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EGMONT HOUSE, 25-31 TAVISTOCK PLACE
OUTLINE ENERGY STRATEGY

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1. EXECUTIVE SUMMARY

This Outline Energy Strategy has been prepared by Ramboll to accompany an outline planning application for the refurbishment of the Egmont House building that is currently at RIBA Stage 2. The building is located at 25-31 Tavistock Place, London Borough of Camden.

The existing building will provide up to a maximum of 1,769 m² GIA of floorspace (modelled floor area), including office and meeting space, internal plant and equipment and substation.

The Proposed Development is targeting a BREEAM 'Very Good' rating and will be assessed under the BREEAM UK Refurbishment and Fit-out 2014 scheme.

This report establishes how this development will achieve compliance with Building Regulations and Local Authority requirements. This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems); be green (use of low or zero carbon technologies) and be seen (energy performance monitoring).

The energy strategy has been prepared in two parts; using the GLA 2020 guidance and spreadsheet, which are based on the Part L 2013 methodology as well as using the GLA 2022 guidance and spreadsheet, which are based on the Part L 2021 methodology. This strategy allows to:

- Demonstrate energy and CO2 savings based on the current GLA 2020 guidance and Part L 2013, which incorporate a gas boiler baseline and interim electricity carbon factors.
- Demonstrate energy and CO2 savings based on the proposed GLA 2022 guidance and Part L 2021 with updated carbon factors, which favour the decarbonisation projects and provide a closer alignment with the energy efficiency targets and the improvements due to technological advancements.

Reducing carbon emissions through lean measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications significantly improved over and above Building Regulation requirements;
- Reduced air permeability;
- Specification of efficient heating services and control systems;
- Energy efficient lighting and controls throughout the development;
- Energy efficient ventilation systems.

It has been identified through the modelling undertaken that a meaningful reduction in CO2 emissions per year can be achieved over the baseline emissions, via the implementation of the energy efficient design aspects listed above.

Reducing carbon emissions through clean measures

The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It is considered that the installation of either of these options is not practicable for this development. Further narrative on this is provided in Section 4.4.

Reducing carbon emissions through green measures

A low or zero carbon (LZC) technology feasibility study has been carried out (section 4.5) as part of this Energy Assessment. This study compares the feasibility of different technologies based on the energy demand of the development.

Based on this, it was identified that the most appropriate technologies for the development to meet the sustainability and energy targets are the air source heat pumps and PV panels.

The proposed strategy achieves a total 69% reduction of the regulated carbon dioxide emissions over Building Regulations 2013 Part L2A and a total 54% reduction of the regulated carbon dioxide emissions over Building Regulations 2021 Part L.

Tables 1 and 2 below illustrate the reductions in CO2 emissions for the assessed development. A complete set of calculations has been provided within the GLA spreadsheet (Appendix A).

Table 1 Carbon dioxide savings from Be Lean, Be Clean and Be Green stages of energy hierarchy, based on GLA 2020 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	48.5		
Be lean	22.0	26.5	55%
Be clean	22.0	0.0	0%
Be green	15.1	6.9	14%
Total Savings	**-**	**33.4**	**69%**

Table 2 Carbon dioxide savings from Be Lean, Be Clean and Be Green stages of energy hierarchy, based on GLA 2022 Guidance

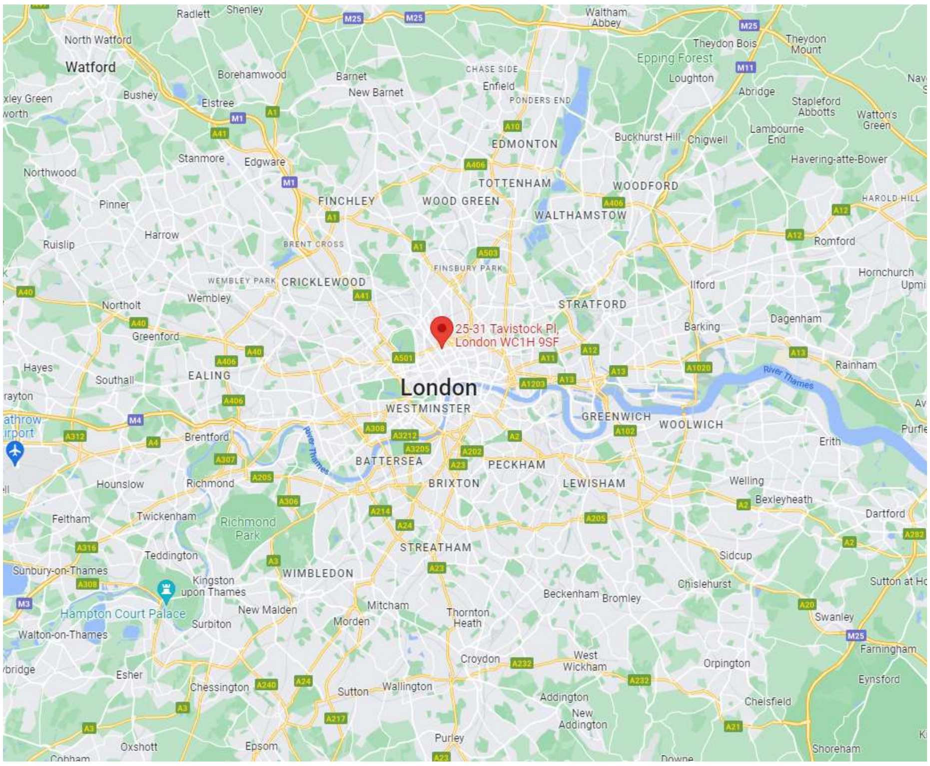
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	20.5		
Be lean	12.1	8.3	41%
Be clean	12.1	0.0	0%
Be green	9.4	2.8	13%
Total Savings	**-**	**11.1**	**54%**

2. PROPOSED DEVELOPMENT

2.1 Description of the Existing Site

The site is located in the Royal Borough of Camden. It is located at 25-31 Tavistock Place (see figure below).

Figure 1 Location of Tavistock Place within the GLA



The application site is located in central London and is surrounded by a substantial amount of properties, including hotels, cafes and retail units, and offices.

2.2 Description of the Proposed Development

The project proposals are for the refurbishment of this building, which incorporates fabric and building services upgrade.

