014c. Energy Planning – Greater London Authority Guidance on Preparing Energy Assessments

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

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 has 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 and the opportunity to construct the Silvertown Tunnel could be permanently lost.

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; and
- PO7: to achieve value for money and, through road user charging, to manage congestion.

2.1.7 Appendix A of the Case for the Scheme (Document Reference: 7.1) contains an appraisal of all scheme options against the above project objectives.

2.2 Scheme description

2.2.1 The Silvertown Tunnel (the Scheme) – 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 Scheme is described in detail in Chapter 4 – *Scheme Description* of the Environmental Statement (ES) (Document Reference: 6.1.4).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.

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 heavy good vehicle lane, which would enable opportunities for TfL to provide additional cross-river bus routes.

2.2.5 Main construction works could commence in late 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. The main construction compound would be located at Silvertown to utilising the existing barge facilities at Thames Wharf along with a new temporary jetty for 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 The Scheme construction design is described in detail in Appendix 4.A – *Construction Method Statement (CMS)* of the Environmental Statement (ES) (Document Reference: 6.3.4.1).

2.3.2 The methodology proposed is not the only option available but is the method TfL envisages could be adopted for the Scheme. It represents a feasible and safe methodology which has been used to assess the likely significant effects of the Scheme’s construction.

2.3.3 The envisaged method of construction assumes that an experienced and competent contractor is used to undertake construction of works, and that the organisation is efficient and effective in safely delivering construction in a way which is consistent with best practice.

2.3.4 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 period of approximately 4 years.

2.3.5 A worksite compound office would 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 demand on the local highway network.

2.3.6 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.

2.3.7 The phasing of the envisioned construction works is determined by three prime issues:

- timing of occupation of worksites;
- traffic management requirements for the maintenance of highway routes; and
- sequencing of construction activities.

2.3.8 The sequencing (overall construction logistics) and durations of the programme activities (including productivity rates) have been developed based on current design, relevant experience and wit reference to industry best practice from similar large infrastructure projects, including Crossrail, DLR Woolwich Extension and Tideway Lee Tunnel.

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 Network National Policy Statement (NN NPS)

3.2.1 This statement sets out the need for, and Government's policies to deliver development of nationally significant infrastructure projects (NSIPs) on the national road and rail networks in England. It is also the key policy document against which highway DCO applications are examined and determined. It includes specific requirements for carbon emissions, but flood risk and reiteration of EIA climatic factors requirements are the only climatic issues covered.

3.2.2 Paragraph 5.16 of the NN NPS states: *'The Government has a legally binding framework to cut greenhouse gas emissions by at least 80% by 2050. As stated above, the impact of road development on aggregate levels of emissions is likely to be very small. Emission reductions will be delivered through a system of five year carbon budgets that set a trajectory to 2050. Carbon budgets and plans will include policies to reduce transport emissions, taking into account the impact of the Government's overall programme of new infrastructure as part of that.'*

3.2.3 Paragraph 5.17 of the NN NPS states: *'Carbon impacts will be considered as part of the appraisal of scheme options (in the business case), prior to the submission of an application for DCO. Where the development is subject to EIA, any Environmental Statement will need to describe an assessment of any likely significant climate factors in accordance with the requirements in the EIA Directive. It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets. However, for road projects applicants should provide evidence of the carbon impact of the project and an assessment against the Government's carbon budgets.'*

3.2.4 Paragraph 5.19 of the NN NPS states: *'Evidence of appropriate mitigation measures (incorporating engineering plans on configuration and layout, and use of materials) in both design and construction should be* *presented. The Secretary of State will consider the effectiveness of such mitigation measures in order to ensure that, in relation to design and construction, the carbon footprint is not unnecessarily high. The Secretary of State's view of the adequacy of the mitigation measures relating to design and construction will be a material factor in the decision making process.'*

3.2.5 A separate climatic factors topic was agreed with the Planning Inspectorate (PINS) not to be required within the ES at the scoping stage, as described in Chapter 5 – *Assessment Methodology* (Document Reference: 6.1.5). Instead, climatic factors are considered in the Chapter 6 - *Air Quality,* in terms of carbon emissions (Document Reference: 6.1.6) and Chapter 13 – *Materials and Waste* (Document Reference: 6.1.13), which assesses the embodied carbon associated with the materials required for construction. Chapter 16 - *Surface Water Quality and Flood Risk* considers flood risk mitigation and climate adaptation (Document Reference: 6.1.16). Climate adaptation issues are also incorporated in and have been considered as part of the Scheme design, described in Chapter 4 of the ES (Document Reference: 6.1.4), for example, as addressed in drainage design, which allows a 30% capacity for climate change. They are also included, where relevant in the Scheme designed in mitigation sections of each ES chapter.

3.2.6 This Energy and Carbon statement provides further assessment of the carbon and energy associated with the construction and operation of the Scheme. It also includes potential appropriate mitigation measures in relation to carbon and energy saving measures for construction and operation. A summary of the amount construction and operational CO_2 associated with the Scheme in relation the five-yearly carbon budgets set by the government to reach the target set by the Climate change Act, described below have also been included in Section 5.3, 6.6 and 7.2 of this report.

National Planning Policy Framework

3.2.7 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.

3.2.8 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).

3.2.9 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)".*

3.2.10 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)[6]

3.2.11 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

[6] Her Majesty's Stationery Office, 2008. Climate Change Act 2008

(CCC) with power to set out carbon budgets binding on the Government for 5 year periods.

3.2.12 In the 2009 budget the first three carbon budgets were announced which set out a binding 34% CO_2 reduction by 2020; and the Government has since proposed that the fourth carbon budget will be a 50% CO_2 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.

3.2.13 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.

3.2.14 The Scheme will generate carbon during operation and construction, and the assessment in Sections 5.3, 6.6 and 7.2 have included a comparison of the carbon generated during both operation and construction of the Scheme against the 3rd (2018-22) and 4th (2023-27) carbon budgets as the Scheme is planned to open in 2022/2023.

Energy Act (2013)[7]

3.2.15 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)[8]

3.2.16 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.

