Derwent Valley Property Developments Limited

Network Building

The Network Building Reserved Matters Application 2 – Class E(g)(ii) Lab Building Energy Statement

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Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

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		Name	Sofie Kirk	Hans Chao	Aleksandar Topalovic
		Signature			
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		Name	Sofie Kirk	Hans Chao	Aleksandar Topalovic
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Executive Summary

This Energy Assessment has been prepared by Ove Arup & Partners Ltd (Arup) on behalf Derwent Valley Property Developments Limited to support the application for reserved matters application for the Laboratory-Enabled Network Building in Camden. The building is 100% non-domestic and therefore only the non-domestic sections of the energy assessment procedure have been considered.

This report has been prepared to ensure energy remains an integral part of building's design and evolution. It presents the results of modelled carbon emission improvements against a defined baseline and outlines strategies to mitigate these emissions.

The assessment is structured according to the Mayor's energy hierarchy

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Stage 1: Use Less Energy

A selection of passive demand reduction measures (including heat recovery systems and optimising u-values) are employed to reduce demand.

Stage 2: Supply Energy Efficiently

The site is not near-by to any existing or planned heat networks in the area, therefore it has not been possible to propose to connect to a DHN at this stage. The building will, however, be designed such that it can connect to a DHN in the future should one become known. CHPs do not align with either the Mayor's or Camden's air quality policies therefore is not appropriate to install at this site. Therefore, no measures have been taken at Stage 2 of the Energy Hierarchy.

Stage 3: Use Renewable Energy

This stage of the energy hierarchy identified air source heat pumps (ASHPs) and solar photovoltaic (PV) panels as appropriate renewable technologies to be installed at the site.

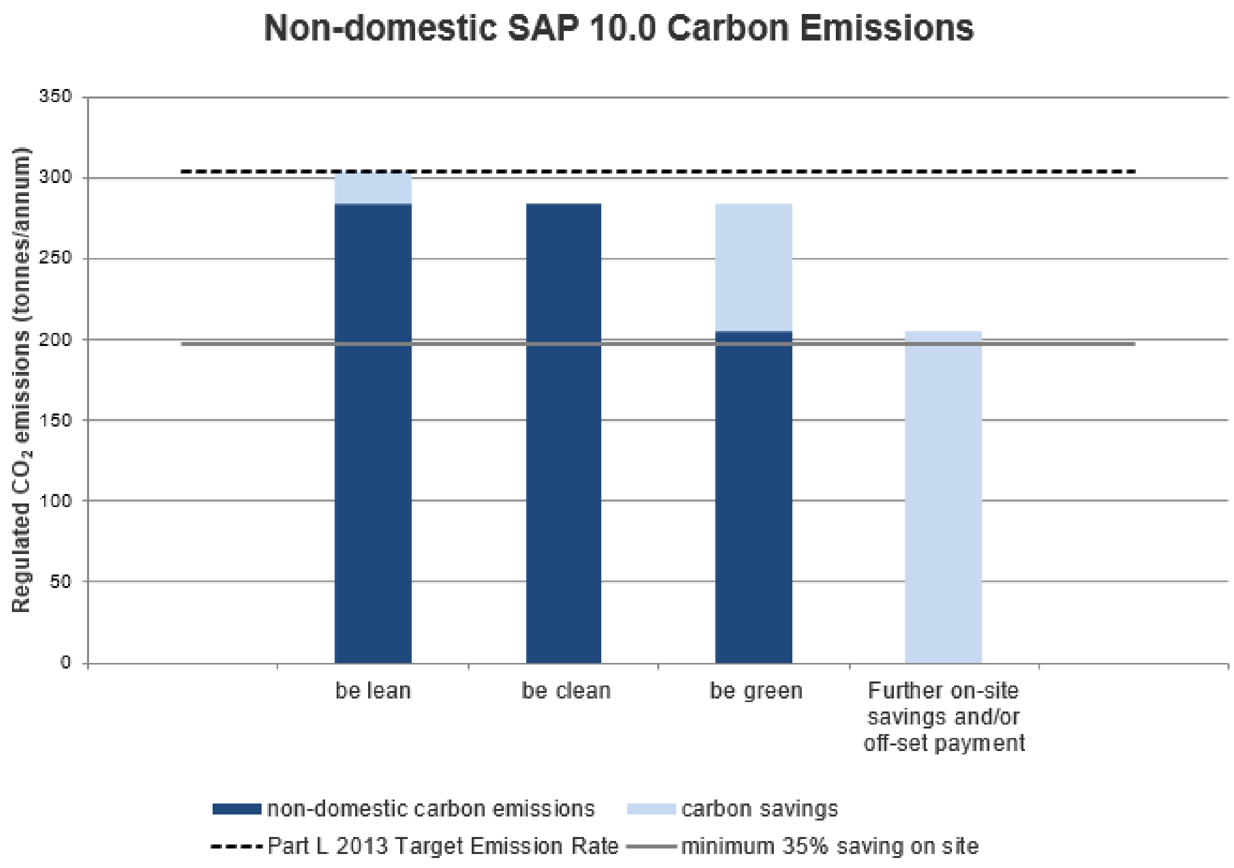
The results of each of these measures of the Energy Hierarchy can be found in the table below.

	Total unregulated emissions (Tonnes CO_2/year)	**Total regulated emissions (Tonnes CO_2 / year)**	**CO_2 savings (Tonnes CO2 / year)**	**Percentage savings (%)**
Part L 2013 baseline	190.1	304.0		
Be lean	190.1	283.6	20.5	7%
Be clean	190.1	283.6	0	0%
Be green	190.1	204.7	78.9	26%
Total Cumulative Savings	-	-	99.3	33%
		-	**CO2 savings off-set (Tonnes CO2)**	-
Off-set		**-**	**6,140**	-

Following the Mayor's energy hierarchy assessment methodology, the proposed energy strategy allows the development to achieve an overall 33% reduction in regulated CO_2 emissions under SAP 10. The 35% minimum cannot be achieved due to the high energy demand of the lab spaces and the insufficient space to place additional renewable technologies. The development is 100% non-domestic, therefore a cash-in-lieu contribution will be required to offset the shortfall in carbon reduction up to 100% below the Part L baseline with a 35% minimum target. The 30-year cumulative carbon shortfall has been calculated as 6,140 tCO_2. Using £95 per tonne as the carbon offset price, this equates to a cash-in-lieu contribution of £583,332.

	Annual Shortfall (Tonnes CO_2)	**Cumulative Shortfall (Tonnes CO_2)**
Total Target Savings	304	-
Shortfall	204.7	6,140
Cash in-lieu contribution (£)	583,332	-

A regulated CO_2 savings summary for the laboratory-enabled network building is illustrated in the figure below.



1 Introduction

This Energy Assessment has been prepared by Ove Arup and Partners Ltd. ('Arup') on behalf of Derwent valley Property Developments Limited.

The Network building is currently being developed by Derwent into a commercial office by a separately appointed design team. This will be submitted under a separate reserved matters application

Derwent appointed Arup to develop the design to support a reserved matters application for the laboratory enabled building. Therefore, 2 energy statements will be submitted to planning for the network building – the office only building and the laboratory enabled building as part of separate reserved matters applications.

This document encompasses the energy statement to be submitted to planning for the laboratory enabled network building. The energy statement presents the proposed energy strategy for the Laboratory Enabled Network Building and presents the results of modelled carbon emission improvements against a defined baseline.

The Network Building is located on Whitfield Street and Howland Street in Fitzrovia, London Borough of Camden. The laboratory-enabled network building will comprise one basement level, ground floor and seven upper floors. The building will include both laboratory and office space – laboratory space is to be located on floors 2-6 and will occupy approximately 50% of the space on these floors.

The development is 100% non-domestic and therefore will follow the carbon emissions reporting for non-domestic developments outlined in the GLA's energy assessment guidance.

2 Review of Regulation, Policy and Guidance

The energy performance and carbon dioxide emissions associated with the development are considered against national, regional and local planning policy.

2.1 Buildings Regulations

The Building Regulations cover energy associated with the *operation* of buildings and include heating, cooling, ventilation, vertical transport and lighting systems. Energy for the *use* of buildings, including cooking, appliances, IT equipment and small power devices, is unregulated.

Energy in buildings is regulated by the provisions of Part L of the Building Regulations. The most recent version of Part L is 2013, which incorporates 2016 amendments. The method of assessment used in Part L, including appropriate benchmarks for different building types, is set out in the Standard Assessment Procedure 12 (SAP 12).

In July 2018 the latest SAP version was published, named SAP 10. SAP 10 has not yet been adopted by building regulations however it is stated within the Greater London Authority (GLA) Energy Assessment Guidance (October 2018) that from January 2019 onwards, planning applicants are “encouraged” to use the SAP 10 emission factors for referable applications. Table 1 summarises SAP10 and SAP2012 carbon factors.

Table 1: SAP2012 and SAP10 carbon factors

	SAP 2012 carbon factors ($kgCO_2/kWh$)	**SAP 10 carbon factors ($kgCO_2/kWh$)**
Grid electricity	0.519	0.233
Grid displaced electricity	0.519	0.233
Mains gas	0.216	0.210

2.2 The London Plan

The London Plan is the Spatial Development Strategy for London. In December 2017, the Draft New London Plan was published for consultation. Following consultation responses, minor suggested changes were made to the plan which were published in August 2018. When published, the final New London Plan will replace the previous 2011 version, therefore policies within the Draft New London Plan are referred to herein.

The following policies are relevant to the Laboratory energy strategy:

- Policy SI1 Improving air quality
- Policy SI2 Minimising greenhouse gas emissions
- Policy SI3 Energy infrastructure
- Policy SI4 Managing heat risk

The overarching principle for new development is to develop a low carbon energy solution in accordance with the Mayor’s energy hierarchy, which meets or exceeds the overall carbon emissions targets defined in Policy SI2 that all major developments should be net-zero carbon. By means of the energy hierarchy, carbon must be cut by a minimum of 35% beyond Building Regulations.

Residential development should aim to achieve 10%, and non-residential development should aim to achieve 15% through energy efficiency alone.

The energy hierarchy is as follows, further details taken from the GLA guidance are included:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Where it is clearly demonstrated that a zero-carbon target cannot be met on site, any shortfall should be provided through a payment contribution to relevant borough's carbon offset fund or off-site generation.