The Proposed Development is also targeting high standards of environmental, social and economic sustainability, including a BREEAM 'Very Good' rating and will be assessed under the BREEAM UK Refurbishment and Fit-out 2014 scheme.

3. BUILDING REGULATIONS AND PLANNING POLICIES

This section summarises the drivers for sustainable and low carbon design required for planning that may affect the scheme. The proposed development is designed to target compliance with the required planning strategies and policies as per table below.

Table 3 Policies influencing the Energy Strategy

Policies/Regulations	Egmont House, 25-31 Tavistock Place
Camden Local Plan (2017)	✓
Camden Planning Guidance (2021)	✓
The London Plan (March 2021) and the GLA (June 2022)	✓
Part L Volume 2 (Buildings other than dwellings)	✓
Part L Volume 1 (Dwellings)	n/a

3.1 Camden Local Plan (2017)

Camden Local Plan was adopted in 2017. The Local Plan covers the period from 2016-2031.

Camden Local Plan contains a number of policies relating to energy; those most relevant to the energy assessment of development are detailed below.

a) Policy CC1: Climate change mitigation - all developments are required to minimise the effects of climate change and all developments are required to meet the highest feasible environmental standards that are financially viable during construction and occupation.
b) Policy CC2: Adapting to climate change - all development should adopt appropriate climate change adaptation measures, as far as feasible.

3.2 Camden Planning Guidance (2021)

The Council has prepared the Camden Planning Guidance (CPG) on energy and resources to support the policies in the Camden Local Plan 2017.

The Camden Planning Guidance denotes a number of key targets to be achieved by the refurbishment projects, including:

a) All developments should demonstrate how sustainable design principles have been considered and incorporated.
b) Sensitive improvements can be made to historic buildings to reduce carbon dioxide emissions.
c) Warm homes and buildings are key to good health and wellbeing. As a guide, at least 10% of the project cost should be spent on environmental improvements.
d) The 20% carbon reduction target (using on-site renewable energy technologies) applies for developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace.

3.3 The London Plan (March 2021) and the GLA (June 2020/ 2022)

The proposed development falls under the London Plan, which defines the following regulated CO2 emissions calculation methodology;

a) Where an existing building or group of buildings is refurbished and the development qualifies as a major refurbishment, applicants are required to provide an energy assessment demonstrating how the individual elements of the energy hierarchy have been implemented and how reductions in regulated CO2 emissions have been achieved.
b) Unlike for new-build developments, for the refurbishment projects, the applicants are required to generate baseline CO2 emissions assuming the notional specification for existing buildings, shown in GLA Guidance Appendix 3, and which is based on Approved Documents L1 and L2. This will provide a consistent baseline across all refurbishments and clearly distinguish the improvements in CO2 emissions that are over and above what would ordinarily be undertaken through meeting Building Regulation requirements.
c) Once the baseline has been established, the applicants are required to demonstrate CO2 emissions reduction following the energy hierarchy. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

    1) be lean: use less energy and manage demand during operation
    2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
    3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
    4) be seen: monitor, verify and report on energy performance.

3.4 Part L2 Conservation of Fuel and Power, Volume 2; Buildings other than dwellings

This AD does not define energy/ CO2 targets for the refurbishment projects, however, there is a requirement to comply with the guidance prescribed for the work on existing buildings as follows:

Table 4 Guidance on Part L 2021 for existing buildings

Element	Description
a	Limiting heat gains and losses: Section 4.
b	Building services: Sections 5 and 6.
c	New elements in existing buildings, including replacing a thermal element and constructing an extension: Section 10.
d	Existing elements in existing buildings, including renovating or retaining a thermal element, material change of use and change to energy status: Section 11.
e	Consequential improvements: Section 12.

4. ENERGY STRATEGY

4.1 Energy Modelling Methodology

The National Calculation Methodology (NCM) for the Energy Performance of Buildings Directive (EPBD) is defined by the Department for Communities and Local Government (DCLG) and it is the procedure for demonstrating compliance with the Building Regulations for buildings. Depending on the complexity of the assessment, either the Simplified Building Energy Model (SBEM) or Dynamic Simulation Methodology (DSM) can be used for non-domestic elements and STROMA FSAP/ Elmhurst for domestic elements. All of these tools are Government approved.

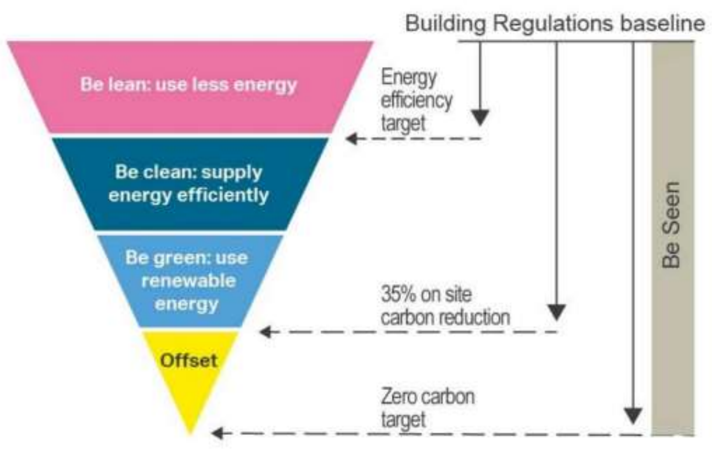
In order to identify the carbon dioxide emissions, an energy assessment was carried out. The energy demand calculated using the NCM methodology is relative to the Regulated Emissions, which includes the energy consumed to power space heating, domestic hot water, cooling, ventilation and internal lighting systems.

The results of the indicative calculations should not be used for any other purpose other than those for which they are intended (namely as a basis for this energy statement). Formal assessments will be required at a later stage of the development process to satisfy Building Control requirements.

The proposed energy strategy approach is based on a recognised structure of reduction in carbon dioxide emissions through:

- Reducing the building energy consumption (Be Lean) by optimising the design and construction of the building to ensure less energy is required;
- Supplying the energy required in an efficient manner (Be Clean);
- Supplying the energy from Low Zero Carbon and Renewable Energy Sources (Be Green);
- Monitoring, verifying and reporting on energy performance through the post construction monitoring platform (Be Seen).