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[7] Her Majesty's Stationery Office, 2013. Energy Act 2013
[8] Her Majesty's Stationery Office, 2006. Climate Change and Sustainable Energy Act 2006

Our Energy Future – Creating a Low Carbon Economy (2003)[9]

3.2.17 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 CO_2 emissions by 2050 (from 2003 levels).

The Carbon Plan: Delivering Our Low Carbon Future (2011)[10]

3.2.18 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.

3.2.19 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)[11]

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 Energy and Carbon 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 CO_2 emissions of 60 per cent by 2025.

3.3.3 Policy 5.2: Minimising CO_2 emissions sets out that the Mayor expects that all new developments will fully contribute towards the reduction of CO_2 emissions. Specifically, Policy 5.2 (A) requires developments to make the fullest contribution to minimising emissions of CO_2 in accordance with the Mayor’s Energy Hierarchy:

[9] Department for Transport, 2003. Our energy future - Creating a low carbon economy, Norwich: The Stationery Office
[10] Department of Energy and Climate Change, 2011. The Carbon Plan: Delivering our low carbon future, UK: Crown Copyright
[11] Greater London Authority, 2015. The London Plan

- 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 CO_2 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; and
- 2019 – 2031: Zero carbon

3.3.5 It should be noted that The London Plan CO_2 emissions targets are to be achieved in part through the requirements of the Building Regulations. Any structures forming part of the scheme that are subject to the building Regulations would not be classified 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; and
- Major development should select energy systems in accordance with the following hierarchy:
    - connection to existing heating or cooling networks;

- o site wide CHP network; and
- o 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 CO_2 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)[12]

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

[12] Greater London Authority, 2014. Energy Planning – Greater London Authority Guidance on Preparing Energy Assessments

strategic planning applications. This Energy and Carbon Statement report follows the methodology outlined in this guidance.

Sustainable Design and Construction Supplementary Planning Guidance (2014)[13]

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)[14]

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 CO_2 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 CO_2 emissions from new development and transport through The London Plan and the Mayor's Transport Strategy.

3.4 Local policy

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.

[13] Greater London Authority, 2014. Sustainable Design and Construction, Supplementary Planning Guidance, London: Greater London Authority
[14] Greater London Authority, 2011. Delivering London's Energy Future: The Mayor's Climate Change Mitigation Energy Strategy

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 CO_2 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); and
- 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.

3.5 Summary

3.5.1 This report pays particular attention to the NN NPS, the government's five year carbon budgets associated with the Climate Change Act. The report also recognises the requirements of policies 5.2 and 5.6 of the London Plan for major developments to prepare an energy statement in accordance with the energy hierarchy (Be Lean, Be Clean, Be Green).

4. CONSTRUCTION CARBON FOOT PRINTING METHODOLOGY

4.1 Introduction

4.1.1 Reporting for the Green House Gas (GHG) impact associated with the construction of the Scheme is carried out using mass of carbon dioxide equivalent (CO_2e) emissions, which allows for the emissions of the six key GHG: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6); to be expressed in terms of their equivalent global warming potential in mass of CO_2. The Highways England (HE) Carbon Calculation for Major Projects (CCMP)[15] model has been selected to calculate the carbon footprint associated with construction of the Scheme as it is based on the widely used Greenhouse Gas Protocol[16] and has also been designed by HE specifically for major road schemes of a similar scale to the Silvertown Tunnel.

4.1.2 The CCMP contains carbon factors related to the types of materials commonly used in highway construction. It was most recently updated in January 2013, to bring carbon factors in line with the latest guidance.

4.2 Methodology

4.2.1 The general methodology used is that described within the Carbon Calculation Tool Instruction Manual for Major Projects[17]. The specific methods of data collection relating to each model input are described in Section 5.3.

4.2.2 The collected data comprises estimates of materials, energy use and commuting journeys. The data has been inputted into the CCMP in order to generate an initial estimate of the carbon footprint related to construction of the Scheme. The input data included:

- energy use during construction, based on the assumptions outlined in Section 6.3 of this document;

[15] The Highways England - Carbon Calculation for Major Projects (CCMP), 2013
[16] Greenhouse Gas Protocol – World Resources Institute, 2004
[17] Highways England - Carbon Calculation Tool Instruction Manual For Major Projects, 2009

- materials quantities, described in Volume 3, Appendix 4.A – *Construction Method Statement* of the ES (Document Reference: 6.3.4.1);
- labour force information, as described in Volume 1,Chapter 4 – *Scheme Description* of the ES (Document Reference: 6.1.4); and
- information on the quantities, and dispositions, of construction and demolition waste, is described in Chapter 13 – *Materials and Waste* of the ES (Document Reference: 6.1.13); and
- assumptions regarding material transport to site, as described in Section 5.3.

5. CONSTRUCTION ENERGY AND CARBON

5.1.1 This section of the statement focuses solely on the energy and carbon associated with the construction process (e.g. plant, welfare facilities and equipment).

5.1.2 The envisaged construction methodology, set out in Appendix 4.A – *CMS* of the ES (Document Reference: 6.3.4.1), has been developed to inform the assessment of the environmental and traffic 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 Contractor appointed to undertake these works.

5.1.3 A Code of Construction Practice (CoCP) (Document Reference: 6.10), is included with the DCO application, sets 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 (ES) (Document Reference: 6.1). The CEMP will be completed prior to the start of construction.

5.2 Energy

5.2.1 This section identifies areas of high energy consumption and with high potential to reduce it. 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.

5.2.2 A comprehensive review of construction requirements, logistics and wider considerations of the Scheme's construction was undertaken as part of the development of the design for the Scheme, an envisaged description of this design is set out in the Construction Method Statement (Document Reference: 6.3.4.1).

5.2.3 In support of the Scheme securing the necessary power requirements during construction an assessment was undertaken as part of the development of the design for the Scheme of the temporary power supply needed during the construction phase. This was built-up using a comprehensive list of the likely equipment required to fulfil the needs of the Scheme's construction activities and reviewed against the construction programme.

