Building Services Engineering
Sustainability Consultants
Low Carbon Design

FLATT

FOR:

Lakenorth Limited

22 ENDELL STREET LONDON

ENERGY STATEMENT

Engineering Sustainability

Revision

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CONTENT PAGE NO.

EXECUTIVE SUMMARY

This report has been prepared by **FLATT** in support of the planning application for the refurbishment of 22 Endell Street, London to provide refurbished B1 Office space to a Cat A standard from Basement Floor to Third Floor. The refurbishment includes B1 Office facilities, showers and associated cycle parking, waste storage, plant and services on behalf of **Lakenorth Limited**.

The building refurbishment includes fabric improvements in the form of additional insulation to the large area of roof exposed to the third-floor office. Also, windows are to be provided with a high-quality solar control film, neutral in colour, to reduce building cooling load.

The services refurbishment includes replacement of the mixture of small scale and VRV comfort cooling installations with modern energy efficient installations serving individual floors. The existing lighting is fluorescent and will be replaced with low energy LED lighting and controls.

The building will remain predominantly naturally ventilated as existing, with toilets/showers and basement mechanically ventilated.

The SBEM Energy and Emissions results for the refurbished building, when compared to the existing building, are summarised as follows:

- 56% reduction in regulated emissions compared to the existing building
- 63% reduction in regulated energy consumption compared to the existing building
- 18% reduction in regulated emissions via renewables (ASHP)
- A preliminary improved EPC of B40 compared to the existing D91 for building and E113 for the basement.

The GLA Table below summarises the results of the SBEM calculations for the refurbishment.

Table 3: Regulated Carbon Dioxide Emissions from each stage of the Energy Hierarchy for **Non-Domestic Buildings**

	Carbon Dioxide Emissions for Non-Domestic Buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline : (Existing Building)	28.78	11.30
After energy demand reduction (Be lean)	17.73	11.30
After heat network / CHP (Be Clean)	17.73	11.30
After renewable energy (Be Green)	12.58	11.30

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for **Non-Domestic Buildings**

	Regulated Non-Domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be Lean: Savings from energy demand reduction	11.05	38%
Be Clean: Savings from heat network	0.00	0%
Be Green: Savings from renewable energy	5.16	18%
Cumulative on-site savings	**16.20**	**56%**

Table 5: Shortfall in regulated carbon dioxide savings	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2/year)
Total Target Savings **(0%)**	**0.00**	
Carbon Shortfall	**0.00**	**0.00**
Cash-in-Lieu Contribution	**0.00**	

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO_2/year)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Baseline	28.8		
Be Lean	17.7	11.05	38%
Be Clean	17.7	0.00	0%
Be Green	12.6	5.16	**18%**
		CO_2 savings off-set (Tonnes CO_2)	
Off-set		**0**	

Figure 1. Energy Hierarchy - Refurbished Building

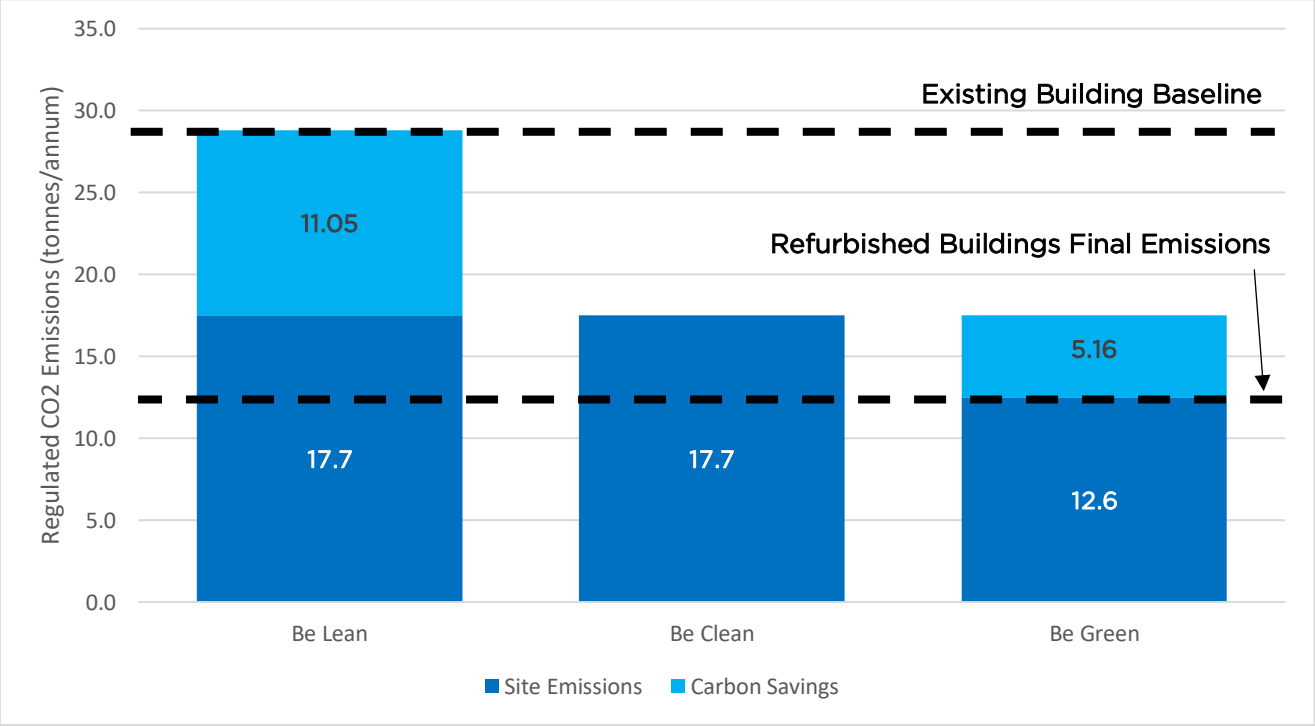


Figure 2. Energy Hierarchy - Refurbished Building

1.0 INTRODUCTION

This report has been prepared by **FLATT** in support of the planning application for the refurbishment of 22 Endell Street, London to provide refurbished B1 Office space to a Cat A standard from Basement Floor to Third Floor. The refurbishment includes B1 Office facilities, showers and associated cycle parking, waste storage, plant and services on behalf of **Lakenorth Ltd**.

This Energy Statement outlines how the reductions in CO_2 emissions are achieved through the use of improvements in building fabric and new energy efficient services installations, thereby demonstrating compliance with Building Regulations and Local Authority energy polices.

The report focuses on:

- Building Regulations / SBEM Compliance
- Government and Local Authority Policies
- Energy Demand and Consumption

The aim is to ensure the client, design team and planners are fully informed as to how the development, in context to the planning conditions, will:

- Minimises its Carbon Footprint
- Maximises its Energy Efficiency

The report follows the guidance detailed within the document titled "Energy Assessment Guidance – Greater London Authority guidance on Preparing Energy Assessments" dated October 2018.

The project is a minor development to refurbish an existing office building and thus is non referable to the GLA and consequently the detailed requirements of The London Plan 2018.

1.1 Camden Council

Camden Council details its requirements for Energy Statements for existing buildings undergoing refurbishment within its Energy Efficiency and Adaption Document (March 2019)

The presentation of the emissions and energy results within this report uses the methodology described within the approved GLA document; Energy Assessment Guide (Oct 2018) which is regarded as being suitable to inform all parties as to the process and the emissions reductions achieved and renewable energy provisions required.

2.0 THE DEVELOPMENT

2.1 General

The building provides office accommodation with a GIA of 570m² and a NIA of circa 426m² over 5 storeys. Located in Covent Garden, this listed property was built in mid-19th century in a Gothic revival-style. The building is a former stained-glass studio and includes stonework detailing 'Lavers and Barraud, stained glass works' who are former makers of stained glass. No 22 Endell Street is a Grade II listed building.

The building is of a traditional masonry construction. The slated roof contains symmetrically arranged gable dormers and Lombardic eaves. A large pointed arch window containing stained glass is present on the gable to Betterton Street. Single glazed timber sash windows sit within arched pattered brickwork above stone lintels.

Internally, the building comprises exposed plasterboard ceilings, painted plaster walls and painted / varnished timber joinery surfaces. The building is provided with a mixture of carpet, vinyl and solid timber floor finishes laid directly over the structural timber.

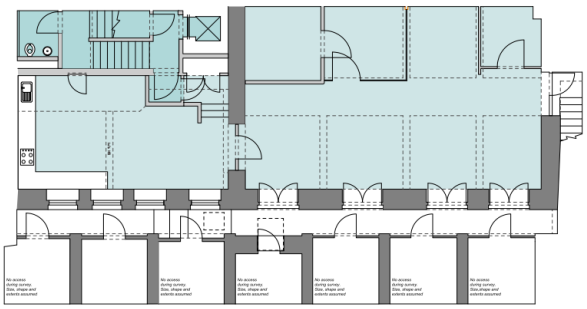
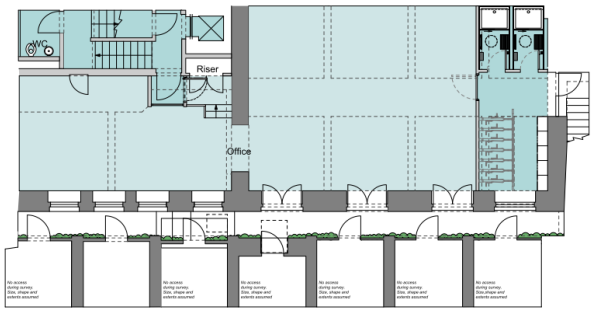
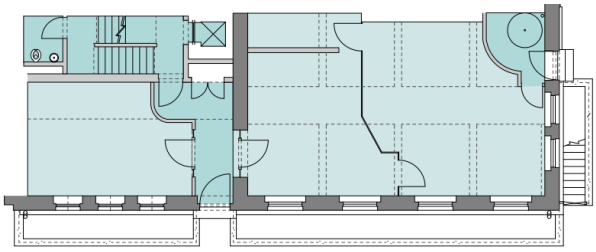
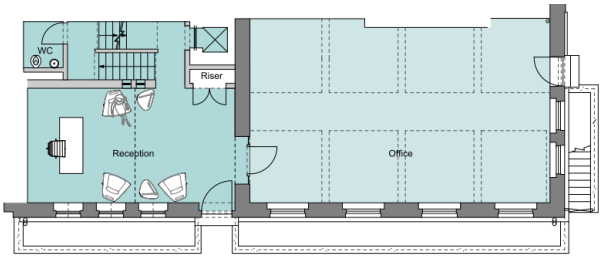
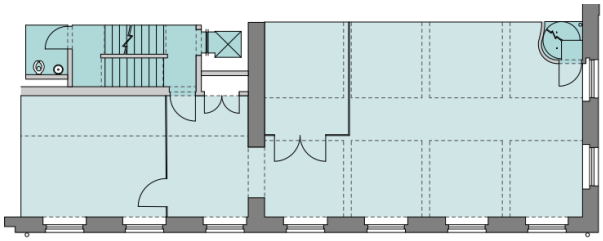
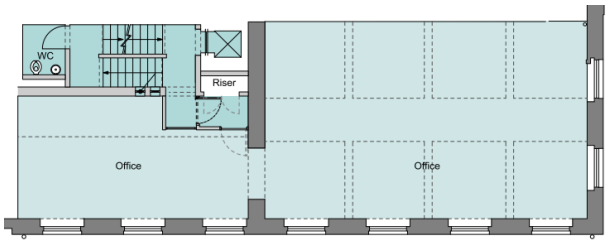
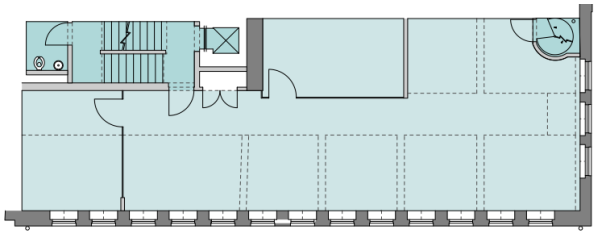
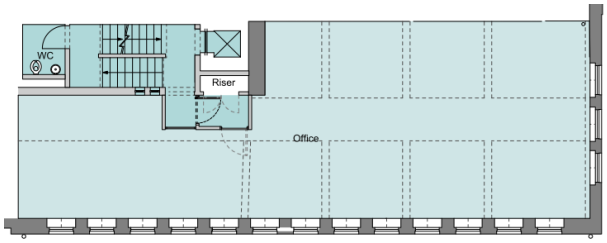
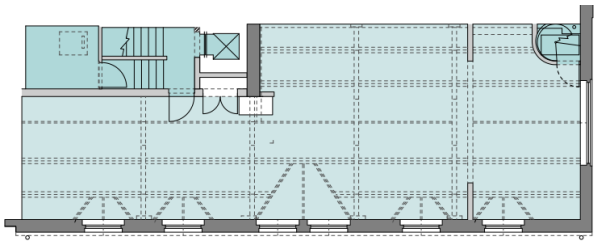
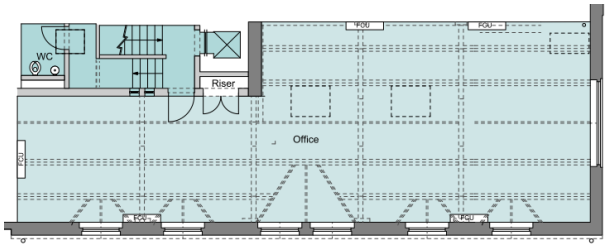
The refurbishment will focus on enhancing elements of the existing building fabric and replacing the mechanical and electrical services.

