PADDINGTON GREEN

POLICE STATION

JANUARY 2023

Energy Statement

Energy Statement – January 2023 – GLA0711

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Berkeley

Designed for life

BURO HAPPOLD

Paddington Green Police Station

Energy Statement

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Glossary

Term	Definition
ASHP	Air Source Heat Pump
CHP	Combined Heat and Power. This is defined as the simultaneous generation of heat and power in a single process.
DFEE	Dwelling Fabric Energy Efficiency
BER	Building Emissions Rate (predicted emissions from the proposed building) for Part L
BRUKL	Building Regulations UK Part L
DHN	District Heat Network
DHW	Domestic Hot Water
GLA	Greater London Authority
LETI	Low Energy Transformation Initiative
LTHW	Low Temperature Hot Water
LZC	Low and Zero Carbon technologies
NCM	National Calculation Methodology (for Part L2 Building Regulation Compliance)
PGPS	Paddington Green Police Station
Regulated CO_2 emissions	The CO_2 emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.
SAP	Standard Assessment Procedure (for Part L1 Building Regulation Compliance)
TER	Target Emissions Rate for Part L
TFEE	Target Fabric Energy Efficiency
UKGBC	UK Green Building Council
Unregulated CO_2 Emissions	The CO_2 emissions arising from energy used by non-fixed building services such as those relating to cooking, all electrical appliances and other small power.
WCC	Westminster City Council

1 Executive Summary

This Energy Strategy report has been compiled by Buro Happold on behalf of the Applicant to support the Full Planning Application (FPA) of Paddington Green Police Station (PGPS) scheme at 4 Harrow Road, London, W2 (the Site). The redevelopment of the strategic site aims to provide high quality retail, and residential uses, with an exemplary public realm around the perimeter of the site.

The proposal has been assessed using the relevant Building Regulation methodology, in order to estimate the carbon dioxide emissions associated with each aspect of the development. The energy modelling has been used to demonstrate the carbon dioxide emissions reduction achieved through application of the energy hierarchy in comparison to a Part L of the Building Regulations 2021 Baseline building.

A low-carbon strategy has been implemented across the development. This includes highly insulated and airtight building fabric, energy efficient MEP systems and the provision of renewable sources such as ASHPs and PVs. The energy and emissions reduction strategy are described in more detail throughout this report and shall be adhered to in order to achieve the current performance.

Through the application of the energy hierarchy, the development achieves on-site sitewide carbon dioxide emissions reduction of **67%** below the Building Regulations 2021 TER (ASHP heating system). This is a significant reduction considering the stringent NCM and SAP methodologies (2022) for assessing new schemes under Part L 2021.

The total carbon emissions for the development incorporating the GLA energy hierarchy are given in Table 1—1. A total one-off carbon off-set payment of **£470,302** is required to achieve the "Zero Carbon" target.

Table 1—1 Predicted Site wide carbon dioxide emissions and savings after each stage of the Energy Hierarchy (Part L 2021)

Part L 2021	Total regulated emissions (Tonnes CO_2/year)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2021 Baseline	502.7	-	-
Be Lean: savings from energy demand reduction	408.7	93.9	19%
Be Clean: savings from heat network	408.7	0	0%
Be Green: savings from renewable energy	165.0	243.7	48%
Cumulative on-site savings	-	**337.6**	**67%**
		CO_2 savings off-set (Tonnes CO_2)	**CO_2 off-set payment (£)**
Total site wide off-set	-	**4,950.5**	**470,302**

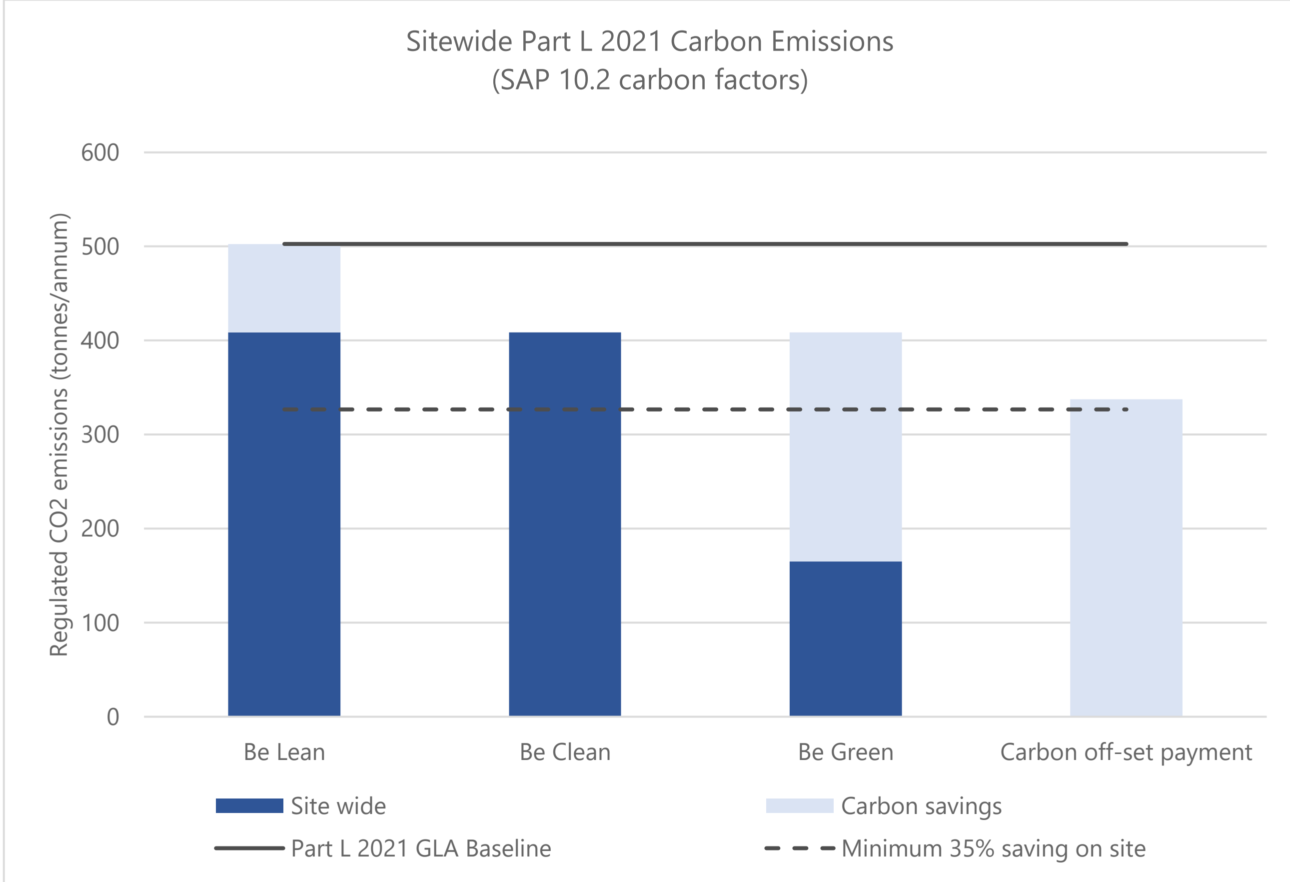


Figure 1-1 PGPS Site Wide Carbon Savings throughout the energy hierarchy (Part L 2021)

1.1 'Be Seen'

Following the 'Be Seen' Energy Monitoring Guidance (October 2020), and as per GLA monitoring requirement stated in Policy SI2 of the London Plan, the Applicant will demonstrate a commitment to monitor, verify and report on the energy performance post-construction of the PGPS scheme.

The methodology used for reporting the energy consumption (kWh/yr) and carbon emissions (tonnes CO_2/yr) estimates follows the CIBSE TM54 recommendations on regulated and unregulated loads. Advanced dynamic thermal modelling simulations were carried out to estimate the space heating, cooling, ventilation and fan power demand, alongside overall best practice benchmarks based on CIBSE Guide F to estimate the additional energy use for the scheme (e.g., IT loads, lighting and lifts). For residential areas, SAP calculations were considered for the purpose of Be Seen compliance. As the technical design progresses, the energy prediction for the scheme will be estimated based on further dynamic simulation model and energy metering aspirations.

The energy consumption and carbon emissions estimations for the development, based on both regulated and unregulated energy, are described in Table 1-2 and Table 1-3.

Table 1—2 Estimated Energy Demand and Carbon Emissions (Residential)

Performance Indicator Group	Indicator	Unit	Part L1/SAP
Building Energy Use	Grid electricity	kWh/year	1,386,207
	Energy generation	kWh/year	61,057
Carbon Emissions	Predicted annual carbon emissions	tCO_2/year	153.36

Table 1—3 Estimated Energy Demand and Carbon Emissions (Commercial)

Performance Indicator Group	Indicator	Unit	Part L2 Calculations	CIBSE TM54/F Calculations
Building Energy Use	Grid electricity	kWh/year	86,700	906,000
	Energy generation	kWh/year	-	-
Carbon Emissions	Predicted annual carbon emissions	tCO_2/year	9.2	122

2 Introduction

This Energy Statement had been prepared by Buro Happold on behalf of Berkeley Homes ('the Applicant') in support of a full planning application for PGPS ('the Site') within the Westminster City Council ('WCC'). The redevelopment of the strategic site aims to provide exemplary new high-quality retail, restaurants, and residential uses, with a significant public realm around the perimeter of the site.

2.1 Development Description

The description of the proposed development is as follows:

"Demolition of the existing building and redevelopment of the site to provide three buildings of 39, 24 and 17 storeys in height, providing residential units (including affordable units)(Class C3), commercial uses (Class E), a community use (Class F.2), landscaping, tree and other planting, public realm improvements throughout the site including new pedestrian and cycle links, provision of public art and play space, basement level excavation to provide associated plant, servicing, disabled car parking and cycle parking and connection through to the basement of the neighbouring West End Gate development."

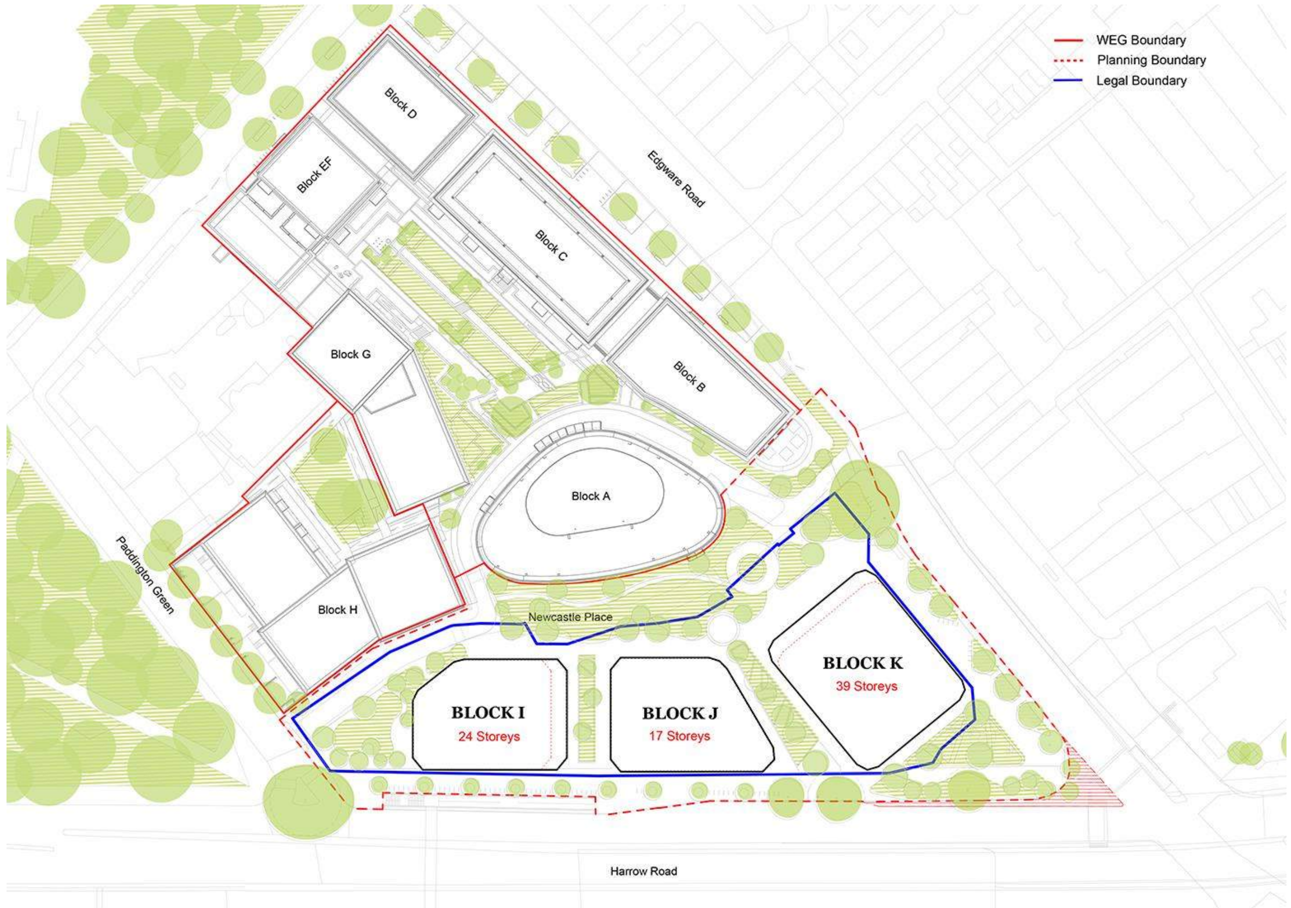


Figure 2-1 Location Plan of PGPS (planning boundary in red)