5.2.4 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 TBM.

5.2.5 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.

5.2.6 The workforce amenity and welfare facilities have been assumed to be entirely electrically powered, including space heating, catering, auxiliary plant and hot water. The total baseline estimated construction energy demands are included in Table 5-1.

Table 5-1 Total estimated baseline construction energy demands

Activity	**Power demand (MWh)**	**Percentage of Total**
TBM, Conveyors & General Tunnel Plant	21,259	66%
Shaft Top, Loading & General Surface Plant	2,806	9%
Piling Plant	941	3%
Site Facilities	7,332	22%
Total	**32,338**	

5.3 Embodied Carbon

5.3.1 In order to calculate the baseline carbon footprint for the Scheme the Highways England CCMP tool was used to calculate CO_2e[18] associated

[18] CO_2e - carbon dioxide equivalent, is a standard unit for measuring carbon footprints. The idea is to express the impact of each different greenhouse gas in terms of the amount of CO_2 that would create the same amount of warming.

with energy, materials, transport and waste, as described in Section 4.2. The data sources and key assumptions when using the CCMP for each of these inputs are described below.

Energy

5.3.2 This section of the CCMP considers the energy use of ‘site offices and fixed plant (e.g. generators and the TBM)’ and ‘mobile plant’ during construction i.e. plant which is licensed for use on public highways.

5.3.3 Embodied carbon from energy use from site offices and fixed plant, including the TBM has been calculated using the data in Table 5-1, however this has been converted to kWh for the purposes of the model input. In terms of mobile plant there are two options for calculating the amount of embodied carbon, the first option requires detailed inputs in terms of fuel usage from all plant and vehicles. As the construction design is at a preliminary design stage this is not possible, therefore option B has been adopted. This includes an estimate of the CO_2e to be calculated by determining the size of the project which in the case of this Scheme is ‘very large’, with more than 25 people working on-site and spending of more than £10 million and the number of weeks over which construction will take place. As construction will take place over approximately 4 years a total of 227 weeks has been used to represent the total duration of works.

5.3.4 Water will also be required during construction and will have associated carbon emissions; this is addressed in the CCMP through the indirect impact of using mains water, or the direct impact of the road transport of water. The construction compounds located in Greenwich and Silvertown will be within close proximity to water utilities and potable water needs would be met through a mains water connection, therefore no water will be transported by road or abstracted. The volume of water that may be required for the Scheme is currently unknown, therefore a similar approach to that adopted on the A14 Cambridge to Huntingdon Improvement Scheme has been adopted and industry benchmarks for fresh water, published by WRAP[19] have been used to make an estimate. For highways the WRAP benchmark ranges between

[19] http://www.wrap.org.uk/content/water-efficiency-construction

1.3 and 9.2m^3 fresh water per £100k project value. Applying the approximate Scheme value gives an estimate of 52,500m^3.

Energy Results

5.3.5 The estimates for site energy and mobile plant are presented in Table 5-2.

Table 5-2 Total Carbon from Energy Use

Energy	**Tonnes (CO_2e)**
Site offices and fixed plant	16,846
Mobile plant	1,419
Total	**18, 265**

Materials

5.3.6 The information for the calculation of embodied carbon in materials is taken from the description of the principal materials envisaged in Appendix 4.A – *CMS* of the ES (Document Reference: 6.3.4.1) and has been interpreted for input into the CCMP for the purposes of this specific assessment following the assumptions set out in Table 5-3 below. A more detailed breakdown of the material quantities envisaged in the CMS is provided in table 5-3 for the purposes of this carbon assessment.

Table 5-3 Material assumptions

Type of material required	**Type of material selected within CCMP**	**Estimated Quantities of Material (tonnes)**
Excavated Material	All material excavation is inputted as quarry-sourced soil	991,000
Concrete materials	Ready Mix Concrete: General Concrete	398,000
Fill materials including	Quarry Sourced Material: quarried aggregate	172,000
Dredged Spoil	All material excavation is inputted as quarry-sourced soil	95,000

Tunnel segments	Ready Mix Concrete: Prefabricated Concrete	80,000
Highway / pavement material	Ready Mix Concrete: General Road and Pavement	30,000
Steel (Reinforcement & Structural)	Metals: Steel (bar and rod)	17,000
Miscellaneous, highway concrete inc. kerbs	Ready Mix Concrete: General Concrete	1,000
Landscaping Material	Quarry Sourced Material: Soil	15,000

Material results

5.3.7 Table 5-4 shows the embodied carbon that has been calculated in relation to these materials used for construction.

Table 5-4 Material embodied carbon results

Type of material required	**Tonnes (CO2e)**
Metals	23,800
Quarry Sourced Materials	27,500
Ready-Mix Concrete	57,383
Lighting	277
Total Tonnes (CO_2e)	**108, 961**

5.3.8 The largest contributor of carbon is concrete which is required to construct large elements of the Scheme, with significant contributions also being provided by metals used to reinforce many concrete structures including the cut and cover sections. The quarry sourced materials which represent the excavated material mainly from the tunnel and cut and cover sections also represents a significant portion of the carbon footprint. The lighting and gantry design set out in Chapter 4 – *Scheme Description* of the ES (Document Reference: 6.1.4) has been used to estimate the installation of lighting columns, luminaries and proposed gantries. However these materials reflect the smallest amount of embodied carbon.

Logistics

5.3.9 It is intended that required materials for the construction of the Scheme would be imported by either road, using the strategic road network or river using the temporary jetty and/or the Not Always Afloat but Safely Aground (NABSA) berth, located at Thames wharf, Silvertown and an operational wharf located in Greenwich. The total number of HGV and barge movements associated with the import and export of materials and waste is included in Appendix 4.A – *CMS* of the ES (Document Reference: 6.3.4.1). TfL commits to transport at least 50% by weight of all materials associated with the Scheme by River, as further described in the CoCP (Document Reference: 6.10).

