Cundy Street Quarter

Energy Statement

Prepared by Cundall

May 2020

GROSVENOR

Project Cundy Street Quarter

Energy Statement

Grosvenor Estate Belgravia

Job No: 1019409

Doc Ref: 1019409-RPT-SY-003

Revision: —

Revision Date: 19 May 2020

Project title	Project Cundy Street Quarter	Job Number
Report title	Energy Statement	1019409

Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
—	19/05/2020	Planning

Document Validation (latest issue)

21/05/2020
X T. Creswell-Wells
Principal author
Signed by: Creswell-Wells, Tavis

21/05/2020
X Oliver Watts
Checked by
Signed by: Watts, Oliver

21/05/2020
X
Verified by
Signed by: Kumari, Kavita

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Executive Summary

In accordance with the Westminster City Council's planning requirements and the GLA's draft London Plan (December 2019), the following Energy Statement has been developed for the proposed Cundy Street Quarter development in London.

The proposed mixed-use development consists primarily of domestic spaces but also accommodates non-domestic activities as well.

For this exercise SAP 10 emission factors have been used to calculate the Part L1A and L2A 2013 emissions results. The Energy Strategy has been developed by following the Energy Hierarchy; Be Lean, Be Clean, Be Green and Be Seen.

Be Lean Summary

The building's envelope will be designed to perform significantly better than the Building Regulation standards with low U-values, G-values, Y-values and a low air permeability to control heat transfer through the envelope.

Passive solar considerations have formed an integral part of the design for the Proposed Development. Analysis has been carried out to optimise the facades so that the solar gains and associated cooling loads are reduced, providing a more comfortable internal environment for occupants.

Ventilation to domestic aspects will be provided by localised MVHR (in combination with natural ventilation systems). Non-domestic aspects will be served by localised AHUs.

All spaces will include highly efficient Light Emitting Diode lighting coupled with PIR occupancy sensing where appropriate. Daylight dimming will be included where possible at perimeter commercial zones.

Electrical and mechanical systems will be tightly metered and controlled by BMS enabling energy use to be tracked and opportunities for improvements.

The application of passive and active design measures enables the domestic aspects to achieve a 14% reduction over the Part L1A 2013 TER. The non-domestic aspects achieve a 8% reduction over the Part L2A 2013 TER. The combined site wide Be Lean performance achieve a 10% reduction over the Part L TERs.

The 'Be Lean' SAP and BRUKL documents can be provided upon request.

Be Clean Summary

An investigation into the feasibility of connecting to an existing or proposed district network indicates that there is an existing district heating network within a feasible distance. However, major train lines running into Victoria Station prohibit the network from extending to the Cundy Street Quarter site. As such there is no possibility of connection to this or any other network. Regardless, space and base plant will be allocated to the scheme to connect to a district network should that eventuate.

Combined Heat & Power is also unfeasible due to the air quality issues inherent with these systems. In addition, gas-fired CHPs are no longer offering high carbon savings over electric systems as a result of the more up to date SAP10 emission factors.

Therefore, no decentralised system is included in the energy strategy.

Be Green Summary

An analysis of a range of Low and Zero Carbon technologies has been conducted to determine which offer feasible carbon emissions savings.

The analysis found that the highest potential for savings was enabled through the following measures:

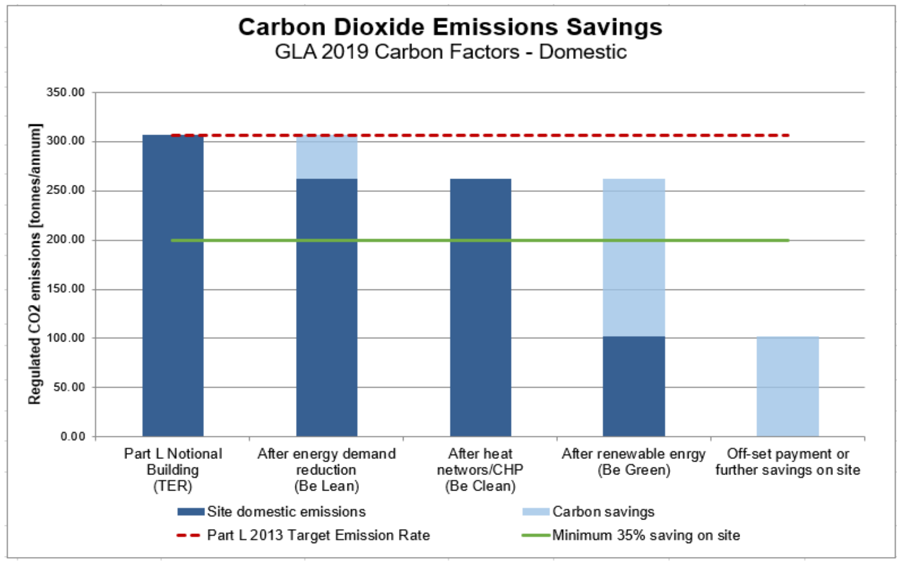
- A centralised a low temperature heat loop feeding all domestic type spaces. Thermal energy for the heat loop will first be generated centrally by ASHPs. Then at the local level, the heat will be upgraded using WSHP in each dwelling. This will deliver space heating, cooling and DHW demands.
- For the speculative non-domestic areas, it has been anticipated that space heating and cooling will be provided by a localised VRF systems; DHW will be via either electric instantaneous point of use or heat pump technology. This would be subject to tenant design and fit-out.
- Additionally, an approx. 35kWp PV array will be installed on the roof of the development to maximise the site-wide reduction of carbon emissions.

The 'Be Green' SAP and BRUKL documents can be provided upon request.

Results – Domestic

The regulated CO_2 emissions and savings for the proposed domestic building elements are presented below.

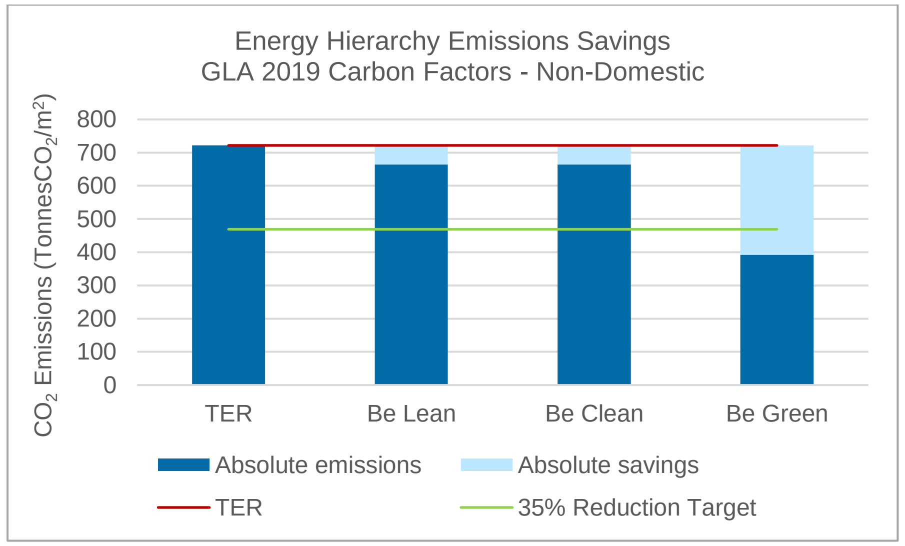
Regulated Carbon Dioxide Savings for the Domestic Buildings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	44	14%
Savings from decentralised energy	0	0%
Savings from renewable energy	160	52%
Total Cumulative Savings	204	67%



Results – Non-domestic

The regulated CO_2 emissions and savings for the proposed non-domestic elements are presented below.

Table 4. Non-domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	58	8%
Savings from decentralised energy	0	0%
Savings from renewable energy	270	37%
Total Cumulative Savings	328	45%



Results – Site Wide

The area-weighted calculation for the domestic and non-domestic elements indicates that the Proposed Development is achieving a 51% improvement over the Building Regulations Part L 2013 Target Emission Rate. Therefore, the development exceeds the 35% on-site target. However, a carbon offset payment through the Section 106 agreement is required to address the remaining regulated emissions for both the domestic and non-domestic.

(Tonnes CO_2/yr)	Domestic	Non-domestic	Total
Part L 2013 TER	306	728	1,035
Total savings	204	328	532
Remaining shortfall	102	400	502

Contents

1.0

Introduction

1.0 Introduction

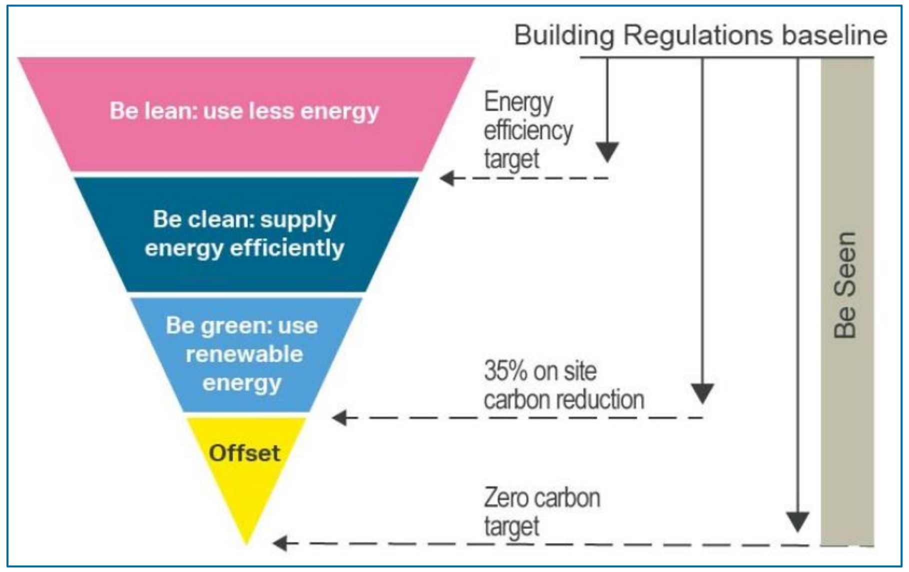
1.1 Purpose of Statement

This Energy and Sustainability Statement has been prepared in support of the planning application for the Cundy Street Quarter (CSQ) mixed-use development, located in London. It responds to the energy and climate change policy requirements of the City of Westminster, the Greater London Authority (GLA) and National Regulations. A summary of the relevant planning documents and policies is provided in Section 2.

The Statement also outlines varying sustainability factors and sets out measures that will be implemented throughout the design and construction stages of the development to ensure its environmental impact is limited.

1.2 Methodology – The Energy Hierarchy

The design of the proposed scheme has been developed to reduce its annual energy consumption, provide energy in an environmentally friendly way, and to minimize its annual CO_2 footprint. To achieve this, the Statement follows the 'Energy Hierarchy' as set forth by the GLA, illustrated below.



'Energy Hierarchy' steps to low carbon buildings.

To calculate carbon emissions and reductions, the design will be assessed under 'Part L 2013: Conservation of Fuel and Power' of the UK Building Regulations, using the National Calculation Methodology (NCM). A detailed energy model will be created using Government approved software Integrated Environmental Solutions: Virtual Environment (IES: VE) 2019, in line with CIBSE AM11. The model will be revised for each of the steps of the Energy Hierarchy to establish expected performance and satisfaction of the policy requirements. As per the GLA Energy Assessment Guidance (Oct 2018) document, calculations will incorporate SAP 10 emission factors, as opposed to the outdated National level emission factors.

In support of this energy statement a Whole Life Carbon Assessment can be found in Appendix G.

1.3 Existing Site

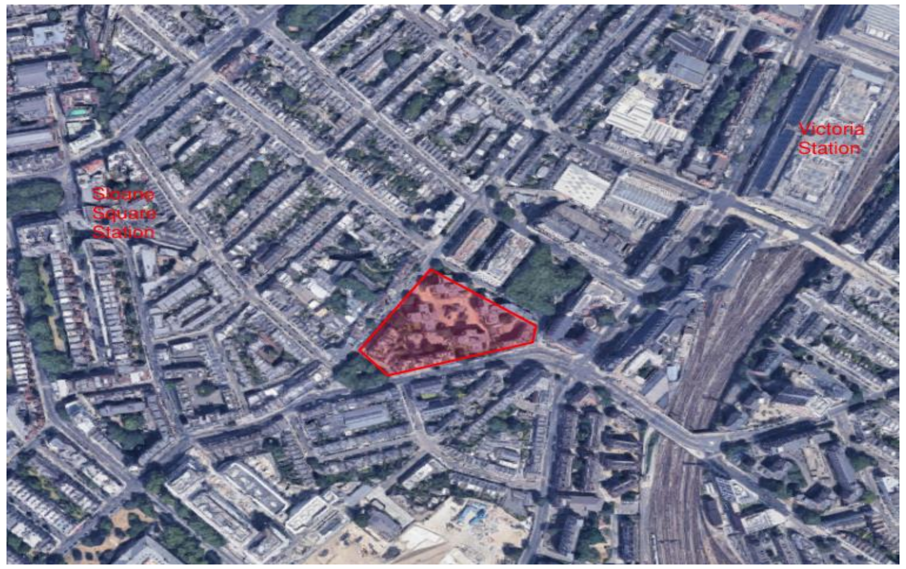
The existing site, known as the Cundy Street Quarter, is located between Cundy St. to the north, Ebury St. to the west and the Pimlico Road to the south. It currently consists of a range of residential flats across three separate buildings (Cundy St. Flats, Walden House, and Coleshill Flats). The project lies within the jurisdiction of the City of Westminster.

1.4 Proposed Development

The Proposed Development would provide a residential-led scheme, which delivers new homes for a range of people, with a mix of uses, high quality architecture, public realm and landscaping, which will activate pedestrian routes through the site.

The Proposed Development is a comprehensive residential-led mixed-use redevelopment, including demolition of Kylestrome House, Lochmore House, Laxford House, Stack House, Walden House and structures attached to Coleshill Flats; tree removal and pollarding; erection of a partial sub-basement, basement and buildings varying in height from five to 11 storeys, to provide affordable homes (Class C3), market homes (Class C3), senior living accommodation (comprising Class C3 and / or Class C2), alongside a range of uses at partial sub-basement, basement and ground floor level including retail (Class A1), restaurants / cafes (Class A3), drinking establishments (Class A4); offices (Class B1), community space (Class D1), cinema (Class D2); use of the lower ground floor of the Coleshill Flats as retail and / or workspace (Class A1 and / or B1); provision of new pedestrian routes; basement car parking; basement and ground floor circulation, servicing, refuse, ancillary plant and storage; provision of hard and soft landscaping; landscaping works and creation of new play facilities at Ebury Square; rooftop PV panels; rooftop plant equipment; relocation of Arnrid Johnston obelisk to Five Fields Row; relocation of water fountain on Avery Farm Row; repair and relocation of the telephone boxes on Orange Square; and other associated works.

Demise	GIA (m^2)
Market housing (C3)	14,018
Affordable housing (C3)	11,005
Senior living (C2/C3)	20,003
Retail (A1)	1,070
Class A1/A3/A4/B1	1,952
Community (D1)	154
Cinema (D2)	846
Total	**49,048**



Arial view establishing the site context in Central London.

1.5 Planning Policy

The following statutory requirements are being addressed and/ or used as guidance to the development of this statement.

	Policy Reference
National	National Planning Policy Framework – February 2019
Regional	Greater London Authority (GLA): New London Plan – "Intend to Publish" – December 2019 GLA Energy Assessment Guidance – October 2018
Local	Westminster's City Plan: Strategic Policies – November 2016

Further details regarding specific policies relevant to energy and sustainability have been detailed in Appendix A

2.0

‘Be Lean’ Demand Reduction

2.0 'Be Lean' Demand Reduction

Under Policy SI 2 of the new London Plan (December 2019) certain levels of emissions savings should be achieved at the Be Lean stage of the energy hierarchy. This is represented as a reduction in emissions from the Part L 2013 Notional Building Target Emissions Rate (TER) to the development's design represented by the Dwelling Emissions Rate (DER – residential) or Building Emissions Rate (BER – non-residential). The reductions targeted are as follows:

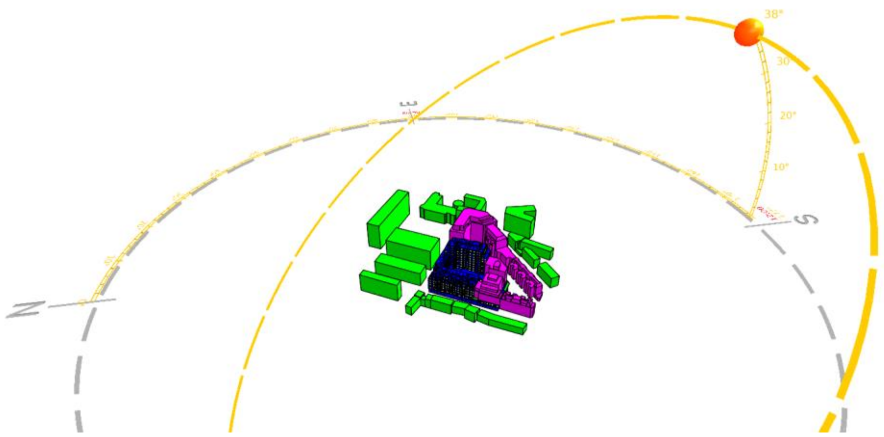
- Residential developments should achieve a 10% saving over the TER;
- Non-residential developments should achieve a 15% saving over the TER;

2.1 Passive Design

Substantial reductions in energy usage for the scheme, together with improved occupancy comfort, will be achieved through consideration of the passive elements of the design. The design team have looked to optimise the passive solar design and building envelope performance as described in the following sections.

2.1.1 Passive Solar Design

Maintaining adequate levels of natural light but at the same time limiting the solar heat gains inside the building has been an essential part of the project's design philosophy. All glazing in the development will be specified with a low solar transmission (g-value) to control solar gains and a high visible light transmission (VLT) to enable effective daylighting. The specified g-value means that solar gains into the spaces are limited, reducing the cooling demand required to keep the zones within acceptable comfort levels and limiting the risk of overheating.



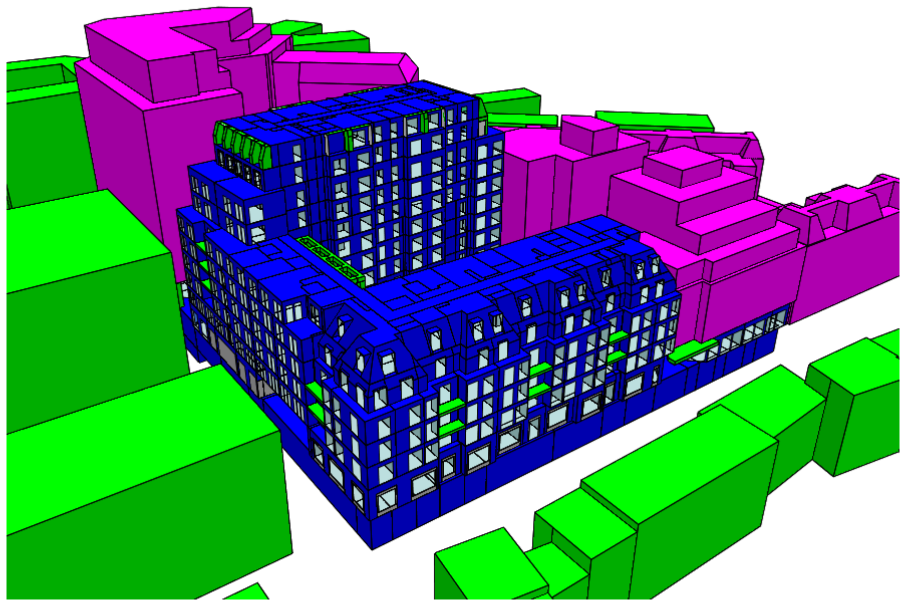
Sun path analysis conducted in the energy modelling software.

2.1.2 Building Fabric

Improving the thermal insulation standards beyond the Building Regulation standards will help to reduce the annual CO_2 emissions associated with the building's heating and cooling systems, by limiting the heat loss though the building's fabric. The following thermal performance specifications will be targeted.

Fabric Thermal Performance – Part L1A Domestic elements	Minimum Standards	Proposed Design
Floor area weighted U-value (W/m²K)	0.25	0.15
Roof area weighted U-value (W/m²K)	0.20	0.12
External wall area weighted U-value (W/m²K)	0.30	0.15
Pedestrian doors U-value (W/m²K)	2.20	1.40
Window (inc frame) area weighted U-value (W/m²K)	2.20	1.40
External glazing total solar transmission G-value	-	0.40
Air permeability @ 50 Pascals (m³/(hr.m²))	10.0	3.0
Thermal bridging Y-values as per the NCM Notional building.		