2.2 Area schedule

For the purposes of the Energy Strategy, all typologies included within the application have been modelled using detailed energy modelling software. The non-domestic has been modelled using the VE Compliance module of the Dynamic Simulation Modelling software IES Virtual Environment 2022, and the domestic areas have been assessed using approved software FSAP (Stroma) following SAP 10.2 methodology.

Table 2-1 outlines the area schedule used to produce both estimated energy demand figures and carbon emissions.

Table 2—1 Area Schedule

Typology	NIA (m^2)	GIA (m^2)	GIA (ft^2)
Residential	43,024	59,068	635,799
Commercial/Community Space	1,122	1,212	13,045
Other - Circulation & Basement	-	5,494	59,137
Total	**44,146**	**65,774**	**707,981**

The purpose of this Energy Statement is to describe the energy objectives and deliverables for the design, construction and operation of the project, including the legislative requirements for the site.

3 Policy

3.1 Overview

This policy section outlines some of the key national, strategic and local policy frameworks relating to energy and carbon.

Strategic planning in London is a shared responsibility of the Mayor of London, London Boroughs and the City of London Corporation. The London Plan is the spatial development strategy for London, produced by the Greater London Authority (GLA) on behalf of the Mayor of London. Every London City Council Local Plan must be in general conformity with the London Plan. The Site is located in the City of Westminster and as such any development proposal will be determined against the Westminster City Plan 2019-2040 (April 2021) and the London Plan, and other relevant material considerations, such as Westminster Environmental Supplementary Planning Document (ESPD, 2022).

Figure 3-1 - Summary of planning policy framework of the GLA and Local Policy

3.2 National Energy Policy and Guidance

3.2.1 The United Nations Paris Climate Agreement

The Paris Agreement is a major international climate action agreement to which the UK is signatory. The 196 countries under the agreement have committed to limit global warming to 2°C over pre-industrial levels and aim to safely adapt to any consequences of climate change. The UK ratified this in 2016.

While countries may set their own policies and targets (NDCs), these are assessed as to their level of ambition and to their progressive approach and must be tracked and published. The UK currently falls under NDCs produced collectively with the European Union. These commit to at least a 40% domestic reduction in GHG emissions by 2030 compared to 1990 (CAIT), including energy consumption and industrial processes. Though this calculation may change in light of Brexit, the UK will remain signatory to the Paris Agreement, with its NDC revised.

3.2.2 The National Planning Policy Framework, NPPF

The NPPF consolidates previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG). The NPPF sets out an expectation that local plans will include a positive strategy for use and supply of renewable and low carbon energy sources.

Within the NPPF's planning guidance relating to energy is set out in section 14 – "meeting the challenge of climate change, flooding and coastal change".

3.2.3 Climate Change Act

The Climate Change Act 2008 established a legally binding target to reduce the UK's greenhouse gas emissions by at least 80% below 1990 levels by 2050. To drive progress and set the UK on a pathway towards this target, the Act introduced a system of carbon budgets which provide legally binding limits on the emissions that may be produced in successive five-year periods, beginning in 2008.

The first three carbon budgets were set in law in May 2009 and require emissions to be reduced by at least 34% below base year levels in 2020. The fourth carbon budget, covering the period 2023–27, was set in law in June 2011 and requires emissions to be reduced by 50% below 1990 levels. The fifth carbon came into force in July 2016, limiting the budget for 2028–2032 of is 1,725 mega tonnes of carbon dioxide equivalent. This correlates to the reduction of 57% in greenhouse gas emissions compared to 1990 levels.

3.2.4 UK decarbonisation context

The UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. The target will require the UK to bring all greenhouse gas emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels.

3.2.4.1 Electricity grid decarbonisation

The carbon intensity of electricity in the UK has been reducing from 0.519 kg CO_2/ kWh to 0.136 kg CO_2/ kWh as per SAP methodologies 2012 and SAP 10.2. This is due to the closure of coal fired power stations and the increase in renewable energy. As a result, electricity is becoming a more feasible lower carbon fuel source compared to traditional gas combustion. This is also resulting in Gas fired CHP engines not providing the long-term carbon savings shown previously and going forward will be a high carbon technology based on Part L. These changes result in a difference in Part L carbon reductions shown by recent developments and for new ones coming forward now.

London Plan Policy is looking to push towards the future of low carbon heating, with the application of heat pumps, and therefore the GLA ask for the SAP 10.2 carbon factors to be used as these provide the most accurate representation of the latest carbon intensity of the grid.

3.2.5 Policy and Building Regulations Changes

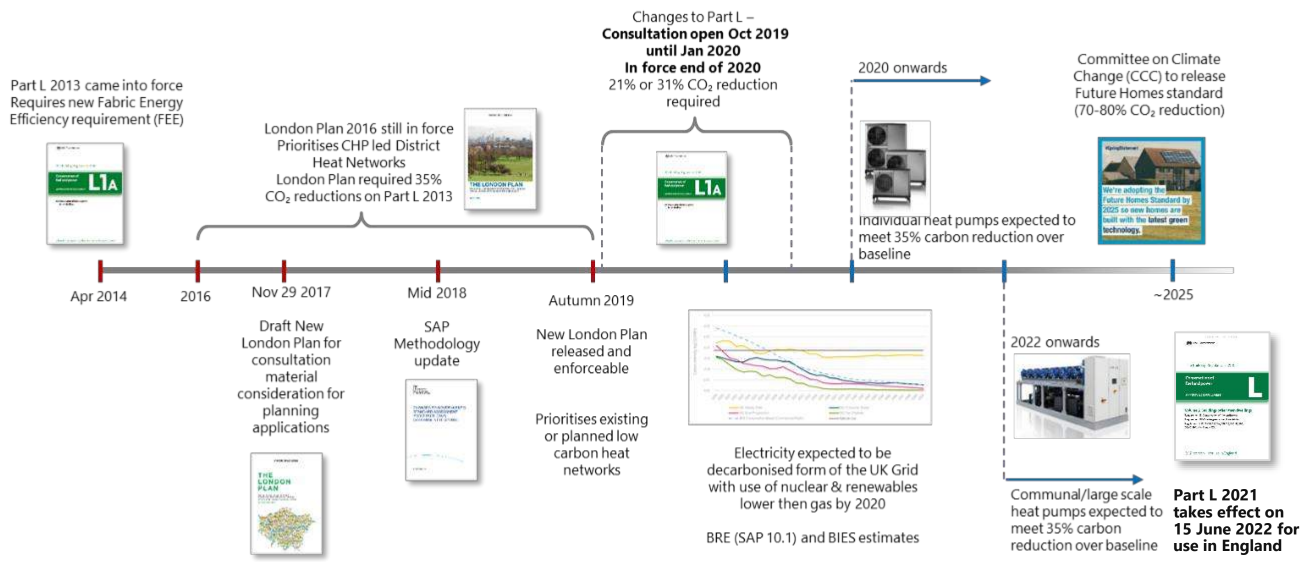


Figure 3-2 - UK Past and future UK carbon regulations

Figure 3-2 shows the changing policy and regulatory landscape since 2014. It was outlined by BEIS that district heat networks (DHN), heat pumps and electric heating, along with improved fabric will meet these future emissions reductions targets. The consultation report stated:

> "*2.9 The CCC stated in its report Net Zero: The UK's contribution to stopping global warming that achieving the net zero target will require the full decarbonisation of buildings by 2050. There are a number of existing low carbon heating technologies with the potential to support the scale of change needed. We anticipate that low carbon heating may be delivered through heat pumps, heat networks and in some circumstance's direct electric heating.*"

With the release of Part L 2013 and shortly after the London Plan 2016, many developments were locked into long term, high carbon solution with CHP, with priorities set to District Heat Networks connections.

As developments in design now come forward, they would be expected to be registered under a future set of regulations, i.e., in the early to mid-2020s. As a result, changes will be required to the baseline energy strategy to ensure future proofing.

The Building Regulations Part L governs the conservation of fuel and power in both new construction and refurbishment of England building stock. Compliance with Building Regulations is a regulatory requirement for all new developments. Carbon emissions of a development comparative to compliance with Part L is the key performance indicator for many carbon targets, including those set out in the London Plan.

The current version of the Approved Document Part L1 for domestic buildings and Part L2 for non-domestic buildings were published in December 2021, taking effect buy the 15 June 2022 and are referred to as Part L 2021. The Part L procedure uses SBEM or other software tool approved under the Notice of Approval, to assess the energy performance of buildings.

3.3 Regional Policy: London Plan

The Mayor of London formally adopted the London Plan on March 4th 2021. This new London Plan forms part of the development plan, against which development proposals in London are assessed against.

Policies surrounding energy and carbon are summarised as follows.

Policy SI2 Minimising greenhouse gas emissions

Major development should be net zero carbon. This means reducing greenhouse gas emissions in operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

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

A minimum on-site reduction of at least 35% from Building Regulations is required for major developments. Schemes should also achieve **10%** for residential elements and **15%** for non-domestic elements through energy efficiency ("Lean") measures alone.

The GLA requires the zero-carbon target to be achieved with a minimum 35% savings on-site, beyond the notional Part L 2021 baseline. The remaining carbon emissions (typically 65%) are offset through a cash in lieu payment to Westminster City Council in this instance. The money is used to fund carbon reduction projects in WCC boundary. This payment must account for 30 years of carbon emissions at a fixed rate of cost and carbon intensity.

Policy SI3 Energy infrastructure

Major development proposals within Heat Network Priority Areas should have a communal low temperature heating system

1) the heat source for the **communal heating system should be selected in accordance** with the following heating hierarchy:
   a. connect to local existing or planned heat networks
   b. use available zero-emission or local secondary heat sources (in conjunction with heat pump, if required,
   c. use low emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network)
   d. use ultra-low NOx gas boilers
5) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy SI1 (A)
6) where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI4 Managing heat risk

Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.

3.1.1 3.3.1 Resulting Energy and Carbon Approach

Zero carbon implies that the target for new developments is to reduce carbon dioxide emissions down to zero. This requires at least 35% reduction in regulated carbon dioxide emissions (using SAP 10.2) to be achieved on-site; the remaining regulated carbon dioxide emissions – to 100% – are to be offset off-site, see the following Figure as per the London Plan.

