Revised Energy Strategy

Camden Goods Yard

On Behalf Of St George West London Ltd

Date: 06th July 2020

Contents

1. Revision History

Revision	Issue Date	Description	Issued By	Checked By
A	24.04.2020	Initial Draft	CC	
B	04.05.2020	Internal review	CC	SJC
B	05.05.2020	First draft for comment	CC	AP
C	08.06.2020	Second draft for comment	CC	SJC
D	23.06.2020	Final Draft	CC	SJC
E	06.07.2020	Final Issue	CC	SJC

Calculations contained within this report have been produced based on information supplied by St George West London Ltd and the design team. Any alterations to the technical specification on which this report is based will invalidate its findings.

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2. Executive Summary

This Energy Strategy has been prepared to accompany an S73 application for the proposed development at Camden Goods Yard. The site has been approved for redevelopment through an earlier 2018 planning application, which was amended pursuant to a s73 application of 5 May 2020. This document seeks to clarify further changes made to the approved May 2020 scheme, in order to optimise the site, improve carbon emissions and minimise energy use.

This document seeks to establish the revised emissions predictions for the development, and to demonstrate an improvement to those outlined within the original planning consent. Where applicable, compliance with recent policy and guidance changes, that have been adopted since the original grant of planning consent, has also been evaluated for feasibility.

The general energy strategy approach is broadly similar to the consented scheme, with ASHPs used, in conjunction with gas fired boilers, to fulfil the site energy demand. However, significant optimisation has occurred, which has resulted in an increase in the energy and carbon savings predicted at each stage of the energy hierarchy. Where feasible, alterations have also been incorporated in order to bring the proposals in line with the latest energy planning guidance, and emerging policy requirements of the draft new London Plan.

The revisions include additional demand reduction measures, to improve the inhrent energy efficiency of the scheme, which has resulted in the 'Be Lean' performance improving to a 13% site-wide improvement over the calculated baseline. High-efficiency heat pumps, gas boilers and photovoltaic arrays are also proposed in order to reduce site emissions further, resulting in total predicted emissions 40% lower than the Part L target baseline, which exceeds the requirements of the both the applicable and latest policy and guidance.

This is also a significant improvement over the 27% reduction outlined within the extant permission. However, it must be understood that these are not diretly comparable owing to the change in quantity, design and assessment method to reflect the latest GLA and Camden requirements.

The following tables and graphs detail how the revised design performs against the stages of the energy hierarchy, formatted to the requirements of the Greater London Authority.

Residential

Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	673	359
After Energy Demand Reduction	608	359
After DHN/CHP	608	359
After Renewable Energy	387	359

Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	65	10
Savings from DHN/CHP	0	0
Savings from renewable energy	221	33
Cumulative savings	286	42
Annual savings from offset	387	N/A
Cumulative savings from offset	11,610	N/A

Non-Residential

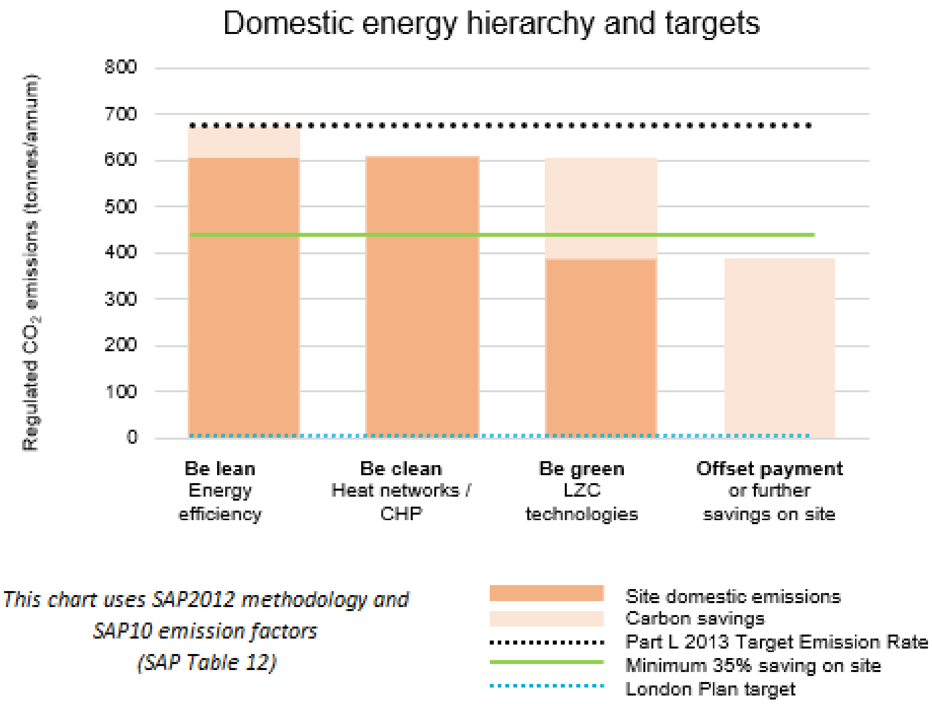
Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	389	196
After Energy Demand Reduction	321	196
After DHN/CHP	321	196
After Renewable Energy	253	196

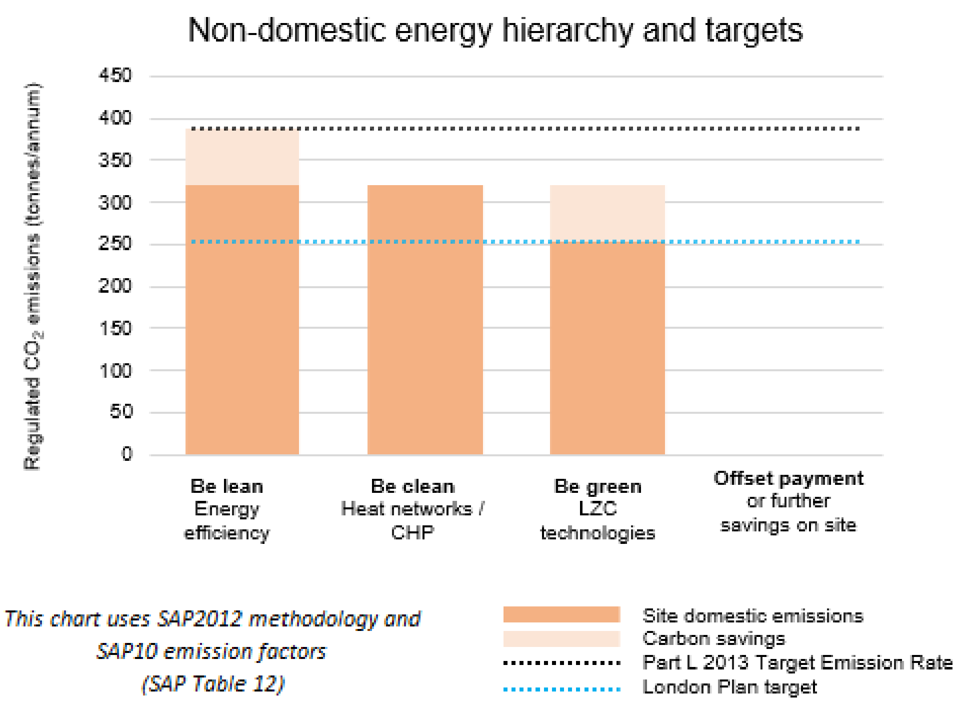
Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	68	18
Savings from DHN/CHP	0	0
Savings from renewable energy	68	17
Cumulative savings	136	35

Site-Wide

Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	1062	555
After Energy Demand Reduction	929	555
After DHN/CHP	929	555
After Renewable Energy	640	555

Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	133	13
Savings from DHN/CHP	0	0
Savings from renewable energy	289	27
Cumulative savings	422	40
Annual savings from offset	387	N/A
Cumulative savings from offset	11,610	N/A


Domestic energy hierarchy and targets
Regulated CO_2 emissions (tonnes/annum)
800
700
600
500
400
300
200
100
0
Be lean
Energy efficiency
Be clean
Heat networks / CHP
Be green
LZC technologies
Offset payment
or further savings on site
This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)
Site domestic emissions
Carbon savings
Part L 2013 Target Emission Rate
Minimum 35% saving on site
London Plan target


Non-domestic energy hierarchy and targets
Regulated CO_2 emissions (tonnes/annum)
450
400
350
300
250
200
150
100
50
0
Be lean
Energy efficiency
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Offset payment
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This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)
Site domestic emissions
Carbon savings
Part L 2013 Target Emission Rate
London Plan target

3. Introduction

3.1. Purpose of this statement

This Energy Strategy has been prepared to accompany an S73 application for the proposed development at Camden Goods Yard. This document seeks to clarify the changes made to the approved scheme in order to further reduce carbon emissions and minimise energy use.

Planning permission was granted 15th June 2018 for the redevelopment of the existing Morrisons supermarket, surface car park and Petrol Filling Station (PFS) (ref. 2017/3847/P) – to be referred to as the 'extant scheme'. The approved development would deliver 573 new homes and circa 39,500 sq m GEA of non-residential floorspace, including a replacement supermarket, replacement PFS and new A1, A3, B1, D2 and SG floorspace, together with associated public realm and landscaping. This permission was amended on 5 May 2020 via a s73 application, and all reference to the 'approved scheme' within this document is with reference to the amended, approved May 2020 permission.

This current application is for an optimisation of the approved May 2020 scheme. The 'optimisation scheme' makes amendments to predominantly to Blocks A, B, C and F, including inserting additional storeys as a result of reducing floor-to-ceiling heights, as well as alterations to floorplans and reconfiguration of internal layouts. The scheme will deliver 71 additional homes, for a total of 644 new homes. Commercial floorspace will remain largely unchanged.

This document seeks to establish the revised emissions predictions for the development, and to demonstrate an uplift to those outlined within the original planning consent. Where applicable, compliance with recent policy and guidance changes that have been adopted since the original grant of planning consent have also been evaluated.

This statement shall set out the applicable policies on energy for proposed scheme, as well as the methodology for, and results from, an Energy Assessment.

It contains CO_2 emissions assessment in line with the guidance set out by the planning authority and shall detail the energy efficiency measures and low carbon technologies proposed within the design.

The Strategy will demonstrate measures taken by the Applicant to comply with:

i) National Planning Policy Framework.

ii) The London Plan (Greater London Authority, 2016) planning policies 5.2 to 5.7 and 5.15 on climate change mitigation measures to:

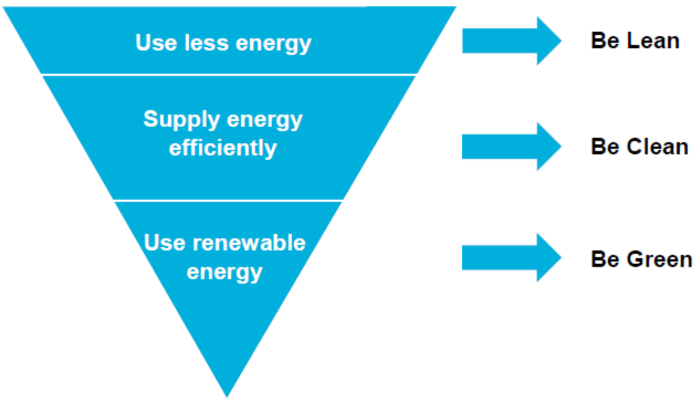
- Achieve a minimum 35% on-site reduction in CO_2 emissions over Approved Document Part L (AD L) 2013 for all major, domestic and non-domestic development.
- Achieve the zero carbon homes standard in full on all major developments and, where this cannot be achieved on site, a commitment to offset the shortfall in CO_2 emissions through a carbon offset payment.
- Evaluate the viability of decentralised energy in accordance with the following hierarchy: 1) connection to existing heating or cooling networks, 2) site-wide CHP network and 3) communal heating
- Design domestic development so that mains-water consumption meets a target of 105 litres or less per person per day (excluding an allowance of 5 litres or less per person per day for external water consumption).

iii) Energy Planning, Greater London Authority guidance on preparing energy assessments (March 2016).

iv) Local Planning Policy requirements (e.g. Policy CC1/CC2)

In addition, guidance released by the GLA in October 2018 shall also be considered within this report, along with additional requirements of the Intend to Publish London Plan. Compliance with these documents shall be demonstrated where feasible within the constraints of the design and original planning consent.

The way in which the Applicant incorporates climate change mitigation measures and meets the CO_2 reduction target will be explained in line with the London Energy Hierarchy:



- **The Baseline:** The Development's baseline energy demand, the Target Emission Rate (TER): This will be calculated to establish the minimum on-site standard for compliance with AD L 2013. The baseline is calculated using a mains gas heating system.

- **Be Lean:** The Development's Building Emission Rate (BER)/Dwelling Emission Rate (DER) will be calculated to explain how the Applicant's design specification has led to a reduced energy demand and an improved fabric-energy efficiency. The better the design of the building fabric in terms of, for example, insulation, air tightness and orientation to maximise solar gain, the less energy required to heat the dwelling and so the better the fabric energy efficiency.
- **Be Clean:** The potential to provide energy to the development in an efficient way, by either connecting to a District Heat Network (DHN) or installing on-site Combined Heat and Power (CHP), will be assessed and viability concluded.
- **Be Green:** Low-carbon and renewable energy technologies will be assessed for their suitability and viability in relation to the Development. Solutions will be put forward for the development and the resulting CO_2 emission savings presented.
- **Carbon Offset:** Where it is demonstrated that the energy target for the Development cannot be met onsite then any shortfall in CO_2 emissions reduction will be offset through a mechanism agreed in consultation with the Local Planning Authority.