Fabric Thermal Performance – Part L2A Non-domestic elements	Minimum Standards	Proposed Design
Floor area weighted U-value (W/m²K)	0.25	0.15
Roof area weighted U-value (W/m²K)	0.25	0.12
External wall area weighted U-value (W/m²K)	0.35	0.18
Pedestrian doors U-value (W/m²K)	2.20	1.40
Window (inc frame) area weighted U-value (W/m²K)	2.20	1.40
External glazing total solar transmission G-value	-	0.40
Air permeability @ 50 Pascals (m³/(hr.m²))	10.0	3.0



Perspective image of the energy model used for the analysis.

2.1.3 Air Permeability

An air leakage rate of 3m³/hr/m² at 50Pa should be targeted for all aspects of the development. This is in comparison with 10m³/hr/m² at 50Pa maximum under the Building Regulation minimum standards. Good air tightness can be achieved by prefabrication of several key building components under factory conditions, robust detailing of junctions and good building practices on site.

2.2 Energy Efficient Systems

After assessing the contribution of the passive elements to the overall energy balance, the aim is to further reduce CO_2 emissions by selecting efficient mechanical, electrical and control systems to manage the energy use during operation. On the basis of good practice, the following principles will be adopted throughout the Proposed Development where possible.

2.2.1 Low-energy Lighting

Installing efficient low energy light fittings internally and externally can significantly reduce a building's overall lighting load hence lowering its annual CO_2 emissions. The development will reduce the energy consumption by the specification of low energy, high efficacy, LED luminaires in all areas. Where appropriate, perimeter office and retail areas with access to daylight will be equipped with daylight sensors and dimming.

2.2.2 Heating and Cooling

In accordance with the GLA's guidance, the 'Be Lean' scenario utilises a centralised gas-fired boiler system to deliver the space heating and domestic hot water requirements to all areas. Similarly, cooling will be provided by an electric chiller. These heating and cooling systems will be replaced by the actual building design systems in the following Be Clean and Be Green sections.

2.2.3 Ventilation

Ventilation to commercial and ancillary support areas will be provided by central air handling units (AHUs) with heat recovery. Residential aspects will utilise localised mechanical ventilation heat recovery (MVHR) units in each apartment.

All MVHR units will incorporate heat recovery with at least the minimum Energy Related Products (ErP) 2018 efficiencies to reduce space heating loads and will utilise low specific fan powers with variable speed drives.

A dynamic simulation overheating assessment has been undertaken and methodology and results are presented in Section 6.

2.2.4 HVAC Plant Efficiencies

The design team will specify all equipment and plant to exceed the minimum requirements of the Building Services Compliance Guides. These documents provide guidance on the means of complying with the requirements of Part L1A and L2A of the Building Regulations for conventional space heating/ cooling systems, hot water systems and ventilation systems.

2.2.5 Variable Speed Pumps and Drives

All fans and pumps will be specified with variable-speed drives with differential sensors, which will reduce their energy consumption by more than two-thirds compared with equivalent constant speed alternatives, by only supplying the required flow rate to meet the demand.

2.2.6 Controls

The heating and cooling systems for both the domestic and non-domestic aspects shall be appropriately zoned, with local fast responding controls. Appropriate lighting controls, including timers, occupancy controls, and daylight sensors and dimming shall be specified where applicable for all internal and external lighting.

2.2.7 Building Energy Management System (BEMS)

Where appropriate Building Energy Management System (BEMS) will be used to promote and facilitate a system that supports the energy demand management for commercial buildings (e.g. a system that recognises real-time room conditions in buildings by temperature sensors and/or the optimal operation of lighting and air-conditioning responding to the room condition). A combination of energy saving control techniques, such as optimum start with communication and information systems will allow active management of the building services and the capability to achieve and maintain a high level of energy efficiency.

A full BEMS system will be installed for the development and linked to central control systems. The systems will be easily accessible by the onsite team with automatic monitoring, targeting and automatic alarms for out of range values.

2.2.8 Commissioning

Commissioning is a systematic process, which configures a building's HVAC system and integrated control systems to operate at peak performance. Commissioning building systems can provide significant benefits such as improving occupant comfort, reducing energy cost, improving indoor air quality, enhancing building operations and extending equipment life. Hence, an extensive commissioning exercise will be incorporated in the project programme, with time allowed for reconfiguring plant and equipment if needed.

2.2.9 Energy Metering

Separate metering systems of the energy uses within the development will help the building users identify areas of excessive consumption and highlight potential energy-saving measures for the future. This will enable on-going reduction of annual CO_2 emissions from these systems.

2.2.10 Fixed Building Services

Several improvements over the Building Regulation's 'notional' building have been incorporated in order to reduce the CO_2 emissions of the development and hence comply with the Building Regulations. The table below provides a summary of the fixed building services inputs for the 'Be Lean' scenario.

Fixed Building Services – Be Lean – Domestic	
Energy Loop Heat Source	N/A
Energy Loop Source Efficiency	N/A
Space heating type	Boiler
Space heating emitters	FCUs
Space heating fuel	Natural gas
Space heating efficiency	90%
Space Cooling type	Chiller
Space Cooling emitters	FCUs
Space Cooling fuel	Electricity
Space Cooling efficiency	260%
DHW heating type	Boiler
DHW heating fuel	Natural gas
DHW heating efficiency	90%
DHW storage volume (L)	150
DHW storage losses	1.39
DHW water daily usage	< 125 l/p/day
Communal Heating Distribution Efficiency	Piping system 1991, Pre-insulated, Med temp, Variable
Controls	Programmer, TRVs, Boiler Interlock, 2+ room thermostats
Ventilation type	MVHR
Ventilation minimum heat recovery efficiency	90%
Ventilation maximum SFP (W/l/s)	0.57
Duct Type	Rigid
Low energy light fittings	100%

Fixed Building Services – Be Lean – Non-Domestic	
Ventilation 1	Assisted living units
Ventilation 1 - Type	MVHR zonal
Ventilation 1 - SFP central	0.57
Ventilation 1 - SFP terminal	0.2
Ventilation 1 - Heat recovery type	Exchange plates
Ventilation 1 - Heat recovery efficiency	90%
Ventilation 2	Communal spaces
Ventilation 2 - Type	AHU central
Ventilation 2 - SFP central	1.60
Ventilation 2 - SFP terminal	0.2
Ventilation 2 - Heat recovery type	Exchange plates
Ventilation 2 - Heat recovery efficiency	75%
Ventilation 3	Spec retail
Ventilation 3 - Type	MVHR zonal
Ventilation 3 - SFP central	1.40
Ventilation 3 - SFP terminal	0.2
Ventilation 3 - Heat recovery type	Exchange plates
Ventilation 3 - Heat recovery efficiency	75%
AHU leakage classification	Default
Ductwork leakage classification	Default
Space heating type	Boilers
Space heating emitters	FCUs
Space heating fuel	Natural gas
Space heating efficiency SCoP	95.79%
Space cooling type	Chillers
Space cooling emitters	FCUs
Space cooling fuel	Electricity
Space cooling efficiency SEER	4.74
DHW heating type	Boilers
DHW heating fuel	Natural gas
DHW heating seasonal efficiency	95.79%
DHW delivery efficiency	90%
Pump speed	Variable
Luminaire efficacies (Llm/cW) - Residential spaces	80
Luminaire efficacies (Llm/cW) - Front of House	110
Luminaire efficacies (Llm/cW) - Back of House	130
Lighting controls - Residential spaces	None
Lighting controls - Front of House	None
Lighting controls - Back of House	Auto on / auto off
Daylighting	None
Lighting systems metering	Yes
Lighting systems out of range warning	Yes
Power factor correction	>0.95

2.3 'Be Lean' Part L Performance Results

In accordance with the City of Westminster and the Mayor's Energy Hierarchy, an energy assessment has been carried out for the entire development with the aforementioned passive design and energy efficiency measures.

As per the GLA's 'Guidance on Preparing Energy Statements October 2018, the 'Be Lean' scenario assumes a centralised gas-fired boiler system to deliver the space heating and domestic hot water requirements, and a centralised chiller system for the cooling requirements. The domestic and non-domestic elements of the development have been assessed separately.

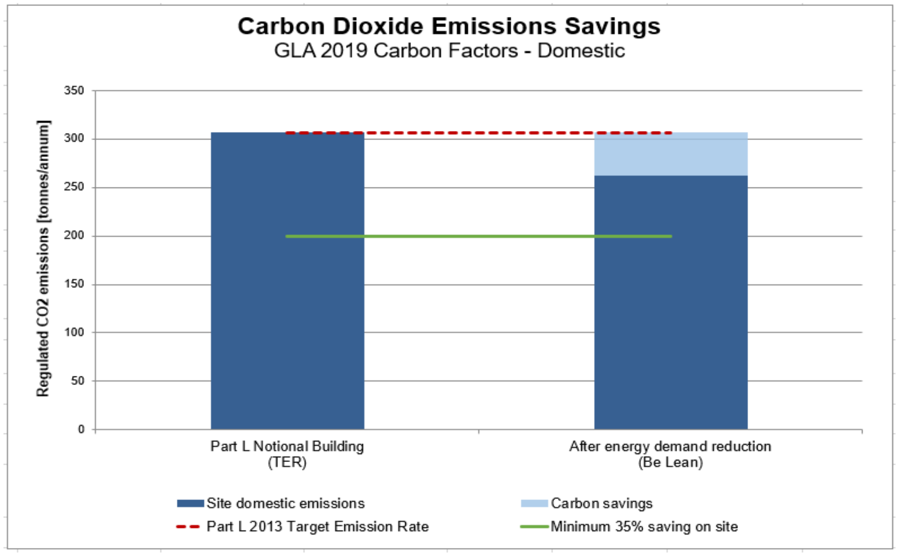
2.3.1 Results – Domestic

The preliminary energy assessment for the proposed domestic aspects is based on the requirements of Part L1A (2013) of the Building Regulations. The analysis indicates that the proposed Be Lean Dwelling Emissions Rate (DER) is performing significantly better than the TER and achieves an improvement of 14% as highlighted below.

Part L1A 2013 End-uses Breakdown ($kgCO_2/m^2$)		
End-use	TER	DER
Heating	6.23	3.76
DHW	5.97	6.01
Cooling	0.00	0.08
Auxiliary	0.21	0.64
Lighting	0.97	0.96
Renewables	0.00	0.00
Total	13.38	11.45
Improvement over TER		**14.0%**
Part L Status (DER<TER)		**Pass**

Table 1. Domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	306	181
After energy demand reduction	262	181

Table 2. Domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	44	14%



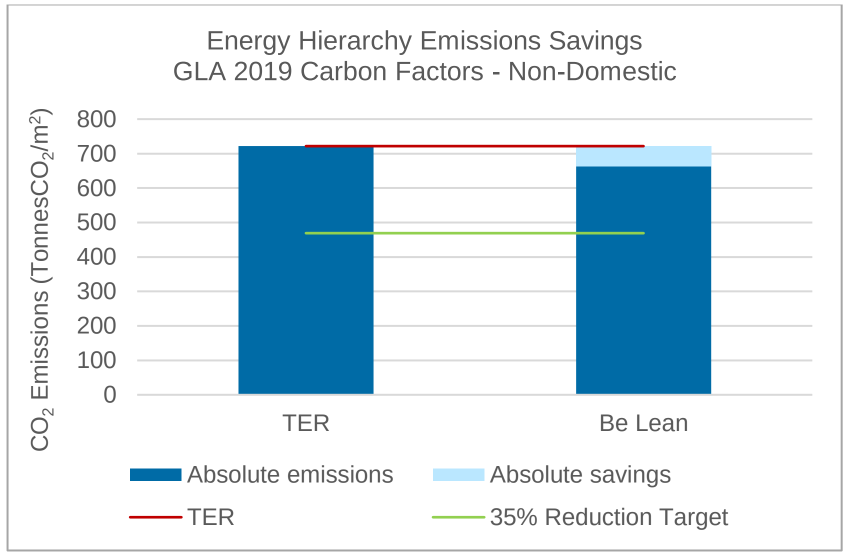
2.3.2 Results – Non-domestic

The preliminary energy assessment for the proposed non-domestic aspects is based on the requirements of Part L2A (2013). The analysis indicates that the proposed Be Lean Building Emissions Rate (BER) is performing significantly better than the Target Emissions Rate (TER) and achieves an improvement of 8% as highlighted below.

Part L2A 2013 End-uses Breakdown ($kgCO_2/m^2$)		
End-use	TER	BER
Heating	2.00	2.10
DHW	15.50	15.24
Cooling	3.16	2.86
Auxiliary	3.92	3.67
Lighting	6.37	4.58
Renewables	0.00	0.00
Total	30.94	28.46
Improvement over TER		**8.0%**
Part L Status (BER<TER)		**Pass**

Table 3. Non-domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	728	792
After energy demand reduction	671	792

Table 4. Non-domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	58	8%



2.3.3 Results – Site Wide

The area-weighted calculation for the refurbished and new building elements indicates that the Proposed Development is achieving a 10% improvement over the Building Regulations Part L 2013 Target Emission Rate.

	Total regulated emissions (Tonnes CO_2/yr)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 (TER)	1,035	-	-
BER - Be Lean	933	102	10%

2.4 Total Energy Demand

The development's total energy demand has been calculated and presented in the following table. The annual regulated energy demand is estimated to be 11,823MWh/year. This is based upon the NCM Part L methodology and may not provide a representation of reality.

Total Energy Demand Following Efficiency Measures (MWh/year)							
End-uses	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated gas
Domestic	6897	1068	682	76	0	778	0
Non-domestic	238	1,727	468	375	292	3,398	0

3.0

‘Be Clean’ Heating Infrastructure

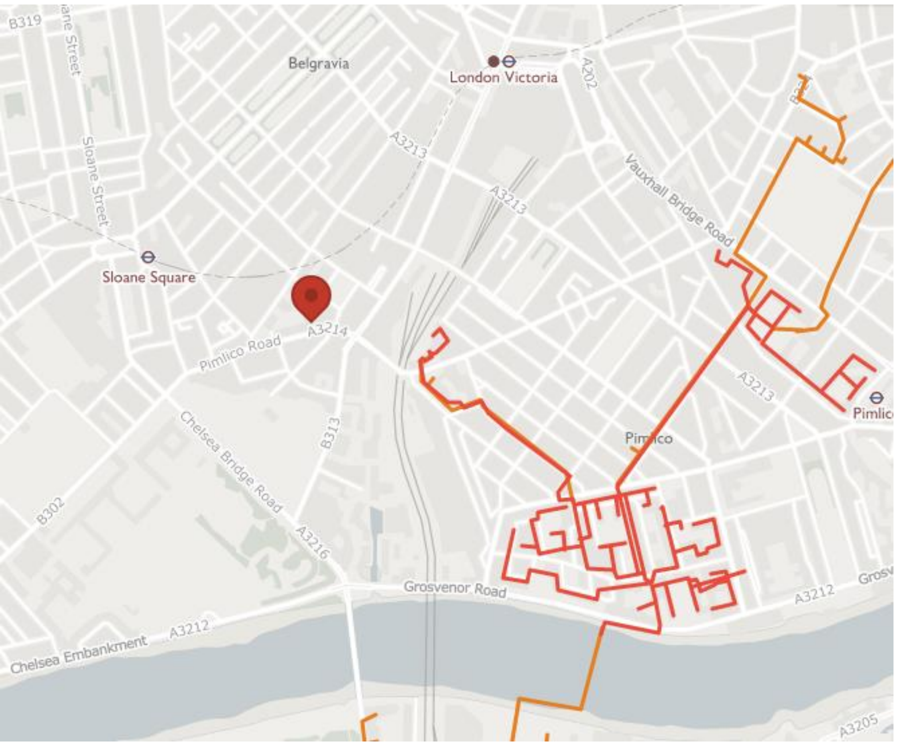
3.0 'Be Clean' Heating Infrastructure

3.1 District Heating Networks

A district heating network can be utilised to provide low carbon heat to both water-based systems: space heating and domestic hot water supplies. In a development with high heating and DHW loads – such as residential or leisure centre developments – a heating network can deliver significant CO_2 savings potential. In an office or retail-based development, where heating requirements are relatively minimal, the heating network carbon savings potential is not as significant.

The feasibility of connecting to an existing district network has been investigated for the site in accordance with Policy 5.6 of the London Plan.

An analysis of the London Heat Map (www.londonheatmap.org) indicates that there are existing and proposed district heating networks nearby to the project site. However, dialogue with the Westminster City Council (refer to Appendix B) revealed that these networks cannot be extended across the railway lines leading into Victoria train station. There are discussions being held on the potential to extend across the lines towards the West, but the outlook is that this is not a viable option currently and such extensions would be several years away at least. As such, there is no opportunity or intention to connect to a district heat network for this project at this time. To facilitate future connection, space will be earmarked at the basement level to host a plate heat exchanger, pump and calorifier should a district energy network be commissioned at a later date.



London Heat Map illustrating the existing heat networks (red) and proposed heat networks (orange) near the project site (red pin).

3.2 Combined Heat and Power (CHP)

In accordance with the NPPF, the potential to integrate a new decentralised heating network utilising a combined heat and power unit was investigated.

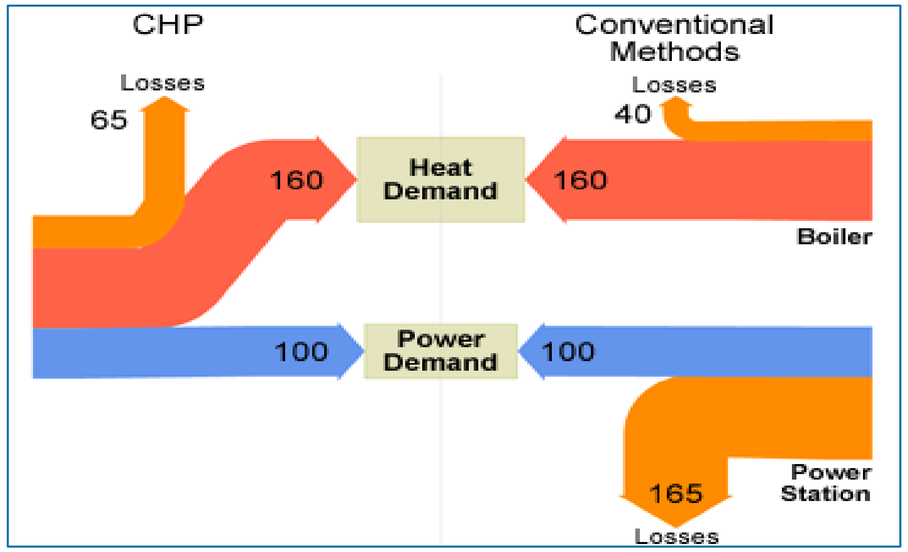
As with a district heating network, a CHP system can provide significant carbon savings in high heating demand buildings. Where heating demands are low, CHP has the added benefit of electricity generation. In an office building, CHP can be programmed to be 'electrically led', meaning operation is programmed to prioritize the production of electrical energy, rather than thermal. Crucially, the efficiency of a CHP system depends on consistent, around-the-clock operation. As office and retail units have an electricity demand that differs dramatically between day and night, it cannot operate with a high level of effectiveness or with high levels of utilisation.

The proposed CSQ development includes a range of domestic type activities which generally have high and consistent space and domestic hot water heating demands. This means that a CHP system would be well suited to this development in terms of energy and emissions efficiency.

However, CHP plant generates harmful NOx and SOx emissions which can be detrimental to human health more directly than CO_2 emissions. As this is a largely domestic development and accommodates vulnerable older people in assisted living arrangements, the pollutants generated by CHP should be avoided.

Further to the substantial health issues above, when utilising the SAP 10 emissions factors as required by the GLA's energy guidance, CHP systems no longer result in any CO_2 savings compared to electric options.

For these reasons, a combined heat and power unit is not considered feasible for the CSQ development.



Sankey diagram illustrating the energy flows and benefits of CHP vs boiler heating.

3.3 'Be Clean' Part L Performance Results

A decentralised source of heat and power is not compatible with the proposed CSQ development. Therefore, the Part L results are unchanged from the Be Lean step of the energy hierarchy.

3.3.1 Results – Domestic

Table 1. Domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	306	181
After energy demand reduction	262	181

3.3.2 Results – Non-domestic

Table 3. Non-domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	728	792
After energy demand reduction	671	792

3.3.3 Results – Site Wide

	Total regulated emissions (Tonnes CO_2/yr)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2013 TER	1,035	-	-
Be Lean	933	102	10%
Be Clean	933	0	0%

4.0

‘Be Green’ Renewable Energy

4.0 'Be Green' Renewable Energy

Policy SI 2 of the draft London Plan 2019 ('Intend to Publish') and the latest GLA Energy Assessment Guidance (October 2018) require that major developments seek to maximise reduction of CO_2 emissions through onsite renewable energy generation, wherever feasible.

The following technologies have been considered for supplying a portion of each development's energy demand. The feasibility of each of the energy sources listed has been assessed with regard to the potential contribution each could make to supply a proportion of the development's delivered energy requirement, whilst considering relevant technical, planning, land use and financial issues.

4.1 Biomass Heating

Biomass in the form of logs, wood chips and wood pellets are classified as a renewable source of energy since the carbon dioxide emitted when the biomass is burned has been taken out of the atmosphere by the growing plants. Even allowing for emissions of carbon dioxide in planting, harvesting, processing and transporting the fuel they will typically reduce net CO_2 emissions by over 90%.