Figure 2 The four stages of the Energy Hierarchy



On the whole, it becomes more expensive to implement both carbon reduction and sustainability measures the further along the design process, as the opportunities available diminish. This highlights the importance of early consideration of these measures within the design process.

A passive, well insulated envelope will last for the life of the building; with this being difficult to upgrade once building work is complete. The services installed within the building have a shorter life span and can be replaced / upgraded at a later date, when their lifetime will have expired and new more efficient services will be available. Once the most efficient building envelope and services are provided, the installation of Low and Zero Carbon technologies should be considered.

4.2 Baseline Scenario

For the purposes of energy analysis of the existing buildings the baseline CO2 emissions should be estimated assuming the notional specification for existing buildings, shown in Appendix 3 of the GLA 2020 and 2022 Energy Assessment Guidance, and which is based on Approved Document Part L. This provides a consistent baseline across all refurbishments and clearly distinguishes the improvements in CO2 emissions that are over and above what would ordinarily be undertaken through meeting Building Regulation requirements.

The total baseline CO_2 emissions based on GLA 2020 guidance are illustrated below:

Table 5 Baseline: Part L 2013 of the Building Regulations, based on GLA 2020 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	48.5	n/a	n/a

The total baseline CO_2 emissions based on GLA 2022 guidance are illustrated below:

Table 6 Baseline: Part L 2021 of the Building Regulations, based on GLA 2022 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	20.5	n/a	n/a

4.3 Energy Saving Measures (Be Lean)

Minimising energy use through design has been factored in from the beginning of the design process. A number of architectural and building fabric measures (passive design) and energy efficient services (active design), as described in the SPG, have been explored and further explanations have been provided below clarifying which measures will be adopted and integrated into the design, and why it is not feasible to incorporate certain measures into the proposed development.

4.3.1 Site Location, Weather and Microclimate

Proposed development is an existing building and is located in London, therefore, the model used the closest TRY (Test Reference Year) weather data. This data is provided by CIBSE to IES for use in calculations.

A TRY weather file of the type used in this simulation consists of weather data from a historical sequence of twelve non-consecutive months selected from the last 30 years' weather data for the relevant location. The individual months are selected based on their correlation with the average weather conditions for that month over the 30-year selection period and combined to make a 12-month compilation of "typical" months.

While the design will meet the client's environmental design brief for the agreed external design conditions, a consideration for a design for performance approach will make appropriate system selections for the prevailing external conditions to maximise the opportunities for optimising part-load performance and utilising free cooling.

4.3.2 Building Layout, Orientation and Form

Proposed development is an existing building, therefore, features such as orientation and form will remain fixed.

Building layout will have minimal changes within the office areas. Key layout changes will be within the corridors and communal areas.

The building's ability to heat up throughout the day and cool down during the night is determined by the ratio of volume to exposed surface area or so-called volume-to-surface ratio. Volume-to-surface ratio is an indicator of compactness, and the higher the compactness the lower the heat losses.

The existing building possesses a compact shape with a substantial percentage of glazing letting light into the building during the day to enhance the availability of daylight and improve occupants health and wellbeing.

4.3.3 Building Fabric

For this refurbishment, significant upgrades have been proposed to minimise operational energy use and carbon dioxide emissions, as well as further exceed Part L requirements. The table below summarises Notional and proposed U-values.

Table 7 Notional and Proposed Fabric Performance

U-values (W/(m²K))	Notional - 2020 Guidance	Notional - 2022 Guidance	Proposed Building
Flat roof	0.18	0.18	0.18
Pitched roof	0.18	0.16	0.18
External (cavity) wall	0.55	0.55	n/a
External (external or internal insulation) wall	0.55	0.3	0.26
Floor	0.25	0.25	0.18
Glazing elements/rooflight (including frame)	1.8; g=0.40	1.40; g=0.40	1.60; g=0.40
Door	no specification given	no specification given	1.6
Air permeability (m3/m2hr)	25	25	10

Glazing

Low U-values for glazing are as important as low U-values for fabric elements. Building design of the proposed refurbishment will utilise low U-value glazing in order to diminish heat losses over the winter period.

The proposed building design includes glazing with a U-value of 1.6 W/(m2K). A low g-value glazing (0.40) will be utilised for the glazing elements to reduce solar gains.

4.3.4 Thermal Mass

The use of heavyweight building materials can provide thermal mass and inertia, which will help regulate the internal temperature and reduce the risk of overheating. At night, the exposed concrete can be cooled through a combination of natural and/or mechanical means. This night purging facilitates the storing of 'coolth' by the heavyweight fabric which can be released the following day.

Wherever possible, the existing building will incorporate thermal mass via blockwork into the walls and exposed concrete planks as the floor/soffit. This will be combined with a night ventilation strategy where feasible.

4.3.5 Air Permeability

The air tightness of a building impacts on its energy consumption and hence the CO2 emissions. The lower the air tightness, the more heated warm air is retained within the occupied spaces of the building, therefore less energy is required to heat the building in winter.

The proposed target for the building is 10m3/hr per m2 @ 50Pa. This demonstrates a considerable improvement over a default value of 25m3/hr per m2 @ 50Pa.

4.3.6 Building Services

In addition to upgrading the insulation and air tightness standards, it is important that the energy used within the building is efficient. Therefore, the building services systems should be designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. All proposed systems have efficiencies and controls, which will meet or exceed the requirements of Part L 2021 of Building Regulations.
A full ASHP selection specification has been provided within Appendix C.

Table 8 Notional and Proposed Building Services

System	Notional - 2020 Guidance	Notional - 2022 Guidance	Proposed Building
Space heating	Gas combi boiler - 84% efficiency	ASHP - COP at 2.5	ASHP - COP at 3.17
Air distribution systems	Balanced supply and extract ventilation system with heat recovery	Balanced supply and extract ventilation system with heat recovery	Balanced supply and extract ventilation system with heat recovery
	SFP=2.2 W/l/s; terminal SFP=0.50 W/l/s	SFP=2.6 W/l/s; terminal SFP=0.40 W/l/s	SFP=1.87 W/l/s; terminal SFP=0.20 W/l/s
	HR=70%	HR=70%	HR=81.6%
Cooling	Chiller - SEER of 3.90	Chiller - SEER of 4.0	Chiller - SEER of 5.21
Domestic Hot Water	System same as space heating	Electric point of use at 100%	Electric point of use at 100%
Internal lighting systems	51 lm/cw	60 lm/cw	>95 lm/cw

4.3.7 Building Occupancy Type

Occupants, lighting, equipment and machinery within a building will emit sensible and latent heat. This excess heat can lead to an increase in the temperature and humidity within the space and can have a marked effect on the heating and cooling demands within a building.

