Energy Assessment

Prepared by Scotch Partners

Submitted on behalf of Lab Selkirk House Ltd

Selkirk House, 166 High Holborn and 1 Museum Street, 10-12 Museum Street, 35-41 New Oxford Street and 16A-18 West Central Street, London, WC1A 1JR

June 2023

ScotchPartners
Building Services Engineering | Sustainability | Acoustics

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Labs Selkirk House Ltd.

Energy Statement

Revision 11
June 2023

Scotch Partners LLP
Building Services Engineering | Sustainability | Acoustics

16 St John's Lane
London EC1M 4BS

+44 (0) 203 544 5400
www.scotchpartners.com

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Revision History

Revision	Description	Date	Prepared By	Checked By
00	1st draft	09/02/2021	KE	
01	2nd draft	04/03/2021	AG, EP, MH, RP	JQ, KE
02	Final	13/04/2021	KE	JQ
03	Scheme Redesign	07/06/2022	IO	JQ
04	Final	16/09/2022	AM	JQ
05	Final incorporating final comments	22/09/2022	AM	JQ
06	For Planning	06/10/2022	KE	JQ
07	For Planning	11/10/2022	RM	JQ
08	Update to GLA 2022 guidance and scheme redesign draft	12/05/2023	AH	JQ
09	For comment	22/05/2023	AH	KE
10	For Planning	24/05/2023	AH	JQ
11	For Planning	01/06/2023	AH	JQ

Contents

1 Executive summary

1.1 Overall sustainability aspirations and objectives

Camden Council and the Mayor of London have declared a 'Climate Emergency' with Camden's declaration including an 'Ecological Emergency'. Both have an aspiration to achieve a Net Zero Carbon borough and city by 2030, 20 years ahead of the national target. In June 2020, Camden approved a 5-year 'Climate Action Plan' which creates a framework for action across all aspects of the borough with the aim of achieving zero carbon by 2030.

Health and wellness are critical social issues and the Camden Health and Wellbeing Strategy 2022-30 is one of the Council's initiatives to improve the health and wellbeing of Camden residents and reduce health inequalities across the borough.

The Applicant and the project team have fully embraced the sustainability and Net Zero Carbon objectives of Camden and the Mayor of London. They are keen for the proposed development to fully support these objectives and to go further by adopting both mandatory and voluntary standards (such as WELL, WiredScore and Net Zero Carbon) in order to maximise longevity, market relevance and social sustainability, and minimise environmental impact over the buildings' life cycle. The intention of the scheme is to act in support of Camden's sustainability aspirations & commitments for the coming years.

Targeting these accreditations ensures the scheme will provide a good balance of proposals, including a focus on both public and private outdoor amenity, a highly-tuned facade providing passive environmental shading and cooling measures, fossil-fuel free heating/cooling and significant contributions to local biodiversity.

The proposed approach to development combines substantive retention of the existing basement and substructure of Selkirk House and replacement new-build above ground. this approach offers the opportunity to achieve cutting-edge environmental performance for the office space that a refurbishment scheme cannot match This in turn, improves performance of a newbuild scheme on a life cycle basis.

The proposed development has been designed to also consider the key policies relating to sustainable design and construction, focusing primarily on the following documents:

- Camden Local Plan 2017
- Camden Planning Guidance (CPG) Energy efficiency and adaptation, January 2021
- CPG Planning for Health and Wellbeing, January 2021
- CPG Biodiversity, March 2018
- The London Plan 2021

This Statement forms part of a suite of sustainability documents that collectively demonstrate how the development proposals have responded to both Camden and the Applicant's sustainability objectives, and its performance against mandatory and voluntary sustainability targets. As such, this document should be read in parallel with the following reports submitted with the planning application:

– Sustainability Statement
– Circular Economy Statement
– Whole Life Carbon Assessment & Report

This Energy Statement has been prepared in accordance with the GLA Energy Assessment Guidance (June 2022), Part L 2021 GLA carbon emissions reporting spreadsheet v2.0_0 and Part L 2021 assessment methodology in accordance with the guidance notes published on the Energy Planning Guidance page of the GLA website at the time of publication.

1.2 Development description

This Energy Statement has been prepared in accordance with the GLA's Energy Assessment Guidance in support of the detailed planning application submitted by Labs Selkirk House Ltd ('the Applicant') to the London Borough of Camden ('the Council') for the redevelopment of the land at Selkirk House, 166 High Holborn, and 1 Museum Street, 10-12 Museum Street, 35-41 New Oxford Street and 16A-18 West Central Street, London, WC1A 1JR ('the site').

This application relates to a site covered by another application (ref. 2021/2954/P) it is the intention that this application supersedes the previous application which will in turn fall away. This new planning application has been prepared in the context of the recent listing of 10-12 Museum Street and 35-37 New Oxford Street, both of which sit within the application boundary. As a result a listed building application is being submitted alongside the planning application. Whilst the original application gave significant weight to the heritage interest of these now Grade II listed buildings, the applicant wanted the opportunity to properly consider the implications of the listings on the proposals in order to deliver a revised scheme which maximises the heritage benefits of the site.

Following the recent decisions by Historic England, the status of the buildings within the One Museum Street element of West Central Street area of the site is as follows:

Grade II Listed:

- 10-12 Museum Street
- 35-37 New Oxford Street

Certificate of Immunity from Listing granted:

- 39 – 41 New Oxford Street
- 16a West Central Street
- 18 West Central Street
- 16b West Central Street

The proposed development comprises of the following components:

- Museum Street - a single new building rising to 19 storeys, providing office (Class E(g)(i)) accommodation on upper levels and a range of flexible town centre uses (Class E) at ground level.
- High Holborn - a single new building rising to 6 storeys, providing residential (Class C3) accommodation on upper levels and a flexible town centre use (Class E) at ground level.
- Vine Lane - a single new building rising to 5 storeys, providing market residential units with a flexible town centre use (Class E) at ground level.
- West Central Street ¬- a series of new and refurbished buildings rising to 6 storeys, providing residential accommodation (market, LCR and Intermediate) on upper levels (Class C3) and flexible town centre uses (Class E) at ground level.

In summary, the proposed development is seeking detailed planning permission for:

- 22,650 sqm (GIA) of office floorspace falling within Class E(g)(i). This will be provided within the Museum Street building.
- 1,481 sqm (GIA) of flexible town centre floorspace at ground floor level falling within Class E. This will be provided within the Museum Street, Vine Lane, High Holborn, and West Central Street buildings. The planning application specifies the range of uses within Class E that each of these units is seeking permission for.
- 3,992 sqm (GIA) of residential floorspace will be provided. This represents an uplift of 2,078 sqm (GIA) of residential floorspace falling within Class C3. This will be provided within the West Central Street, Vine Lane and High Holborn buildings.
- All of the affordable housing component (1,693 sqm GIA) is provided with the West Central Street buildings along with 294 sqm (GIA) of market housing.
- 1,579 sqm (GIA) of market housing is provided within the Vine Lane block with a further 426 sqm (GIA) of market housing being provided within the High Holborn block.
- Two basements which will be used for cycle parking, servicing areas, plant, storage, and other ancillary uses.
- A high proportion of open space across the site totalling 2,201 sqm provided as public realm, pocket parks, communal areas, play space and private amenity for residents and office occupants.
- The creation of new public pedestrian route through the site known as 'Vine Lane', which will link High Holborn with West Central Street.
- 465 cycle parking spaces allocated as follows:
  - 345 long stay cycle parking spaces allocated to the office component.
  - 11 long stay cycle parking spaces allocated to the flexible town centre uses floorspace component.
  - 73 long stay cycle parking spaces allocated to the residential component.
  - 36 cycle parking spaces allocated to visitors to the site and located within the public realm areas.
  - 0 vehicle parking spaces.
- Extensive provision of open space across the site (2,201 sqm) including:
  - 1,083 sqm provided as public realm within the Applicant's ownership across the site.
  - 509 sqm provided as communal offices terraces within the Vina Lane and Museum Street buildings.
  - 186 sqm provided as play space within the West Central Street courtyard, which also provides communal open space for residents of those buildings.
  - 195 sqm of communal open space within the Vine Lane block - 74 sqm within the courtyard and 121 sqm at level 4. roof top level.
  - 87 sqm for West Central Street, 130 sqm for Vine Lane, 11 sqm for High Holborn of private amenity space.
- In addition to the open space provision within the Applicant's ownership, 729 sqm of public realm and streetscape improvements outside of the Applicant's ownership is proposed.

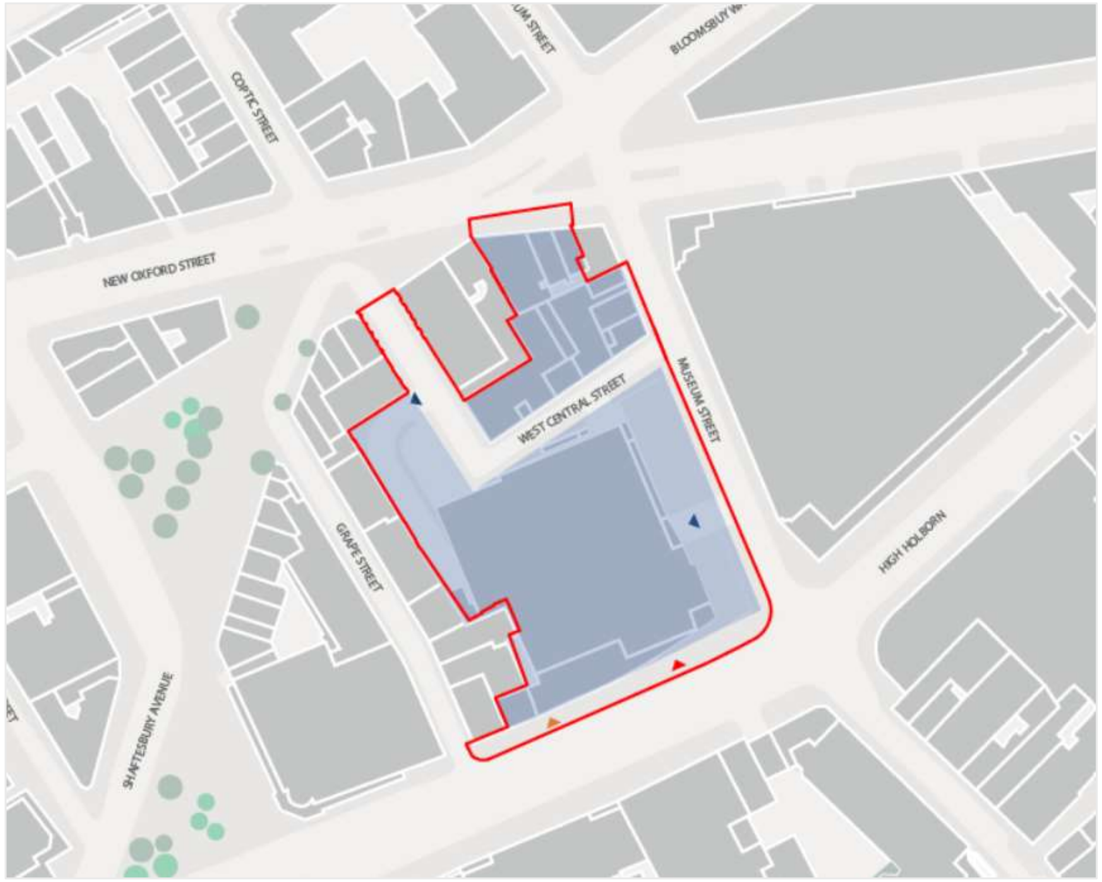

Figure 1-1 – Red line boundary

1.3 Energy reduction targets

Based on current planning policy requirements (refer to section 2.3) the regulated CO_2 emissions reduction targets against Part L for the proposed development are as follows:

Figure 1-1 Site wide CO_2 reduction targets

	'Lean' target	Minimum total target	Zero carbon
Domestic refurbishment (West Central Street)	Best endeavours (10% has been adopted)	Best endeavours (35% has been adopted)	✓
Non domestic refurbishment (West Central Street)	Best endeavours (15% has been adopted)	Best endeavours (35% has been adopted)	✓
Domestic new build (High Holborn, Vine Lane and West Central Street)	10%	35% 50% stretch target	✓
Non-Domestic New Build (Museum Street and Class E uses)	15%	35%	✓

In their Energy Assessment Guidance cover note of June 2022, the GLA acknowledge that non domestic buildings may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35% improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments.

1.3.1 Emissions factors

The carbon emission factors used in this report are as Part L 2021. Gas emissions rates are 0.210 $kgCO_2/kWh$. Grid supplied electricity emission factors vary by month and are shown below.

Table 1-1 CO_2 emission factors for grid-supplied electricity (kCO_2/kWh)

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
0.163	0.160	0.153	0.143	0.132	0.120	0.111	0.112	0.122	0.136	0.151	0.163

1.4 Energy reduction measures

The Applicant is committed to reducing energy demand and CO_2 emissions related to the proposed development. The following measures are proposed to that effect.

1.4.1 Be Lean – reduce energy demand

Whilst the measures differ slightly across the 4 site components, in general the following key demand reduction measures and principles have been adopted:

- High performance building fabric, improving upon Part L U-values and air permeability rate.
- Consideration for appropriate glazing to solid ratio, balanced with requirements for daylighting, views out, and commercial marketing requirements.
- Provision of a means of natural ventilation where external conditions allow
- Mechanical ventilation with high efficiency heat recovery.
- Low energy lighting with occupancy sensing and daylight dimming controls.

1.4.2 Be Clean – supply energy efficiently

There are no existing heat networks within 1km of the Site.

The Museum Street and Vine Lane site components will be served by an onsite single communal energy centre with heating plant that will distribute heat to these components via heat network. The West Central Street site component is also proposed to be served by an onsite communal energy centre distributing heat to all units within this site area via a heat network.

Both heat networks will be designed to facilitate interconnection between the two networks and future connection to off-site networks.

1.4.3 Be Green – use renewable energy

The Development will be fossil fuel free for heating and hot water.

An appraisal of available renewable energy solutions has been carried out, which has identified Air Source Heat Pumps as the most appropriate technology for the Development. PV has been discounted due to the lack of suitable available roof space.

1.5 LETI net zero carbon

The Applicant is keen for Museum Street, as the largest building on the proposed site, to target Net Zero Carbon through achieving a Net Zero Carbon balance between on and offsite measures, prioritising the former. Appropriate offsite methods are currently being explored.

A review has been carried out by the project team of the design measures and indicators which should be considered in order for Museum Street to aim towards Net Zero Carbon. The review is based on the measures set out in London Energy Transformation Initiative (LETI) Climate Emergency Design Guide (for office buildings) which was published in January 2020. The Guide's definition of Net Zero Carbon relates to whole life carbon i.e. both operational carbon and embodied carbon. At this stage, Museum Street is focusing on operational carbon, as per LETI's definition:

Operational Carbon

A new building with net zero operational carbon does not burn fossil fuels, is 100% powered by renewable energy, and achieves a level of energy performance in-use in line with national climate change targets.

The proposed energy strategy includes applicable and appropriate measures and indicators from the LETI Design Guide; however, it is acknowledged that the Guide will evolve over time through feedback and contributions from the industry.

Due to the efforts being made by the Applicant in this area, Museum Street is registered as LETI 'Pioneer Project' and is part of the network of other projects aspiring for Net Zero Carbon.

1.6 Performance against reduction targets

The performance against policy targets has been calculated using the Part L 2021 GLA carbon emissions reporting spreadsheet v2.0_0. Due to the size and format of the Excel workbook it is not appropriate to append the completed document to this energy statement. It has instead been provided under separate cover to GLA and to the local authority to review in parallel with the information presented in this report.

The regulated CO_2 savings from each stage of the energy hierarchy and total cumulative performance is shown on the following pages.

1.6.1 Domestic refurbishment CO_2 savings

Both the block on New Oxford Street and the block in 10-12 Museum Street (within the West Central Street part of the development) are refurbished. Whilst the targets are not applicable to domestic refurbishments, the 10% lean target has been adopted and exceeded and the overall performance exceeds the minimum 35% level.

Table 1-2 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the domestic

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean	2.7	14
Be clean	0.0	0
Be green	13.6	69
Cumulative on site savings	16.3	82
Annual savings from off-set payment	3.5	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	104	

**Figures are rounded in the GLA spreadsheet*

1.6.2 Domestic new build CO_2 savings

The 10% lean target for West Central Street, Vine Lane and High Holborn has been exceeded and the overall performance exceeds the minimum 35% level and the 50% stretch target.

Table 1-3 - Regulated carbon dioxide savings from each stage of the energy hierarchy for the domestic new build

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean	5.4	16
Be clean	0.0	0
Be green	21	61
Cumulative on site savings	26.4	77
Annual savings from off-set payment	8.1	-
	CO_2 savings off-set (tonnes CO_2)	
Cumulative savings for off-set payment	242	

**Figures are rounded up/down in the GLA spreadsheet*

1.6.3 Non domestic refurbishment CO_2 savings

The Class E units at 10-12 Museum Street and 35-41 New Oxford Street will be refurbished. Whilst the targets are not applicable to refurbishments, the 10% lean target has been adopted and exceeded and the overall performance exceeds the minimum 35% level.