Biomass boilers require comprehensive maintenance policies to ensure smooth operation and supply chains to be set up to supply the boilers with a constant stream of fuel. They also require significant space for storage and delivery of fuel.

A major issue for biomass boilers is air quality due to the NOx and SOx emissions they generate. These pollutants can be detrimental to human health and should be avoided where population density is high.

Despite a substantial heating demand on this scheme, the air quality and logistics issues associated with biomass heating make it an unfavourable strategy for this development. As such, it is not proposed as part of the energy strategy.

4.2 Solar Hot Water Collectors (SHWC)

Solar hot water collectors (SHWC) utilise solar radiation to heat water for use in buildings. The optimum orientation for a solar collector in the UK is a south-facing surface, tilted at an angle of 30º from the horizontal.

Solar collectors are typically designed to meet a development's base heat load, associated with its domestic hot water requirements. For residential development, this usually equates to 60-70% of the total DHW annual load, with the natural gas-fired boilers meeting the remainder of the load. For office and retail developments, the hot water demand is usually a lower proportion of the overall heating demand, unless there are comprehensive changing facilities with showers. Therefore, the advantages of solar thermal collectors are limited for this type of developments as the domestic hot water load is limited.

As the CSQ development includes a significant domestic demise, a SHWC system offers potential for emissions savings.

However, SHWC require substantial roof space to generate enough hot water for a development of this scale. This will compete with air source heat pumps, which are the preferred source of heat generation, for the limited roof space.

For this reason, solar hot water collectors are not considered viable for the CSQ development.

4.3 Air Source Heat Pumps (AHSP)

Air source heat pumps exchange heat between the outside air and a building to provide space heating in winter and cooling in the summer months. The efficiency of these systems is inherently linked to the ambient air temperatures.

Heat pumps supply more energy than they consume, by extracting heat from their surroundings. Heat pump systems can supply as much as 4kW of heat output for just 1kW of electrical energy input.

The main type of air source heat pump system is the Variable Refrigerant Flow (VRF), which transfer heat from one location to another using refrigerant. The volume or flow rate of refrigerant is accurately matched to the required heating or cooling loads, thereby saving energy and providing more accurate control of temperature and energy consumption. VRF heat pumps enable an improvement in efficiency over conventional air-cooled chillers when in cooling mode, and they can recover heat when in heating mode, further improving their efficiency.

Analysis indicates that using heat pump systems for heating and cooling in the development could reduce CO_2 emissions by approximately 15.5% for the domestic aspects, and 26.2% for the non-domestic aspects, compared with a conventional HVAC configuration. Therefore, a heat pump based system is the preferred means of delivering thermal energy for the development.

Below is an outline of assumptions and performance for the heat pump system:

- ASHPs will provide thermal energy for a central low temperature heat loop, which will feed all domestic spaces for heating and cooling demands.
- Localised VRF ASHPs will provide space heating and cooling for the non-domestic aspects in order to efficiently share heat through different zones.
- The ASHPs would provide approximately 1,811MWh of heating and cooling energy to the development, representing 100% of the annual requirement.
- The heating Seasonal Coefficient of Performance (SCOP) varies depending on the part of the development served but is in the range of 3.06 and 4.62. Similarly, the cooling Seasonal Energy Efficiency Ratio (SEER) also varies in the range of 3.0 to 4.0. Efficiency calculations and manufacturer's datasheets showing preliminary selected units and their performances are included in Appendix C.
- The VRF ASHPs should comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria and the relevant issues as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification.
- The CO_2 savings associated with this system are 151 tonnes CO_2/year for domestic elements and 271 tonnes CO_2/year for non-domestic elements.
- The expected heating and cooling cost per residential unit is estimated to be roughly £200/year; and, £6 per m^2 of retail space.
- A full BEMS system will be included to supply end-users with regular information to control and operate the system. The performance of the ASHP systems will be monitored at post-construction to ensure they are achieving the expected performance.

Full details of the low temperature heat loop are provided in Appendix C.

4.4 Ground Source Heat Pumps (GHSP)

Ground source heat pumps differ from air source heat pumps in that they extract heat from the ground and pump it into a building to provide space heating and to pre-heat domestic hot water. In the summer months, this process can be reversed, rejecting heat to the ground, to meet the cooling requirements.

GSHPs rely on the stable temperature of the ground of between 10-14ºC. In winter when the ambient air temperatures are below this ground source heat pumps have higher CoPs than air source heat pumps (as there is more thermal energy in the ground).

A GSHP is not considered a viable solution in this development as it does not have balanced cooling and heating load. In addition, as the proposed development is located on a constrained site and with limited ground space it would not be possible to install any ground coupled system and hence GSHP have been discounted from this proposal.

4.5 Wind Turbines

The output from wind turbines is highly sensitive to wind speed. Hence it is essential that turbines should be sited away from obstructions, with a clear exposure, or fetch, for the prevailing wind.

In urban environments, it is difficult to achieve high wind speeds that would make the operation of turbines viable. Turbines need to be located at a site where wind is channelled and is of a consistently high speed and laminar flow. The most likely option for this is on top of a tall building, clear of the urban canopy layer, where obstructions and surrounding buildings don't interfere with the wind flow.

The location of the CSQ site within a densely built-up urban environment would result in a turbulent flow regime across the site, which would reduce the potential electrical output from wind turbines. It is also unlikely to be acceptable in townscape terms and as such it is not proposed to include wind turbines as part of the development.

4.6 Photovoltaics (PV)

Photovoltaic solar cells convert solar energy directly into electricity. The cells consist of two layers of silicon with a chemical layer between. The incoming solar energy charges the electrons held within the chemical. The energised electrons move through the cell into a wire creating an electrical current. Another advantage of PV systems is once they are installed, they require minimal maintenance over their operational life and have no primary fuel requirements.

An area of the roof is available for PV to be mounted without interference from other plant and equipment. A survey of the roof area found that approximately 340m^2 is available for a PV system. Calculations indicate that this could enable a ~35kWp output and generate up to approximately 28,000kWh/year of electricity for the domestic aspect of the development.

4.7 Renewables Summary

It is proposed that heat pumps are used to provide the majority of the thermal energy for both the domestic (space heating and DHW) and non-domestic (space heating and cooling) aspects of the development. For the domestic and senior living aspects this will be delivered via a central low temperature heat loop; for non-domestic aspects, localised VRF will be used.

A roof-mounted PV array will also be included to provide clean electricity.

The combination of these renewable technologies ensures the development maximises carbon emissions savings in line with Policy SI 2 of the draft London Plan (2019) and the latest GLA Energy Assessment Guidance (2018).

The renewables strategy also complies with Policy S40 of the Westminster City Plan, reducing carbon emissions by more than 20%.

The Be Green Part L results are presented in the following section.

4.8 'Be Green' Part L Performance Results

In accordance with Policy SI 2 of the draft London Plan (2019), investigations into providing a proportion of the site's energy requirements through renewables was undertaken.

In accordance with the City of Westminster and the Mayor's Energy Hierarchy, an energy assessment has been carried out for the entire development with the aforementioned passive design and energy efficiency measures. As per the GLA's guidance, the domestic and non-domestic elements of the development have been assessed separately.

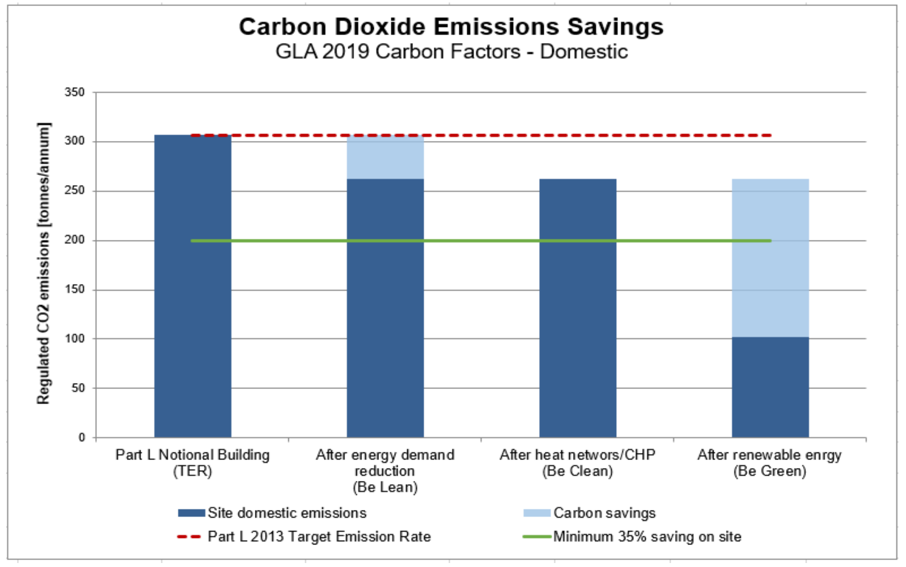
The tables below present the CO_2 emissions of the site at each stage of the energy hierarchy.

4.8.1 Results – Domestic

The preliminary energy assessment for the proposed domestic aspects is based on the requirements of Part L1A (2013) of the Building Regulations. The analysis indicates that the proposed Be Green Dwelling Emissions Rate (DER) is performing significantly better than the TER and achieves an improvement of 67% as highlighted below.

Table 1. Domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	306	181
After energy demand reduction	262	181
After heat network / CHP	262	181
After renewable energy	102	181

Table 2. Domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	44	14%
Savings from decentralised energy	0	0%
Savings from renewable energy	160	52%
Total Cumulative Savings	204	67%

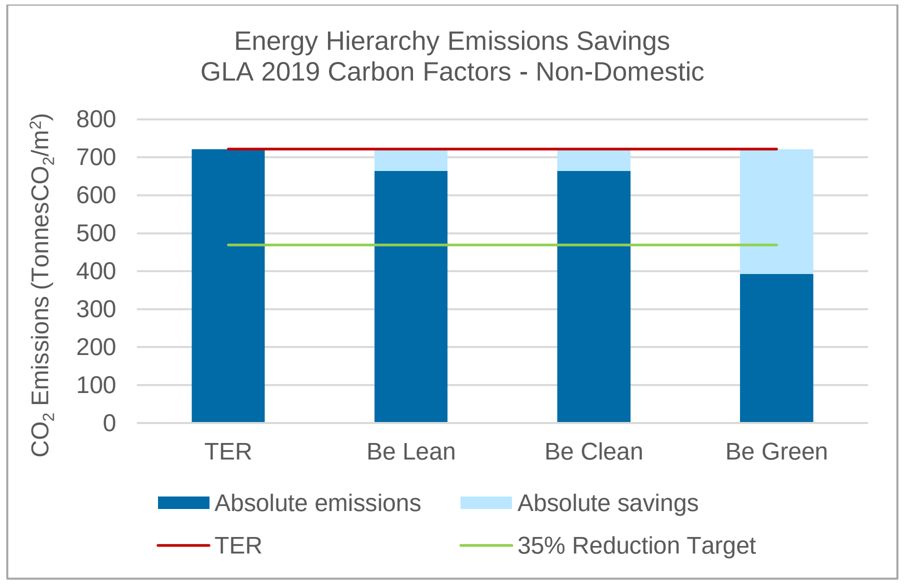


4.8.2 Results – Non-domestic

The preliminary energy assessment for the proposed non-domestic aspects is based on the requirements of Part L2A (2013). The analysis indicates that the proposed Be Green Building Emissions Rate (BER) is performing significantly better than the Target Emissions Rate (TER) and achieves an improvement of 46% as highlighted below.

Table 3. Non-domestic Aspects Carbon Dioxide Emissions	Regulated (Tonnes CO_2/yr)	Unregulated (Tonnes CO_2/yr)
Baseline: Part L 2013 of the Building Regulations Compliant Development	728	792
After energy demand reduction	671	792
After heat network / CHP	671	792
After renewable energy	400	792

Table 4. Non-domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	58	8%
Savings from decentralised energy	0	0%
Savings from renewable energy	270	37%
Total Cumulative Savings	328	45%



4.8.3 Results – Site Wide

The area-weighted calculation for the domestic and non-domestic elements indicates that the proposed development is achieving a 51% improvement over the Building Regulations Part L 2013 Target Emission Rate. Therefore, the development exceeds the 35% on-site target. However, a carbon offset payment through the Section 106 agreement is required to address the remaining regulated emissions for both the domestic and non-domestic.

(Tonnes CO_2/yr)	Domestic	Non-domestic	Total
Part L 2013 TER	306	728	1,035
Total savings	204	328	532
Remaining shortfall	102	400	502

5.0

Proposed Energy Strategy

5.0 Proposed Energy Strategy

In accordance with the Westminster City Council's planning requirements and the GLA's London Plan, the following Energy Strategy has been developed for the proposed Cundy Street Quarter development in London.

SAP 10 emission factors have been used as the basis of these calculations. The energy strategy has been developed by following the energy hierarchy; Be Lean, Be Clean and Be Green.

As per the GLA's guidance, the domestic and non-domestic elements of the development have been assessed separately.

Be Lean Summary

The building's envelope will be designed to perform significantly better than the Building Regulation standards with low U-values, G-values, Y-values and a low air permeability to control heat transfer through the envelope.

Passive solar considerations have formed an integral part of the design for the Proposed Development. Analysis has been carried out to optimise the facades so that the solar gains and associated cooling loads are reduced, providing a more comfortable internal environment for occupants.

As per the GLA's 'Guidance on Preparing Energy Statements October 2018, the 'Be Lean' scenario assumes a centralised gas-fired boiler system to deliver the space heating and domestic hot water requirements, and a centralised chiller system for the cooling requirements.

Ventilation to domestic aspects will be provided by localised MVHR (in combination with natural ventilation systems). Non-domestic aspects will be served by localised AHUs.

All spaces will include highly efficient Light Emitting Diode lighting coupled with PIR occupancy sensing where appropriate. Daylight dimming will be included where possible at perimeter commercial zones.

Electrical and mechanical systems will be tightly metered and controlled with a Building Management System. This will enable energy use to be tracked and opportunities for efficiency improvements to be made.

The application of passive and active design measures enables the domestic aspects to achieve a 14% reduction over the Part L1A 2013 TER. The non-domestic aspects achieve an 8% reduction over the Part L2A 2013 TER.

The 'Be Lean' BRUKL documents can be provided upon request.

Be Clean Summary

An investigation into the feasibility of connecting to an existing or proposed district network indicates that there is an existing district heating network within a feasible distance. However, major train lines running into Victoria Station prohibit the network from extending to the CSQ site. As such there is no possibility of connection to this or any other network. Regardless, space and base plant will be allocated to the scheme to connect to a district network should that eventuate.

Combined Heat & Power is also unfeasible due to the air quality issues inherent with these systems. In addition, gas-fired CHPs are no longer offering high carbon savings over electric systems as a result of the more up to date SAP10 emission factors.

Therefore, no decentralised system is included in the energy strategy.

Be Green Summary

An analysis of a range of Low and Zero Carbon technologies has been conducted to determine which offer feasible carbon emissions savings.

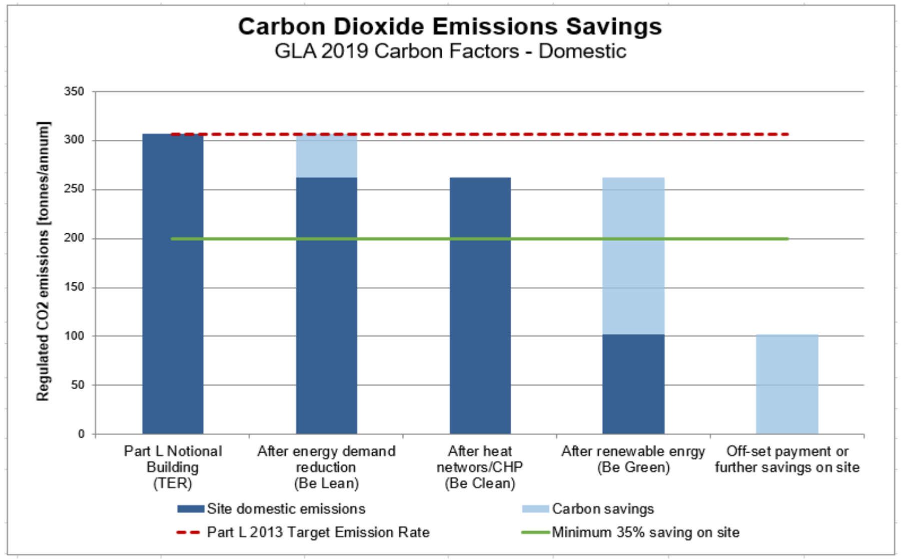
The analysis found that the highest potential for savings was enabled through the following measures:

- A centralised a low temperature heat loop feeding all domestic type spaces. Thermal energy for the heat loop will first be generated centrally by ASHPs. Then at the local level, the heat will be upgraded using WSHP VRF units on each floor. This will deliver space heating, cooling and DHW demands.
- For non-domestic speculative activities, space heating and cooling will be provided by a localised VRF systems; DHW will be via electric instantaneous point of use.
- Additionally, a 35kWp PV array will be installed on the roof of the development to maximise the site-wide reduction of carbon emissions.

The 'Be Green' BRUKL documents can be provided upon request.

Results – Domestic

The regulated CO_2 emissions and savings for the proposed domestic building elements are presented below. They demonstrate that CO^2 savings are approximately 67% over the Regulations Baseline, therefore complying with the 35% target set in the London Plan.

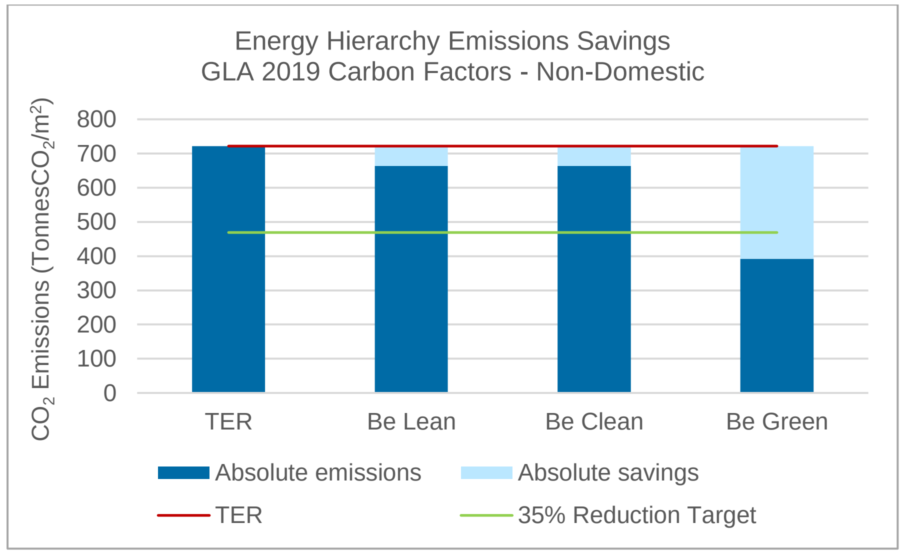


Regulated Carbon Dioxide Savings for the Domestic Building	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	44	14%
Savings from decentralised energy	0	0%
Savings from renewable energy	160	52%
Total Cumulative Savings	204	67%

Results – Non-domestic

The regulated CO_2 emissions and savings for the proposed non-domestic elements are presented below. They demonstrate that CO^2 savings are approximately 45% over the Regulations Baseline, therefore complying with the 35% target set in the London Plan.

Table 4. Non-domestic Aspects Regulated Carbon Dioxide Savings	(Tonnes CO_2/yr)	(%)
Savings from energy demand reduction	58	8%
Savings from decentralised energy	0	0%
Savings from renewable energy	270	37%
Total Cumulative Savings	328	45%



Results – Site Wide

The area-weighted calculation for the domestic and non-domestic elements indicates that the proposed development is achieving a 51% improvement over the Building Regulations Part L 2013 Target Emission Rate. Therefore, the development exceeds the 35% target complying with the London Plan.

Carbon Offset Payment

The draft London Plan (2019) requires all major developments to achieve a minimum on-site reduction of at least 35% beyond Building Regulations. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough through a cash in lieu contribution to the borough's carbon offset fund.

Therefore, a carbon offset payment through the Section 106 agreement will be agreed to address the remaining regulated emissions for both the domestic and non-domestic.

(Tonnes CO_2/yr)	Domestic	Non-domestic	Total
Part L 2013 TER	306	728	1,035
Total savings	204	328	532
Remaining shortfall	102	400	502

6.0

Cooling and Overheating

6.0 Cooling and Overheating

6.1 GLA Cooling Hierarchy

As per Policy SI 4 of the Draft London Plan 2019, proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure. Proposals should demonstrate through an Energy Strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy. The following is an outline of how the development has been designed in line with the cooling hierarchy.

6.1.1 Reduce Heat Entering Building

Through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure, solar heat gains can be controlled.