The fabric improvements are providing additional insulation to the large area of roof exposed to the third-floor office. Also, windows are to be provided with a high-quality solar control film, neutral in colour and of similar reflectance to the existing glazing, to reduce building cooling load.

The design and provision of the new comfort cooling and heating systems and new lighting, in particular, will significantly reduce energy consumption and associated emissions whilst providing flexibility to let the building on a floor by floor basis, or as a whole building.

2.2 Existing and Proposed Building Plans

The existing building plans and the proposed building plans are as follows:

Existing Building Plans	Proposed Building Plans
	
Basement Level	Basement Level
	
Ground Floor	Ground Floor
	
First Floor	First Floor
	
Second Floor	Second Floor
	
Third Floor	Third Floor

3.0 PLANNING POLICY AND CONTEXT

3.1 National Policy

The National Planning Policy Framework (NPPF) was adopted in March 2012, current revision is February 2019, and this document supersedes the previous national planning policy statements and guidance. The framework sets out a structure for delivering sustainable development with particular relevance for energy and carbon issues.

Ministry of Housing, Communities & Local Government

3.2 Building Regulations

This development is required to comply with Approved Document Part L2B. The following should be noted:

- Refurbished Areas: The refurbished areas are to be constructed to the requirements of the current Building Regulations Part L2B 2013
- All controlled services to comply with the Non-Domestic Compliance Guide (NDCG).

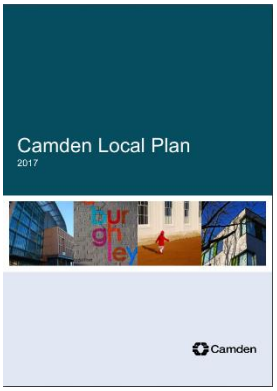
3.3 Regional Policy – Camden Council

The key local documents regarding planning policy in Camden Council are as follows:

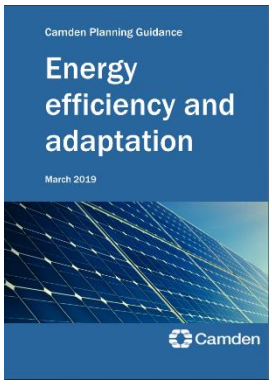
Camden Local Plan (2017)

The Local Plan was adopted in 2017 and replaces the Core Strategy and Development Policies.

One of the key themes in the Local Plan is the principle of sustainable development. The policies aim to strike the right balance between protecting the Borough's environment whilst ensuring that essential development to support the local economy and meet local residents needs takes place.



Energy Efficiency and Adaptation (2017)



This Camden Planning Guidance (CPG) was prepared to support and amplify the saved policies set out in the Camden Local Plan (2017).

This guidance is therefore consistent with the Local Plan and forms a Supplementary Planning Document (SPD) which is an additional "material consideration" in planning decisions.

The following figures are extracted from the CPG document.

Table 1b: Energy statement information, non-domestic

✓ Development should comply with these standards/provide this information	Non-domestic New Build (assessed under L2A)			Non-domestic Refurbishment (assessed under L2B)		
	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)	Major (>1,000 sqm)	Medium (500sq.m and <1,000 sqm)	Minor (<500sq.m)
Energy and carbon reduction targets						
Energy Statement required *(Local Plan CC1, London Plan 5.2, 5.3)* follow GLA Guidance on Preparing Energy Assessments.	✓	✓	Not required	✓	✓	Not required
Energy assessment methodology	National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) v5.2d or later or equivalent software – presented in the BRUKL Non regulated emissions (i.e. catering and computing) should also be included in the report but included in the overall carbon reduction figures. The total non-regulated emissions can be established from individual end use figures from CIBSE guide baselines (e.g. CIBSE Guide F) or through evidence established through previous development work					
Baseline calculation	Notional Building Target Emissions Rate (TER)			Building Emissions Rate (BER) for the existing building, as well as a Building Regulations		

Table 2b Energy reduction targets, non-domestic

Development should comply with these standards/provide this information	Non-domestic New Build (assessed under L2A)			Non-domestic Refurbishment (assessed under L2B)		
	Major (>1,000 sqm)	**Medium (500sq.m and <1,000 sqm)**	**Minor (<500sq.m)**	**Major (>1,000 sqm)**	**Medium (500sq.m and <1,000 sqm)**	**Minor (<500sq.m)**
Energy and carbon reduction targets						
Overall carbon reduction targets	*35% below Part L of 2013 Building Regulations (London Plan 5.2, Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction, meeting Part L2B for retained thermal elements. (London Plan 5.4, Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*	*Greatest possible reduction below Part L of 2013 Building Regulations (Local Plan CC1)*
Reduction in CO2 from onsite renewables (after all other energy efficiency measures have been incorporated)	*20% (London Plan 5.7, Local Plan CC1)*	*20% (London Plan 5.7, Local Plan CC1)*	*Incorporate renewables where feasible*	*20% (London Plan 5.4, 5.7, Local Plan CC1*	*20% (London Plan 5.4, 5.7, Local Plan CC1*	*Incorporate renewables where feasible*

4.0 OBJECTIVES

4.1 General

The 'Energy Hierarchy' sets out an approach to achieving CO_2 reductions by improving the efficiency of the building design, before introducing low or zero carbon technologies, by applying the following measures:

Be Lean - Passive Design i.e. fabric site layout, orientation, building fabric, air tightness, natural ventilation and lighting.
Active Design i.e. heat recovery mechanical ventilation, high efficacy lighting.

Be Clean - Efficient supply of energy through combined heat and power or connection to district heating / cooling networks.

Be Green - Renewable energy sources.

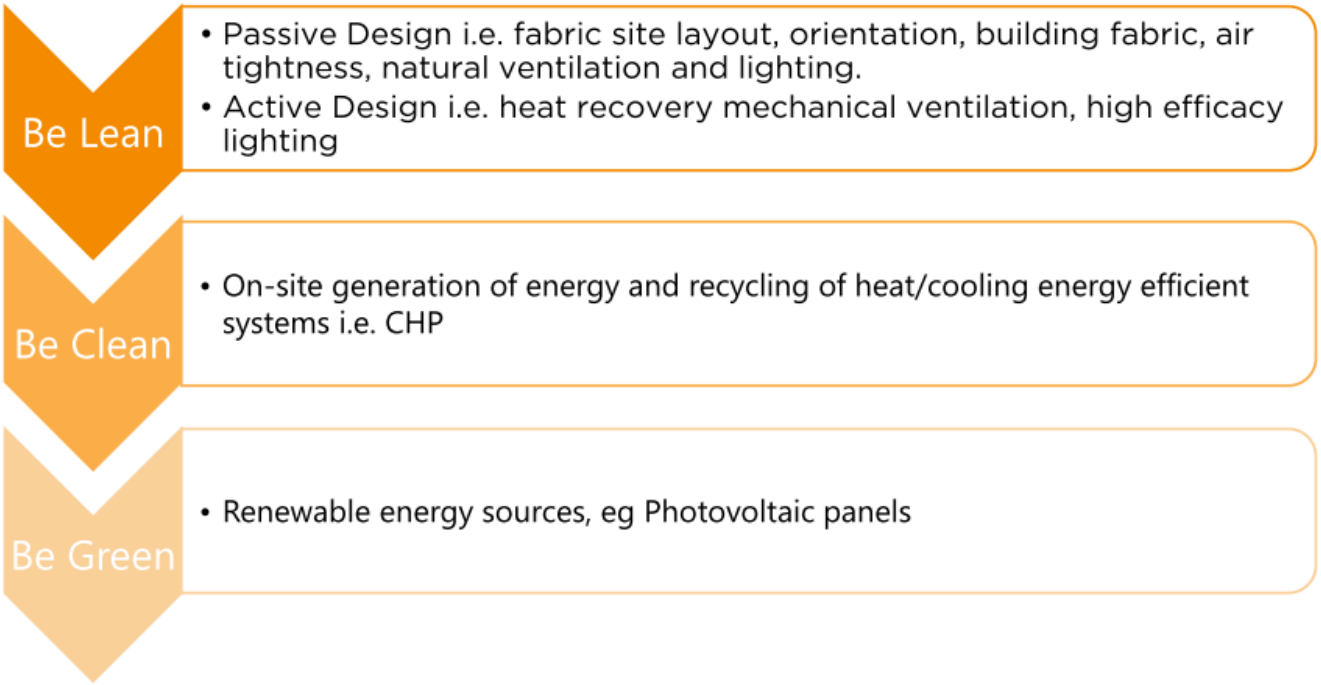


Figure 3. Energy Hierarchy

4.2 Specific Development Objectives

The development objectives are in line with the requirements of Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings (2010 edition incorporating 2010, 2011, 2013 and 2016 amendments).

The Energy and Emissions objectives are as follows:

- Compliance with Approved Document ADL2B
- Compliance with the Non-Domestic Compliance Guide (NDCG).
- Compliance with Para 8.24 of the CPG Energy Efficiency and Adaptation (2019) – refer Section 4.5.

4.3 Demand Reduction (Be Lean)

The design intent of the development is to provide a building, which will achieve significantly reduced carbon emissions by the introduction of sustainable solutions and low carbon technologies.

To achieve energy demand and CO_2 emissions reductions, the energy efficiency of the building envelope and building services will be improved, by considering the following Passive and Active design measures where practicable and feasible for an existing Grade II listed building:

Passive Measures

- Optimising the building through the construction of the front extensions.
- Improving the penetration of natural light into the building, inclusion of light well..
- Enhancing the building fabric performance and air permeability standard through the provision of the new façade.
- Minimising cold bridging through insulation measures within the provision of the new façade.

Active Measures

- High efficiency plant incorporating heat recovery.
- High efficiency lighting and controls
- Heat recovery ventilation
- Low water usage fittings
- Minimising hot water storage
- Installation of renewable technologies

By incorporating the above principles into the development, less energy will be required to maintain comfortable conditions for occupants; these principles will also help prevent overheating in the summer and maintain temperatures in winter.

4.4 Heating Infrastructure including CHP (Be Clean)

General

As a minor refurbishment CHP is not considered for this project. The GLA no longer supports CHP for small to medium new construction developments. Furthermore, its inclusion or consideration for this project is deemed inappropriate.

5.0 HISTORIC AND LISTED STATUS REVIEW

The following checklist is extracted from Camden's CPG Energy Efficiency and Adaptation (2019).

Page 40, Para 8.24 A range of thermal efficiency measures can then be implemented, which avoid harm to the historic environment. Ranked according to their impact on heritage and the technical risks, these include:

1. Ensure that the building is in a good state of repair
2. Minor interventions - upgrade the easier and non-contentious elements:
    a. insulate roof spaces and suspended floors.
    b. provide flue dampers - (close in winter, open in summer).
    c. provide energy efficient lighting and appliances draught-seal doors and windows.
    d. provide hot water tank and pipe insulation.
3. Moderate interventions - upgrade vulnerable elements:
    a. install secondary (or double) glazing (if practicable).
4. Upgrade building services and give advice to building users on managing them efficiently:
    a. install high-efficiency boiler and heating controls.
    b. install smart metering.
    c. install solar panels, where not visible from the street or public spaces.
5. Major interventions - upgrade more difficult and contentious elements (where impact on heritage values and level of technical risk shown to be acceptable)
    a. provide solid wall insulation.