In presenting this information the Energy Statement demonstrates that the proposed development will fully satisfy the applicable planning policies relating to energy conservation, regulated building emissions and renewable energy.

3.2. Calculation Methodology

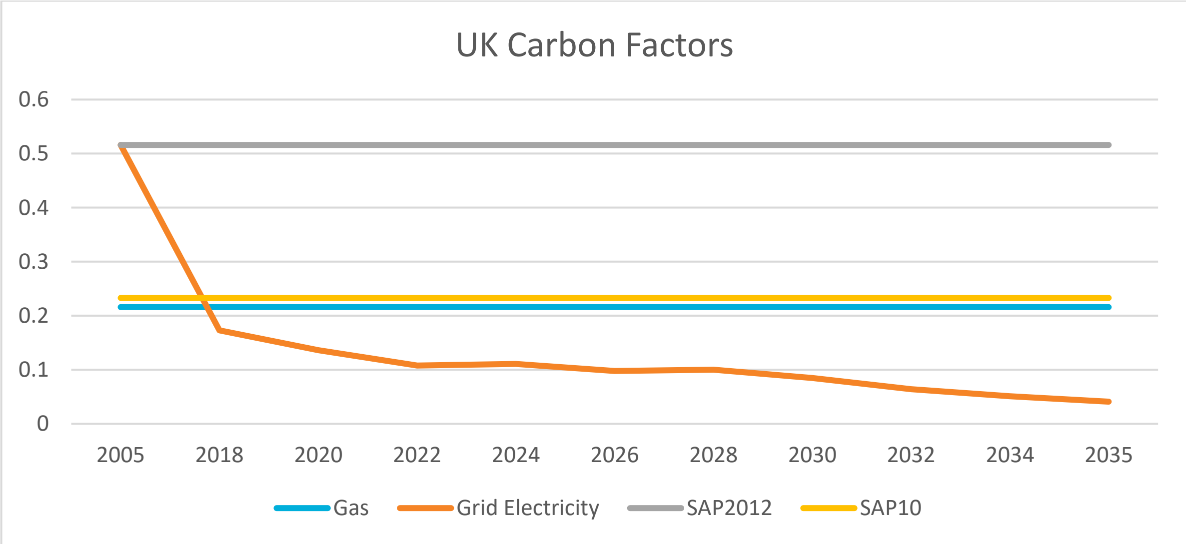
The Energy Assessment undertaken follows the detailed methodology set out within the Greater London Authority (GLA) guidance document "Energy Planning – GLA guidance on preparing energy assessments". It references the 2016 and 2018 versions of the guidance, owing to the extant planning permission requiring compliance with the 2016 requirements, and the aim of the developer to meet the targets outlined by the latest guidance, as far as the constraints of the approved scheme shall allow.

As such, the scheme has had its regulated energy demand and emissions for the homes calculated using the Standard Assessment Procedure (SAP) 2012. This is the Government's approved tool for assessing regulated carbon emissions from homes and is used to demonstrate compliance with the Building Regulations Part L: Conservation of Fuel and Power. The non-residential spaces have been assessed using dynamic simulation software IES:VE, which is an approved tool for assessing non-residential buildings for Part L compliance.

These emissions have then been manually converted in order to account for revised fuel carbon factors outlined by the GLA (SAP10), which is meant to better reflect the emissions of the building over its lifetime. The calculations have been undertaken within the approved conversion calculator published by the GLA, and is included as appendix I.

The following graph details the recent and predicted changes to the 'real-world' electricity carbon intensity, compared to the assumptions of SAP 2012 (data from BEIS). The disparity between the calculation carbon factor, and the 'real' carbon factor. This is the primary reason for the GLA introducing this change. It should also be noted that the SAP10 carbon factors are also being continuously revised, and the latest data indicates a grid carbon intensity closer to 0.136, which is approximately 40% lower than the SAP10 estimates, and 75% lower than the SAP2012 factors. However, despite this, the GLA have mandated the SAP10 figures to be used in order to allow comparison between developments.

Unless otherwise stated, all emissions figures detailed within this report have been converted to SAP10, per the latest GLA guidance.



Owing to the current review of the building regulations, the regulatory method for compliance with Part L is still linked to the SAP2012 calculation. Therefore, an appendix has been prepared in order to demonstrate that compliance with SAP2012 shall still be met. This is provided as appendix C of this report.

It should be noted that the compliance methodology was produced with the sole intention of demonstrating compliance with the Building Regulations Part L. As such, standardised assumptions are made regarding building occupancy, use, conditioning setpoints etc. It is therefore important to note that they are intended to be used on a comparable scale, rather than give accurate predictions of real energy use. The results herein are provided solely for the purposes of demonstrating compliance and are not envisioned as an accurate prediction of operational energy use.

The energy calculations have been undertaken by an accredited Energy Assessor, licensed to use all applicable assessment software's.

4. Establishing the Baseline Emissions

The SAP calculations have been undertaken to assess regulated energy use, accounting for energy demands from space heating and hot water, and electricity for pumps, fans and lighting. A separate calculation has been completed for unregulated energy demand.

The TER is the maximum permitted emissions for the development, and is expressed in $kgCO_2/m^2$. Thus, the total baseline emissions are the product of the TER and the total floor area, calculated separately for the residential and non-residential portions of the site.

The unregulated emissions can be estimated using BREDEM-12. However, since the developer has no control over this aspect of energy use, no energy saving measures can be proposed. Therefore, no change to the unregulated emissions will occur throughout the stages of the energy hierarchy.

The baseline emissions have been calculated in line with GLA guidance. Therefore, the heating is calculated as provided via gas fired boilers, and cooling via electrically powered equipment.

The following tables detail the predicted emissions for the development.

Scenario	CO_2 Emissions (tonnes/CO_2/year)
Residential (regulated)	673
Residential (unregulated)	359
Non-Residential (regulated)	389
Non-Residential (unregulated)	196

Scenario	CO2 Emissions (tonnes/CO2/year)
Site-Wide Total (regulated)	1,062
Site-Wide Total (unregulated)	555

The above regulated figures are deemed the maximum permissible emissions from the development. The following sections detail the measures proposed to reduce this figure as far as practical within the design, in line with the energy hierarchy.

5. Be Lean – Use Less Energy

5.1. Introduction

This section outlines the energy efficiency proposals to minimise energy demand. Performance and savings are assessed against the previously calculated notional baseline emissions.

At an early stage, the design team have explored a range of energy efficiency measures including, enhanced construction details to minimise thermal bridging, high-efficiency specifications, and the use of efficient mechanical ventilation systems.

The London Plan target under the 'Be Lean' policy is to exceed the requirements of Part L:2013 using energy efficiency measures alone.

This requirement has been tightened under the draft new London Plan, in order to target a 10% improvement at this stage for residential uses, and 15% improvement for commercial uses. The original planning consent was granted prior to the release of this guidance and the draft new London Plan is still in draft form, therefore this target is not relevant to the application.

However, compliance with this Draft London Plan policy has been targeted nonetheless by the applicant, in order to demonstrate their commitment to sustainable design and energy demand reduction at the site.

5.2. Thermal Envelope

Fundamental to achieving energy efficiency in any new building is a suitably designed and specified thermal envelope. Passive design features such as appropriate orientation, balancing solar gain and limiting heat loss are all proven techniques to reduce energy consumption. In addition, minimising thermal bridging and controlling air infiltration are important factors.

The following tables illustrate the proposed building fabric performance specification, with respect to the limiting values stipulated in Part L 2013. It is shown that the proposed specification represents a significant betterment of the minimum standards.

Element	Proposed	Minimum	Improvement
External Walls	0.24 W/m²K	0.30 W/m²K	20%
Roofs	0.12 W/m²K	0.20 W/m²K	40%
Ground Floors	0.12 W/m²K	0.25 W/m²K	52%
Separating floors to unheated areas (refuse, cycle stores etc)	0.2 W/m²K	0.25 W/m²K	25%

Separating floors (residential to commercial)	0.1 W/m^2K	0.25 W/m^2K	60%
Air Permeability	4.0 m^3/hm^2	10 m^3/hm^2	60%

Glazing is proposed as a mild solar control glass throughout the development, in order to balance heat loss, daylight provision and overheating. The proposals for Block A contain a relatively large glazed percentage. In order to reduce heat loss through this additional glass, Triple glazing has been specified to all homes in Block A. The proposed Glazing specification can be seen below:

Element	Window U-value	G-Value
Block A Glazing	0.9 W/m^2K	0.45
Other Blocks Glazing	1.3 W/m^2K	0.45
Commercial Spaces Glazing	1.4 W/m^2K	0.45

It is possible that alterations to the above glazing specification shall be made during the detailed design, with higher G-value glass to the north façade where overheating is not generally an issue, and lower G-values to the southern and western façades where limiting solar gains is beneficial. However, this shall need to be investigated thoroughly during the detailed design to ensure the aesthetics and buildability of the proposals are not adversely impacted.

In addition to the primary envelope specification, non-repeating thermal bridging shall play a vital role in reducing energy demand, by ensuring that heat leakage at junctions is kept to a minimum. As a minimum, it is proposed that all junctions shall match or exceed Accredited Construction Details (ACD) standards where possible. Balconies shall be installed with thermal breaks, with a reduced bridging psi value, and parapets shall be wrapped in order to minimise heat loss.

5.3. Building Services

For the 'Be Lean' case, the GLA guidance states that the same heating specifications must be used as per the 'baseline' case. This is so that the improvements from energy efficiency measures alone can be understood.

Therefore, the applicable building services improvements relate to the controls, ventilation, lighting and auxiliary power equipment.

The below tables detail the proposed building services specification for both the residential and non-residential aspects of the scheme.

Residential Services	Specification
Heating System	Communal Gas Boilers
Heating System Controls	Time & Temperature Zone Control
Hot Water System	From HIU
Lighting Systems	100% Low Energy

Ventilation	Mechanical ventilation with heat recovery
Cooling System (where applicable)	High Efficiency (A++ rated) VRF type cooling systems

Commercial Services	**Specification**
Heating System	Communal Gas Boilers
Heating System Controls	BMS with capacity for metering and automatic monitoring and targeting
Hot Water System	From HIU
Lighting Systems	High-efficacy Lighting to all spaces Daylight Dimming to all perimeter zones Presence detection controls to all areas
Ventilation	Mechanical ventilation with heat recovery to all spaces
Cooling Systems	Air Source Chillers - SEER > 3.3

5.4. Be Lean Emissions

The below tables detail the results of the Be Lean assessment

Scenario	**CO_2 Emissions (tonnes/CO_2/year)**	**CO_2 reduction**	**Cumulative CO_2 reduction**
Residential (regulated)	608	10%	10%
Non-Residential (regulated)	321	18%	18%

Scenario	**CO2 Emissions (tonnes/CO2/year)**	**CO_2 reduction**	**Cumulative CO_2 reduction**
Site-Wide Total (regulated)	929	13%	13%

As detailed in the tables above, the passive design proposals demonstrate a vast improvement over the regulatory baseline. The proposals result in savings above and beyond those required by the current London Plan, and meet or exceed the requirements of the draft new London Plan for both residential and non-residential elements. In addition, the proposals report a significant uplift from the approved scheme.

The above results demonstrate the applicant's clear commitment to sustainable design and ensures compliance with the relevant current and emerging planning policies, relative to demand reduction in development.

6. Summertime Overheating

6.1. Introduction

Effects of overheating have been well documented over recent years, often cited to result from climate change and modern materials and construction techniques.

Although guidance exists across the industry to forecast the risk of overheating, design considerations are often required at concept stage to provide adequate mitigation.

For new-build construction projects, reducing the risk of overheating should be given consideration at the earliest possible opportunity. Although certain measures can be incorporated at later stages, the most robust and effective techniques are often inherent to a buildings design.

The 'cooling hierarchy', referred within Policy 5.9 of The London Plan indicates the preferred approach to reducing overheating risk and a reliance upon mechanical cooling. The hierarchal steps are:

1. Minimise heat generation through energy efficient design.
2. Reduce the amount of heat entering a building in summer.
3. Manage the heat within the building through exposed thermal mass and high ceilings.
4. Passive ventilation.
5. Mechanical ventilation

6.2. Proposed mitigation strategy

A dynamic thermal model has been constructed to support this Energy Statement, and an overheating risk analysis undertaken.

A detailed overheating assessment report has been submitted in support of the application, which indicates that overheating risk has been reduced in line with the London Plan cooling hierarchy

- The heat network design shall comply with 'CIBSE CP1: Heat networks code of practice', and steps shall be taken in order to minimise heat losses from pipework to the surrounding environment. This is important for both mitigating overheating risk, and reducing operational carbon emissions. LED lighting shall also be specified throughout in order to reduce the gain from lighting systems, and energy efficient appliances specified where provided

- A relatively low glazing g-value of 0.45 has been specified in order to reduce solar gains. This has been selected after considerable investigation as a good balance between heat loss, overheating mitigation, and daylight provision. In addition, shading shall be provided to homes by way of overhanging balconies, and many commercial spaces benefit from recessed windows, overhangs, and shading from other blocks. In addition, spaces that are highly glazed for aesthetic purposes, such as the Block A concierge at the entrance to the development, have been designed with a northern orientation, in order to minimise cooling demands to these spaces

- Many residential spaces benefit from high ceilings on order to reduce overheating risk, with some homes up to 2.7m and no home under 2.5m. This is noted as good practice and allows heat to collect at high level, away from occupants. Many commercial spaces are double height in order to provide the same benefits, and most non-residential spaces report a ceiling height >3.0m. Owing to the lightweight frame design within the approved strategy, the opportunity for exposing thermal mass is limited, commercial spaces are shell and core, and therefore the developer will not have the ability to mandate the final finish, however, commercial tenants will be encouraged to adopt exposed mass solutions, in order to reduce the cooling demand.