In relation to part 2 of the energy hierarchy, Policy SI3 outlines the new heating hierarchy, which will also be considered in the development of this energy assessment:

1. Connect to local existing or planned heat network/s
2. Use available local secondary heat sources (in conjunction with heat pump, if required, and a lower temperature heating system)
3. Generate clean heat and/or power from zero-emission sources
4. Use fuel cells (if using natural gas in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NO_x gas boiler)
5. Use low emission combined heat and power (CHP) (in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NO_x gas boiler)
6. Use ultra-low NO_x gas boilers.

Similarly, Policy 5.9 of the London Plan sets out the cooling hierarchy which will also inform this assessment:

1. Minimise internal heat generation through energy efficient design
2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
3. Manage the heat within the building though exposed internal thermal mass and high ceilings.
4. Passive ventilation.
5. Mechanical ventilation.
6. Active cooling systems (ensuring they are the lowest carbon options).

2.3 GLA Energy Assessment Guidance

The GLA published its updated guidance on preparing energy assessments in October 2018. As previously identified, the guidance encourages applicants to use SAP 10 carbon factors from 2019 onwards. It also provides more detail on the energy hierarchy, strongly encouraging the monitoring of energy use during occupation.

Other key requirements which link to this energy assessment and the Draft New London Plan Policies SI1 to SI4 include:

- Commit to reducing regulated CO_2 emissions below those of a development complaint with Part L 2013 of the Building regulation through energy efficiency measures alone.
- Demonstrate zero carbon emissions with a 35% minimum on-site reduction beyond Part L 2013 for non-residential development. Developments comprised of both domestic and non-domestic uses must demonstrate this target has been achieved for domestic and non-domestic uses separately.
- Include information demonstrating that the risk of overheating has been mitigated through the incorporation of passive design measures.
- Demonstrate that connection to existing or planned district heating networks has been prioritised and provide correspondence to support this.
- Investigate and commit to maximising the installation of renewable technologies (including the potential for storage) on site.
- In addition, the document provides specific guidance on the assessment method and reporting format. These requirements have been taken into account in developing the energy assessment and this report.
- The new GLA assessment guidance states that at least 15% of emission reduction should be achieved at the Be Lean stage of the hierarchy, while at least 20% should be achieved at the Be Clean and Be Green Stages.

2.4 London Borough of Camden Local Development Framework

The Camden Local Plan was adopted in July 2017. It replaced the Core Strategy and Camden Development Policies as the basis for planning decisions and future development in Camden. Relevant polices from these prior documents will be considered during this assessment, as well as relevant policies in the draft new Local Plan:

- CC1 Climate change mitigation -
  The Council requires all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met.
- CC2 Adapting to Climate Change -
  The Council expects non-domestic developments of 500 sqm of floorspace or above to achieve “excellent” in BREEAM assessments and encouraging zero carbon in new development from 2019.
- CC4 Air quality -
  Air Quality Assessments (AQA) are required where development is likely to expose residents to high levels of air pollution.

2.5 Camden Planning Guidance Energy Efficiency and Adaptation

Camden council prepared a additional planning guidance on energy and resources to support the policies set out in the Camden local Plan 2017. This guidance provides information on key energy and resource issues within the borough and supports Local Plan Policies CC1 Climate Change mitigation and CC2 Adapting to climate change.

2.6 BREEAM New Construction 2018

Camden Local Council expect the application of a BREEAM assessment to non-residential developments of 500 sqm or more. It is expected that these developments will achieve rating of excellent and will encourage zero carbon from 2019.

The latest BREEAM scheme is BREEAM New Construction 2018. The relevant BREEAM issues for this Energy Assessment report is ENE01 'Reduction of energy use and carbon emissions', the minimum requirement under this issue for achieving 'Excellent' level is:

- To achieve a minimum of 6 credits under *ENE01 Reduction of energy use and carbon emissions* of which 4 minimum credits under Energy modelling and reporting
- To achieve 1 credit under *ENE02 Energy monitoring*

3 The Energy Hierarchy

The energy hierarchy (figure below) informs the design, construction and operation of new buildings. The priority is to minimise energy demand, and then address how energy will be supplied and renewable technologies incorporated. An important aspect of managing demand will be to reduce peak energy loadings.

The energy performance of the proposed scheme has been assessed following the procedure laid out by the document titled "Energy Assessment Guidance – Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018)", following the Mayor's Energy hierarchy:

Priority 1 – Use less energy (Be Lean)
Priority 2 – Supply energy efficiently (Be Clean)
Priority 3 – Use renewable energy (Be Green)
Priority 4 – Monitor, verify and report on energy performance (Be Seen)

Priority 1 – Use less energy (Be Lean)

The reduction or elimination of unnecessary energy use; Conservation is often achieved through behavioural changes such as switching appliances off when they are not being used, or the introduction of passive design features, an example of which would be to implement shading devices in order to reduce the need for cooling in summer etc.

Energy efficiency improvements are usually achieved through the application of engineering principles.

Priority 2 – Supply energy efficiently (Be Clean)

Finite natural resources such as oil, coal, gas and uranium provide the vast majority of global and UK energy supply. The current transport systems, buildings and power generation infrastructure have been built such that they are all largely dependent on the continued supply of these resources. Examples of low carbon technologies are Heat Pumps, Combined Heat & Power and District Heating/Cooling etc.

Priority 3 – Use renewable energy (Be Green)

Having taken all reasonable steps to minimise energy demand and improve efficiency, this next priority is to supply that demand from clean energy sources that are effectively infinite. Effective, sustainable energy provision, though, is not just about resource availability, it must also embrace wider issues such as affordability, societal acceptability and environmental impact.

Priority 4 – Monitor, verify and report on energy performance (Be Seen)

Disclosure of building energy use is a central component underpinning process in reducing carbon emissions and running costs. There should be a platform to display energy consumption transparently along with the predicted energy performance from the energy assessment. This platform can be used to show how developments and buildings are performing.

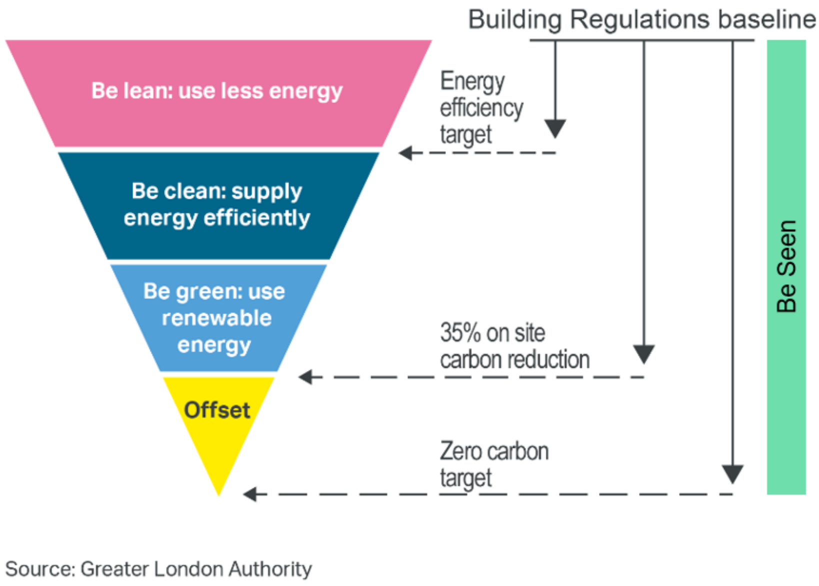


Figure 1: Draft London Plan (Dec 2017) Figure 9.2 - The energy hierarchy and associated targets

4 Energy assessment methodology

This section describes the method applied to the energy assessment. It identifies how relevant guidance was applied and highlights the approach taken in relation to key methodological challenges.

The overall approach taken for the energy assessment comprised the following work elements:

- Creating a model of the laboratory enabled network building to project energy demand and test the energy and carbon emissions impact of different demand reduction, energy efficiency and renewable and low carbon supply solutions. The energy modelling approach is compliant with the requirements of Building Regulations Part L 2013.
- Research on existing and planned heating and cooling networks and other potential low carbon heating and cooling sources in the area.
- Providing a feasibility assessment to ensure that whichever heating technology is used is optimised to meet the domestic hot water and part of the spacing heating demand.
- Investigation of the feasibility of different on-site renewable and low carbon energy supply technologies and estimation of the potential available yield from each technology.
- Refinement through an iterative process of testing energy options and confirmation of the proposed energy strategy.
- Estimating site-wide regulated CO_2 emissions and reductions (broken down by domestic and non-domestic elements of the development) after each stage of the energy hierarchy using the GLA carbon report toolkit spreadsheet

4.1 Modelling software

Dynamic modelling software, *Integrated Environmental Solutions Virtual Environment (IES VE)* has been used to calculate the carbon dioxide emission rate. *IES VE pro* is an accredited software for demonstrating UK building regulation Part L compliance and for producing Energy Performance Certificates. The version of the tool used for this analysis was *IES VE 2019 Feature Pack 3*, which was the most recent release at the time of modelling.

4.2 Building geometry

The energy model us based on HOK Architects GAs received 07/10/2020. **Error! Reference source not found.**Figure 2 and Figure 3 illustrate a 3D and plan view of the prop.