5.1 Response to Para 8.24

1. Generally the building is in a good state of repair with significant refurbishments having been carried in the past. As a consequence, only limited maintenance/repair/redecoration to the fabric, including the windows, is required. It is proposed that the building services will be replaced to provide a 15-20 years life for these installations.
2. Minor interventions - upgrade the easier and non-contentious elements:
    a. The roof space is open to the office on the 3rd floor and it is proposed to line the existing internal roof/ceiling surface with a layer of plasterboard backed insulation to improve the thermal performance of the roof. This shall be undertaken with due consideration to maintaining the expressed appearance of the existing timber structure.
    b. The existing single glazing has a mixture of films and coverings applied. These will be removed and new, high performance solar control film will be applied. Furthermore, the solar film may be removed with no adverse effects to the existing glazing.
    c. The building will remain heated via the heat pumps, hence no boilers and flues provided.

d. The existing fluorescent light will be replaced by a new low energy LED lighting and controls installation in accordance with the non-domestic compliance guide. Lighting energy is a significant proportion of an offices regulated energy consumption, it is proposed that a min efficacy of 80Lum/W shall be provided improving upon the minimum 60Lum/W required by the NDCG. Full lighting controls and occupancy sensing shall be provided to minimise this energy consumption.

e. Only limited toilet facilities are provided to suit the size of the office, appropriately no hot water storage shall be provided with DHW supplied via local point of use electric water heaters. All hot pipework shall be provided with new insulation.

3. No moderate interventions are proposed as roof, walls and windows shall undergo repair, redecoration and making good only.

4. Upgrade of the building services will be achieved by the installation of new energy efficient HVAC services.

a. New VRV systems to replace the existing fatigued systems shall be provided. These systems shall come complete with full supervisory controls which shall include energy metering and monitoring.

b. The above VRV systems shall be provided on a floor by floor control basis to permit easy management and monitoring of energy consumption by tenants.

c. The installation of PV panels has been considered and found to be unsuitable for installation on the property. The roof has two pitches, at the front of the building the roof is compromised by dormers and is highly visible, hence unsuitable for the installation of PV panels.

The rear roof pitch is of limited area, faces North East and is shaded by the adjacent property, hence also unsuitable for the installation of PV panels.

3. No major interventions are proposed. As an existing building with heritage status, upgrading the existing solid brick walls to the standards laid out in Table 5 of AD Part L2B would have prohibitive cost implications. The complexity of such works and costs are increased due to the appearance of the arched differing windows that exist, hence these works are not proposed.

6.0 LOW AND ZERO CARBON TECHNOLOGIES / RENEWABLES

6.1 Renewable Energy Technologies

The following summarises a review of the renewable energy technologies available and if they are appropriate for use on this development, meeting site spatial and system integration requirements.

Technology	Feasible	System & Viability
Solar Thermal	**No**	Solar thermal collectors use the sun's energy to generate domestic hot water. **This option has been discounted as the office has low hot water usage and the use of hot water storage systems is not considered the most energy efficient way of meeting the hot water demand.**
Photovoltaics	**No**	PV panels generate electricity from solar energy, which can be used onsite or potentially exported, where agreement can be reached with the relevant electricity provider. PV panels are relatively simple to install, requiring little maintenance and can easily be integrated into the electrical distribution system to provide electricity that can be utilised on site. The installation of PV panels has been considered and found to be unsuitable for installation on the property. The roof has two pitches, the roof at the front of the building is compromised by dormers and is highly visible, hence unsuitable for the installation of PV panels. The rear roof pitch is of limited area, faces North East and is shaded by the adjacent property, hence also unsuitable for the installation of PV panels. **This option has therefore been discounted**.
Wind turbine	**No**	Wind turbines are not recommended for this development due to the heritage nature of the site, site location and limitations to suitably locate a wind turbine at roof level with a meaningful output, whilst meeting building planning/aesthetic requirements. **This option has therefore been discounted**.

Technology	Feasible	System & Viability
Biomass boiler	No	The extent of the refurbishment does not include the installation of a wet heating installation; hence the inclusion of biomass boilers is not appropriate. This option has therefore been discounted.
Heat Pumps – Heating only	No	The extent of the refurbishment does not include the installation of a wet heating installation; hence the inclusion of heat pumps (air source, ground or water source) for wet heating systems is not appropriate. This option has therefore been discounted.
Variable Refrigerant Volume (VRV) Air Source Heat Pump – Heating & Cooling	Yes	VRV systems utilise air source heat pumps to provide space heating and cooling. Instead of using water to transport the heat/coolth extracted from the air, a VRV system uses a refrigerant gas as the transport medium to the terminal unit. VRV systems are a highly efficient and well understood heat pump technology. A VRV system providing heating and comfort cooling is proposed for the refurbishment to serve the offices. The VRV system under heating mode shall be specified to ensure it has an sCoP > 4.0. This is in accordance with Page 23, Para 5.16 of the CPG. This option has therefore been adopted.

Figure 4. Renewables Energy Option Review

6.2 VRV Air Source Heat Pumps

Variable refrigerant volume (VRV) systems are a popular method of providing heating and cooling to office buildings.

Modern VRV systems are extremely capable, incorporating zoning, individual temperature control, minimised ductwork, high comfort levels and low installation costs.

This all-electric technology consists of an outdoor condensing unit serving multiple indoor room terminal units, refrigerant piping and associated controls.

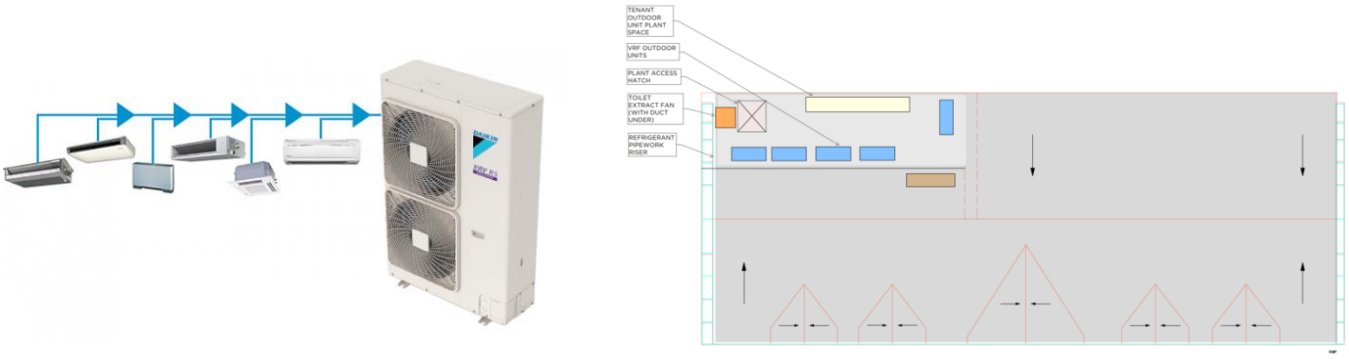


Figure 5. VRV System and Roof Plan

In cooling mode, the VRV systems transfer the heat from the room directly to evaporator coils located within the terminal units in the conditioned space. The heat is then transferred to condenser coils in the external unit which rejects the heat to atmosphere. In heating mode this process is reversed. The heat-transfer media is the refrigerant, delivering the heating or cooling to the conditioned space with less energy than when compared with air or water.

The VRV system uses R-410A refrigerant as the heat-transfer fluid and the working fluid, achieving a very high energy efficiency ratio (SEER) of 4.0 to 5.0. They can be 20% to 30% more efficient than conventional HVAC systems due to partial load operation, speed modulation and zoning capabilities.

Camdens CPG stipulates that a heat pump shall have an sCoP > 4.0 before they consider the unit to be renewable. Modern VRV plant have significantly greater efficiencies due to improvements on compressor and EC fan technologies amongst other improvements. This has resulted in sCoP's being vastly improved. It is envisaged that the final selected units shall have an sCoP in excess of 5.0. However, the specification shall insist that the minimum sCoP shall be > 4.0 to ensure compliance with Camden CPG. All thermal modelling shall use sCoP of 4.0 as its minimum to ensure savings are not exaggerated at this stage.

7.0 CALCULATION METHODOLOGY

7.1 Simplified Building Energy Model (SBEM)

SBEM is a software tool developed by BRE that provides an analysis of a building's energy consumption. Its full title is Simplified Building Energy Model. SBEM is by definition "simplified". It is a form of steady state calculation which runs a series of iterations to obtain the annual overall energy results.

The main purpose of SBEM is to provide a free tool endorsed by the UK government which can be used to assess all new non-domestic buildings for compliance under the newly implemented National Calculation Methodology (NCM).

The NCM is the UK's official framework which has been created in order to allow the energy performance and CO_2 emissions of all new non-domestic buildings to be assessed and compared against target benchmarks in order that the UK can achieve the targets specified by the European Performance of Buildings Directive (EPBD).

For the purpose of this Energy Statement, a more advanced Dynamic Simulation Model (DSM) has been undertaken using IES-VE Apache software to give greater accuracy in the building thermal model generating the SBEM results.

DSM breaks the analysis down into 5 minute time steps - or less if required. By monitoring the building at this very detailed level over the full year and using real site historical weather data recorded at hourly intervals a very detailed energy analysis can be simulated. The DSM model uses the LondonDSY weather data for Building Regulations compliance calculations.

This means that the DSM Apache Simulation model is a much more accurate portrayal of a building's annual energy usage and consequently the buildings emissions.

The IES Apache Sim method has been approved by the DCLG as an official tool which can be used to test a building under the NCM methodology.

7.1.1 Thermal Modelling Software

The thermal modelling has been undertaken using IES-VE 2019.1.0.0 with VE Compliance v7.0.12.0 software.

8.0 EXISTING BUILDING ANALYSIS

8.1 Dynamic Simulation Thermal Modelling

The Simplified Building Energy Model is a full-scale 3D computer generated thermal model developed from the existing and proposed drawings by Hale Brown Architects. combined with information obtained from surveying the existing premises, by FLATT, to generate a Level 5 EPC for both the existing building and the proposed building by an accredited L5 Energy Assessor.

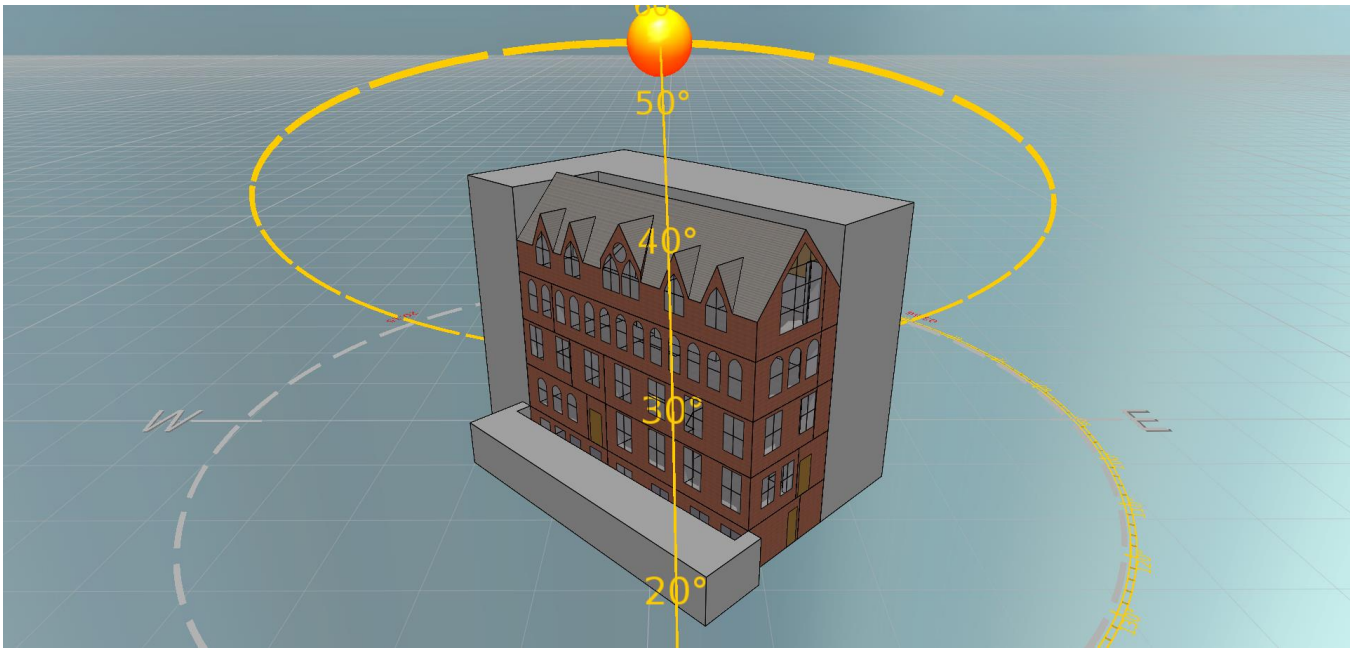


Figure 6. Building Thermal Model

8.2 Design Criteria

To establish the benchmark energy usage and building emissions for the Existing Building (pre-refurbishment), the following design criteria have been applied along with the NCM conventions in Appendix A.