- All residential spaces shall have openable windows in order to purge heat. These have been designed as large openings or Juliet balconies to maximise the rate of heat purge when open

- All residential spaces shall also be provided with mechanical ventilation with heat recovery. These systems shall incorporate a summer bypass in order to allow a degree of free cooling during the summer.

6.3. Residential Cooling

Certain residential spaces are designed with comfort cooling per the extant scheme. However, the cooling demand has been minimised by the adoption of passive mitigation measures. The cooling proposals shall also use the latest VRF-style heat pump technology to deliver the cooling, reporting energy efficiency ratios as high as 6.0, which is a significant improvement form the approved scheme.

From the SAP results undertaken, it is calculated that the regulated emissions from the residential cooling systems shall amount to an average of 9Kg/CO_2 per home per year. This shall amount to <5 tonnes/CO_2/year for all cooled homes, which amounts to just 0.7% of the residential baseline emissions, and <0.5% of the total site baseline emissions.

In line with the extant planning permission, it is demonstrated that the residential cooling shall have a negligible impact on the regulated emissions for the development, and that the regulated energy and carbon impact of the inclusion of residential cooling should be treated as non-material.

6.4. Non-residential Cooling

Commercial spaces are also to be provided with cooling. The actual cooling demand from the compliance calculations is shown in the tables below and has been reduced 18% less than that of the notional target building. This exceeds the requirements of the London Plan cooling hierarchy and guidance issued from the GLA.

	Notional Building	Actual Building	Reduction
Site-Wide Cooling Demand	221.8 MJ/m²	181.9 MJ/m²	18%

At this stage, it is not possible to provide a breakdown per building zone of actual vs cooling demand, since the internal arrangements for many buildings are yet to be finalised, and the majority will be down to the fit-out contractors. Therefore, the results have been presented on a site-wide basis, the same process used to model the site within the compliance software.

Whilst the above results demonstrate compliance with local and regional policy. Additional investigations shall also be undertaken during the detailed and technical designs of the buildings, in line with BREEAM HEA04 requirements. This shall ensure that tailored bespoke solutions to reduce cooling demand for each building use are investigated and incorporated.

7. Be Clean – Supply Energy Efficiently

7.1. Introduction

Steps have been taken by the Applicant to reduce the energy demand of the Development as far as is feasible.

The next step in the energy hierarchy is to consider how the remaining energy demand can be met and whether there is the potential for this to be done through the mechanism of establishing and/or linking up with existing or planned decentralised energy systems.

To ensure compliance with the London Plan energy hierarchy, the potential to supply energy efficiently to the development at Camden Goods Yard, and further reduce regulated CO_2 emissions through Be Clean measures, has been evaluated.

7.2. Policy Drivers

The London Plan (2016) Planning Policy 5.6 sets out:

…For 25% of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025…

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

***B** Major Development proposals should select energy systems in accordance with the following hierarchy:*

- *Connection to existing heating or cooling networks*
- *Site wide CHP network*
- *Communal heating and cooling*

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

The draft new London Plan broadly follows this same hierarchy, however has removed the requirement to evaluate CHP, owing to concerns with regard to air quality, and poor environmental performance.

In place of the above, the draft London Plan, and latest guidance from the GLA, outlines the following heating hierarchy:

1. ***Connection to an area wide heat network***

   Where proposed developments are located near to existing or planned networks, connection must be prioritised.

2. ***Communal Heating System***

   Site-wide heat network
   Where proposed developments are located in areas of decentralised energy potential, but no heat networks currently exist or are planned, developers should provide a site-wide heat network served by a single energy centre to future proof the development for easy connection to a wider heat network in the future.

   Building-level heating system
   Appropriate for single building applications or low-density developments with residential blocks, where no district heating networks are planned or feasible.

3. ***Individual Heating System***

   Appropriate for low density individual housing, where no district heating networks are planned or feasible, and where evidence is provided that a site-wide heat network is uneconomic.

   Direct electric heating will not be accepted in the majority of cases as it will not provide any on-site carbon savings in line with the energy hierarchy and it is likely to result in higher energy bills. Direct electric systems are also not compatible with connection to district heating networks.

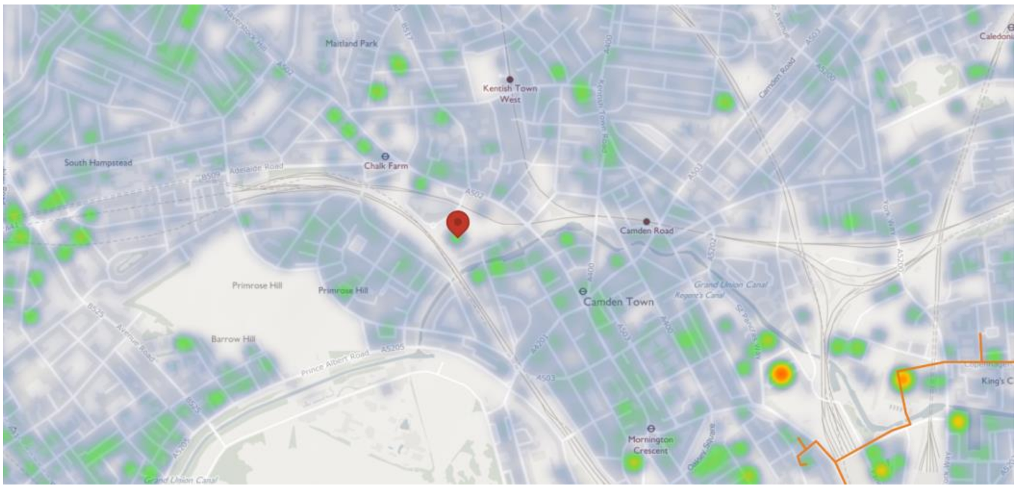
The above hierarchy has been followed in the preparation of the revised energy strategy and proposals, in order to future-roof the design against emerging policy.

7.3. District Heating

Where location and development permits; the opportunity of connecting to existing district heating networks or the creation of new district heating networks should be prioritised. District heating networks have the potential to offer significant energy, carbon and cost savings over localised alternatives, as they often utilise low-carbon energy generation/harnessing technologies such as Anaerobic Digestion (AD), Combined Heat and Power (CHP) and Waste Heat Recovery (WHR). District networks also enable heat loads to be balanced between sites and therefore plant to operate more continuously and efficiently.

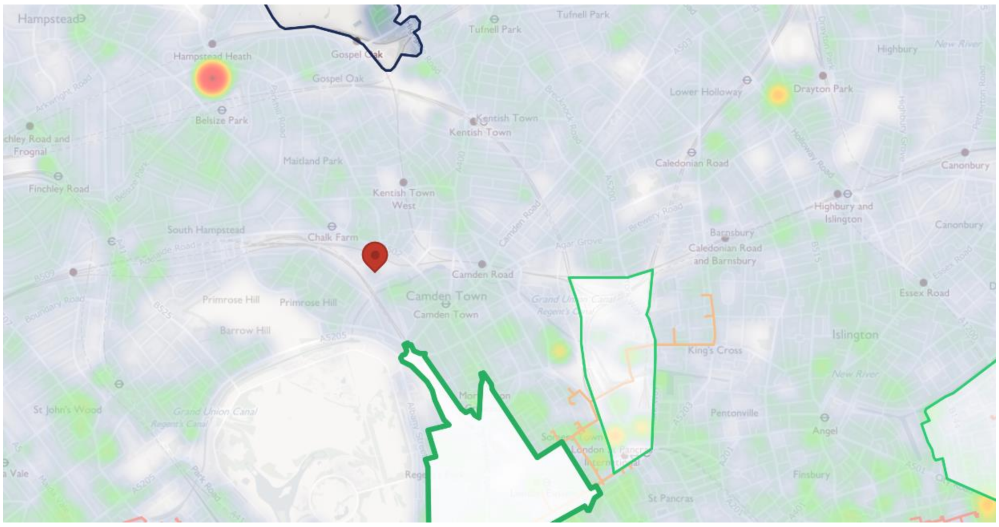
District energy networks are only generally feasible where there is a high density of heat demand. Capital costs and distribution losses must be relatively insignificant to support their viability. Where an opportunity exists, the network operator should be contacted to assess the viability and costs of current or, future connection.

The London Heat Map has been investigated for the development site. This shows there to be no existing or, proposed district heating networks within the vicinity of the development. An excerpt can be seen below:



The nearest proposed network is identified as the Euston Road network, which is not planned for expansion to the development site.

Another excerpt from the London Heat map (below), also confirms that the site does not lie within an identified heat network priority area, or opportunity area.



Additional studies have been carried out by LBC, in order to evaluate the potential for additional district heat networks within the borough. However, at the current time, no district heat networks are in firm development to supply the site location.

Nonetheless, as the development is within an area that could potentially be served by an area-wide network, the design will be progressed to facilitate future connection, should an area-wide network be implemented to the area.

7.4. Combined Heat and Power

CHP was originally proposed for the scheme and would be an economically feasible option to supply the site heating demand. However, this was removed in favour of heat pumps within the original grant of planning, in order to improve air quality and lower site emissions in real terms. In addition, the updated guidance from the GLA, including the revised CO_2 emissions factor for electricity, make CHP unviable in environmental terms.

For these reasons, CHP has not been investigated further within this report.

7.5. Be Clean Summary

Connection to an existing or proposed district heating scheme is not considered a viable option for the development. However, it is feasible that a district scheme may be introduced to the area in the future. Therefore, the design shall incorporate measures to facilitate a future connection, including a single connection point, allowances for required infrastructure within the existing plant room, and designing the communal system in line with CIBSE CP1.

The below tables detail the proposed carbon emissions at this stage of the hierarchy. As there is no district heating scheme available, and CHP is not viable, there are no improvements from this stage of the hierarchy. This is in line with the approved energy strategy, current and emerging policy guidance.

Scenario	CO_2 Emissions (tonnes/CO_2/year)	CO_2 reduction	Cumulative CO_2 reduction
Residential (regulated)	608	0%	10%
Non-Residential (regulated)	321	0%	18%

Scenario	CO2 Emissions (tonnes/CO2/year)	CO_2 reduction	Cumulative CO_2 reduction
Site-Wide Total (regulated)	929	0%	13%

8. Be Green – Use Renewable Energy

8.1. Introduction

The applicant has adopted a fabric-first approach as the priority solution for this development and steps have been taken to reduce energy demand through passive measures and high-quality sustainable design. The planned integration of efficient building fabric and building services has been modelled per the earlier section and is calculated to lead to a site wide improvement of 14% over the baseline emissions.

The next step in the energy hierarchy is referred to as 'Be Green'. To ensure compliance with the Greater London Authority's energy hierarchy, opportunities to supply energy through low-carbon and renewable energy technologies will be assessed for their feasibility and adopted solutions presented.

Renewable energy is defined as energy derived from energy flows that occur naturally and repeatedly in the environment. It may be contrasted with energy sources that can be depleted such as fossil fuels.

Renewable energy technologies, with a couple of exceptions, all utilise energy from the sun – either directly or indirectly, the exceptions being true geothermal, which uses heat from the earth's core, and tidal / marine current electricity generation which uses the gravitational forces between the earth and the moon, (although some marine currents are also greatly affected by solar energy). Insofar as this report is only concerned with practical options for on-site renewable energy, these options are not considered further. The remaining range of "solar" technologies are however vast, and some would not even appear to be solar on superficial inspection. They can be summarised as follows:

- Solar thermal – direct heating of water for space heating or domestic hot water
- Photovoltaic – direct generation of electricity from sunlight
- Hydroelectricity – use of solar (water cycle) driven water flows to generate electricity
- Wind turbines – use of solar driven air movement to generate electricity
- Heat pumps – extraction of solar heat from the earth, atmosphere or water bodies
- Bio-fuels – combustion of solid or liquid bio-fuels to produce heat or electricity

8.2. SELECTED TECHNOLOGIES

The following technologies have been deemed viable for the development and shall be adopted into the design. Further detail of renewable technologies considered, and the reasons for their inclusion or adoption, can be found within appendix B.

Heat Pumps

The communal heating strategy shall be designed in order to utilise heat pump technology. This is in line with the existing approved energy strategy for the site, and is fundamental to the reduction of carbon emissions from the development.

Heat pumps collect low temperature heat from renewable sources and "concentrate" it to a usable temperature. Fossil fuel based (grid) electricity is generally required to operate the pumps and the renewable component of the output is therefore by convention taken as the difference between the output energy and the input energy. A typical heat pump will deliver 3-4 kWh of useful energy for every 1 kWh of input energy. A heat pump operating in this way can therefore be deemed to have delivered 2-3 kWh of renewable energy.

The design shall incorporate 12 air source heat pumps to supply heat from the network. These shall be designed to supply 70% of the annual heat demand, and an SCOP of >2.8 is targeted. The manufacturer has provided calculations and datasheets detailing a SCOP of 3.1, which is provided within appendix E, and the mechanical design team will work with the manufacturer throughout the detailed design to maximise contribution and efficiency of the heat pump units. However, for the purposes of this strategy document, the figure of 2.8 has been used within the SAP calculations in order to ensure that the performance is not overstated.