Latent heat results in an instantaneous addition of moisture to the air, so there is no cooling load factor associated with it. Sensible heat, however, is absorbed by the surrounding surfaces and radiated more slowly into the building.

The proposed refurbishment will contain offices, meeting rooms suites, reception/ social space and communal areas. Reception/ social space will contain a break-out space that can be adapted to include presenting and audience capabilities.

Typically, the meetings rooms will have the greatest occupancy for a few hours at a time, whilst the reception and lobby will have short periods of high occupancy as people move in and out of the building. These areas will have limited equipment and good daylight factors, meaning internal heat gains in these areas will be low. Offices and meetings rooms will have higher gains, due to the greater amount of equipment and lighting and the subsequent heat release.

4.3.8 Daylighting

Encouraging a greater use of natural light within the building not only enhances the wellbeing of occupants, but can provide significant savings in the electrical demand associated with artificial lighting when combined with intelligent light controls and photoelectric sensors.

The location and percentage of glazing area within the façade are fixed for this building, but the general recommendations to improve daylighting are as follows:

- Window head height should be as high as possible in space to increase penetration of light into the space.
- Glazing should ideally be distributed evenly and as horizontally as possible. Thin tall windows can lead to poor daylight uniformity compared to short and wide.
- Rooflights to channel daylight into central areas, corridors and reception.
- Light transmission properties are as high as possible, when balanced with solar control considerations.

4.3.9 Ventilation Strategy

A mixed-mode ventilation system is being considered within the office areas, however a number of key risks have been identified and need to be mitigated before this option can be deemed feasible. This includes:

- Occupancy and small density/schedule
- Opening types and percentages
- Ensuring intelligent controls via a building management system or that occupants understand when these various modes are in operation to avoid windows being opened when the air conditioning is on.

4.3.10 Adaptation to Climate Change

Since the 1970s, average temperatures for Central England have risen by nearly 1°C, and the last decade was the warmest on record. It is likely that the climate will continue to change with higher temperatures, changing rainfall patterns, rising sea levels and more unpredictable extreme weather ranging from floods, droughts and freezing winters. The UK Climate Change Risk Assessment: Government Report (2012) outlines the risks faced to businesses, buildings, and health and wellbeing in the future.

Risks noted within this report include the likelihood of increased external temperatures, which could lead to a loss of staff hours, and damage to equipment due to high internal building temperatures. Increased external temperatures would also lead to increased energy demand for cooling, which would not only further increase atmospheric carbon emissions, but also put strain on the energy infrastructure. Energy infrastructure itself would also be at risk of disruption, meaning that there will be less energy available on the grid.

Passive design features of the Egmont House mean that the building is well adapted to these risks. Firstly, the energy demand has been reduced thus the building will be less affected by the decreased availability of energy. Secondly, the building will have a relatively low carbon footprint, helping to stop the effects of climate change from increasing this further.

Efficient lighting and mechanical systems will keep the internal heat gains to a minimum. The upgraded fabric elements will retain heat within the building. This means that heat cannot enter nor escape the building through the fabric.

High thermal mass will absorb much of the heat that is present within rooms during the occupied times.

As a consequence of COVID and working-from-home trends the building occupancy is expected to be lower than originally expected. This means that there will be a reduced demand for heating and cooling, keeping the building's energy demand low.

This combination of passive design measures will act to stabilise the temperatures within the building and enable it to adapt to the likely extremes of both heat and cold.

The total Be Lean CO_2 emissions based on 2020 guidance are illustrated below:

Table 9 Be Lean regulated CO2 emissions savings, based on GLA 2020 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	48.5	n/a	n/a
Be lean	22.0	26.5	55%

The total Be Lean CO_2 emissions based on 2022 guidance are illustrated below:

Table 10 Be Lean regulated CO2 emissions savings, based on GLA 2022 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	20.5	n/a	n/a
Be lean	12.1	8.3	41%