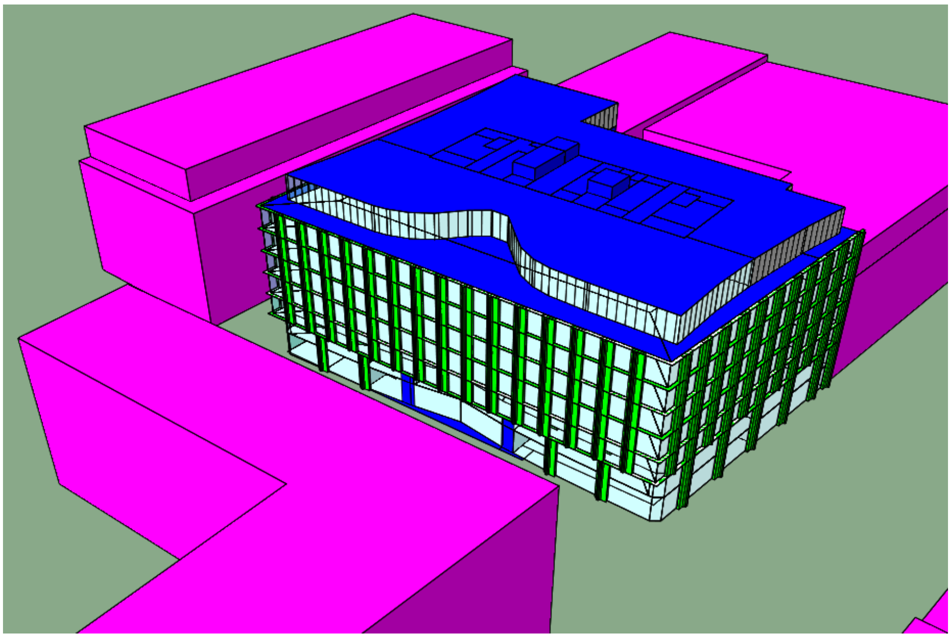


Figure 2: Proposed building IES model with adjacent buildings

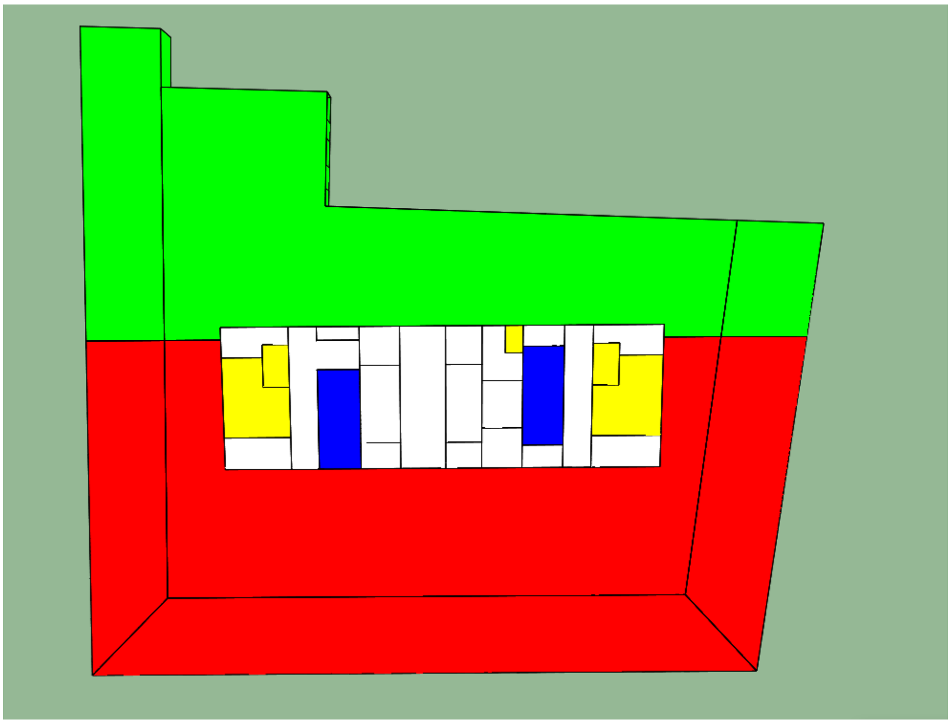


Figure 3: Plan view of typical floor with office space in green and laboratory space in red and office space in green

5 Energy Consumption and Carbon Dioxide Emissions Baseline

The Notional Baseline represents the energy consumption and carbon dioxide emissions baseline associated with a typical laboratory-office that is designed to the 2013 UK Building Regulations Part-L standards. The performance metric of this notional building is extracted from the Part-L model in the form of the Target Emission Rate (TER). The TER is the minimum energy performance requirement required by the UK building regulations under Part L and is measured in $kgCO_2/m^2$/annum. It is calculated in accordance with the National Calculation Methodology (NCM).

The total energy demand for the baseline case for a Part L 2013 Buildings Regulations compliant development is outlined in Table 2. As discussed, the development will be using SAP 10 factors, therefore tables hereafter will contain carbon emissions on SAP 10 basis. Outputs from the GLA Carbon Emission Reporting spreadsheet is included within the appendix with details both SAP 2012 and SAP 10 emissions for the development.

Table 2: Baseline scenario site wide regulated and unregulated carbon emissions (SAP 10)

Scenario	Regulated CO_2 emissions	Unregulated CO_2 emissions
Baseline	304 tCO2/annum	190 tCO2/annum

6 Energy Conservations and Energy Efficiency (Be Lean)

The second stage of the of the Mayor's Energy Hierarchy approach focusses on energy efficiency measures, which aim to reduce energy losses within the building and eliminate the unnecessary use of energy.

6.1 Passive Design

Optimising passive design is the most effective means, both in carbon and financial terms, of ensuring the buildings are inherently low in energy usage. Passive design measures can reduce the heating demand and any active cooling requirements. Passive design measures were modelled based on assumptions that the build standard should be equal or better that the Part L 2013 notional building. Table 3 summarises the weighted average building fabric performance for each building element.

Table 3: Weighted average building fabric performance

Building Element	Part L 2013 limit	Design Targets
External Wall	0.35 W/m²K	0.22 W/m²K
Roof	0.25 W/m²K	0.14 W/m²K
Ground/Exposed Floors	0.25 W/m²K	0.12 W/m²K
Windows	2.2 W/m²K G-value 0.40	1.6 W/m²K G-value 0.34
Air Permeability	10 m³/(h.m²) at 50Pa	5 m³/(h.m²) at 50Pa

6.2 Daylighting

Effective use of day lighting can reduce the need for artificial lighting in the development. This is particularly appropriate because the building will be typically occupied during the day when good levels of natural light are available. Daylighting is achieved through careful sitting of windows and other glazed elements. When considering the admission of daylight, it is important to bear in mind that solar overheating can be an unwanted consequential impact and external shading is often required to mitigate this.

To maximise the energy savings that good natural daylight can provide it is important that it is complemented by a good performing lighting control system to allow artificial lighting to be dimmed or turned off when natural daylight levels are suitable.

6.3 Low Lighting Energy and Lighting Control

Preliminary design with low energy light fittings to achieve an average target luminaire efficiency greater than the Part-L minimum of 60 lumen per circuit watt. Table 4 summaries the indicative lighting efficacy and control for each room type assigned within the building model in IES VE.

Table 4: Lighting efficacies and controls

Room/Area	Indicative Efficacy (LL/CW)	Typical Lighting Control
Laboratory space	116	Absence detection daylight dimming
Corridor	111	PIRs
WCs	93	PIRs
Office	129	Absence detection daylight dimming
Office	120	Absence detection daylight dimming
Office	114	Absence detection daylight dimming
Plant room	140	Manual control
Plant room, cycle stores, BOH etc.	155	PIRs
Stairs	129	PIRs
Others	90	-

6.4 Variable flow for pumps

Most existing pumping systems requiring flow control make use of bypass lines, throttling valves, or pump speed adjustments. The most efficient of these is pump speed control. When a pump's speed is reduced, less energy is imparted to the fluid and less energy needs to be throttled or bypassed. Speed can be controlled in a number of ways, with the most popular type of variable speed drive (VSD) being the variable frequency drive (VFD).

The saving from Variable Speed Pumps may go well beyond energy, and may include improved performance, improved reliability and reduced life cycle cost.

6.5 Heat Recovery Ventilation

As building efficiency is improved with insulation and weather-stripping, buildings are intentionally made more airtight and consequently less well ventilated. While opening a window does provide ventilation, the building's heat and humidity will then be lost in the winter and gained in the summer, both of which are undesirable for the indoor climate and for energy efficiency, since the building's HVAC system must compensate, Heat Recovery Ventilation technology offers an optimal solution.

The efficient heat recovery efficiency in central ventilation plant is assumed to exhibit an overall heat recovery efficiency of 73%.

6.6 Building Energy Management System

Building (Energy) Management System is a central computer controlling, monitoring and optimising building services and systems such as heating, air- conditioning, lighting and security. To achieve BREEAM 'Excellent', the following major energy consuming systems (where present) are monitored using either a BEMS on:

- Space Heating

- Domestic Hot Water
- Fans (Major)
- Lighting
- Small Power
- Other major energy-consuming items where appropriate

The end energy consumption use is identifiable to the building user through labelling or data outputs.

6.7 Results of Stage 1: Be Lean

The building energy demands after Be Lean measures have been carried out are summarised in Table 5.Building energy demands after Be Lean

Table 5: Building energy demands after Be Lean

	Energy demand following energy efficiency measures (MWh/year)					
	Space heating	**Hot water**	**Lighting**	**Cooling**	**Auxiliary**	**Unregulated gas**
Non-domestic total	93	386	163	50	592	0

Implementing the estimated savings through passive design measures and energy efficient building systems result in a site-wide regulated CO_2 emissions saving of 23 tCO_2/year, translating to a reduction of 7% from the baseline under SAP 10. This is below the 15% target for Be Lean measures outlined by the GLA in the new draft London Plan. This is due to the inherently high energy consumption of the lab spaces. The results associated with SAP 10 are outlined in Table 6.

Table 6: Building CO_2 emissions after Be Lean (SAP 10)

	Regulated CO_2 emissions (tCO_2/year)	**Unregulated CO_2 emissions (tCO_2/year)**	**Regulated non-domestic carbon dioxide savings**	
			(Tonnes CO_2 per annum)	(%)
Baseline	304.0	190.1	-	-
Be Lean	283.6	190.1	20.5	7%

7 Heating and Cooling Infrastructure Hierarchy

The heating and cooling infrastructure hierarchy as set out by the GLA is as follows

7.1 Priority 1 – Connection to an area wide heat distribution network

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

Existing networks

Where a heat network exists in the vicinity of the proposed development, the applicant must prioritise connection.

- This must include confirmation from network operator that there is excess capacity to serve new development, together with supporting estimates of installation cost and timescales for connection.
- The carbon factor associated with the heat supplied by a network should be obtained from network operator and applied in the energy assessment, accompanied by assumptions used to derive carbon factor including heat losses.
- Applicant is expected to contact developments in the vicinity to enquire about opportunities and provide evidence of correspondence with any heat network operator (Include in report Appendix)

Planned networks

If no existing network is present, the applicant must investigate whether such a network is planned in the area.

- Make reference to borough's heat mapping report or borough's energy masterplans
- Applicant is expected to make enquiry to appropriate contacts in borough and evidence of correspondence should be included in energy assessment report
- Applicant must demonstrate the design incorporate the mechanism to connect to planned networks, if a network is planned, follow guidance form *London Heat Network Manual*.
- Should applicant contend providing a site-wide heat network to allow future connection result in uneconomic costs to end users, applicant must provide a Whole Life Cost (WLC) analysis.