Table 1-4 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the non-domestic refurbishment

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean	1.3	38
Be clean	0.0	0
Be green	0.1	4
Cumulative on site savings	1.4	42
Annual savings from off-set payment	2	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	60	

**Figures are rounded in the GLA spreadsheet*

1.6.4 Non-domestic new build CO_2 savings

On a site-wide scale, the 15% lean target saving and the overall 35% saving targets have not been met.

Table 1-5 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the new build non-domestic

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean	8.3	12
Be clean	0.0	0
Be green	7.4	10
Cumulative on site savings	15.6	22
Annual savings from off-set payment	56.3	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	1,688	

**Figures are rounded up/down in the GLA spreadsheet*

In their Energy Assessment Guidance cover note of June 2022, the GLA acknowledge that non domestic buildings may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35% improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. Every effort has been made to comply with the requirements for the non-domestic areas.

1.6.5 Total development CO_2 savings

The overall development performance exceeds the minimum 35% overall savings target.

Table 1-6 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the whole development

	Total regulated emissions (Tonnes CO_2 /a)	CO_2 savings (Tonnes CO_2 /a)	Percentage savings (%)
Part L 2021 baseline	129.6		
Be lean	111.8	17.7	14
Be clean	118.8	0.0	0
Be green	69.8	42.0	32
Total savings		59.8	46
	CO_2 savings off-set (tonnes CO_2)		
Cumulative savings for offset payment	2093.5		

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Figure 1-2 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the total domestic areas

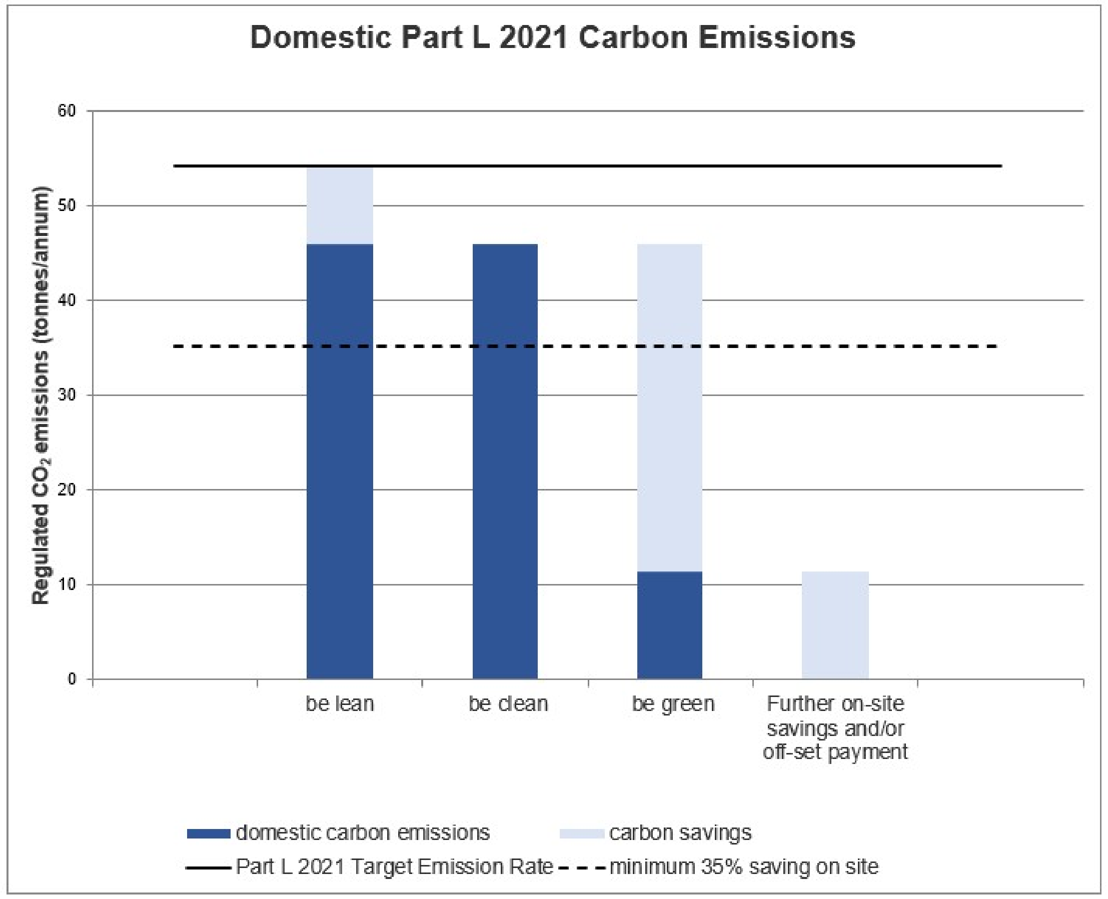
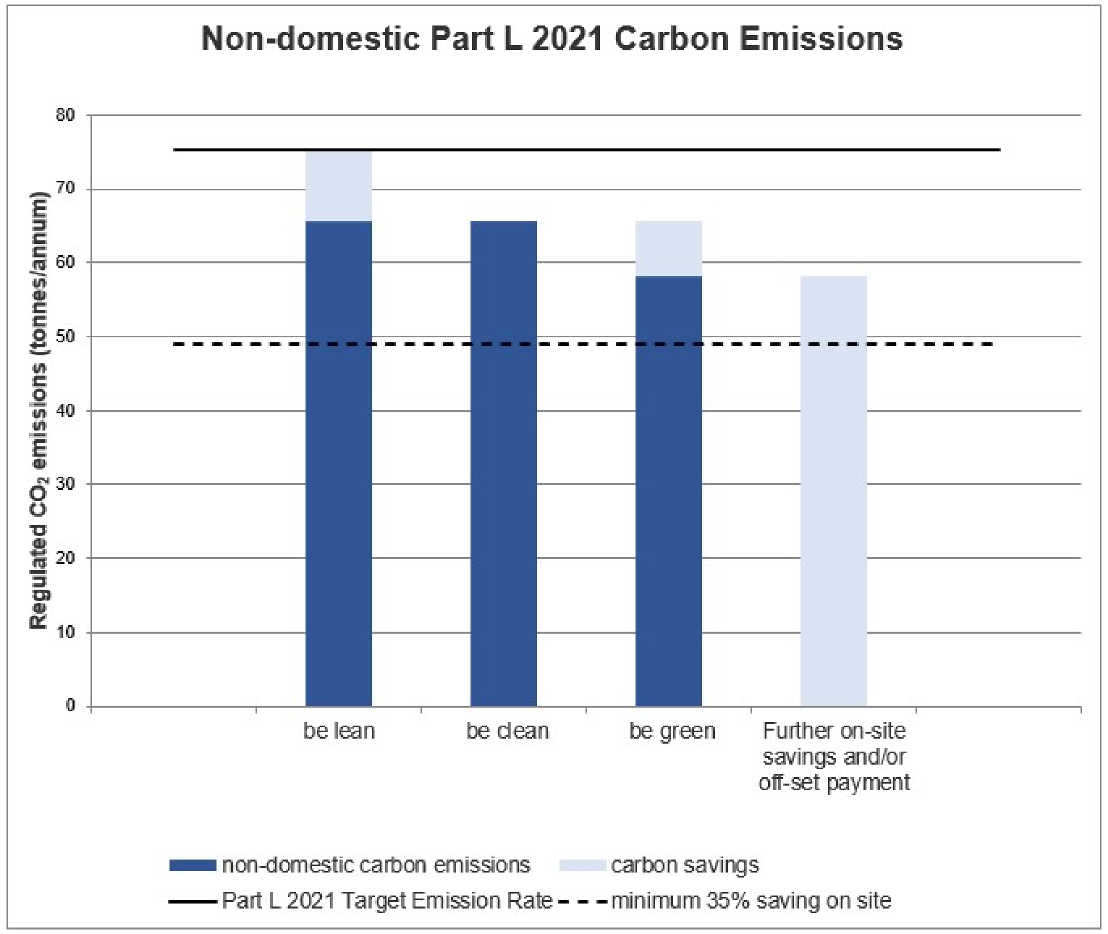


Figure 1-3 - Regulated carbon dioxide savings from each stage of the energy hierarchy for the total non-domestic areas



1.7 Carbon offsetting

The Council's preferred mechanism for carbon offsetting is a payment into the Camden Climate Fund. The Applicant proposes to consult with the Planning Authority during the submission period to agree a method for off-setting the residual development CO_2 emissions to achieve the Net Zero Carbon target.

1.8 Whole Life-Cycle carbon emissions

The New London Plan Policy SI 2 requires development proposals to calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment (WLCA) and to demonstrate actions taken to reduce life-cycle carbon emissions. A Whole Life-Cycle Carbon Assessment has been carried out following the GLA guidance document Whole Life-Cycle Carbon Assessments (March 2022) in accordance with BS EN 1578, with additional guidance from RICS Professional Statement. This assessment was completed using the GLA approved oneclick software tool. The results are presented within the WLCA report which is submitted under separate cover with this application.

2 Introduction

2.1 Overall sustainability aspirations and objectives

Camden Council and the Mayor of London have declared a 'Climate Emergency' with Camden's declaration including an 'Ecological Emergency'. Both have an aspiration to achieve a Net Zero Carbon borough and city by 2030, 20 years ahead of the national target. In June 2020, Camden approved a 5-year 'Climate Action Plan' which creates a framework for action across all aspects of the borough with the aim of achieving zero carbon by 2030.

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Certificate of Immunity from Listing granted:

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[1] Energy Assessment Guidance - Greater London Authority guidance on preparing energy assessments as part of planning applications, Greater London Authority, June 2022

- 16a West Central Street
- 18 West Central Street
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- In addition to the open space provision within the Applicant’s ownership, 729 sqm of public realm and streetscape improvements outside of the Applicant’s ownership is proposed.

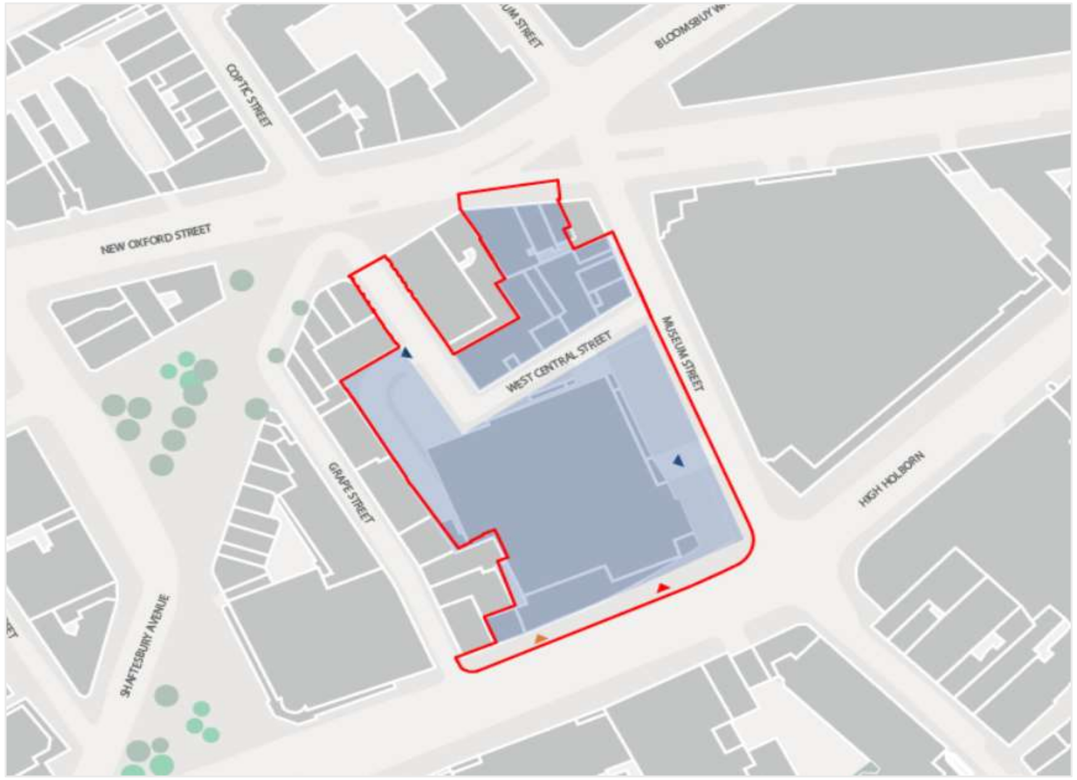

Figure 2-1 – Red line boundary

Figure 2-2 – Proposed Scheme Overview

2.3 Planning policy

This section provides a summary of the Greater London Authority (GLA) and the London Borough of Camden's key planning policy requirements relating to energy and carbon that have been taken into consideration by the design proposals.

2.3.1 Key policies and requirements

Camden Council and the Mayor of London have declared a 'Climate Emergency', with Camden's declaration including an 'Ecological Emergency'.

Both have an aspiration to achieve a Net Zero Carbon borough and city by 2030, 20 years ahead of the national target. It is expected that both new development and refurbishments will actively contribute to this.

In June 2020, Camden approved a 5-year 'Climate Action Plan' which creates a framework for action across all aspects of the borough with the aim of achieving zero carbon by 2030.

The Development proposals have been designed with consideration for these aspirations and for the key policies relating to energy and carbon as summarised in the table opposite.

2.3.2 GLA energy assessment guidance (June 2022)

This guidance document explains how to prepare an energy assessment to accompany major planning applications and sets out what information should be included within the energy statement. This energy statement has been prepared in accordance with that guidance.

This Energy Statement has been prepared in accordance with the GLA Energy Assessment Guidance (June 2022), Part L 2021 GLA carbon emissions reporting spreadsheet v2.0_0 and Part L 2021 assessment methodology.

2.3.3 Be Seen energy monitoring guidance (September 2021)

The 'Be Seen' Energy Monitoring Guidance, published in September 2021, explains the process that needs to be followed for new major developments to comply with the 'be seen' post-construction monitoring requirement of the LP Policy SI2. The later requires monitoring, verifying and reporting of the actual operational energy performance of major developments for at least five years via the Mayor's 'be seen' monitoring portal.

2.4 Policy summary

Table 2-1 – Energy policy summary

Policy	Summary of requirements
London Plan (March 2021)	
Policy SI 2 Minimising greenhouse gas emissions	• Follow the energy hierarchy. • Minimum overall CO_2 reduction of 35% to be achieved; Target is net zero carbon in operation. • Cash-in-lieu contribution will be required for residual onsite CO2. *(Note that New London Plan suggests £95 tCO2 calculated against 30 years).* • Minimum 'lean' (energy efficiency) target of 10% for residential and 15% for non-domestic. • Monitor and report on energy performance for at least 5 years. • Carry out whole life carbon emissions assessment.
Policy SI 3 Energy infrastructure	• Engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development. • Connect to existing heat network where possible.
Policy SI 4 Managing heat risk	• Measures to reduce impact of urban and dwelling overheating (apply 'cooling hierarchy' and demonstrate mitigation through CIBSE modelling). • Minimise overheating risk in accordance with cooling hierarchy (passive design first; active cooling to be avoided as far as possible). Use CIBSE methodology to demonstrate overheating risk has been reduced as far as possible.
Camden Local Plan 2017	
Policy CC1 Climate change mitigation	• Promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy
Policy CC2 Adapting to climate change	• Measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy

2.5 Target development CO_2 emissions reduction

Based on current planning policy requirements listed in Section 2.3 the regulated CO_2 emissions reduction targets against Part L 2021 for the proposed development are as follows:

Table 2-2 – Regulated carbon dioxide savings from each stage of the energy hierarchy for the new build non-domestic

	'Lean' target	Minimum total target	Zero carbon
Domestic refurbishment (West Central Street)	Best endeavours (10% has been adopted)	Best endeavours (35% has been adopted)	✓
Non domestic refurbishment (West Central Street)	Best endeavours (15% has been adopted)	Best endeavours (35% has been adopted)	✓
Domestic new build (High Holborn, Vine Lane and West Central Street)	10%	35%	✓
Non-Domestic New Build (Museum Street and Class E uses)	15%	35% 50% stretch target	✓

2.6 LETI net zero carbon

The Applicant is keen for Museum Street, as the largest building on the proposed site, to target Net Zero Carbon through achieving a Net Zero Carbon balance between on and offsite measures, prioritising the former. Appropriate offsite methods are currently being explored.

A review has been carried out by the project team of the design measures and indicators which should be considered in order for Museum Street to aim towards Net Zero Carbon. The review is based on the measures set out in London Energy Transformation Initiative (LETI) Climate Emergency Design Guide (for office buildings) which was published in January 2020. The Guide's definition of Net Zero Carbon relates to whole life carbon i.e. both operational carbon and embodied carbon. At this stage, Museum Street is focusing on operational carbon, as per LETI's definition:

Operational Carbon

A new building with net zero operational carbon does not burn fossil fuels, is 100% powered by renewable energy, and achieves a level of energy performance in-use in line with national climate change targets.

The proposed energy strategy includes applicable and appropriate measures and indicators from the LETI Design Guide; however, it is acknowledged that the Guide will evolve over time through feedback and contributions from the industry. Due to the efforts being made by the Applicant in this area, Museum Street is registered as LETI 'Pioneer Project' and is part of the network of other projects aspiring for Net Zero Carbon.

2.7 Supporting information

This energy statement should be read in conjunction with the following reports submitted with this application:

- Design & Access Statement
- Air Quality Assessment
- Noise Impact Assessment
- Sustainability Statement
- Whole Life Carbon Assessment

3 Establishing CO_2 emissions

3.1 Energy hierarchy

The energy strategy for the Development follows the energy hierarchy of, 'Be Lean', 'Be Clean', 'Be Green', and 'Be Seen', as set out within the London Plan. At each stage of the hierarchy the proposed development's CO_2 emissions are evaluated and the percentage reduction achieved for the measures applied are reported.