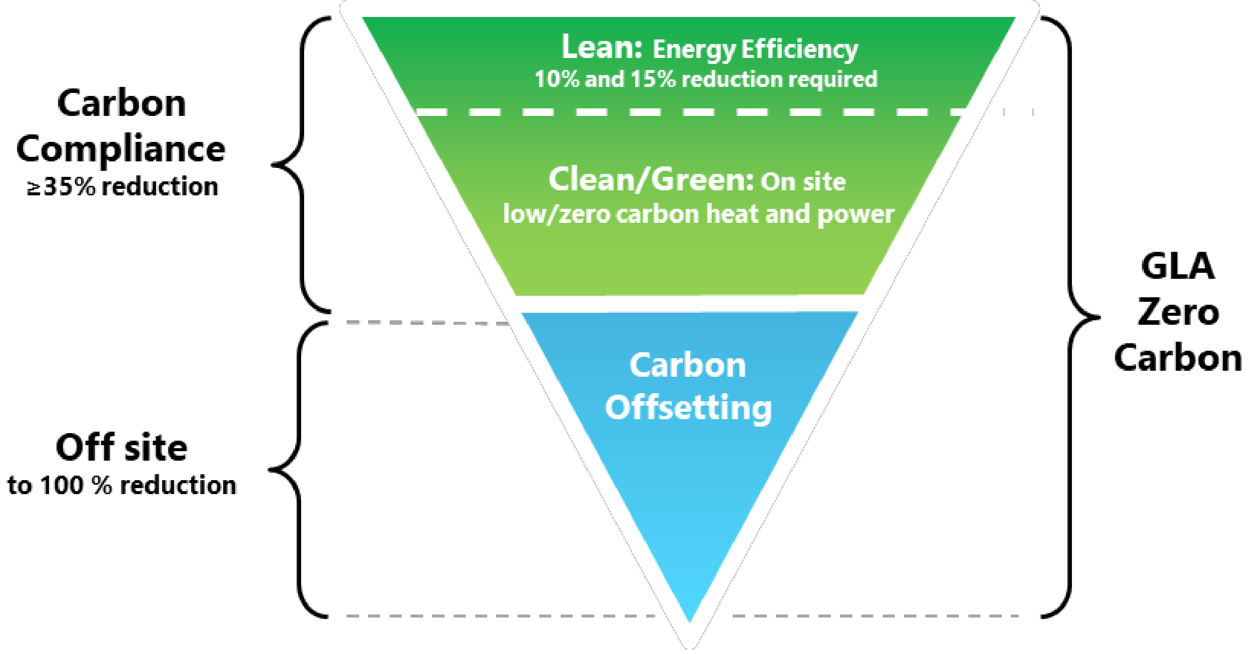


Figure 3-3 Zero carbon requirements

The London Plan **Policy SI2** shows that the GLA are concentrating on a truly **fabric first approach**, meaning they will expect to see how the fabric specification has been challenged as much as possible.

On-site regulated carbon dioxide emissions are to be reduced by means of a combination of measures, following the structure outlined in the GLA Energy Hierarchy:

- Be Lean: reduce energy demand by improving the building's fabric efficiency and ventilation system, and reducing lighting consumption to meet the 10% (Domestic) and 15% (Non-Domestic) reduction required;
- Be Clean: exploit local energy resources where feasible and supply energy efficiently; and
- Be Green: install and use power generated by renewable energy sources on-site.
- In line with the GLA Guidance (Policy SI3, 9.3.8), renewable energy sources are to be installed regardless of whether the on-site 35% reduction target has been already achieved with the previous steps of the Energy Hierarchy. An exception can be made in cases where it can be demonstrated that renewable technologies are not technically feasible or economically viable for the considered development.
- Off-site carbon offsetting can be achieved through two main strategies:
  - Investing in existing local properties in the area, improving energy efficiency or installing renewable energy in order to generate an equivalent carbon reduction
  - Cash in lieu payment to the WCC

3.4 Local Policy – Westminster City Plan 2019-2040

The Westminster City Plan 2019-2040 (April 2021) outlines the strategic ambitions of the wider Westminster area. The Local Plan sets out goals across all elements of the sustainability and energy spectrum. These policies are in alignment with the London Plan.

In summary requirements relating to energy and carbon include the following:

Policy 36A Energy - The council will promote zero carbon development and expects all development to reduce on-site energy demand and maximise the use of low carbon energy sources to minimise the effects of climate change. WCC through their Environmental Supplementary Planning Guidance (2022) support the UKGBC's Framework Definition of Net Zero as follows:

- **Net Zero Carbon Construction:** *"When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy."*
- **Net Zero Carbon Operational:** *"When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset."*

Policy 36B Carbon Reduction - All development proposals should follow the principles of the Mayor of London's energy hierarchy. Major development should be net zero carbon and demonstrate through an energy strategy how this target can be achieved.

Policy 36C Carbon Reduction - Where it is clearly demonstrated that it is not financially or technically viable to achieve zero-carbon on-site, any shortfall in carbon reduction targets should be addressed via off-site measures or through the provision of a carbon offset payment secured by legal agreement.

Policy 36D Heat Networks - Developments should be designed in accordance with the Mayor of London's heating hierarchy. Major developments must connect to existing or planned local heat networks, or establish a new network, wherever feasible.

Policy 36E Overheating - All developments should be designed and operated to minimise the risk of internal overheating. Major development proposals will include a cooling strategy in line with the Mayor of London's cooling hierarchy.

Table 3-1 Energy targets

GLA London Plan and Westminster City Plan (2019-2040)
1. 10% savings in residential and 15% in non-residential from energy efficiency alone 2. Following the energy and overheating hierarchy 3. 35% on-site total carbon savings (using SAP 10.2 future carbon factors) 4. Zero carbon through borough offsets 5. Minimise/justify the need for cooling 6. Decentralised heat networks with no net NOx and air quality impacts

3.5 Building Regulation Part L

Part L of the 2021 Building Regulations, refers to the Conservation of Fuel and Power. This document stipulates the minimum level of energy efficiency that buildings must be constructed to. It provides guidance on new build as well as refurbishments and covers all domestic and non-domestic buildings. It is a key component of the Government's objective to reduce carbon dioxide emissions originating from the built environment and establishes a very stringent performance standard.

New build non-domestic developments must comply with Approved Document L2, and domestic developments must comply with Approved Document L1.

For non-domestic buildings, dynamic simulation energy modelling or SBEM (Simplified Building Energy Model) is required for calculating the CO_2 emission rate of the development from comparing a notional building with the actual or proposed building. The notional building is of the same size and shape as the actual building, but with specified properties as outlined in Part L2 document.

For domestic buildings, compliance with the Standard Assessment Procedure (SAP 10.2) is required, with approved BRE software pack such as Design SAP (Elmhurst Energy) or FSAP (Stroma). The calculations on CO_2 emission rate of the residential development will compare a notional building with the actual or proposed building. The notional building is of the same size and shape as the actual building, but with specified properties as outlined in Part L1 document.

The updated Building Regulations Part L1 and L2 introduced a range of changes, including imperative uplifts. Along with Part L 2021, an updated Part F (Ventilation) version and a new Part O (Overheating) were release in December 2021. As part of Part L 2021, increased energy performance standards have been introduced, with around 30% less CO_2 emissions compared to Part L 2013, in line with the UK 2050 net zero commitments.

It is expected that under the upcoming Future Homes Standard a demand of at least 75% less carbon emission compared with Part L 2013 will be introduced for new homes. It is anticipated that the move towards district heating networks (DHN), heat pumps and high-efficient electrical heating, along with improved fabric (close to Passivhaus Standard), will meet UK current and future emissions reductions targets.

Figure 3-4 Part L, F and O 2021 Versions

3.6 SAP 10.2 for Part L1 Compliance

Over the beginning of 2021, BRE approved SAP software providers such as Stroma and Elmhurst have been working hard into developing SAP 10.2 batches (1 to 4) to ensure adequate accuracy to assess Part L1 2021 under the updated SAP 10.2 conventions. Both Stroma and Elmhurst developed fully online software versions for SAP 10.2 calculations and Approved Document L 2021 compliance.

Unfortunately, compared to old SAP pack software with local desktop installation, the SAP 10.2 software online versions do not allow dwelling records to be exported to the old desktop SAP software packs (SAP 2012). As a result, applicants are not able to assess all the recorded Part L1 2021 dwellings (SAP 10.2) into desktop version for Part L1A 2013, without assessing from the beginning all individual units.

However, from 15 June 2022 all planning applications submitted on or after this date are required by the GLA to follow Part L 2021 compliance. Therefore, SAP 2012 software packs to assess Part L 2013 are no longer relevant.

3.7 LETI Guidance

LETI or Low Energy Transformation Initiative (LETI) has recently published a series of important guidance on actions and targets to enable new developments to achieve the carbon reduction targets set by the London Plan and local boroughs.

Embracing a ‘fabric first’ approach and the incorporation of efficient and integrated systems to minimise the energy demand from heating, cooling, lighting and ventilation, the Westminster Environmental Planning Document (2022) recognises the recommendations on minimum design standards stated within LETI Climate Emergency Design Guide and encourages new developments to implement the indicative design measures as summarised in Table 3-2 wherever feasible and appropriate.

Table 3-2 LETI Design Guide Recommended Standards

	Small scale residential (terraced or semi-detached homes)	**Medium scale (up to 4 storeys) and large scale (more than 4 storeys) residential**	**Commercial**
Fabric U-Values			
Walls	0.13 - 0.15	0.12 - 0.15	0.12 - 0.15
Floor	0.08 - 0.10	0.10 - 0.12	0.10 - 0.12
Roof	0.10 - 0.12	0.10 - 0.12	0.10 - 0.12
Windows	0.80 (triple glazing)	1.00 (triple glazing)	1.00 (triple glazing)
	-	1.20 (double glazing)	1.20 (double glazing)
Doors	1.0	1.0	1.0
Efficiency Measures			
Air tightness	<1 ($m^3/h.m^2$@50pa)	<1 ($m^3/h.m^2$@50pa)	<1 ($m^3/h.m^2$@50pa)
Thermal bridging	0.04 (y-value)	0.04 (y-value)	0.04 (y-value)
g-value of glass	0.6 - 0.5	0.6 - 0.5	0.4 - 0.3
Energy Use Intensity	35 kWh/m^2/year	35 kWh/m^2/year	55 kWh/m^2/year
Space heating demand	15 kWh/m^2/year	15 kWh/m^2/year	15 kWh/m^2/year

4 Energy Strategy

4.1 Overview

The following section describes the energy strategy and methodology for assessment for the development. This assessment has been outlined to align with the *GLA Energy Assessment Guidance (June 2022)*. The energy strategy follows the GLA Lean, Clean, Green hierarchy (Part L 2021) and GLA Cooling Hierarchy (Figures 4-1 and 4-2).

The energy statement identifies the carbon emissions associated with the proposed development after each stage of the energy hierarchy. Regulated emissions are provided and, separately, those emissions associated with uses not covered by Building Regulations, i.e. unregulated energy uses for the whole site.