5.3.10 The requirements for the transport of material to the site have been estimated by material type in order to calculate the estimated embodied carbon associated with the transport of each material. The total total transport tonne-km's for each material for transport by river (shipping) and road have been input into the CCMP, following the HE guidance[20]. It should be noted the tonne-km's for the shipping of ready mix concrete cannot be included in the CCMP so a conservative average estimate for all transport by road has been included for this material type. As the design is at a preliminary stage and it is not known where materials will be procured from, it has been assumed for the purposes of input into the CCMP that all material transported by road (excluding ready mixed concrete) would be approximately 50km per trip (one way) from the Scheme boundary and all barge or ship movements would be approximately 35km. This represents the journey length of a barge or ship movement to Tilbury, the most likely dock location for the import of materials. Where materials have been associated with the ready mixed concrete category a conservative transport distance of up to 20km by road

[20] Major Project Instruction Manual – Appendix 2, 2009

has been assumed as it is considered that the majority of concrete would be supplied from localised batching plant. However, as previously mentioned TfL has committed to transport at least 50% by weight of all materials associated with the Scheme by River, as further described in the COCP (Document Reference: 6.10).

5.3.11 The embodied carbon associated with employee commuting has been based on the estimates made of the number of available car parking spaces in the Greenwich and Silvertown compounds during construction. These are envisaged to be limited to 100 spaces in Silvertown and 50 spaces in Greenwich for cars and vans. As no detailed information is available on potential journey lengths for these vehicles it has been assumed that as for HGV movements above, an average daily trip would be approximately 50km each way, based on a worker travelling on a daily basis from a location outside of the M25, but within roughly 1 hours commute. It has also been considered that at least 25% of the non-specialist elements of the workforce will be local (recruited from within the three host boroughs), there are therefore assumed to have travelled less than 10 km.

5.3.12 Both work sites are well connected the public transport system it has therefore been assumed that of the 1000 people who would be working on site during the peak construction phase they would theoretically all travel to site by train, tube or bus. As a worst case all journeys have been assumed to be by rail in the CCMP with an average journey length of 50km each way. Information on the transport of fuels to site and the movement of HGV vehicles within the Order Limits would not be available until the detailed design stage and therefore has not been included in the CCMP model.

Logistic results

5.3.13 Table 5-5 shows the results of emissions form transport and logistics.

Table 5-5 Transport embodied carbon results

Transport Type	**Tonnes (CO2e)**
Employee Commuting	9, 453
Materials Transport	5,694
…of which Shipping	318
…of which Road	4,012
Average Road	1,365
Total Tonnes (CO_2e)	**15,148**

5.3.14 The most significant contribution of carbon from transport is related to the employee commuting, however the overall embodied carbon from transport is still relatively low from due to the significant proportion of workers travelling to site by public transport. A peak number of workers on site has also been assumed, which represents a worst case.

Waste

5.3.15 Construction waste has been calculated using the information presented in Chapter 13 – Materials and Waste (Document Reference: 6.1.13) and the Site Waste Management Plan (SWMP) (Document Reference: 6.10). This calculation has assumed that all waste is transported regionally.

5.3.16 Office waste which includes on site construction offices was estimated using the *CCMP* method 4b. The Scheme duration was considered to be up to 4 years and the maximum number of people working on site of 1000 people was used to represent a worst case number of employees. The distance waste will travel was assumed to be regional i.e. between 25 and 150km, which is one of a limited number of options in the CCMP. Local is less than 25km which is too localised for central London and National is over 125km, it is consider in Chapter 13 – Waste and Materials (Document Reference: 6.1.13) that most waste will be disposed of within this regional radius.

Waste results

5.3.17 Table 5-6 presents the results of the waste calculation for embodied carbon.

Table 5-6 Waste embodied carbon results

Waste Removal	**Tonnes (CO2e)**
Office Construction waste	8.26
Construction Waste	10,898
Total Tonnes (CO_2e)	**10,906**

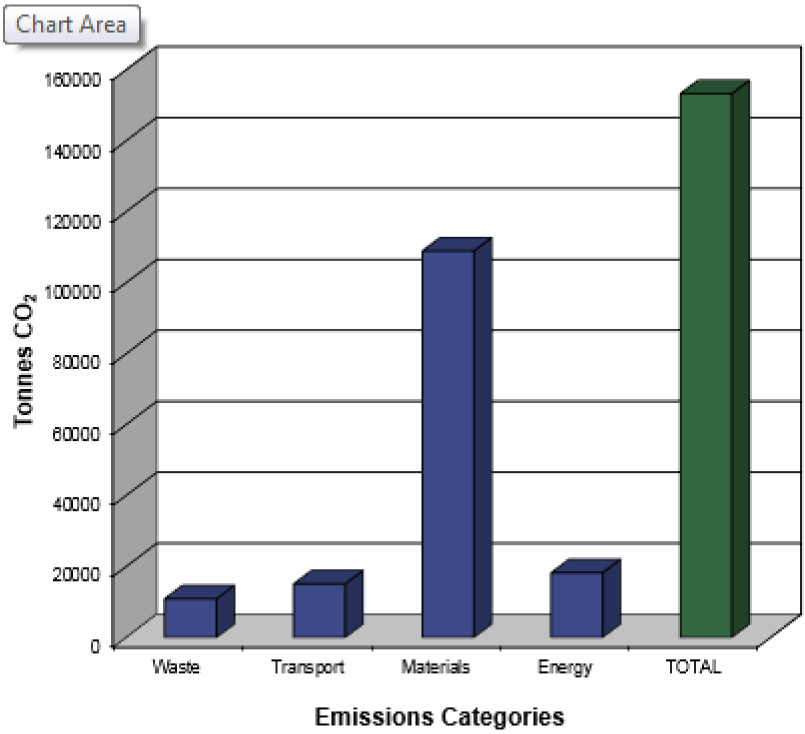
Overall carbon footprint

5.3.18 Across the entire scheme, the estimates shown in Table 5-7 and Figure 5 -1 show that carbon embodied in materials would make up the largest proportion of the construction stage carbon footprint and energy and waste would make up a small proportion.