3.2 Methodology

Regulated energy use and the associated CO_2 emissions have been calculated using the Dynamic Simulation Model methodology with IES Virtual Environment software for the non-domestic areas and Elmhurst Energy Design v10.2 for the domestic dwellings. The CO_2 emissions have been evaluated at each stage of the energy hierarchy.

The total residential (new build) development, total non-domestic development, and the total whole development CO_2 emissions reported are based on the outputs from the BRUKL reports and the SAP output reports. Total figures are calculated on an area weighted average basis.

Note: the areas given in the results tables are as per the DSM and SAP models and as reported in the BRUKL and SAP reports (which accompany this statement) as opposed to the proposed development GIA quoted elsewhere. The DSM model has been constructed in compliance with the 'National Calculation Methodology', and therefore includes minor geometric simplifications resulting in a slight difference in floor area.

3.2.1 Carbon dioxide emission factors

The carbon emission factors used in this report are as Part L 2021, SAP 10.2. Gas emissions rates are 0.210 $kgCO_2/kWh$. Grid supplied electricity emission factors vary by month and are shown below.

Table 3-1 CO_2 emission factors for grid-supplied electricity (kCO_2/kWh)

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
0.163	0.160	0.153	0.143	0.132	0.120	0.111	0.112	0.122	0.136	0.151	0.163

3.3 Development baseline emissions

In accordance with the GLA Energy Assessment Guidance the proposed development baseline emissions have been calculated assuming that the heating would be provided by air source heat pumps (notional building performance) for the non-domestic buildings and gas boilers for the domestic buildings. Any active cooling is provided by electrically powered equipment. Appendix 3 of the GLA's Energy Assessment Guidance provides the specification for baseline emissions of refurbishments.

Table 3-2 shows the total calculated carbon emissions for the baselines of the proposed development.

3.3.1 Domestic refurbishment baseline emissions

Table 3-2 – Regulated carbon dioxide emissions – Baseline, domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	19.7		
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

3.3.2 Domestic new build baseline emissions

Table 3-3 – Regulated carbon dioxide emissions – Baseline, domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	34.5		
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

3.3.3 Non-domestic refurbishment baseline emissions

Table 3-4 – Regulated carbon dioxide emissions – Baseline, non-domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	3.4		
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

3.3.4 Non-domestic new build baseline emissions

Table 3-5 – Regulated carbon dioxide emissions – Baseline, non-domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	71.9		
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

3.3.5 Total development baseline emissions

Table 3-6 – Regulated carbon dioxide emissions – Baseline, total development

	Total regulated Eemissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	129.6		
Be Lean	-	-	-
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

3.4 Summary outputs from modelling – baseline case

Refer to the SAP Output Sheets in Appendix A for details of the outputs from the baseline energy assessment for residential refurbishments, and Appendices H and I for the baseline (TER values) for all other areas.

4 Demand reduction (Be Lean)

The Mayor has set efficiency targets through the publication of the London Plan. It is expected that non-domestic developments should achieve at least a 15% improvement on Building Regulations, and domestic developments should achieve at least 10%, energy efficiency (i.e. lean) measures alone.

Passive and active design measures are proposed to reduce energy demand at source as far as possible. Where appropriate and applicable, these measures have been informed by LETI Net Zero Carbon guidance.

4.1 Passive design measures

Enhanced fabric elements have been considered for the proposed development with consideration for compatibility with the façade design and geometry, construction type and method.

The glazing throughout the site has been designed to balance daylight, solar gains, heat losses and openable area for natural ventilation. The specification is show in Table 4-1.

Table 4-1 - Glazing throughout the site

	Solar control glazing	Daylighting maximised	Opportunity for natural ventilation
Museum Street office	0.35 g-value	✓	✓
Vine Lane dwellings	0.45 g-value	✓	✓
West Central Street refurbished dwellings	0.62 g-value	✓	✓
West Central Street new build dwellings	0.45 g-value	✓	✓
High Holborn dwellings	0.45 g-value	✓	✓
New build Class E	0.5 g-value	✓	✖
Refurbished Class E	0.53 g-value	✓	✖

Fabric performance values have been provided by the architect and façade consultant, as specified in the tables below.

4.1.1 Domestic refurbishment passive measures

Within the West Central Street development, both blocks known as 10-12 Museum Street and New Oxford Street are to be refurbished. The Grade II listing on 10-12 Museum Street and 35-37 New Oxford Street limits the fabric upgrades that can be made to those areas. Refer to the façade consultant's report for the detailed build-up of the various elements.

Table 4-2 - Comparison of fabric performance of refurbished dwelling against GLA baseline values

Area	Wall U-value (W/m²K)	Floor U-value (W/m²K)	Roof U-value (W/m²K)	Window U-value (W/m²K)	Air perm. (m³/h/m² @ 50 Pa)
GLA baseline	0.55	0.25	0.16	1.60	-
10 Museum Street	0.30	0.25	0.16	1.60	10.0
11-12 Museum Street	0.30	-	0.16	1.60	10.0
35 New Oxford Street	0.30	0.25	0.16	1.60	10.0
37 New Oxford Street	0.3	0.25	0.16	1.60	10.0
39-41 New Oxford Street	0.21	-	-	1.60	10.0

4.1.2 Domestic new build passive measures

The fabric performance for the new build dwellings is shown below.

Table 4-3 - Comparison of fabric performance of new build dwellings against Part L 2021 Building Regulations notional dwelling

Area	Wall U-value (W/m²K)	Floor U-value (W/m²K)	Roof U-value (W/m²K)	Window U-value (W/m²K)	Air perm. (m³/h/m² @ 50 Pa)
Part L 2021 notional	0.18	0.13	0.11	1.20	5.0
High Holborn	0.16	0.10	0.10	0.95	3.0
Vine Lane	0.15	0.12	0.10	0.95	3.0
16A West Central Street	0.15	0.12	0.1	0.95	3.0
16B – 18 West Central Street	0.15	0.12	0.10	0.95	3.0

4.1.3 Non-domestic new build passive measures

Table 4-4 - Comparison of fabric Performance of actual building against Building Regulations Part L 2021 notional building

Area	Wall U-value (W/m^2K)	Floor U-value (W/m^2K)	Roof U-value (W/m^2K)	Window U-value (W/m^2K)	Air perm. ($m^3/h/m^2$ @ 50 Pa)
Part L notional	0.18	0.15	0.15	1.40	3.0
Museum Street	1.45*	0.18	0.18	1.45*	3
High Holborn	0.16	0.12	NA	1.20	3
Vine Lane	0.15	0.12	0.12	1.22	3
16A West Central Street	0.24	NA	NA	1.30	3
16B-18 West Central Street	0.15	NA	NA	1.30	3

**Overall curtain wall U-value including thermal bridging. Notional building does not include thermal bridging*

The office building at 1 Museum Street includes openable panels in the façade. These allow for mixed mode operation of the building, reducing cooling demand in shoulder seasons.

4.2 Active design measures

The following active energy efficiency measures have been considered and incorporated into the building services design:

- Low energy LED lighting is proposed throughout the proposed development, both internally and externally to minimise associated electrical demand. See table below for details.
- Efficient mechanical ventilation with heat recovery with minimised specific fan power and optimised heat exchanger efficiency. See table below for details.
- Energy metering, including smart meters for the tenants and energy meters on the electrical supply to the air source heat pumps to monitor the consumption.
- Demand-side response through intelligent controls is being considered and will be detailed at RIBA Stage 4 onwards

Table 4-5 - Summary of Lean measures

Building	LED lighting	Mechanical ventilation	
	Lamp efficacy	AHU SFP	Heat recovery efficiency
Museum Street	140 lm/W has been used for the offices (based on Fagerhult Appareo range) with Photoelectric dimming and a parasitic power of $0.02W/m^2$. Areas other than the office have a lighting efficacy of 110 lm/W.	1.5 W/l/s office 1.1 W/l/s retail	80% (seasonal)
Vine Lane	Domestic - 100% low energy lighting used 140 lm/W has been used for retail (based on Fagerhult Appareo range) and landlord areas with 80 lm/W for display lighting.	Local domestic high efficiency MVHR units 1.1 W/l/s	 90% (based on Nuaire XBC+ range)
West Central Street	110 lm/W has been used for retail (based on Fagerhult Appareo range) and landlord areas with 80 lm/W for display lighting.	1.1 W/l/s	90% (based on Nuaire XBC+ range)
High Holborn	110 lm/W has been used for retail (based on Fagerhult Appareo range) and landlord areas with 80 lm/W for display lighting.	1.1 W/l/s	90% (based on Nuaire XBC+ range)

4.3 Demand side response plans

The demand side response plans for the development are based primarily on the principles of:

- Peak reduction
- Active demand response measures

Peak reduction across the site is achieved by the passive and active energy efficiency measures set out above, which aim to minimise the peak heating and cooling demands of each plot. In particular, the provision of openable windows or ventilation panels in the office of 1 Museum Street to be used for mixed-mode free cooling (where environmental noise and air quality permits) has been demonstrated to significantly reduce the daily peak and annual cooling requirements.

Figure 4-1.2.2 is an excerpt from a study carried out by Scotch Partners on the benefits of adopting a mixed-mode ventilation strategy for the 1 Museum Street block. The graph indicates the cooling load for a typical floor of 1 Museum Street throughout a typical summers day both with (indicated in blue) and without (indicated in green) the free cooling natural ventilation strategy applied, compared to the Building Regulations notional building values for the same space.

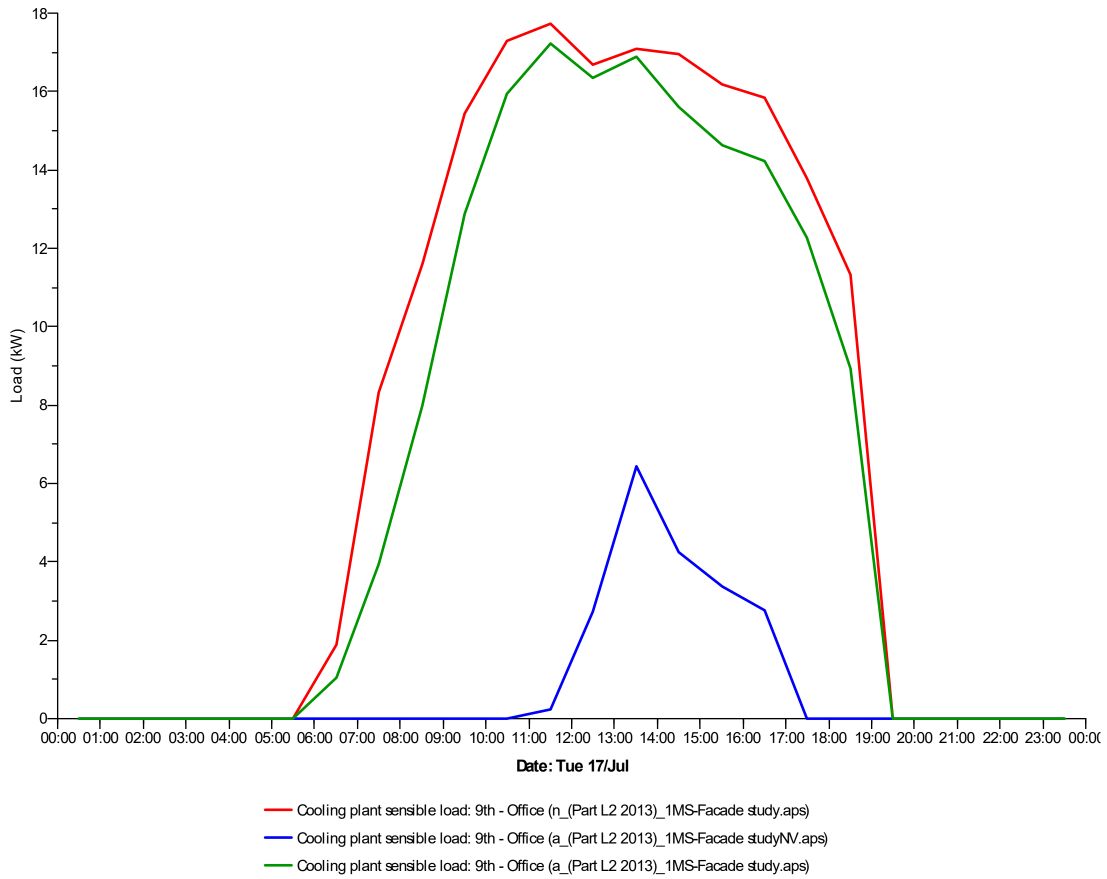

Figure 4-1.2.2 - Comparison of cooling demand on a typical summer day for building with (blue line) and without (green line) mixed-mode free cooling strategy compared to the Building Regulations Notional Building (red)

It can be seen from the graph that in this case the use of the operable panels for free cooling

1. Reduces the peak load on the cooling plant
2. Significantly reduces the overall cooling consumption for this 24 hour period.
3. Shortens the peak cooling period & moves the peak relative to the fully comfort cooled scenario

Peak reduction for domestic hot water is achieved through the provision of water storage throughout the development where appropriate. The domestic hot for the shower areas of 1 Museum Street which is expected to be one of the largest peak consumers of domestic hot water on site, is generated via a water source heat pump connected to the condenser loop system, and stored in a 2000 litre thermal store. The water source heat pump allows the hot water to be generated utilising waste heat from other parts of 1 Museum Street where available, and the thermal storage allows domestic hot water to be generated at times where surplus heat is available and/or grid demand is low.

Heating and cooling setpoints are intended to be adaptive with increased comfort bands. Heating and cooling setpoints and comfort bands will respond to occupant usage of the mixed mode natural ventilation system with the comfort bands being broadened and/or heating & cooling operation being inhibited whilst the panels are opened.

4.4 CO_2 savings from lean measures

The regulated carbon dioxide savings at the 'lean' stage of the energy hierarchy are provided in the tables below, and demonstrates that the residential areas and new build refurbishment areas are compliant with London Plan and Camden policy requirements. The new build non-domestic areas do not meet the required 15% savings, but in their Energy Assessment Guidance cover note of June 2022, the GLA acknowledge that non domestic buildings may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet energy efficiency target. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. Every effort has been made to comply with the requirements for the non-domestic areas.

4.4.1 Domestic refurbishment savings from lean measures

Table 4-6 – Regulated carbon dioxide savings – Lean, domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	19.7		
Be Lean	17	2.7	14
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

4.4.2 Domestic new build savings from lean measures

Table 4-7 – Regulated carbon dioxide savings – Lean, domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	34.5		
Be Lean	29.0	5.4	16
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

4.4.3 Non-domestic refurbishment savings from lean measures

Table 4-8 – Regulated carbon dioxide savings – Lean, non-domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	3.4		
Be Lean	2.1	1.3	38
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

4.4.4 Non-domestic new build savings from lean measures

Table 4-9 – Regulated carbon dioxide savings – Lean, non-domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	71.9		
Be Lean	63.6	8.3	12
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

4.4.5 Total development savings from lean measures

Table 4-10 – Regulated carbon dioxide savings – Lean total development

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	129.6		
Be Lean	111.8	17.7	14
Be Clean	-	-	-
Be Green	-	-	-
Total cumulative savings	-	-	-

4.5 Summary outputs from modelling – Lean case

Refer to the BRUKL and SAP Output Sheets in Appendix B and Appendix C for details of the outputs from the 'lean case' energy assessment.

4.5.1 Domestic fabric performance

The total Part L Fabric Energy Efficiency Standard (FEES) for the domestic new build is provided in the table below:

Table 4-11 New build domestic FEES performance

	Target Fabric Energy Efficiency (MWh/a)	Design Energy Efficiency (MWh/a)	Improvement (%)
Development total	41.87	39.87	5

4.6 Space heating demand

The site space heating demands for the Site are shown below. It should be noted that this is a reporting requirement only, and the figure does not need to be met and is particularly challenging for refurbishments, especially in Grade II Listed buildings

Table 4-12 Site space heating demands

Area	Space heating demand ($kWh/m^2/yr$)
GLA benchmark value	15
1 Museum Street office	10.0
1 Museum Street Class E	20.4
High Holborn new build residential	25.9*
High Holborn new build Class E	19.6
Vine Lane new build residential	18.4*
Vine Lane new build Class E	5.9
West Central Street refurbished residential	58.4*
West Central Street new build residential	18.9*
West Central Street block Class E	7.2

**by Treated Floor Area from SAP calculations*

These numbers have been calculated using CIBSE TM54 for the Be Seen reporting for the non-domestic and using SAP for the dwellings, following Be Seen calculation guidance.

5 Cooling and overheating

5.1 The cooling hierarchy

The cooling hierarchy as set out within the London Plan Policy SI 4 requires passive design measures to be maximised to reduce the requirement for active cooling.

> **Policy SI 4 Managing heat risk**
>
> A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.
>
> B Major development 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 following cooling hierarchy:
>
> 1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
> 2) minimise internal heat generation through energy efficient design
> 3) manage the heat within the building through exposed internal thermal mass and high ceilings
> 4) provide passive ventilation
> 5) provide mechanical ventilation
> 6) provide active cooling systems.