7.2 Priority 2 – Communal heating system

Whilst there may appear to be no prospect of a district heating network in the vicinity, all developments will be required to provide a site-wide heat network, there may be an exception for smaller developments, where it is demonstrated that a site-wide heat network is uneconomic.

Site-wide heat networks

Where proposed developments are located in areas of decentralised energy potential, 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 network are planned or feasible.

7.3 Priority 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 acceptable 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.

7.4 Heating and cooling infrastructure hierarchy

Priority 1

Section 8 below of this report summarises the review of existing and proposed heat networks in the area and the feasibility of connecting to them.

Priority 2

As the proposed development is a single building, a communal building level heating system throughout the building is proposed.

8 Use of Low Carbon Technologies (Be Clean)

This section examines the second tier of the Mayor's energy hierarchy. The successful integration of low carbon technologies with buildings depends on a number of technical, economic and social factors.

8.1 Heat Networks

8.1.1 Existing heat networks

Figure 4: London Heat Map detailing no existing heat networks – location of Laboratory-Enabled Network Building marked in blue circle

In accordance with the new heating hierarchy, primary consideration should be given to connection to an existing or planned heat network. At the time of writing, no district heat networks were identified within the area. This has been demonstrated using the London Heat Map tool, where no existing networks were found within the local vicinity. This is shown in Figure 4.

8.1.2 Planned future heat networks

Figure 5: Proposed networks using the London Heat Map tool

The London Heat Map was also used to determine whether the building was nearby to any proposed heat network. One proposed network was located on Euston Road, but it was deemed that this network is not close enough to the proposed building to connect to. Connecting to this network would require digging up significant amounts of road surface to place pipework and excavations making it unviable. The network also does not yet exist so cannot propose to connect to this time.

Therefore, investigation into the area found that the development is not located nearby to any planned low carbon heat networks at the time of writing that would be financially and technically viable to connect to. However, the design of the building shall be such that if a district heat network is to become live close to the proposed building in the future, the development will be able to connect to it.

At this stage, it involved make sure that there is enough room in plant rooms for heat exchangers that can take heat from a heat network and ensuring there is space for additional pipework to make the connection. Figure 6 shows indicative plan on ground floor for location of district heat network plantroom.

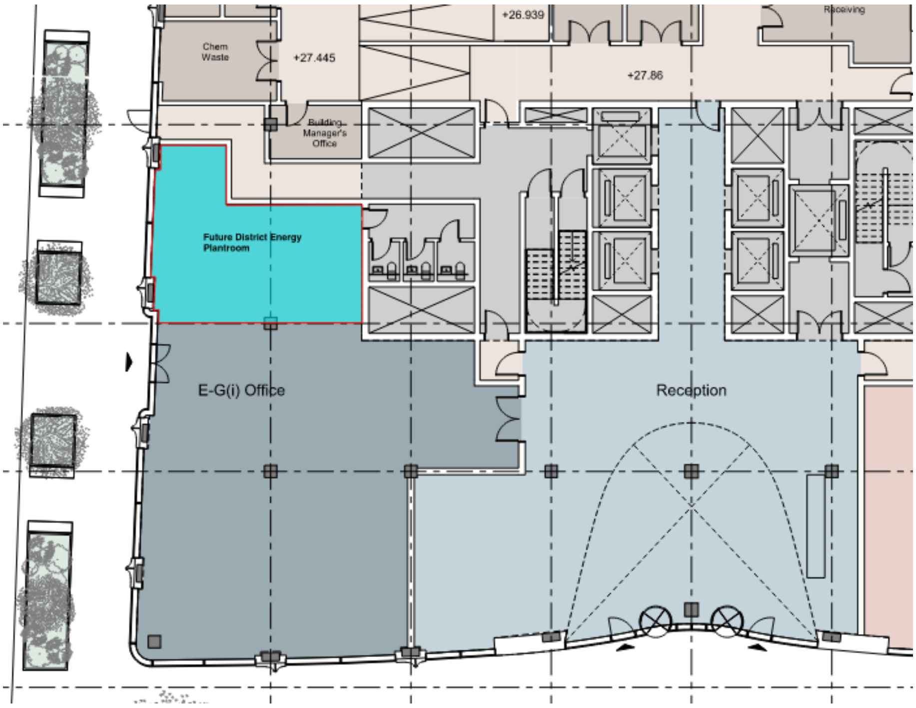


Figure 6: Indicative plan showing location of future district heat network plantroom

8.2 Combined Heat and Power

Gas fired Combined Heat & Power (CHP) Plants, also known as cogeneration, uses conventional stationary internal combustion engines or turbines to generate both electricity and heat. A generator is coupled directly to the output shaft of the engine in order to generate electricity. Heat is recovered from the engine via the water jacket, and from the exhaust gas. Assuming the CHP plant is well-designed and as such will be able to utilise large proportions of waste heat on an annual basis, this leads to an overall increase in the CHP plant efficiency to figures significantly greater than those of a conventional internal combustion engine, and is the basic advantage of a CHP plant.

Gas fired CHPs do, however, impact local air quality and require large amounts of space within plantrooms. There are associated problems of combusting fuels within cities in terms of NO_x emissions and particulate matter (PM10). It is likely that the installation of a CHP will not align with Camden's core policies or GLA policies. For this reason, gas CHP engines have been deemed unsuitable for installation in the laboratory enabled Derwent network building.

8.3 Results of Stage 2: Be Clean

No measures under the Be Clean stage of the hierarchy have been taken due to the following reasons (explained in detail above):

- No suitable existing or planned heat networks have been identified within the Fitzrovia region of Camden where the Laboratory Enabled Derwent Network Building will be located
- CHP does not align with the Air Quality Strategy set out by Camden Council in its Local Plan

For these reasons, no reduction below the Part L baseline is achieved under Stage 2: Be Clean of the Energy Hierarchy procedure. It is expected that the development will aim to meet the 35% reduction as far as possible through Be Lean and Be Green measures only.

9 Use of renewable, sustainable resources (Be Green)

The successful integration of renewable energy technologies within buildings depends on a number of technical, economic and social factors. This section examines the third step of the Mayor's energy hierarchy for reducing carbon dioxide emissions, which involves the use of renewable energy sources on site.

Error! Reference source not found. Table 7 below summarises the results of the analysis of suitability of each renewable energy technology. This is followed by individual discussions of each technology, organised by technology type.

The section concludes with the resulting improvement in CO_2 emissions.

Table 7: Summary of renewable energy options

Technology	Feasible?	Key issues / risks	Adopted?
Solar thermal	✓	Competes with solar PV. Need to be couple with additional heating technology to meet desired temperatures	✗
Solar PV	✓	Roof area specifically allocated for solar PV which can be easily integrated to provide electricity	✓
Heat pumps	✓	Allows simultaneous 4 pipe heating and cooling, allows all-electric option	✓
Biomass heating	✓	Does not align with Camden's air quality aspirations	✗
Biomass CHP	✓	Air quality impact, traffic impact, space requirements and incompatibility with future connection to LVHN scheme.	✗
Wind	✗	Low efficiencies in urban developments and visual impact.	✗

9.1 Solar technologies

9.1.1 Solar thermal

Solar thermal energy is a proven, low-cost renewable heat technology. Its traditional application is for domestic hot water heating. Solar thermal provides low temperature heat; it is normally paired with another higher temperature heat source such as gas with the solar thermal energy providing the primary heat to be topped up.

Constraints and considerations for use include overshadowing from adjacent buildings and other rooftop structures, as well as compatibility with other roof space uses (including roof plant and green roofs). Solar thermal will be competing for roof space with Solar PV.

As heat pumps will be installed to provide space heating, these can also provide the primary energy which the solar thermal technologies would provide. As a technology is therefore already being installed which can provide this primary energy for domestic hot water (DHW), it was deemed more suitable to utilise the roof space for solar photovoltaic installation.

9.1.2 Photovoltaic panels

PV (photovoltaic) modules are an established technology with the capability to integrate readily into a number of different site-wide energy strategies regardless of the heating or cooling strategy chosen.

However, this system suffers from requiring significant equipment investment and have relatively low efficiencies.

Further considerations regarding PV are:

- The mean time to failure for inverters is 10-15 years. As these represent up to 25% of installed cost, the owner of the building would need to set aside monies to cover replacement costs of this equipment.
- PV panels need to be cleaned periodically and therefore staff and resources would need to be made available over the lifetime of the installation.
- PV panels require roof space with an uninterrupted view of the sun through most of the day.

The embodied carbon and energy associated with higher efficiency monocrystalline photovoltaics can be very high, and certain countries (e.g. Germany) are moving towards the lower efficiency, lower environmental impact amorphous and thin film technologies. The effect of such a specification would be to reduce the operational carbon savings from the panels by up to one third.

9.1.3 Conclusion on solar technologies

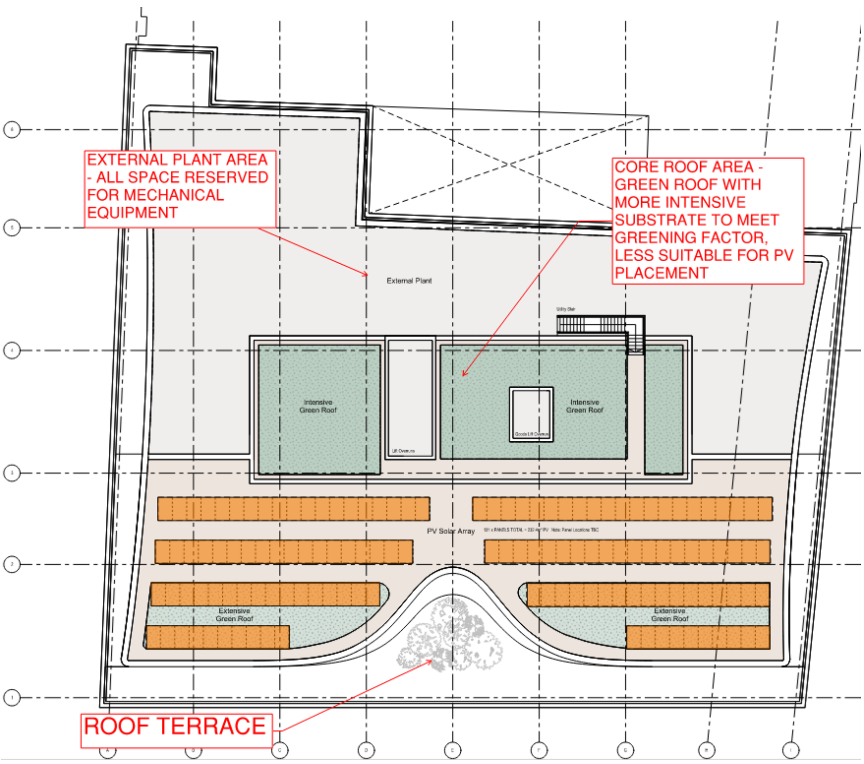


Figure 7: PV layout

Solar PV panels are considered most suitable for the development due to the heat pumps intending to be installed already provided a source for the primary energy for DHW.