Table 5-7 Carbon footprint summary table

CO_2 category	**Tonnes (CO_2e)**	**% proportion**
Waste	10,906	7
Transport	15,148	10
Materials	108,961	71
Energy	18,265	12
Total	153,279	100

Figure 5-1 Summary of the CCMP Carbon Footprint for the Scheme



Construction CO_2 and the Government's carbon budgets

5.3.19 Table 5-7 summarises that a total of 153,279 tonnes of CO_{2e} would be generated by the construction of the Scheme based on the envisaged construction methodology undertaken between 2019 and 2022. If this is compared against the government targets for the of 3rd Carbon budget for the UK from (2018-22) of 2,544 $MtCO_2e$[21], this would represent 0.006% of this budget. Although the Scheme does generate carbon emissions, the following measures listed in Section 5.4 have been incorporated into the Scheme design or will be adopted by the Contractor through the CoCP to ensure that carbon emissions are minimised as far as reasonably practicable.

[21] https://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/carbon-budgets-and-targets/

5.4 Potential energy and Carbon saving measures

Energy saving measures

5.4.1 The Contractor would address working methods that reduce energy consumption through the CoCP (Document Reference: 6.10) 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 CO_2 emissions. Particular attention would therefore be paid to those measures associated with high energy consuming activities, such as the tunnelling.

5.4.2 The 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 5-8 below.

5.4.3 Table 5-8 presents potential energy saving measures based on good practice, including measures from the Considerate Constructors Scheme[22]. Furthermore, the Carbon Trust's recommendations within their Action Plan to Reduce Carbon Emissions (2010)[23] are included. It is also intended that the Scheme achieves at least the target of 'Very Good' and ideally 'Excellent' for CEEQUAL. These measures are also included in the CoCP (Document Reference: 6.10).

[22] Considerate Constructors Scheme, 2016. Site Registration Monitors' Checklist
[23] Carbon Trust, 2010. Action Plan to Reduce Carbon Emissions.

Table 5-8 Potential energy saving measures during construction

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.
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

Measure	Feasibility	CO_2 saving	Notes
			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
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.

Materials and logistics saving measures

5.4.4 As set out in Chapter 13 – Materials and Waste of the ES (Document Reference: 6.1.13) the Contractor will follow the Waste Hierarchy when managing waste. This will reduce the construction materials and waste and therefore the transport of these materials to site.

5.4.5 TfL has committed to transport at least 50% by weight of all materials associated with the Scheme by River, as further described in the CoCP (Document Reference: 6.10).

5.4.6 This has reduced the number of potential HGV movements and therefore the associated embodied carbon. The emissions associated with river and road movements has been incorporated into the baseline carbon model. If at the detailed design stage it were considered practicable a larger proportion of movements could be undertaken by river rather than by road.

5.4.7 As mentioned above, the Scheme is also registered for CEEQUAL, which considers physical material use and management and has also committed to the use of low carbon alternatives for materials, where possible and the use of sustainable timbre.

5.4.8 A proportion of transport emissions are associated with staff commuting. The number of car parking spaces has deliberately been limited, further to consultation with the London Borough Newham and the Royal Borough of Greenwich, to encourage staff to travel by public transport, and this has been taken into account in the assessments of the number of trips to the site that would be made by road. A staff travel plan dealing with these issues will be implemented as set out in the CMS and CoCP.

5.4.9 The Scheme has made commitments in relation to the management of Material Transportation to limit its impacts. These can be found in the CD&E Commitments document (Appendix to CoCP, Document Reference: 6.10).

6. OPERATIONAL ENERGY AND CARBON (excluding Traffic)

6.1.1 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.

6.1.2 The purpose of the energy hierarchy approach is to demonstrate that climate change mitigation measures form a fundamental part of the development of the design for the proposed Scheme. Any measures taken forward must be appropriate and feasible in the context of the overall development.

6.1.3 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.

6.1.4 The first principle stresses the primacy of seeking to reduce energy consumption. Within the built environment this comprises adopting energy efficiency measures in the design 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.

6.1.5 For the purposes of this Energy and Carbon Statement, the baseline energy consumption and associated CO_2 emissions of the Scheme represent an estimate of the energy usage during operation 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 2013[24] in relation to CO_2 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.

6.1.6 Energy consumption and associated CO_2 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)[25] , Transportation systems in buildings - CIBSE Guide D (2010)[26], Energy Benchmarks - TM46 (2008)[27].

6.1.7 The expected whole energy use during operation 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.

6.2 Baseline assessment

6.2.1 TfL have undertaken a baseline energy demand assessment to 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

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[24] 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.
[25] 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
[26] 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
[27] The Chartered Institution of Building Services Engineers, 2008. Energy Benchmarks- CIBSE TM46: 2008, London: The Chartered Institution of Building Services Engineers

information is not available, industry standard benchmarks are used to calculate the energy demand for the Scheme.

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

6.2.3 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.

6.2.4 The following assumptions have been made with regards to the service buildings, however these may vary as the design progresses. There are three common component parts to the Scheme at each end of the tunnel and these comprise:

- portal Structure including retaining walls;
- ancillary Services Buildings housing mechanical, electrical and fire suppression accommodation; and
- an Operational Compound sited within operational land and containing the services buildings and providing parking for operational and maintenance vehicles.

6.2.5 In addition, there will be a permanently staffed Control Centre Building at Silvertown which operates the tunnel systems and services, as well as the portal specific infrastructure in relation to fire fighting and ventilation.