Heat Network

heat network is based on a low temperature design, instantaneous hot water systems have been selected so that the heat network temperature can be minimised. The aim is to achieve a flow temperature of 65°C and a return of <35°C. An array of ASHPs will be the primary heat source and be connected on the return side (<35°C) before any other heat generation (i.e. gas boilers). The heat pumps, located on the roof, are to be arranged in a cascaded set-up, with 4No. ASHP blocks, with each block raising the temperature of the LTHW by 7.5°C. This will ensure that the heat pump array performs at the highest COP possible. Excess heat will be stored in an array of thermal stores, situated within the energy centre, to be used when heating demand rises above the maximum output of the heat pumps. Gas fired boilers, located in the energy centre, are connected in parallel and will come into operation only when the demand cannot be met by the ASHP and the stored energy in the Thermal Stores.

The energy centre shall also provide cooling to commercial and resident facilities areas located on site, with the utilisation of Cooling Interface units local to each demise. The aim is to achieve a flow temperature of 6°C and return of 12°C.To further increase the efficiency of the energy strategy, the ASHPs providing cooling as well as heating shall be of the heat recovery type. This will ensure that heat rejected into the system by the commercial unit cooling will not be rejected to the atmosphere but reused for LTHW generation.

The Heat pumps shall target an SCOP of >2.8, and a contribution of 70% of the annual heat demand. Gas boilers shall be installed to supplement the ASHPs and allow a high COP to be maintained whilst ensuring the network temperature is kept to the design flow.

Network losses shall be minimised through careful design in line with CIBSE CP1. Where feasible twin pipe configurations shall be used, lateral pipe runs shall be minimised, and extensive insulation used in order to reduce losses to a target of 20%

The following performance figures have been used for the heat network within the energy calculations.

Item	Performance
Gas Boilers	Efficiency 93.9% (Wessex Modumax Mk3)
ASHPs	SCOP – 2.8-3.6 (AERMEC NRK/NRP)
Demand Fulfilment	70% Heat Pumps / 30% Boilers
Network Losses	20%
Temperatures	70/40 at Energy Centre - 65/35 Site Distribution

Preliminary drawings of the heat network distribution and energy centre layout have been provided within appendix D, and product datasheets within appendix E. Please note that the selected plant is preliminary and shall be subject to review during the detailed design of the scheme. However, efficiency targets shall be maintained or improved.

It should be noted that the calculations received from the manufacturer (detailed within appendix E) outline that a SCOP of 3.10 could be achieved. However, the figure of 2.8 has been used within the energy calculations in order to provide flexibility, and avoid overestimating the performance

It is confirmed that all residential and non-residential units shall be connected to the network. Where non-residential units are being designed shell & core, capped connections will be provided in order to ensure that the fit-out contractors can connect to the network for supply of heat and DHW

Cooling

The centralised ASHPs shall be the reversible type, and also used to provide cooling to the non-residential spaces. This shall remove the need for additional commercial chiller plant, which shall increase the amount of roof space available for PVs, reduce maintenance costs, and reduce the overall embodied energy of the required plant. This shall also ensure that the heat rejected into the system by the commercial unit cooling will not be rejected to the atmosphere but reused for LTHW generation.

An efficiency figure (SEER) of 3.3 has been used for the commercial cooling within the calculations.

Where proposed, cooling for the residential homes shall be provided via building-level VRF style heat pumps. These can operate with very high SEER figures (up to 6.0) and have been specified in order to minimise water distribution across the site. This shall reduce the risk of leaks, reduce the required pumping energy, and is considered the most energy efficient option for residential cooling. Owing to the nature of the systems, refrigerant leak detection systems shall be incorporated to all residential cooling systems as best practice guidelines dictate.

Photovoltaics

Photovoltaic panels are conceptually straightforward. The panels produce "zero carbon" electricity that is used in place of grid electricity, and the carbon dioxide emissions saved are the emissions that would have occurred had the electricity been produced by a power station feeding the grid.

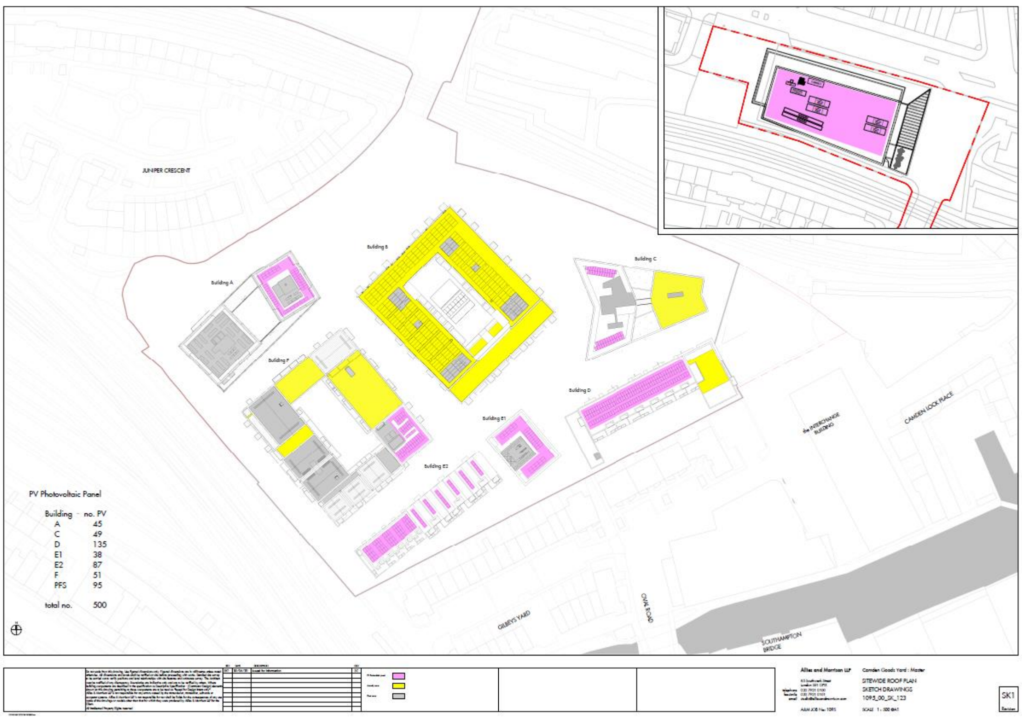
Photovoltaic panels have certain siting constraints. To produce the maximum output, they should face due south, although south-east to south-west is certainly acceptable, and even east or west will be acceptable if the angle of inclination is no more than 20º. When not in direct sunlight, but shaded by obstacles such as adjacent buildings or trees, the output of the affected panel is significantly reduced. As groups of panels are connected electrically in "series" a reduced output from one panel will reduce the output from all the panels in the group. This means that it is particularly important to avoid over-shading. However, photovoltaic panels have many advantages. They are clean, silent, reliable, low maintenance, and are easy to install. They also have a very long life – up to 40 years – which is at least double that typically quoted for other technologies.

The PV proposals for the site have been re-evaluated, as it was noted that the extant scheme has maximised PV provision across the site. The increase in heat pump capacity within the revised proposals had reduced the space available for PV panels within block A. Therefore, a reduction in PV output was expected.

However, following a review of the design, it has been calculated that an upgrade to the specified panel efficiency, along with careful design, should allow the PV proposals for the scheme to be maintained per the approved scheme, despite the ruction in available space for arrays. The below table details the differences in PV provision per block, between the extant scheme and new proposals.

Block	Approved Scheme (kWp)	New Proposals (kWp)
Block A	27.75	17.00
Block B	0.00	0.00
Block C	17.60	15.40
Block D	22.00	38.5
Block E1	13.75	13.75
Block E2	26.95	26.95
Block F	22.55	16.00
PFS	37.40	37.40
Totals	165.00	165.00

The PV arrays are based on 315W panels, scattered across the majority of buildings. The only areas that PV has not been proposed are to the roof of the Urban Farm on Block B, and pitched roofs of Block F, which do not offer suitable orientation. This is in line with the original approved strategy, and deemed acceptable. It is also shown that PV has been maximised across the development, in line with emerging policy requirements.



Please note that the specifics of the PV design, shall be evaluated fully during detailed design by a suitably qualified specialist.

The system inverter will convert DC output to AC, bringing power into phase with the mains electricity supply. It is expected that the PV will feed directly into the landlord's electricity supplies, and the power produced used to power the communal areas of the buildings (lifts, lighting etc), or to power the communal ASHP's. However, if there is any surplus electricity produced, this can be exported to the grid to be utilised by others.

8.3. Be Green Summary

The implementation of heat pumps and photovoltaics into the design yields a substantial improvement in the predicted on-site CO_2 emissions.

The below tables detail the emissions at this stage of the energy hierarchy

Scenario	CO_2 Emissions (tonnes/CO_2/year)	CO_2 reduction	Cumulative CO_2 reduction
Residential (regulated)	387	33%	42%
Non-Residential (regulated)	253	17%	35%

Scenario	CO2 Emissions (tonnes/CO2/year)	CO_2 reduction	Cumulative CO_2 reduction
Site-Wide Total (regulated)	640	27%	40%

9. Carbon Offsetting

As of the 1st October 2016 it is a requirement of the London Plan Policy 5.2 that all major residential development must achieve the Zero Carbon Standard. This is done by meeting a minimum onsite CO2 reduction of 35% against the Building Regulations Part L baseline, and then offsetting the remaining emissions via additional carbon savings elsewhere, and then a financial contribution to the relevant Borough's carbon offset fund.

Contributions to the carbon offset fund are to be spent within the vicinity of the named development and used for retrofitting existing buildings, decentralised energy networks, renewable energy or any other programme that achieves a calculable reduction in carbon emissions.

The emissions from the proposed residential scheme have been shown to have been reduced by 42% over the Part L baseline, which equates to a reduction in regulated CO2 emissions of 286 tonnes of CO2 per year.

The final emissions total requiring offset is therefore calculated as 387 tonnes CO_2/year

In accordance with the London Borough of Camden planning policy, the offset fee is calculated as £60/tonne for a period of 30 years (equivalent to £1,800 per tonne). The offset fee required can therefore be calculated as per the below:

Carbon emissions (tonnes/CO_2/year)	Calculated Offset Payment (£)
387	£696,600

This represents a reduction to the offset agreed for the extant scheme, of £718,000. This original figure was derived from the offset payment that would be required in the event that the scheme used the conventional CHP approach to district heating. As can be demonstrated, the revised proposals result in a lower offset, and therefore lower CO_2 emissions than all variants of the original scheme.

10. WATER EFFICIENCY

The water consumption of a home has a significant impact on not only direct operational running costs (i.e. water consumption charges), but also indirectly through additional energy usage and the heating of water for domestic use. This is, in part, reflected in SAP 2012 methodology which assumes reduced energy consumption should a home be compliant with Approved Document Part G 2013.

The standard of 105 litres of water per person per day can be met using the following specification as set out in the table below. Note that this is not finalised and shall be subject to detailed design. However, the overall target of 105 l/p/day shall be achieved.

Item	Performance
Kitchen Tap	6 litres/minute
Other Taps	4 litres/minute
WC Flush	6/4 Full/Part
Shower Flow	7 litres/minute
Bath Volume	150 litres
Dishwasher Consumption	0.75 litres/place setting
Washing Machine Consumption	6.8 litres/kg

11. Conclusions

This Energy Statement has outlined the proposed preliminary specification for the development and the resulting savings implemented at each stage of the energy hierarchy. A fabric-first approach realises considerable savings against the current Building Regulations baseline.

The opportunity for connected heat and CHP has been evaluated and found to be technically unviable at this time. However, the scheme shall be designed to facilitate a future connection to an area wide DHN, should one become available.

Additional energy and CO2 savings will then be achieved through the use of renewable energy technology, specifically heat pumps to serve 70% of the annual energy demand, and photovoltaics to generate zero carbon electricity

Finally, the remaining emissions shall be offset via a financial contribution to the London Borough of Camden carbon offset fund. In order to contribute to sustainable improvements elsewhere in the Borough.

Therefore, the foregoing results show that the development proposals shall meet the applicable planning policies of the London Plan: Policy 5.2: Minimising Carbon Dioxide Emissions; Policy 5.3 Sustainable Design and Construction; Policy 5.6: Decentralised Energy in Development Proposals; and Policy 5.7: Renewable Energy, in addition to the local policies of the London Borough of Camden.

The below tables and graphs detail the site emissions at each stage of the energy hierarchy, confirming that the above targets have been met.