The roof of the proposed building includes plant area, a terrace area and a green roof area. The plant area is already fully occupied with the large amount of plant required for lab space, so it is not possible to install PV in this area. The Level 7 terrace will be used by building occupants and therefore it is not suitable to install PV in this area. It was decided that PV could be installed on the Level 8 Roof. Some of the upper terrace area is occupied with green roof. PV can be installed on top of the green roof areas using a solar PV solution by Bauder. Bauder's PV mounting solution involves a structure which allow the PV panels to be used in green roof applications in a penetration free manner. Bauder's PV mounting solution is shown in

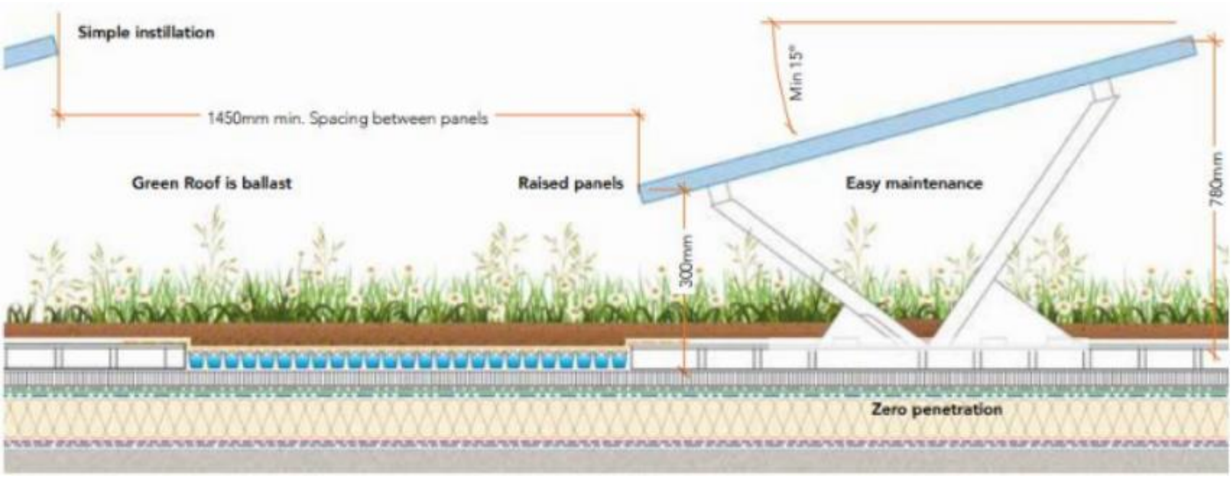


Figure 8: Bauder PV mounting solution

Bauder's PV structures require minimum spacing of 1450mm between PV arrays. SunPower Maxeon 3 PV panels were used to determine PV panel placement, which have dimensions of 1,690 × 1,046 mm. At least 1 m of spacing between panels and edge of the roof is required and therefore determines PV placement.

Figure 7**Error! Reference source not found.Error! Reference source not found.** shows the provisional PV arrangement layout on the upper terrace roof area of the Derwent Laboratory Scheme. A total of 131 panels can potentially be installed, which equates to a total array rea of 232.4m^2. This is equivalent to a total solar PV electrical output capacity of 52.4 kWp.

9.2 Heat pumps

9.2.1 Ground source heating and cooling

The relatively constant year-round temperature of the ground makes it a possible heat source and heat sink to which a heat pump can be coupled to amplify its heating/cooling capacity. Coupling is achieved via a buried closed loop pipe circuit through which water is circulated, either in dedicated vertical boreholes or horizontal trenches, or as part of the structural piles of the building. Ground source systems can achieve seasonal coefficients of performance (SCoP) of 4.0.

Pipes buried within dedicated boreholes or trenches incur a relatively large capital cost due to the extra excavation required. Horizontal loops have a relatively low yield and a preliminary investigation of the Application Site and the estimated yield required from the system makes this option technically unfeasible.

Thermal piles involve incorporating the pipe circuit within the reinforcement cages of the building's piles requires no additional excavation but may add some complexity to the structural design.

Thermal piles are also generally a low yield system and without preliminary structural design of the buildings are not currently considered.

Vertical closed loop boreholes can be made deeper than energy piles and provide a higher yield and with space constraints on the Application Site are more suitable than a horizontal trench system.

Vertical open-loop boreholes are essentially water wells. While there are instances of the application of this technology in the UK, it is by no means prevalent. A number of boreholes are drilled deep into the aquifer (circa 150m) and water is abstracted from one or more and re-injected into other sited a distance away.

Thermal balancing restricts output of GSHP systems in order to maintain their long-term usage. This is because an imbalance has the potential to alter long term ground temperatures. Balancing is achieved by limiting the amount of heat rejected to the ground during the warmer months to equal the amount of heat extracted in the winter months.

As the cooling load within the laboratory building is higher than the heating load, installation of GSHPs would also require additional technologies to meet the remaining cooling demand so that the system remains balanced. GSHP systems require a significant amount of investment to be made and often come with many complications when installed due to imbalance. Figure 9 shows an IES VistaPro output graph summarising the room heating and cooling plant sensible load over a year. It can be seen the cooling load greatly exceeds the heating load.

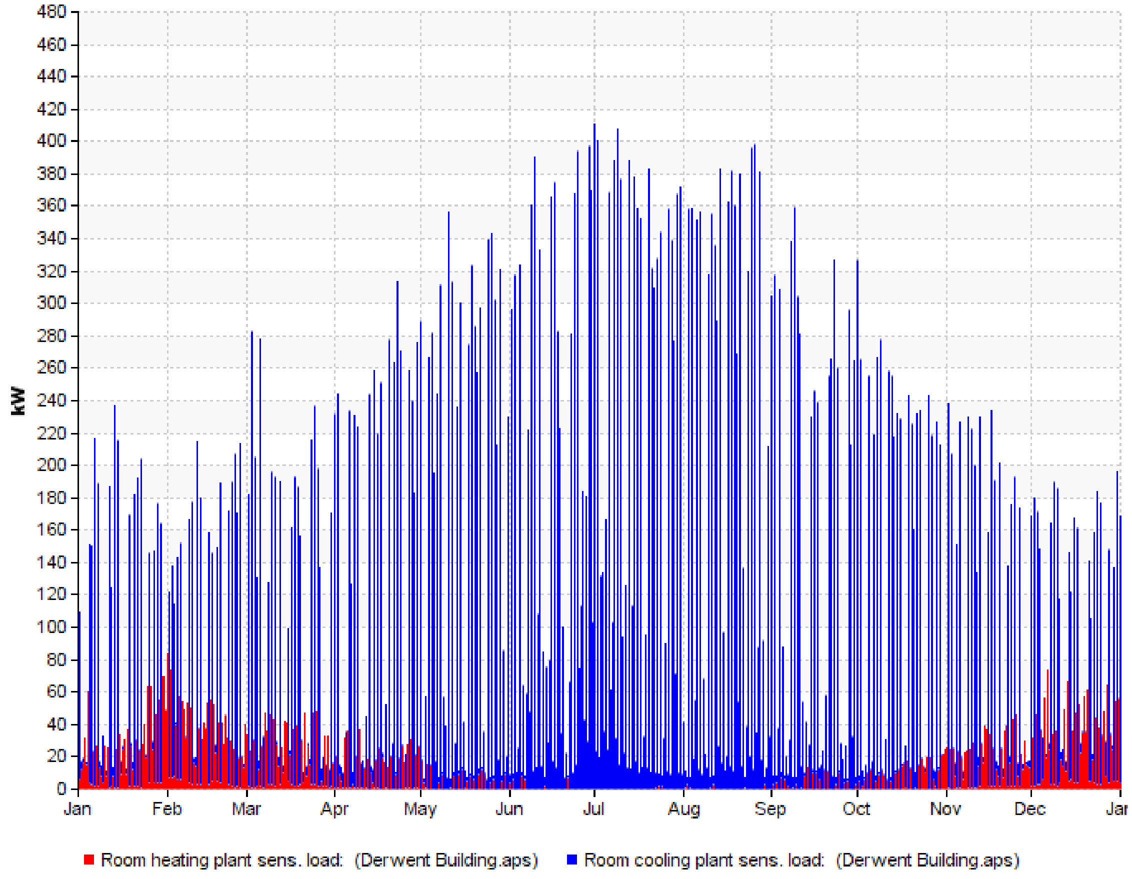


Figure 9: IES VistaPro output graph showing annual room heating and room cooling plant sensible load

9.2.2 Air source heating and cooling

Reversible Air Source Heat Pumps (ASHPs) uses the air as a heat source instead of the ground. This means that the performance of the heat pump will vary according to the external conditions but avoids the need to provide a heat balance as is often required with ground source heat pumps. Units are now available that can provide simultaneous and reversible heating and cooling with a typical modelled SCoP of 3.0.

Another advantage is that they do not require a significant area of land in which to lay the pipes. However, they are required to be placed outside so require space to be allocated on, for example, the roof of the building.

Because these heat pumps are reversible, it can potentially displace or reduce the size of the cooling plant otherwise would be installed and thus does not add much roof plant space. The building design for heating would have to be adapt to cater for lower grade heat output from these ASHPs, typically at 45℃ max, as oppose to conventional design involving gas fired boilers, typically can deliver higher grade heat output at or above 80℃.

Because of the lower grade heat output for space heating, ASHPs can only deliver pre-heating for the building's domestic hot water demand, gas-fired or further water-water heat pumps are needed to provide DHW temperature top-up as required.