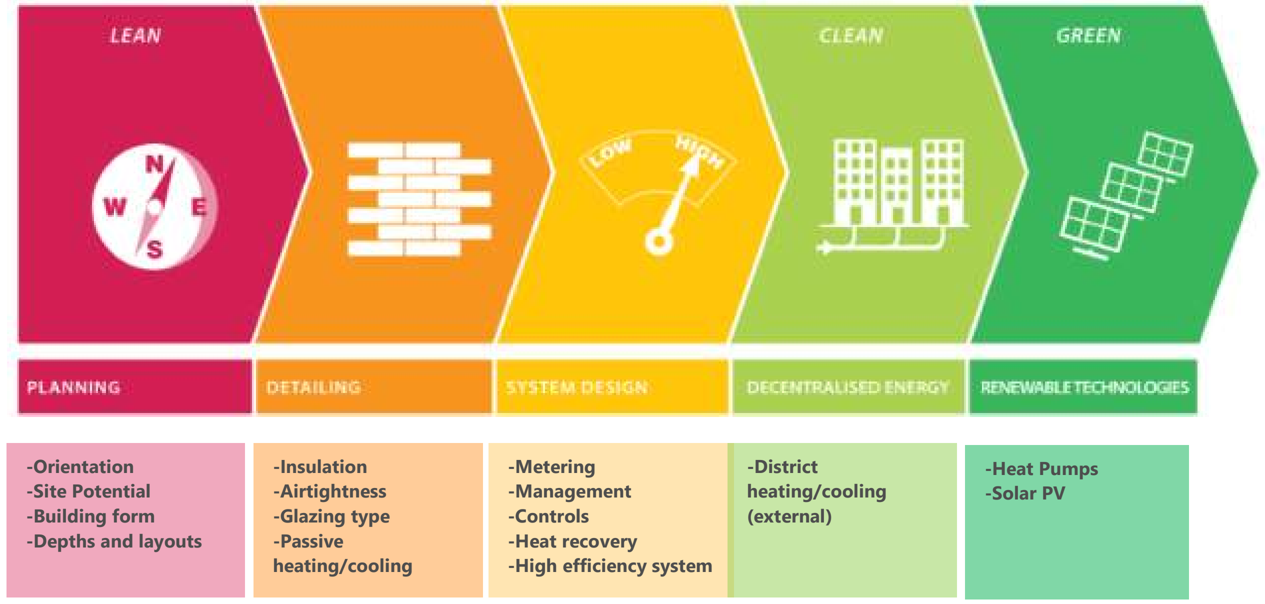


Figure 4-1 GLA Energy Hierarchy

Figure 4-2 GLA Cooling Hierarchy

4.2 Energy Strategy

4.2.1 Fabric First Approach

PGPS has been designed following high end industry standards and best practice such as London Energy Transformation Initiative (LETI) as a response to the climate emergency. The GLA London Plan, Energy Strategy guidance has also been considered in the design development of this project. This involves considering a fabric first approach where passive design measures are maximised to reduce energy demands before efficient equipment is installed.

The passive design measures include optimum façade fabric performance (U-values, y-values and g-values), minimising glazing percentages throughout the facades for solar gain reduction but ensuring good natural daylight (hence reducing lighting power) and minimal heat gains (reducing cooling power), articulating the façade to incorporate shading through window recess and inset balconies and incorporating openable panes through all façade orientations to allow for mixed-mode ventilation (reducing the MVHR demand).

4.2.2 Energy Efficient HVAC Strategy

An all-electric and zero fossil fuel heating and cooling strategy has been proposed to minimise carbon emissions. This strategy is shown in Figure 4-3.

Three no. highly efficient Air Sourced Heat Pumps (ASHP) provide primary heating demand, 1 no. 4-pipe ASHP with heat recovery (heat recovery chiller) provides a portion of the cooling demand (35%) and heat harvesting, 1 no. Air-Cooled Chiller provides the remaining cooling load (65%) and 1 no. WSHPs provides the heating capacity to match the heat recovery heat rejection for temperature elevation. These units are to be located at the basement and roof level. Thermal stores in the basement plant room are used as a method to balance the output from the heat pumps. In times of low demand, energy from the heat pumps is stored in the form of hot water and once the stores are full, they are routinely discharged to ensure continuation of operation for the heat pumps. The discharge of the stores should be programmed to coincide with times of peak demand, such as the morning peak.

For affordable dwellings, MVHR systems incorporate DX units to temper the supply air. Comfort cooling will be provided to private development (PD) residential apartments and the flexible commercial areas on ground floor. At times of high cooling demand on-site, where the heat recovery chiller capacity is exceeded, the additional air-cooled chiller supplements on the remain load to cover, optimising the energy efficiency of the heat network.

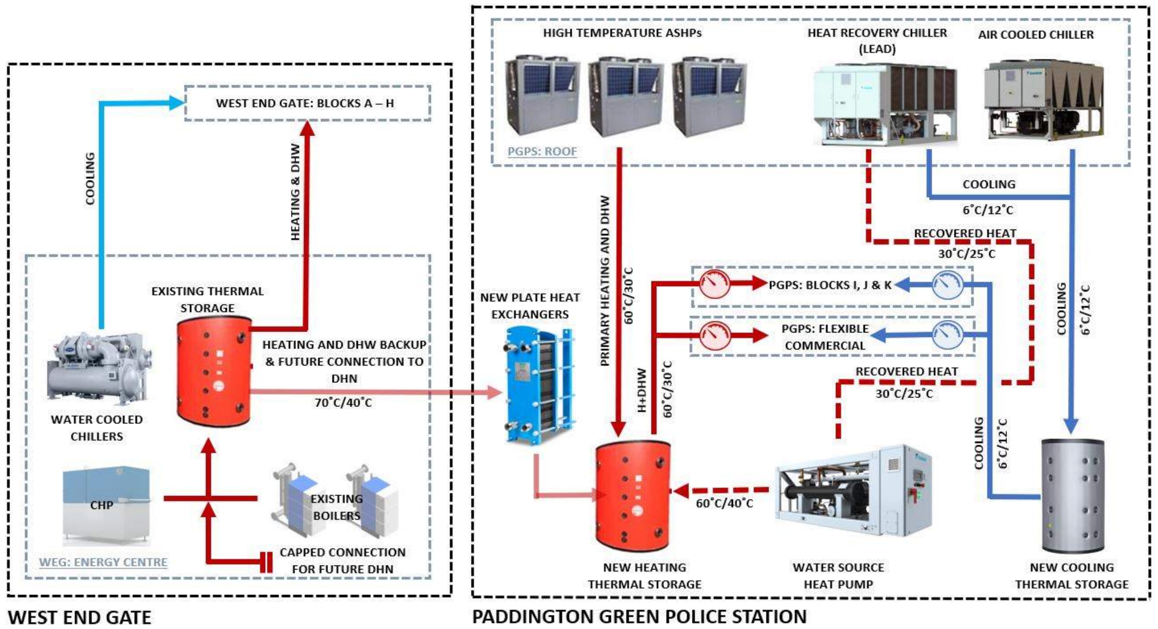


Figure 4-3 PGPS HVAC strategy

4.3 Energy Hierarchy Methodology

Predicted carbon emissions have been taken from computer modelling software (SBEM and SAP methodology), in line with guidance outlined in the document entitled *GLA Energy Assessment Guidance (June 2022)*.

The GLA energy hierarchy has been adhered to, and each stage 'Be Lean', 'Be Clean' and 'Be Green' has been explored. The following sections explain the GLA energy hierarchy inputs outlined for the Site.

Table 4-1 Summary of modelling assumptions through the energy hierarchy

	Model assumptions and inclusions
Baseline – Building Regulations Notional Development (as generated by Part L software)	Baseline Target / Building Emission Rate (TER / BER) is modelled as a reference 'compliant' building, with the following features: Non-Domestic Areas: - Notional fabric and glazing areas - Heat generation via low carbon heat source as per Actual (Heat Pumps) Domestic Areas: - Notional fabric and glazing areas - Heat generation via individual gas boilers
Lean - Energy efficiency measures applied	Improved energy efficient model, with the following features: - Improved building fabric and air tightness over notional - Energy efficiency measures as required to achieve 10% reduction for residential areas, on Part L 2021 (NCM and SAP) compliance - Highly energy efficient lighting fittings and controls
Clean - Connecting to District Heat Network (DHN)	- Same as Lean model
Green -Renewable Energy Technology	Improved model, with the following features: - Heat pumps - PV panels
Be Seen	A suitable operational energy assessment was carried out as described within Section 11 in this report

5 Energy Baseline Demand and CO_2 Emissions – 'TER'

Baseline energy demands and associated CO_2 emissions have been estimated in line with the methodology set out in Section 4, following the GLA guidance for preparing energy statements. Part L compliance modelling has been carried out to assess the proposed development geometry using notional fabric and building services specification as stipulated in the National Calculation Methodology (2022).

Figure 5-1 PGPS Façade South

5.1 Baseline Demand and CO_2 Emissions

Baseline energy demands have been estimated in line with the methodology set out in the previous section. For commercial areas, a thermal model using IES 2022 (ApacheSIM) has been created based on actual design geometry and systems following the NCM (2022) specifications. For domestic areas, all dwellings were modelled using FSAP 10.2 (Stroma) as per actual design geometry and systems following SAP 10.2 (2022) specifications.

The separate calculations have been generated using indicative service specifications and the following guidance documents: CIBSE Guide A: Environmental Design 2015 and 2013 Non-Domestic Building Services Compliance Guide. These were used in order to produce an estimate of the non-domestic energy demands and CO_2 emissions. Baseline energy demands and carbon emissions use Notional building parameters as outlined in Part L1 (domestic) and L2 (non-domestic) 2021.

5.1.1 Non-Domestic Regulated emissions

The proposed development contains all non-domestic spaces including flexible commercial (retail), main entrance lobbies, communal corridors, and flexible amenity spaces, as shown in Figure 5-2. Domestic areas were modelled to account for the generated shading from the massing. However, the equivalent loads from the dwellings are assessed through a separate compliant software.

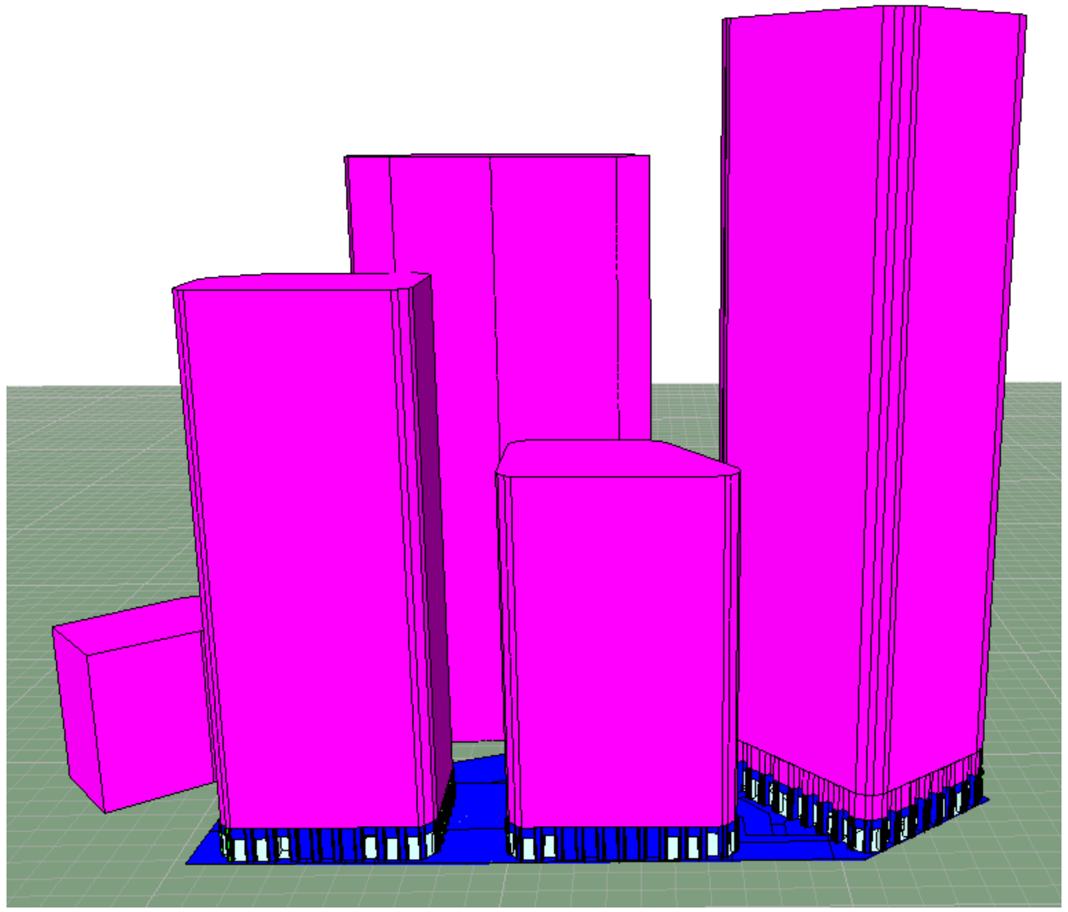


Figure 5-2 Non-Domestic spaces assessed

5.1.2 Domestic Regulated emissions

3.1.2 As shown in Table 5-1, a total of 126 dwellings have been assessed, representing 23% sample units and area weighted to represent the entire development. The assessment accurately captures the energy and carbon performance of all dwellings.