The design team has responded to this policy by incorporating measures following this hierarchy, set out below:

A - The site design incorporates green roofs and landscaped areas in aid of reducing the building's impact on the urban heat island.

B1 – To minimise the amount of heat entering the building during summer and unseasonably warm months the following measures to limit unwanted solar gains have been considered as part of the architectural design (refer to the Design & Access Statement for further detail). The table opposite summarises the measures adopted:

In the dynamic building simulation models, the adjacent buildings have also been included to account for the shading that these cast onto the Development.

B2 - To minimise internal heat generation, energy efficient lighting is proposed to all areas; it is anticipated that for the base build low energy appliances will be provided throughout.

Enhanced insulation will be installed to the pipework distribution and to the thermal storage to minimise heat loss. Additionally, the services distribution throughout the building has been designed to minimise pipe lengths as far as practicable. Further measures are shown below.

Table 5-1 - Cooling hierarchy measures

Measure	Museum Street	Vine Lane	West Central Street	High Holborn
g-value	0.35	0.47	0.47	0.47
Internal blinds	Not provided, however fittings to be installed for tenant fit-out	Provided, but not included in assessment as required by Part O	Not provided	
External Shading	Building articulation includes recessed windows and 2m deep overhangs where terraces are provided. Class E units shaded by adjacent buildings	Adjacent buildings, External solar shading via balcony overhangs to the eastern facades as well as an external access gallery to the western façade.	Adjacent buildings, recessed windows Class E units shaded by adjacent buildings	
Natural Ventilation	Operable ventilation panels provided to all office floors except from ground to second floor. Openable doors to terraces at levels where provided.	Openable windows throughout. (Note within modelling opening times have been modelling in line with acoustic restrictions)	Openable windows. Dual aspect allows for cross ventilation.	Openable windows subject to noise and air quality restrictions

B3 – Museum Street has exposed concrete soffits and generous floor to ceiling heights providing some element of thermal mass. Exposed thermal mass is not proposed for domestic areas due to 24 hour occupancy.

B4 & B5 - Museum Street

A mixed mode ventilation strategy has been developed for Museum Street. A centralised ventilation system is proposed to serve all office areas with air handling units located at both basement level (B2) and roof level. Basement air handling units will serve office floors 01 to 08 and connect to atmosphere via an intake air shaft within the Grape Street block and exhaust air shafts discharging at ground floor level within 1 Museum Street and at 1st floor level within the Grape Street block. Roof level air handling units will serve office floors 09 to 20 and connect to atmosphere via separated intake and exhaust points.

All air handling units will incorporate high efficiency heat recovery, with thermal wheel heat recovery preferred where possible due to the higher heat recovery efficiencies that can be achieved with this technology. Run-around coil type heat recovery is proposed for the air handling units located at roof level due to the limitations on overall unit height at roof level.

Particulate filters will be provided within each air handling unit to meet the internal air quality requirements set out under the WELL Building standard. The requirement for gas filters (carbon filters for scrubbing of oxides of nitrogen) is to be confirmed once the results of the detailed air quality analysis are available. *Note: Arup have advised that the height of the air intakes above street level should result in NOx levels being sufficiently low so as to mitigate the requirement for gas filters, and therefore no allowance for gas filtration has been made in the Stage 2 design proposals.*

The system is intended to operate as a "demand control ventilation" system, with fresh air rates to each tenancy automatically varied to maintain a constant CO_2 level within the space. Fresh air rates are to be varied through variable air volume (VAV) dampers located within each tenancy, with the supply volumes of the main air handling units modulated through variable speed drives fitted to all fans.

Openable panels are provided within the façade to compliment the mechanical ventilation system serving the office floor levels and provide the opportunity for "mixed-mode" free cooling when external conditions permit. A monitoring and control system including contactors on each operable panel and a roof mounted weather station will be provided to encourage users to utilise the operable panels when external environmental conditions permit, and prevent energy wastage by adapting setpoints and inhibiting the operation of the active heating & cooling systems where appropriate

B4 Vine Lane

Passive ventilation measures have been included within the design of the building via openable side-hung, full-height windows to all apartments. Restrictions due to plant noise generated by rooftop plant serving nearby offices places a limit on the opening of windows during plant operational hours (typical office working week). This applies to the south-east of the site.

B5 Dwellings - Each apartment will be provided with supply and extract ventilation through an independent mechanical ventilation with heat recovery (MVHR) unit. The MVHR will supply tempered (via heat recovery only) and filtered, fresh air to the living areas and bedrooms and will extract vitiated air from the kitchens, bathrooms, and WCs. The MVHR units will incorporate a summer bypass operation mode.

Each apartment will be provided with a local MVHR unit providing ventilation in line with minimum Part F flow rates. The MVHR units will incorporate summer bypass. The units will provide a contribution to managing overheating risk, but have not been over-engineered or over-sized for this purpose.

The air quality assessment by Arup found that there are air quality issues at ground, first and second floors on the New Oxford Street elevation of the West Central Street block. For this reason, the intake connection for the MVHRs serving these apartments will be on the internal courtyard side, which will guarantee enough distance from the main street and avoid the requirement of NOx filtration.

Arup have also advised that the High Holborn apartments should not rely on operable windows due to the proximity of the main road. NOx filters will be fitted to the air intakes for the MVHR.

B5 – Retail - A series of high-level louvres at ground floor will provide allowance for future dedicated ventilation plant in the ground floor retail units.

B6 – Active cooling systems are proposed for the building where natural ventilation and mixed-mode is not sufficient to provide occupant comfort.

5.2 Overheating risk analysis

The London Plan requires new developments to assess their overheating risk against CIBSE TM52 for non-domestic buildings and Part O of the building regulations for dwellings.

5.2.1 Overheating criteria for domestic areas

An initial review of overheating risk was undertaken using the Good Homes Allowance Early Stage Overheating Risk Tool for the new buildings. This is included in Appendix D. The purpose of the tool is to identify the baseline overheating risk of a development, and comprises 14 questions against which a score is allocated covering geography, local context, site and scheme characteristics, dwelling design and solar heat gains and ventilation.

The Tool has returned a site-wide score of 30 which represents a high risk of overheating. This is the norm for multi-residential buildings in London. It is important to note that the GHA Overheating Risk Tool is a simplified tool and is designed to recommend appropriate next steps to reduce the risk of overheating. The design team has undertaken Part O dynamic thermal modelling, based on CIBSE TM59, to demonstrate that the overheating risk has been mitigated.

Thermal comfort has subsequently been assessed using dynamic thermal modelling, against the criteria set out in Part O 2021.

All residential spaces will have general ventilation via a local MVHR system with additional summertime purge ventilation provided via openable windows and doors as part of the overheating reduction strategy for summertime. Part O adopts TM 59 assessment methods and overheating criteria:

Criteria 1 - Hours of exceedance (He) for living rooms, kitchens and bedrooms:
The number of hours, during which the temperature difference (between indoor and outdoor) is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours (TM52 Criterion 1: Hours of exceedance).

Criteria 2 – Bedrooms only:
To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms equates to 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

For predominantly mechanically ventilated or cooled rooms the operative temperature should not exceed 26°C for more than 3% of the annual occupied hours

Part O additionally states that windows should start to open when the internal temperature reaches 22°C and are fully open when internal temperature reaches 26°C. If there are noise or air quality issues then windows also cannot be assumed to be open at night. Windows that can be left open overnight are fully opened overnight only if the internal temperature is 23°C or above at 11pm.

There are further limits on night time window opening due to external noise. Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

a) 40dB L_{AeqT} averaged over 8 hours (between 11pm and 7am)
b) 55dB L_{AFmax} more than 10 times a night (between 11pm and 7am)

5.2.2 Overheating for non-domestic areas

Thermal comfort has been assessed against the criteria set out in CIBSE TM52:2013 'The limits of thermal comfort: avoiding overheating in European buildings.' A room or building that fails any two of the three criteria is classed as overheating.

Criterion 1: Hours of exceedance (H_e)

The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September). The number of hours (He) during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.

Criterion 2: Daily weighted exceedance (W_e)

The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability. To allow for the severity of overheating the weighted exceedance (We) shall be less than or equal to 6 in any one day.

Criterion 3: Upper limit temperature (T_{upp})

The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable. To set an absolute maximum value for the indoor operative temperature the value of ΔT shall not exceed 4 K.

5.2.3 Model inputs and assumptions

The key modelling inputs are shown in the following tables.

Domestic

Table 5-2 - Model Inputs and Values

Software	ModelIT, ApacheSIM Dynamic Simulation, Suncast and Macroflo (IESVE)
CIBSE DSY Weather Files	Location: London Weather Centre Iteration 1 - DSY 1 2020's high emissions 50th percentile range Iteration 2 - DSY 2 2020's high emissions 50th percentile range Iteration 3 - DSY 3 2020's high emissions 50th percentile range
Lighting*	2W/m² Sensible Heat Gain with a 0.45 Radiant Fraction
Occupancy*	Each occupant generates 75W sensible and 55W latent heat gain. This is reduced by 30% for bedrooms during night time when occupants are sleeping. Living/kitchens: 1 bedroom dwelling - 1 occupant 2 bedroom dwelling – 2 occupants Bedrooms: Single bedroom- 1 occupant Double bedroom - 2 occupants
Equipment*	Living/kitchens: Peak 450W evening gain, 110W daytime gain and 85W base gain. Bedrooms: Peak 80W daytime gain and 10W base gain
Fabric performance	As per section 4
Mechanical ventilation	Living/Kitchens – 21l/s Bedroom – 8l/s

**Lighting, occupancy and equipment gains profiles are based on CIBSE TM59:2017 Table 2.*

Non- domestic

Table 5-3 - Model inputs and values

Software	ModelIT, ApacheSIM Dynamic Simulation, Suncast and Macroflo (IESVE)
CIBSE DSY weather files	Location: London Weather Centre Iteration 1 - DSY 1 2020's high emissions 50th percentile range Iteration 2 - DSY 2 2020's high emissions 50th percentile range Iteration 3 - DSY 3 2020's high emissions 50th percentile range
Internal gains	Refer to raw data results provided separately in Appendix E, in accordance with TM52
Fabric performance	As per Section 4
Mechanical ventilation	Centralised and decentralised mechanical systems. Refer to Section 4.2
Cooling	Via Air Source Heat Pumps