Window sizes have been limited in order to reduce the amount of solar gain entering the building and contributing to overheating. Glazing with relatively low solar transmittance (G-values) have also been targeted to control solar gains.

6.1.2 Minimising Internal Heat Generation

Plug-loads and occupant densities associated with residential and retail activities cannot be altered beyond the client's brief. Therefore, the only area that can be targeted is the lighting. Low energy, high efficacy, Light Emitting Diodes (LED) will be used through-out the development to minimize internal heat gains.

6.1.3 Manage Internal Heat Storage

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

The development utilises high ceilings to help alleviate heat build-up with in internal spaces. However, due to the nature and aesthetic preference of the development, as well as the construction techniques being used, it is not possible to incorporate thermal mass to provide a thermal benefit.

6.1.4 Passive Ventilation

Passive ventilation should take priority over mechanical systems where external noise and air quality allow.

While some parts of the development are hindered by air quality and noise issues, the majority of spaces are not and can therefore use natural ventilation methods. Manually openable windows are provided for occupants use at their discretion.

6.1.5 Mechanical Ventilation

Where natural ventilation methods are not possible, mechanical ventilation can be used to help mitigate overheating in some cases.

Mechanical ventilation with heat recovery is provided to all occupied spaces for the purposes of background fresh air provision. However, mechanical ventilation alone is not used as a means of maintaining thermal comfort. This will be done by natural ventilation in most cases, or comfort cooling.

6.1.6 Active Cooling Systems

Active cooling systems are the most energy and emissions intensive means of mitigating overheating and contribute to the UHI effect. These should only be used if all prior options do not provide an adequate solution.

In the minority of spaces where natural ventilation cannot be utilised, comfort cooling will be provided by heat pumps via the low temperature heat loop in the domestic elements, and local VRF in the speculative commercial space. Efficiency values of these systems will exceed the requirements of the 'Non-Domestic Building Services Compliance Guide'.

6.2 Overheating Risk Analysis

In line with GLA's planning requirements, all developments are required to undertake an analysis of overheating risk and cooling demands. The following sections present various methods for quantifying this risk.

6.2.1 Part L Criterion 3 Limiting Solar Gains

Under Part L of the building regulations, developments must demonstrate solar gains have been reduced to a sufficient level under 'Criterion 3 – Limiting the effects of heat gains in summer'.

The assessment has shown that all spaces comply with the requirements of Criterion 3. Full Criterion 3 results can be provided upon request.

6.2.2 Part L Cooling Energy

The Part L assessment also provides a quantification of the energy demands likely to be expected of the cooling system. The table below compares the actual building cooling demand to the notional building benchmark.

Part L Annual Cooling Demand (MJ/m^2)	
Notional Building (Benchmark)	48.8
Actual Building (Proposed)	58.4

6.2.3 Dynamic Overheating Simulation

The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in buildings. TM59 should be used for domestic developments and TM52 should be used for non-domestic developments. In addition, TM49 guidance and datasets should also be used to ensure that all new development is designed for the climate it will experience over its design life.

Thermal modelling has been conducted to investigate and mitigate the risk of overheating within the Proposed Development.

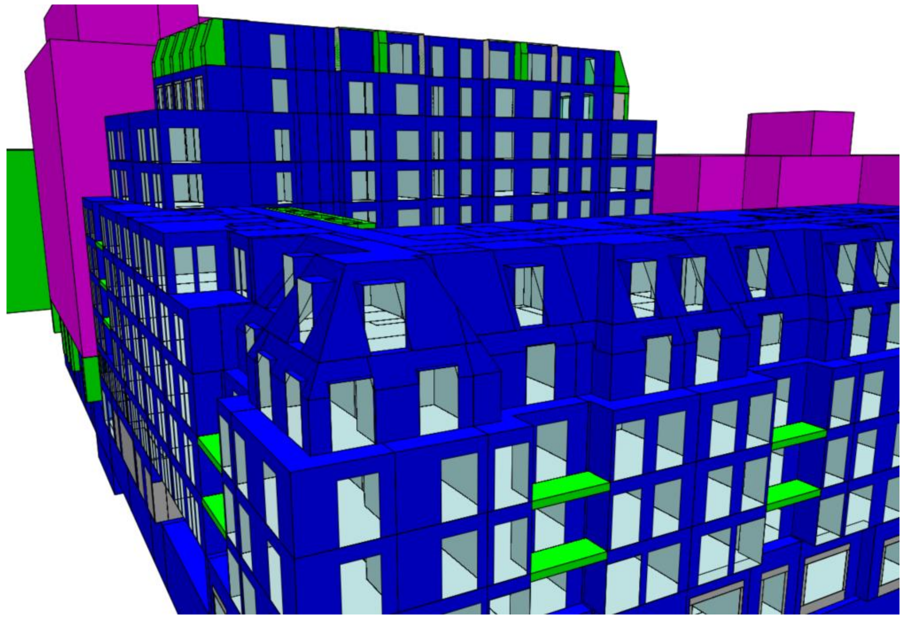
In accordance with CIBSE AM11: Building Energy and Environmental Modelling, approved software IES:VE 2019 was used for this exercise.

The model adopted the building fabric details outlined in this report.

Internal gains and operation/occupancy profiles were as per TM59.

The simulation used the London Heathrow DSY1-2020High50 weather file.

No blinds were included in the modelling, so to represent a worst-case scenario.



Screenshot of the computer model used for the thermal comfort analysis.

CIBSE TM59 outlines two criteria under which to assess overheating:

1. For living rooms, kitchens, and bedrooms, the number of hours (He) that ΔT is greater than or equal to 1K from May to September inclusive shall not exceed 3% of occupied hours. ΔT represents the difference between the zone operative temperature and the maximum allowable temperature set with reference to recent ambient conditions.
2. For bedrooms only, to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

6.2.4 Overheating Results

The results indicate that under the DSY1 scenario, the spaces tested are expected to comply with the TM59 requirements.

In addition, the analysis was run under the DSY2 and DSY3 weather files to emulate a short intense heat wave, and a long less intense warm spell, respectively. It should be noted that these sets of results are for information only and compliance with them is not mandatory. It is noted that GLA guidance confirms it is very difficult to achieve a pass result when testing using the DSY 2 and DSY 3 weather files, but in accordance with the guidance we note that occupants will be able to mitigate overheating through use of local fans and shutting internal blinds during the particularly long or particularly intense hot periods represented by these files.

The full set of assessment results and required equivalent areas; as well as results for circulation zones, DSY2 and DSY3, can be found in Appendix E. The GLA's Residential Overheating Checklist can be found in Appendix F.

Appendices

Appendix A – Planning Policy

National Policy

The revised National Planning Policy Framework (NPPF) was published in February 2019 and sets out the government's planning policies for England and states a clear presumption in favour of sustainable development. The revised Framework replaces the previous NPPF published in March 2012.

The NPPF supports the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourages the reuse of existing resources, including conversion of existing buildings, and encourages the use of renewable resources.

The NPPF, Section 9 outlines the transport issues that should be considered from the earliest stages of plan-making and development proposals.

The NPPF, Section 14 outlines its energy and climate change policies. New development should be planned for in ways that:

- Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
- Can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national standards.

To support the move to a low carbon future, local planning authorities should:

- Plan for development in ways which reduce greenhouse gas emissions.
- Actively support energy efficiency improvements to existing buildings; and
- When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

The NPPF states that in determining planning applications, local planning authorities should expect new development to:

- Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

When determining planning applications for renewable and low carbon development, local planning authorities should:

- Not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
- Approve the application if its impacts are (or can be made) acceptable49. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

The key focus of the NPPF is to support local and regional planning authorities.

Regional Policy

The Greater London Authority (GLA) London Plan 2016 and the GLA's Guidance on Preparing Energy Assessments October 2018 document are the benchmark for London planning regulation. Together they provide a useful tool to undertake energy and sustainability assessments.

GLA Energy Assessment Guidance (October 2018)

The GLA Energy Assessment Guidance (October 2018) looks to standardise how energy assessments for developments within London are presented and reported. As part of the this process the guidance from January 2019 referable developments are encouraged to use the updated SAP 10 emissions factors while continuing to use the current Building Regulation methodology.

Draft New London Plan

In December 2019 the Mayor released a draft new London Plan ('Intend to Publish'). The Plan is currently under the final stages of the development process and as such has not yet been formally adopted but it is likely to be in mid-2020. In relation to energy and sustainability the Plan looks to further push the requirements on referable developments. Following is an outline of the relevant Policies for the Plan.

Policy SI 1: Improving Air Quality

Major developments should seek opportunities to improve local air quality and should not reduce air quality benefits from the Mayor's or boroughs' activities.

Proposals must be submitted with an Air Quality Assessment, outlining how air quality neutral will be achieved. At a minimum, proposals must be at least Air Quality Neutral.

Development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach.

In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

Policy SI 2: Minimising Greenhouse Gases

Major developments should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

- Be Lean: use less energy and manage demand during operation.
- Be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.
- Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
- Be Seen: monitor, verify and report on energy performance.

Major development proposals should include a detailed Energy Strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy. Carbon emissions should be minimised on site as far as is practical and feasible.

A minimum on-site reduction of at least 35% beyond Building Regulations is required for major development (Be Green). Residential development should achieve 10%, and non-residential development should achieve 15% through energy efficiency measures (Be Lean). Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

- Through a cash in lieu contribution to the borough's carbon offset fund, or
- Off-site provided an alternative proposal is identified and delivery is certain.

Boroughs must establish, administer and regularly review a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. Where London Boroughs have not established an offset rate, the GLA figure should be used. The GLA's suggested carbon offset price is currently £95 per tonne; this will be updated in future guidance.

Major development proposals should calculate and minimise unregulated carbon emissions from any other part of the development that are not covered by Building Regulations.

Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3: Energy Infrastructure

Energy masterplans should be developed for large-scale development locations (such as Town centres, Opportunity areas other growth areas) which establish the most effective energy supply options. Energy masterplans should identify any opportunities to generate, utilise and share otherwise wasted heat.

Policy SI 4: Managing Heat Risk

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure. Proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the Cooling Hierarchy. Section 6 provides full details of the overheating and cooling strategy and analysis.

Policy SI 5: Water Infrastructure

In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner. Development proposals should:

- Through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day.
- Achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial developments).
- Incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise futureproofing.

Policy SI 7: Reducing Waste and Supporting Circular Economy

The Mayor and waste planning authorities will encourage waste prevention, reuse and minimisation, as well as promote a more circular economy that improves resource efficiency by supporting proposals which demonstrate how the following waste targets will be achieved:

- Construction and demolition – 95% reuse/recycling/recovery.
- Excavation – 95% beneficial use.

Referable applications should promote circular economy outcomes and aim to be net zero-waste and submit a Circular Economy Statement in support.

Policy SI 12: Flood Risk Management

Current and expected flood risk from all sources across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies to identify flood risk issues and develop mitigation measures.

Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

Policy SI 13: Sustainable Drainage

Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

- Rainwater resource (e.g. rainwater harvesting, blue roofs for irrigation).
- Rainwater infiltration to ground at or close to source.
- Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens).
- Rainwater discharge direct to a watercourse (unless not appropriate).
- Controlled rainwater discharge to a surface water sewer or drain.
- Controlled rainwater discharge to a combined sewer.

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

Policy GG 6: Increasing Efficiency and Resilience

To help London become a more efficient and resilient city, those involved in planning and development must:

- Seek to improve energy efficiency and support the move towards a low carbon circular economy, contributing towards London becoming a zero-carbon city by 2050.
- Ensure buildings and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing impacts from natural hazards like flooding and heatwaves, while mitigating and avoiding contributing to the urban heat island effect.

Local Policy – City of Westminster

The 'Westminster's City Plan: Strategic Policies' document adopted November 2016 has the following policies regarding sustainable development:

Policy S28 Design - The development must incorporate exemplary standards of sustainable and inclusive urban design and architecture. Development will:

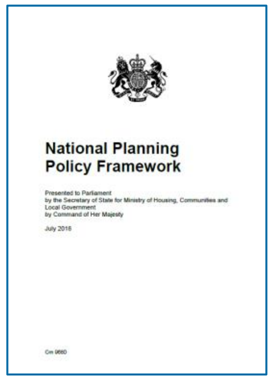
- reduce energy use and emissions that contribute to climate change during the life cycle of the development; and
- ensure the reduction, reuse or recycling of recourses and materials, including water, waste and aggregates.

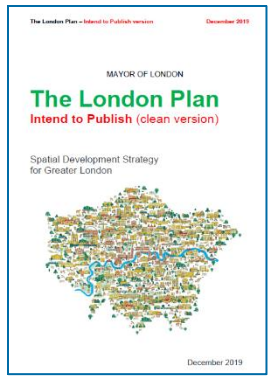
Policy S39 Decentralised Energy Networks - The Council will require all major developments to be designed to link and extend existing heat and energy networks in the vicinity, except where the council considers that it is not practical or viable to do so.

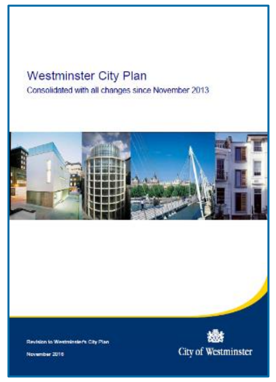
Where it is not possible to link to an existing heat and energy network, major development will be required to provide site-wide decentralised energy generation. This generation should minimise greenhouse gas emissions and have expansion potential to serve other development sites in the vicinity. The inclusion of any heat generation should consider viability as well as any unacceptable impact on local air quality.

Policy S40 Renewable Energy - The Council also requires all major developments throughout Westminster to maximise on-site renewable energy generation to achieve at least 20% reduction of carbon dioxide emissions, where feasible.

A draft update to the Westminster City Plan (2019-2040) is currently out for consultation but looks to build upon the spatial strategies and policies within the existing adopted plan.







Appendix B – District Heat Network Confirmation

Below is the correspondence with the local Borough confirming the current state and future intention of district heating networks in the project's vicinity.

From: Watts, Oliver <o.watts@cundall.com>
Sent: 24 Jun 2019 13:50
To: CRichardson@cwh.org.uk
Subject: PDHU connection

Dear Chris,

I am in the processing of advising of likely energy strategies on a number of developments in the Westminster area, of varying distances away from the existing Pimlico network. Are there any initial considerations/ rules that can be applied? In particular guidance on the below would be really appreciated:

- Carbon factor of the network
- The status of the proposed network extension as shown on the London heat map
- Rules of thumb regarding potential extension
- Potential of crossing major rail networks
- Typical costs for extending the network

The developments we are working on in the area include a large mixed use development, office conversions and new build offices.

More than happy to discuss over the phone if required. Your help is greatly appreciated. Please let me know if you need any further details but there are some confidentially issues with the developments.

Kind regards,

Oli

Oliver Watts
Senior Sustainability Consultant
Cundall

From: Richardson, Chris: WCC <crichardson1@westminster.gov.uk>
Sent: 16 August 2019 16:30
To: Watts, Oliver <o.watts@cundall.com>
Cc: Wyatt, Simon <s.wyatt@cundall.com>; Smith, Steven <s.smith@cundall.com>; Stocks, Peter <P.Stocks@cundall.com>; Kade Motley <K.Motley@Gardiner.com>
Subject: RE: PDHU connection

Dear Oli

Further to our telephone discussion on yesterday, I can summarise what we discussed in response to your questions below.

In case you are not already aware, PDHU is wholly owned by Westminster City Council. The PDHU heat network exists to the extent bordered to the west by the railway tracks (shown on the map). Currently, it is not possible to connect across the tracks and then on to your site. When we previously investigated the option of doing so across the tracks, the crossing (ie. Ebury Bridge and/or Elizabeth Bridge) required was not suitable to cater for the size of pipe to supply that area. However, due to another development just before your site, we have recently started discussions to see if we could cross the tracks with an alternate route that would avoid a pipe bridge, and it might be that we look into going under the tracks instead. This might not be for a years yet.

As you know, the planners require that all developments are 'future ready' to be able to connect to a local district heating network should one become available and appropriate to connect. If you would like to meet with my team to have some high level discussions both to understand what we have, operate and do as well as shed more light on your scheme, we would be pleased to have you at our Pump House. Do let me know.

As I mentioned, the London Heatmap has indications on it which require updating because there was a proposal to extend the PDHU heat network north-eastwards towards Whitehall (which is shown on the map) but this did not go ahead.

Our general principle for new connections is that we would need to appoint consultants to undertake an analysis of the distribution network so as to determine how best any additional load could dovetail into our scheme. Additionally, they would need to undertake a survey of the utilities in the streets leading to your development in order to identify a potential route.

The cost for any surveys and reports etc. incidental to the connection would need to be borne by you (your client). We would however be able to give an early indication whether it is possible to connect or not and encourage discussions at an early stage before designs get too far down the road.

In terms of giving an indication of costs, as mentioned and subject to the above studies, I would not be able to give an indication of that at this time.

The Carbon factor of the network is 0.239 $kgCO_2/kWh$ for heat and 0.149 $kgCO_2/kWh$ for electricity. We supply heat at a flow temperature of 80C and a return temperature of 60C. However, with new connections, we require a delta T of 30C and would usually require a PHE with a heat meter and a pair of valves to a point on your site (plant room).

Let me know if you require any other information.

With best wishes
Chris

Chris Richardson MBA
Head of PDHU & Energy

Growth, Planning and Housing
12th Floor
Westminster City Council
64 Victoria Street
London SW1E 6QP

020 7233 7457
07909 533376
crichardson1@westminster.gov.uk
www.westminster.gov.uk

Appendix C – Heat Loop Details

System Description

The low temperature heat loop strategy will serve the domestic and senior living aspects of the development. Roof-mounted air source heat pumps will generate the heat energy, which will be feed down to the buffer tanks at ground/basement level before being distributed around the buildings via the primary heat loops. At each core, risers will branch off and up the risers where it is distributed across each floor. Each apartment will have its own local internal water source heat pump which will upgrade the heat from the main system to effective heating temperatures within the dwellings. Some units will include VRF instead of WSHPs which will enable space cooling as well.

Operation

Losses across the system will be minimised through the following mechanisms:

- Heat pumps sized appropriately to modulate through load ranges up to peak;
- Buffer vessels used and sized to effectively store thermal energy and smooth supply of heat to the wider system;
- Heat loop temperatures will be kept low to minimize the deltaT between LTHW and ambient spaces. Heat source and primary heat loop operating temperature range 40°C - 35°C; Secondary heat loop and distribution to each apartment operating range 25°C - 15°C.
- Equipment will be included in the system to monitor and regulate temperature and flow control across the system;
- Plant efficiencies and pipework insulation beyond the standards required by the Domestic (and Non-domestic) Building Services Compliance Guides;

Heating Performance

Heating costs for occupants have been minimised through measures including:

- Extremely high-performance thermal envelope with low u-values, thermal bridging and air permeability, ensuring space heating loads are significantly lower than typical residential buildings.
- The low temperature heat loop using high efficiency heat pumps provides LTHW efficiently to all occupants.
- Low flow water fittings will enable reductions on domestic hot water usage compared to standard fittings.
- Specific metering strategies of energy use will ensure occupants are billed only for the heat they use.
- Based on the SAP calculations and assuming £0.12/kWh of electricity, the estimated heating cost (space + DHW) is calculated to range between roughly £120 and £350 depending on apartment type. This works out to be approximately £200 on average per apartment per year, which is significantly lower than typical costs.
- Site-wide, heat pumps are expected to consume approximately 1,811MWh of energy, which represents a saving of 422 Tonnes (151 domestic, 271 non-domestic) of CO_2 per year.

Metering and Monitoring

The central heat loop system will be metered, monitored and reported to enable the high level of performance to be achieved during operation as per the design.

A central automatic control and energy monitoring system will be provided to control, monitor and record main items of plant and monitor all meters and sub-meters. This consists of the digital control of all central plant including starting and stopping of the plant, temperature control system monitoring and energy metering, all provided by a specialist controls contractor.

Additional meters will be installed to comply with the requirements if CIBSE TM 39 and the Building Regulations Part L2A.

Each apartment is to be provided with an apartment control panel (APC) housing the outstation controllers in a Form 2 enclosure. The panel is to be fitted with a facia mounted touch screen display screen and laptop connection point.

The landlord's plant is to be provided with Form 2 plant control panels (PCP) housing the outstations to control and manage the shell and core plant.

The landlord is to be able to view and log the energy consumption and plant alarms from each of the apartments systems via a Bacnet over IP network serving the BMS throughout the building.