4.4 Decentralised Energy – District Heating and CHP (Be Clean)

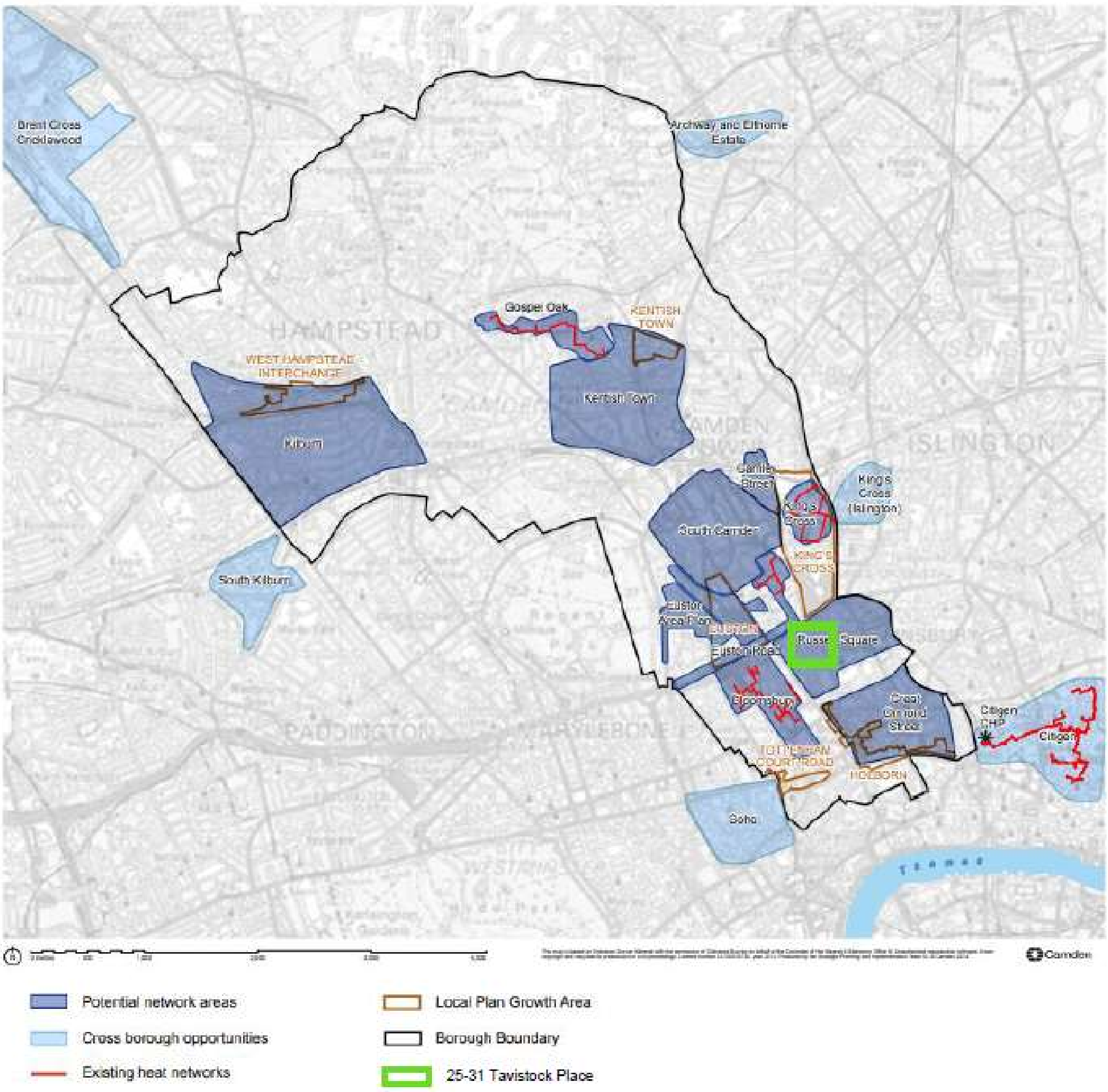
4.4.1 Heat Network

There are several existing and proposed district heat networks in the near proximity of the site as per Figure 3.

The existing site is currently using air source heat pumps as a heating and cooling energy source. Due to the lack of financial feasibility associated with the distance to the nearest heat network energy centre in combination with the minimal heating demand it is not suggested to explore a connection to any of the identified district heating networks in Figure 3.

As advised by the London Plan Guidance, the development will maintain communal heat distribution systems via ASHP to facilitate a single point of connection to decentralised energy networks in the future.

Figure 3 Existing and Proposed Networks (courtesy of Camden City Council)



4.4.2 Combined Heat and Power

The installation of a Combined Heat and Power (CHP) unit for the development has also been considered. CHP units can achieve considerable savings in CO2 emissions when installed and utilised correctly. To maximise the performance of a CHP, long operating hours are required and the heating demand of the development needs to match the power generation. According to 'GLA guidance on preparing energy assessments' non-residential developments with simultaneous demand for heat and power of less than 5,000hrs/yr are not expected to install on-site CHP. The minimum hours of simultaneous demand for heat and power cannot be achieved on this project.

Therefore, it has been decided not to implement CHP system. This is due the decarbonisation of the electricity grid, where that electrically powered equipment now has got a lower carbon emission impact when compared to the gas-powered equipment.

CIBSE experts claim that in some cases CHP might be economic, but it is increasingly falling down on CO2 emissions. The lower carbon factors mean heat pumps only need a coefficient of performance (COP) of 1.1 to have CO2 emissions lower than a gas system.

Therefore, in view of the updated carbon emissions factors, the installation of a CHP system will not be considered any further for this development.

The total Be Clean CO_2 emissions remain identical to Be Lean, as per below:

Table 11 Be Clean regulated CO2 emissions savings, based on GLA 2020 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	48.5	n/a	n/a
Be lean	22.0	26.5	55%
Be clean	22.0	0.0	0%

The total Be Clean CO_2 emissions remain identical to Be Lean, as per below:

Table 12 Be Clean regulated CO2 emissions savings, based on GLA 2022 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	20.5	n/a	n/a
Be lean	12.1	8.3	41%
Be clean	12.1	0.0	0%

4.5 Low and Zero Carbon Technologies (Be Green)

In order to address the London Plan requirement for the integration of LZC technologies on site, the installation of the technologies mentioned below has been investigated.

Biomass Boiler – Not Adopted

A biomass system designed for this development would be fuelled by wood pellets due to their high energy content. Wood pellets also require less volume of storage than other biomass fuels, require less maintenance and produce considerably less ash residue.

A biomass system would not be an appropriate low-carbon technology for the site for the following reasons:

- The burning of wood pellets releases substantially more NOx emissions than gas boiler equivalents. This would significantly reduce the air quality of the site which is located in an urban environment.
- Storage and delivery of wood pellets would be difficult due to the site constraints and the lack of local biomass suppliers. Pellets would have to be transported from elsewhere in the UK.

Biomass CHP – Not Adopted

For the size of system required for this development, a biomass CHP is still in its infancy and brings several financial and technological risks. Therefore, this option is not considered feasible.

For the reasons listed above, biomass is not considered feasible for this development.

Wind Energy – Not Adopted

Due to the limited space on site, building-integrated turbines would be most suited to the development, as opposed to stand alone turbines.

Based on the current design of the development, any roof-mounted wind turbine would need to be located above the highest residential units. In addition, a roof-mounted wind turbine would have a significant visual impact.

In urban areas the efficiency of wind turbines is limited due to reduced wind speeds (less than 5m/s), thereby reducing the ability of the wind turbines to operate efficiently.

For these reasons, wind turbines would not be feasible for this project.

Photovoltaic Panels – Adopted

Four types of solar cells are available at present; these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaics will be considered a suitable technology for this development for the following reasons:

- The development provides sufficient roof space for the installation of PV panels (78m2);
- PV arrays are relatively easy to install when compared to other renewable systems;
- PV panels provide significant CO_2 savings.

Based on the calculations it can be concluded that considerable energy and CO2 savings can be achieved with this technology.

Solar Thermal Panels - Not Adopted

Solar thermal arrays include evacuated tubes and flat plate collectors. Evacuated tubes are more efficient, produce higher temperatures and are more suited to the UK climate when compared to flat plate collectors. Evacuated tubes tend to be more costly than flat plate collectors.