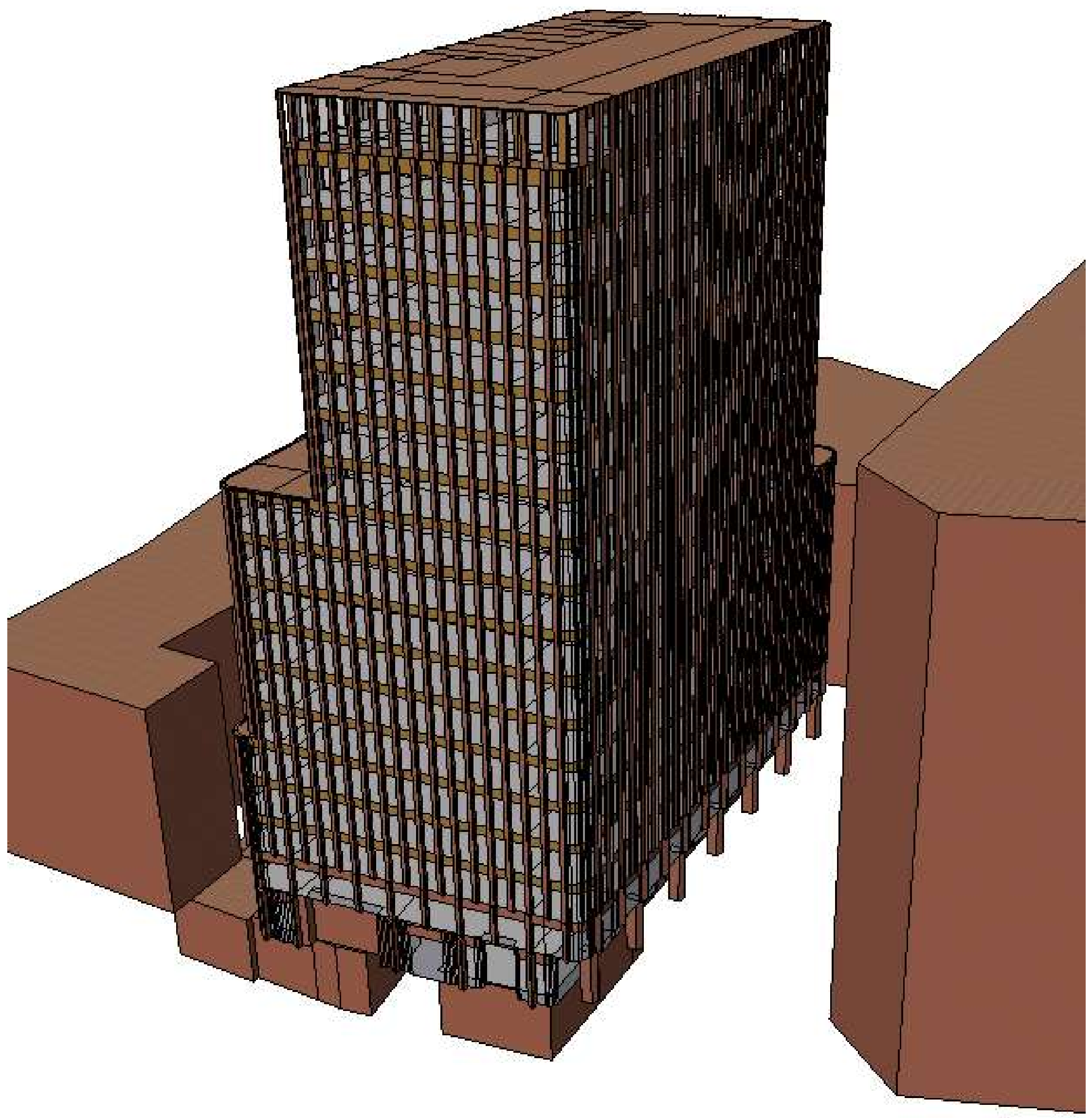

Figure 5-1 Image of 1 Museum Street dynamic thermal model

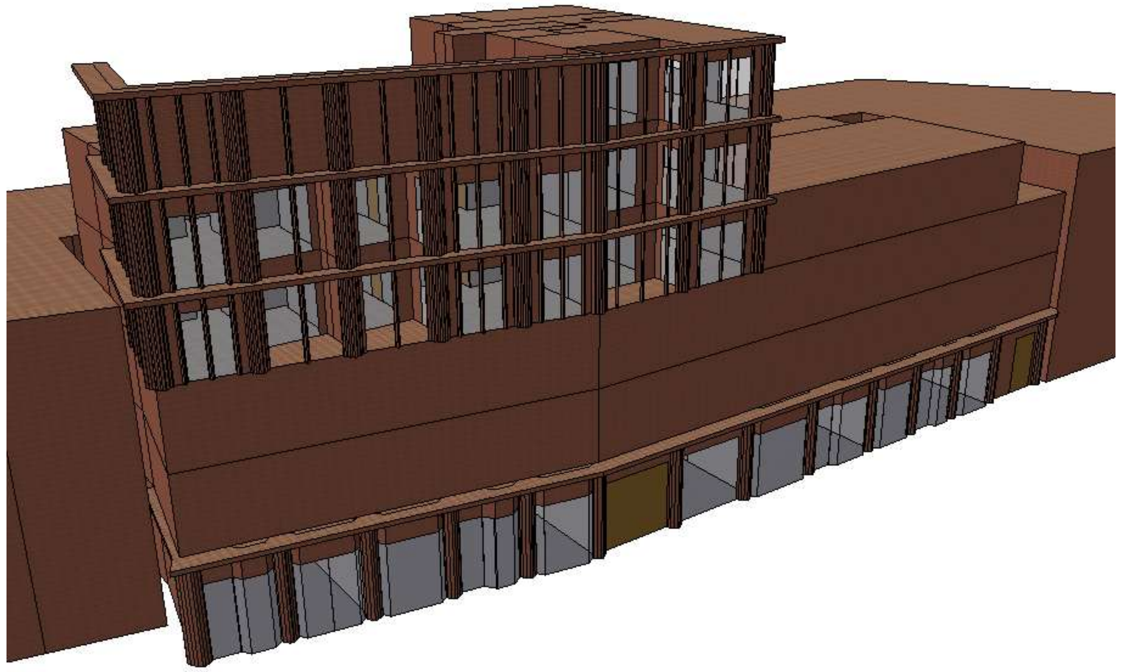

Figure 5-2 Image of Vine Lane dynamic thermal model

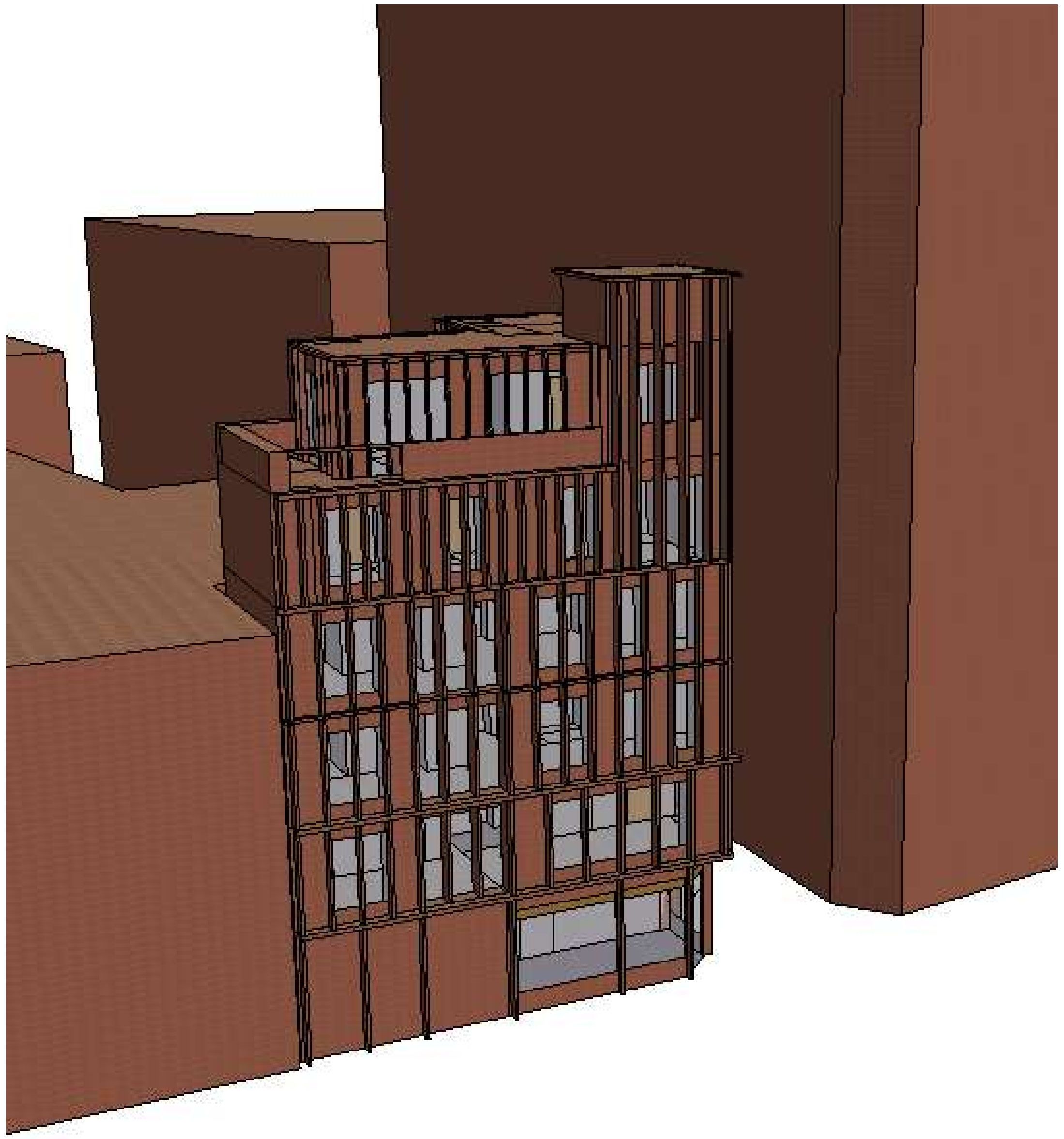

Figure 5-3 Image of High Holborn dynamic thermal model

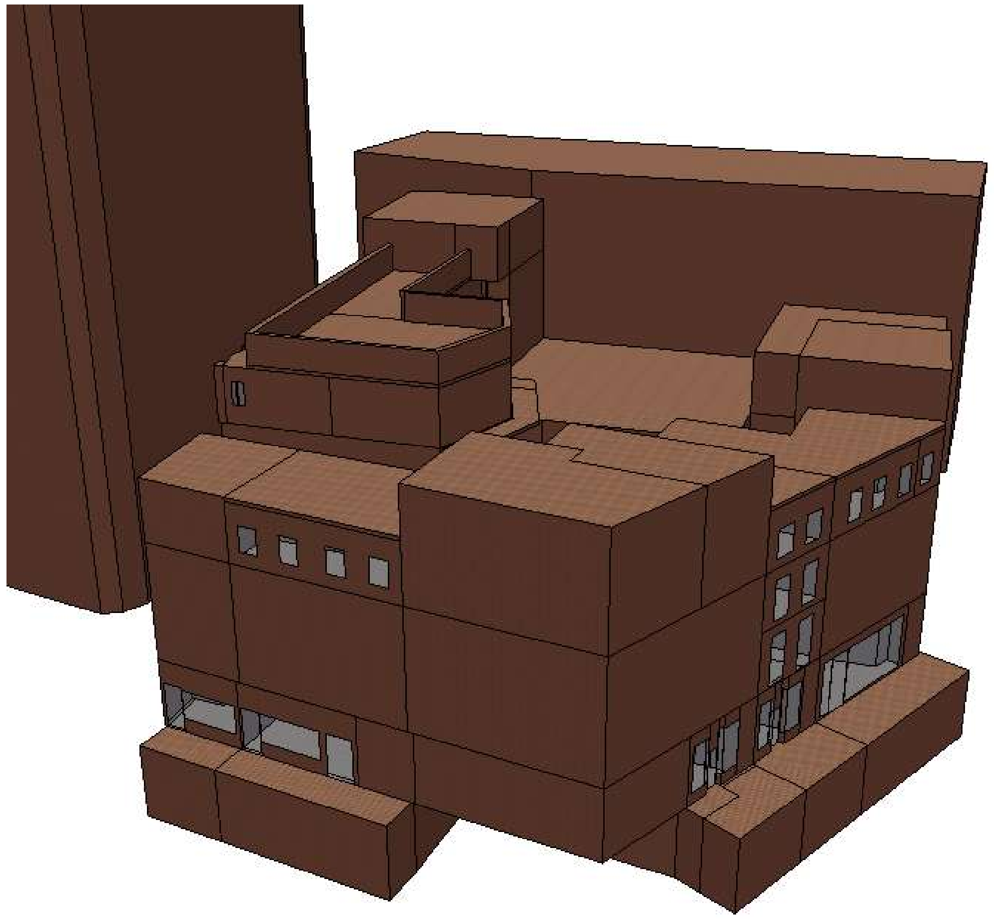

Figure 5-4 Image of West Central Street dynamic thermal model

5.2.4 Overheating assessment results

The Applicant has assessed the risk of overheating according to Part O and CIBSE TM52 via dynamic thermal modelling. The overheating risk analysis has been assessed via a dynamic thermal model using DSY1 weather file (high emissions, 50% percentile scenario). Additional testing has been undertaken using DSY2 (very intense single warm spell) and DSY3 (prolonged period of sustained warmth). Sample flats have been modelled for the residential units, and sample zones for the office at 1 Museum Street.

Full overheating raw data results are provided in Appendix E.

West Central Street

The modelling outputs show that all of the sample apartments in West Central Street pass both criteria under Part O when relying on openable windows alone without restriction.

Table 5-4 - West Central Street overheating analysis against Part O, natural ventilation

Room Name	Weather file DSY 1 2020		
	Criterion 1:	Criterion 2:	Pass/ Fail
Pass/Fail Threshold	3%	32 hrs	
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 1	0.1	16	Pass
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 2	0	18	Pass
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 3	0	15	Pass
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 4	0	17	Pass
1F-3F REFURB APT 4B8P KITCHEN	0.2	-	Pass
1F-3F REFURB APT 4B8P LIVING	1	-	Pass
3F LISTED APT 1B2P DOUBLE BEDROOM	0	15	Pass
3F LISTED APT 1B2P LIVING/DINING/KITCHEN	0.1		Pass
3F REFURB APT 1B2P DOUBLE BEDROOM	0	18	Pass
3F REFURB APT 1B2P LIVING/DINING/KITCHEN	0.1	-	Pass
4F NEW 402 1B2P DOUBLE BEDROOM	0	17	Pass
4F NEW 402 1B2P LIVING/DINING/KITCHEN	0.3	-	Pass
4F NEW 403 2B4P DOUBLE BEDROOM 1	0.2	20	Pass
4F NEW 403 2B4P DOUBLE BEDROOM 1	0.1	18	Pass
4F NEW 403 2B4P LIVING/DINING/KITCHEN	0.1	-	Pass

However, there are restrictions overnight due to noise. See Figure 5-5 for details. A subsequent assessment was undertaken with windows shut at night time.

Table 5-5 - West Central Street overheating analysis against Part O, natural ventilation windows closed at night

Room Name	Weather file DSY 1 2020		
	Criterion 1:	Criterion 2:	Pass/ Fail
Pass/Fail Threshold	3%	32 hrs	
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 1	1.2	147	Fail
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 2	0.2	25	Pass
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 3	0.4	105	Fail
1F-3F REFURB APT 4B8P DOUBLE BEDROOM 4	0	26	Pass
1F-3F REFURB APT 4B8P KITCHEN	0.5	-	Pass
3F LISTED APT 1B2P DOUBLE BEDROOM	1.4	247	Fail
3F LISTED APT 1B2P LIVING/DINING/KITCHEN	2.5	-	Pass
3F REFURB APT 1B2P DOUBLE BEDROOM	0.1	45	Pass
3F REFURB APT 1B2P LIVING/DINING/KITCHEN	1.8	-	Pass
4F NEW 402 1B2P DOUBLE BEDROOM	0.1	12	Pass
4F NEW 402 1B2P DOUBLE BEDROOM	0.1	-	Pass
4F NEW 402 1B2P LIVING/DINING/KITCHEN	0.4	-	Pass
4F NEW 403 2B4P DOUBLE BEDROOM 1	1.5	100	Fail
4F NEW 403 2B4P DOUBLE BEDROOM 1	2	233	Fail
4F NEW 403 2B4P DOUBLE BEDROOM 1	1.5	-	Pass

As all rooms in a dwelling need to meet the Part O criteria for the dwelling as a whole to pass, closed windows at night mean that most dwellings fail if windows must be closed at night. The subsequent mixed mode ventilation strategy and the dual aspect of the dwellings have contribute to reducing the overheating risk as far as possible, and subsequently the cooling demand during peak summer months. The cooling design for the affected areas will be developed at the next stage to ensure that the Part O limits for predominantly mechanically ventilated or cooled dwellings are met. See section 5.3 for details of affected areas.

1 Museum Street

The modelling outputs of sample zones show that Museum Street fails all 3 criteria of the CIBSE TM52 overheating analysis, as shown in Table 5-6 when assessed as a free running building with mixed mode. The mixed mode ventilation strategy contributes to reducing the overheating risk and subsequently the cooling demand during peak summer months, however, to ensure occupants' comfort, mechanical cooling is proposed.

Table 5-6 - 1 Museum Street overheating analysis against CIBSE TM52

Room Name	Weather File DSY 1 2020			
	Criteria 1:	Criteria 2:	Criteria 3:	Pass/ Fail
Pass/Fail Threshold	3%	6	4 K	
G3 Office	20%	29	4 K	Fail
G6 Office	23.4%	35	5 K	Fail
G9 Office	24.1%	42	6 K	Fail
G19 Office	43.5%	54	7 K	Fail

Active cooling is therefore to be provided to 1 Museum Street.

High Holborn

The modelling outputs show that all of the sample apartments in High Holborn pass both criteria under Part O when relying on openable windows alone without restriction.

Table 5-7 - High Holborn overheating analysis against Part O, natural ventilation

Room Name	Weather File DSY 1 2020		
	Criteria 1:	Criteria 2:	Pass/ Fail
Pass/Fail Threshold	3%	32 hrs	
1F 1B2P DOUBLE BEDROOM	1	20	Pass
1F 1B2P LIVING/DINING/KITCHEN	2	-	Pass
2F 1B2P DOUBLE BEDROOM	1	20	Pass
2F 1B2P LIVING/DINING/KITCHEN	1.8	-	Pass
3F 1B2P DOUBLE BEDROOM	1	20	Pass
3F 1B2P LIVING/DINING/KITCHEN	1.8	-	Pass
4F 3B5P SINGLE BEDROOM	0.3	18	Pass
4F 3B5P DOUBLE BEDROOM 1	0.7	13	Pass
4F 3B5P DOUBLE BEDROOM 2	0.4	20	Pass
5F 3B5P STUDY	0.5	-	Pass

Room Name	Weather File DSY 1 2020		
	Criteria 1:	Criteria 2:	Pass/ Fail
5F 3B5P LIVING/KITCHEN/DINING	2.8		Pass

However, there are restrictions overnight due to noise and air quality. A subsequent assessment was undertaken with windows shut at night time.

Table 5-8 - High Holborn overheating analysis against Part O, natural ventilation windows closed at night

Room Name	Weather File DSY 1 2020		
	Criteria 1:	Criteria 2:	Pass/ Fail
Pass/Fail Threshold	3%	32 hrs	
1F 1B2P DOUBLE BEDROOM	6	316	Fail
1F 1B2P LIVING/DINING/KITCHEN	6.9	-	Fail
2F 1B2P DOUBLE BEDROOM	5.3	308	Fail
2F 1B2P LIVING/DINING/KITCHEN	4.7	-	Fail
3F 1B2P DOUBLE BEDROOM	5.7	317	Fail
3F 1B2P LIVING/DINING/KITCHEN	5.1	-	Fail
4F 3B5P SINGLE BEDROOM	6.5	386	Fail
4F 3B5P DOUBLE BEDROOM 1	10	379	Fail
4F 3B5P DOUBLE BEDROOM 2	7.5	457	Fail
5F 3B5P STUDY	1	-	Fail
5F 3B5P LIVING/KITCHEN/DINING	14.7		Fail

As all rooms in a dwelling need to meet the Part O criteria for the dwelling as a whole to pass, closed windows at night mean that most dwellings fail if windows must be closed at night. The subsequent mixed mode ventilation strategy and the dual aspect of the dwellings have contributed to reducing the overheating risk as far as possible, and subsequently the cooling demand during peak summer months. The cooling design for the affected areas will be developed at the next stage to ensure that the Part O limits for predominantly mechanically ventilated or cooled dwellings are met. See section 5.3 for details of affected areas.

Vine Lane

The modelling outputs show that all of the sample apartments in Vine Lane pass both criteria under Part O when relying on openable windows alone without restriction.

Table 5-9 – Vine Lane overheating analysis against Part O, natural ventilation

Room Name	Weather File DSY 1 2020		
	Criteria 1:	Criteria 2:	Pass/ Fail
Pass/Fail Threshold	3%	32 hrs	
4F 1B2P DOUBLE BEDROOM	0.6	14	Pass
4F 1B2P LIVING/DINING/KITCHEN	1.1	-	Pass
3F 1B2P DOUBLE BEDROOM	0.7	15	Pass
3F 1B2P LIVING/DINING/KITCHEN	1.5	-	Pass

Room Name	Weather File DSY 1 2020		
	Criteria 1:	Criteria 2:	Pass/ Fail
3F 1B2P LIVING/DINING/KITCHEN	0.8	-	Pass
3F 1B2P DOUBLE BEDROOM	0.6	14	Pass
3F 1B2P DOUBLE BEDROOM	0.2	14	Pass
3F 1B2P LIVING/DINING/KITCHEN	0	-	Pass
5F 1B2P DOUBLE BEDROOM	0.7	14	Pass
5F 1B2P LIVING/DINING/KITCHEN	1.2	-	Pass
4F 1B2P DOUBLE BEDROOM	0.6	14	Pass
4F 1B2P LIVING/DINING/KITCHEN	0.9	-	Pass
4F 1B2P LIVING/DINING/KITCHEN	1.6	-	Pass
4F 1B2P DOUBLE BEDROOM	1	13	Pass

The noise assessment indicated that the top floor apartments will be affected by noise during the day from plant, but there are no day time noise limits in Part O. Therefore no cooling is proposed in the Vine Lane block.

5.3 Active cooling strategy

On the dwellings there are both air quality and noise issues that will prevent the use of openable windows in some areas for some or all of the time.

The air quality assessment by Arup found that there are air quality issues at ground, first and second floors on the New Oxford Street elevation of the West Central Street block. They have also advised that the High Holborn apartments should not rely on operable windows due to the proximity of the main road.

The noise survey showed that certain facades are expected to exceed the night time limits. In addition, the top floor bedrooms of Vine Lane will be affected by noise from local plant. The facades affected by noise are shown in red in Figure 5-5.

Figure 5-5 Areas affected by night time noise

The applicant has followed the cooling hierarchy set out in the London Plan to reduce as far as practicable the demand for active cooling through passive measures. Where it has not been possible to mitigate all overheating risks through passive design measures, or where external environmental conditions make opening windows undesirable, cooling is proposed to ensure occupant health and comfort during hot weather events.

High levels of ventilation are required overheating, as demonstrated by the natural ventilation modelling. It is not possible to provide attenuated openings with the same free area of the windows within the available façade. If this external ventilation were to be provided mechanically, additional boost fans would be required in bedrooms which would consume high amounts of energy and would themselves be noisy. The design therefore incorporates cooling via reversible heat pumps to affected dwellings.

1 Museum Street will be provided with ASHPs connected to a condenser loop system providing a heat source/sink for local water cooled heat pumps located throughout. The condenser loop system will serve all areas in both Museum Street and Vine Lane.

The advantages of this system as compared to ASHP generating LTHW and CHW directly include:

- The opportunity to locally recover heat between different tenancies
- The opportunity to recover any waste heat into the scheme
- Reduced annual primary energy requirement, with associated reductions in carbon emissions and running costs
- Reduced heat losses from vertical and horizontal distribution pipework
- Reduced extent of roof plant

The disadvantages of the proposed solution as compared to ASHP generating LTHW include:

- Increased system complexity, with associated increase in capital and maintenance costs
- Larger risers required to house water cooled heat pumps

An array of modular air-to-water heat pumps are proposed to be located on the Vine Lane block roof. The heat pumps are to be mounted within a bespoke acoustic enclosure within the architectural plant screen, which will include acoustic louvres to all openings in the vertical plant screen, and a "roof" built up from intake and discharge attenuators.