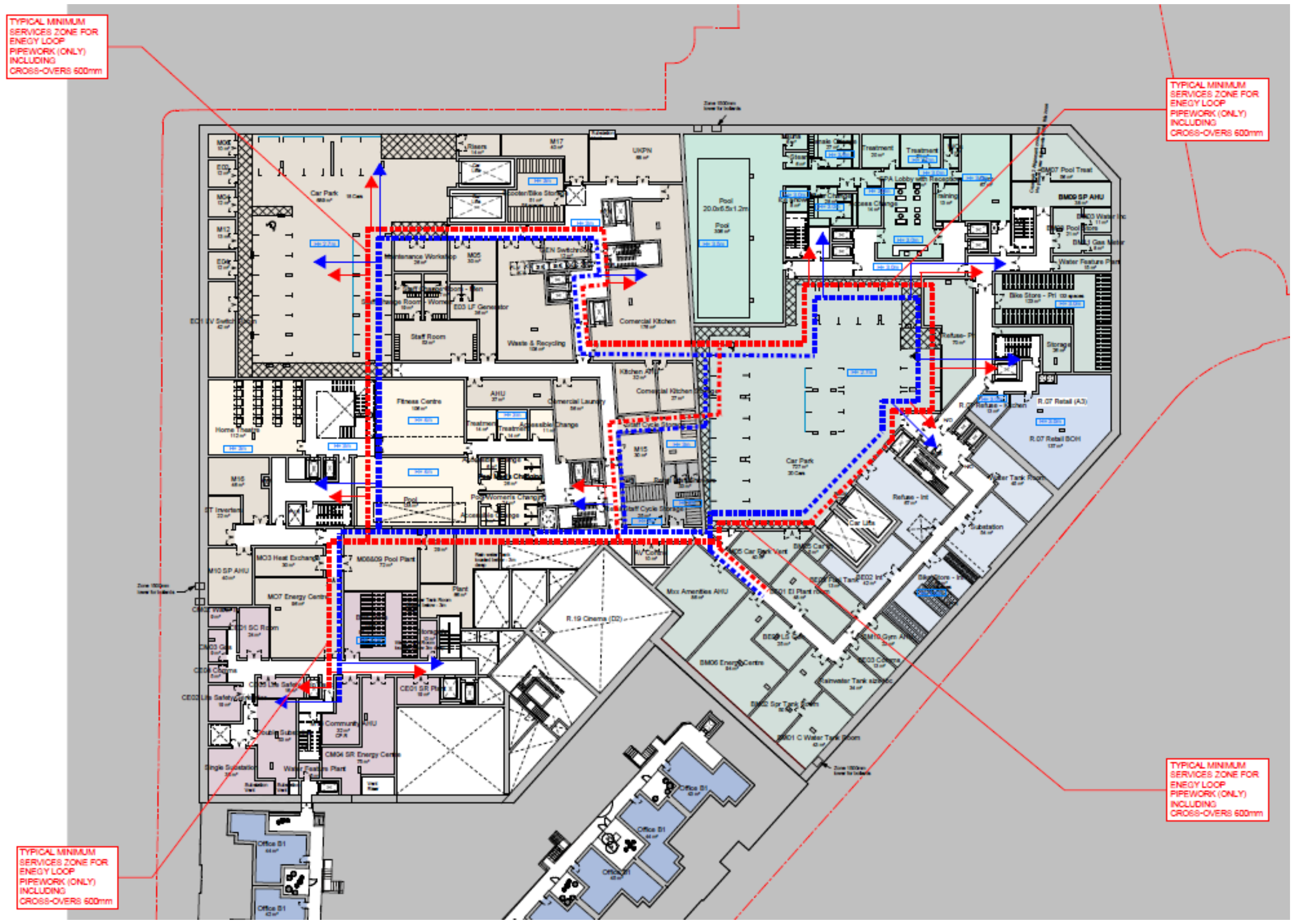
The controls platform and communications protocol used will utilise Ethernet BACnet IP with Modbus monitoring of meters via a Synapsis SIP module.

A remote common alarm output will also be provided to draw the attention of maintenance staff to any major problem with the system, including safety systems (location of remote alarm to be determined).

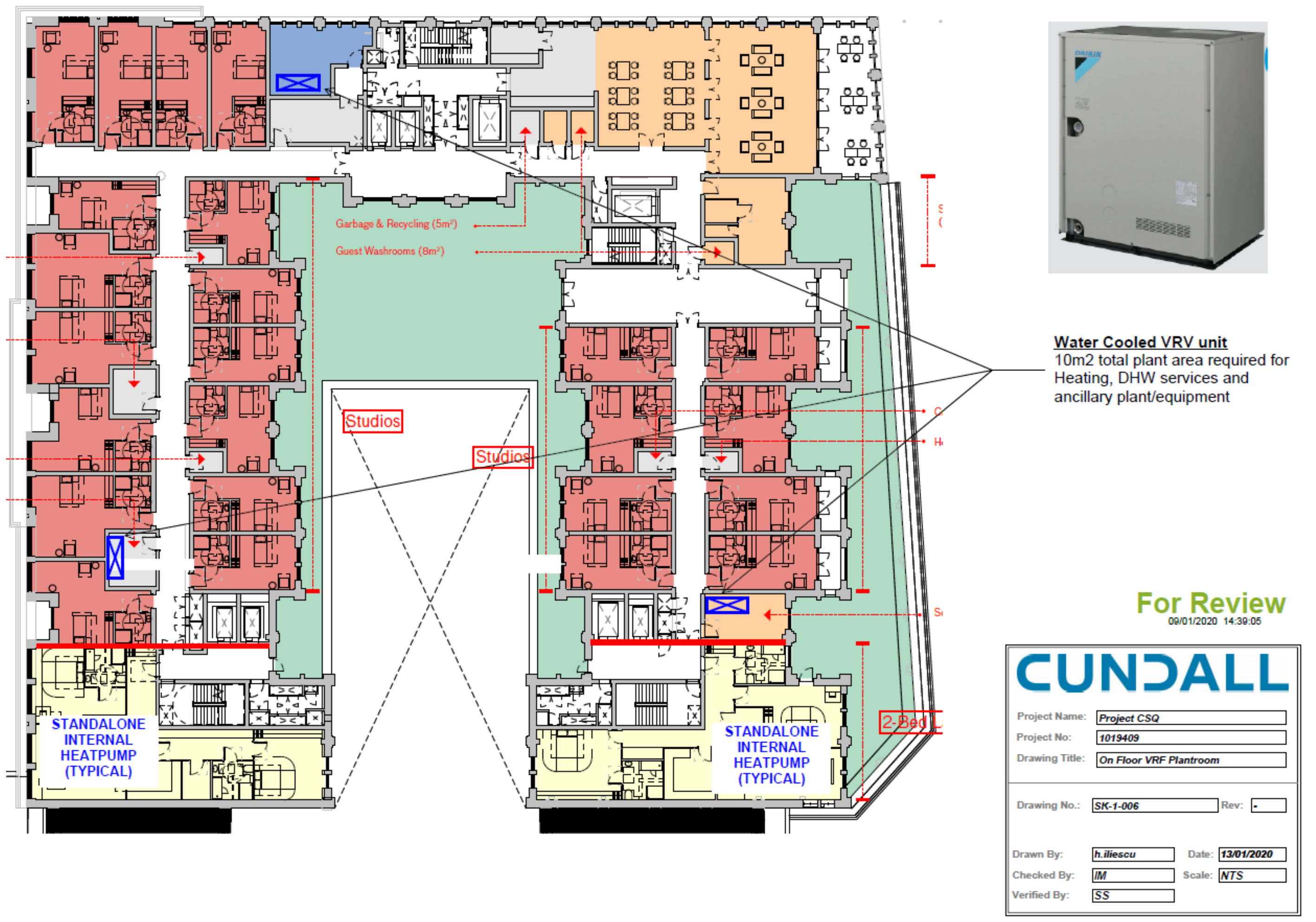
A web connection is to be configured to allow the system to be controlled and overridden from the central building managers BMS and remotely via a suitably password protected web browser interface.

Distribution Routes

Site-wide plan drawing showing indicative heat network route to through the development. Pipework will run at high-level within the basement spaces where it can access all Blocks A, B and C.

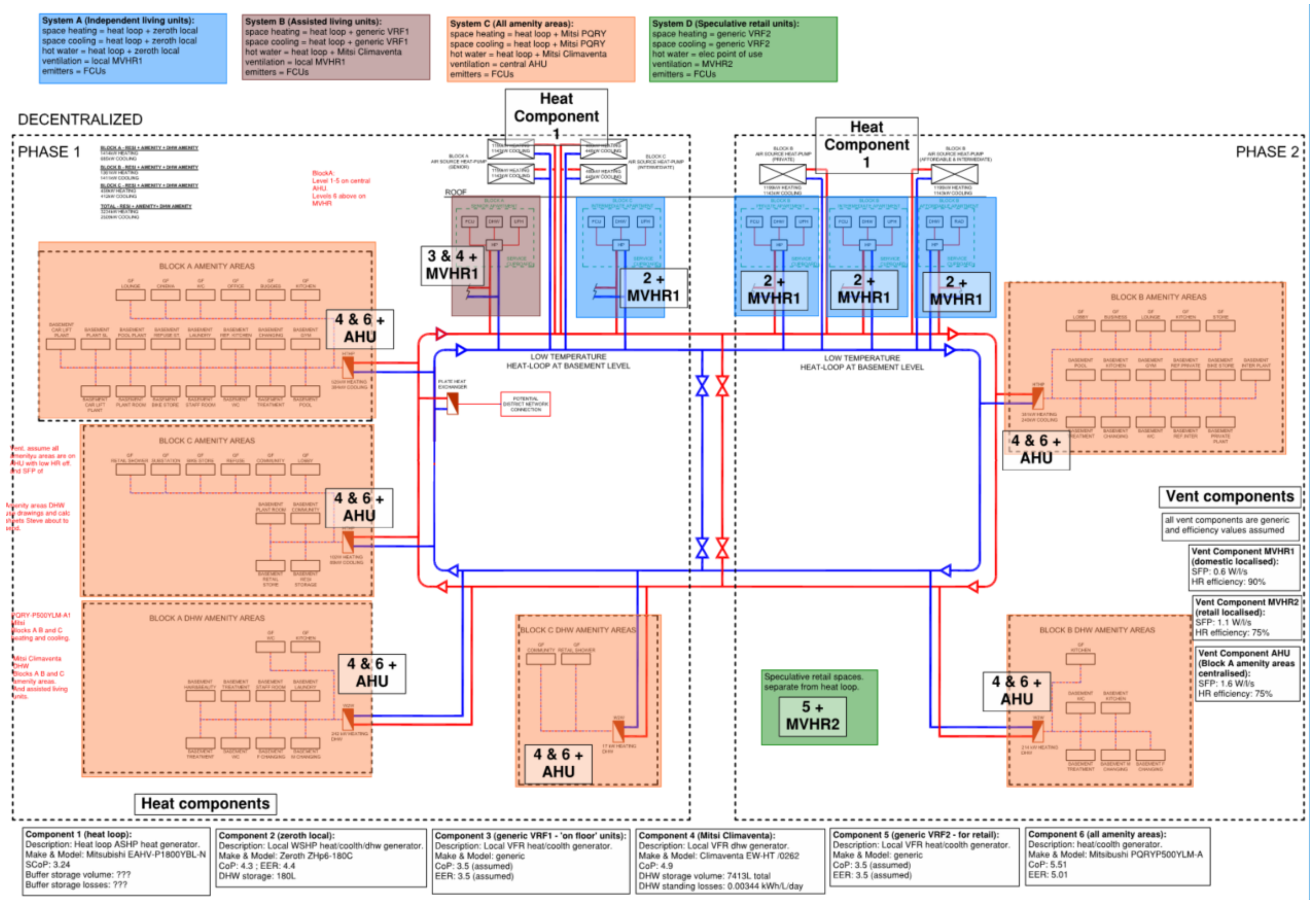


A closer view of the domestic aspects illustrates how the heat network provides low temperature hot water to each block with pipework vertically through risers.



Below is a schematic illustrating the arrangement of the low temperature heat loop system as intended by the design team. It shows how the air source heat pumps (Heat Component 1) feeds low temperature water to the central loop. Heat exchangers then transfer the heat to secondary loops which transport the LTHW through each core of the buildings. Individual branches to each apartment then feed local heat pump units (Heat Components 2, 3 and 4) which upgrade the heat to operational temperatures. The technical details of the Heat Components referenced in this schematic are provided below.

The diagram also indicates where a provisional connection to possible future district heat networks is included in the heat loop system (toward centre of diagram).



Products and Efficiencies

Following are a range of technical details that were used to model the heat loop system outlined in the diagram above.

90kW Module ▶

150/180kW Modules ▶

Page **19**

1 - External ASHP

e-series Modular Chiller (90-1,080kW)

Heat Pump			EAHV-P900YA-N	EAHV-P1500YBL-N	EAHV-P1800YBL-N
POWER SOURCE			3-phase 4-wire 380-400-415v, 50/60Hz	3-phase 4-wire 380-400-415v, 50/60Hz	3-phase 4-wire 380-400-415v, 50/60Hz
COOLING CAPACITY *1 WATER		kW	90.0	150.0	180.0
		kcal/h	77,400	129,000	154,800
		BTU/h	307,080	511,800	614,160
	Power Input	kW	30.6	45.1	59.01
	EER (Pump input is not included)		3.30	3.33	3.05
	IPLV *3		6.34	6.55	6.33
	Water Flow Rate	m^3/h	15.5	25.8	31
COOLING CAPACITY (EN14511) *2 WATER		kW	90	148.6	177.8
		kcal/h	77,400	127,779	152,874
		BTU/h	307,080	506,955	606,517
	Power Input	kW	29.2	46.52	61.25
Heating only	EER		2.94	3.19	2.90
	Eurovent Efficiency Class		B	A	B
	ESEER*6		4.71	4.74	4.45
	SEER (ηsc) (BS EN14825)		4.88 (192%)	4.62 (181%)	4.58 (180%)
	Water Flow Rate	m^3/h	15.5	25.8	31.0
	Minimum Water Circuit Volume	L	780	1450	1450
HEATING CAPACITY*3		kW	90.0	150	180
		kcal/h	77,400	129,000	154,800
		BTU/h	307,080	511,800	614,160
	Power Input *3	kW	25.71	44.59	55.68
	COP		3.50	3.36	3.23
	Water Flow Rate	m^3/h	15.5	25.8	31.0
HEATING CAPACITY (EN14511) *4		kW	90.0	151.42	182.24
		kcal/h	77,400	130,221	156,726
		BTU/h	307,080	516,645	621,803
	Power Input *3	kW	27.6	46.01	57.92
	COP		3.25	3.29	3.15
	Eurovent Efficiency Class		A+	A	B
	SCOP Low/Medium		3.66 (143%) / 2.89 (113%)	3.24 (127%) / 2.85 (112%)	3.24 (127%) / 2.85 (112%)
	Water Flow Rate	m^3/h	15.5	25.8	31.0
CURRENT INPUT	Cooling Current 380 - 400 - 415V *1	A	46.0 - 43.7 - 42.3	77 - 73 - 70	77 - 73 - 70
	Heating Current 380 - 400 - 415V *3	A	43.4 - 41.2 - 39.7	76 - 72 - 69	76 - 72 - 69
	Maximum Current Input	A	61	111	111

Ability

GlenDimplex HEATING & VENTILATION

Zeroth Apartment Heat Pump with integrated cylinder

4 and 6 KW Heating & Cooling models

2 - Zeroth WSHP

The Zeroth Heat Pump comes in two sizes, 4kW and 6kW. The integrated cylinder is made from Stainless Steel with a Heat Pump mounted underneath, in a removable module. The outer casing is made from painted white steel formed around a rigid frame, with adjustable feet. The heat pump can produce heating, cooling or hot water very efficiently as it extracts energy from an energy loop at between 15 and 25 degrees. The end user controls are mounted flush on the front and all pipework and cable entries are on the top, except for a drain hose connected at the back and the discharge which can be piped left or right, through the knockout.

Provides DHW, Heating and Cooling for new build dwellings

Energy recovery features as standard by utilising simultaneous cooling and DHW

Compact unit with 550mm x 550mm footprint, ideal for integrated kitchen or cupboard installation

Stainless steel tank with no requirement for sacrificial anode.

Very quiet operation due to free swinging compressor base plate, inverter compressor, variable speed pumps, acoustic insulation and flexible pipework connections.

Use with an energy loop reduces overheating risk and improves building energy performance

Prewired and Pre-plumbed, simplifying the installation

2 year manufacturers guarantee, which can be extended to 5 years.

Heat pump performance		ZHP4-180C	ZHP6-180C
Cooling Capacity	kW	3	5
Required Capacity from Loop (Cool)	kW	4	6
Heating Capacity	kW	4	6
Required Capacity from Loop (Heat)	kW	3.2	4.8
Energy Efficiency Ratio, Cooling	W25/W14	4.1	4.4
Coefficient of performance, Heating	W25/W35	8	8.3
Coefficient of performance, Heating	W25/W55	4	4.3
Nominal Flow Rate from loop	m^3/h	0.7	1.03
Loop operating range	°C	15-25 on a 5K delta T	
Maximum Static Pressure Rating	Bar	10	
Heating/Cooling flow rate	m^3/h	0.7	1.03
Max Heating Flow Temperature	°C	55	
Min Cooling Flow Temperature	°C	10	
Sound power level at 1m	dB(A)	43	
Refrigerant	Type/kg	R410A/0.82	
Available Pump Head (Heat/Cool)	kPa	53	39
Available Pump Head (Loop)	kPa	45	23
Dimensions and connections			
Dimensions	mm	550 x 550 x 2000	
Weight when filled	kg	363	
Weight without packaging (empty)	kg	178 or 110/68 split	
Loop connections	mm	22 copper stub	
Heating/Cooling connections	mm	22 copper stub	
Discharge Drain	mm	1.5m length supplied loose	
Discharge (G3 T and P Valve)	mm	15	
Cold Mains inlet to cylinder	mm	22 copper stub	
Hot Water outlet/return	mm	22 copper stub	
IP rating		IPX4	
Expansion Vessel (heating/cooling)	Litre	8	
Electrical			
Nominal Power Consumption Heat Pump, inc pumps (W25/W35)	kW	0.6	0.82
Electrical supply Immersion (230v)	A/Rating	9A with 10A Type B RCBO	
Electrical supply HP Module (230v)	A/Rating	13A with 16A Type C RCBO	
Number of Electrical supplies		2	
Hot water cylinder			
Type		Unvented	
Material		Stainless Steel	
Insulation		EPS Foam	
T&P Valve Rating		6 Bar or 95°C	
Maximum water inlet pressure	bar	6	
Capacity	L	180	
Integrated electric immersion	kW	2	
Maximum temperature with immersion	°C	70	
Water regulations		G3 KIWA approval to EN12897	
T&P valve		Factory fitted	
Standing heat loss	kWh/24h	1.85	
Cylinder heat up time (from 10 to 60°C)	hrs	2.5	1.7
Accessories Supplied Loose		Tundish, pre-formed discharge pipework, 1.5m hose, adjustable feet	

GlenDimplex. have developed a guidance document in conjunction with the BRE detailing how their Zeroth heat loop system should be entered into NCM software. Manufacturer technical data has also been obtained which outlines the efficiencies modelled can be achieved by their products. Confirmation directly from the manufacturer has also been obtained which indicates the system seasonal efficiency could in fact be higher than what the guidance has stated and has been modelled. This has been deemed to be a reasonable and conservative approach to the exercise.

zeroth energy system

Zeroth and putting the solution through SAP (2012)

Glen Dimplex Heating and Ventilation are currently undertaking in depth consultation with the Building Research Establishment (BRE) on how to correctly model the Zeroth Energy System within SAP. This document outlines two interim methods, which have been approved by the BRE, for use while the SAP methodology is suitably amended for SAP 10.

Route 1: Zeroth with Heat Pumps

One of the most energy efficient ways to use Zeroth is with heat pumps as the central plant. The method provided by the BRE requires the assessor to either model the heat network with a default efficiency for heat pumps at 300% or if the ASHP SCOP is known (calculated to BSEN 14825) then this can be added to the box, as manufacturer declared. The value shown is for the Dimplex LA 60 TU or LA 60 TUR+ models. A distribution loss factor of 1.05 can be adopted for the network efficiency.