Residential

Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	673	359
After Energy Demand Reduction	608	359
After DHN/CHP	608	359
After Renewable Energy	387	359

Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	65	10
Savings from DHN/CHP	0	0
Savings from renewable energy	221	33
Cumulative savings	286	42
Annual savings from offset	387	N/A
Cumulative savings from offset	11,610	N/A

Non-Residential

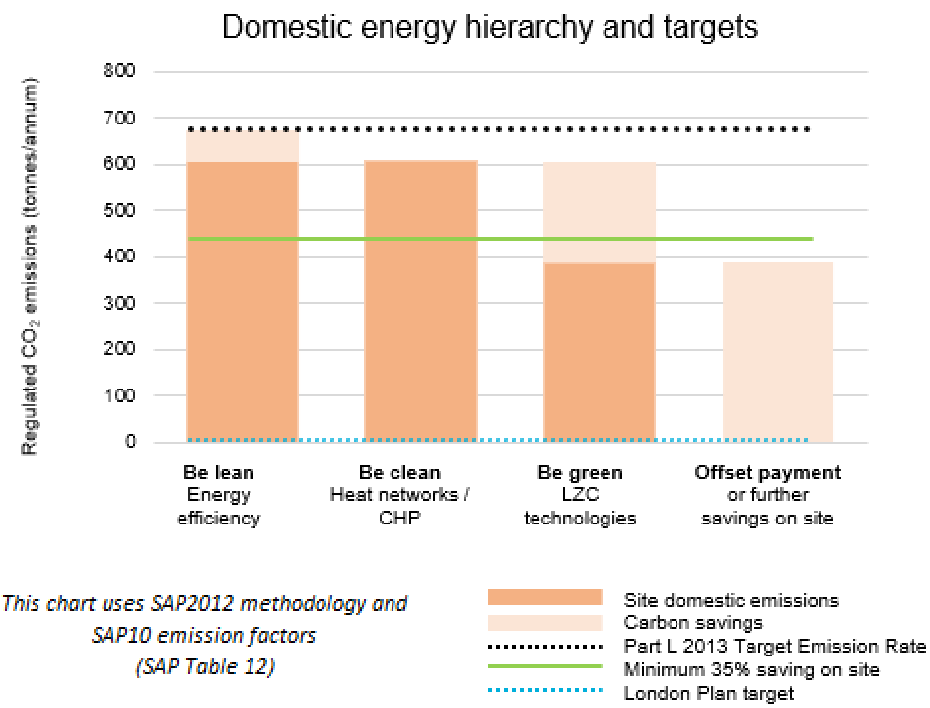
Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	389	196
After Energy Demand Reduction	321	196
After DHN/CHP	321	196
After Renewable Energy	253	196

Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	68	18
Savings from DHN/CHP	0	0
Savings from renewable energy	68	17
Cumulative savings	136	35

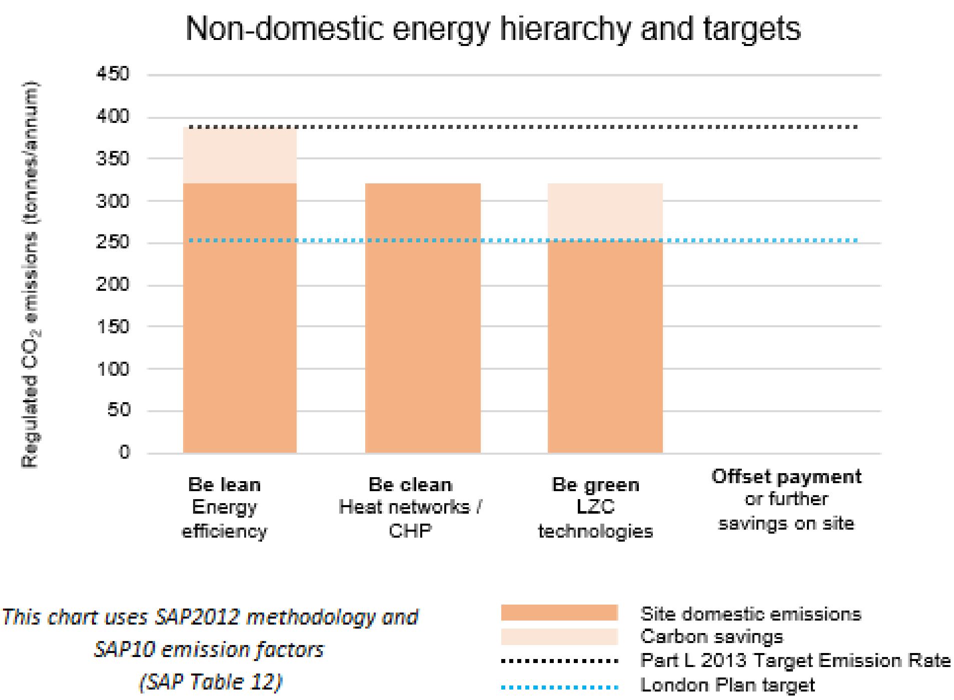
Site-Wide

Scenario	Regulated ($kgCO_2$/year)	Unregulated ($kgCO_2$/year)
Baseline	1062	555
After Energy Demand Reduction	929	555
After DHN/CHP	929	555
After Renewable Energy	640	555

Scenario	Tonnes CO_2 / Year	%
Savings from demand reduction	133	13
Savings from DHN/CHP	0	0
Savings from renewable energy	289	27
Cumulative savings	422	40
Annual savings from offset	387	N/A
Cumulative savings from offset	11,610	N/A



Domestic energy hierarchy and targets
Regulated CO_2 emissions (tonnes/annum)
800
700
600
500
400
300
200
100
0
Be lean
Energy efficiency
Be clean
Heat networks / CHP
Be green
LZC technologies
Offset payment
or further savings on site
This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)
Site domestic emissions
Carbon savings
Part L 2013 Target Emission Rate
Minimum 35% saving on site
London Plan target



Non-domestic energy hierarchy and targets
Regulated CO_2 emissions (tonnes/annum)
450
400
350
300
250
200
150
100
50
0
Be lean
Energy efficiency
Be clean
Heat networks / CHP
Be green
LZC technologies
Offset payment
or further savings on site
This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)
Site domestic emissions
Carbon savings
Part L 2013 Target Emission Rate
London Plan target

Appendix A: Acronyms

Acronym	Definition
AD L 2013	Approved Document Part L of Buildings Regulations 2013
ASHP	Air Source Heat Pump
BER	Building Emission Rate
CHP	Combined Heat & Power
DER	Dwelling Emission Rate
DHN	District Heat Network
DHW	Domestic Hot Water
ESCO	Energy Services Company
GSHP	Ground Source Heat Pump
LPA	Local Planning Authority
PV	Photovoltaics
SAP	Standard Assessment Procedure
DSM	Dynamic Simulation Modelling
TER	Target Emission Rate
LBC	London Borough of Camden
GLA	Greater London Authority

Appendix B: Renewable Energy Feasibility

Feasibility study

6.3 Wind	*The ability to generate electricity via a turbine or similar device which harnesses natural wind energy. This could be considered as an onsite solution to reducing carbon emissions (turbines included within the development), or offsite (investing financially into a nearby wind farm).*
Installation considerations	▪ Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available. ▪ A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier) ▪ Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required. ▪ Noise considerations can be an issue dependent on density and build-up of the surrounding area. ▪ Buildings in the immediate area can disrupt wind speed and reduce performance of the system. ▪ Planning permission will be required along with suitable space to site the turbine, whether ground installed or roof mounted.
Advantages	▪ Generation of clean electricity which can be exported to the grid or used onsite. ▪ Can benefit from the Feed in Tariff, reducing payback costs.
Disadvantages	▪ Planning restrictions and local climate often limit installation opportunities.

- Annual maintenance required.
- High initial capital cost. It is usual for an investor to consider a series of turbines to make the investment financially sound.

Development feasibility

✗

- Installing a large turbine in an area such as this is not considered to be appropriate due to its appearance and physical impact on the built-up environment. Residents' and neighbours' concerns may include the look of the turbine, the hum of the generator and the possibility of stroboscopic shadowing from the blades on homes.

- Wind speed has been checked for the development scheme using the NOABL wind map: http://www.rensmart.com/Weather/BERR. The wind speed for the development is too low for technical viability.

- Typical payback times for a single turbine are expected to be greater than 15 years which means that the cost of installing and maintaining a single wind turbine is not considered a commercially-viable option.

6.4 Solar PV and Solar Thermal

The ability to generate energy (either electricity, hot water or a combination of the two) through harnessing natural solar energy. This could include the use of solar thermal panels, photovoltaic (PV) panels, or a combined solution. PV panels, similarly to turbines, can be considered both on and offsite.

Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid.

Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months and overheating of the system.

Installation considerations	▪ Operate most efficiently on a south-facing sloping roof (between 30 and 45-degree pitch.) ▪ Shading must be minimal (one shaded panel can impact the output of the rest of the array.) ▪ Panels must not be laid horizontally on a flat roof as they will not self-clean. Panels will therefore need to be installed at an angle and with appropriate space between them, to avoid over-shading. ▪ Large arrays may require upgrades to substations if exporting electricity to the grid. ▪ Local planning requirements may restrict installation of panels on certain elevations. ▪ Installation must take into account pitch and fall of the roof, along with any additional plant on the roof to ensure there is sufficient room. ▪ The average domestic solar PV system is 4kWp and costs £5,000 - £8,000 (including VAT at 5 per cent) - (taken from the Energy Saving Trust, TBC by supplier.)
Advantages	▪ Relatively straightforward installation, connection to landlord's supply and metering. ▪ Linear improvement in performance as more panels are installed. ▪ Maintenance free. ▪ Installation costs are continually reducing. ▪ Can benefit from the Feed in Tariff to improve financial payback.
Disadvantages	▪ Not appropriate for high-rise developments, due to lack of roof space in relation to total floor area. ▪ With Solar Thermal, performance is limited by the hot water demand of the building – system oversizing will lead to overheating.

Development feasibility ✓	▪ The suitability of Solar panels has been considered for this Development and are concluded as a technically viable option. ▪ There are potential areas of roof space suitable for the positioning of unshaded Solar PV arrays. ▪ The Development is not on land which is protected or listed, so it is considered that Solar panels would not have a negative impact on the local historical environment or the aesthetics of the area.

6.5 Aerothermal	*The transfer of latent heat in the atmosphere to a compressed refrigerant gas to warm the water in a heating system. This includes air to water heat pumps and air conditioning systems.* Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water. They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.
Installation	▪ ASHPs operate effectively in buildings with a low energy demand, as they emit low levels of energy

energist®

Considerations	suitable for maintaining rather than dramatically increasing internal temperatures. It is therefore vital that the dwelling has a low heating demand to ensure the system can provide appropriate space-heating capability. ▪ Underfloor heating will give the best performance but oversized radiators can also be used. ▪ Immersion heater back-up required to ensure appropriate Domestic Hot Water (DHW) temperature in winter months. ▪ Noise from the external unit can limit areas for installation.
Advantages	▪ Air source systems are a good alternative solution to providing heating and hot water to well-insulated, low heat loss dwellings. ▪ They require additional space when compared to a gas boiler. Space for an external unit is needed, as is space for the hot water cylinder and internal pump. ▪ Heat pumps are generally quiet to run, however if a collection of pumps were used, this could generate a noticeable hum while in operation.
Disadvantages	▪ Residents need to be made aware of the most efficient way of using a heat pump; as the low flow rates used by such a system means that room temperature cannot be changed as reactively as a conventional gas or oil boiler system. ▪ Will not perform well in homes that are left unoccupied and unheated for a long period of time. ▪ Back-up immersion heating can drastically increase running costs. ▪ Noise and aesthetic considerations limit installation opportunities.
Development feasibility ✓	▪ ASHPs are considered a technically-viable option for this development scheme.

6.6 Geothermal	*The transfer of latent heat from the ground to a compressed refrigerant gas to warm the water in a heating system. This includes ground source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.* Ground Source Heat Pumps (GSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the ground) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the ground, either through coils or in bore holes and piles, circulating a mix of water and antifreeze to extract energy from the ground, where the year-round temperature is relatively consistent (approx. 10℃ at 4 metres depth). This leads to a reliable source of heat for the building. Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for GSHPs tend to be higher than those of ASHPs.
Installation considerations	▪ Require appropriate ground conditions to sink piles/bore holes or excavate for coils (which also require a large area of land.) ▪ Decision between coils or piles can lead to significant extra cost. ▪ Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators. ▪ Similar to ASHPs, perform best in well-insulated buildings with a low heating demand. ▪ Electric immersion heater required for winter use. ▪ £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust, TBC by supplier.)
Advantages	▪ Perform well in well-insulated buildings, with limited heating demand. ▪ More efficient than ASHPs.

Disadvantages	▪ The coils can be damaged by natural earthworks and by intensive gardening practices – occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. ▪ Will not perform well in buildings that are left unoccupied and unheated for a long period of time. ▪ Back up immersion heating can drastically increase running costs. ▪ Large area of ground needed for coil installation.
Development feasibility ✗	▪ Ground conditions, space, cost, and other technical considerations make GSHP unfeasible for the scheme

6.7 Biomass	*Providing a heating system fuelled by plant based materials such as wood, crops or food waste.* Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.
Installation considerations	▪ Biomass boilers are larger than conventional gas-fired boilers and also require what can be significant storage space for the fuel source. This needs to be considered at planning stage to ensure an appropriate plant room can be provided. ▪ Flue required to expel exhaust gases – design needs to be in line with the requirements of the Building Regulations.

	▪ Need to consider whether fuel deliveries will be reliable and consistent to the location of the site (especially relevant in rural areas) and whether the plant room can be easily accessed by the delivery vehicle. ▪ £9,000-£21,000 per dwelling dependent on size (taken from Energy Saving Trust, TBC by Supplier).
Advantages	▪ Considerable reduction in CO_2 emissions.
Disadvantages	▪ Limited reduction in running costs compared to A-rated gas boilers, but at a substantially higher up-front cost. ▪ Plant room space required for boiler and storage. ▪ Dependent on consistent delivery of fuel. ▪ Ongoing maintenance costs (need to be cleaned regularly to remove ash.)
Development Feasibility ✗	▪ Biomass is not considered a technically-viable option for the development scheme. The primary reason for this is down to the Development's location within the context of Inner London and the negative environmental impact of high levels of NOx gases that are emitted from biomass boilers and the subsequent impact on local air quality. This is contrary to planning policies for air quality in London. ▪ There are, however, also concerns regarding a sustainable supply of biomass to the site. ▪ The capital installation cost would also be high which leads us to the conclusion that biomass would not be a commercially-viable option for this development scheme.