It is anticipated that all heating and cooling (including cooling for comms rooms etc.) associated with the office areas of 1 Museum Street will be via the condenser loop system.

5.4 Cooling demand

The cooling demand of the non-domestic buildings in the proposed development has been calculated in order to provide a comparison against the site notional cooling demand. The calculations show that the actual cooling demand for non-domestic properties is less than the notional cooling demand for non-domestic benchmark, as shown in Table 5-10.

Also show is the total cooling demand from the dwellings.

Table 5-10 –Site cooling demand

	Domestic		Non-domestic	
	Area weighted average cooling demand (MJ/m^2)	Total area weighted average cooling demand (MJ/a)	Area weighted average cooling demand (MJ/m^2)	Total area weighted average cooling demand (MJ/a)
Actual	3.9	15417	32.02	560,298
Notional	NA	NA	43.63	763,285

6 Heating infrastructure (Be Clean)

6.1 Heating hierarchy

The heating strategy has been developed following the steps of London Plan heating hierarchy, as per Table 6-1.

Table 6-1 – Hierarchy for selecting an energy system

Hierarchical Element	Explanation
1. Connection to an area wide heat networks	Where proposed developments are located near to existing or planned networks, connection must be prioritised (see paragraph 10.5 onwards).
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.

6.2 Step 1: Connection to area wide heat network

According to the London Heat Map (Figure 6-1), there are currently no existing (red-orange line) District Heating Networks (DHN) identified within 1000m distance. The map does indicate that there are two proposed DHNs (orange line), however both are proposed to be further than 1000m from the site. We have contacted Citigen, the operators of the existing network located to the east of the site to understand whether they have any plans for future expansion towards our site and await a response, and Camden to confirm that no existing networks are within reach. This correspondence can be found in Appendix F.

Should a DHN in close proximity of the site become available in the future, the Museum Street site heating plant room (i.e. energy centre) is located at basement level on the perimeter of the site and has been sized to accommodate plate heat exchangers and associated equipment (in place of the existing heating plant which would be removed), thereby facilitating connection to a heat network in the future.

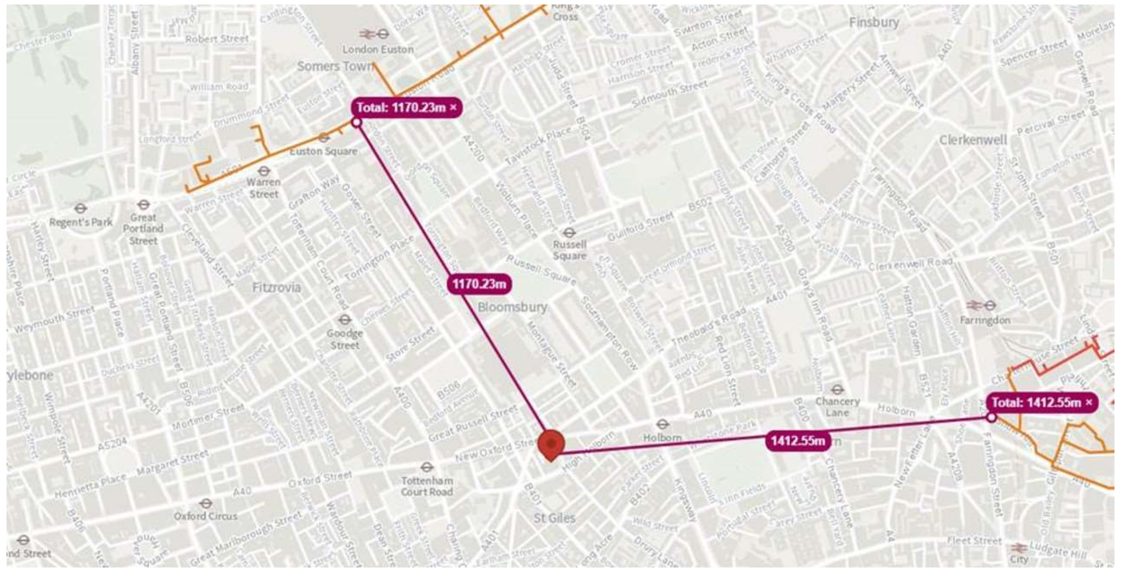

Figure 6-1 – Proximity of the Site to a proposed heat network, as indicated by the London Heat Map

6.3 Step 2: Communal heating system - site-wide heat network

It is proposed that the entire development is fossil-fuel free for all heating and hot water generation. As a result, electric heat pumps are proposed as the primary source of heat for all sites within the development.

The site location and limited extent of basement piling works mean that a ground source or water source heat pump based solution is not feasible, and therefore an air source heat pump led heating and hot water solution is proposed throughout.

6.3.1 Museum Street and Vine Lane

Museum Street and Vine Lane will be provided with ASHPs connected to a condenser loop system providing a heat source/sink for local water cooled heat pumps located throughout. The condenser loop system will serve all areas in both Museum Street and Vine Lane.

The advantages of this system as compared to ASHP generating LTHW and CHW directly include:

- The opportunity to locally recover heat between different tenancies
- The opportunity to recover any waste heat into the scheme

- Reduced annual primary energy requirement, with associated reductions in carbon emissions and running costs
- Reduced heat losses from vertical and horizontal distribution pipework
- Reduced extent of roof plant

The disadvantages of the proposed solution as compared to ASHP generating LTHW include:

- Increased system complexity, with associated increase in capital and maintenance costs
- Larger risers required to house water cooled heat pumps

A dedicated heat distribution plantroom located at basement (B2) level will circulate condenser water throughout Museum Street and Vine Lane via vertical risers located in each circulation core.

For Museum Street, as part of the CAT A future fit out, dedicated water cooled heat pumps are to be provided for each tenancy split at each floor level. Secondary distribution from the water-cooled heat pumps is proposed to be of the variable refrigerant flow (VRF) type utilising low GWP R32 refrigerant, however the system is flexible and allows for a wide range of water source heat pump technology to be used, including heat recovery VRF, hybrid VRF or reversible water-to-water. Each tenant connection will be metered with an MID approved energy meter connected to the site wide AMR system for billing purposes.

It is anticipated that all heating and cooling (including cooling for comms rooms etc.) associated with the office areas of Museum Street will be via the condenser loop system.

The retail units will be provided with dedicated metered capped connections to the condenser loop system to allow the tenant to install their own water source heat pump system, similar to the office floors. This scenario has been modelled for the energy assessment.

For Vine Lane, dedicated water sourced heat pumps are to be provided for each dwelling. Distribution from the water sourced heat pumps is proposed to be LTHW serving the domestic hot water requirements and underfloor heating. Each dwelling connection will be metered with an MID approved energy meter connected to the site wide AMR system for billing purposes.

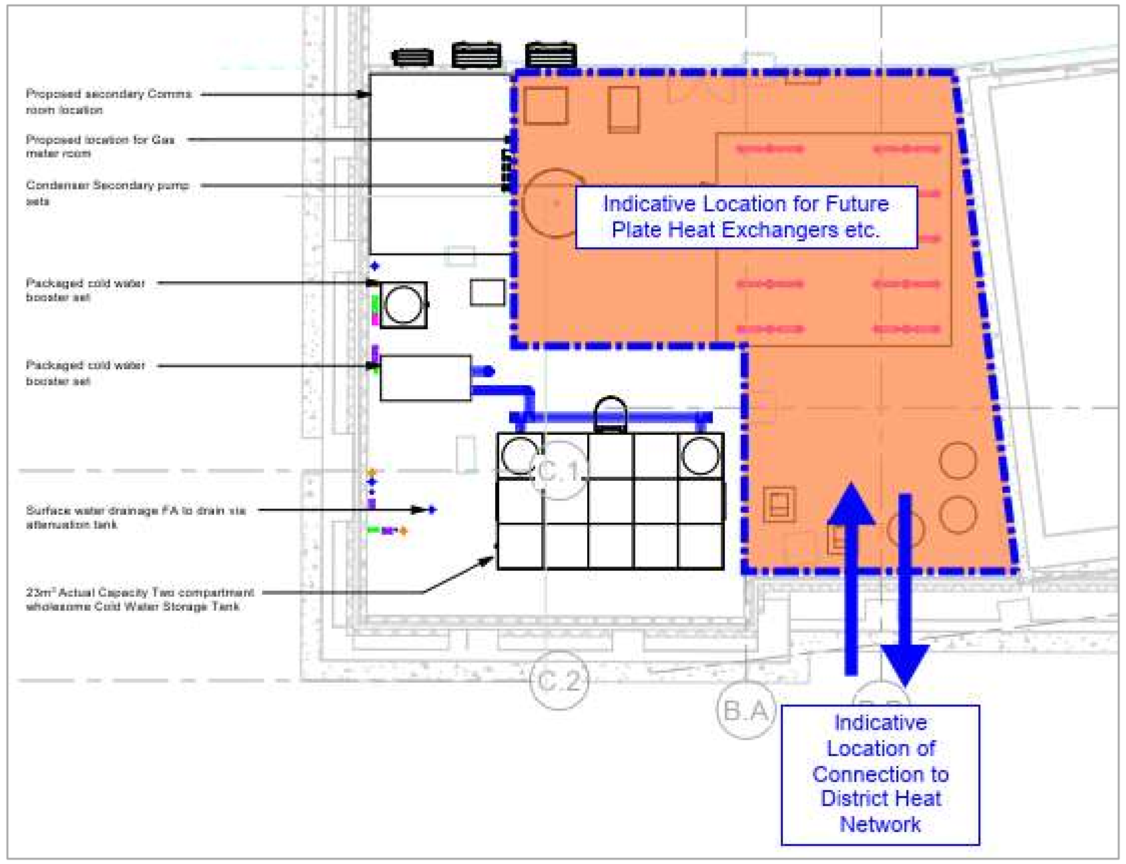

Figure 6-2 – Museum Street heating plant room (energy centre) location

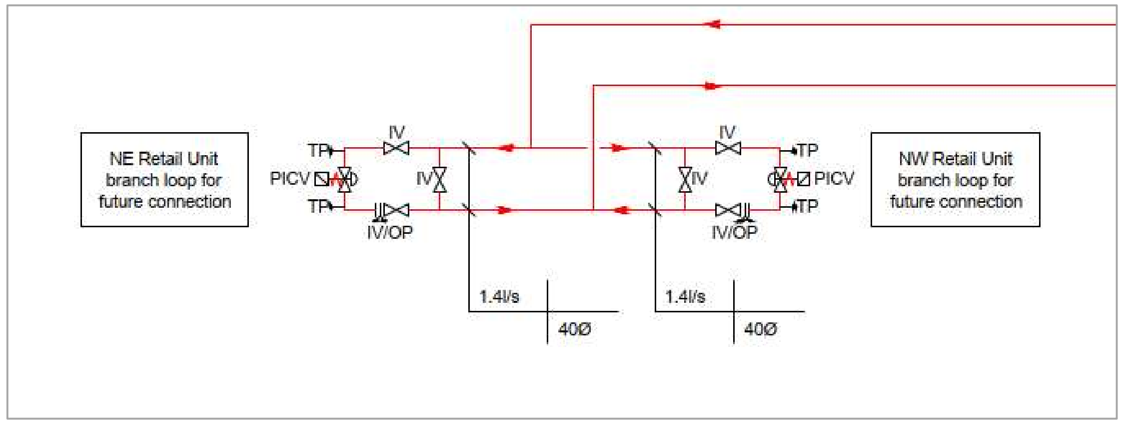

Figure 6-3 – On site heat distribution network

6.3.2 West Central Street

West Central Street will be provided with ASHPs connected to a condenser loop system providing a heat source/sink for local water source heat pumps located throughout. The condenser loop system will serve all areas in West Central Street.

The advantages of this system as compared to ASHP generating LTHW and CHW directly include:

- The opportunity to locally recover heat between different tenancies
- The opportunity to recover any waste heat into the scheme
- Reduced annual primary energy requirement, with associated reductions in carbon emissions and running costs
- Reduced heat losses from vertical and horizontal distribution pipework
- Reduced extent of roof plant

The disadvantages of the proposed solution as compared to ASHP generating LTHW include:

- Increased system complexity, with associated increase in capital and maintenance costs
- Internal service cupboards required to house water cooled heat pumps

A dedicated heat distribution plantroom located at basement level will circulate condenser water throughout West Central Street via vertical risers located in each circulation core. Water source heat pumps will be fitted in each dwelling providing heating and domestic hot water, and future connections will be provided for each retail unit to allow for the tenants to connect their own water source heat pumps in the future. It is anticipated that secondary distribution from the water source heat pumps in the retail tenancies will be of the variable refrigerant flow (VRF) type utilising low GWP R32 refrigerant, however the system is flexible and allows for a wide range of water source heat pump technology to be used, including heat recovery VRF, hybrid VRF or reversible water-to-water. Each tenant connection will be metered with an MID approved energy meter connected to the site wide AMR system for billing purposes.

West Central Street is a relatively small development that comprises a mixture of both existing and new buildings, with an existing communal basement (with very limited heights in certain areas); existing foundations are intended to be retained. Adopting a Ground Source Heat Pump solution would involve a series of additional challenges, including (and not limited to) the correct location to the boreholes, allowing for a suitable distance among them and their coordination with the existing buildings. Furthermore, the size of the GSHP system that could be installed on site would not be sufficient to cover the energy requirements for the whole development. It is therefore envisaged that the adoption of a GSHP is not technically and commercially feasible.

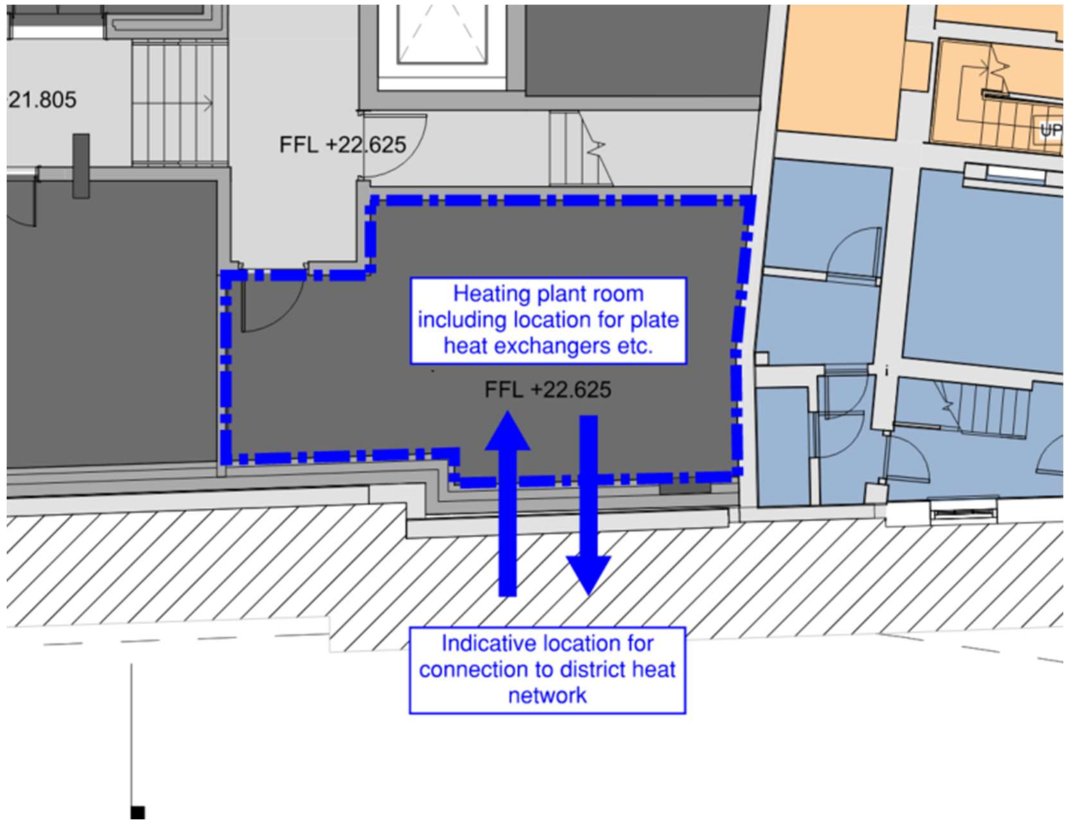

Figure 6-4 - West Central Street Heating plant room location

6.3.3 High Holborn

The proposed strategy for heating and hot water to High Holborn is to have a decentralised Air Source Heat Pump (ASHP) solution comprising a dedicated ASHP for each dwelling providing LTHW heating and domestic hot water. This system gives the following advantages:

- Heat is generated using the dwelling's metered electrical supply, providing control to the tenant on the cost of energy
- Decentralised plant is smaller and can be located closer to the end user
- Energy efficiency is comparable to a centralised solution and can be better due to the lower heat losses and auxiliary power consumption

A wet underfloor heating system is proposed to deliver heat throughout all dwellings, with electric type underfloor heating proposed to all wet rooms.

6.3.4 Heat network infrastructure

The heat distribution infrastructure has been designed to accord with relevant CIBSE and Heat Pump Association (HPA) guidance, with reference to relevant aspects of the CIBSE *Heat Networks: Code of Practice for the UK*.