General considerations

When modelling the Zeroth Energy System, it is important to remember that hot water services are provided using a cylinder. Therefore, the SAP assessor will need to enter the relevant values:

- Cylinder in dwelling
- Cylinder Volume – 180L
- Heat loss from cylinder – manufacturer declared
- Value – 1.85 kwh/day

TECHNICAL SELECTION - EUROPEAN GROSS Page 1 / 5

EW-HT /0262

Software version: ELCA World 1.2.1.0
Database version: 1.1.3.0
User: Callum Jarrald
Print data: 03/04/2019 15:54

HEATING | SCROLL | HFC R-134a

3 - WSHP DHW

Code		EW-HT /0262
Version		
Size		0262
UNIT DESCRIPTION		Water to water heat pumps, heating only, very high temperature water production
Power supply	V/ph/Hz	400/3/50
PERFORMANCE AT DESIGNED CONDITIONS		
RUNNING CONDITIONS		
HEAT EXCHANGER USER SIDE		
Fluid inlet temperature (heating mode)	°C	65.00
Fluid outlet temperature (heating mode)	°C	70.00
Fluid type		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000
HEAT EXCHANGER SOURCE SIDE		
Fluid inlet temperature (heating mode)	°C	45.00
Fluid outlet temperature (heating mode)	°C	40.00
Fluid		WATER
Glycol	%	0
Fouling factor	m²K/kW	0.000
HEATING		
Total heating capacity	kW	115.5
Compressors power input (heating mode)	kW	23.5
Total power input	kW	23.55
COP	kW/kW	4.915
SCOP		
SCOP Official (Reg. 813/2013 EU)		
MEDIUM TEMPERATURE		
Type climate		Average
Temperature application	°C	55
Type flow		Fixed
Type Temperature		Variable
Bivalent temperature	°C	-7.0
PDesign	kW	61.6
Qhe	kWh	38590
SCOP		3.30
Performance ηs	%	124
Seasonal efficiency class		A+

Air Conditioning

Product Information

WR2 Series (22.4-56kW) Water Cooled Condensing Unit Simultaneous Heating and Cooling with Double Heat Recovery

Making a World of Difference

6 - Amenities Heating & Cooling

CONDENSING UNITS		PQRY-P200YLM-A	PQRY-P250YLM-A	PQRY-P300YLM-A	PQRY-P350YLM-A	PQRY-P400YLM-A	PQRY-P400YSLM-A	PQRY-P450YLM-A	PQRY-P450YSLM-A	PQRY-P500YLM-A	PQRY-P500YSLM-A
CAPACITY (kW)	Heating (nominal)	25.0	31.5	37.5	45.0	50.0	50.0	56.0	56.0	63.0	63.0
	Cooling (nominal)	22.4	28.0	33.5	40.0	45.0	45.0	50.0	50.0	56.0	56.0
POWER INPUT (kW)	Heating (nominal)	3.97	5.08	6.25	7.53	8.37	7.94	9.79	6.24	11.43	10.16
	Cooling (nominal)	3.71	4.90	6.04	7.14	8.03	7.70	9.29	5.69	11.17	10.12
OPERATING WATER VOLUME (m^3/h)		3.0 ~ 7.2	3.0 ~ 7.2	3.0 ~ 7.2	4.5 ~ 11.6	4.5 ~ 11.6	3.0+3.0~7.2+7.2	4.5 ~ 11.6	3.0+3.0~7.2+7.2	4.5 ~ 11.6	3.0+3.0~7.2+7.2
GUARANTEED OPERATING RANGE (°C) Heating / Cooling		-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45	-5~45 / -5~45
COP / EER (nominal)		6.29 / 6.03	6.20 / 5.71	6.25 / 5.54	5.97 / 5.60	5.97 / 5.60	6.29 / 5.84	5.72 / 5.38	6.24 / 5.69	5.51 / 5.01	6.20 / 5.53
SCOP / SEER'		-	-	-	-	-	-	-	-	-	

Efficiencies Calculations

Following are the calculations made to estimate the varying system efficiencies.

Calculations of the various systems efficiencies considering the low temperature heat loop element.

Summary for input into model

System	Heating CoP	Heating SCoP	DHW CoP	DHW SCoP	Cooling EER	Cooling SEER	Vent SFP	HR eff.	DHW Volum	DHW losses (kWh/l/day
A (self contained domestic)	4.01	3.81	4.11	3.87	4.4	3.0	0.57	90%	180	0.01028
B (assisted domestic)	3.41	3.06	4.62	3.29	3.5	3.0	0.57	90%	180	0.01500
C (amenity areas)	4.92	4.56	4.62	3.29	5.01	4.0	1.6	75%	7415	0.00344
D (Speculative commercial)	3.50	3.00	1.00	1.00	3.5	3.0	1.4	75%	None	None

Temperatures	oC
Mains	10
Heat loop	20
Space heating	50
DHW heating	70

Space heating total system efficiency calculation

	Central				Local				Total average weighted	
System	Product	CoP	SCoP	deltaT	Product	CoP	SCoP	deltaT	CoP	SCoP
A (self contained domestic)	Mitsubishi EAH	3.15	3.24	10	Zeroth ZHp6-1	4.30	4.00	30	4.01	3.81
B (assisted domestic)	Mitsubishi EAH	3.15	3.24	10	Generic VRF	3.50	3.00	30	3.41	3.06
C (amenity areas)	Mitsubishi EAH	3.15	3.24	10	Mitsi PQRY	5.51	5.00	30	4.92	4.56
D (Speculative commercial)	-	-	-	-	Generic VRF	3.50	3.00	40	3.50	3.00

DHW heating total system efficiency calculation

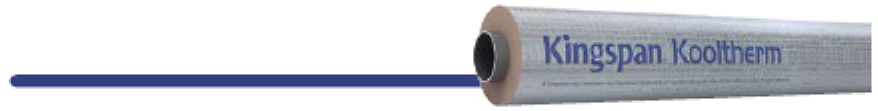
	Central				Local				Total average weighted	
System	Product	CoP	SCoP	deltaT	Product	CoP	SCoP	deltaT	CoP	SCoP
A (self contained domestic)	Mitsubishi EAH	3.15	3.24	10	Zeroth ZHp6-1	4.30	4.00	50	4.11	3.87
B (assisted domestic)	Mitsubishi EAH	3.15	3.24	10	Climaventa E\	4.91	3.30	50	4.62	3.29
C (amenity areas)	Mitsubishi EAH	3.15	3.24	10	Climaventa E\	4.91	3.30	50	4.62	3.29
D (Speculative commercial)	None	-	-	-	Elec PoU	1.00	1.00	50	1.00	1.00

Evidence hyperlinks

Product	Reference	Hyperlink
1 - Central ASHP - Mitsubish	Mitsubishi EAH	\\cjp.co.uk\global\Projects\1019000\1019409 - Project CSQ\Cundall Docs\ESD\13. Planning\MEP\Confirmed\1 - External Mitsubishi ASHP - pg19.pdf
2 - Local WSHP - Zeroth	Zeroth ZHp6-18	\\cjp.co.uk\global\Projects\1019000\1019409 - Project CSQ\Cundall Docs\ESD\13. Planning\MEP\Confirmed\2 - Zeroth WSHP - pg2.pdf
4 - Local DHW - Climaventa	Climaventa EW	\\cjp.co.uk\global\Projects\1019000\1019409 - Project CSQ\Cundall Docs\ESD\13. Planning\MEP\Confirmed\3 - Climaventa WSHP DHW - pg1.pdf
6 - Local WSHP - Mitsi PQRY	Mitsi PQRY	\\cjp.co.uk\global\Projects\1019000\1019409 - Project CSQ\Cundall Docs\ESD\13. Planning\MEP\Confirmed\6 - Mitsi PQRY-P500YLM-A1 Amenities heating and cooling .pdf

Piping Insulation

Below is an indicative pipework insulation with low conductivity characteristics that would be used across the heat loop system.



Insulation Thickness Table to Control Heat Loss: ECA & Y50 Enhanced

Steel Pipe Size			Hot Water 60°C Kooltherm™		max. heat loss	Low Temperature Heating Water ≤95°C Kooltherm™		max. heat loss
NB (Inches)	NB (mm)	OD (mm)	ε=0.05 silver	ε=0.9 black	(W/m)	ε=0.05 silver	ε=0.9 black	(W/m)
3/8	10	17.2	15	20	6.04	20	20	7.78
½	15	21.3	20	20	6.45	20	20	8.42
¾	20	26.9	20	25	7.00	20	25	9.05
1	25	33.7	25	25	7.71	25	25	9.86
1¼	32	42.4	25	25	8.46	25	30	10.83
1½	40	48.3	25	30	9.01	30	30	11.42
2	50	60.3	30	30	9.94	30	35	12.61
2½	65	76.1	30	30	11.25	35	35	14.12
3	80	88.9	30	35	12.17	35	35	15.28
4	100	114.3	35	35	14.29	35	40	17.51
5	125	139.7	35	40	16.09	40	40	19.72
6	150	168.3	35	40	18.24	40	45	22.34
8	200	219.1	35	40	22.06	40	45	26.61
10	250	273.0	40	40	25.95	45	50	30.91

Estimated Mean Temperature of Insulation: +50°C
Ambient Air Temperature: +15°C
Surface Emissivity ε (Outer Surface): 0.05 / 0.9
Assumed Thermal Conductivity (k–value) of Kooltherm™ 37kg/m³ Insulation: 0.025 W/m K

Appendix D – Photovoltaics

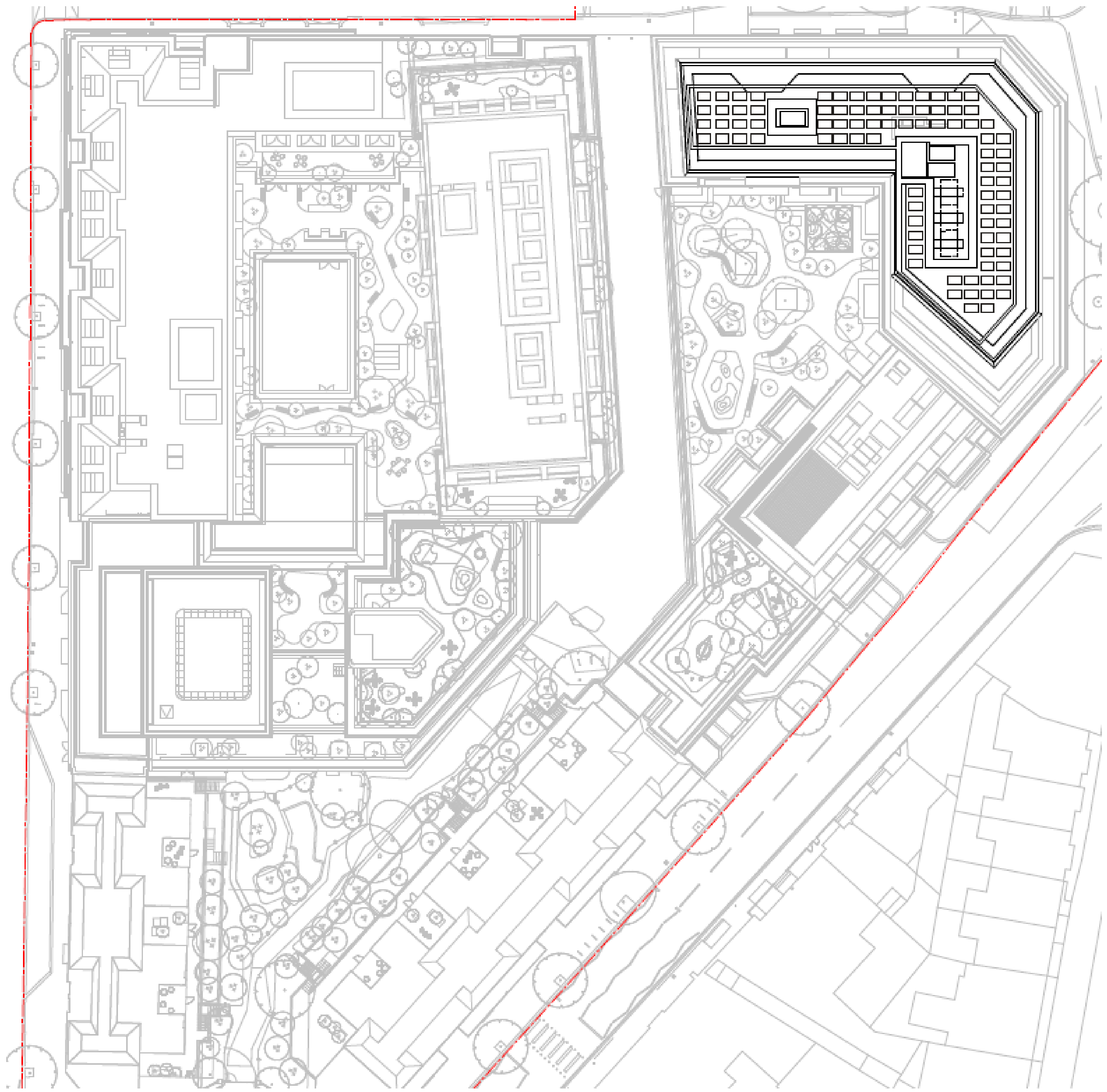
Roof Layout for Photovoltaics

Following are roof plan drawings illustrating the range of roof mounted items that are required for the scheme, including:

- Cores
- Smoke extracts
- Heat pumps
- Residents accessible terraces
- Brown/blue roof
- VRF/heating plant
- AHU extracts

PV positioning must avoid overshadowing as much as possible, otherwise electrical generation can be greatly diminished. Therefore, as PV performs best when oriented South, no array should be located immediately to the North of items elevated above roof level. Simillarly, a reasonable gap should be allowed to the East and West of PV between obstructions, including parapets, to avoid shading from low angle morning and evening sun paths.

The following roof plan drawing indicates the best arrangement of PV to maximize array area and electrical output, considering the factors identified above. As a result, the PV array has been maximised to a total of 35kWp (approximately 202m^2 array).



PV Energy and Emissions Calculations

Site Details

Weather File	London
Azimuth Angle of Collectors	South
Inclination (Tilt Angle) of Collectors	30 °

Photovoltaic Collectors (PVs)

PV System Type	New Build
PV Collectors	PANDA 60
Collector Area	202 m^2
Manufacture	Yingli
Collector Type	Monocrystalline
Module Efficiency	17.2 %
Total System Efficiency	12.2 %

Energy

Potential Annual Energy Generated	28148 kWh/yr
Energy Generated Per m^2	139 kWh/m^2
Installed Power (kWp)	34.8 kWp
Percentage of Electricity Generated	1.9 %

Costs

Capital Cost Per KWp	1300 £/kWp
Potential Electricity Savings	2674 £/year
Grant Available	0 %
Total Capital Cost	45212 £
Stimulus Program Type	None
No Government Stimulus Assumed	0 £/year
Simple Payback Period	17 years

Emissions

Potential Annual CO_2 Saving	15318 kgCO_2/yr
Potential Emissions Reduction	1.6 %

Summary

Capital Cost	45211.92 £
Annual CO_2 Saving	15.3 TCO_2/yr
Reduction Over Baseline (05/06)	1.60 %
Annual Income from FITs	0 £/yr
Annual CRC TAX Saving	245 £/yr
Total Annual Saving	2919 £/yr
Simple Payback Period	15 yrs
Captial Cost per kgCO_2 Saving	2.95 £/kgCO_2

Appendix E – Full Overheating Results

TM59 Compliance Results – DSY1

Occupied Zones	Criterion 1 (%Hrs Top-Tmax>=1K)	Night-time overheating criteria for bedrooms	Status
	Limit 3	Limit 32	
Block A			
L04_UnitSE_Bedrm_SE	2.2	24	Pass
L04_UnitSE_KtchnLvng_SE	1.2	-	Pass
L04_UnitW_Bedrm_W	2.3	23	Pass
L04_UnitW_KtchnLvng_W	1.3	-	Pass
L06_UnitW_Bedrm_W	2.7	25	Pass
L06_UnitW_KtchnLvng_W	2.1	-	Pass
L09_F1_BedDble1_SE	0.8	24	Pass
L09_F1_BedDble2_SE	1.8	27	Pass
L09_F1_Kitchen_SE	2.8	-	Pass
L09_F1_LivingRm_SE	1.7	-	Pass
L09_F2_BedDble1_NW	3	21	Pass
L09_F2_BedDble2_NW	2.8	24	Pass
L09_F2_Kitchen_NW	1.8	-	Pass
L09_F2_LivingRm_NW	2.7	-	Pass
Block B			
B_PRV_B1_10_01_DoubleBedroom1	3	17	Pass
B_PRV_B1_10_01_DoubleBedroom2	2.6	16	Pass
B_PRV_B1_10_01_DoubleBedroom3	0.4	22	Pass
B_PRV_B1_10_01_Living-kitchen	0	-	Pass
B_PRV_B1_10_03_DoubleBedroom1	0.4	20	Pass
B_PRV_B1_10_03_DoubleBedroom2	2.7	17	Pass
B_PRV_B1_10_03_DoubleBedroom3	0.5	25	Pass
B_PRV_B1_10_03_Living-kitchen	2.7	-	Pass
Block C			
L04_UnitSE_Bedrm_SE	0.8	30	Pass
L04_UnitSE_KtchnLvng_SE	0.6	-	Pass
L04_UnitW_Bedrm_W	0.7	28	Pass
L04_UnitW_KtchnLvng_W	0.6	-	Pass
L06_UnitW_Bedrm_W	1.1	31	Pass
L06_UnitW_KtchnLvng_W	0.6	-	Pass

Circulation Zones	Circulation criterion (%Hrs >28ºC)	Status
	Limit 3	
Block A		
L04_UnitSE_CircCommunal	1.2	Pass
L04_UnitW_CircCommunal	1.1	Pass
L06_UnitW_CircCommunal	1.2	Pass
Block B		
B_PRV_B1_10_01_Circulation	0.9	Pass
B_PRV_B1_10_03_Circulation	1.2	Pass
B_PRV_B_10_XX_Circulation	1.7	Pass
Block C		
L04_UnitSE_CircCommunal	1.4	Pass
L04_UnitW_CircCommunal	1.4	Pass
L06_UnitW_CircCommunal	1.7	Pass

TM59 Compliance Results – DSY2

Occupied Zones	Criterion 1 (%Hrs Top-Tmax>=1K)	Night-time overheating criteria for bedrooms
	Limit 3	Limit 32
Block A		
L04_UnitSE_Bedrm_SE	4.2	56
L04_UnitSE_KtchnLvng_SE	4.3	-
L04_UnitW_Bedrm_W	3.3	53
L04_UnitW_KtchnLvng_W	3.5	-
L06_UnitW_Bedrm_W	3.7	55
L06_UnitW_KtchnLvng_W	3.8	-
L09_F1_BedDble1_SE	2.5	57
L09_F1_BedDble2_SE	4.2	59
L09_F1_Kitchen_SE	6.2	-
L09_F1_LivingRm_SE	4.6	-
L09_F2_BedDble1_NW	4.2	51
L09_F2_BedDble2_NW	3.9	52
L09_F2_Kitchen_NW	3.5	-
L09_F2_LivingRm_NW	4.4	-
Block B		
B_PRV_B1_10_01_DoubleBedroom1	4.2	47
B_PRV_B1_10_01_DoubleBedroom2	3.9	41
B_PRV_B1_10_01_DoubleBedroom3	1.7	53
B_PRV_B1_10_01_Living-kitchen	1.1	-
B_PRV_B1_10_03_DoubleBedroom1	1.6	52
B_PRV_B1_10_03_DoubleBedroom2	4	48
B_PRV_B1_10_03_DoubleBedroom3	1.5	57
B_PRV_B1_10_03_Living-kitchen	5.9	-
Block C		
L04_UnitSE_Bedrm_SE	2.6	53
L04_UnitSE_KtchnLvng_SE	2.5	-
L04_UnitW_Bedrm_W	1.8	91
L04_UnitW_KtchnLvng_W	1.8	-
L06_UnitW_Bedrm_W	2.2	72
L06_UnitW_KtchnLvng_W	2.2	-

Circulation Zones	Circulation criterion (%Hrs >28ºC)
	Limit 3
Block A	
L04_UnitSE_CircCommunal	3.8
L04_UnitW_CircCommunal	3.7
L06_UnitW_CircCommunal	3.9
Block B	
B_PRV_B1_10_01_Circulation	2.5
B_PRV_B1_10_03_Circulation	4
B_PRV_B_10_XX_Circulation	5.1
Block C	
L04_UnitSE_CircCommunal	4.2
L04_UnitW_CircCommunal	4.1
L06_UnitW_CircCommunal	4.4

TM59 Compliance Results – DSY3

Occupied Zones	Criterion 1 (%Hrs Top-Tmax>=1K)	Night-time overheating criteria for bedrooms
	Limit 3	Limit 32
Block A		
L04_UnitSE_Bedrm_SE	4.6	52
L04_UnitSE_KtchnLvng_SE	4.1	-
L04_UnitW_Bedrm_W	4.1	54
L04_UnitW_KtchnLvng_W	3.9	-
L06_UnitW_Bedrm_W	4.5	55
L06_UnitW_KtchnLvng_W	4.5	-
L09_F1_BedDble1_SE	2.6	55
L09_F1_BedDble2_SE	4.7	58
L09_F1_Kitchen_SE	7.1	42
L09_F1_LivingRm_SE	4.8	-
L09_F2_BedDble1_NW	5	50
L09_F2_BedDble2_NW	4.9	50
L09_F2_Kitchen_NW	4.3	-
L09_F2_LivingRm_NW	5.7	-
Block B		
B_PRV_B1_10_01_DoubleBedroom1	4.2	45
B_PRV_B1_10_01_DoubleBedroom2	3.9	43
B_PRV_B1_10_01_DoubleBedroom3	1.7	49
B_PRV_B1_10_01_Living-kitchen	1.1	-
B_PRV_B1_10_03_DoubleBedroom1	1.6	50
B_PRV_B1_10_03_DoubleBedroom2	4	50
B_PRV_B1_10_03_DoubleBedroom3	1.5	60
B_PRV_B1_10_03_Living-kitchen	5.9	-
Block C		
L04_UnitSE_Bedrm_SE	2.7	60
L04_UnitSE_KtchnLvng_SE	2.1	-
L04_UnitW_Bedrm_W	2	58
L04_UnitW_KtchnLvng_W	1.9	-
L06_UnitW_Bedrm_W	2.5	61
L06_UnitW_KtchnLvng_W	2.2	-

Circulation Zones	Circulation criterion (%Hrs >28ºC)
	Limit 3
Block A	
L04_UnitSE_CircCommunal	4.7
L04_UnitW_CircCommunal	5.2
L06_UnitW_CircCommunal	5.5
Block B	
B_PRV_B1_10_01_Circulation	3.2
B_PRV_B1_10_03_Circulation	5
B_PRV_B_10_XX_Circulation	8
Block C	
L04_UnitSE_CircCommunal	4.8
L04_UnitW_CircCommunal	5.9
L06_UnitW_CircCommunal	6.2

Appendix F – GLA Domestic Overheating Checklist

Domestic Overheating Checklist

This checklist is intended to assist designers to identify potential overheating risk in residential accommodation early on in the design process and trigger the incorporation of passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan policy 5.9.