8.2.1 Building Fabric

The fabric details for the existing model have been assumed on the basis of the construction date of the building, circa 1859. SAP2005 Appendix S provides useful information of building fabric performance pre Building Regulations and thus the existing fabric, detailed below, has been assumed using this guidance.

Building Fabric	Existing Building Pre Refurbishment U-Values
Glazing – Single Glazed	5.60 W/m² °K g-value = 0.85
Glazing – Secondary Glazed (Ground Floor)	3.60 W/m² °K g-value = 0.75
Rooflights	N/A
External Walls – Solid Brick	2.10 W/m² °K
Ground Floor	0.70 W/m² °K
Roof	2.10 W/m² °K
Infiltration	**Proposed**
Air Tightness	25.0 m³/h/m² @ 50Pa

Figure 7. Existing Building Fabric (Pre-refurbishment)

The high air tightness figures of 25.0 m³/h/m² @ 50Pa reflects the requirements of the EPC Conventions.

8.3 SBEM Analysis Results Summary

The above design criteria was used within the SBEM for the Existing Building (prior to refurbishment) thermal model. The SBEM calculations allow the production of an EPC rating for the building.

8.3.1 Existing Building EPC

No existing EPC rating was available for the buildings no EPC was lodged with the EPC register www.ndepregister.com for the address other than for the basement.

FLATT have produced an updated Level 5 (Dynamic) EPC rating for the Existing (pre refurbishment) building to compare to the refurbished building proposals rather than the more basic 'steady state' Level 4 analysis.

As shown, the predicted performance of the existing building is a D91, which is relatively poor by modern standards but reflects the fact that the services have been replaced in previous refurbishments. The basement has an existing EPC of E113.

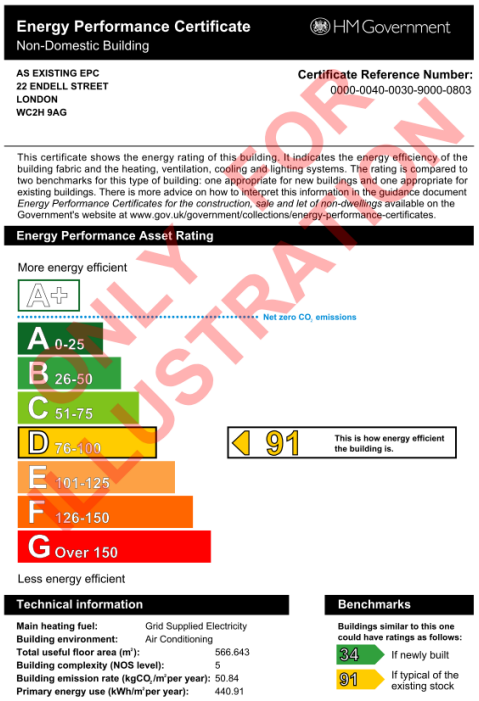


Figure 8. Predicted EPC for the Existing Building

8.3.2 Existing Building SBEM Results

A key parameter is the Building Emissions Rate (BER) which represents regulated CO_2 emissions per m^2 of building floor area. The BER of the Existing Building is 50.8 kgCO2/m^2.yr as shown on the lodged EPC. The following table illustrates the Energy Consumption of the Existing Building.

SBEM energy consumption kWh/m^2.yr	Existing Building (Pre-refurbishment) Actual
Heating	47.41
Cooling	11.34
Auxiliary	0.26
Lighting	36.62
Hot Water	2.32
Equipment	38.44
Total (Excluding Equipment)	**97.95**
Emissions kgCO_2/m^2	
BER	50.8

Figure 9. Compliance Calculation Output – B1 Office

8.3.3 Existing Building - Energy and Emissions Results Summary

- 50.8 kgCO_2/m^2.yr Building Emissions Rating (BER)
- 97.95 kWh/m^2.yr Regulated Energy
- 287.83 Tonnes CO_2/Annum Emissions
- 55.50 MWh/Annum Regulated Energy
- EPC Rating of D91

9.0 REFURBISHED BUILDING ANALYSIS

9.1 Dynamic Simulation Thermal Modelling

Below are images of the refurbished building thermal model. As no alterations or extensions are proposed, this is essentially the same in external appearance to the existing model, however changes to some fabric elements and controlled services and fittings are contained within as described in in this report.

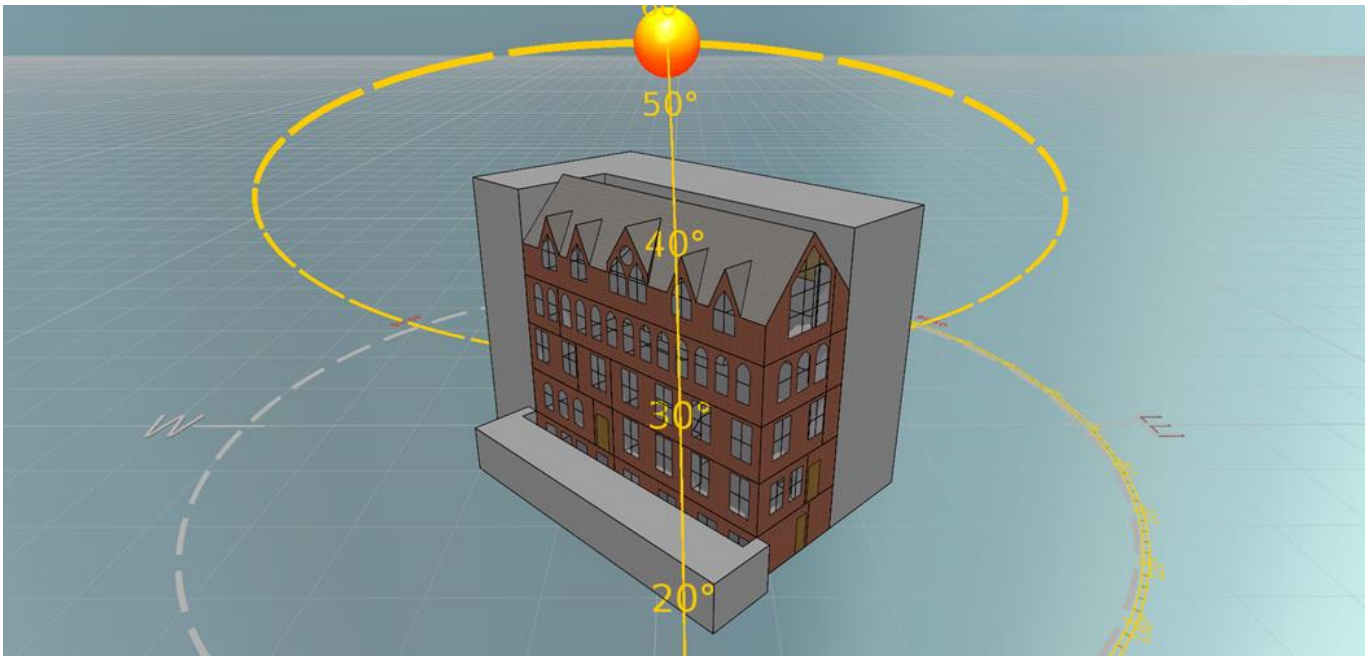


Figure 10. Refurbished Building Thermal Model

9.2 Design Criteria

To establish the benchmark energy usage and building emissions for the Post Refurbishment building, the following design criteria have been applied along with the NCM conventions in Appendix A.

9.2.1 Building Fabric

The fabric details for the refurbished model follows that of the existing building. However, there are alterations to the roof and glazing as identified in the following tables.

Building Fabric	Building Refurbishment U-Values
External Glazing – Single Glazed	5.60 W/m² °K g-value = 0.50 (Solar Film Applied)
Rooflights	1.4 W/m² °K, g-value = 0.25
External Walls – Solid Brick	2.10 W/m² °K
Ground Floor	0.70 W/m² °K
Roof	0.70 W/m² °K
Infiltration	**Proposed**
Air Tightness	25.0 m³/h/m² @ 50Pa

Figure 11. Refurbished Building Fabric

9.2.2 Non-Domestic Compliance Guide (NDCG)

The new controlled services will be required to conform with the requirements of the Non-Domestic Compliance Guide (NDCG) and the ErP (Energy related Products Directive) in terms of equipment and plant efficiencies.

Air Distribution Systems	Specific Fan Power New Buildings
Zonal extract where the fan is remote from the zone	0.5 W/(l/s)

Figure 12. Specific Fan Powers

9.3 SBEM Analysis Results Summary

The above design criteria was used within the SBEM for the Refurbished Building (after refurbishment) thermal model. The SBEM calculations allow the production of an EPC rating for the building.

9.3.1 Refurbished Building EPC

FLATT have produced an Level 5 (Dynamic) EPC rating for the rurbishished building to compare to the existing building rather than the more basic 'steady state' Level 4 analysis.

As shown, the predicted performance of the refurbished building is B40, which is good compared to modern standards but reflects the fact that the it is an existing historic building with retained fabric.

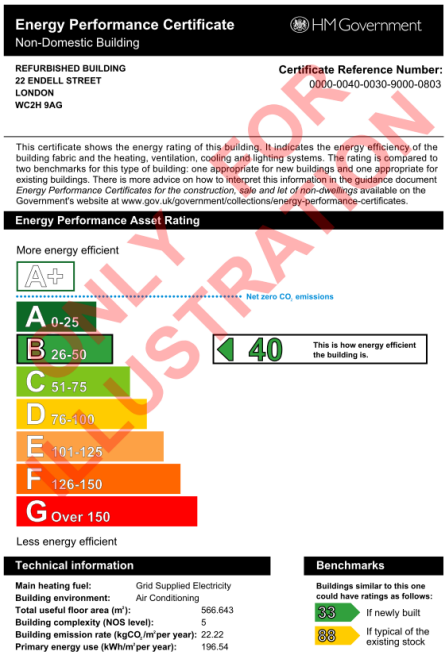


Figure 13. Predicted EPC for the Refurbished Building

9.3.2 Refurbished Building SBEM Results

The following tables summarise the SBEM calculation results for the refurbished building. The full BRUKL documents supporting this table may be found within the appendix.

- **Existing Building BER** – This is the baseline prior to the refurbishment.
- **Existing Building TER –** Building Regulation Pt L 2013 target emission rating
- **Refurbished Building – Be Lean (LTHW htg) –** The refurbished building after the Energy Demand Reduction with Gas Fired LTHW for heating to determine renewable contribution from ASHP
- **Refurbished Building – Be Lean (ASHP htg) –** The refurbished building after the Energy Demand Reduction complete with ASHP doing the heating.

SBEM EMISSIONS	Existing BER Baseline	Existing Part L2013 TER	Refurbished Be Lean (LTHW htg)		Refurbished Be Green (ASHP htg)	
	Actual kWh/m2	Notional kWh/m2	Actual kWh/m2	Notional kWh/m2	Actual kWh/m2	Notional kWh/m2
Heating	47.41	5.00	99.10	15.40	27.11	5.75
Cooling	11.34	8.09	3.22	7.88	3.22	7.88
Auxiliary	0.26	0.24	0.26	0.26	0.26	0.26
Lighting	36.62	22.88	9.82	21.49	9.82	21.49
Hot Water	2.32	2.55	2.41	2.65	2.41	2.65
Equipment	38.44	38.44	39.64	39.64	39.64	39.64
Total (Exc Equipment)	**97.95**	**38.76**	**114.80**	**47.68**	**42.82**	**38.02**
Emissions kgCO2/m2						
TER		19.1		19.3		18.6
BER	50.8		31.3		22.2	
%age improvement		N/A		38%		**56%**
Renewable Energy kWh/m2						
PV Energy	0		0		0.00	
CHP Energy	0		0		0.00	
ASHP Energy	0		0.00		71.99	
Total Renew Energy	0		0.00		71.99	
Percentage Ren Energy	0%		**0%**		**63%**	
Renewable Emissions kgCO2/m2						
PV Emissions Red	0		0.0		0.0	
CHP Emissions Red	0		0.0		0.0	
ASHP Emissions Red	0		0.0		9.1	
Total Renew Emiss Red	0		0.0		9.1	
Percentage Emiss Red	0%		**0%**		**18%**	

Figure 14. Existing Building vs Refurbished Building

9.4 GLA Tables – Refurbished Building

The energy and emissions results data is presented below in the format set out within the GLA Energy Assessment Guidance (Oct 2018) document. It should be noted that the Be Green stage has no facility to account for the renewable contribution from the heat pump heating energy using this format.