The heat networks serving 1 Museum Street and West Central Street will be designed to a common set of operating criteria to allow the two networks to be interlinked and allow for heat sharing between the two networks.

6.3.5 Air quality impact

As the proposed development is fossil fuel free in terms of heating and hot water and will be served by air source heat pumps, the impact on the local air quality has been minimised. An air quality neutral assessment has been carried out by Arup and the results show that predicted emissions from the Proposed development are within the limits set by GLA. Table 6-2 shows the total fuel consumptions as calculated by Scotch Partners. The emissions are related only to the use of the heat pumps.

Table 6-2 – Air quality impacts

Energy source	Total fuel consumption (MWh/a)
Grid electricity	2306
Gas boilers (communal/individual)	n/a
Gas CHP	n/a
Connection to existing DH network	n/a
Other gas use	n/a

7 Renewable energy (Be Green)

7.1 Renewable energy technologies options appraisal

The London Plan requires development to maximise opportunities for renewable energy technologies. A high-level options appraisal has been carried out to understand which technologies are viable for the proposed development, and which are not.

Certain technology options have been automatically discounted due to the lack of available resource. These are anaerobic digestion, mid and large-scale wind, and hydro. The benefits and constraints for the remaining renewable technologies are summarised in Table 7-1 below.

7.2 Proposed technologies

Based on this appraisal, and to maximise CO_2 savings and minimise the impact of the proposed development on local air quality, the proposed energy strategy is based on Air Source Heat Pumps (ASHP) providing heating and hot water.

Table 7-1 - Feasibility assessment of renewable technologies application to the proposed development

Technology	Benefits	Constraints
Biomass Centralised biomass boilers providing heating and hot water to all areas with condensing gas boiler backup	- Biomass is considered a carbon neutral fuel. - Biomass boiler efficiency is approaching that of an equivalent natural gas boiler.	- Large space requirements for fuel store and buffer tank. - Access required for regular fuel deliveries and ash removal. - Reliable fuel source required. - Increased quantities of NO_x, SO_x and particulates PM_{10} compared to natural gas. - Suitable for a centralised system only
Ground Source Heat Pump (GSHP) Centralised GSHP generating warm water for heating to all areas. Hot water via warm water pre-heat and electric immersion	- GSHP system can provide both heating and cooling. - Higher efficiencies than equivalent gas boiler system. - Qualifies for the RHI scheme (noting that the scheme is due to end)	- Initial explorative investigation required for vertical collectors to determine heat yield with no guarantee of viability. - Exploratory work complex and costly. - Spatial implications for accommodating boreholes at appropriate locations across the site.
Air Source Heat Pump (ASHP) Decentralised ASHP generating warm water for heating to all areas plus domestic hot water	- ASHP provide both heating and cooling, if required to tackle overheating within flats - Easy to install and maintain compared to GSHPs - Lower cost than GSHP	- Extensive external plant space (must be in free air), visual implications for external plant. - Night time noise emissions and impact on neighbouring properties. - Functionality limitations with regards to outdoor temperature
Solar hot water Roof mounted, centralised system providing HWS pre-heat	- Can offset a proportion of the Development's heat demand - Simple installation and maintenance	- Added system complexity. - Reduces roof space available. - Competes with other roof uses. -Increases riser space requirements.
Solar photovoltaics Roof mounted / façade mounted centralised system with single inverter fed to landlord supply with provision for export of excess of instantaneous demand	- Low maintenance - Easy to integrate within roof design - Feed in tariff available - Minimum internal plant requirement	- Increased cost with higher efficiency modules - Large roof areas required to achieve notable CO_2 reductions. - Competes with other roof uses - Not suitable for installation on shaded roofs.

7.2.1 ASHP performance details

Details of the ASHP performance are provided below for the 4 main sites within the development. Note that these are subject to change as the design develops at RIBA Stage 4 Technical Design.

Table 7-2 ASHP performance details

	Domestic – West Central Street	Domestic – High Holborn	Domestic – Vine Lane	Non-Domestic – Museum Street
Estimate of space heating energy provided by the ASHP (MWh)	56.8	7.7	19.9	302
Estimate of DHW heating energy provided by the ASHP (MWh)	92.8	13.8	108.9	366
Estimate of cooling energy provided by the ASHP (MWh)	2.5	1.75	0	446
Electricity the heat pump would require (MWh)	77.2	10.5	53.5	309
SCOP for space heating used in the energy modelling area weighted average	2.57	2.91	2.95	3.5
SCOP for DHW using in the energy modelling area weighted average	1.7	1.83	2.33	3.2
SEER used in the energy modelling	5.4 (NOS apartments only)	5.4	N/A	4.0 (main system) and 6.7 (comms rooms)
Notes	SCOP and SEER are calculated by the SAP software (refer to Appendix G). The design is currently at Stage 2 and we expect the final SCOP / SEER values to potentially change once detailed profiling is undertaken at Stage 4 design. This approach aligns with guidance *BSRIA BG 6 (2018) Design Framework for Building Services*. The domestic hot water generation is generated via air source heat pumps. Each apartment is provided with a dedicated hot water cylinder. The building services design allows for extensive insulation to the distribution pipework. This will form part of the final specification and contract with the principal contractor (i.e. through Employer's Requirements). In this way, the difference between the expected heat source temperature and the heat distribution system temperature will be minimised to ensure the system runs efficiently.			SCOP and SEER are based on data provide via manufacturer's information (refer to Appendix G). The design is currently at Stage 2 and we expect the final SCOP / SEER values to potentially change once detailed profiling is undertaken at Stage 4 design. This approach aligns with guidance *BSRIA BG 6 (2018) Design Framework for Building Services*. The building services design allows for extensive insulation to the distribution pipework. This will form part of the final specification and contract with the principal contractor (i.e. through Employer's Requirements). In this way, the difference between the expected heat source temperature and the heat distribution system temperature will be minimised to ensure the system runs efficiently.

Heat pump selection and costs to users

The building services design allows for extensive insulation to the distribution pipework. This will form part of the final specification and contract with the principal contractor (i.e. through Employer's Requirements). In this way, the difference between the expected heat source temperature and the heat distribution system temperature will be minimised to ensure the system runs efficiently.

The Applicant confirms that that the final heat pump selection will comply with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria for the relevant ASHP technology.

The Applicant confirms that the final heat pump selection will comply with other relevant issues as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification Requirements document.

The building services strategy is based on selecting the most efficient systems. This will help to ensure that costs to the end users will be minimised as far as possible. Due to the technical detail of the ASHP heating plant systems not being finalised until Stage 4 technical design, Whole Life Costing (WLC) to determine actual costs to consumers are not available at this stage. However, WLC in accordance with the GLA energy assessment guidance would be undertaken during Stage 4 design with the results provided to Camden and GLA once available, and ideally when input from an energy services operator can be obtained.

The Applicant confirms that the performance of the heat pump system will be monitored post-construction to ensure it is achieving the expected performance approved during planning. End-users will be supplied with regular information to control and operate the system via the control and monitoring system.

7.2.2 Solar PV

The use of PV has been investigated across the development. Due to the other essential uses of available roof space and/or overshading, it has been determined that there is no suitable space available for PV panels, as shown by the roof plans provided below. Modelling has shown that the proposed Museum Street building would shade the roofs of Vine Lane and West Central Street, whilst some roofs are allocated to other uses (i.e. terraces and mechanical equipment on Museum Street, Vine Lane and High Holborn).

Figure 7-1 - West Central Street roofs, overshaded by 1 Museum Street

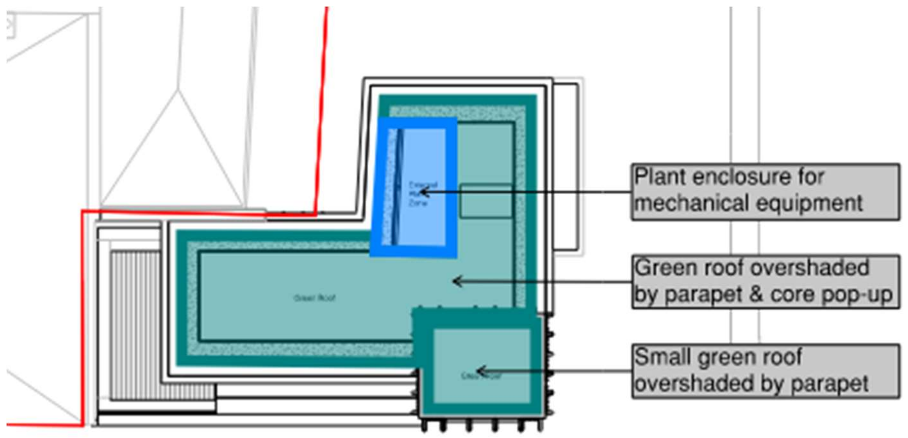

Figure 7-2- High Holborn roof, partially allocated to mechanical equipment & self shaded due to building form

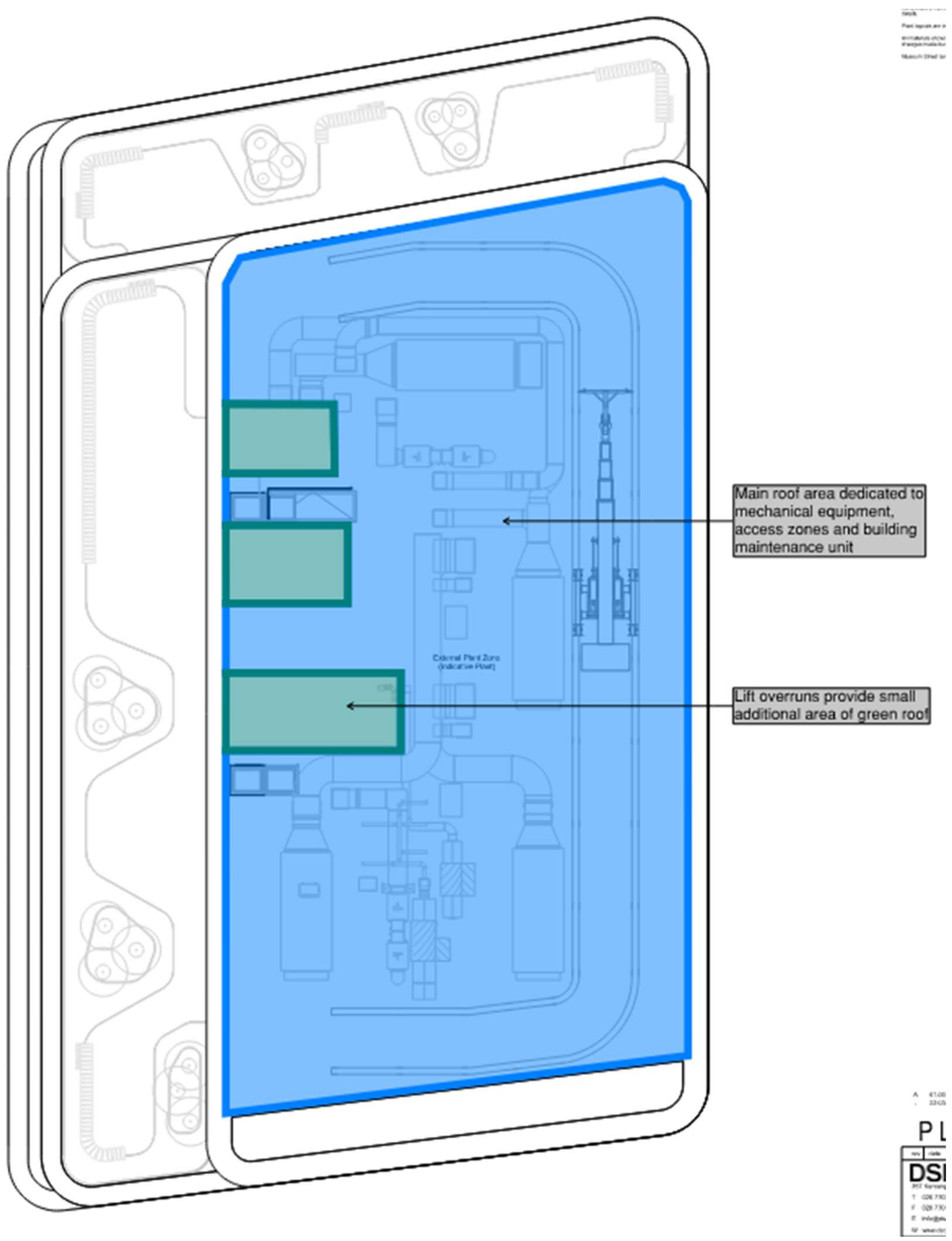

Figure 7-3 - 1 Museum Street roof, allocated to mechanical equipment

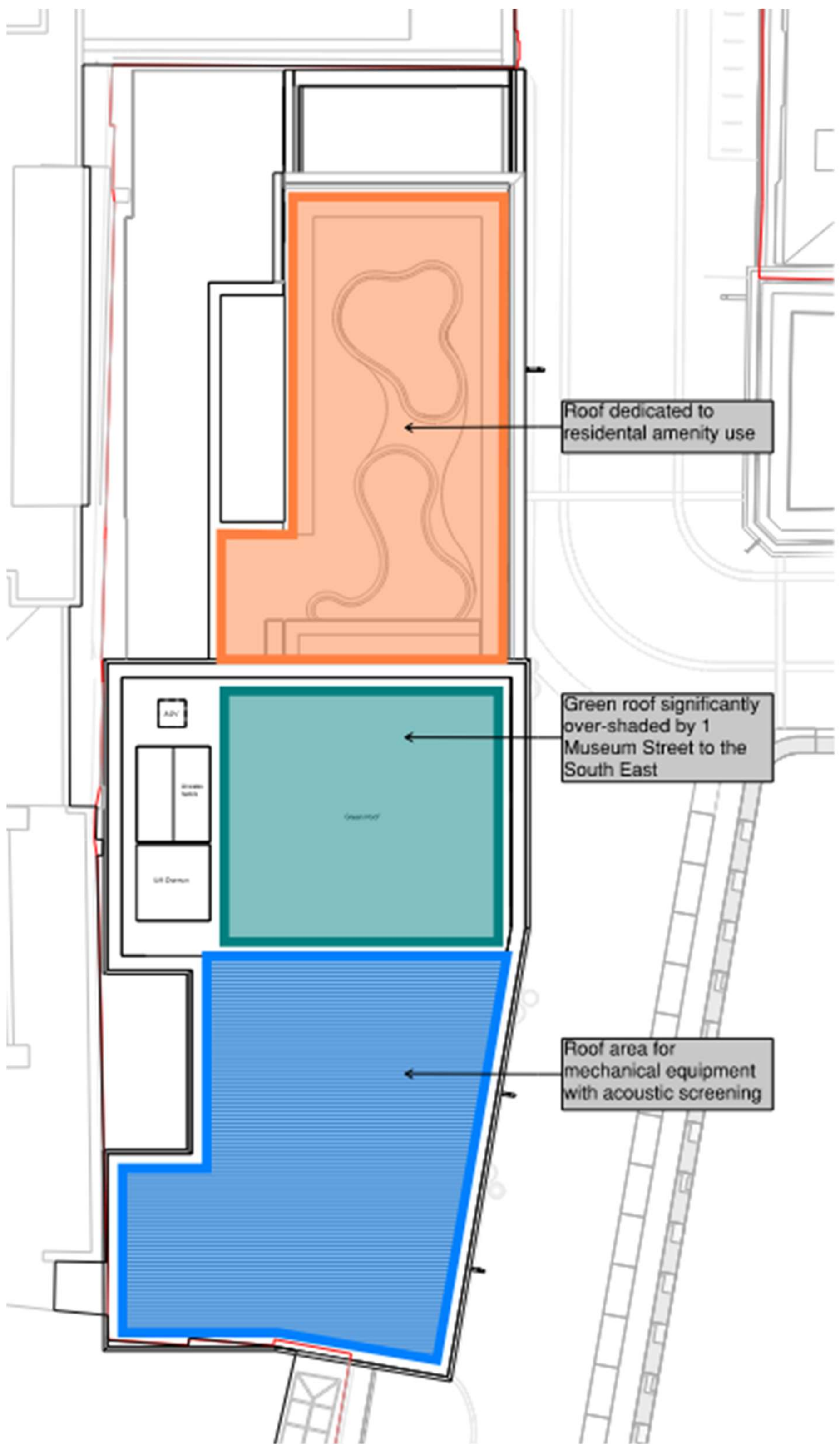

Figure 7-4 - Vine Lane roof, allocated to both mechanical equipment and terrace, overshaded by 1 Museum Street

7.3 Carbon emissions savings from green measures

The regulated carbon dioxide savings at the 'green' stage of the energy hierarchy are provided in the tables below.