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is most effective (during the summer months).

Solar thermal arrays would require additional plumbing which is likely to incur additional financial costs and solar PV would likely offer greater CO2 emission reductions with the same area. Solar thermal technology and PV panels are in direct competition for the same roof space.

For these reasons, solar thermal technology would not be the most feasible option for the proposed development.

Ground Source Heat Pumps (GSHP) - Not Adopted

A ground source heat pump system for the site would include a closed ground loop where a liquid passes through the system, absorbing heat from the ground and relaying this heat via an electrically run heat pump within the building.

A ground source heat pump system would deliver space heating through a low temperature efficient distribution network such as underfloor heating.
The installation of ground source loops significantly increases the construction time and adds to the capital cost of the project.

The site is constrained with little room for a shallow ground source heat pump. Deep bore hole ground source heat pumps require a long-term balance of heating and cooling to avoid a long-term altering of the ground temperature and a resulting long-term decline in system efficiency. As the development is commercial, the demand for heating and cooling are not balanced.

A GSHP system on this site would not deliver substantial carbon savings per unit of cost in comparison to other renewable strategies, such as PV.

For this reason, GSHPs would not be feasible for this development.

Air Source Heat Pumps (ASHP) – Adopted

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air. Air source heat pumps are good at supplying low grade (not very hot) heat and have been proposed for space heating.

The total Be Green CO_2 emissions based on 2020 guidance are illustrated below:

Table 13 Be Green regulated CO2 emissions savings, based on GLA 2020 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	48.5	n/a	n/a
Be lean	22.0	26.5	55%
Be clean	22.0	0.0	0%
Be green	15.1	6.9	14%

The total Be Green CO_2 emissions based on 2022 guidance are illustrated below:

Table 14 Be Green regulated CO2 emissions savings, based on GLA 2022 Guidance

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	20.5	n/a	n/a
Be lean	12.1	8.3	41%
Be clean	12.1	0.0	0%
Be green	9.4	2.8	13%

4.6 Monitoring and Reporting (Be Seen)

All primary energy supplies (electricity and water) to the building will be metered. The ASHP system will be fully metered for inputs and outputs so that the effective efficiency can be monitored.

Sub-metering will be provided to enable at least 90% of the estimated annual energy consumption of each fuel of the building energy to be allocated to specific end-use activities (heating, lighting, pumps, etc). The sub-metering strategy will be developed based on the CIBSE TM39 and BREEAM 2014.

A Landlord's Electrical Energy Management System (EEMS) will be provided to collect and continuously archive all the metered data that is analysed by all of the mechanical, electrical and water services within the building. Submetering will be provided on the mechanical, electrical and public health system throughout the building as well.

The metering strategy will allow for future reporting and comparisons with industry benchmarks.

The building management system (BMS) will be able to collect and capture all metering data and information.

The front-end software will provide the following information to the facility manager for efficient building management:

- energy consumption data for Ofgem type billing in the appropriate format and export electronically for billing where appropriate
- power quality and reliability analysis
- load trends

5. CONCLUSION

This Outline Energy Strategy has been prepared by Ramboll to accompany an outline planning application for the refurbishment of the Egmont House building that is currently at RIBA Stage 2. The building is located at 25-31 Tavistock Place, London Borough of Camden.

The Proposed Development is targeting a BREEAM 'Very Good' rating and will be assessed under the BREEAM UK Refurbishment and Fit-out 2014 scheme.

This report denotes how the proposed development will achieve compliance with Building Regulations and Local Authority requirements. This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems), be green (use of low or zero carbon technologies); and be seen (energy performance monitoring).

The proposed strategy achieves a total 69% reduction of the regulated carbon dioxide emissions over Building Regulations 2013 Part L2A and a total 54% reduction of the regulated carbon dioxide emissions over Building Regulations 2021 Part L.

Tables below illustrate the reductions in CO2 emissions for the assessed development.
A complete set of calculations has been provided within the GLA spreadsheet (Appendix A).

Table 15 Carbon dioxide savings from Be Lean, Be Clean and Be Green stages of energy hierarchy

	Total regulated emissions (Tonnes CO_2 / year)	**CO_2 savings (Tonnes CO_2 / year)**	**Percentage savings (%)**
Part L 2013 baseline	48.5	n/a	n/a
Be lean	22.0	26.5	55%
Be clean	22.0	0.0	0%
Be green	15.1	6.9	14%
Total Savings	**-**	**33.4**	**69%**

Table 16 Carbon dioxide savings from Be Lean, Be Clean and Be Green stages of energy hierarchy

	Total regulated emissions (Tonnes CO_2 / year)	**CO_2 savings (Tonnes CO_2 / year)**	**Percentage savings (%)**
Part L 2021 baseline	20.5		
Be lean	12.1	8.3	41%
Be clean	12.1	0.0	0%
Be green	9.4	2.8	13%
Total Savings	**-**	**11.1**	**54%**

APPENDIX A
GLA CARBON REPORTING SPREADSHEETS

Refer to Appendix A folder.

APPENDIX B
BRUKL DOCUMENTS

Part L 2013 - Notional

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Tavistock Place

As built

Date: Tue Jul 26 16:16:40 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	42.8
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.55	0.55	GR000000:Surf[7]
Floor	0.25	0.25	0.25	LG000000:Surf[0]
Roof	0.25	0.18	0.18	GR000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.8	1.8	GR000000:Surf[1]
Personnel doors	2.2	2.2	2.2	GR000002:Surf[6]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	25

Part L 2013 – Be Lean

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Tavistock Place

As built

Date: Tue Jul 26 16:34:59 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	24.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	24.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	18.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	GR000000:Surf[7]
Floor	0.25	0.18	0.18	LG000000:Surf[0]
Roof	0.25	0.18	0.18	GR000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	GR000000:Surf[1]
Personnel doors	2.2	1.6	1.6	GR000002:Surf[6]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	10

Part L 2013 - Be Green

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Tavistock Place

As built

Date: Tue Jul 26 16:56:14 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	26.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	26.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	19
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.26	0.26	GR000000:Surf[7]
Floor	0.25	0.18	0.18	LG000000:Surf[0]
Roof	0.25	0.18	0.18	GR000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	GR000000:Surf[1]
Personnel doors	2.2	1.6	1.6	GR000002:Surf[6]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	10