Table 3: Regulated Carbon Dioxide Emissions from each stage of the Energy Hierarchy for **Non-Domestic Buildings**	Carbon Dioxide Emissions for Non-Domestic Buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline : (Existing Building)	28.78	11.30
After energy demand reduction (Be lean)	17.73	11.30
After heat network / CHP (Be Clean)	17.73	11.30
After renewable energy (Be Green)	12.58	11.30

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for **Non-Domestic Buildings**	Regulated Non-Domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be Lean: Savings from energy demand reduction	11.05	38%
Be Clean: Savings from heat network	0.00	0%
Be Green: Savings from renewable energy	5.16	18%
Cumulative on-site savings	**16.20**	**56%**

Table 5: Shortfall in regulated carbon dioxide savings	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2/year)
Total Target Savings **(0%)**	**0.00**	
Carbon Shortfall	**0.00**	**0.00**
Cash-in-Lieu Contribution	**0.00**	

Table 6: Site wide regulated carbon dioxide emissions and savings	Total regulated emissions (Tonnes CO_2/year)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Baseline	28.8		
Be Lean	17.7	11.05	38%
Be Clean	17.7	0.00	0%
Be Green	12.6	5.16	**18%**
		CO_2 savings off-set (Tonnes CO_2)	
Off-set		**0**	

Figure 15. GLA Tables for Refurbished Building

9.4.1 Refurbished Building - Energy and Emissions Results Summary

- 56% reduction in regulated emissions as compared to the Existing Building

- 63% reduction in regulated energy consumption
- 18% reduction in regulated emissions via renewables (ASHP)

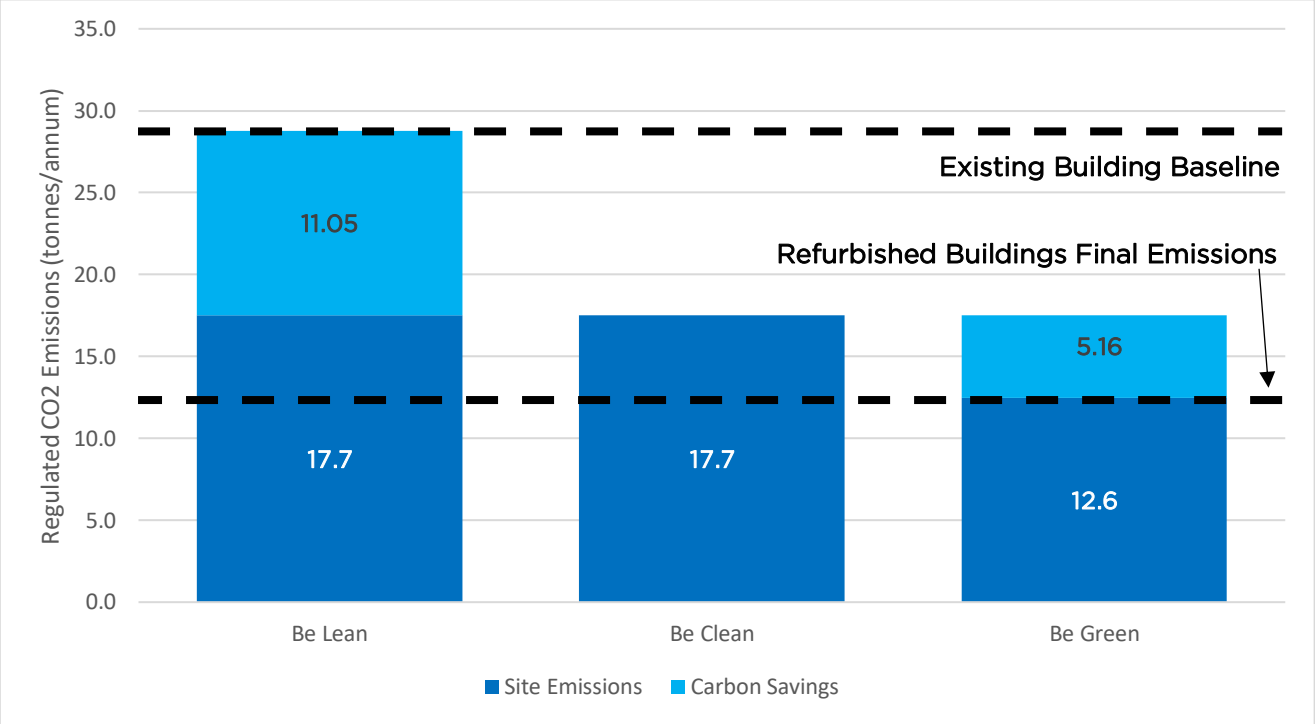


Figure 16. Energy Hierarchy - Refurbished Building

10.0 COOLING AND OVERHEATING

10.1 Cooling Hierarchy

To reduce the impact of the urban heat island effect and encourage the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change the proposals reduce potential overheating and reliance on air conditioning systems. This is demonstrated in accordance with the following cooling hierarchy:

1. Minimising internal heat generation through energy efficient design.
2. Reducing the amount of heat entering the building in summer.
3. Use of thermal mass and high ceilings to manage the heat within the building.
4. Passive ventilation.
5. Mechanical ventilation.
6 Active cooling systems (ensuring they are the lowest carbon options).

The hierarchy has been considered in relation to Refurbished building as follows:

1. No LTHW systems are proposed to serve the building avoiding any wasteful heat losses and unwanted heat gain from heating pipework.

2. The roof will be lined with insulated plasterboard to improve its thermal performance, minimising heat losses and heat gains.

   Solar control film with a g-value of 0.50 has been included to minimise solar gains.

   Internal blinds will be present within the office, although not provided as part of the base build. It is normal for blinds to be added by tenants.

3. The building design incorporates high ceilings generally within the offices in the region of 3.0m, this is achieved through the use of ceiling 'spine' services bulkheads, rather than false ceiling across the whole floor plate.

4. The existing sash windows are to be retained. Ventilation for the office areas is currently natural via openable windows. This shall be retained.

5. There is no scope for 'free cooling' in the traditional sense, however modern VRV systems take advantage of cooling demands during winter periods when the outside air is cooler than the internal room temperature.

6. Installing modern VRV systems with full controls after the demand has been minimised with solar film of glazed areas.

10.2 Overheating Risk Analysis

All developments are required to undertake an analysis of the risk of overheating. Building Regulations requirements are set out in Table 10, and these should be carried out at Stage 1.

Table 10: Overheating requirements as per Building Regulations Non-domestic developments
At Stage 1
Criterion 3 of the Part L 2A of the Building Regulations as summarised in the BRUKL output report must be met. This relates to limiting the effects of heat gains in summer.

Figure 17. GLA Table 10 – Building Regulation Overheating Requirements

In line with the Sustainable Design and Construction SPG19, the GLA requirements are in Table 11.

Table 11: GLA Overheating Requirements Non-domestic developments
At pre-application stage
Outline in the preliminary energy information how the overheating risk will be minimised.
At Stage 1
Undertake dynamic overheating modelling in line with the guidance and data sets in CIBSE TM52 and TM49 respectively
Provide evidence of how the development performs against the overheating criteria along with an outline of the assumptions made in the energy assessment.
Stage 2 onwards
Ensure that the results of the overheating analysis continue to be incorporated into the building design discussions as the design evolves.

Figure 18. GLA Table 11 – GLA Overheating Requirements

As required by the GLA Energy Assessment Guidance (Oct 2018), the following assumptions have been used within the thermal modelling and overheating assessments:

Design Assumptions	
Dynamic overheating analysis software used.	The thermal modelling has been undertaken using IES-VE 2019.1.0.0 with VE Compliance v7.0.12 software.
Site location	22 Endell Street, London
Site orientation	As existing, 2 facades facing South West and South, other perimeters are partied to adjacent premises
Weather file used	Thermal Modelling: LondonDSY weather file TM52 Overheating Analysis: London LWC 2020 DSY1 High percentile 50% weather file
Internal gains	As per NCM templates, refer to Appendix A.
Occupancy profiles	As per NCM templates, refer to Appendix A.
Thermal elements performance (U-values and glazing g-values)	Refer to Fig.11
Shading features (i.e. blinds, overhangs etc.)	Solar Control Film on existing single glazing
Thermal mass details	Medium weight construction (Existing)
Ventilation strategy	Natural Ventilation via openable windows
Model images indicating the sample units modelled	Refer to model images in Sections 7.1 and 8.1.
Units' internal layout	Refer to plans in Section 2.1

Figure 19. Design Assumptions

10.3 Overheating – Building Regulation Compliance

To comply Building Regulations ADL2B, under Consequential Improvements it states:

6.11 Where the installed capacity per unit area of a cooling system is increased:

a. ***thermal elements*** within heated areas which have U-values worse than those set out in column (a) of Table 5 should be upgraded following the guidance in paragraphs 5.12 and 5.13; and

b. if the area of windows, roof windows (but excluding ***display windows***) within the area served exceeds 40 per cent of the façade area or the area of rooflights exceeds 20 per cent of the area of the roof and the design solar load exceeds 25 W/m^2, then the solar control provisions should be upgraded such that at least one of the following four criteria is met:

i. the solar gain per unit floor area averaged over the period 0630 to 1630 GMT is not greater than 25 W/m^2 when the building is subject to solar irradiances for July as given in the table of design irradiancies in CIBSE Design Guide A;

ii. the design solar load is reduced by at least 20 per cent;

iii. the effective g-value is no worse than 0.3;

iv. the zone or zones satisfies the criterion 3 check in Approved Document L2A based on calculations by an approved software tool; and

This will reduce the solar gain and hence the space cooling demand. Section 5.1 of TM 37[15] gives guidance on calculating solar gains, and Sections 4.4 and 4.5 give guidance on the effective g-value.

c. any general lighting system within the area served by the relevant ***fixed building service*** which has an average lamp efficacy of less than 45 lamp-lumens per circuit-watt should be upgraded with new luminaires and/or controls following the guidance in the *Non-Domestic Building Services Compliance Guide*.

This will reduce the lighting load and hence the space cooling demand.

As a further check, the assessment is analysed against Part L ADL2A, Criterion 3 which states:

2.53 For the purposes of Part L, reasonable provision for limiting solar gain through the building fabric would be demonstrated by showing that, for each space in the building that is either occupied or mechanically cooled, the solar gains through the glazing aggregated over the period from April to September inclusive are no greater than would occur through one of the following reference glazing systems with a defined total solar energy transmittance (g-value) calculated according to BS EN 410:

a. For every space that is defined in the National Calculation Methodology (NCM) database as being side lit, the reference case is an east-facing façade with full-width glazing to a height of 1.0 m having a framing factor of 10 per cent and a normal solar energy transmittance (g-value) of 0.68.

b. For every space that is defined in the NCM database as being top lit, and whose average zone height is not greater than 6 m, the reference case is a horizontal roof of the same total area that is 10 per cent glazed as viewed from the inside out and having roof-lights that have a framing factor of 25 per cent and a normal solar energy transmittance (g-value) of 0.68.

c. For every space that is defined in the NCM database as being top lit and whose average zone height is greater than 6 m, the reference case is a horizontal roof of the same total area that is 20 per cent glazed as viewed from the inside out and having roof-lights that have a framing factor of 15 per cent and a normal solar energy transmittance (g-value) of 0.46;

10.3.1 Building Regulations Overheating Compliance

The following table records how Building Regulation compliance is achieved for Consequential Improvements and Criterion 3:

Compliance Requirement	Design Response
Thermal Elements	Existing single glazed windows
Area of Windows <40% of façade area	31% Total
Design Solar Load exceeds 25 W/m^2	37 W/m^2
Glazing Specification (g-value)	Proposed glazing has g value of 0.50 (after solar film)