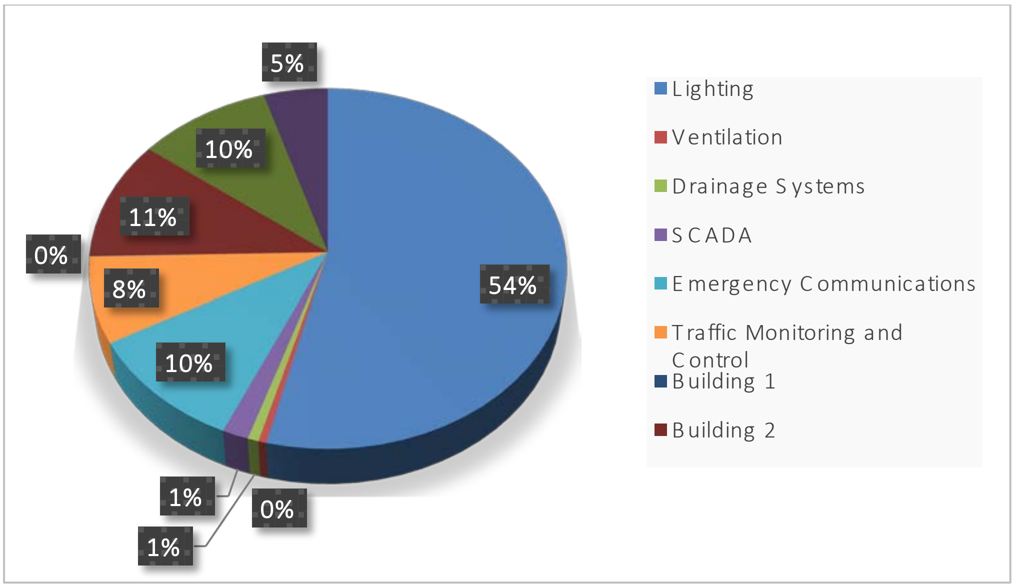
6.2.6 Table 6-1 below outlines the estimated operational energy demand baseline produced using the methods outlined above.

Table 6-1 Baseline energy consumption

Project deliverable	**Energy System**	**Annual energy consumption (MWh)**	**Annual Carbon Emissions (tonnes CO_2)**
Lighting	Electricity	1,893	983
Ventilation	Electricity	17	9
Drainage Systems	Electricity	24	13
SCADA	Electricity	58	30
Emergency Communications	Electricity	364	189
Traffic Monitoring and Control	Electricity	270	140
Service Buildings			
Greenwich buildings	Electricity	379.87	197
Silvertown end compound	Electricity	347	180
Losses			
All Systems	Electricity	166	86
TOTAL		**3,519**	**1,827**

6.2.7 Figure 6-1 shows the breakdown of the operational energy uses.

Figure 6-1 Estimated energy consumption by energy uses



6.2.8 The largest proportion of the energy consumption is estimated to be the lighting (54%).

6.3 Be Lean: Reducing the need

6.3.1 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).

6.3.2 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.

6.3.3 The heat loss of building elements is dependent upon their U-value[28]. The lower the U-value the better the level of insulation which will improve the thermal performance of the building and help to reduce the CO_2 emissions

[28] 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

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.

6.3.4 Table 6-2 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 6-2 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

6.3.5 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

6.3.6 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.

6.3.7 The potential of utilising light tubes for transport of daylight to locations below ground is limited due to the nature of the tunnel beneath the River Thames.

Orientation and site layout

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

6.3.9 Orientation of the service buildings will be largely dictated by the nature of the site however occupied areas will be orientated such as to optimise the availability of heat from direct sunlight whilst ensuring that the potential for overheating is kept to a minimum.

Energy Awareness Scheme for staff

6.3.10 To realise the potential of the design fully, a good and complete initial asset handover to operational staff is essential through the provision of a building user guide.

6.3.11 To achieve an efficient handover, the Contractor would 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

6.3.12 As part of the Mayor's pledge to cut CO_2 emissions, TfL has begun implementing an energy saving plan for its networks which will be delivered over the next three years. By 2016, the programme aims to reduce associated CO_2 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.

6.3.13 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.

6.3.14 Under normal operations the lighting within the tunnels 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.

6.3.15 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.

6.3.16 It is proposed for the Scheme to incorporate high intensity LED lighting for the threshold, transition, interior and exit zones of the tunnel to meet all the required lighting levels. This lighting system is an improvement from conventional fluorescent, stepped scheme.

6.3.17 The baseline scenario assumes Fluorescent T5 (HO) and high pressure sodium (HPS) for Threshold and Transition Zones. The proposed LED scheme therefore offers savings in electrical consumption.

6.3.18 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.

6.3.19 The Service buildings will incorporate high efficiency lighting throughout. The proposed target is to provide 100% of all light fittings as low energy lighting, and will accommodate the compact fluorescent or fluorescent luminaires only.

<u>Heat recovery</u>

6.3.20 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 CO_2 emissions. Mechanical Ventilation Heat Recovery is therefore not proposed.

<u>Efficient heating</u>

6.3.21 The heat profile of the Scheme will be restricted to occupied areas of the Ancillary Service Buildings, Portal Buildings and Control Centre Building 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.

6.3.22 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.

<u>Efficient Cooling</u>

6.3.23 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

6.3.24 The tunnel will be designed for routine operation as a fully automatic facility, with minimum intervention for planned maintenance.

6.3.25 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

6.3.26 Where provided, preference will be given to selecting staff equipment that is energy efficient, e.g. low energy computers and screens.

6.3.27 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.

Be Lean Summary

Table 6-3 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	Very little opportunity to provide natural ventilation	Low	Promote natural ventilation wherever

Reducing the need	Overview	Feasibility	Further action
Ventilation	on scheme		feasible. Some 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.
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.

6.3.28 The Scheme design will also optimise energy performance and CO_2 emissions during the operational phase through:

- The use of enhanced levels of insulation and high efficiency glazing at the portal buildings;
- High efficiency cooling systems;
- Building management system (BMS) and sub-metering strategy;
- The use of high intensity LED lighting, in accordance with TfL's new energy efficient lighting programme; and
- Energy awareness schemes and efficient asset handover

6.4 Be Clean: Using less energy

6.4.1 Once demand for energy has been minimised, the next step in the hierarchy is to meet the demand efficiently. The energy systems have been selected in accordance with the order of preference in Policy 5.6b of the London Plan. This energy statement works through the order of preference and where an approach is not appropriate for the development the assessment provides reasoned justification for a departure from the hierarchy, as set out in the Sustainable Design and Construction – The London Plan Supplementary Planning Guidance.

6.4.2 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.