Part L 2021 – Notional

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Tavistock Place

As built

Date: Tue Jul 26 15:09:16 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 239.59

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	5.42	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	11.58	
Target primary energy rate (TPER), kWh/m^2annum	59.01	
Building primary energy rate (BPER), kWh/m^2annum	125.07	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.3	0.3	GR000000:Surf[7]
Floors	0.18	0.25	0.25	LG000000:Surf[0]
Pitched roofs	0.16	0.16	0.16	RF000000:Surf[0]
Flat roofs	0.18	0.18	0.18	GR000000:Surf[0]
Windows** and roof windows	1.6	1.4	1.4	GR000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	2.2	2.2	GR000002:Surf[6]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]
* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	25

Part L 2021 – Be Lean

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Tavistock Place

As built

Date: Tue Jul 26 14:56:04 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 239.59

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), kgCO_2/m².annum	5.83	
Building CO_2 emission rate (BER), kgCO_2/m².annum	6.86	
Target primary energy rate (TPER), kWh/m².annum	63.58	
Building primary energy rate (BPER), kWh/m².annum	74.32	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.26	0.26	GR000000:Surf[7]
Floors	0.18	0.18	0.18	LG000000:Surf[0]
Pitched roofs	0.16	0.18	0.18	RF000000:Surf[0]
Flat roofs	0.18	0.18	0.18	GR000000:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	GR000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.6	1.6	GR000002:Surf[6]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]
* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	10

Part L 2021 – Be Green

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Tavistock Place

As built

Date: Tue Jul 26 15:41:00 2022

Administrative information

Building Details

Address: 25-31 Tavistock Place, London, WC1H 9SF

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 239.59

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	5.83	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	5.29	
Target primary energy rate (TPER), kWh/m^2annum	63.58	
Building primary energy rate (BPER), kWh/m^2annum	56.88	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.26	0.26	GR000000:Surf[7]
Floors	0.18	0.18	0.18	LG000000:Surf[0]
Pitched roofs	0.16	0.18	0.18	RF000000:Surf[0]
Flat roofs	0.18	0.18	0.18	GR000000:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	GR000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.6	1.6	GR000002:Surf[6]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	10