Figure 20. Overheating Compliance Measures

10.3.2 Overheating – Part L Criterion 3 Check

Criterion 3 - solar gain check

Actual model - Criteria 3

Space (included in analysis)	Floor	Glazing as % floor area	Glazing category	Predominant orientation[8]	Solar gain limit[1]		Shading data[7]			
					Pass/Fail	Solar gain / limit [2,3]	Glazing g value[4]	Internal blinds used? [5]	External shades used?[5]	Local shading devices used?[5]
Sort A-Z	Hi/Lo	Hi/Lo	Sort A-Z	Sort A-Z	Sort A-Z	Hi/Lo	Hi/Lo	Sort A-Z	Sort A-Z	Sort A-Z
Apply		40.0				1.1	0.5			
0/OFFICE01	000	0	Side Lit	N/A	N/A	0.00	0.00	No	No	No
0/OP OFFICE01	000	26	Side Lit	SW	Fail	1.05	0.74	No	No	No
0/OP OFFICE02	000	23	Side Lit	SW	Fail	1.06	0.74	No	No	No
0/OP OFFICE03	000	20	Side Lit	SW	Pass	0.79	0.74	No	No	No
-1/OFFICE01	-1	0	Side Lit	N/A	N/A	0.00	0.00	No	No	No
-1/OFFICE02	-1	0	Side Lit	N/A	N/A	0.00	0.00	No	No	No
-1/OP OFFICE	-1	26	Side Lit	SW	Pass	0.93	0.85	No	No	No
1/OP OFFICE02	001	0	Side Lit	N/A	N/A	0.00	0.00	No	No	No
1/OP OFFICE03	001	21	Side Lit	SW	Fail	1.06	0.85	No	No	No
1/OP OFFICE04	001	27	Side Lit	SW	Fail	1.37	0.85	No	No	No
1/OP OFFICE01	001	28	Side Lit	SW	Fail	1.19	0.85	No	No	No
1/OP OFFICE01	002	0	Side Lit	N/A	N/A	0.00	0.00	No	No	No
1/OP OFFICE02	002	31	Side Lit	SW	Fail	1.32	0.85	No	No	No
1/OP OFFICE03	002	23	Side Lit	SW	Fail	1.17	0.85	No	No	No
-1/TEA ROOM	-1	23	Side Lit	SW	Fail	1.05	0.85	No	No	No
3/OP OFFICE	003	24	Side Lit	SW	Fail	1.24	0.85	No	No	No

Criterion 3 check failed

Notes:

1. Criterion 3 is a check that spaces have appropriate passive control measures to limit the effects of solar gains;
2. When the Criterion 3 limit is exceeded by a small amount (with ratio < 1.3) consider the glazing specification and blinds;
3. When the Criterion 3 limit is exceeded by a large amount (with ratio > 1.5) consider glazing area, external shading, the glazing specification and blinds;
4. Glazing g value; see derived parameters in Apache>constructions; this typically ranges from 0.1 for highly reflective to 0.8 for clear glass (double glazed)-optimal solar/light is approx 0.4-0.5;
5. Shading options defined with the construction in Apache>constructions;
6. If Local shade rooms types are defined and Suncast has been utilised their impact will be included in the result;
7. If more than one glazed construction is specified for the space the largest by area is reported;
8. Orientation & external shading strategy; shades on the north facades have little impact, shades on east & west facades need to work for low sun angles to be effective (consider vertical fins), horizontal shades on south facades work well however recess / vertical shades can also improve early & late performance.

Figure 21. Existing Building Prior to Refurbishment Criterion 3

Criterion 3 - solar gain check

Actual model - Criteri 3

Space (included in analysis)	Floor	Glazing as % floor area	Glazing category	Predominant orientation[8]	Solar gain limit[1]		Shading data[7]			
					Pass/Fail	Solar gain / limit [2,3]	Glazing g value[4]	Internal blinds used? [5]	External shades used?[5]	Local shading devices used?[5]
Sort A-Z	Hi/Lo	Hi/Lo	Sort A-Z	Sort A-Z	Sort A-Z	Hi/Lo	Hi/Lo	Sort A-Z	Sort A-Z	Sort A-Z
Apply		40.0				1.1	0.5			
0/OP OFFICE01	000	21	Side Lit	SW	Pass	0.60	0.50	No	No	No
0/RECEPTION	000	14	Side Lit	SW	Pass	0.41	0.50	No	No	No
-1/CYCLE STORE	-1	34	Side Lit	SW	Pass	0.66	0.50	No	No	No
1/OP OFFICE01	002	25	Side Lit	SW	Pass	0.71	0.50	No	No	No
1/OP OFFICE02	001	23	Side Lit	SW	Pass	0.64	0.50	No	No	No
-1/OP OFFICE01	-1	17	Side Lit	SW	Pass	0.36	0.50	No	No	No
1/OP OFFICE01	001	25	Side Lit	SW	Pass	0.71	0.50	No	No	No
-1/OP OFFICE02	-1	23	Side Lit	SW	Pass	0.60	0.50	No	No	No
3/OP OFFICE01	003	24	Side Lit	SW	Pass	0.68	0.50	No	No	No

Criterion 3 check passed

Notes:

1. Criterion 3 is a check that spaces have appropriate passive control measures to limit the effects of solar gains;
2. When the Criterion 3 limit is exceeded by a small amount (with ratio < 1.3) consider the glazing specification and blinds;
3. When the Criterion 3 limit is exceeded by a large amount (with ratio > 1.5) consider glazing area, external shading, the glazing specification and blinds;
4. Glazing g value; see derived parameters in Apache>constructions; this typically ranges from 0.1 for highly reflective to 0.8 for clear glass (double glazed)-optimal solar/light is approx 0.4-0.5;
5. Shading options defined with the construction in Apache>constructions;
6. If Local shade rooms types are defined and Suncast has been utilised their impact will be included in the result;
7. If more than one glazed construction is specified for the space the largest by area is reported;
8. Orientation & external shading strategy; shades on the north facades have little impact, shades on east & west facades need to work for low sun angles to be effective (consider vertical fins), horizontal shades on south facades work well however recess / vertical shades can also improve early & late performance.

Figure 22. Refurbished Building Criterion 3

Glass Type	Film Type on 6mm Glass	Visible Light Transmission	Visible Reflection Exterior	Visible Reflection Interior	Heat Gain Reduction	G-value (Solar Heat Gain Coefficient)	Total Solar Energy Rejected
Single Pane							
Clear	No film	89%	8%	9%	N/A	0.82	19%
	PR 70	69%	9%	9%	38%	0.50	50%
Tinted	No film	53%	6%	6%	N/A	0.63	37%
	PR 70	**42%**	**6%**	**7%**	**31%**	**0.43**	**57%**
Double Pane							
Clear	No film	79%	15%	15%	N/A	0.70	30%
	PR 70	**62%**	**15%**	**13%**	**21%**	**0.56**	**44%**
Tinted	No film	47%	8%	13%	N/A	0.51	49%
	PR 70	**37%**	**8%**	**12%**	**18%**	**0.42**	**59%**

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Figure 23. Proposed Glazing Film Specification – Clear g-value = 0.5

10.4 Overheating – TM52 Analysis

A TM:52 overheating analysis has been undertaken utilising the London LWC DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario weather file.

The thermal comfort category used as defined within CIBSE Guide A, is Category II, Normal expectations (for new buildings and renovations).

As the project is at Stage 2, the NCM room templates and plant profiles have been applied as per the compliance calculations. Transient occupancy areas such a corridor, lifts stairs etc have been excluded.

The results of the analysis are tabled below, with the overheating analysed under the following scenarios in accordance with cooling hierarchy:

Passive Ventilation
Building has sealed façade to prevent noise ingress, natural infiltration only

Mechanical Ventilation
Mechanical Minimum Fresh Air Ventilation – as proposed
Mechanical Full Fresh Air Ventilation – 8 ach to simulate effect of natural ventilation

Active Cooling
Mechanical VRV comfort cooling and heating – As proposed
Room profiles and schedules are as NCM and as detailed in Appendix A thereon for the Refurbished Building.

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
-1/OP OFFICE01	100	80.7	117	13	1 & 2 & 3
-1/OP OFFICE02	100	39.4	69	9	1 & 2 & 3
0/OP OFFICE01	100	87.2	151	17	1 & 2 & 3
0/RECEPTION	100	81.7	124	15	1 & 2 & 3
1/OP OFFICE01	100	86.1	150	18	1 & 2 & 3
1/OP OFFICE02	100	89.5	159	17	1 & 2 & 3
2/OP OFFICE01	100	85.6	152	18	1 & 2 & 3
3/OP OFFICE01	100	60.6	103	11	1 & 2 & 3

Figure 24. TM:52 Results – Passive Ventilation

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
-1/OP OFFICE01	100	38.1	73	9	1 & 2 & 3
-1/OP OFFICE02	100	16.4	43	6	1 & 2 & 3
0/OP OFFICE01	100	55.9	100	12	1 & 2 & 3
0/RECEPTION	100	44.6	81	11	1 & 2 & 3
1/OP OFFICE01	100	52.8	101	13	1 & 2 & 3
1/OP OFFICE02	100	59.3	106	13	1 & 2 & 3
2/OP OFFICE01	100	55.9	103	13	1 & 2 & 3
3/OP OFFICE01	100	30.1	73	8	1 & 2 & 3

Figure 25. TM:52 Results – Minimum Fresh Air Ventilation

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
-1/OP OFFICE01	100	3.7	24	4	1 & 2
-1/OP OFFICE02	100	1.8	18	3	2
0/OP OFFICE01	100	7	31	5	1 & 2 & 3
0/RECEPTION	100	5	25	5	1 & 2 & 3
1/OP OFFICE01	100	8.5	30	6	1 & 2 & 3
1/OP OFFICE02	100	7	32	5	1 & 2 & 3
2/OP OFFICE01	100	7.7	32	6	1 & 2 & 3
3/OP OFFICE01	100	1.8	18	3	2

Figure 26. TM:52 Results – Full Fresh Air Ventilation – 8ACH

Room Name	Occupied days (%)	Criteria 1 (%Hrs Top-Tmax>=1K)	Criteria 2 (Max. Daily Deg.Hrs)	Criteria 3 (Max. DeltaT)	Criteria failing
-1/OP OFFICE01	100	0	0	0	-
-1/OP OFFICE02	100	0	0	0	-
0/OP OFFICE01	100	0	0	0	-
0/RECEPTION	100	0	0	0	-
1/OP OFFICE01	100	0	0	0	-
1/OP OFFICE02	100	0	0	0	-
2/OP OFFICE01	100	0	0	0	-
3/OP OFFICE01	100	0	0	0	-

Figure 27. TM:52 Results – Active Cooling

The results demonstrate that overheating will occur when passive or mechanical ventilation systems, with no active cooling, are used within the TM:52 analysis. Although it may be seen above that the two areas met TM:52 for 8ACH.

The provision of an active cooling system will maintain acceptable comfort levels; hence no occupied spaces failed the TM52 analysis. Hence the tables above clearly demonstrate that active cooling is desired to maintain comfort levels.

10.5 Active Cooling

The nature of the office accommodation precludes the use of natural or mechanical means of ventilation only to cool the building to the required levels, where a comfort temperature of 23°C is sought to be maintained to provide a high-quality working environment. This is as demonstrated through the TM:52 overheating analysis.

For non-domestic buildings, the BRUKL output reports contain an 'HVAC Systems Performance' table comparing the cooling demand of the actual and notional buildings for different building elements.

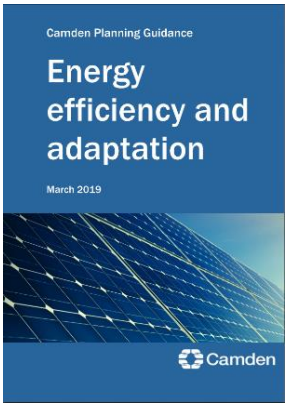
Table 12: Cooling Demand	Total area weighted non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	46.4	26,290
Notional	132.1	74,848
Reduction	85.7	48,558 65%

Figure 28. GLA Table 12 : Cooling Demand for Refurbished Building

The results indicated above for the office accommodation clearly demonstrates that the building design and use solar control film installed on the existing glass reduces the annual active cooling demand, the demand being reduced by 65% when compared to the notional building.

11.0 SUSTAINABILITY

This Camden Planning Guidance (CPG) on Energy Efficiency and Adaptation incorporates a checklist in Section 10 for 'sustainable design and construction measures'.



Whilst it is recognised this checklist is predominantly intended for new build and refurbishments of non-listed buildings the checklist has been reviewed against this project where applicable.

Cooling and Overheating are discussed in detail elsewhere within this document.