BREEAM CHECKLIST

1. **Energy Generated from LZC energy source per year**

   Using the SAP method, PV arrays are estimated to generate 125,000 kWh/year. Heat Pumps are estimated to generate 2,000 MWh/year

2. **CO_2 emission savings from each LZC source per year**

   This cannot be accurately determined, as it shall depend on the carbon intensity of the fuel to be offset by the LZC.
   For the purposes of this checklist, the Heat pumps are assumed to be offsetting emissions that would otherwise be fulfilled by the gas boilers, and therefore shall save 259 tonnes CO_2/year.
   Assuming the PV is offsetting grid electricity set at the SAP 10 carbon factor, the PV array shall save 30 tonnes CO_2 /year

3. **Life Cycle cost of potential specification, including payback.**

   This will not be able to be determined until the detailed design, upon evaluation of the system by a suitable PV specialist. It is not considered relevant, as the cost of the system is not considered a barrier from the opinion of the planning authority, who require the adoption of systems

4. **Local Planning criteria**

   The use of PV and heat pumps are welcomed by the planning authority

5. **Feasibility of exporting energy/heat from the system**

   The PV system shall be capable of exporting renewable energy to the grid, when generation exceeds demand. For heat, the system has been designed to be compatible with area-wide heating schemes, and therefore heat could be imported/exported in the future if commercially suitable

6. **Any available grants**

   The Feed-In-Tariff and Renewable Heat Incentive grant schemes shall be investigated during the detailed design and specification of the systems

7. **All technologies appropriate to the site and demand of the development.**

   Please see section 8 of the report, and the preceding feasibility study

8. **Reasons for excluding other technologies**

   Please refer to the preceding feasibility study

Appendix C: Part L 2013 Compliance

CO2 emission factors are variable, and relate to the carbon intensity of the fuel that is supplied to the building. In the case of natural gas, this is fairly stable, and varies only marginally with regard to processing and delivery of the gas to site. In the case of electricity, this varies substantially, and can range by a factor of 10 over the course of a single day. This is due to peaks and troughs in demand, and the associated electricity production methods that are used in order to provide power to the national grid.

The SAP 2012 carbon emission factors were based on data from 2005-2010, and are widely regarded as being wholly inaccurate and unfit for purpose. However, due to the regulatory methodology, which is designed as a comparative assessment not fit for establishing real-world emissions, this has not caused significant issue with regards to regulatory compliance (as all development is assessed to an equal degree of inaccuracy.

However, due to SAP calculations now being used as a way of measuring carbon emissions reductions, (which is beyond the scope and capability of the software and methodology), this is now causing major issues with regard to inaccurate building performance reporting.

Due to this, the GLA have mandated that all planning submissions submitted from 01 January 2019 must instead use revised draft carbon factors, that more closely reflect the real-world carbon intensity of the grid.

The below table details the revisions to the CO2 emission factors, only fuels used within the site proposals have been listed here:

Fuel	Regulatory (SAP2012) CO2 emission factor (kgCO2/kWh)	London Plan (GLA) CO2 emission factor (kgCO2/kWh)
Natural gas	0.216	0.210
Grid electricity	0.519	0.233

As explained throughout this document, the reported carbon factors have been adjusted in line with the GLA requirements to adopt the SAP10 carbon factors published by the government.

It is noted that these figures are out of date, and the government have since published SAP10.1 factors, and are expected to update these again prior to the adoption of Part L2020. However, the GLA have mandated the above SAP10 figures to be used, in order to allow comparison between developments. Whilst this approach risks the same pitfalls and inaccuracies being realised, as it does not address the variable nature of the grid carbon intensity, it is at least more accurate than using the SAP2012 factors.

However, whilst the reported figures should be used for planning and reporting purposes, they cannot be used for the purposes of Building Control compliance, which must use the adopted methodology in order to remain legally compliant.

Therefore, the below tables detail the performance of the proposed scheme when assessed to the current regulatory standards (SAP2012), demonstrating that compliance with the Building Regulations shall also be met.

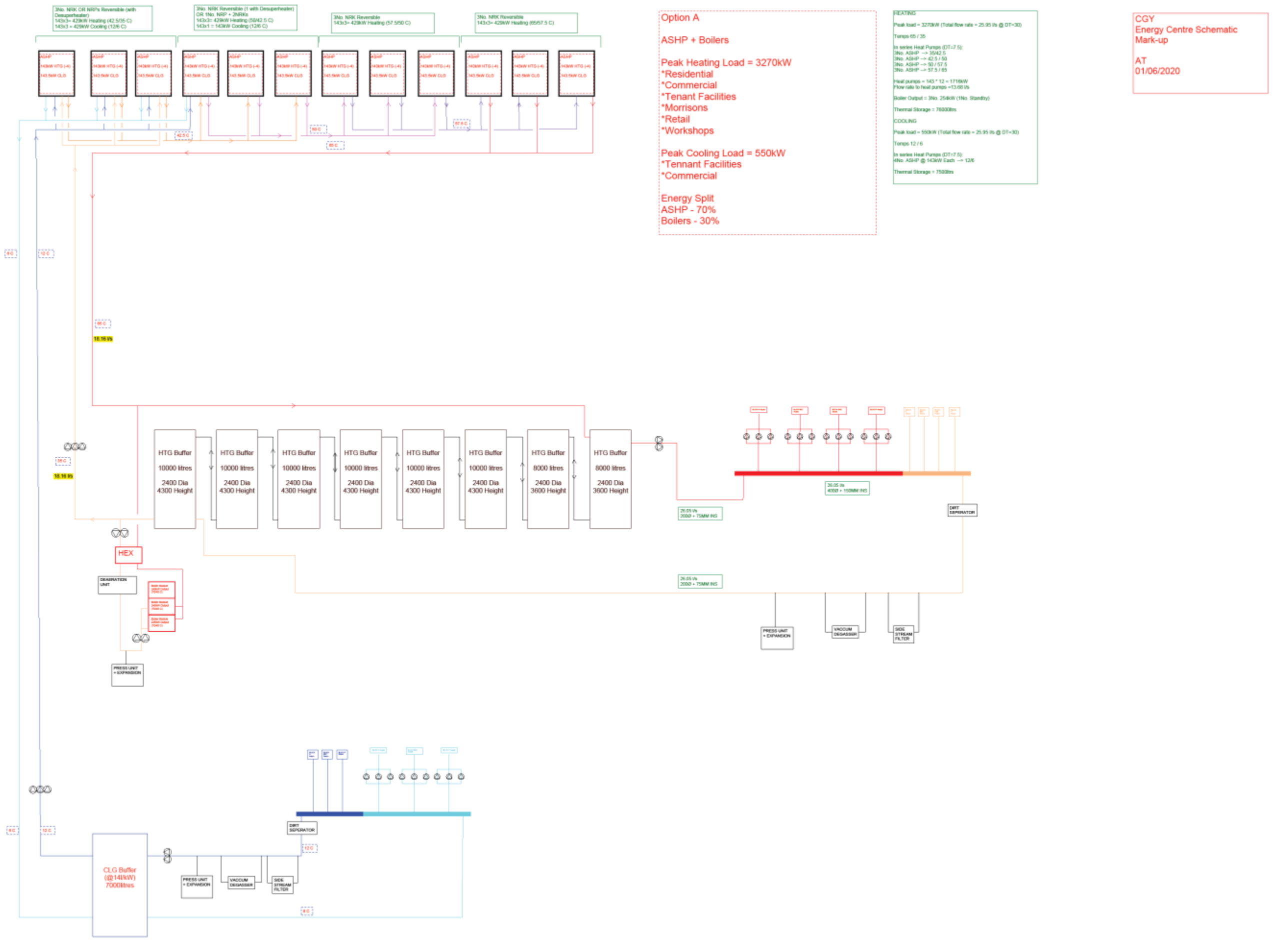
Regulated CO_2 emissions – Residential

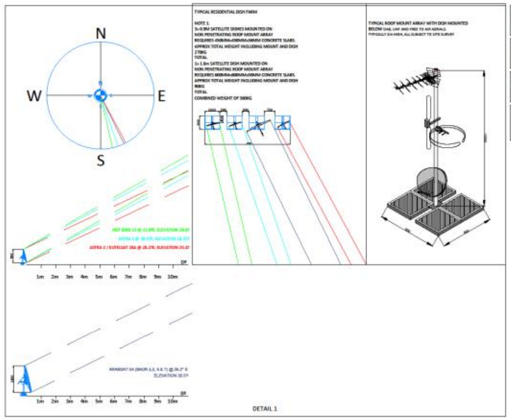
Building CO2 emissions (Tonnes CO2/annum)	Target CO2 emissions (Tonnes CO2/annum)	Improvement	Compliance with Building Regulations Part L
643	762	16%	Yes

Regulated CO_2 emissions – Non-Residential

Building CO2 emissions (Tonnes CO2/annum)	Target CO2 emissions (Tonnes CO2/annum)	Improvement	Compliance with Building Regulations Part L
528	719	27%	Yes

Appendix D: M&E Drawings





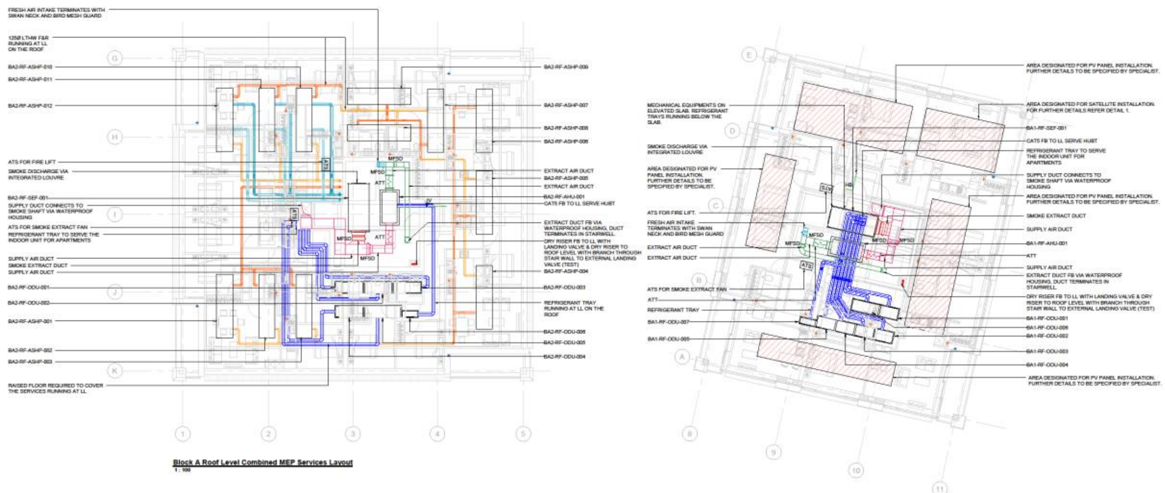
DETAIL 1

DETAIL 2. AUTOMATIC TRANSFER SWITCH, ATS.

LIST OF EQUIPMENT'S - BLOCK A ROOF

S.No	TAG REFERENCE	EQUIPMENT	MANUFACTURER & MODEL MAKE
1	BA1-RF-AHU-001	AHU	FLAKTWOOD OR EQUAL & APPROVED
2	BA1-RF-SEF-001	SMOKE EXTRACT FAN	NUAIRE OR EQUAL & APPROVED
3	BA1-RF-ODU-001	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P400YNW-A OR EQUAL & APPROVED
4	BA1-RF-ODU-002	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P400YNW-A OR EQUAL & APPROVED
5	BA1-RF-ODU-003	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P400YNW-A OR EQUAL & APPROVED
6	BA1-RF-ODU-004	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P400YNW-A OR EQUAL & APPROVED
7	BA1-RF-ODU-005	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P400YNW-A OR EQUAL & APPROVED
8	BA1-RF-ODU-006	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P550YSNW-A OR EQUAL & APPROVED
8	BA1-RF-ODU-007	CONDENSER UNIT FOR AHU	MITSUBISHI PUHZ-ZRP50VKA2 POWER INVERTER R410A OR EQUAL & APPROVED
9	BA2-RF-AHU-001	AHU	FLAKTWOOD OR EQUAL & APPROVED
10	BA2-RF-SEF-001	SMOKE EXTRACT FAN	NUAIRE OR EQUAL & APPROVED
11	BA2-RF-ODU-001	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P600YSNW-A OR EQUAL & APPROVED
12	BA2-RF-ODU-002	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P600YSNW-A OR EQUAL & APPROVED
13	BA2-RF-ODU-003	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P600YSNW-A OR EQUAL & APPROVED
14	BA2-RF-ODU-004	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P600YSNW-A OR EQUAL & APPROVED
15	BA2-RF-ODU-005	VRF OUTDOOR UNIT	MITSUBISHI PUHY-P900YSNW-A OR EQUAL & APPROVED
16	BA2-RF-ODU-005	CONDENSER UNIT FOR AHU	MITSUBISHI PUHZ-ZRP50VKA2 POWER INVERTER R410A OR EQUAL & APPROVED
17	BA2-RF-ASHP-001	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
18	BA2-RF-ASHP-002	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
19	BA2-RF-ASHP-003	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
20	BA2-RF-ASHP-004	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
21	BA2-RF-ASHP-005	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
22	BA2-RF-ASHP-006	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
23	BA2-RF-ASHP-007	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
24	BA2-RF-ASHP-008	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
25	BA2-RF-ASHP-009	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
26	BA2-RF-ASHP-010	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
27	BA2-RF-ASHP-011	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED
28	BA2-RF-ASHP-012	AIR SOURCE HEAT PUMP	AERMEK NRK700 OR EQUAL & APPROVED