Table 5-1 Dwellings assessed

Block	Total dwellings per block	Dwellings modelled per block	% of dwellings modelled
I	149	21	14%
J	98	28	29%
K	309	77	25%
Total	**556**	**126**	**23%**

Modelled Unit	Represen-tative Units	Modelled Unit	Represen-tative Units	Modelled Unit	Represen-tative Units	Modelled Unit	Represen-tative Units	Modelled Unit	Represen-tative Units
I_05_01	20	J_05_01	13	K_01_01	1	K_09_01	9	K_30_05	1
I_05_02	20	J_05_02	13	K_01_02	1	K_11_11	1	K_33_06	1
I_05_03	20	J_05_03	13	K_01_03	1	K_12_10	1	K_33_05	1
I_05_04	12	J_05_04	12	K_01_04	1	K_12_07	5	K_33_04	1
I_05_05	12	J_05_05	12	K_01_05	1	K_12_06	1	K_33_03	1
I_05_06	12	J_05_06	13	K_01_06	1	K_12_02	5	K_33_02	1
I_05_07	12	J_16_01	1	K_01_07	1	K_12_01	4	K_33_01	1
I_01_01	1	J_16_02	1	K_02_11	1	K_16_10	1	K_34_06	3
I_01_05	3	J_16_03	1	K_02_10	1	K_16_09	1	K_34_05	3
I_01_07	3	J_16_04	1	K_02_09	1	K_16_04	1	K_34_04	4
I_16_04	7	J_16_05	1	K_02_08	1	K_16_03	1	K_34_03	3
I_16_05	6	J_16_06	1	K_02_07	1	K_16_01	1	K_34_02	4
I_16_06	6	J_16_07	1	K_02_06	1	K_11_08	1	K_34_01	4
I_22_03	2	J_01_01	1	K_02_05	1	K_11_06	1	K_37_06	1
I_22_05	3	J_01_02	1	K_02_04	1	K_21_07	12	K_37_05	1
I_22_06	3	J_01_03	1	K_02_03	1	K_21_06	16	K_37_03	1
I_23_01	1	J_01_04	1	K_02_02	1	K_21_05	16	K_38_03	1
I_23_02	1	J_01_05	1	K_02_01	1	K_21_04	12	K_38_02	1
I_23_03	1	J_01_06	1	K_09_11	7	K_21_03	13	K_38_01	1
I_14_05	2	J_14_04	1	K_09_10	13	K_21_02	13	K_14_10	1
I_14_06	2	J_14_05	1	K_09_09	14	K_21_01	12	K_14_06	1
		J_15_01	1	K_09_08	8	K_17_07	1		
		J_15_02	1	K_09_07	9	K_17_01	1		
		J_15_03	1	K_09_06	8	K_29_04	1		
		J_15_04	1	K_09_05	14	K_32_06	4		
		J_15_05	1	K_09_04	14	K_32_05	3		
		J_15_06	1	K_09_03	14	K_32_02	4		
		J_15_07	1	K_09_02	9	K_32_01	4		
Block I Total	149	**Block J Total**	98	**Block K Total**					309
Total Units									**556**

5.1.3 Unregulated emissions

3.1.3 Non-domestic unregulated emissions and energy consumption have been estimated using the assumptions for equipment use provided in the NCM activity templates. These demands are assumed to be provided by grid electricity in all instances, with the relevant carbon factor applied to calculate associated carbon emissions.

3.1.4 Domestic unregulated emissions from energy consumption such as electrical appliance usage and cooking have been estimated using the SAP methodology as outlined in Appendix L of The Government's Standard Assessment Procedure for Energy Rating of Dwellings, SAP 10.2.

3.1.5 For both domestic and non-domestic buildings, the estimates are based on floor area and are therefore assumed not to change between each stage of the energy hierarchy.

Table 5—2 Estimated site-wide unregulated carbon emissions

Typology	Unregulated Carbon Emissions	
	Tonnes CO_2/year	kg CO_2/m^2/year
Domestic	276.2	6.4
Non-Domestic	13.9	5.4
Total	290.9	6.3

5.1.4 Baseline' predicted energy demand

The Baseline Target / Building Emission Rate (TER / BER) is modelled as a reference Building Regulations 'compliant' building, with the following features:

- Notional fabric and glazing areas
- Heat generation via Heat Pumps (non-domestic) and individual gas boilers (domestic)

The following Table describe the predicted energy demands for the baseline building.

Table 5-3 'Baseline' predicted energy demands

Typology	Baseline energy demand (MWh/ year)					
	Space heating	Hot water	Cooling	Auxiliary	Lighting	Unregulated Energy
Domestic	952.0	1344.5	0.0	47.8	98.2	2,031.2
Non-Domestic	6.0	11.0	5.6	18.6	32.9	108.2
Subtotal	**958.0**	**1355.5**	**5.6**	**66.4**	**131.2**	**2139.3**
Total	**4,656**					

5.1.5 Baseline' carbon emissions

The following Table describe the predicted carbon demands for the baseline building.

Table 5-4 'Baseline' predicted carbon emissions (using SAP 10.2)

Typology	Baseline Regulated Carbon Emissions	
	kg CO_2/year	Tonnes CO_2/year
Domestic	492,600	492.6
Non-Domestic	10,060	10.1
Total	**502,660**	**502.7**

6 Energy Demand Reduction - 'Lean'

This section outlines the strategic demand reduction and energy efficiency measures integrated in the Proposed Development and their impacts on energy demand and carbon reductions. The values provided are indicative fabric and services specifications which will be reviewed throughout the design process to ensure compliance with Part L and WCC recommendations.

6.1 Passive Design

This section discusses the passive design measures that will be incorporated into the detailed design of the Proposed Development to aim for a 10% reduction over Part L1 2021 (domestic) of the Building Regulation, as illustrated in Figure 6-1.

Passive design aims to investigate ways to reduce the energy use of the project through passive means, such as improved orientation, massing, building fabric performance, daylight, and ventilation; many of which are limited with neighbouring properties on the site.

The following passive design approaches have been considered and incorporated to minimise the energy consumption of the proposed development:

- Optimised Window-to-Wall ratio to 33% to limit unwanted solar gains;
- High levels of airtightness and optimum U-values to minimise heat losses from the thermal envelope;
- Glazing with optimum g-value and U-value to reduce heat gains and losses;
- Recessed glazing and inset balconies for the provision of shading and reduction of cooling demand and control of glare.

The above measures make significant contributions to the passive energy efficiency at PGPS which will be further investigated at later design stages to quantify their benefits via approved energy modelling methods.

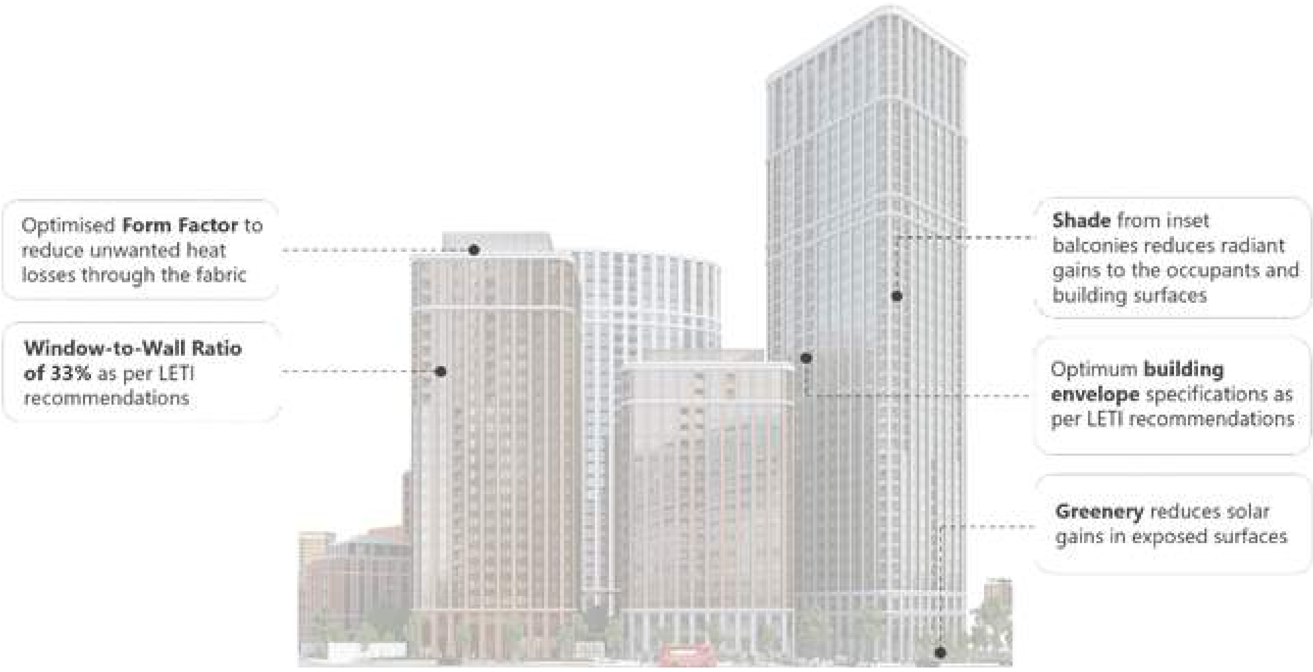


Figure 6-1 – PGPS passive design first approach

6.2 Lean fabric and system improvements

Several fabric and services improvements have been proposed to provide a pathway to compliance. The key specifications and resulting energy demand and CO_2 emissions are summarised by typology in the following Table. These inputs have been used to generate the Lean outputs which in turn have been used to show potential demand reduction and subsequent carbon emission reduction over baseline demands.

Table 6-1 PGPS Fabric Performance for Non-Domestic areas

Building Element	PGPS Non-Domestic areas	Notional Building Part L2 2021	Notional Building Part L2A 2013
External Wall U-value	0.13 W/m²K	0.18 W/m²K	0.26 W/m²K
Floor U-value	0.13 W/m²K	0.15 W/m²K	0.22 W/m²K
Roof U-value	0.13 W/m²K	0.15 W/m²K	0.18 W/m²K
Glazing U-value	Unitised System (Average) Typical Bay: 0.75 W/m²K	1.40 W/m²K	1.60 W/m²K
g-value	Retail & Amenity: 0.30 Circulation: 0.40	Side-lit: 0.29 Top-lit: 0.40	0.40
Air Permeability	3 m³/m²hr	3 m³/m²hr	3 m³/m²hr

Table 6-2 PGPS Fabric Performance for Domestic areas

Building Element	PGPS – Domestic areas	Notional Building Part L1 2021	Notional Building Part L1A 2013
External Wall U-value	0.13 W/m²K	0.18 W/m²K	0.18 W/m²K
Floor U-value	0.13 W/m²K	0.13 W/m²K	0.13 W/m²K
Roof U-value	0.13 W/m²K	0.11 W/m²K	0.13 W/m²K
Glazing U-value	Unitised System (Average) Typical Bay: 0.75 W/m²K Balconies: 1.20 W/m²k	1.20 W/m²K	1.40 W/m²K
g-value	0.55	0.63	0.63
Air Permeability	3 m³/m²hr	5 m³/m²hr	5 m³/m²hr

Table 6-3 PGPS Thermal Bridging Performance for Domestic areas

SAP Table Junctions Ref	Junction Details	psi-values (W/m·K)
E2	Lintel	0
E3	Sill	0
E4	Jamb	0
E5	Ground floor (normal)	0.16
E20	Exposed floor (normal)	0.32
E21	Exposed floor (inverted)	0.32
E7	Party Floor between dwellings (in block of flats)	0
E23	Balcony within or between dwellings, balcony support penetrates wall insulation	0
E24	Eaves (insulation at ceiling level - inverted)	0.15
E14	Flat roof	0.08
E15	Flat roof with parapet	0.20
E16	Corner (normal)	0
E17	Corner (Inverted)	0
E18	Party wall between dwellings (applied to each dwelling)	0.06
E25	Staggered Party Wall between dwellings	0.12
P4	Roof (insulation at ceiling level)	0.48
P7	Exposed Floor (normal)	0.48

6.3 Non-domestic building services

Table 6-5 sets out the recommended performance parameters for the heating, ventilation and air conditioning (HVAC) systems for the non-domestic areas of the building and the modelling assumptions for the Part L2 assessment. The non-domestic areas for PGPS are defined as flexible commercial and all related communal areas (e.g. lobby, corridors).