Item	Response
Energy demand reduction: building fabric (passive measures)	
Layout of uses	Open plan office space
Design of windows and openings	As existing
Floorplate size and depths and floor to ceiling heights	As existing, central ceiling services bulkhead to minimise extent of ceiling and maintain highest possible ceiling height.
Reducing internal heat gains	Insulation added to roof construction. Solar control film proposed for application to single glazed windows.
Reducing the need for artificial lighting	Removal of existing semi-opaque film to windows where applied. Lighting control on occupancy to be provided.
Limiting excessive solar gain	Solar control film proposed for application to single glazed windows.
Optimising natural ventilation	Openable windows provided including new rooflights and 3rd floor to help alleviate heat build up.
Passive cooling	Existing building / not applicable
Green infrastructure	Existing building / not applicable
Best practice levels of insulation	Existing building / no significant works to building fabric.
Draught proofing and air tightness	New front entrance door with effective draught proofing provided.
Thermal mass	Existing building has solid brick walls.
Thermal buffers	Existing building / not applicable
Consideration of renewable energy technology	Heat pumps used to heat building providing renewable energy system.
Energy demand reduction: Energy efficient services (active measures)	
Efficient ventilation	Building is predominantly naturally ventilated (except toilets and basement)
Efficient cooling	New highly efficient VRV heat pump providing comfort cooling proposed.
Efficient heating	New highly efficient VRV heat pump providing heating proposed.

Item	Response
Efficient lighting	New LED lighting and controls proposed
Zoning, controls and sensors	Heating and cooling arranged on a 'floor by floor' basis serving fan coils with own temperature controls.
Efficient appliances and equipment	Speculative Cat.A fit out with no kitchens as these will form part of Cat.B fit out by tenant.
Energy monitoring and building management systems	Manufacturers control system provided for VRV system with intelligent metering.
Metering	Incoming water and electrical supplies metered. Tenant check metering of lighting and power.
Energy generation	
Inclusion of low and zero carbon technologies	Heat pumps provide renewable energy in heating mode with sCOP of > 4.0.
Water conservation	
Efficient water use	Flow restrictors applied taps
Re-use of water	Limited water use / not applicable
Adaptation to climate change	
Sustainable urban drainage	Existing building / not applicable
Impact on microclimate	Existing building / not applicable
Measures to reduce overheating (cooling hierarchy)	Roof insulation and solar film to windows proposed.
Materials and resource conservation	
Recycling provision	Space allocated in bin store
Reuse and recycling of materials	Building retained and refurbished
Responsible sourcing	Green guide to specification to be used where applicable.
Nature conservation and biodiversity	
Green walls, roofs and landscaping	Basement light well to incorporate green wall.
Enhancement and creation of wildlife habitats	Basement light well to incorporate green wall.
Sustainable and active travel	
Bicycle storage	New cycle store created in basement
Low carbon vehicles	No parking available
Other	
Education and awareness raising	not applicable
On-going management and review	Building refurbishment positions accommodation for future office use.
Future use of the building and flexibility to change	Building refurbishment positions accommodation for future office use.

12.0 CONCLUSIONS

22 Endell Street was constructed in circa 1859 and is Grade II listed and situated within the Seven Dials (Covent Garden) Conservation Area. The building provides office accommodation with a GIA of 570m^2 and a NIA of circa 426m^2 over 5 storeys.

It is proposed to refurbish the premises to bring it up to date and as a consequence of the existing services reaching their end of life. A sympathetic approach is proposed which, for the most part, shall retain the existing fabric as it exists whilst only providing remedial maintenance.

The refurbishment includes fabric improvements in the form of additional insulation to the large area of roof exposed to the third-floor office. Also, windows are to be provided with a high-quality solar control film, neutral in colour, to reduce building cooling load.

The services refurbishment includes replacement of the mixture of small scale and VRV comfort cooling installations with modern energy efficient installations serving individual floors. The existing lighting is fluorescent and will be replaced with low energy LED lighting and controls.

The building will remain predominantly naturally ventilated as existing, with toilets/showers and basement mechanically ventilated.

As a consequence of these actions, the building will be well positioned for the next 20 years.

The improvements achieved by the refurbishment are summarised below.

Refurbished Building - Energy and Emissions Results Summary

- 57% reduction in regulated emissions as compared to the Existing Building
- 62% reduction in regulated energy consumption
- 18% reduction in regulated emissions via renewables (ASHP)
- An improved EPC of B40 compared to the existing D91 for building and E113 for the basement.

APPENDIX A

DESIGN CRITERIA / NCM DATA

EXISTING BUILDING – NCM Input Data

The Existing Building has a variety of individual spaces and each room's services criteria are applied based according to the nature of the space. The ApacheSIM model utilised, but is not limited to, the following NCM criteria:

Baseline Model – B1:Office – Office Areas

1. Primary Heating - VRV sCOP=2.5
2. Primary Cooling - VRV SEER=2.5, EER=3.2
3. Hot Water - POU Instantaneous Hot Water
4. Ventilation - Natural
5. Lighting - T5 – 37.5Lumens/Circuit Watt – Lighting Controls
6. Air Permeability - 25$m^3/h/m^2$ Standard (As per EPC Conventions)

Baseline Model – B1:Office – WC

1. Primary Heating - Electric Panel Radiators η=100%
2. Primary Cooling - None
3. Hot Water - POU Instantaneous Hot Water
4. Ventilation - Mechanical Extract SFP = 0.5W/l/s
5. Lighting - Compact Fluorescent - 22.5Lumens/Circuit Watt – Lighting Controls
6. Air Permeability - 25$m^3/h/m^2$ Standard (As per EPC Conventions)

Baseline Model – B1:Office – Circulation/Lobbies

1. Primary Heating - Electric Panel Radiators η=100%
2. Primary Cooling - None
3. Hot Water - POU Instantaneous Hot Water
4. Ventilation - Natural
5. Lighting - Compact Fluorescent - 22.5Lumens/Circuit Watt – Lighting Controls
6. Air Permeability - 25$m^3/h/m^2$ Standard (As per EPC Conventions)

Baseline Model – B1:Office – Plant

1. Primary Heating - None
2. Primary Cooling - None
3. Hot Water - 1,000l DHW Storage
4. Ventilation - Mechanical Extract Ventilation (where applicable)
5. Lighting - T8 – 27.5Lumens/Circuit Watt – No Lighting Controls
6. Air Permeability - 25$m^3/h/m^2$ Standard (As per EPC Conventions)

Baseline Model – B1:Office – Direct Hot Water

- POU Instantaneous Hot Water
- Factory Insulated

REFURBISHED BUILDING – NCM Input Data

The Refurbished Building has a variety of individual spaces and each room's services criteria are applied based according to the nature of the space. The ApacheSIM model utilised, but is not limited to, the following NCM criteria:

Baseline Model – B1:Office – Office (Open Plan)

1. Primary Heating - Split or Multi Split H-VRV System – CoP = 4.0
2. Primary Cooling - Split or Multi Split H-VRV System – EER = 4.0, SEER = 4.5
3. Hot Water - Instantaneous POU Electric Water Heater
4. Ventilation - Natural Ventilation
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Off Control
6. Air Permeability - 25m^3/h/m^2 Standard (As per EPC Conventions)

Baseline Model – B1:Office – Reception

1. Primary Heating - Split or Multi Split H-VRV System – CoP = 4.0
2. Primary Cooling - Split or Multi Split H-VRV System – EER = 4.0, SEER = 4.5
3. Hot Water - Instantaneous POU Electric Water Heater
4. Ventilation - Natural Ventilation
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Off Control
6. Air Permeability - 25m^3/h/m^2 Standard (As per EPC Conventions)

Baseline Model – B1:Office – WC/Shower/Changing Rooms

1. Primary Heating - Electric Panel Heater
2. Primary Cooling - None
3. Hot Water - Instantaneous POU Electric Water Heater/Electric Shower
4. Ventilation - Mechanical Extract Ventilation SFP = 0.5 W/l/s
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Off Control
6. Air Permeability - 25m^3/h/m^2 Standard (As per EPC Conventions)
7.

Baseline Model – B1:Office – Circulation/Lobbies

1. Primary Heating - Electric Panel Heater
2. Primary Cooling - None
3. Hot Water - Instantaneous POU Electric Water Heater
4. Ventilation - Natural Ventilation
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Dimming Control
6. Air Permeability - 25m^3/h/m^2 Standard (As per EPC Conventions)

Baseline Model – B1:Office – Stores/Cycle Store/Bin Sore

1. Primary Heating - Electric Panel Heater
2. Primary Cooling - None
3. Hot Water - Instantaneous POU Electric Water Heater
4. Ventilation - Mechanical Extract Ventilation SFP = 0.5 W/l/s
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Off Control

6. Air Permeability - 25m³/h/m² Standard (As per EPC Conventions)

Baseline Model – B1:Office – Plant

1. Primary Heating - None
2. Primary Cooling - None
3. Hot Water - Instantaneous POU Electric Water Heater
4. Ventilation - Mechanical Extract Ventilation (where applicable)
5. Lighting - LED – 80 Lumens/Circuit Watt – Auto On/Off Control
6. Air Permeability - 25m³/h/m² Standard (As per EPC Conventions)

Baseline Model – B1:Office – Direct Hot Water

- Instantaneous POU Electric Water Heater
- Factory Insulated

APPENDIX B – BRUKL/EPC

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

AS EXISTING BASELINE

As built

Date: Thu May 28 10:50:29 2020

Administrative information

Building Details

Address: 22 ENDELL STREET, LONDON,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Mark John Glover

Telephone number: 01883 331630

Address: Hillside House. 204B Godstone Road, caterham, CR3 6RD

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, $kgCO_2/m^2.annum$	19.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	50.8
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	2.18	2.18	1P000000:Surf[2]
Floor	0.25	0.71	0.71	1L000000:Surf[0]
Roof	0.25	2.02	2.02	3P000003:Surf[0]
Windows***, roof windows, and rooflights	2.2	5.23	5.56	1P000000:Surf[3]
Personnel doors	2.2	2.2	2.2	1P000000:Surf[1]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	25

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- 1. EXISTING VRF

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.5	3.2	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- 2. WC ELEC MEV

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- 9. POU DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
-1/OFFICE01	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OFFICE02	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OP OFFICE	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/TEA ROOM	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
0/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
3/WC	-	-	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
-1/LIFT	-	23	-	41
-1/OFFICE01	38	-	-	179
-1/OFFICE02	38	-	-	184
-1/OP OFFICE	38	-	-	818
-1/RISER	23	-	-	68
-1/STAIR	-	23	-	94
-1/STAIR LOBBY	-	23	-	62
-1/TEA ROOM	23	-	-	819
-1/WC	-	23	-	98
0/ENTRANCE	-	38	-	60
0/LIFT	-	23	-	45
0/OFFICE01	38	-	-	186
0/OP OFFICE01	38	-	-	597
0/OP OFFICE02	38	-	-	438
0/OP OFFICE03	38	-	-	417
0/RISER	23	-	-	68
0/SPIRAL STAIR	-	23	-	61
0/STAIR	-	23	-	99
0/WC	-	23	-	107
1/LIFT	-	23	-	45
1/LIFT	-	23	-	45
1/OP OFFICE01	38	-	-	282
1/OP OFFICE01	38	-	-	925
1/OP OFFICE02	38	-	-	243
1/OP OFFICE02	38	-	-	1192
1/OP OFFICE03	38	-	-	272
1/OP OFFICE03	38	-	-	261
1/OP OFFICE04	38	-	-	359
1/RISER	23	-	-	68
1/RISER	23	-	-	68
1/SPIRAL STAIR	-	23	-	34
1/SPIRAL STAIR	-	23	-	34
1/STAIR	-	23	-	99
1/STAIR	-	23	-	99
1/WC	-	23	-	107
1/WC	-	23	-	107
3/LIFT	-	23	-	38
3/RISER	23	-	-	68
3/SPIRAL STAIR	-	23	-	33
3/STAIR	-	23	-	103
3/WC	-	23	-	113
3/OP OFFICE	38	-	-	1587