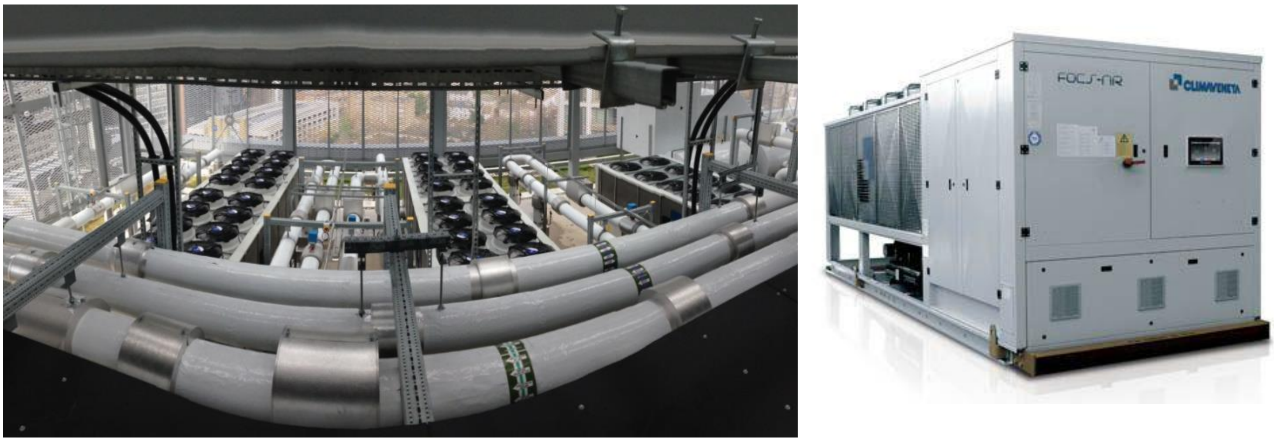


Figure 10: Photo (left) showing installation of Reversible Air Source Heat Pumps (left and centre) and Air Cooled Chiller (right)

This form of technology is still evolving and there are units out on the market now that can deliver simultaneous heating and cooling, via heat recovery when the heat pumps are operating in cooling mode, thus further improve the energy efficiency.

9.2.3 Water source heating and cooling

As above with air source and ground source heat pumps, a water source heat pump uses the relatively constant temperature of the river as a heat source and sink to amplify its heating and/or cooling capacity. The performance of the heat pump can be more readily predicted than for air source heat pumps and remains more constant with a modelled typical SCOP value of around 4.0.

Coupling can be achieved by either direct extraction of the water from the reservoir, extraction with an intermediate heat exchanger or by a closed loop coil. Water source heat pumps are better suited to a district heating solution than air and ground source heat pumps because most of the plant and equipment can be situated within a single energy centre or plant room

Licences and permits would be required for the methods involving abstraction and discharge and in all cases for works in river.

No near-by water sources have been deemed suitable for the installation on water source heat pumps therefore this option will not be taken forward.

9.2.4 Conclusion on heat pumps

GSHPs require a large amount of capital investment and are significantly more complicated in operation when compared to air and water source heat pumps, Water source heat pumps require access to a large body of water which is not possible at this site.

Reversible ASHPs have therefore been deemed the most appropriate heat pump technology at the Derwent Laboratory site. These technologies have relatively high efficiencies and require the lowest capital investment. They also promote good air quality within the area and the technology will decarbonise further over time with the decarbonisation of the grid.

9.3 Biomass and energy from waste

9.3.1 Biomass heating

Biomass heating is an established technology in Europe and is increasing in use in the UK. The supplier market is growing and there is increasing interest in the use of biomass for heating in cities.

Biomass for boilers can be supplied in the form of wood chips or wood pellets. There are numerous suppliers for each fuel around London, with the number of suppliers growing as the demand increases. Biomass boilers are typically slightly larger than gas boilers of equivalent size, but a significant additional volume is required for fuel storage on site. However, for a development of this size a large amount of fuel storage would be required in order to keep the boiler running between deliveries. Reducing storage results in an increased frequency of deliveries and could become problematic for residents of both the proposed development and the local area.

While biomass is of increasing interest owing to the assumed low carbon nature of the fuel, there are increasing concerns being voiced publicly. These include noise and emissions associated with delivery of the fuel and also the impact of combusting an organic fuel in cities in terms of NO_x emissions and particulate matter (PM10). The adverse impact on air quality does not lend itself to being sited within the Camden region according to the Policy CC4 "*Air Quality*".

9.3.2 Biofuel combined heat and power

Biomass CHP plant can be run on a selection of biomass fuels from woodchip, to digester biogas however as described above the generation of biogas on site is not considered suitable for the proposed development.

Biodiesel is an increasingly interesting alternative to mineral oils and capacity is increasing in the UK. However, the entire UK production of biodiesel is already destined for an alternative to transport diesel and is therefore likely to be scarce. A conventional reciprocating CHP engine can be run on biodiesel with minor modifications; however, there is an increase in the maintenance costs and the overall efficiency drops a little.

It should be noted that there are currently quite serious environmental concerns regarding the use of biodiesel owing to the embodied energy and the displacement of both food-crops and virgin land. The use of biodiesel in a building in a city centre does not seem to be a sensible use of fuel given that it should be used for transportation needs.

Biomass CHP using wood and waste is an established technology on the continent, especially in Austria and Finland. As mentioned in the previous section above, there are associated problems of combusting an organic fuel in cities in terms of NO_x emissions and particulate matter (PM10) and it is likely that the installation of a biomass CHP will not align with Camden's core policies.

9.3.3 Conclusion on biomass

Biomass heating would be a technically feasible source of heating, however due to the existing issues surrounding air quality in Camden and the increase in local traffic due to deliveries of biomass it was deemed incompatible with this site.

9.4 Wind

Wind turbines are generally less suitable in dense urban environments such as the proposed development as the wind speed will be lower and more disrupted than on a similar site in a more rural location. In order to get any power from wind turbines they need to be mounted significantly above all obstacles, which means they have a visual impact not considered appropriate in this environment.

9.4.1 Conclusions on wind

Wind turbines are not a suitable renewable energy option for the development.

9.5 Renewable technology integration

The above review has identified that air source heat pumps and solar PV panels are the most suitable renewable technologies for use within the proposed development.

ASHPs will be installed on the roof of the development and will operate under a four-pipe system in which heating and cooling can be provided simultaneously (essentially acting as a water to water heat pump at these times). The air source mechanism is used when the cooling load exceeds the heating load or vice versa. The domestic hot water demand will primarily be met via the ASHPs, with the remainder being met by water-to-water heat pumps (to top-up the water to 65ºC.

Taking into consideration the roof area required for building services plant and the area allocated to dedicated green roofs, a total photovoltaic system size of 52.4 kWp could be installed. A plan illustrating the potential roof area at this planning stage available for the implementation of solar PV panels is shown in **Error! Reference source not found.**.

9.6 Results for Stage 3: Be Green – Use renewable energy

Looking at the 'Be Green' stage of the hierarchy specifically, solar PV plus ASHPs results in a total carbon saving of 78 tCO_2/year, which accounts for a 26% reduction from the baseline. This meets the GLA and Camden minimum requirement of 20% for Be Green.

After implementation of passive design measures, energy efficient building systems, the installation of ASHPs and solar PV panels, the scheme achieves a regulated CO_2 emission rates of 203 tCO_2/year, this translates to total of 33% reduction over the baseline of 304 tCO_2/year per year.

The Regulated and Unregulated CO_2 emissions for the scheme are summarised in Table 8.

Table 8: SAP 10 emissions after Stage 3: Be Green of the Energy Hierarchy

	Regulated CO_2 emissions (tCO_2/year)	**Unregulated CO_2 emissions (tCO_2/year)**	**Regulated non-domestic carbon dioxide savings**	
			(Tonnes CO_2 per annum)	(%)
Baseline	304.0	190.1	-	-
Be Lean	283.6	190.1	20.5	7%
Be Clean	283.6	190.1	0	0%
Be Green	204.7	190.1	78.9	26%
Total Cumulative Savings			**99.3**	**33%**

10 Monitor, verify and report on energy performance (Be Seen)

The final stage of the Energy Hierarchy is Be Seen: monitor, verify and report on energy performance. The move towards zero-carbon development requires comprehensive monitoring of energy demand and carbon emissions to ensure that planning commitments are being delivered.

Energy use shall be monitored through monitoring equipment to enable occupants to monitor and reduce their energy use, and energy usage data shall be recorded and reported to the Mayor of London, this is expected to be a new requirement from the Draft London Plan, expected in 2019.

Therefore, the proposed energy monitoring features shall include as a minimum and not limited to the following:

- Sub-meters provided for lettable spaces and designated landlord's area(s)
- All AHUs to be individually energy metered
- Meters connected to BMS system capable of monitoring and reporting function
- LV switchgear and lighting and power distribution boards to be metered and monitoring by BMS system
- All meters to be accessible and labelled with the appropriate energy end-use category
- Electricity smart meters shall be provided to all residents and tenants
- All heat interface units (HIUs) shall be equipped with heat meters

Monitoring of energy consumption shall be broken down by end-uses:

- Space heating
- Domestic hot water
- Humidification
- Cooling
- Fans
- Pumps
- Lighting
- Small power / office equipment
- IT Equipment
- Other major energy-consuming items where appropriate
- Other electrical and catering

All energy metering shall be implemented in accordance with energy efficiency best practice that complies with the relevant Building Regulations Part-L requirement and in accordance with CIBSE TM39: Building Energy Metering

11 Energy Hierarchy Summary

Following the three stages of the Mayor's energy hierarchy assessment methodology, the proposed energy strategy allows the site to achieve an overall 33% reduction in regulated CO_2 emissions under SAP 10.

Under SAP10 reporting, the development does not surpass the carbon reduction target set by the GLA. This development is 100% non-domestic, and therefore it is required that a payment-in-lieu contribution is made to make up the carbon shortfall over 30 years to 100%, with a minimum 35% target. Table 9 summarises the CO_2 savings shortfall from the reduction under SAP10.

Table 9: SAP 10 site-wide regulated emissions and off-set

	Total regulated emissions (Tonnes CO2 / year)	**CO2 savings (Tonnes CO2 / year)**	**Percentage savings (%)**
Part L 2013 baseline	304.0		
Be lean	283.6	20.5	7%
Be clean	283.6	0	0%
Be green	204.7	78.9	26%
Total 7	-	99.3	33%
	-	**CO2 savings off-set (Tonnes CO2)**	**-**
Off-set	**-**	**6,140**	**-**

One way in which it would be possible to meet the 35% minimum is to install additional PV on the roof of the building. However, it has been demonstrated that the PV has been maximised on the roof of the building and there is no scope to add additional PV panels on the roof to achieve the 67% shortfall of CO_2 reduction. Reasons as follows:

- PV has been maximised on the Level 8 Roof
- Other roof areas on Level 7 and Level 8 are allocated for plant and tenant terrace and it is not suitable to install PV in these areas (plant space is currently fully in use with plant and other will be used frequently by tenants)
- Installation of PV panels on cages above the plant area is likely to penetrate the viewing corridor for St. Pauls cathedral making it unsuitable
- Installing the PV on the core area of Level 8 Roof is not feasible due to it having a more intensive substrate to meet the greening factor which would not be suitable for PV installation using Bauder solution

The payment-in-lieu contributions required as a result of the development not meeting the 100% reduction below the Part L baseline is summarised in Table 10. This lieu contribution is priced at £95 per tonne of regulated CO_2.