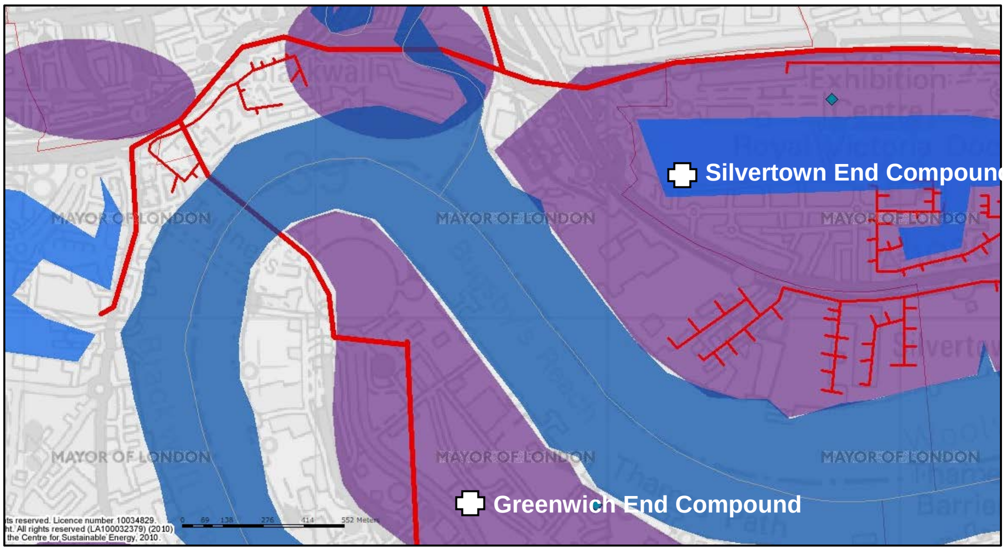
Connection to existing heating or cooling networks

6.4.3 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.

6.4.4 The energy centre serving an area often includes a CHP plant. A DEN with CHP is considered one of the most cost-effective ways of cutting CO_2 emissions for multi-building applications, and has one of the lowest CO_2 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.

6.4.5 The London Heat Map below demonstrates that there are no 'existing' heating or cooling networks in close proximity to the Scheme. However there is a potential District Heating Transmission Line shown passing relatively close to the Greenwich End Compound (red pipeline).

Figure 6-2 London Heat Map[29]



6.4.6 Greenwich Power Station 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 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.

6.4.7 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 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 a decision will be made as to the council's potential involvement in the project and the process that would be required.

6.4.8 In addition to this, Cofely District Energy have signed a 40 year energy services contract with ExCeL to supply heat, chilled water and CHP-

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

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.

6.4.9 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.

6.4.10 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.

6.4.11 TfL are working closely with Arup via the GLA's "Decentralised Energy for London" programme to ensure the Scheme maximise synergies and potentials from these local plans. Discussions, outside of the DCO application, will continue around Discussions will continue around the potential for passive provision in the tunnel for future DHP networks identified in the vision'. 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.

6.4.12 In contrast, the extensive electrical requirements expected from the scheme warrants further investigation into potential connections to external sources (such as Greenwich Power Station) through private wire. This could result in significant carbon reductions and a cheaper electricity supply.

6.4.13 At the time of writing this report, Pinnacle Power, who will own and operate (on behalf of TfL) the District Energy scheme on the Greenwich Peninsula, have designed the proposed building to take 10 MW of CHP, which would be more than sufficient to meet the schemes estimated energy demands. 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.

6.4.14 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.

Site wide CHP network

6.4.15 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 CO_2 emissions savings and potential utility cost benefits comparative to grid electricity.

6.4.16 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.

6.4.17 CHP primarily offers carbon emission reductions by reducing the amount of carbon heavy electricity imported from the national grid.

6.4.18 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).

6.4.19 Given the nature of the development conventional CHP is therefore not considered suitable.

6.4.20 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.

6.4.21 However, due to the high capital costs for CCHP, limited expected site heating and cooling loads and therefore limited improvement in CO_2

savings offered by the CCHP system, the level of additional plant space and system complexity, CCHP is not proposed for the Scheme.

6.5 Be Green: Renewable energy technologies

6.5.1 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.

6.5.2 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.

6.5.3 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 no 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.

6.5.4 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.

6.5.5 Table 6-4 below provides an overview of potential LZC technologies and their feasibility relative to incorporation within the Scheme.

Table 6-4 LZC technology review

LZC Technology	Overview	Feasibility	Further action
Solar hot water panels	Solar hot water panels harvest energy from the sun to warm water. However the requirements for hot water on the Scheme will be minimal 'and as such these panels would not be appropriate for this Scheme'.	Low	None
Wind	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. 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	Low	None

LZC Technology	Overview	Feasibility	Further action
	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. Alongside undesirable visual impacts of wind turbines and space constraints the reasons outlined above make wind technology impractical for this scheme.		
Solar Photovoltaic Panels	Photovoltaic panels harvest energy from the sun to produce electricity. Small opportunity to incorporate panels at the portal entrances. Use of photovoltaic panels reduces the need to source energy from the National Grid. This reduces the amount of carbon associated with the project.	Low	Design team to investigate feasibility of incorporating in the design of the tunnel portals and the buildings, as described in the Design Principles document (Document Reference: 7.4).
Ground Source Heat Pump Technology (GSHP)	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	Low	None

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

LZC Technology	Overview	Feasibility	Further action
	• 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). Biomass boilers are therefore not considered to be viable.		
Anaerobic Digester	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). There are also potential odour issues associated with this technology which would point to it being located away from residential development. These issues, coupled with	Low	None

LZC Technology	Overview	Feasibility	Further action
	high maintenance, space and operational restrictions suggest that this technology is not appropriate for this development.		
Fuel Cells	Gas fuelled stationary duel cells, which could produce electricity and heat as a CHP technology. 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. • 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. Fuel cells are therefore not considered feasible.	Low	None

6.5.6 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.