7.3.1 Domestic refurbishment savings from green measures

Table 7-3 – Regulated carbon dioxide savings – Green, domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	19.7		
Be Lean	17.0	2.7	14
Be Clean	17.0	0.0	0
Be Green	3.5	13.6	69
Total cumulative savings	-	-	-

7.3.2 Domestic new build savings from green measures

Table 7-4 – Regulated carbon dioxide savings – Green, domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	34.5		
Be Lean	29.0	5.4	16
Be Clean	29.0	0.0	0
Be Green	8.1	21.0	61
Total cumulative savings	-	-	-

7.3.3 Non-Domestic refurbishment savings from green measures

Table 7-5 – Regulated carbon dioxide savings - Green

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	3.4		
Be Lean	2.1	1.3	38
Be Clean	2.1	0.0	0
Be Green	2.0	0.1	4
Total cumulative savings	-	-	-

7.3.4 Non-Domestic new build savings from green measures

Table 7-6 – Regulated carbon dioxide savings - Green

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	71.9		
Be Lean	63.6	8.3	12
Be Clean	63.6	0.0	0
Be Green	56.3	7.4	10
Total cumulative savings	-	-	-

7.3.5 Total development savings from green measures

Table 7-7 – Regulated carbon dioxide savings – Green total development

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	129.6		
Be Lean	111.8	17.7	14
Be Clean	111.8	0.0	0
Be Green	69.8	42.0	32
Total cumulative savings	-	-	-

7.3.6 Summary outputs from modelling – Green case

Refer to the BRUKL and SAP Output Sheets provided in Appendix H and Appendix I for details of the outputs from the 'green case' energy assessments.

8 Total carbon savings and carbon offsetting

The total CO_2 savings for the domestic scheme, non-domestic scheme, and whole development are provided in the tables and charts below.

In their Energy Assessment Guidance cover note of June 2022, the GLA acknowledge that non domestic buildings may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35% improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments. Every effort has been made to comply with the requirements for the non-domestic areas.

The site as a whole demonstrates 14% savings at Be Lean and 46% savings overall. The new build dwellings exceed the 50% overall savings stretch target.

8.1 Domestic development carbon savings

8.1.1 Domestic refurbishment carbon savings

Table 8-1 – Regulated carbon dioxide savings – total, domestic refurbishment

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	19.7		
Be Lean	17.0	2.7	14
Be Clean	17.0	0.0	0
Be Green	3.5	13.6	69
Total cumulative savings	-	16.3	82

8.1.2 Domestic new build carbon savings

Table 8-2 – Regulated carbon dioxide savings – total, domestic new build

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	34.5		
Be Lean	29.0	5.4	16
Be Clean	29.0	0.0	0
Be Green	8.1	21.0	61
Total cumulative savings	-	26.4	77

8.1.3 Domestic total carbon savings

Table 8-3 – Regulated carbon dioxide savings – Green, total domestic

	Total regulated emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	54.2		
Be Lean	46.1	8.2	15
Be Clean	46.1	0.0	0
Be Green	11.5	34.5	64
Total cumulative savings	-	42.7	79

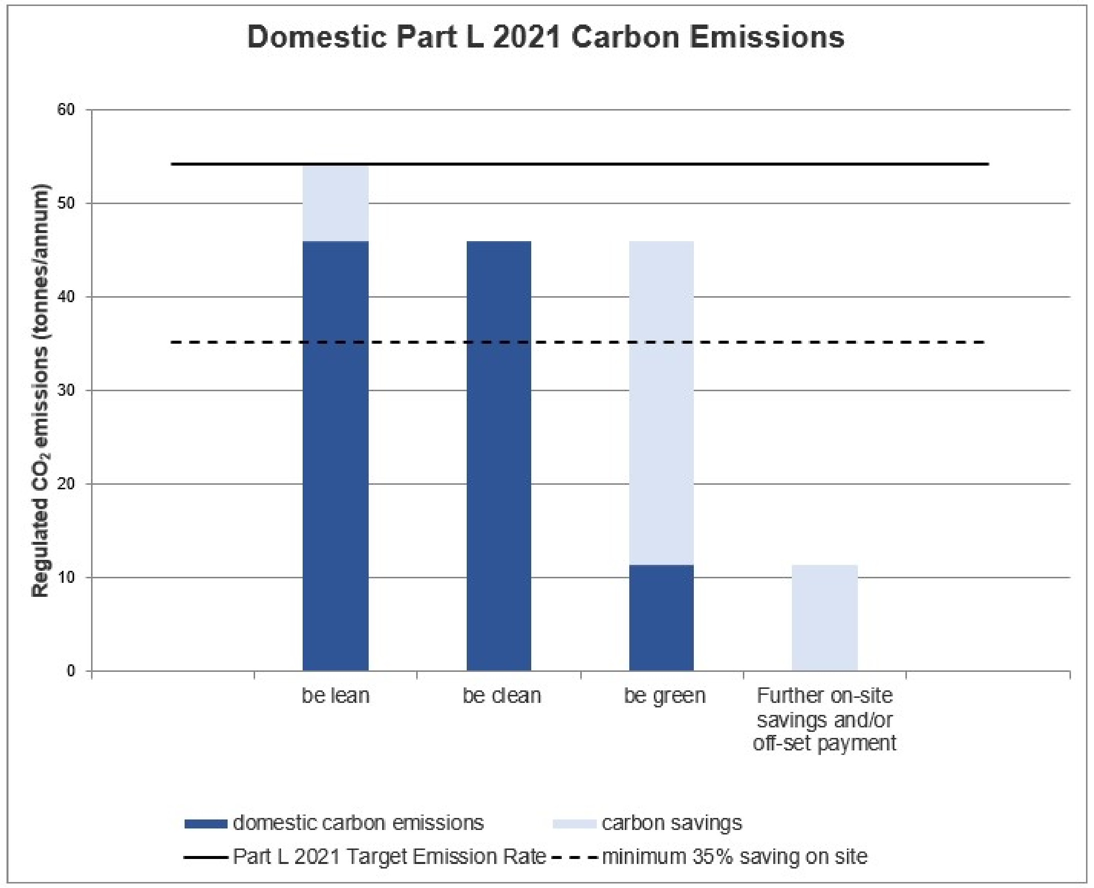

Figure 8-1 Proposed domestic development performance against targets

8.2 Non domestic development carbon savings

8.2.1 Non domestic refurbishment development carbon savings

Table 8-4 – Regulated carbon dioxide savings – total, non domestic refurbishment

	Total regulated Emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	3.4		
Be Lean	2.1	1.3	38
Be Clean	2.1	0.0	0
Be Green	2.0	0.1	42
Total cumulative savings	-	1.4	42

8.2.2 Non domestic new build development carbon savings

Table 8-5 – Regulated carbon dioxide savings – total, non domestic refurbishment

	Total regulated Emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	71.9		
Be Lean	63.6	8.3	12
Be Clean	63.6	0.0	0
Be Green	56.3	7.4	10
Total cumulative savings	-	15.6	22

8.2.3 Non domestic total development carbon savings

Table 8-6 – Regulated carbon dioxide savings – total, non domestic refurbishment

	Total regulated Emissions (tCO_2/a)	CO_2 savings (tCO_2/a)	Percentage saving (%)
Part L 2021 baseline	75.3		
Be Lean	65.7	9.6	13
Be Clean	65.7	0.0	0
Be Green	58.3	7.5	10
Total cumulative savings	-	17.1	23

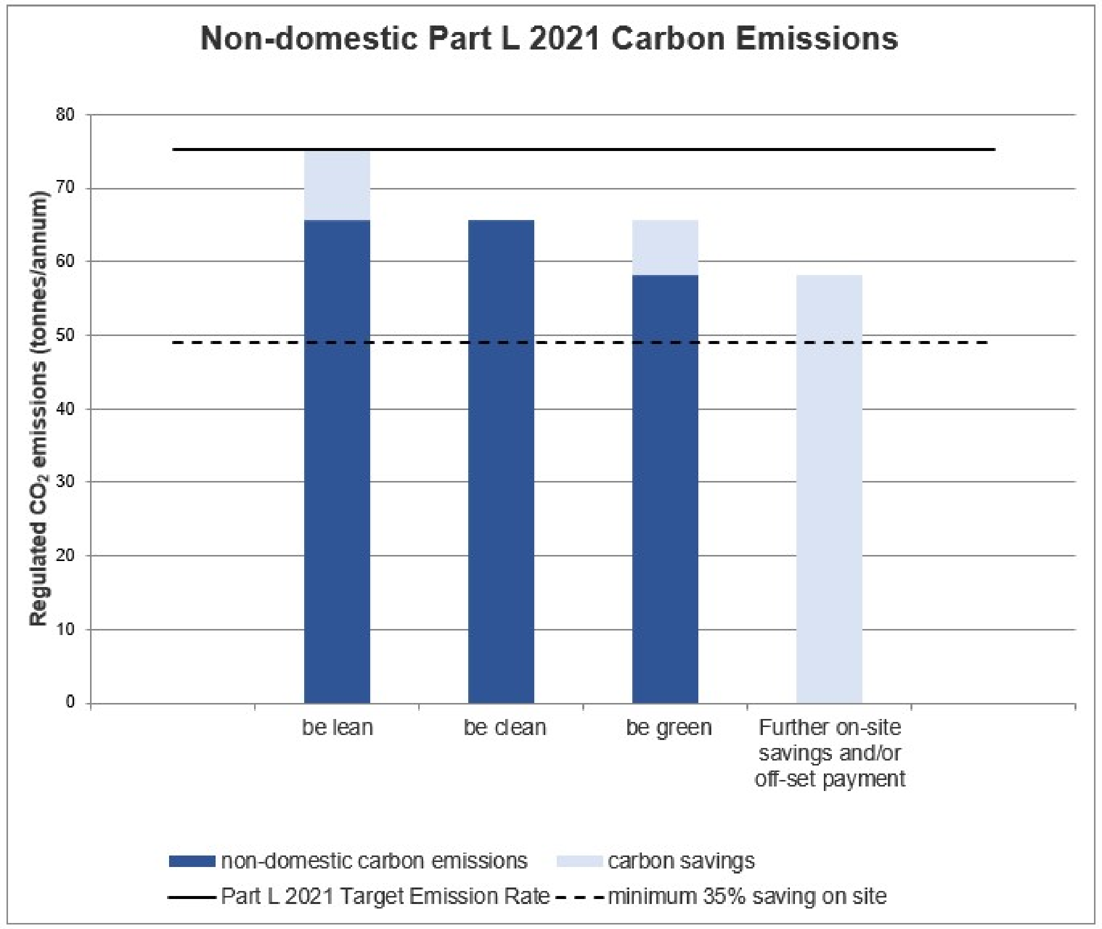

Figure 8-2 – Proposed non-domestic development performance against targets

8.3 Whole development total carbon emissions savings

Table 8-7 – Total cumulative regulated carbon dioxide savings

	Total regulated emissions (Tonnes CO_2 /a)	CO_2 savings (Tonnes CO_2 /a)	Percentage savings (%)
Part L 2021 baseline	129.6		
Be lean	111.8	17.7	14
Be clean	111.8	0.0	0
Be green	69.8	42.0	32
Total cumulative savings	-	59.8	46
	CO_2 savings off-set (Tonnes CO_2)		
Cumulative savings for offset payment	2,093.5		

8.4 Carbon offsetting

Carbon offsetting is required as the policy Net Zero Carbon target has not been met on site.

The Council's preferred mechanism for carbon offsetting is a payment into the Camden Climate Fund. The Applicant proposes to consult with the Planning Authority during the submission period to agree a method for off-setting the residual development CO_2 emissions to achieve the Net Zero Carbon target.

8.5 GLA carbon emissions spreadsheets

All carbon emissions savings data has been entered into the GLA's carbon emissions spreadsheet "Part_l_2021_gla_carbon_emission_reporting_spreadsheet_v2.0_0". The following spreadsheets have been prepared:

- New build non-domestic
- Refurbished non-domestic
- Total non-domestic
- New build residential
- Refurbished residential
- Total residential
- Total site

The spreadsheets have been included in Appendix J.

9 Monitoring (Be Seen) and EUI

The move towards zero-carbon proposed development requires comprehensive monitoring of energy demand and carbon emissions to ensure that planning commitments are being delivered.

The Applicant commits to implementing measures to monitor and report on energy performance for at least five years via the online portal in line with the Be Seen requirements, in order to enable the GLA to identify good practice and report on the operational performance of new development in London.

The metering strategy will be developed in full at RIBA Stage 4 and will facilitate the Be Seen criteria being met.

The GLA's 'Planning' stage Be Seen Reporting Spreadsheet has been completed and will be submitted with the planning application, in accordance with the Be Seen Energy Monitoring Guidance, September 2021. The operational energy use of the proposed development have been assessed using the methodology set out by the GLA's Be Seen policy. Dwelling operational energy has been calculated from the SAP assessments and non-domestic operational energy has been calculated using CIBSE TM54. CIBSE TM54 provides guidance on predicting operational energy use considering its specific use and including unregulated energy uses not included Part L compliance assessments. Results of these assessments have been used to populate the GLA's spreadsheets.

9.1 Key TM54 modelling assumptions

The analysis was based on RIBA Stage 2 level of performance information for both building architecture and building services. Reasonable assumptions have been made for the anticipated office use for 1 Museum Street and retail use elsewhere. Where project specific assumptions were not available, assumptions for operational profiles have been modelled according to available data from the NABERS assessment method, best practice and the NCM.

Key assumptions include:

- Office small power and lighting do not fully turn off during night time, following NABERS guidance
- Office occupancy diversities based on NABERS guidance
- Domestic hot water consumption assumed to be 14l/per/day for office occupants, following CIBSE TM54 guidance
- Lift energy use has been calculated using CIBSE Guide D methodology
- Retail operation follows NCM profiles

9.2 TM54/EUI results summary

The CIBSE TM54 and Energy Use Intensity (EUI) results are shown below. The GLA have benchmark EUIs of 35 kWh/m^2 GIA for residential, and 55 kWh/m^2 GIA for all other uses at the Site. It is widely recognised that these figures are very hard to achieve, and are given for comparison only by the GLA.

Figure 9-1 EUI results

Area	EUI kWh/m^2/yr GIA
1 Museum Street office	73.6
1 Museum Street Class E	114.50
High Holborn dwellings	50.7
High Holborn Class E	150.7
High Holborn landlord communal circulation*	2.4
Vine Lane dwellings	70.9
Vine Lane Class E	125.4
Vine Lane landlord communal circulation*	3.7
West Central Street dwellings	86.0
West Central Street Class E	121.9
West Central Street landlord communal circulation*	3.3

**Including external lighting*

These numbers have been used to populate the Site GLA carbon emission reporting spreadsheet (Appendix J) and the GLA Be Seen form (Appendix K).

The baseline estimation of the site energy use is approximately 2,306 MWh/year total energy consumption. Our calculations indicate that in 1 Museum Street (the largest energy consumer) small power (48%), fans and pumps (10%) and interior lighting (16%) consume the highest amount of energy, representing nearly 75% of the calculated total. Fan and pumps energy use is a large proportion of total energy use due to high ventilation rates to improve air quality. Additionally, pump energy use is significant due to additional pressure breaks and vertical and horizontal distribution needs in a tower typology. Lift energy use is significant due to the vertical transport needs in a tower typology.

We attribute low heating energy use to:

- Highly effective ventilation heat recovery and demand-controlled ventilation reducing ventilation heat losses.
- High efficiency heat generation system using air source heat pumps.
- High internal heat gains typical of the prestige-office typology.

Our results provide a potential route to reduce operational energy use during subsequent design stages. The following may be considered to reduce energy consumption:

- Enhance ventilation and water circulation system design including equipment selection and control systems to reduce specific fan power and specific pump power, and improve energy efficient part load performance.
- Improve installed lighting power and controls particularly in landlord areas to ensure lights are only used when and where needed
- Expand free cooling opportunities through improved natural and mechanical ventilation measures
- Explore use of cloud services for information technology needs which shifts server energy use from the building to a more efficient dedicated data centre
- Continue improving heat generation efficiency through ongoing development of central plant configurations

The largest uncertainty within the CIBSE TM54 calculations is related to the internal gains and unregulated processes, including office equipment, servers, and lifts which in turn affect HVAC energy use. Because of the speculative nature of the development and limited resolution of design details during RIBA Stage 2, information relating to operational energy use is limited and may potentially vary significantly. Consequently, the results of this analysis should be read as indicative of the potential performance, with room for refinement as project details continue to be developed, as a better understanding of the fit-out is gained, and as details of the likely tenant energy use scenarios are agreed. In addition, computer simulations used in this analysis can only provide an estimate of performance. This estimate is based on simplifications that do not and cannot fully represent all of the intricacies of performance of a building once built. As a result, simulation results only represent an interpretation of the potential performance. No guarantee or warrantee of performance in practice can be based on this early stage assessment alone.

10 Whole Life-Cycle Carbon Assessment

The New London Plan Policy SI 2 requires development proposals to calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment (WLCA) and to demonstrate actions taken to reduce life-cycle carbon emissions.

A Whole Life-Cycle Carbon Assessment was carried out following the GLA Whole Life-Cycle Carbon Assessments Guidance (March 2022), with additional guidance from RICS Professional Statement. This assessment was completed using the GLA approved Oneclick software.

Refer to the full WLCA report and completed GLA assessment spreadsheet tool.

Appendices

The following documents that append this report are provided as separate documents:

- Appendix A – SAP baseline reports
- Appendix B – BRUKL be lean reports
- Appendix C – SAP be lean reports
- Appendix D – GHA overheating tool
- Appendix E – overheating results
- Appendix F – DHN correspondence with Camden
- Appendix G – ASHP data
- Appendix H – BRUKL be green reports
- Appendix I – SAP be green reports
- Appendix J – GLA CO_2 emissions spreadsheets, Part L 2021, version 2.0_0

ScotchPartners
Building Services Engineering | Sustainability | Acoustics
90 High Holborn
London
WC1V 6LJ

T 0203 544 5400

www.scotchpartners.com