6.4 Domestic building services

The energy performance values for the proposed building services used in the SAP modelling (10.2) and following Part L1 compliance are set out in the Table 6-4.

Table 6-4 PGPS Domestic building services specifications

Element	Value	Notes
Ventilation Specific Fan Power (SFP)	0.58 W/L/s 0.55 W/L/s 0.63 W/L/s	Values provide are from SAP Product Characteristics Database (PCDB) for Kitchen +1 wet rooms, Kitchen +2 wet rooms, Kitchen +3 wet rooms
Ventilation heat recovery efficiency	91 %	Value from PCDB
Lighting	100 %	Energy efficient lighting to be specified

To minimise energy consumption from lighting within residential areas, the number of light fittings will be minimised whilst specifying 100% low energy lighting (compact fluorescent lights or LEDs) with appropriate controls.

6.4.1 Heating, Cooling and Ventilation

Space heating and domestic hot water (DHW) will be provided from dedicated Heat Pump Units for all dwellings. They will be fed from a communal Heat Pump system installed on roof in conjunction with a Water Source Heat Pump unit at the basement. A communal system provides greater flexibility for decarbonisation of heat in the future. The Heat Pumps will have built-in metering capability to ensure tenants are billed for the heat used.

Comfort cooling systems are currently proposed for all private development (PD) dwellings in the scheme where noise risk could not be sufficiently mitigated through passive design measures alone. For affordable dwellings, MVHR systems incorporate DX units designed to temper the supply air provided by the mechanical ventilation system.

Background ventilation will be provided by individual Mechanical Ventilation with Heat Recovery (MVHR) units in each dwelling. This provides the simultaneous benefits of significantly reducing the heat loss from ventilation, ensuring good internal air quality and improving the internal acoustic environment in comparison to natural ventilation. All MVHR units will include a summer by-pass feature to reduce the risk of overheating.

Table 6-5 PGPS Be Lean Building energy modelling inputs (non-domestic)

Element	PGPS Part L			Notional building	Part L minimum requirements
Fabric	Floor U-value: 0.13 W/m^2k			Floor U-value: 0.15 W/m^2k	Floor U-value: 0.18 W/m^2k
	Roof U-value: N/A			Roof U-value: 0.15 W/m^2k	Roof U-value: 0.18 W/m^2k
	Air Permeability: 3 m^3/m^2hr			Air Permeability: 3 m^3/m^2hr	Air Permeability: 8 m^3/m^2hr
	External Wall U-value: 0.13 W/m^2k			External Wall U-value: 0.18 W/m^2k	External Wall U-value: 0.26 W/m^2k
	Basement wall (cores only): 0.20 $/m^2k$				
	Glazing U-value: 1.2 W/m^2k			Glazing U-value: 1.4 W/m^2k	Glazing U-value: 1.6 W/m^2k
	g-value: 0.3 in the entrances, flexible commercial. 0.4 in circulation			g-value: 0.28	g-value: N/A
Heating	Fan coils - Central AHUs	Heat Pump Heating Generator Seasonal CoP	3	Air-source Heat Pump: SCOP 2.64	Air-source Heat Pump: SCOP 2.5
	Rads				
	Radiators + extract				
	Supply & Extract (kitchen)				
Ventilation	Fan coils - Central AHUs	Ventilation Heat Recovery Efficiency (%)	85	Vent heat rec: 76% eff, SPF 0.6 – 1.8 depending on space	Vent heat rec: 65% eff, SPF 0.4 – 2.0 depending on space
		Ventilation Fresh Air SFP (W/(l/s))	1.4		
	Radiators + extract	Ventilation Heat Recovery Efficiency (%)	N/A		
		Ventilation Fresh Air SFP (W/(l/s))	0.4		
	Radiators	Ventilation Heat Recovery Efficiency (%)	N/A		
		Ventilation Fresh Air SFP (W/(l/s))	N/A		
Hot Water	Heat Pump Electric Water Source	Hot Water Generator Seasonal COP	3.8	Water-source heat pump: SCOP 2.86	Water-source heat pump: SCOP 2.0
Cooling	Fan Coil Units - Central AHUs	Cooling Generator Chiller Type	Air Cooled	FCUs provided by air cooled chillers, SEER – 5.78	FCUs provided by air cooled chillers, SEER – 4.5
		Cooling Generator Seasonal CoP	5		
Lighting	Lamp - 120 lm/W, Display lighting 80 lm/W			Lamp - 95 lm/W, Display lighting 95 lm/W	Lamp - 95 lm/W, Display lighting 80 lm/W
	Occupancy sensing time switch, Constant illuminance control in circulation spaces			Daylight Dimming in all spaces	N/A
	Daylight Dimming				

6.5 'Lean' predicted energy demand

The Lean calculations demonstrate an improved model from energy efficient measures and optimum envelope compared to Baseline, with the following features:

- Improved glazing percentage, building fabric and air tightness over notional
- Energy efficiency measures as required to achieve 10% reduction on Part L 2021 compliance (residential)
- Highly energy efficient lighting fittings and controls

The following Tables describe the predicted energy and carbon demands for the Lean building.

Table 6-6 Predicted Lean energy demands

Typology	Lean energy demand (MWh/ year)					
	Space heating	Hot water	Cooling	Auxiliary	Lighting	Unregulated Energy
Domestic	723.3	1466.1	59.2	214.2	100.4	2031.2
Non-Domestic	10.0	10.2	7.0	21.1	22.0	108.2
Subtotal	**733.3**	**1476.3**	**66.2**	**235.3**	**122.5**	**2139.3**
Total	**4,773**					

6.6 'Lean' Carbon Emissions

Table 6-7 Predicted Lean carbon emissions (using SAP 10.2 carbon factors)

Typology	Baseline Regulated Carbon Emissions		Lean Regulated Carbon Emissions		
	kg CO_2/year	Tonnes CO_2/year	kg CO_2/year	Tonnes CO_2/year	% Improvement over Baseline
Domestic	492,600	492.6	399145.9	399.1	19.0%
Non-Domestic	10,060	10.1	9,601	9.6	4.6%
Total	**502,660**	**502.7**	**408,747**	**408.7**	**18.7%**

The Proposed Development Residential Be Lean building currently achieves **19%** reduction through energy efficiency measures and based on optimised fabric performance, including typical bay façade average as described in Table 6-2. Non-Domestic Be Lean achieves **4.6%** carbon savings. The commercial areas at PGPS represent a minor percentage of the scheme, but feed with a highly efficient energy network and an optimum envelope that follows LETI recommendations. Building Regulation Part L2 2021 for commercial spaces states a notional building with the same system as the actual building compared to a notional building on gas boilers (Part L 2A 2013), thus a stringent comparison to reach the 15% Be Lean commercial target.

6.7 Dwelling Fabric Energy Efficiency (DFEE)

Criterion 1 of Part L1 of Building Regulations stipulates that all new dwellings must achieve a minimum level of fabric energy efficiency. This requirement is satisfied by demonstrating the Dwelling Fabric Energy Efficiency (DFEE) is lower than or equal to the Target Fabric Energy Efficiency (TFEE) as calculated using the SAP 10.2 methodology (2022).

SAP calculations have been carried out for all dwellings in the development using the fabric specification provided in Table 6-2 and Table 6-3. The results, displayed in Table 6-8, show that an improvement over the Building Regulations target will be achieved using the proposed building fabric specification for all dwellings.

Table 6-8 PGPS Fabric Energy Efficiency results

FEE Compliance	DFEE (kWh/m^2/yr)	TFEE (kWh/m^2/yr)	Percentage of Improvement (%)
Residential Site-Wide (556 Units)	26.07	26.15	0.32%

7 Energy Heating Infrastructure including CHP - 'Clean'

7.1 Addressing the London Plan heating hierarchy

The GLA promotes that once the demand for energy has been minimised, all planning applications must demonstrate how their energy systems will exploit local energy sources (such as secondary heat) and supply energy efficiently and cleanly to reduce carbon emissions, by following the heating hierarchy in London Plan Policy SI 3.

7.2 Connection to existing heating or cooling networks

Figure 7-1 illustrates the proximity of PGPS to an existing district heat network. The Proposed Development, highlighted in blue, is shown to be ~165m away from the Church Street heat network and an existing on-site CHP led energy centre called West End Gate (Figure 7-2). This heat network is shown as an 'Existing heat network' on the official London Heat map published by the Mayor's office. There is in fact no heat network here and this was confirmed by the Senior Development Delivery Manager from Growth Planning and Housing of Westminster council via email in March 2022.

The West End Gate (WEG) energy centre has designed to provide both peak capacity and also to meet the annual heat demand for Blocks A to H. A low carbon heat network supplied by a CHP engine and boilers from a single energy provides space heating and domestic hot water (DHW) for all residential and non-residential units in the WEG masterplan site.