Section 1 of the checklist should be completed at the start of the design process concept design] and should be submitted with the preliminary energy information provided to GLA at pre-app stage. Section 1 and 2 should be reviewed as the design progresses and the full checklist should be completed and included within the energy assessment submitted at stage 1 of the planning application.

Section 1 – Site features affecting vulnerability to overheating		Yes or no
Site location	Urban — within central London[29] or in a high-density conurbation	Yes
	Peri-urban — on the suburban fringes of London [30]	No
Air quality and/or Noise sensitivity — are any of the following in the vicinity of buildings?'	Busy roads / A roads	Yes
	Railways / Overground / DLR	Yes
	Airport / Flight path	No
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Yes
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units'	Yes
Glazing ratio	Is the glazing ratio (glazing:internal floor-area) greater than 25%?	Yes
	If yes, is this to allow acceptable levels of Daylighting?	Yes
Security - Are there any security issues that could limit opening of windows for ventilation?'	Single storey ground floor units	No
	Vulnerable areas identified by the Police Architectural Liaison Officer	No
	Other	No

[29] Urban - as defined in CIBSE Guide TM49. Broadly equivalent to Central Activities Zone and Inner London areas in Map 2.2 of the London Plan
[30] Peri-urban — as defined in CIBSE Guise TM49. Broadly equivalent to Outer London areas in Map 2.2 of the London Plan

GLA guidance on preparing energy assessments

Section 2 – Design Features implemented to mitigate overheating risk		Please respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?'	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?'	No
Materials	Have high albedo (light color) materials been specified7	No
Dwelling aspect	% of total units that are single aspect	80%
	% single aspect with N / NE/ NW orientation	20%
	% single aspect with E orientation	25%
	% single aspect with S / SE/ SW orientation	30%
	% simple aspect with W orientation	25%
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade7	N / NE/ NW	40%
	E	40%
	S / SE/ SW	40%
	W	40%
Daylighting	What is the average daylight factor range?	1-3%
Window opening	Are windows openable?	Yes
Window opening	What is the average percentage of openable area for the windows?	30%
Window opening - What is the extent of the opening?'	Fully openable	No
	Limited (e.g. for security, safety, wind loading reasons)	Yes
Security	Where there are security issues (e.g. ground floor flats) has an alternative nighttime natural ventilation method been provided (e.g. ventilation grates)?'	No
Shading	Is there any external shading?	Yes
	Is there any internal shading?'	Yes
Glazing specification	Is there any solar control glazing?'	Yes
Ventilation - What is the ventilation strategy?'	Natural — background	Yes
	Natural — purge	Yes
	Mechanical — background (e.g. MVHR)	Yes
	Mechanical — purge	No
	What is the average design air change rate	1
Heating system	Is communal heating present?	Yes
	What is the flow/return temperature?'	Low temp heat loop
	Have horizontal pipe runs been minimized?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual[31]	Yes

[31] http://www.londonheatmap.org.uk/Content/uploaded/documents/LHNM_Manual201 4Low.pdf

Appendix G – Whole Life Carbon Assessment

Cundy Street Quarter

Whole Life Carbon Assessment Statement

Grosvenor Estate Belgravia

Job No:	1019409
Doc Ref:	1019409-RPT-SY-004
Revision:	C
Revision Date:	13 May 2020

Executive Summary

In accordance with the Westminster City Council's planning requirements and the GLA's draft London Plan (December 2019), the following Whole Life Carbon Assessment has been developed for the Proposed Development in London.

The proposed mixed-use development consists primarily of domestic spaces but also accommodates non-domestic activities as well.

For this exercise the Sturgis Carbon Calculator was used to calculate the Whole Life Carbon emissions results. The assessment tool is deemed to be compliant in the WLC guidance document from GLA.

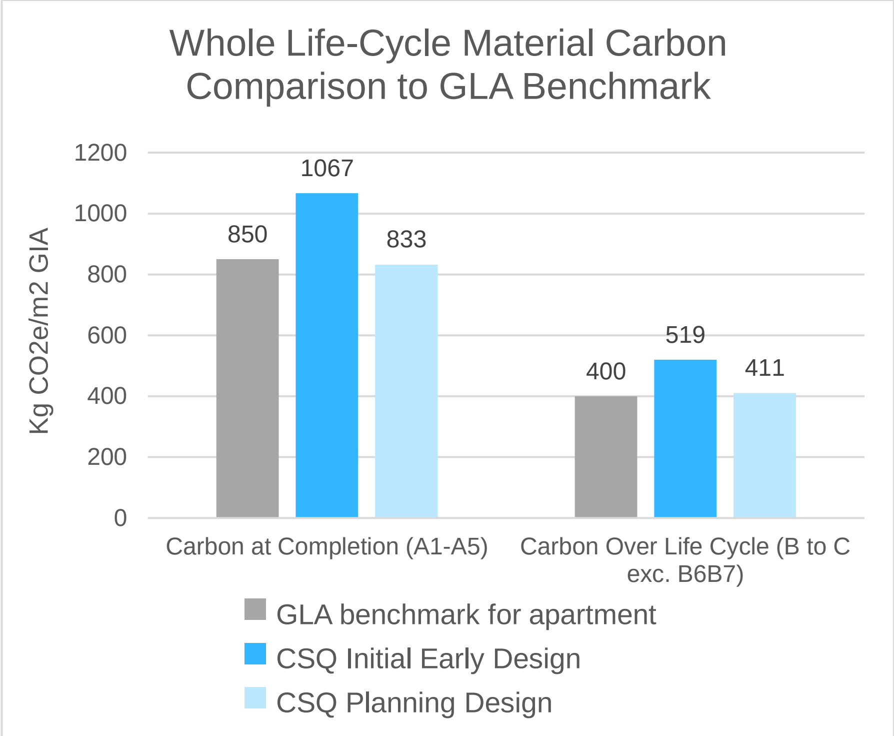
An early design stage WLC assessment was carried out using design information at the time, default material baseline recommended by the RICS PS and the component life spans recommended by RICS PS were used, this was to setup the project 'carbon baseline' and identify areas with great carbon impacts. The main object was to:

- Assess the current carbon footprint position
- Integrate embodied carbon thinking into the project design and construction.
- Identify embodied carbon footprint reduction options of the project.

The result from the baseline assessment has indicated the carbon 'hotspots. Due to the complex nature of the development, the baseline emissions are higher than the recommended GLA benchmark values for residential buildings.

A series of carbon reduction options were investigated amongst the design team in order to reduce the life cycle carbon impact, the following options have been incorporated into the Proposed Development.

- Superstructure Concrete to have > 50% GGBS cement replacement
- Substructure Concrete to have > 70% GGBS cement replacement
- Raft foundation in lieu of piled foundation
- Heavy building component like Brickwork, concrete and stone to be locally sourced where possible
- Change from 250mm concrete slab to 225mm slab
- Change aluminium window frame to timber combi frame
- Change to hand laid brick where possible to remove precast concrete
- Lower carbon specification of ceiling finishes



With the team's design intervention and the options adopted, the proposal has successfully reduced the carbon footprint by more than 20% and the carbon at completion is now below the benchmark (833 vs 850) with life cycle emissions slightly over (413 vs 400). This is normal at the early stage of design, within the detailed design stage, when specification is developed and material warranty confirmed, further reductions could be expected and will enable the development to be lower than the benchmark values set.

Contents

1.0

Introduction

1.0 Introduction

1.1 Purpose of Statement

This Whole Life-Cycle Carbon (WLC) Assessment has been prepared in support of the planning application for the Cundy Street Quarter 'CSQ' mixed-use development, located in London. It responds to the draft (in consultation) policy SI2 requirements of the Greater London Authority (GLA).

The Statement also outlines varying WLC reduction options actions that have and would be taken to reduce WLC emissions and sets out measures that could be implemented throughout the design and construction stages of the development to ensure its environmental impact is limited.

1.2 Aims of the assessment:

WLC emissions are those carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e. those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. A WLC assessment also includes an assessment of the potential carbon emissions 'benefits' from the reuse or recycling of components after the end of a building's useful life. It provides a true picture of a building's carbon impact on the environment.

Calculating and reducing WLC emissions offers a wealth of benefits including:

- Ensuring that a significant source of emissions from the built environment are accounted for which is necessary in achieving a net zero-carbon city.
- Achieving resource efficiency and cost savings by encouraging the re-use of existing materials instead of new materials and the retrofit and retention of existing structures and fabric over new construction.
- Identifying the carbon benefits of using recycled material and the benefits of designing for future reuse and recycling to reduce waste and support the circular economy.
- Encouraging a 'fabric first' approach to building design thereby minimising mechanical plant and services in favour of natural ventilation.
- Considering operational and embodied emissions simultaneously to find the optimum solutions for the development over its lifetime.
- Identifying the impact of maintenance, repair and replacement over a building's life-cycle which improves life-time resource efficiency and reduces life-cycle costs, contributing to the future proofing of asset value.
- Encouraging local sourcing of materials and short supply chains, with resulting carbon, social and economic benefits for the local economy.
- Encouraging durable construction and flexible design, both of which contribute to greater longevity, reduced obsolescence of buildings and avoiding carbon emissions associated with demolition and new construction.

1.3 Methodology

The assessment followed GLA's Whole Life-Cycle Carbon Assessments guidance and a nationally recognised assessment methodology, namely, BS EN 15978: 2011: (Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method).

Underpinning BS EN 15978 is the RICS Professional Statement: Whole Life Carbon assessment for the built environment (referred to as the RICS PS for the remainder of this document). The RICS PS serves as a guide to the practical implementation of the BS EN 15978 principles. It sets out technical details and calculation details and was used as the methodology for the assessment.

The assessment should cover the development's carbon emissions over its life-time, accounting for:

- its operational carbon emissions (both regulated and unregulated)
- its embodied carbon emissions
- any future potential carbon emissions 'benefits', post 'end of life', including benefits from reuse and recycling of building structure and materials. See also London Plan Policy SI 7 'Reducing waste and supporting the circular economy' (intend to be published soon).

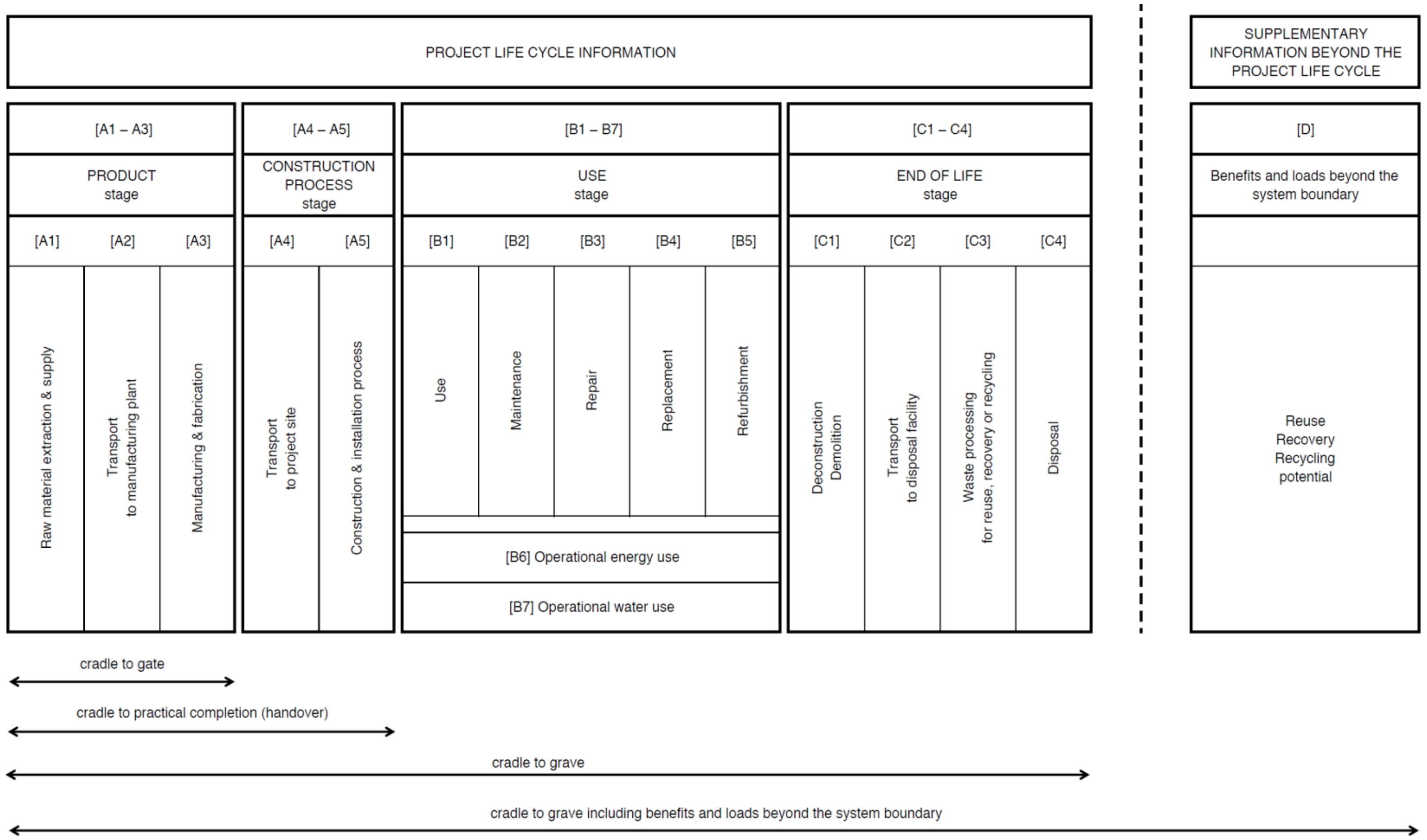


Table 2: Whole Life-Cycle assessment stages

1.4 Life-cycle modules

The WLC assessment covered the all modules A, B, C and D set out in BS EN 15978 and the RICS PS in the life of a typical project described as life-cycle modules. The reference study period (i.e. the assumed building life expectancy) for the purposes of the assessment is 60 years.

- Module A1 – A5 (Product sourcing and construction stage)
- Module B1 – B7 (Use stage)
- Module C1 – C4 (End of life stage)
- Module D (Benefits and loads beyond the system boundary)

2.0

Whole Life Cycle Carbon Assessment

2.0 Whole Life-Cycle Carbon Assessment

2.1 Assessment Process:

An early design stage WLC assessment was carried out using design information at the time, default material baseline recommended by the RICS PS and the component life spans recommended by RICS PS were used, this was to setup the project 'carbon baseline' (referred to as 'Initial early design') and identify areas with great carbon impacts. The main object was to:

- Assess the current carbon footprint position
- Integrate embodied carbon thinking into the project design and construction.
- Identify embodied carbon footprint reduction options of the project.

The next step was to look into options that the design could adapt during this stage to reduce life-cycle carbon and identify what future reductions could be targeted during further design and construction stages.

2.2 Data Source and General Assumptions

Design information used:

- Design report by DSHDA
- Structure report by HTS
- Cost plan by Gardiner and Theobald
- Energy assessment result by Cundall
- Communication and discussion with the design team and the Client

Assessment tool used:

- Sturgis Carbon Calculator and its associated material EPD database

The following general assumption of material specification, transport and life span were used for WLC initial early design assessment, as required in the RICS PS:

Material	Details	Specification
Concrete	Piling	C32/40 20% cement replacement
	Substructure	C32/40 20% cement replacement
	Superstructure	C32/40 20% cement replacement
	Generic concrete	C16/20 0% cement replacement
Steel	Reinforcement bars	97% Recycled Content
	Structural steel sections	20% Recycled Content
	Studwork/Support frames	Galvanised steel, 15% Recycled Content
Blockwork	Precast concrete blocks	Lightweight blocks for building envelope
		Dense blocks for other uses
Timber	Manufactured structural timber CLT, Glulam, etc.	100% FSC/PEFC
	Formwork	Plywood
	Studwork/Framing/Flooring	Softwood
Aluminium	Cladding panels	Aluminium sheet, 35% Recycled Content
	Glazing frames	Aluminium sheet, 35% Recycled Content
Plasterboard	Partitioning/Ceilings	Min. 60% Recycled Content
Insulation	To floors, roofs & external walls	PIR

Table 3: Default specifications for main building materials

Transport scenario	km by road	km by sea
Locally manufactured e.g. concrete, aggregate, earth	50	-
Nationally manufactured e.g. plasterboard, blockwork, insulation	300	
European manufactured e.g. CLT, façade modules, carpet	1500	
Globally manufactured e.g. specialist stone cladding	200	10,000

Table 4: Default transport scenarios for UK projects

Building part	Building elements/components	Expected lifespan
Roof	Roof coverings	30 years
Superstructure	Internal partitioning and dry lining	30 years
Finishes	Wall finishes: Render/Paint	30/10 years respectively
	Floor finishes Raised Access Floor (RAF)/Finish layers	30/10 years respectively
	Ceiling finishes Substrate/Paint	20/10 years respectively
FF&E	Loose furniture and fittings	10 years
Services/MEP	Heat source, e.g. boilers, calorifiers	20 years
	Space heating and air treatment	20 years
	Ductwork	20 years
	Electrical installations	30 years
	Lighting fittings	15 years
	Communications installations and controls	15 years
	Water and disposal installations	25 years
	Sanitaryware	20 years
	Lift and conveyor installations	20 years
Façade	Opaque modular cladding e.g. rain screens, timber panels	30 years
	Glazed cladding/Curtain walling	35 years
	Windows and external doors	30 years

Table 5: Default Life Span assumptions

2.3 Scope of assessment

The following building element and category (where applicable) were included in the assessment of the proposal.

Building element group	Building element (NRM level 2)
0.Demolition	0.1 Toxic/hazardous/contaminated material treatment
	0.2 Major demolition works
0.Facilitating works	0.3 & 0.5 Temporary/enabling works
	0.4 Specialist groundworks
1 Substructure	1.1 Substructure
2 Superstructure	2.1 Frame
	2.2 Upper floors incl. balconies
	2.3 Roof
	2.4 Stairs and ramps
	2.5 External walls
	2.6 Windows and external doors
	2.7 Internal walls and partitions
	2.8 Internal doors
3 Finishes	3.1 Wall finishes
	3.2 Floor finishes
	3.3 Ceiling finishes
4 FF&E	4.1 Fittings, furnishings & equipment incl. building-related*
5 Building services/MEP	5.1–5.14 Services incl. building-related*
6 Prefabricated Buildings and Units	6.1 Prefabricated buildings and building units
7 Work to Existing Building	7.1 Minor demolition and alteration works
8.External works	8.1 Site preparation works
	8.2 Roads, paths, paving and surfacing
	8.3 to 8.8 Fencing, railings and walls

** Building-related items: building-integrated technical systems and furniture, fittings and fixtures built into the fabric or included in the shell and core specification. Building-related MEP and FF&E typically include the items classified under Shell and Core and Category A fit-out.

** Non-building-related items: loose furniture, fittings and other technical equipment like desks, chairs, computers, refrigerators, etc. Such items are usually part of Category B fit-out. Therefore, for Shell and Core construction this is not part of the assessment scope.

2.4 Whole Life-Cycle Assessment

2.4.1 Initial Early Design Assessment results

The Initial Early Design Whole life-cycle carbon emissions of the proposed design are: 82,130 tonne CO2e, this is over the 60 years assumed life span of the development.

Over 60% of the emissions are consumed at Practical Completion with building structure and façade being the key sources of emissions, during the life cycle of the building, frequently replaced building component will account for the 'life cycle stage' emissions and building service will account for the highest life-cycle material carbon emissions due to the assumed two replacements at year 20 and 40.