FOR DRAINAGE DETAILS REFER TO BLOCK A ROOF DRAINAGE LAYOUT CGYA0-ACM-ZZZ-RF-DR-ME-520001



Block A Roof Level Combined MEP Services Layout
1 : 100

AECOM

Project
Camden Goods Yard

Chalk Farm Road
LONDON NW1 8EH

Client
St George

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Ramboll Environ
240 Blackfriars Road, London SE1 8NW
Murdoch Wickham
The Tithe Barn Bradbourne House, East Malling Kent ME19 6DZ

Notes

1. ALL DIMENSIONS ARE IN MILLIMETER (mm), UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT STRUCTURAL ENGINEERS DRAWINGS AND DETAILS, THE RELEVANT ARCHITECTS DRAWINGS AND ANY OTHER SPECIALISTS DRAWINGS.
3. ALL SYSTEMS SHALL BE IN FULL COMPLIANCE WITH THE FIRE STRATEGY, LOCAL FIRE OFFICER & BUILDING CONTROL & INSURANCE COMPANY REQUIREMENTS.
4. THIS DRAWING IS BASED ON CGYA0-AAM-ZZZ-ZZ-M3-AR-00001 RECEIVED ON 22 MAY'20.
5. THIS DRAWING IS BASED ON THE FIRE STRATEGY REPORT - HHF REPORT REV 05, DATED 13 MAR'20.
6. THIS DRAWING IS BASED ON HIGH LEVEL SGWL DEVELOPMENT BRIEF TO CONSULTANTS - CAMDEN GOODS YARD DRAFT & SCHEDULE - TECHNICAL DESIGN GUIDE - REV G

LEGEND:

	SUPPLY DUCT
	SMOKE DUCT
	EXHAUST DUCT
	EXTRACT DUCT
	FRESH AIR DUCT
	REFRIGERANT PIPEWORK TRAY
AHU	AIR HANDLING UNIT
AOV	AUTOMATIC OPENING VENT
ATT	ATTENUATOR
c/w	COMPLETE WITH
EA	EXTRACT AIR
HL	HIGH LEVEL
LL	LOW LEVEL
MFSD	MOTORIZED FIRE/SMOKE DAMPER
ODU	OUTDOOR UNIT
SE	SMOKE EXTRACT
SEF	SMOKE EXTRACT FAN
TA	TO ABOVE
TB	TO BELOW
VCD	VOLUME CONTROL DAMPER
	RAIN WATER OUTLET
	SOIL VENT PIPE TERMINATE WITH VENT COWL

Issue/Revision

Rev	Date	Description	Apr
P01	June'20	Stage 2+ Issue	TT

Key Plan

Suitability Status
S4 - Suitable For Stage Approval

Project Number
60624157

Sheet Title
Block A
Roof Level
Combined MEP Services Layout

Sheet Number
CGYA0-ACM-ZZZ-RF-DR-ME-000001

Scale: As indicated@A0 Rev: P01

energist®

AECOM

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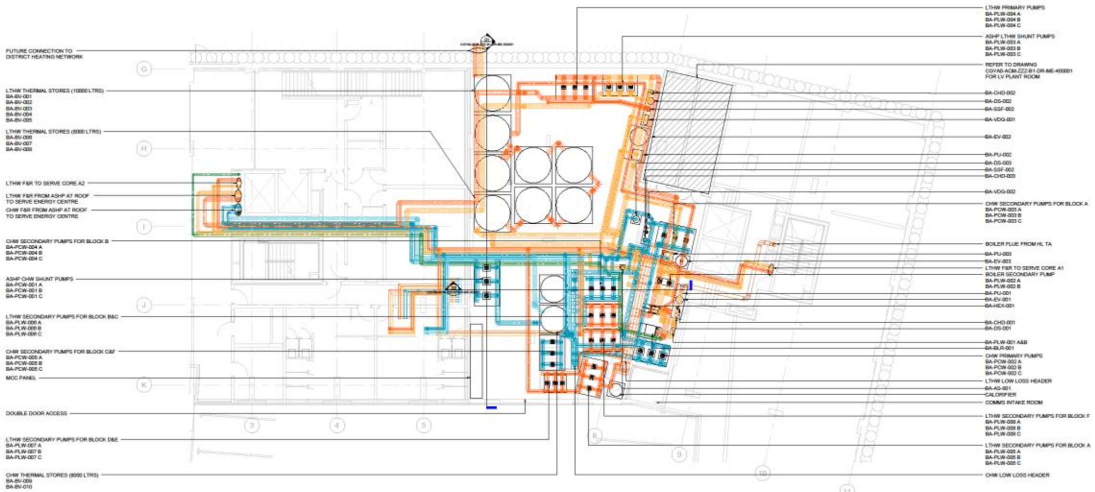


Energy Centre Layout
1 : 100

LIST OF EQUIPMENT'S - HOT WATER SIDE			
S.No	**TAG REFERENCE**	**EQUIPMENT**	**MANUFACTURER & MODEL MAKE**
1	BA-BV-001	LTHW BUFFER VESSEL	10000 Ltrs CAPACITY
2	BA-BV-002	LTHW BUFFER VESSEL	10000 Ltrs CAPACITY
3	BA-BV-003	LTHW BUFFER VESSEL	10000 Ltrs CAPACITY
4	BA-BV-004	LTHW BUFFER VESSEL	10000 Ltrs CAPACITY
5	BA-BV-005	LTHW BUFFER VESSEL	10000 Ltrs CAPACITY
6	BA-BV-006	LTHW BUFFER VESSEL	8000 Ltrs CAPACITY
7	BA-BV-007	LTHW BUFFER VESSEL	8000 Ltrs CAPACITY
8	BA-BV-008	LTHW BUFFER VESSEL	8000 Ltrs CAPACITY
9	BA-BLR-001	BOILER	HAMWORTHY WESSEX MODUMAX OR EQUAL & APPROVED
10	BA-PLW-001 A	BOILER SHUNT PUMP	GRUNDFOS TPED 32-230 OR EQUAL & APPROVED
11	BA-PLW-001 B	BOILER SHUNT PUMP	GRUNDFOS TPED 32-230 OR EQUAL & APPROVED
12	BA-PLW-002 A	BOILER SECONDARY PUMP	GRUNDFOS TPE2 32-200 OR EQUAL & APPROVED
13	BA-PLW-002 B	BOILER SECONDARY PUMP	GRUNDFOS TPE2 32-200 OR EQUAL & APPROVED
14	BA-PLW-003 A	ASHP LTHW SHUNT PUMP	GRUNDFOS HVAC80 Multi-E 3 TPE2 50-200 OR EQUAL & APPROVED
15	BA-PLW-003 B	ASHP LTHW SHUNT PUMP	GRUNDFOS HVAC80 Multi-E 3 TPE2 50-200 OR EQUAL & APPROVED
16	BA-PLW-003 C	ASHP LTHW SHUNT PUMP	GRUNDFOS HVAC80 Multi-E 3 TPE2 50-200 OR EQUAL & APPROVED
17	BA-PLW-004 A	LTHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
18	BA-PLW-004 B	LTHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
19	BA-PLW-004 C	LTHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
20	BA-PLW-005 A	LTHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC80 Multi-E 3 TPE 32-320/2 OR EQUAL & APPROVED
21	BA-PLW-005 B	LTHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC80 Multi-E 3 TPE 32-320/2 OR EQUAL & APPROVED
22	BA-PLW-005 C	LTHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC80 Multi-E 3 TPE 32-320/2 OR EQUAL & APPROVED
23	BA-PLW-006 A	LTHW SECONDARY PUMP FOR BLOCK B & C	GRUNDFOS HVAC100 Multi-E 3 TPE 40-530/2 OR EQUAL & APPROVED
24	BA-PLW-006 B	LTHW SECONDARY PUMP FOR BLOCK B & C	GRUNDFOS HVAC100 Multi-E 3 TPE 40-530/2 OR EQUAL & APPROVED
25	BA-PLW-006 C	LTHW SECONDARY PUMP FOR BLOCK B & C	GRUNDFOS HVAC100 Multi-E 3 TPE 40-530/2 OR EQUAL & APPROVED
26	BA-PLW-007 A	LTHW SECONDARY PUMP FOR BLOCK D & E	GRUNDFOS HVAC65 Multi-E 3 CRIE 10-3 OR EQUAL & APPROVED
27	BA-PLW-007 B	LTHW SECONDARY PUMP FOR BLOCK D & E	GRUNDFOS HVAC65 Multi-E 3 CRIE 10-3 OR EQUAL & APPROVED
28	BA-PLW-007 C	LTHW SECONDARY PUMP FOR BLOCK D & E	GRUNDFOS HVAC65 Multi-E 3 CRIE 10-3 OR EQUAL & APPROVED
29	BA-PLW-008 A	LTHW SECONDARY PUMP FOR BLOCK F	GRUNDFOS HVAC80 Multi-E 3 TPE 32-380/2 OR EQUAL & APPROVED
30	BA-PLW-008 B	LTHW SECONDARY PUMP FOR BLOCK F	GRUNDFOS HVAC80 Multi-E 3 TPE 32-380/2 OR EQUAL & APPROVED
31	BA-PLW-008 C	LTHW SECONDARY PUMP FOR BLOCK F	GRUNDFOS HVAC80 Multi-E 3 TPE 32-380/2 OR EQUAL & APPROVED
32	BA-HEX-001	LTHW PLATE HEAT EXCHANGER	ALFALAVAL AQHL-FM OR EQUAL & APPROVED
33	BA-PU-001	LTHW BOILER CIRCUIT PRESSURISATION UNIT	FLAMCOMAT FLEXFILLER 2250 OR EQUAL & APPROVED
34	BA-EV-001	LTHW BOILER CIRCUIT EXPANSION VESSEL	FLAMCOMAT FLEXCON PREMIUM 80/1 OR EQUAL & APPROVED
35	BA-DS-001	LTHW BOILER CIRCUIT DIRT SEPARATOR	FLAMCO CLEAN SMART F DN80 OR EQUAL & APPROVED
36	BA-AS-001	LTHW BOILER CIRCUIT AIR SEPARATOR	FLAMCOVENT SMART F DN80 OR EQUAL & APPROVED
37	BA-CHD-001	LTHW BOILER CIRCUIT DOSING POT	FLAMCO DOSING POT 3.5L OR EQUAL & APPROVED
38	BA-PU-002	LTHW PRIMARY CIRCUIT PRESSURISATION UNIT	FLAMCOMAT PUMPSET D8 CABINETISED OR EQUAL & APPROVED
39	BA-EV-002	LTHW PRIMARY CIRCUIT EXPANSION VESSEL	FLAMCOMAT FG MAIN VESSEL 3500Ltr OR EQUAL & APPROVED
40	BA-DS-002	LTHW PRIMARY CIRCUIT DIRT SEPARATOR	FLAMCO CLEAN SMART F DN200 OR EQUAL & APPROVED
41	BA-SSF-001	LTHW PRIMARY CIRCUIT SIDE STREAM FILTER	FLAMCO SIDEFLOW CLEAN + PICV OR EQUAL & APPROVED
42	BA-VDG-001	LTHW PRIMARY CIRCUIT VACUUM DEGASSER	FLAMCOMAT VACUMAT ECO 900 OR EQUAL & APPROVED
43	BA-CHD-002	LTHW PRIMARY CIRCUIT DOSING POT	FLAMCO DOSING POT 35L OR EQUAL & APPROVED

LIST OF EQUIPMENT'S - CHILLED WATER SIDE			
S.No	**TAG REFERENCE**	**EQUIPMENT**	**MANUFACTURER & MODEL MAKE**
1	BA-BV-009	CHW BUFFER VESSEL	8000 Ltrs CAPACITY
2	BA-BV-010	CHW BUFFER VESSEL	8000 Ltrs CAPACITY
3	BA-PCW-001 A	ASHP CHW SHUNT PUMP	GRUNDFOS HVAC125 Multi-E 3 TPE65-210/2 OR EQUAL & APPROVED
4	BA-PCW-001 B	ASHP CHW SHUNT PUMP	GRUNDFOS HVAC125 Multi-E 3 TPE65-210/2 OR EQUAL & APPROVED
5	BA-PCW-001 C	ASHP CHW SHUNT PUMP	GRUNDFOS HVAC125 Multi-E 3 TPE65-210/2 OR EQUAL & APPROVED
6	BA-PCW-002 A	CHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
7	BA-PCW-002 B	CHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
8	BA-PCW-002 C	CHW PRIMARY PUMP	GRUNDFOS TPE 100-110 OR EQUAL & APPROVED
9	BA-PCW-003 A	CHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC65 Multi-E 3 TPE32-150/2 OR EQUAL & APPROVED
10	BA-PCW-003 B	CHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC65 Multi-E 3 TPE32-150/2 OR EQUAL & APPROVED
11	BA-PCW-003 C	CHW SECONDARY PUMP FOR BLOCK A	GRUNDFOS HVAC65 Multi-E 3 TPE32-150/2 OR EQUAL & APPROVED
12	BA-PCW-004 A	CHW SECONDARY PUMP FOR BLOCK B	GRUNDFOS HVAC80 Multi-E 3 TPE40-450/2 OR EQUAL & APPROVED
13	BA-PCW-004 B	CHW SECONDARY PUMP FOR BLOCK B	GRUNDFOS HVAC80 Multi-E 3 TPE40-450/2 OR EQUAL & APPROVED
14	BA-PCW-004 C	CHW SECONDARY PUMP FOR BLOCK B	GRUNDFOS HVAC80 Multi-E 3 TPE40-450/2 OR EQUAL & APPROVED
15	BA-PCW-005 A	CHW SECONDARY PUMP FOR BLOCK C & F	GRUNDFOS HVAC65 Multi-E 3 CRIE5-4 OR EQUAL & APPROVED
16	BA-PCW-005 B	CHW SECONDARY PUMP FOR BLOCK C & F	GRUNDFOS HVAC65 Multi-E 3 CRIE5-4 OR EQUAL & APPROVED
17	BA-PCW-005 C	CHW SECONDARY PUMP FOR BLOCK C & F	GRUNDFOS HVAC65 Multi-E 3 CRIE5-4 OR EQUAL & APPROVED
18	BA-PU-003	CHW PRIMARY CIRCUIT PRESSURISATION UNIT	FLAMCOMAT PUMPSET D5 CABINETISED OR EQUAL & APPROVED
19	BA-EV-003	CHW PRIMARY CIRCUIT EXPANSION VESSEL	FLAMCOMAT FG MAIN VESSEL 400Ltr OR EQUAL & APPROVED
20	BA-SSF-002	CHW PRIMARY CIRCUIT SIDE STREAM FILTER	FLAMCO SIDEFLOW CLEAN + PICV OR EQUAL & APPROVED
21	BA-VDG-002	CHW PRIMARY CIRCUIT VACUUM DEGASSER	FLAMCOMAT VACUMAT ECO 900 OR EQUAL & APPROVED
22	BA-DS-003	CHW PRIMARY CIRCUIT DIRT SEPARATOR	FLAMCO CLEAN SMART F DN200 OR EQUAL & APPROVED
23	BA-CHD-003	CHW PRIMARY CIRCUIT DOSING POT	FLAMCO DOSING POT 35L OR EQUAL & APPROVED