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
-1/SPIRAL STAIR	-	23	-	56

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
-1/OFFICE01	N/A	N/A
-1/OFFICE02	N/A	N/A
-1/OP OFFICE	YES (+150.9%)	NO
-1/TEA ROOM	YES (+124.8%)	NO
0/OFFICE01	N/A	N/A
0/OP OFFICE01	YES (+5.9%)	NO
0/OP OFFICE02	YES (+5.6%)	NO
0/OP OFFICE03	NO (-21%)	NO
1/OP OFFICE01	N/A	N/A
1/OP OFFICE01	YES (+19.3%)	NO
1/OP OFFICE02	N/A	N/A
1/OP OFFICE02	YES (+31.7%)	NO
1/OP OFFICE03	YES (+17.5%)	NO
1/OP OFFICE03	YES (+6.1%)	NO
1/OP OFFICE04	YES (+37.4%)	NO
3/OP OFFICE	YES (+23.9%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	566.6	566.6
External area [m^2]	647.6	647.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	1540.91	311.46
Average U-value [W/m^2K]	2.38	0.48
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	47.41	5
Cooling	11.34	8.09
Auxiliary	0.26	0.24
Lighting	36.62	22.88
Hot water	2.32	2.55
Equipment*	38.44	38.44
TOTAL**	**97.95**	**38.76**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	460.41	155.67
Primary energy* [kWh/m^2]	440.91	125.52
Total emissions [kg/m^2]	50.8	19.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	477.2	90.3	56.9	14.1	0.3	2.33	1.78	2.5	2.5
	Notional	55.9	137.6	6.1	10.1	0.2	2.56	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	174.9	0	60.7	0	1.4	0.8	0	1	0
	Notional	14.3	0	4.6	0	1.6	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	2.18	1P000000:Surf[2]
Floor	0.2	0.71	1L000000:Surf[0]
Roof	0.15	2.02	3P000003:Surf[0]
Windows, roof windows, and rooflights	1.5	3.62	0P000000:Surf[0]
Personnel doors	1.5	2.2	1P000000:Surf[1]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	25

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

REFURBISHED LTHW

As built

Date: Mon Jun 01 11:45:56 2020

Administrative information

Building Details

Address: REFURBISHED BUILDING, LONDON, WC2H 9AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Mark John Glover

Telephone number: 01883 331630

Address: Hillside House. 204B Godstone Road, Caterham, CR3 6RD

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, $kgCO_2/m^2.annum$	19.3
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.3
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	31.3
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.42	2.18	1S000005:Surf[1]
Floor	0.25	0.44	0.71	1L000000:Surf[0]
Roof	0.25	0.67	0.67	3P000003:Surf[0]
Windows***, roof windows, and rooflights	2.2	5.56	5.56	1P000000:Surf[2]
Personnel doors	2.2	2.2	2.2	1P000000:Surf[0]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	25

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- 2. WC ELEC MEV

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- 1.NEW VRF

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	4.5	0	0	-
Standard value	0.91*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- 9. POU DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
-1/CYCLE STORE	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OP OFFICE01	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OP OFFICE02	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
0/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
2/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
3/WC	-	-	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
-1/CYCLE STORE	80	-	-	98
-1/LIFT	-	80	-	12
-1/NEW SHOWER	-	80	-	31
-1/OP OFFICE01	80	-	-	413
-1/OP OFFICE02	80	-	-	230
-1/RISER	80	-	-	19
-1/STAIR	-	80	-	27
-1/STAIR LOBBY	-	80	-	18
-1/WC	-	80	-	28
0/LIFT	-	80	-	13
0/OP OFFICE01	80	-	-	516
0/RECEPTION	80	-	-	259
0/RISER	80	-	-	19
0/STAIR	-	80	-	28
0/WC	-	80	-	30
1/LIFT	-	80	-	13
1/LIFT	-	80	-	13
1/OP OFFICE01	80	-	-	259
1/OP OFFICE01	80	-	-	753
1/OP OFFICE02	80	-	-	516
1/RISER	80	-	-	19
1/RISER	80	-	-	19
1/STAIR	-	80	-	28
1/STAIR	-	80	-	28
1/WC	-	80	-	30
2/WC	-	80	-	30
3/LIFT	-	80	-	11
3/OP OFFICE01	80	-	-	754
3/RISER	80	-	-	19
3/STAIR	-	80	-	29
3/WC	-	80	-	32

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
-1/CYCLE STORE	NO (-33.7%)	NO
-1/OP OFFICE01	NO (-64.2%)	NO
-1/OP OFFICE02	NO (-40%)	NO
0/OP OFFICE01	NO (-40.2%)	NO
0/RECEPTION	NO (-59.1%)	NO
1/OP OFFICE01	NO (-29.2%)	NO
1/OP OFFICE01	NO (-28.8%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1/OP OFFICE02	NO (-36%)	NO
3/OP OFFICE01	NO (-31.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	566.6	566.6
External area [m^2]	647.6	647.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	874.55	311.11
Average U-value [W/m^2K]	1.35	0.48
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	99.1	15.4
Cooling	3.22	7.88
Auxiliary	0.26	0.26
Lighting	9.82	21.49
Hot water	2.41	2.65
Equipment*	39.64	39.64
TOTAL**	**114.8**	**47.68**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	351.96	155.27
Primary energy* [kWh/m^2]	180.06	110.29
Total emissions [kg/m^2]	31.3	19.3

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	365.9	42.3	113.9	3.9	0.2	0.89	2.99	0.91	4
	Notional	55.2	131.3	17.8	9.6	0.2	0.86	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	342.4	0	112.9	0	1.3	0.84	0	1	0
	Notional	49.8	0	16.1	0	1.5	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	1P000000:Surf[1]
Floor	0.2	0.22	1P000000:Surf[5]
Roof	0.15	0.67	3P000003:Surf[0]
Windows, roof windows, and rooflights	1.5	5.56	1P000000:Surf[2]
Personnel doors	1.5	2.2	1P000000:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	25

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

REFURBISHED

As built

Date: Mon Jun 01 11:41:09 2020

Administrative information

Building Details

Address: REFURBISHED BUILDING, LONDON, WC2H 9AG

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.12

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.12

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Mark John Glover

Telephone number: 01883 331630

Address: Hillside House. 204B Godstone Road, Caterham, CR3 6RD

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, $kgCO_2/m^2.annum$	18.6
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	18.6
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	22.2
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	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.42	2.18	1S000005:Surf[1]
Floor	0.25	0.44	0.71	1L000000:Surf[0]
Roof	0.25	0.67	0.67	3P000003:Surf[0]
Windows***, roof windows, and rooflights	2.2	5.56	5.56	1P000000:Surf[2]
Personnel doors	2.2	2.2	2.2	1P000000:Surf[0]
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

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* 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	25

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- 2. WC ELEC MEV

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	0.2	0	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- 1.NEW VRF

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4	4.5	0	0	-
Standard value	2.5*	3.2	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

1- 9. POU DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
-1/CYCLE STORE	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OP OFFICE01	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/OP OFFICE02	-	-	0.5	-	-	-	-	-	-	-	N/A
-1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
0/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
1/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
2/WC	-	-	0.5	-	-	-	-	-	-	-	N/A
3/WC	-	-	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
-1/CYCLE STORE	80	-	-	98
-1/LIFT	-	80	-	12
-1/NEW SHOWER	-	80	-	31
-1/OP OFFICE01	80	-	-	413
-1/OP OFFICE02	80	-	-	230
-1/RISER	80	-	-	19
-1/STAIR	-	80	-	27
-1/STAIR LOBBY	-	80	-	18
-1/WC	-	80	-	28
0/LIFT	-	80	-	13
0/OP OFFICE01	80	-	-	516
0/RECEPTION	80	-	-	259
0/RISER	80	-	-	19
0/STAIR	-	80	-	28
0/WC	-	80	-	30
1/LIFT	-	80	-	13
1/LIFT	-	80	-	13
1/OP OFFICE01	80	-	-	259
1/OP OFFICE01	80	-	-	753
1/OP OFFICE02	80	-	-	516
1/RISER	80	-	-	19
1/RISER	80	-	-	19
1/STAIR	-	80	-	28
1/STAIR	-	80	-	28
1/WC	-	80	-	30
2/WC	-	80	-	30
3/LIFT	-	80	-	11
3/OP OFFICE01	80	-	-	754
3/RISER	80	-	-	19
3/STAIR	-	80	-	29
3/WC	-	80	-	32

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
-1/CYCLE STORE	NO (-33.7%)	NO
-1/OP OFFICE01	NO (-64.2%)	NO
-1/OP OFFICE02	NO (-40%)	NO
0/OP OFFICE01	NO (-40.2%)	NO
0/RECEPTION	NO (-59.1%)	NO
1/OP OFFICE01	NO (-29.2%)	NO
1/OP OFFICE01	NO (-28.8%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
1/OP OFFICE02	NO (-36%)	NO
3/OP OFFICE01	NO (-31.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	566.6	566.6
External area [m^2]	647.6	647.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	25	3
Average conductance [W/K]	874.55	311.11
Average U-value [W/m^2K]	1.35	0.48
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	27.11	5.75
Cooling	3.22	7.88
Auxiliary	0.26	0.26
Lighting	9.82	21.49
Hot water	2.41	2.65
Equipment*	39.64	39.64
TOTAL**	**42.82**	**38.02**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	351.96	155.27
Primary energy* [kWh/m^2]	196.54	121.9
Total emissions [kg/m^2]	22.2	18.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	365.9	42.3	25.9	3.9	0.2	3.92	2.99	4	4
	Notional	55.2	131.3	6	9.6	0.2	2.56	3.79	----	----
[ST] Other local room heater - unfanned, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity										
	Actual	342.4	0	112.9	0	1.3	0.84	0	1	0
	Notional	49.8	0	16.1	0	1.5	0.86	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.26	1P000000:Surf[1]
Floor	0.2	0.22	1P000000:Surf[5]
Roof	0.15	0.67	3P000003:Surf[0]
Windows, roof windows, and rooflights	1.5	5.56	1P000000:Surf[2]
Personnel doors	1.5	2.2	1P000000:Surf[0]
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	25

Energy Performance Certificate

Non-Domestic Building

HM Government

AS EXISTING EPC
22 ENDELL STREET
LONDON
WC2H 9AG

Certificate Reference Number:
0000-0040-0030-9000-0803

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government's website at www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Asset Rating

More energy efficient

A+

Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

91 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Grid Supplied Electricity
Building environment:	Air Conditioning
Total useful floor area (m^2):	566.643
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$ per year):	50.84
Primary energy use (kWh/m^2 per year):	440.91

Benchmarks

Buildings similar to this one could have ratings as follows:

34 If newly built

91 If typical of the existing stock

Administrative information

This is an Energy Performance Certificate as defined in the Energy Performance of Buildings Regulations 2012 as amended.

Assessment Software:	Virtual Environment v7.0.12 using calculation engine ApacheSim v7.0.12
Property Reference:	000000000000
Assessor Name:	Mark John Glover
Assessor Number:	LCEA099758
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	Flatt Ltd
Employer/Trading Address:	Hillside House, 204B Godstone Road, Caterham, Surrey. CR3 6RD
Issue Date:	28 May 2020
Valid Until:	27 May 2030 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report: 0040-0000-0408-0900-0004

About this document and the data in it

This document has been produced following an energy assessment undertaken by a qualified Energy Assessor, accredited by CIBSE Certification Limited. You can obtain contact details of the Accreditation Scheme at www.cibsecertification.com.

A copy of this certificate has been lodged on a national register as a requirement under the Energy Performance of Buildings Regulations 2012 as amended. It will be made available via the online search function at www.ndepcregister.com. The certificate (including the building address) and other data about the building collected during the energy assessment but not shown on the certificate, for instance heating system data, will be made publicly available at www.opendatacommunities.org.

This certificate and other data about the building may be shared with other bodies (including government departments and enforcement agencies) for research, statistical and enforcement purposes. For further information about how data about the property are used, please visit www.ndepcregister.com. To opt out of having information about your building made publicly available, please visit www.ndepcregister.com/optout.

There is more information in the guidance document *Energy Performance Certificates for the construction, sale and let of non-dwellings* available on the Government website at: www.gov.uk/government/collections/energy-performance-certificates. It explains the content and use of this document and advises on how to identify the authenticity of a certificate and how to make a complaint.

Opportunity to benefit from a Green Deal on this property

The Green Deal can help you cut your energy bills by making energy efficiency improvements at no upfront costs. Use the Green Deal to find trusted advisors who will come to your property, recommend measures that are right for you and help you access a range of accredited installers. Responsibility for repayments stays with the property - whoever pays the energy bills benefits so they are responsible for the payments.

To find out how you could use Green Deal finance to improve your property please call 0300 123 1234.

Energy Performance Certificate

Non-Domestic Building

HM Government

REFURBISHED BUILDING
22 ENDELL STREET
LONDON
WC2H 9AG

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0000-0040-0030-9000-0803

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Assessor Number:	LCEA099758
Accreditation Scheme:	CIBSE Certification Limited
Employer/Trading Name:	Flatt Ltd
Employer/Trading Address:	Hillside House, 204B Godstone Road, Caterham, Surrey. CR36RD
Issue Date:	01 Jun 2020
Valid Until:	31 May 2030 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the energy performance of the building are contained in the associated Recommendation Report: 0040-0000-0408-0900-0004

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