	Carbon at Practical Completion (TCO_2e)	[B2-B5] Life Stages Impacts (TCO_2e)	**[C1-C4] EoL impacts** (TCO_2e)	**Whole Life Carbon** (TCO_2e)
1.0 Substructure	**11,630**	290	2,510	**14,420**
2.1 Frame	**11,650**	0	750	**12,400**
2.2 Upper Floors	**580**	0	50	**630**
2.3 Roof	**2,760**	1,150	160	**4,060**
2.4 Stairs and ramps	**1,200**	80	20	**1,310**
2.5 External walls	**5,750**	1,250	40	**7,050**
2.6 Windows and external doors	2,280	2,300	20	4,590
2.7 2.8 Internal Walls and Partitions and doors	1,980	2,030	40	4,050
3.1 Wall Finishes	**1,050**	1,070	20	**2,150**
3.2 Floor Finishes	**940**	1,880	40	**2,860**
3.3 Ceiling Finishes	**2,860**	5,750	10	**8,620**
5 Services	**6,140**	10,760	60	**16,960**
8 External Works	**1,210**	0	0	**1,210**
Demolition and temporary work	**1,820**	0	0	**1,820**
Total tonne CO2	**51,850**	**26,560**	**3,720**	**82,130**
Total CO2/m2 GIA	**1,067**	**547**	**97**	**1,690**

Table 6: Initial Early Design Whole Life-Cycle Carbon Emissions

The operational emissions will be about 1,744 kg CO2e/m2 GIA based on the energy assessment (including regulated and unregulated emissions), this means the life-cycle material and operational emission are almost equal. This demonstrated the importance to equally emphasis on material carbon reductions, in order to effectively reduce life cycle emissions of buildings.

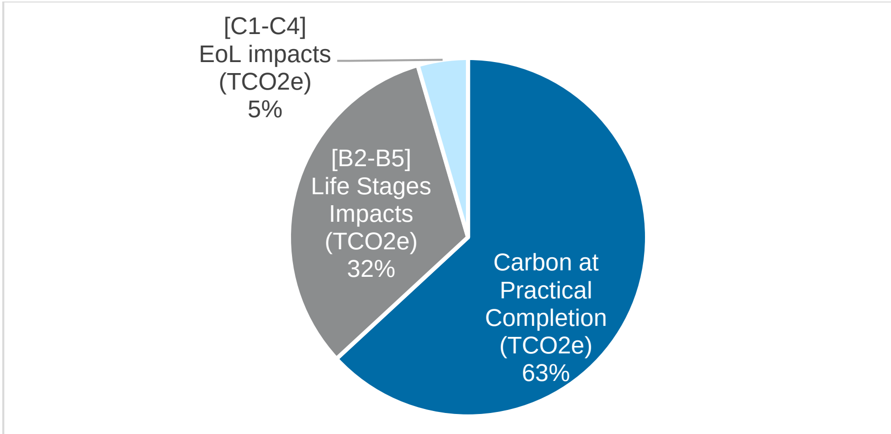


Table 7: Whole Life-Cycle Carbon Breakdown

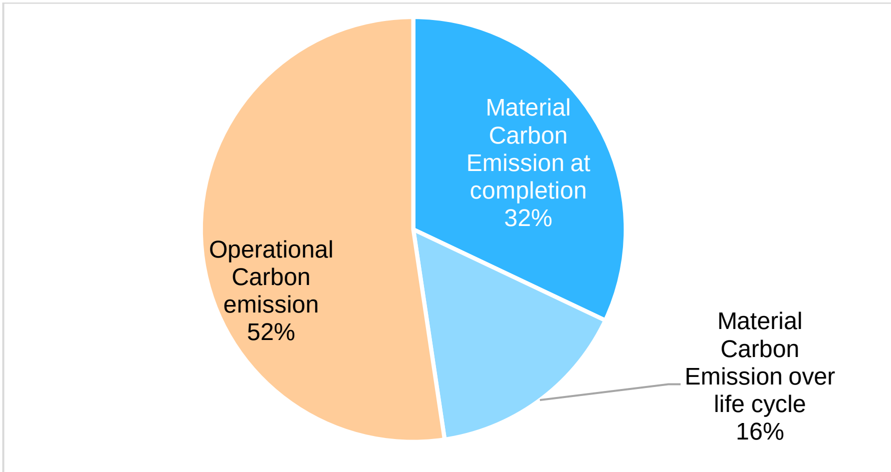
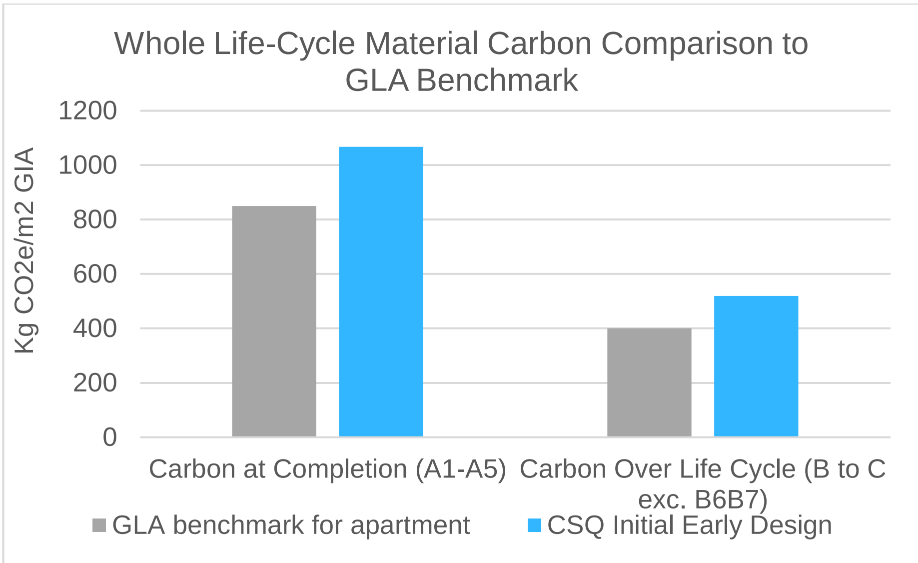


Table 8: Initial Early Design Material and Operational Whole Life-Cycle Carbon emission comparison

2.4.2 Comparing to GLA benchmark



Due to the complicated site conditions, the development baseline carbon emissions, when comparing to the GLA benchmark for residential buildings, are about 26% higher at completion and the life cycle emissions are over 30% higher. Therefore, a series of carbon reduction options have been investigated in order to reduce the life cycle carbon emissions.

2.4.3 Whole Life Carbon Reduction options studied

The result from the baseline assessment has indicated the carbon 'hotspots' and a series of carbon reduction options were investigated amongst the design team in order to reduce the life cycle carbon impact, the following options have been incorporated into the Proposed Development.

- Superstructure Concrete to have > 50% GGBS cement replacement
- Substructure Concrete to have > 70% GGBS cement replacement
- Raft foundation in lieu of piled foundation
- Heavy building component like Brickwork, concrete and stone to be locally sourced where possible
- Change from 250mm concrete slab to 225mm slab
- Change aluminium window frame to timber combi frame
- Change to hand laid brick to remove precast concrete
- Lower carbon specification of ceiling finishes
- Internal wall /door assumed to not require replacement as they will be owned individually by lease holders.

	Carbon at Practical Completion (TCO_2e)	[B2-B5] Life Stages Impacts (TCO_2e)	**[C1-C4] EoL impacts** (TCO_2e)	**Whole Life Carbon** (TCO_2e)
1.0 Substructure	**7,430**	290	1,260	**8,980**
2.1 Frame	**9,280**	0	700	**9,970**
2.2 Upper Floors	**440**	0	50	**490**
2.3 Roof	**2,390**	1,150	160	**3,700**
2.4 Stairs and ramps	**460**	80	10	**560**
2.5 External walls	**4,100**	1,250	40	**5,400**
2.6 Windows and external doors	**1,770**	1,780	20	**3,570**
2.7 2.8 Internal Walls and Partitions and doors	**1,980**	0	40	**2,030**
3.1 Wall Finishes	**920**	940	20	**1,870**
3.2 Floor Finishes	**940**	1,880	40	**2,860**
3.3 Ceiling Finishes	**1,580**	3,200	20	**4,790**
5 Services	**6,140**	6,970	60	**13,160**
8 External Works	**1,210**	0	0	**1,210**
Demolition and temporary work	**1,820**	0	0	**1,820**
Total tonne CO2	**40,460**	**17,540**	**2,420**	**60,410**
Total CO2/m2 GIA	**833**	**361**	**50**	**1,243**

Table 9: Planning Design Whole Life-Cycle Carbon Emissions

Due to the complex nature of the development, the baseline emissions are higher than the recommended GLA benchmark values for residential buildings, however, with the team's design intervention and the options adopted, the proposal has successfully reduced the carbon footprint by more than 20% and the carbon at completion is now below the benchmark (833 vs 850) with life cycle emissions slightly over (413 vs 400). This is normal at early stages of design, within the detailed design stage when specification is developed and material warranty confirmed, further reductions could be expected and will enable the development to be lower than the benchmark.

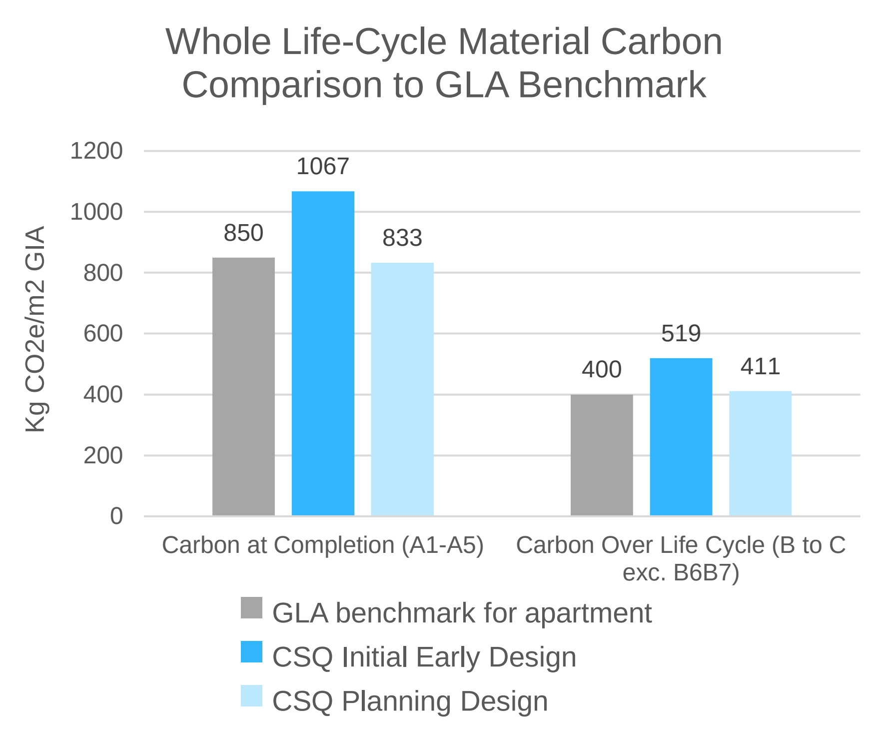


Table 10: Planning Design Whole Life-Cycle Material Carbon emission comparison

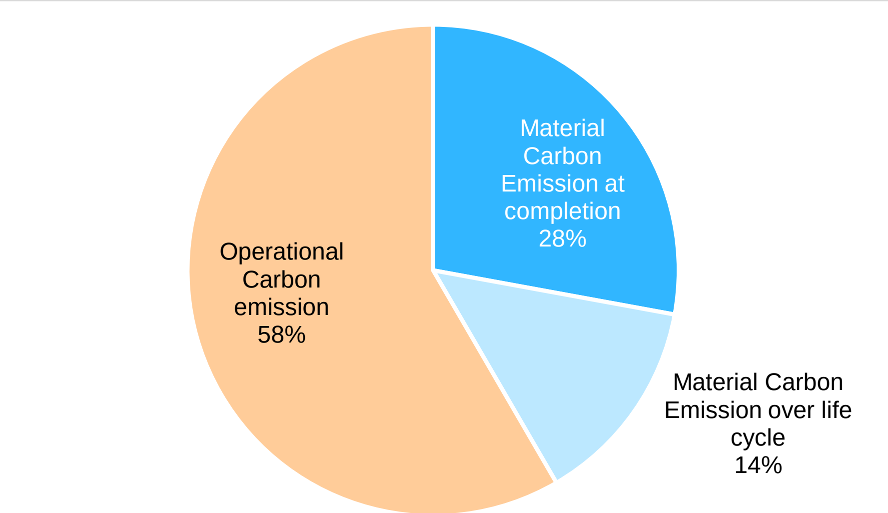


Table 11: Planning Design Material and Operational Whole Life-Cycle Carbon emission comparison

2.5 Further reduction options under investigation

The Client is committed to further reducing the development's whole life carbon by investigating feasible design options during the detailed design, procurement and construction stages. The following options are currently being discussed amongst the team and will be confirmed during the detailed design stages. The whole life-cycle carbon benefit will be summarized in the post-competition carbon update.

#	Options/Building Elements	Specification
1	Change from timber formwork to plastic/steel formwork	Plastic formwork could be reused for more than 100 times compare to 3 times for timber ones, especially for projects with repetitive areas
2	Top floors from in-situ concrete to CLT floor with steel support system (7165m2)	260thk CLT panel steel frame tonnage 40kg/m2
3	Change all other floor to CLT with steel support system	260mm Cross Laminated floor supported by 40kg/m2 steel frames
4	Drylining to use timber studwork	Change from (70mm C-stud) to 50x70 timber stud.
5	Better plasterboard	Use better plasterboard like Fermacell which is made from recycled gypsum and recycled paper fibres
6	Acoustic insulation for drylining	Change from rockwool insulation to sheep wool
7	Soft flooring	Change from carpet to cork flooring
8	Sitework	Using renewable energy (i.e. biodiesel and renewable electricity etc.) to reduce carbon emissions during construction

Table 12 Whole Life Cycle Carbon calculation of alternative Designs and Scheme Evolution

At the start of the project, the Client did not have a pre-determined view in terms of what form of development the proposals should take. Indeed in the first instance more light touch schemes were considered, including refurbishment only and refurbishment & extension schemes. However, following a comparison of these with more whole-scale redevelopment it was considered that these would result in significant missed opportunities in terms of providing an exemplar form of urban development which crucially would result in a wide range of public benefits for the wider neighbourhood.

High-level Whole Life-Cycle calculation of alternative designs were carried out to compare the environmental performance of the schemes.

4 options were assessed, key design information are listed below, more details of the schemes can be found in the design and access statement.

	Doing nothing	'Light touch' Refurbishment scheme	Refurbishment and Extension scheme	New Development Scheme
Upgrades to Existing Fabric	None	Light fittings Floor finishes Painting	Extend existing fabric of Cundy Street Flats and Walden House to increase area of some of the current units	As per Planning Design
Assumption of Material Carbon:	None	Floor finishes same as new build and 5% for wall and ceiling finish 10% of MEP	20% embodied carbon of structure and same embodied carbon for finishes and MEP	As per Planning Design
Life Cycle material impact assumption	The maintenance and repair carbon (module B) are typically higher in a refurbishment. there is no clear guidance on this but it would be expected that would be safe to include a least a 10% uplift. In terms of end of life, Again there is no clear guidance on this but it would be reasonable to include least a 25% saving for this, assuming it is allowed in the design.			As per Planning Design
WLC Material Emissions (KgCO2e/m2)	460	494	803	1,243

	Doing nothing	'Light touch' Refurbishment scheme	Refurbishment and Extension scheme	New Development Scheme
Operational energy assumption	Existing gas boiler system	Lighting upgrade Assume 10% reduction of electricity consumption	Building fabric upgrade to Part L1/2B New central Heat Pump Lighting upgrade Removal of gas connection Assume 60% reduction of energy consumption	As per Planning Design – Part L output
Regulated Operational emissions - (KgCO2e/m2) over 60 years*	3,592	3,409	1,399	598

*Does not account for predicted national grid decarbonisation

Table 13: WLC assumptions and results of each design options

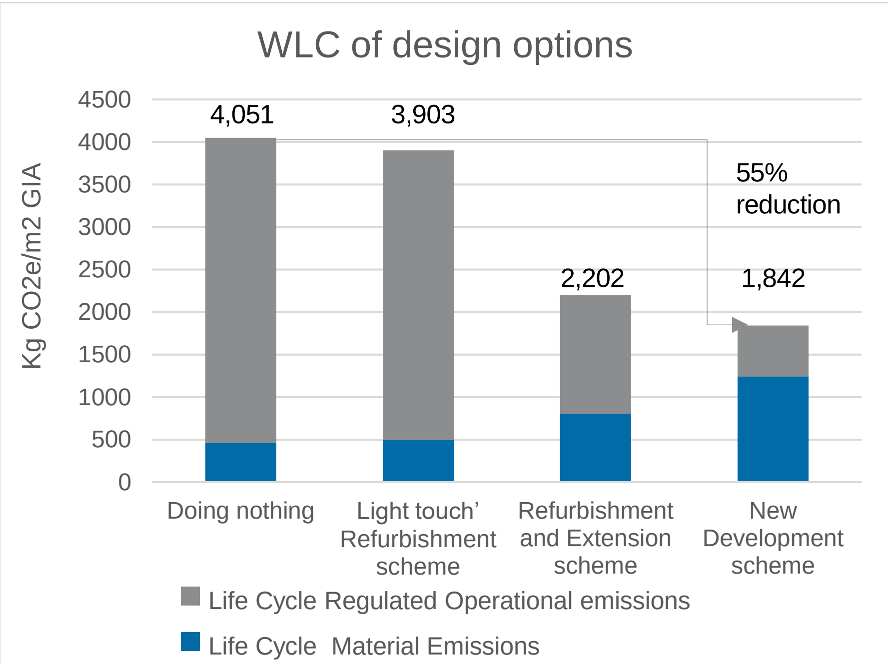


Table 14: Overall Life Cycle Carbon emissions comparison

The graph in table 14 compared the Whole Life-Cycle emissions of each design option that combines both operational and material carbon emissions, the 'doing nothing' and 'light touch option' are obviously low in terms of material embodied carbon as less modifications are needed, however, these have also resulted in higher operational emissions and the overall Whole Life Cycle emissions are much greater than the other options.

The increased modification to the building fabric (Refurbishment and Extension and New Build) will result in higher material carbon emissions but the life cycle emissions are significantly lower due to the much-improved operational emissions.

The table below plotted the aggregated yearly carbon emissions of the design options, it is a useful way to identify the carbon emission positions of each design option. It was clear that the overall emission of light touch options will surpass the other options around year 16-17. When comparing refurbishment and new development options, the carbon 'pay back' period of the new build option will be about 30-35 years.

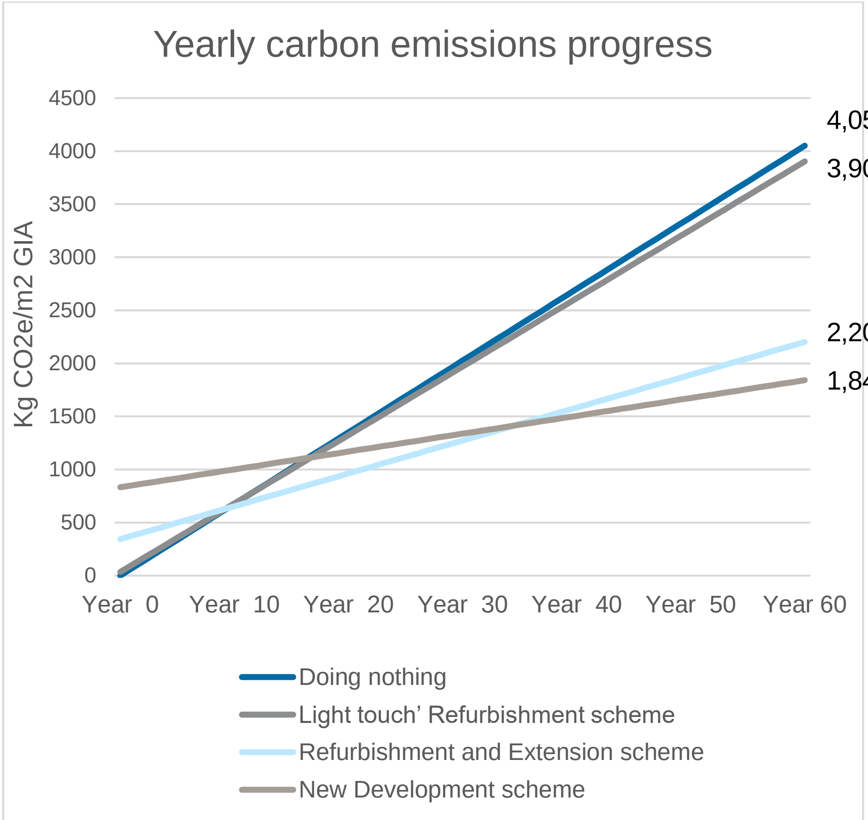


Table 15: Overall Life Cycle Carbon emissions comparison

Cundall Johnston & Partners LLP
One Carter Lane London EC4V 5ER United Kingdom Tel:+44 (0)20 7438 1600
Asia Australia Europe MENA UK and Ireland
www.cundall.com

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