Issue/Revision

Key Plan

Suitability Status

S4 - Suitable For Stage Approval

Project Number

60624157

Sheet Title

Energy Centre Layout

Sheet Number

CGYA0-ACM-ZZZ-B1-DR-ME-300001

Scale: As indicated@A0 Rev: P01

Appendix E: Product Datasheets

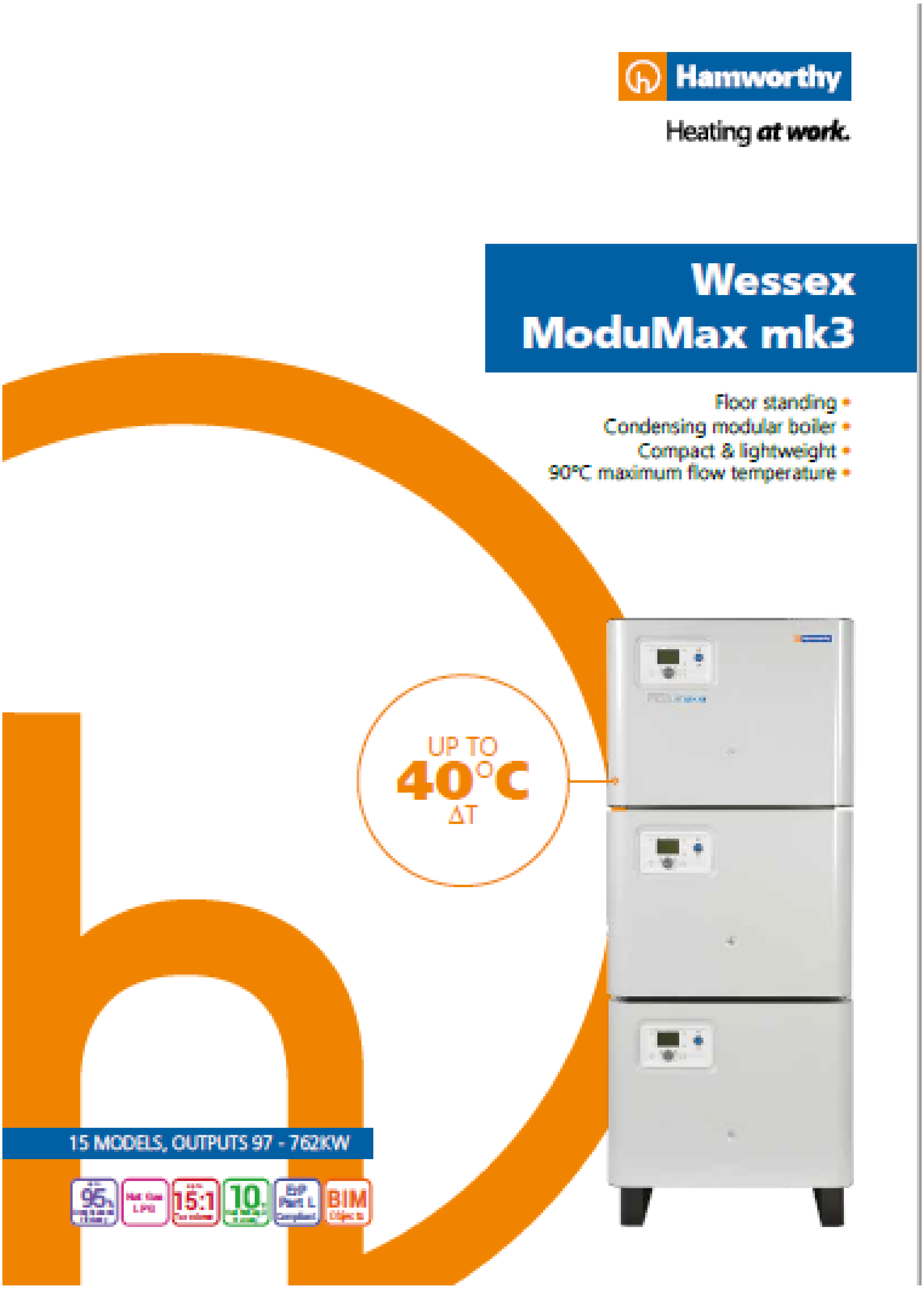
Camden Goods Yard - Energy Centre	Q190439-01h	AECOM					AERMEC air conditioning		
				Design total peak load	3270.0	kW			
ASHP		Cooling @ 32.0c (6_12)	EER	low_Retur	Heating @ 7.0c (Variance)	Flow_Return	kW Power Input (Heating mode)	COP	SCOP
ASHP1	NRK0700°H°EVJ°01				193.6	65_57.5	73.5	2.63	2.8
ASHP2	NRK0700°H°EVJ°01				193.6	65_57.5	73.5	2.63	2.8
ASHP3	NRK0700°H°EVJ°01				193.6	65_57.5	73.5	2.63	2.8
ASHP4	NRK0700°H°EVJ°01				184.1	57.5_50	64.6	2.85	2.95
ASHP5	NRK0700°H°EVJ°01				184.1	57.5_50	64.6	2.85	2.95
ASHP6	NRK0700°H°EVJ°01				184.1	57.5_50	64.6	2.85	2.95
ASHP7	NRK0700°H°EVJ°01				178.5	50_42.5	56.0	3.19	3.05
ASHP8	NRK0700°H°EVJ°01				178.5	50_42.5	56.0	3.19	3.05
ASHP9	NRP0700E4VJ°0100	151.9	2.46	6_12	177.8	50_42.5	55.3	3.56	3.05
ASHP10	NRP0700E4VJ°0100	151.9	2.46	6_12	177.8	42.5_35	44.5	3.56	3.6
ASHP11	NRP0700E4VJ°0100	151.9	2.46	6_12	177.8	42.5_35	44.5	3.56	3.6
ASHP12	NRP0700E4VJ°0100	151.9	2.46	6_12	177.8	42.5_35	44.5	3.56	3.6
		607.6	kW		2201.3		715.1	3.09	3.10

7.0c 65.0_57.5 NRK0700°H°EVJ°01.p(

7.0c 57.5_50.0 NRK0700°H°EVJ°01.p(

7.0c 50.0_42.5 NRK0700°H°EVJ°01.p(

7.0c 42.5_35.0 NRK0700°H°EVJ°01.p(


Hamworthy
Heating at work.
Wessex
ModuMax mk3
Floor standing
Condensing modular boiler
Compact & lightweight
90°C maximum flow temperature
UP TO
40°C
ΔT
15 MODELS, OUTPUTS 97 - 762KW
BIM

6 MODELS

97-348 kW OUTPUT

Technical data & dimensions

Models WM97/97H, WM 97/194V, WM97/291V, WM116/116H, WM116/232V, WM116/348V

97 and **116kW** modules

	Wessex ModuMax mk3 boiler model	Units	97/97H	97/194V	97/291V	116/116H	116/232V	116/348V
	No. of modules		1	2	3	1	2	3
Energy	Building regulations Part L seasonal efficiency	% gross	94.9	94.9	94.9	93.1	93.1	93.1
	BS EN 15502 seasonal efficiency	% gross	95.2	95.2	95.2	93.4	93.4	93.4
	Boiler output 80/60°C, NG & LPG	kW	95.7	191.4	287.1	115.2	230.4	345.6
	Boiler output 50/30°C, NG & LPG	kW	97.2	194.4	291.6	116.2	232.5	348.7
	Boiler input (gross) - maximum, NG	kW	109	218	327	133	266	399
	Boiler input (gross) - maximum, LPG	kW	106.7	213.4	320.1	130.2	260.4	390.5
	Boiler input (net) - maximum, NG & LPG	kW	98.2	196.4	294.6	119.8	239.6	359.4
	Boiler output - minimum 80/60°C, NG & LPG	kW	19.1	19.1	19.1	23.5	23.5	23.5
Water	Water content	litres	16	32	48	16	32	48
	System design flow rate @ 40°C ΔT rise	l/s	0.6	1.2	1.8	0.7	1.4	2.1
	Water side pressure loss @ 40°C ΔT rise	mbar	5	5	5	7	7	7
	System design flow rate @ 30°C ΔT rise	l/s	0.8	1.6	2.4	1	2	3
	Water side pressure loss @ 30°C ΔT rise	mbar	9	9	9	14	14	14
	System design flow rate @ 20°C ΔT rise	l/s	1.2	2.4	3.6	1.4	2.8	4.2
	Water side pressure loss @ 20°C ΔT rise	mbar	20	20	20	27	27	27
	System design flow rate @ 11°C ΔT rise	l/s	2.2	4.4	6.6	2.6	5.2	7.8
	Water side pressure loss @ 11°C ΔT rise	mbar	61	61	61	91	91	91
	Minimum water pressure	barg	Dependent on differential temperature – see page 25					
	Maximum water pressure	barg	10	10	10	10	10	10
	Maximum flow temperature setting	°C	90	90	90	90	90	90
Gas	Gas flow rate, NG (G20) - maximum	m³/hr	10.8	21.6	32.4	12.7	25.4	38.1
	Gas flow rate, LPG (G31) - maximum	m³/hr	4	8	12	5	10	15
	Nominal inlet pressure, NG (LPG) - maximum	mbar	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)
	Maximum gas inlet pressure NG (LPG)	mbar	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)
Flue	Approx. flue gas volume @ 15°C, 8.75-9.25% CO_2	m³/hr	143	286	429	160	320	480
	Maximum flue gas temperature @ 80/60°C	°C	83	83	83	83	83	83
	Pressure at boiler flue connection	Pa mbar	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5
	Dry NOx emission (0% excess oxygen, dry air free) - NG	mg/kWh	39.8	39.8	39.8	34.3	34.3	34.3
	Dry NOx emission (0% excess oxygen, dry air free) - LPG	mg/kWh	42	42	42	57.3	57.3	57.3
Connection	Water flow/return connections	inches	G1½" male	G1½" male	G1½" male	G1½" male	G1½" male	G1½" male
	Gas inlet connection pipe thread size	inches	R1" male	R1" male	R1" male	R1" male	R1" male	R1" male
	Nominal flue diameter (I/D)	mm	100	180	180	100	180	180
	Condensate trap connection(s) (O/D)	mm	32	32	32	32	32	32
Electrics	Electrical supply		230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz
	Power consumption - maximum boiler modulation	W	166	332	498	166	332	498
	Start current (per module)	Amp	1.2	1.2	1.2	1.2	1.2	1.2
	Run current (per module)	Amp	0.72	0.72	0.72	0.72	0.72	0.72
	Approx shipping weight	kg	180	355	540	180	355	540
	Noise emission @1m @maximum modulation	Max dB (A)	60	60	60	60	60	60
	Noise emission @1m @minimum modulation	Min dB (A)	47	47	47	47	47	47

Appendix F: Residents Heating Costs

The below tables detail the estimated energy costs to the occupant, for Heating and DHW uses. It excludes energy used for lighting, MVHR systems, or unregulated uses such as plug loads and cooking. This cost analysis is undertaken using standard average 2019 prices and the fuel prices used include flat rate electricity prices of £0.14/kWh, and a gas rate of £0.04/kWh. Energy costs have been averaged for 1 bed, 2 bed and 3 bed homes.

Additional costs have been applied based on guidance from the GLA Heat pumps report (Sep 2018). This estimates for a flat standing rate of £110/year for metering and billing, a cost of £220/year relating to maintenance and replacement of the heat network and associated plant, and a cost of £100/year relating to "other charges". Please note that these are GLA estimates and therefore may not be in line with actual operational parameters. Therefore, no guarantee is given as to the accuracy of the predictions, which must be taken as high-level, indicative figures.

Energy Cost			Other associated costs			Totals (£)		
1 Bed	2 Bed	3 Bed	1 Bed	2 Bed	3 Bed	1 Bed	2 Bed	3 Bed
£163	£223	£285	£430	£430	£430	£593	£653	£715

Appendix G: Sample SAP Calculations

Submitted Separately

APPENDIX H: DSM CALCULATIONS

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APPENDIX I: GLA CONVERSION SPREADSHEET

Submitted Separately