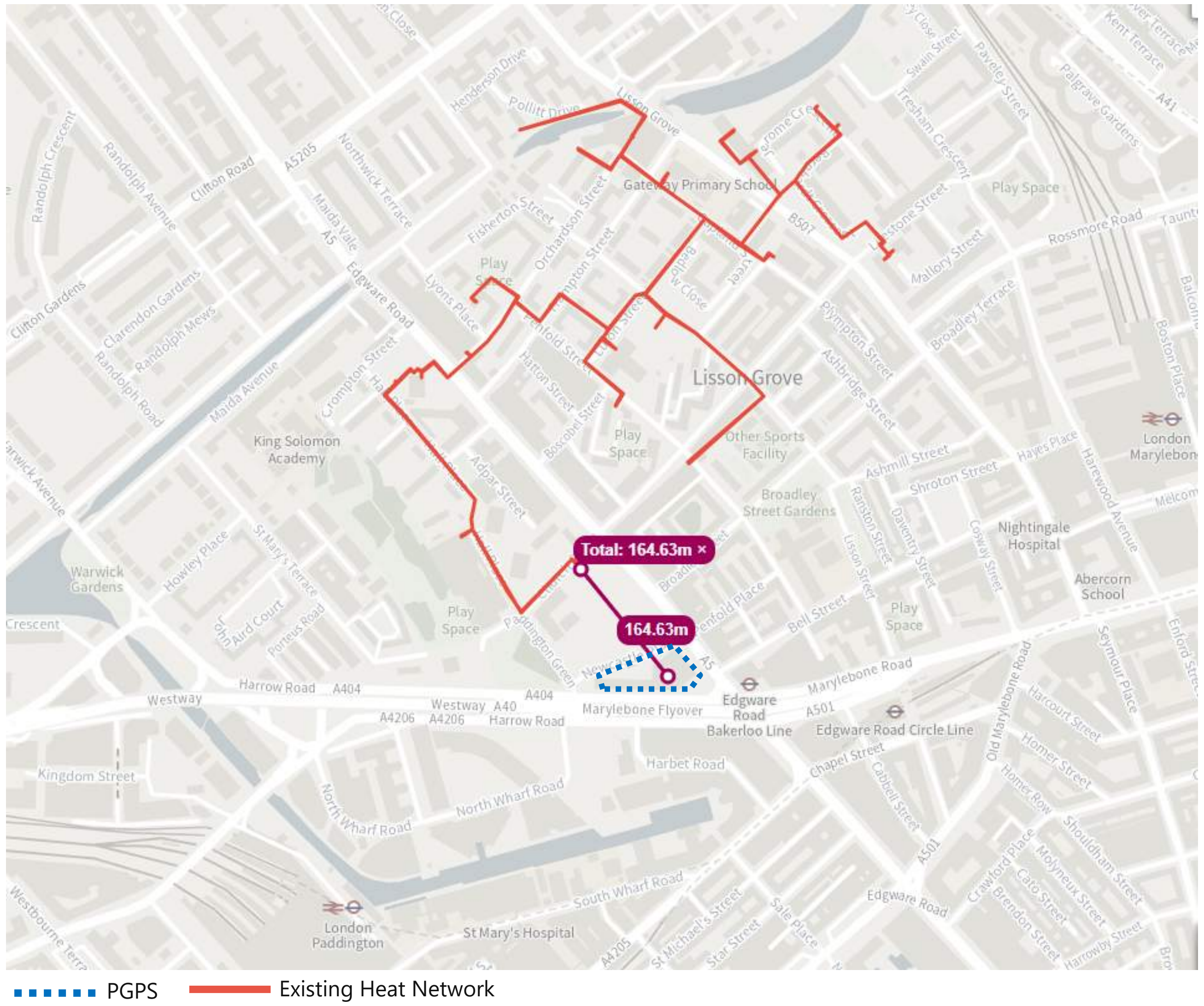


Figure 7-1 Existing Heat Networks in proximity with PGPS (https://maps.london.gov.uk/heatmap)

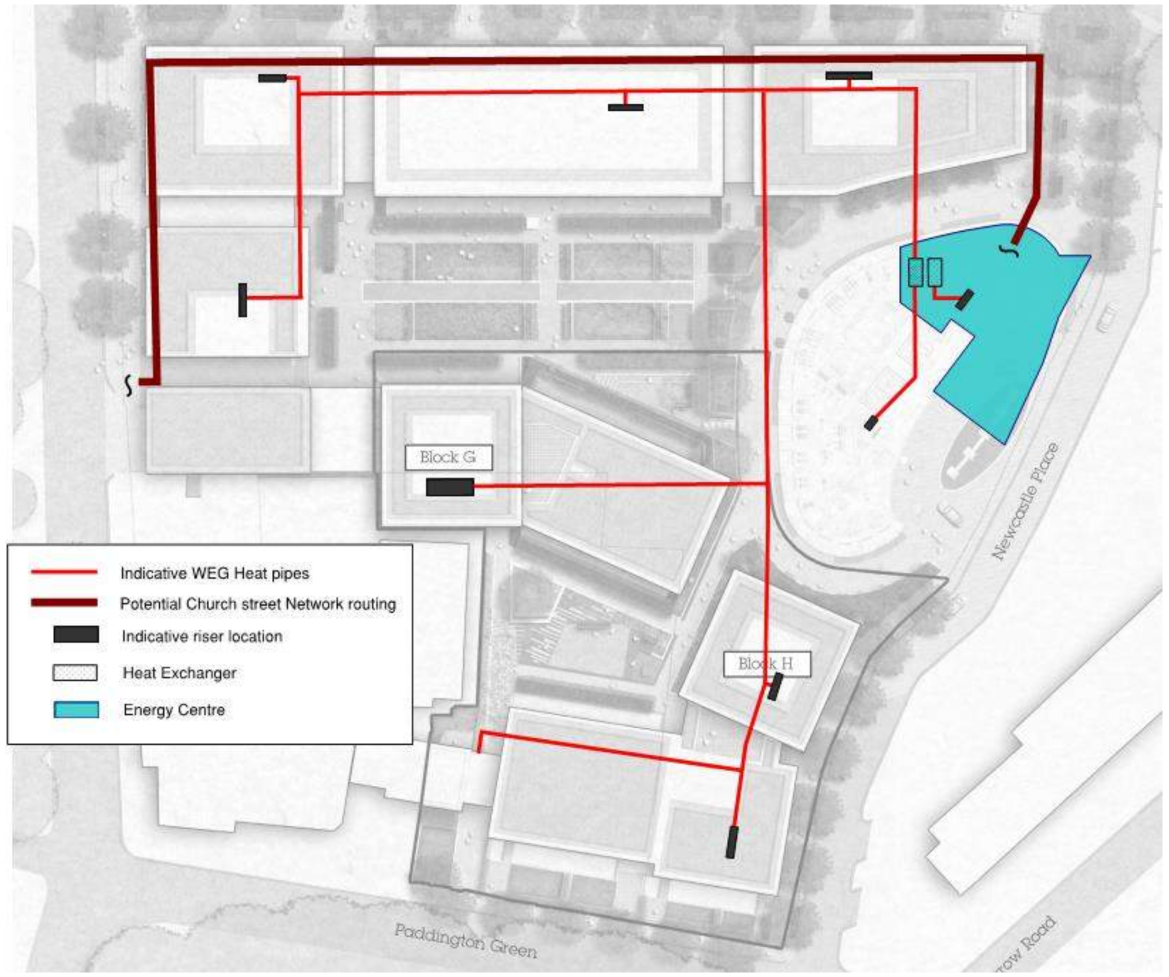


Figure 7-2 Indicative WEG heat network routing

The West End Gate heat network has the pipework installed for a future connection to the proposed (not existing) Church Street heat network should that heat network be installed. This is illustrated in Figure 7 – 2 above.

For PGPS, a series of energy options were considered for heating and cooling systems for application on-site and in alignment with West End Gate strategy and London Plan Policy SI 3. The energy strategy with a potential WEG connection assessed the incorporation of high temperature Air Source Heat Pumps at the roof of PGPS to provide 60% of the base heat load for all parts of the masterplan (Paddington Green Police Station Blocks I, J, K, and A to H) along with the provision of heat recovery chillers to feed the commercial areas at PGPS with heat harvesting to the site wide heat network (Figure 7-3). However, due to the constraints on roof space availability for the estimated number of ASHP units, considerable reduction of commercial areas with low opportunity for heat harvesting, and the reliance of incorporating new gas boilers within WEG energy centre, resulted into a non-viable solution for the Proposed Development.

The heating demand of the scheme is fulfilled via on-site all electric heat source (Air Source Heat Pumps) as described in Section 4 and supplemented by an Air-Cooled Chiller for meeting peak cooling demands when the useful heat from the cooling process cannot be used elsewhere. A highly efficient Water Source Heat Pump also takes part to the on-site heat network to allow for heat harvesting. The facility will be provided in the new PGPS community heat network to back connect to the WEG community heat network for resilience purposes. In times of low demand or when maintenance is being carried out on either of the networks the central plant in one can feed the other and vice versa.

This also ensures that the DHN connection pipework which has been installed for WEG can be used to also connect the PGPS community heat network to the same DHN connection.

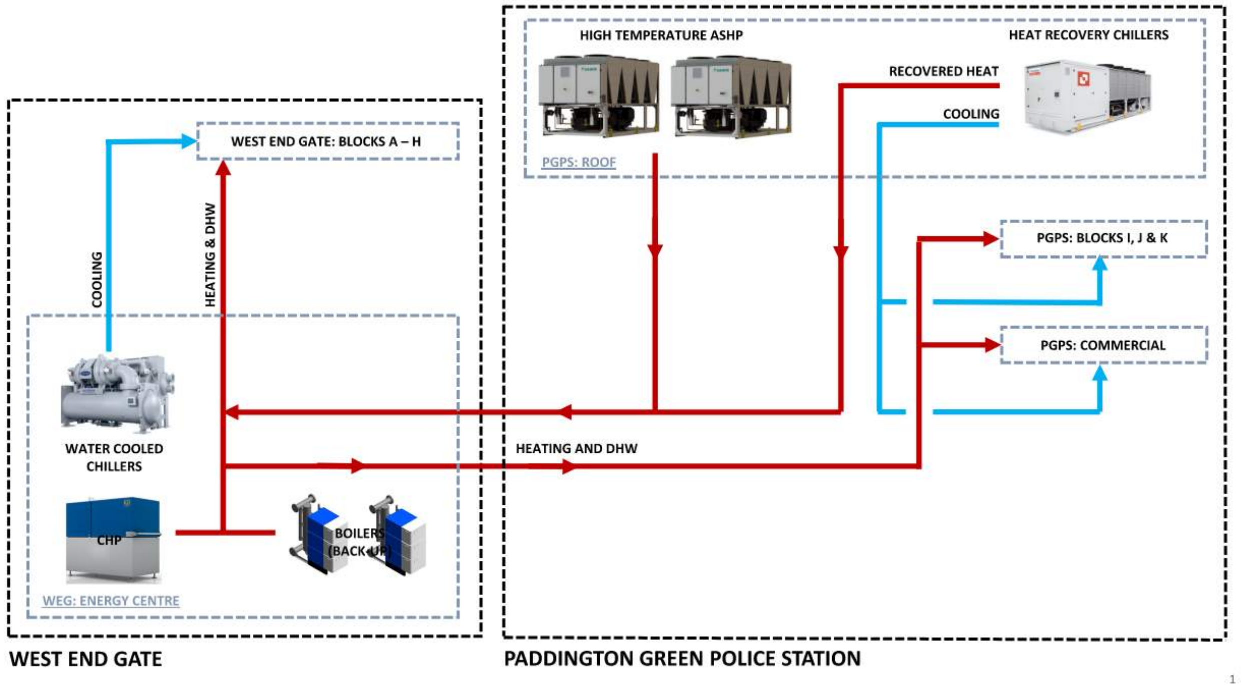


Figure 7-3 Discarded Energy Strategy for PGPS with WEG connection

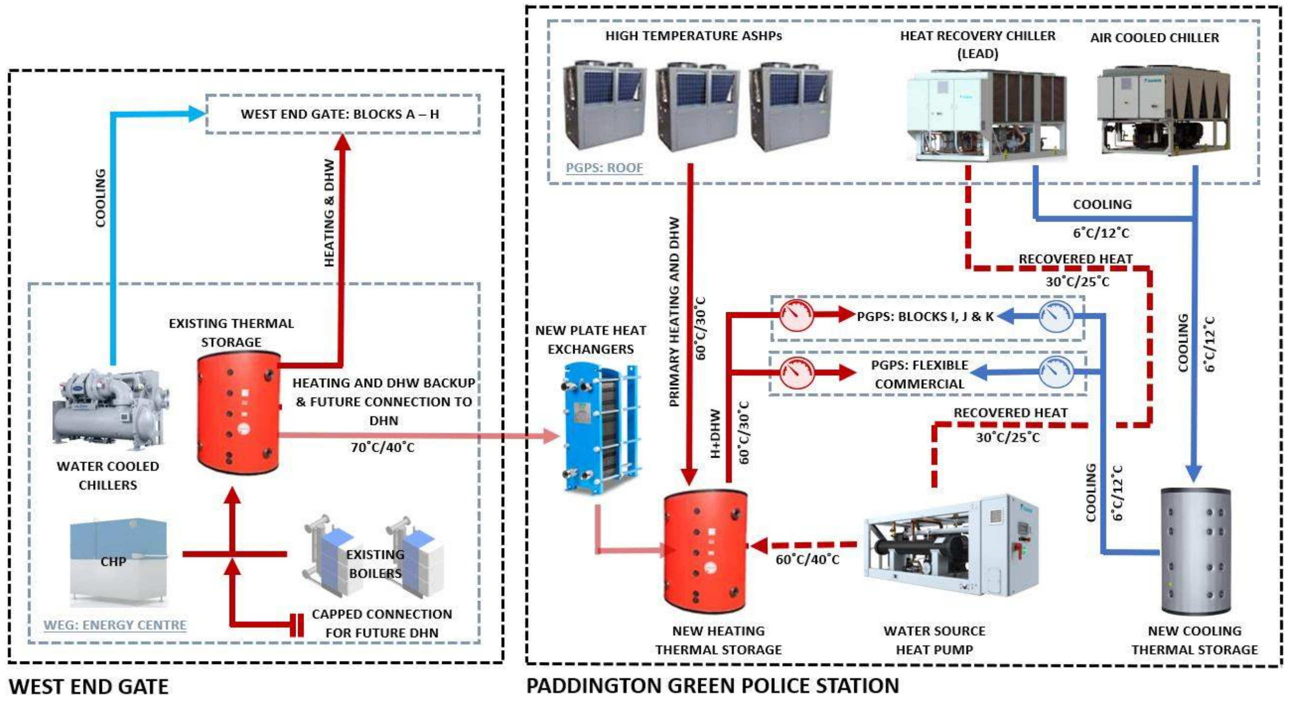


Figure 7-4 Schematic of PGPS clearly identifying facility to back connect into WEG community heat network its future DHN connection

7.3 Heating strategy

The application of a CHP system at PGPS has been ruled out of the energy strategy for this Site for several reasons. These are outlined below:

- Limited carbon emissions savings now and particularly in the future when compared with an increasingly decarbonised electrical grid;
- Negative impact on local air quality due to high NO_x emissions;
- Heating source against current UK strategy on grid decarbonisation. The change in the relative carbon content of electricity and gas signifies all-electric alternative heating sources will have lower carbon emissions than the more traditional gas engine CHP.