Table 10: SAP 10 shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	**Cumulative Shortfall (Tonnes CO_2)**
Total Target Savings	304	-
Shortfall	204.7	6,140
Cash in-lieu contribution (£)	**583,332**	**-**

BRUKL reports summarising the results for the Be Lean and Be Clean stages of the Energy Hierarchy are included in Appendix A.

12 Cooling Hierarchy

Climate change means London is already experiencing higher than historic average temperatures and more severe hot weather events. This, combined with a growing population and the urban heat island effect, means that London must manage heat risk in new developments, using the cooling hierarchy set out below:

The cooling and mitigation of overheating performance of the Laboratory Enabled Network Building has been assessed following the procedure laid out by the document titled "Energy Assessment Guidance – Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018)", following the Mayor's cooling hierarchy:

Priority 1 – Minimising internal heat generation through energy efficient design

This includes specification of efficient equipment which does not, for example, overheat unnecessarily.

Priority 2 – Reducing the amount of heat entering the building in summer

Many aspects of building design can lead to increases in overheating risk, including high proportions of glazing and an increase in the air tightness of buildings. However, there are a number of low-energy-intensive measures that can mitigate overheating risk by reducing the amount of heat entering the building in summer, these include solar shading, building orientation and solar-controlled glazing and green roofs etc.

Priority 3 – Use of thermal mass and high ceilings to manage the heat within the building

Materials with high thermal mass such as concrete slabs or masonry walls can absorb sunlight and internal gains and store it during the day for it to be released at night. Through careful design and consideration, thermal mass and high ceilings as design features can potentially be incorporated to control the overheating levels experienced in buildings.

Priority 4 – Passive ventilation

Passive ventilation or natural ventilation system that make use of natural forces, such as wind and thermal buoyancy, to circulate air to and from an indoor space. These energy-free ventilation systems work to regulate the internal air temperature as well as bring fresh air in and send stale air out through openings windows and vents.

Priority 5 – Mechanical ventilation

Mechanical ventilation is a method of forced or induced ventilation by using mechanical air handling systems, which circulate fresh air using ducts and fans as oppose to energy-free ventilation system that make use of natural wind and thermal buoyancy, it is more controllable than natural ventilation but system insures energy consumption.

Priority 6 – Active cooling systems

The increase use of air conditioning systems is not desirable as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. Therefore, active cooling systems should only be deployed in necessary situations. The design of active cooling systems should also incorporate waste heat recovery wherever possible i.e. future district heating networks are expected to be supplied with heat from waste heat sources such as building cooling systems.

12.1 Active Cooling Demand

The proposed building will require active cooling due to nature in which it will operate. The use of natural ventilation will very likely not be sufficient to guarantee the occupant’s comfort therefore additional measures to cool the building are needed.

This is to be further reviewed and validated as the project proceeds to Stage 3. Table 11 below shows a breakdown of high-level estimates of the building’s cooling demand.

Table 11: Breakdown of building cooling demand

	Area weighted average non-domestic cooling demand (MJ/m^2)	**Total area weighted non-domestic cooling demand (MJ/year)**
Actual	46.5	725,249.6
Notional	70.7	1,102,901,2

The cooling demand will be met via air source heat pumps. These heat pumps will provide simultaneous heating and cooling to the development via a 4-pipe system. This means that when the building is being cooled, the heat will be recovered and used for heating processes elsewhere within the building. The SSER of the heat pumps has been estimated at 4.1 for cooling and 3 for heating.

No free cooling potential has been identified in this building.

13 Overheating assessment

A separate overheating assessment has been carried out on the Laboratory Enabled Network Building. The assessment was carried out using IES VE ApacheSim Dynamic Simulation Modelling (DSM) software using London DSY weather files. Under GLA energy assessment guidance, the simulation is required to be carried out using 3 weather file scenarios. This study also considered an additional 4 future weather files. The weather files used are as follows:

- CIBSE LWC DSY1 (Moderately warm summer): 2020 high emissions, 50% scenario
- CIBSE LWC DSY2 (Short, intense warm spell): 2020 high emissions, 50% scenario
- CIBSE LWC DSY3 (Long, intense warm spell): 2020 high emissions, 50% scenario
- CIBSE LWC DSY1 (Moderately warm summer): 2050 medium emissions, 50% scenario
- CIBSE LWC DSY1 (Moderately warm summer): 2080 medium emissions, 50% scenario
- CIBSE LWC DSY2 (Short, intense warm spell): 2080 high emissions, 50% scenario
- CIBSE LWC DSY3 (Long, less intense warm spell): 2080 high emissions, 50% scenario

13.1 Thermal Modelling

Under GLA overheating assessment guidance, it is required that for air-conditioned buildings the operative temperature in occupied spaces must not exceed maximum temperatures for indoor spaces outlined in CIBSE Technical Memorandum TM52 and CIBSE Guide A. Laboratories are not included in the TM52 guidance but are assumed to be equal to office in terms of comfort levels. The occupied and functional spaces within the Laboratory Enables Network Building include the reception area, offices and laboratory spaces. Table 12 summarises the maximum indoor temperatures for these spaces.

Table 12: Maximum temperatures for indoor space types in accordance with CIBSE TM52

Type and use of space	**Summer maximum temperature (°C)**
Offices	26
Laboratory	26
Foyers	26

13.2 Overheating thermal model Inputs

Internal Gains

The model considers 3 internal gain types for the overheating analysis. These are as follows:

- Lighting gain – specific lighting gain values have been taken from the energy model on a room by room basis, refer to Table 4 in Section 6.3 above.
- Equipment gain – 23 W/m^2 for Office and Laboratory spaces, 15 W/m^2 for reception space
- Occupancy gain – 90 W/m^2 sensible gain, 60 W/m^2 latent gain in all occupied spaces

Occupancy Profiles

It has been assumed that the building will be occupied from 7am-7pm on weekdays, and unoccupied over weekends. The equipment and occupancy gain profiles have been set to match the 7am-7pm profile. The lighting profile has been altered slighting to reflect more accurate use and follows a profile of 6am-10pm on weekdays.

Thermal Element Performance

Thermal element performance details for building elements are summarised in Table 3 in the Be Lean section of this report.

Shading Features

Shading features to minimise solar gain is incorporated in the building design via recess feature of the windows, as illustrated in Figure 11 below.

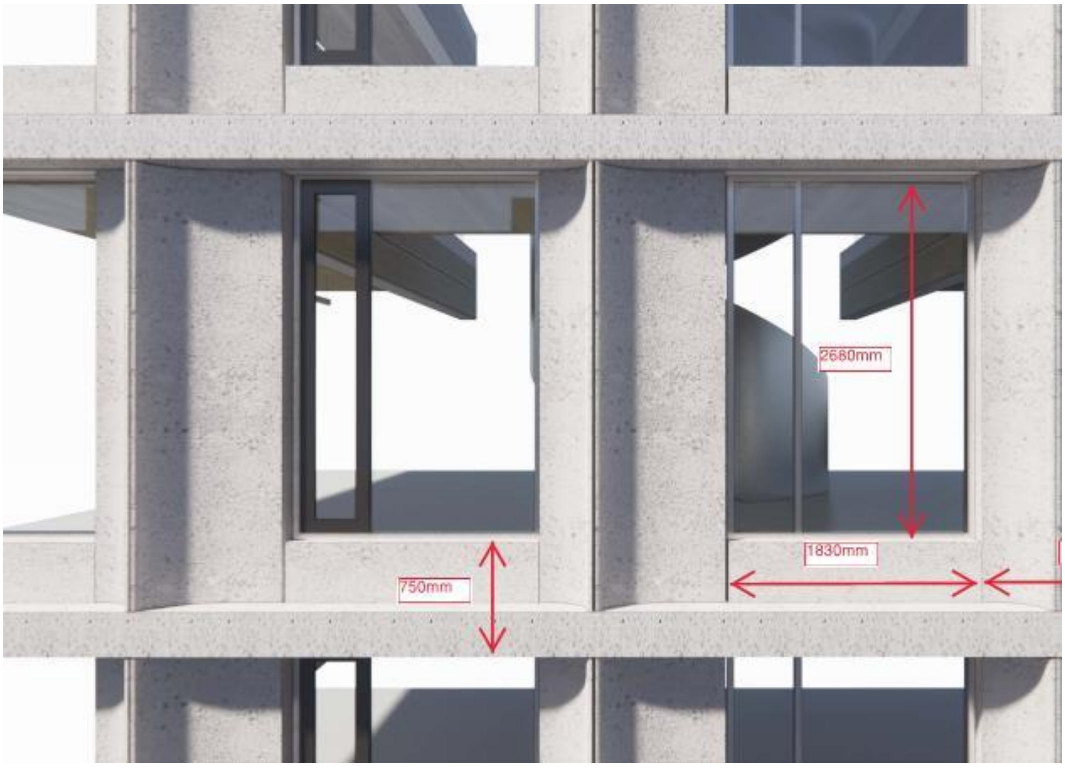


Figure 11: Architect façade illustration showing recessed windows

Thermal Mass Details

Using the architect façade illustration as shown in in Figure 11 above, **t**he thermal mass of the external wall and internal slab of the building is estimated to be around 8.75 kJ/m^{2}K as calculated in the IES model. This represents light weight construction.

Ventilation Strategy

The current assumption is that mechanical ventilation shall be provided via centralised Air Handling Units. The office and reception areas shall be provided fresh air at a rate of at least 10 l/s/person, while the laboratory areas will be provided fresh air at a rate of 6 ACH minimum.

The viability of natural ventilation and detailed design of ventilation system shall be reviewed and carried out in due course.

13.3 Results

The figures below summarise the results of the overheating assessment for the weather files detailed in previously. It has been found that all occupied spaces are within the acceptable temperature ranges in all 3 DSY scenarios. Results for the Overheating Assessment are included in Appendix B.