6.6 Operational Energy Evaluation and Calculation

Reducing the need

6.6.1 The proposed measures to reduce the energy demand could result in a CO_2 reduction of approximately 246 tonnes from the baseline numbers presented in Table 5-1. This represents a 13.50% reduction over the baseline scenario.

6.6.2 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 and Carbon Statement in order to identify and bring about savings in CO_2 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 6-5 Reducing the need

Project deliverable	Energy System	Annual energy consumption (MWh)	Annual Carbon Emissions (tonnes CO_2)
Lighting	Electricity	1,308 MWh	679 tCO_2
Ventilation	Electricity	17 MWh	9 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 CO_2)
Greenwich site Buildings	Electricity	379.97 MWh	197 tCO_2
Silvertown site Buildings	Electricity	347 MWh	180 tCO_2
Losses			
All Systems	Electricity	166 MWh	86 tCO_2
TOTAL		**3,044 MWh**	**1,580 tCO_2**
Percentage Reduction		**13.50%**	**13.50%**

Using less energy

6.6.3 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 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.

6.6.4 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.

Using efficient energy supply or renewable energy

6.6.5 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.

Summary of Measures

6.6.6 In line with the local and regional policy guidance, the analysis presented in this report demonstrates the initial energy and CO_2 emissions reductions achievable through the implementation of passive design and energy efficiency measures.

6.6.7 The proposed measures presented in this report would allow the Scheme to achieve a 13.50% reduction in CO_2 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 CO_2 emissions as the Scheme progresses.

6.6.8 They key energy saving measures to consider will be:

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

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

6.6.10 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 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.

6.6.11 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 6-6 Summary of potential energy and CO_2 reductions

	Annual energy use (MWh pa)	**% reduction**	**Annual Carbon Emissions (tonnes CO_2)**	**% reduction**
Baseline Consumption	3,519 MWh pa		1,827 tCO_2	
Savings from:				
Reduce the need	3,044 MWh pa	13.50%	1,580 tCO_2	13.50%
Using less energy	3,044 MWh pa	0	1,580 tCO_2	0
Using efficient energy supply or renewable energy	3,044 MWh pa	0	1,580 tCO_2	0
Total Savings	**475 MWh pa**	**13.50%**	**246 tCO_2**	**13.50%**

6.6.12 Table 6-6 summarises that a total of 1,580 tonnes of CO_2e would be generated by the Scheme based on the operation of the tunnel and the buildings (excluding traffic). If this is compared against the government targets for the of 4th Carbon budget for the UK from (2023-27) of 1,950 $MtCO_2e$, this would represent 0.00008% of this budget. Although the Scheme does generate carbon emissions, the various measures listed within this section will be incorporated into the Scheme design to ensure that carbon emissions are minimised as far as reasonably practicable.

7. OPERATIONAL TRAFFIC EMISSIONS

7.1 Methodology for emissions from traffic

7.1.1 The emissions to air that are likely to result from the change in operational traffic i.e. traffic that will be using the Scheme following completion of the Scheme have been calculated as part of Chapter 6 – Air Quality in the ES (Document Reference: 6.1.6).

7.1.2 This air quality assessment in the ES assesses difference between the air quality that would be likely with the Scheme (the ‘do- something’ scenario) and without the scheme (the ‘do-minimum’ scenario, in which changes such as growth in traffic, standard maintenance regimes, or known future changes in regulations or policy that are entirely independent of the Scheme for the predicted) for the ‘opening year’ which for the purposes of the air quality modelling is assumed to be 2021, which represents a worst case.

7.1.3 The ES assessment presents total regional CO_2 emissions for the road network covered in the affected road network (ARN), in both do- minimum and do-something scenarios, and is based on modelled changes in number of vehicles, speed of vehicles and altered routes.

7.1.4 The use of the traffic model has the advantage of wide network coverage, so all of the network effects of the proposed Scheme are encompassed by the assessment. The methodology used to calculate emissions is consistent with many other road projects and it is recognised as the current best practice, and is described in more detail in Chapter 6 of the ES.

7.2 Results

7.2.1 The findings presented in the Chapter 6 – Air Quality in the ES (Document Reference: 6.1.6) indicate a decrease of 3,000 tonnes per year of CO_2 emissions between the do-minimum (without the Scheme) and do-something (with the Scheme) scenarios in 2021 and an increase of 23,000 tonnes per year of CO_2 for the design year 2036 (15 years after opening the Scheme).

7.2.2 The annual road transport emissions for the Greater London Area (GLA) are projected to be 5,728,930t CO_2 in 2030 according to the London Atmospheric Emissions Inventory (LAEI) 2013[30] data. Therefore the calculated increases in the do-something scenario for 2036 are roughly equivalent to 0.4% of the GLA's projected road transport emissions.

Operational Traffic CO_2 and the Government's carbon budgets

7.2.3 Over a four year period, based on the design year CO_2 emissions calculated for the Scheme a total of 92,000 additional tonnes of CO_2 would be generated by the Scheme based on the traffic using the tunnel. If this is compared against the government targets for the of 4th Carbon budget for the UK from (2023-27) of 1,950 MtCO2e this would represent 0.004% of this budget.

[30] London Atmospheric Emissions Inventory (LAEI), 2013 (http://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2013)

8. CONCLUSIONS

8.1.1 This Energy and Carbon 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 CO_2 emissions.

8.1.2 Energy consumption and overall CO_2 emissions during construction has been estimated using the HE CCMP and a number of measures identified as part of this to reduce the CO_2 emissions associated with construction activities. The total CO_2 generated has been compared against the governments CO_2 budgets and it has been demonstrated that the Scheme would contribute approximately 0.000081% to the 2023 - 2027 budget.

8.1.3 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 CO_2 emissions associated with transport in London.

8.1.4 A wide range of energy saving measures has been considered for construction and operation. 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 CO_2 emissions savings.

8.1.5 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.

8.1.6 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.

8.1.7 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 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.

8.1.8 To ensure energy efficient operation, a comprehensive commissioning strategy and energy management system, in accordance with TfL standard operating procedures, will be implemented and the relevant staff will be provided with information and guidance on how to use energy efficiently.