APPENDIX C
ASHP SELECTION

Heat pump EWYT-CZ series

Heating & cooling				EWYT-CZN/CZP/CZH	016	021	025	032	40 - MONO	40 - DUAL	050	064	090
Cooling capacity	Nom.			kW	15.9 (1)/16.1 (2)/16.2 (3)	20.9 (1)/21.1 (2)/21.2 (3)	25.6 (1)/25.9 (2)/25.9 (3)	32.4 (1)/32.7 (2)/32.8 (3)	39.6 (1)/39.9 (2)/40.1 (3)	41.4 (1)/41.7 (2)/41.8 (3)	50.8 (1)/51.1 (2)/51.3 (3)	64 (1)/64.4 (2)/64.5 (3)	88.3 (1)/88.8 (2)/88.9 (3)
	Max.			kW	18.3 (1)/18.6 (2)/18.7 (3)	25 (1)/25.3 (2)/25.4 (3)	29.3 (1)/29.6 (2)/29.6 (3)	38.6 (1)/38.9 (2)/39.1 (3)	45.2 (1)/45.6 (2)/45.7 (3)	49.6 (1)/50 (2)/50.1 (3)	58.2 (1)/ 58.6(2)/58.7 (3)	72.7 (1)/ 73.3 (2)/73.4 (3)	98.3 (1)/ 98.8 (2)/98.9 (3)
Heating capacity	Nom.			kW	15.9 (1)/15.62 (2)/15.5 (3)	20.2 (1)/19.95 (2)/19.8 (3)	24.8 (1)/24.6 (2)/24.5 (3)	32.4 (1)/32.08 (2)/32 (3)	39.4 (1)/39 (2)/38.9 (3)	40.3 (1)/40.01 (2)/39.9 (3)	49.8 (1)/49.49 (2)/49.4 (3)	61.9 (1)/61.43 (2)/61.3 (3)	85.8 (1)/85.33 (2)/85.2 (3)
	Max.			kW	18.3 (1)/18 (2)/18 (3)	24.3 (1)/24 (2)/23.9 (3)	28.7 (1)/28.4 (2)/28.3 (3)	36.5 (1)/36.2 (2)/36.1 (3)	44.7 (1)/44.3 (2)/44.2 (3)	48.7 (1)/48.4 (2)/48.3 (3)	57.3 (1)/ 58.9 (2)/56.7 (3)	69.2 (1)/68.7 (2)/68.6 (3)	94.7 (1)/94.1 (2)/94 (3)
Power input	Cooling	Nom.		kW	5.5 (1)/5.45 (2)/5.6 (3)	6.6 (1)/6.56 (2)/6.7 (3)	8.5 (1)/8.48 (2)/8.7 (3)	10.3 (1)/10.3 (2)/10.4 (3)	13.4 (1)/13.3 (2)/13.5 (3)	13.2 (1)/13.2 (2)/13.3 (3)	17 (1)/16.9 (2)/17 (3)	21.8 (1)/21.9 (2)/22 (3)	31 (1)/31.1 (2)/31.2 (3)
	Heating	Nom.		kW	4.7 (1)/4.63 (2)/4.8 (3)	5.8 (1)/5.81 (2)/6 (3)	7.5 (1)/7.42 (2)/7.6 (3)	9.4 (1)/9.32 (2)/9.5 (3)	11.8 (1)/11.7 (2)/11.9 (3)	11.9 (1)/11.8 (2)/12 (3)	15.4 (1)/15.3 (2)/15.4 (3)	19.1 (1)/19.2 (2)/19.3 (3)	27.2 (1)/27.3 (2)/27.4 (3)
Capacity control	Method				Inverter controlled								
	Minimum capacity			%	18	14	12	19	15	14	12	15	14
EER					2.9 (1)/2.94 (2)/2.89 (3)	3.16 (1)/3.22 (2)/3.15 (3)	3 (1)/3.05 (2)/2.98 (3)	3.13 (1)/3.18 (2)/3.14 (3)	2.95 (1)/3 (2)/2.97 (3)	3.12 (1)/3.17 (2)/3.15 (3)	2.98 (1)/3.03 (2)/3.02 (3)	2.93 (1)/2.95 (2)/2.93 (3)	2.84 (1)/2.85 (2)/2.85 (3)
COP					3.41 (1)/3.37 (2)/3.24 (3)	3.46 (1)/3.43 (2)/3.31 (3)	3.33 (1)/3.31 (2)/3.22 (3)	3.45 (1)/3.44 (2)/3.37 (3)	3.33 (1)/3.33 (2)/3.28 (3)	3.38 (1)/3.38 (2)/3.33 (3)	3.24 (1)/3.23 (2)/3.2 (3)	3.23 (1)/3.2 (2)/3.17 (3)	3.16 (1)/3.13 (2)/3.12 (3)
SEER					5 (1)/5.3 (2)/5.2 (3)	5 (1)/5.41 (2)/5.32 (3)	5.06 (1)/5.41 (2)/5.34 (3)	5.21 (1)/5.7 (2)/5.67 (3)	5.09 (1)/5.36 (2)/5.34 (3)	5.41 (1)/5.76 (2)/5.76 (3)	5.33 (1)/5.48 (2)/5.4 (3)	5.21 (1)/5.34 (2)/5.27 (3)	5.03 (1)/5.18 (2)/5.12 (3)
ηs,c				%	197 (1)/209 (2)/205 (3)	197 (1)/213 (2)/210 (3)	200 (1)/213 (2)/211 (3)	205 (1)/225 (2)/224 (3)	201 (1)/211 (2)/210 (3)	213 (1)/228 (2)/227 (3)	210 (1)/216 (2)/213 (3)	205 (1)/211 (2)/208 (3)	198 (1)/204 (2)/202 (3)
Space heating	Average climate water outlet 35°C	General	ηs (Seasonal space heating efficiency)	%	153 (1)/158 (2)/152 (3)	157 (1)/165 (2)/159 (3)	160 (1)/165 (2)/160 (3)	159 (1)/164 (2)/161 (3)	160 (1)/164 (2)/162 (3)	158 (1)/165 (2)/163 (3)	157 (1)/162 (2)/161 (3)	156 (1)/157 (2)/155 (3)	157 (1)/159 (2)/157 (3)
			SCOP Low Temp.		3.89 (1)/4.03 (2)/3.88 (3)	4 (1)/4.19 (2)/4.06 (3)	4.07 (1)/4.19 (2)/4.08 (3)	4.06 (1)/4.18 (2)/4.11 (3)	4.07 (1)/4.18 (2)/4.13 (3)	4.02 (1)/4.19 (2)/4.14 (3)	4 (1)/4.12 (2)/4.09 (3)	3.98 (1)/4.01 (2)/3.94 (3)	(1)/4.04 (2)/4 (3)
			Seasonal space heating eff. Class		A++	A++	A++	A++	A++	A++	A++	A++	A++
Dimensions	Unit	Height		mm	1,878								
		Width		mm	1,152			1,752		2,306		2,906	3,506
		Depth		mm	802					[illegible]			
Weight	Unit			kg	227 (1)/261 (2) (3)	252 (1)/286 (2) (3)		350 (1)/393 (2) (3)	349 (1)/392 (2)(3)	494 (1)/546 (2) (3)		88 (1)/644 (2) (3)	93 (1)/749 (2) (3)
Water heat exchanger	Type				Brazed plate HE								
	Water flow rate	Cooling	Nom.	l/s	0.8	1	1.2	1.6	1.9	2	2.4	3.1	4.2
		Heating	Nom.	l/s	0.8	1	1.2	1.6	1.9	2	2.4	3.1	4.2
	Water pressure drop	Cooling	Total	kPa	19.8	11.3	16.3	19.2	27.6	9.91	14.3	21.7	20.1
	Water volume			l	1	2				5			8
Air heat exchanger	Type				Al Fins&Cu Tubes								
Compressor	Type				Hermetically sealed scroll compressor								
	Quantity				1								
Fan	Type				Axial								
	Quantity				1			2				3	4
	Air flow rate	Cooling	Nom.	l/s	3227	3122	3524	5080	6701	5444	7048	8967	13402
		Heating	Nom.	l/s									
Sound power level	Cooling	Nom.		dBA	76		78	79	80		81	83	85
Operation range	Air side	Cooling	Min.~Max.	°CDB	-20~52								
		Heating	Min.~Max.	°CDB	-20~35								
	Water side	Cooling	Min.~Max.	°CDB	-15~25								
		Heating	Min.~Max.	°CDB	20~60								
Refrigerant	Type				R32								
	Circuits	Quantity			1								
	Control				Electronic expansion valve								
	GWP				675								
Refrigerant charge	Total			kg	3	5.5	5.5	7	8	12	12	13	16
				kgCO2eq	2025	3713	3713	4725	5400	8100	8100	8775	10800
Water circuit	Piping connections diameter			inch	1-1/4" (female)					2" (f[illegible]ale)			
Unit	Running current	Max		A	17 (1)/21 (2)/21 (3)	21 (1)/25 (2)/25 (3)	23 (1)/27 (2)/27 (3)	34 (1)/38 (2)/39 (3)	38 (1)/42 (2)/45 (3)	41 (1)/45 (2)/46 (3)	46 (1)/50 (2)/51 (3)	1 (1)/66 (2)/68 (3)	(1)/88 (2)/90 (3)
Power supply	Phase/Frequency/Voltage			Hz/V	3N~/50/400								

(1) EWYT-CZN: version without pump. (2) EWYT-CZP: version with pump low lift. (3) EWYT-CZH: version with pump high lift.
All the cooling performances (cooling capacity, unit power input in cooling and EER) are based on the following conditions: 12,0/7,0°C; ambient 35,0°C, unit at full load operation; operating fluid: water; fouling factor = 0. EN14511:2018
All the heating performances (heating capacity, unit power input in heating and COP) are based on the following conditions: 40,0/45,0°C; ambient 7,0°C, unit at full load operation; operating fluid: water; fouling factor = 0. EN14511:2018
SEER is calculated in accordance with the regulation No. 2281/2016 and standard EN14825 for information only, unless the unit is a "cooling-only" type.
The values of Low Temperature SCOP and ηs are calculated in accordance with the Ecodesign regulation No. 813/2013 and the standard EN 14825-2018.