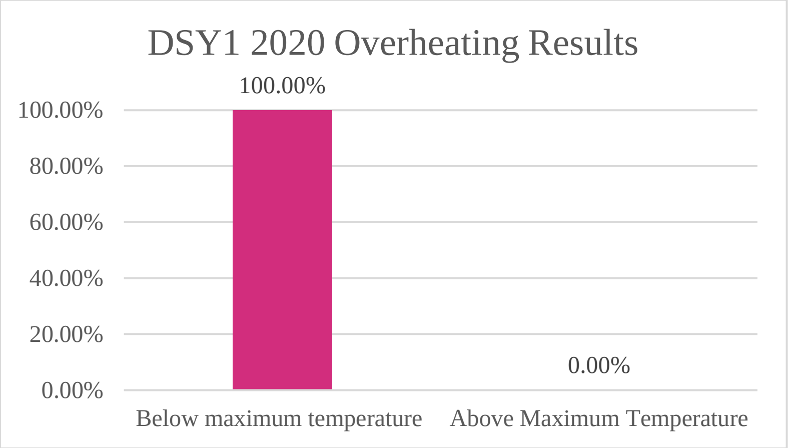


Figure 12: Distribution of indoor temperature in occupied rooms under DSY1 2020 scenario

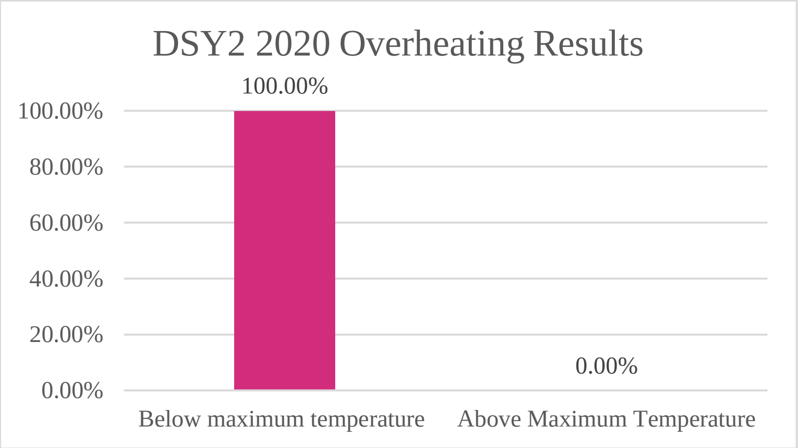


Figure 13: Distribution of indoor temperature in occupied rooms under DSY1 2050 scenario

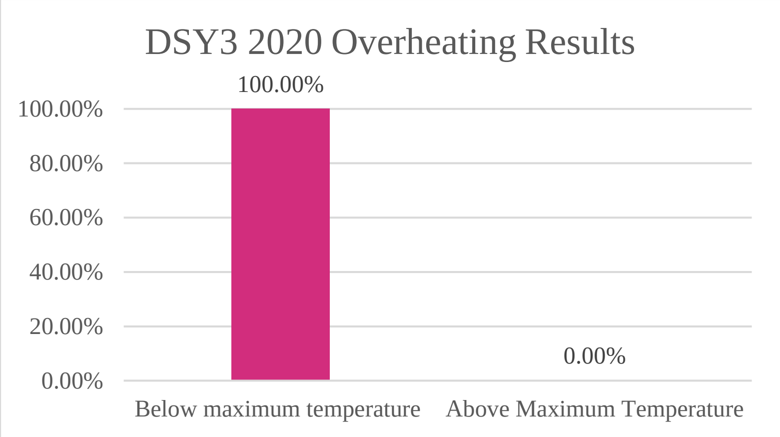


Figure 14: Distribution of indoor temperature in occupied rooms under DSY3 2020 scenario

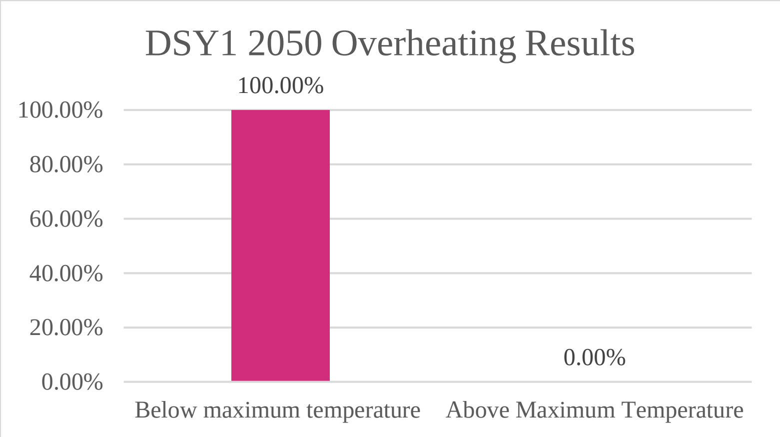


Figure 15: Distribution of indoor temperature in occupied rooms under DSY1 2050 scenario

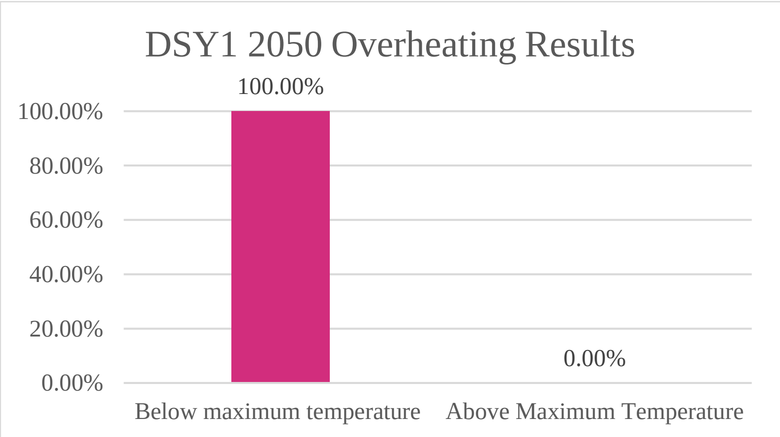


Figure 16: Distribution of indoor temperature in occupied rooms under DSY1 2080 scenario

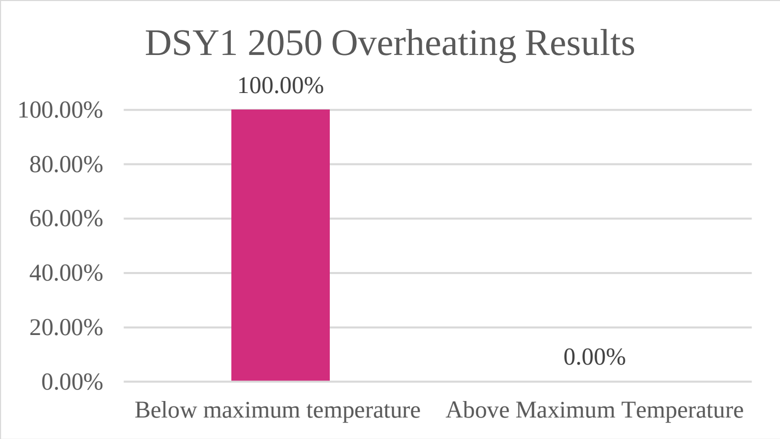


Figure 17: Distribution of indoor temperature in occupied rooms under DSY2 2080 scenario

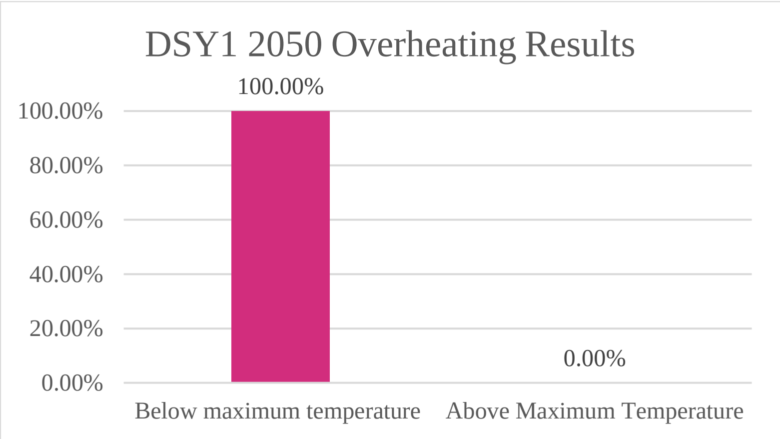


Figure 18: Distribution of indoor temperature in occupied rooms under DSY3 2080 scenario

14 Air Quality

The GLA's energy assessment guidance states that the energy assessment reports must report on the following emissions:

- Carbon Dioxide (CO_2)
- Nitrous Oxide (NO_x)
- Particulate Matter (PM10)
- Volatile Organic Compound (VOC)

The carbon dioxide emissions associated with the development have been calculated are summarised in the Energy Hierarchy Summary section of this report.

The proposal in this energy statement advocates for a fully grid electric energy solution, with some on-site electricity generation via solar PVs. On-site combustion technologies are not proposed. Therefore, there are no direct NO_x, PM10 or VOC emissions to report.

15 Conclusion

An assessment has been undertaken for the lab-enabled network building following the approach set out in GLA guidance and The Camden Local Plan.

The emission baselines for the proposed redevelopment (Be Lean, Be Clean & Be Green) have been estimated on a 'Regulated Energy' approach. The energy hierarchy is as follows:

Priority 1 – Use less energy (Be Lean)
Priority 2 – Supply energy efficiently (Be Clean)
Priority 3 – Use renewable energy (Be Green)
Priority 4 – Monitor, verify and report on energy performance (Be Seen)

The implementation of energy efficiency measures in the form of fabric performance improvements, energy efficient building services and intelligent monitoring and controls resulted in a 7% reduction in regulated energy carbon dioxide emissions below the baseline.

No emission reductions were seen at Stage 2: Be Clean due to no appropriate heat network being identified in the surrounding area for the proposed development to connect to.

Renewable energy technologies were implemented into the proposed scheme, resulting in an additional 26% reduction in carbon emissions. The most appropriate renewable technologies to be installed at the site were identified as air source heat pumps and solar photovoltaics.

After stage 3 of the energy hierarchy, the total emissions below the Part L baseline was determined as 33%. The development does not meet the 35% minimum requirement on site due to the high energy demand of the lab spaces and space restrictions on the instalment of additional renewable technologies. There is a shortfall of 67% from the 100% reduction below Part L and therefore a cash-in-lieu payment is required.