As a result, this option has not been proposed or modelled. Alternatively, a highly efficient heat pump systems have been specified, providing heating and hot water where necessary.

The PGPS energy centre has been designed to include a heating connection with WEG and its future DHN connection to Church Street. Which is part of the WEG decarbonisation strategy. While design stage progresses, opportunities for heat harvesting from the Site's low carbon heat network to feed WEG energy centre will be investigated and detailed further.

8 Energy Renewable Energy - 'Green'

8.1 Low Zero Carbon Technologies

This section provides a summary of the feasibility of low and zero carbon (LZC) technologies for the proposed building, in line with GLA recommendations.

An assessment of the project context relating to LZC technologies has been made, including the drivers for installing LZC technologies, the site opportunities and constraints, the estimated energy demands of the development and the potential for any financial support. The following aspects were addressed:

- Energy generated and CO_2 savings
- Life cycle costs and payback including grants and incentives
- Space and land use requirements
- Local planning requirements, including noise
- Potential to export energy from the system
- Potential for energy storage

Table 8-1 presents the findings of the feasibility analysis for the suitable LZC technology options for the project. The conclusions of this analysis are as follows:

- Air and Water Source Heat Pump (ASHP) is considered as the most viable solution for satisfying the space heating and hot water demand of the building, considering the grid will decarbonise in years to come. They can also recover waste heat from cooling circuits for covering additional loads in the building, significantly increasing the system efficiency
- Solar PV is also considered a viable method of generating renewable electricity and reducing the carbon emissions considering the effectiveness and space constraints
- Ground Source Heat Pump (GSHP) systems and solar thermal are found not viable due to space requirement, high capital costs and high payback periods
- Small scale turbines (horizontal or vertical axis) were considered unsuitable for the Site due to the space requirements, noise impact, high capital cost and long payback compared to the total energy savings estimations.

Table 8-1 – PGPS LZC feasiblity

Option	Suitability for Scheme	Viability
Air/Water Source Heat pumps	The European directive recognises air source heat pumps as a renewable energy source. In a similar way to the ground sourced technologies, the air is used to provide thermal energy. Recent technological developments have increased capacity and efficiency of ASHPs. Air source heat pumps should be located externally, and location should consider ambient noise emissions. As described in section 4, air source heat pumps are proposed to supply the community heating network aiming for a low carbon option that will achieve minimised carbon emissions and improved system efficiency. It is proven then to be highly effective to deliver high CO_2 savings and thus considered as a viable solution.	● (Viable)
Ground Source Heat pumps	There are a number of ways in which the ground can be used: horizontal pipes in the ground; vertical boreholes and putting the pipe work in piles. In all cases, the system is closed, and the working fluid is pumped around. Open loop systems tend to use an aquifer deep underground to act as a heat sink; this technology is not widely used in the UK which may pose an element of risk. In Southeast of England, the ground make-up is such that clay is typically found in the tens of metres under the surface; unfortunately, clay does not allow for the dissipation of heat effectively as it does not allow the free movement of water. Even though this technology could provide significant carbon savings; it is subject to ground conditions and heat balances. Further ground investigations are needed, and it is suggested that this option could be considered at masterplan scale in the future.	● (To be further assessed)
Solar PV	Electrical generation using solar photovoltaic panels is a typical, cost-effective solution for high density urban development. The proposed roof spaces offer some opportunity for PV panel installation, albeit space limitations for plant installation requirements. A PV array, even limited, will benefit the scheme for uplifting the energy savings from renewables. Therefore, a 90-degree PV array installed to the plant screens is considered suitable for the scheme for uplifting the energy savings from renewables.	● (Viable)
Solar Thermal	Solar panels can be used to provide domestic hot water, as by exploiting the absorbed sun energy can preheat the water stored up in a cylinder. These systems are efficient during summer months, where the hot water demand of the scheme is not proven to be significant. In addition, solar thermal systems have a long payback and high capital cost. It is therefore not a viable option for the current scheme and instead PV panels can be mounted in the available to reduce further the electrical load.	● (Unsuitable)
Biomass	Biomass boilers are not suitable for this project due to the risk of producing harmful levels of nitrogen dioxide and particulate matter in close proximity to a densely populated area.	● (Unsuitable)
Wind	Wind turbines harness the kinetic energy in the wind and convert this to electrical energy using a mechanical turbine. The efficacy of wind turbines depends heavily on (i) the wind speed and (ii) the swept area of the turbine's blades. In an urban environment such as the area of PGPS Scheme, wind characteristics are generally turbulent owning to the surrounding buildings obstructing its path at low level. Its installation within the Proposed Development would have significant impacts on the amenity of surrounding residents. There is also not enough roof space to make this viable and there are other limitations on the building's profile.	● (Unsuitable)
Water Technologies	The site is not located in near proximity with a watercourse. Electricity generation technologies such as small-scale hydropower, tidal power or wave power would not be appropriate as the infrastructure required would have a high capital cost and long payback in addition to the risk of interference with river traffic or local ecosystems.	● (Unsuitable)

● Viable ● To be further assessed ● Unsuitable

8.2 Solar Photovoltaic Panels (PVs)

Photovoltaic panels are semi-conductors which convert incident sunlight into electricity. They work well in a semi-rural or urban context as long as unshaded space can be identified.

The proposed PV Panels area equates to 313m^2 based on an integrated solution for 90-degree mounting PVs on plant rooms at roof. To maximise exposure to solar radiation and allow for roof geometry, south, southeast and south west facing flat 170 No. PVs are proposed.

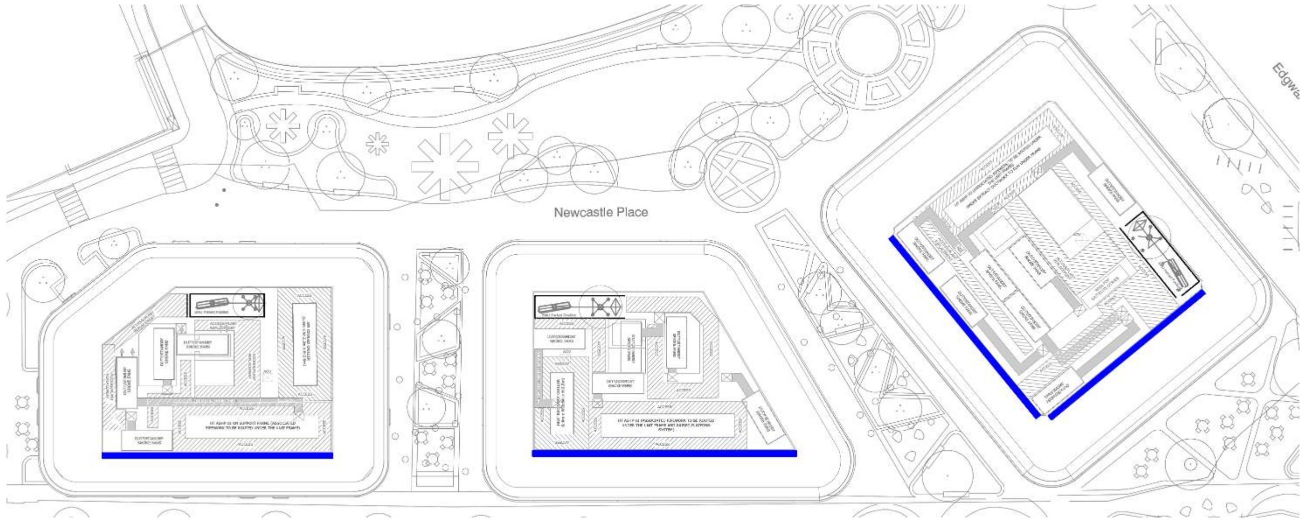


Figure 8-1 PGPS PV panels array

Table 8—2 Estimated PV Generation

Description	Block I	Block J	Block K	Total
Number of Panels	40	50	80	**170**
kWp	16	20	32	**68**
Area (m^2)	74	92	147	**313**
Tilt	90°	90°	90°	**-**
Orientation	South	South	SE and SW	**-**
Annual Energy Generation (kWh/Annum)	14,366	17,958	28,733	**6,1057**

8.3 'Green' predicted energy demand

The Green calculations demonstrate an improved model from renewable energy measures, with the following features:

- Highly efficient heat pumps
- Solar PV panels

The following Tables describe the predicted energy and carbon demands for the Green building.

The Proposed Development Green building currently achieves 49% through renewable energy only and **67%** on-site carbon emissions savings.

Table 8-3 Predicted Green energy demands

Typology	Green energy demand (MWh/ year)					
	Space heating	Hot water	Cooling	Auxiliary	Lighting	Unregulated Energy
Domestic *	278.9	572.9	223.8	207.4	103.1	2031.2
Non-Domestic	8.6	8.8	9.8	28.9	30.5	20.7
Subtotal	**287.5**	**581.7**	**233.7**	**236.4**	**133.6**	**2051.9**
Total	**3,524.8**					

* Values unchanged from previous submission as they are no longer available due to a software fault. Does not impact subsequent carbon emissions figures

8.4 'Green' Carbon Emissions

This section outlines the strategic approach applied to renewable energy to achieve the necessary carbon reduction requirement across the Proposed Development. It outlines the technologies to be implemented and their effectiveness across the site, as well as their impact on site wide carbon emissions.

Emissions from the heat pumps have been included in the green emissions section to follow, as heat pumps are considered a renewable technology. In addition, PV panels are proposed.

Emissions shown include the savings from the high efficiency heat pump systems and 313 m^2 area of PV panels using the SAP 10.2 carbon factors.

Table 8-4 Predicted Green carbon emissions (using SAP 10.2 carbon factors)

Typology	Baseline Regulated Carbon Emissions		Green Regulated Carbon Emissions		
	kg CO_2/year	Tonnes CO_2/year	kg CO_2/year	Tonnes CO_2/year	% Improvement over Baseline
Domestic	492,600	492.6	155,803	155.8	68.4%
Non-Domestic	10,060	10.1	9,215	9.2	8.4%
Total	**502,660**	**502.7**	**165,018**	**165.0**	**67.2%**

9 Energy Hierarchy Conclusions

The Lean, Clean, and Green (as outlined by the London Plan) modelling results have been collated in the format required for the planning submission as outlined in the GLA's Energy Assessment Guidance (2022). The following Figure and Table outline the carbon emissions of the site using the SAP 10.2 emissions factors and Part L 2021.

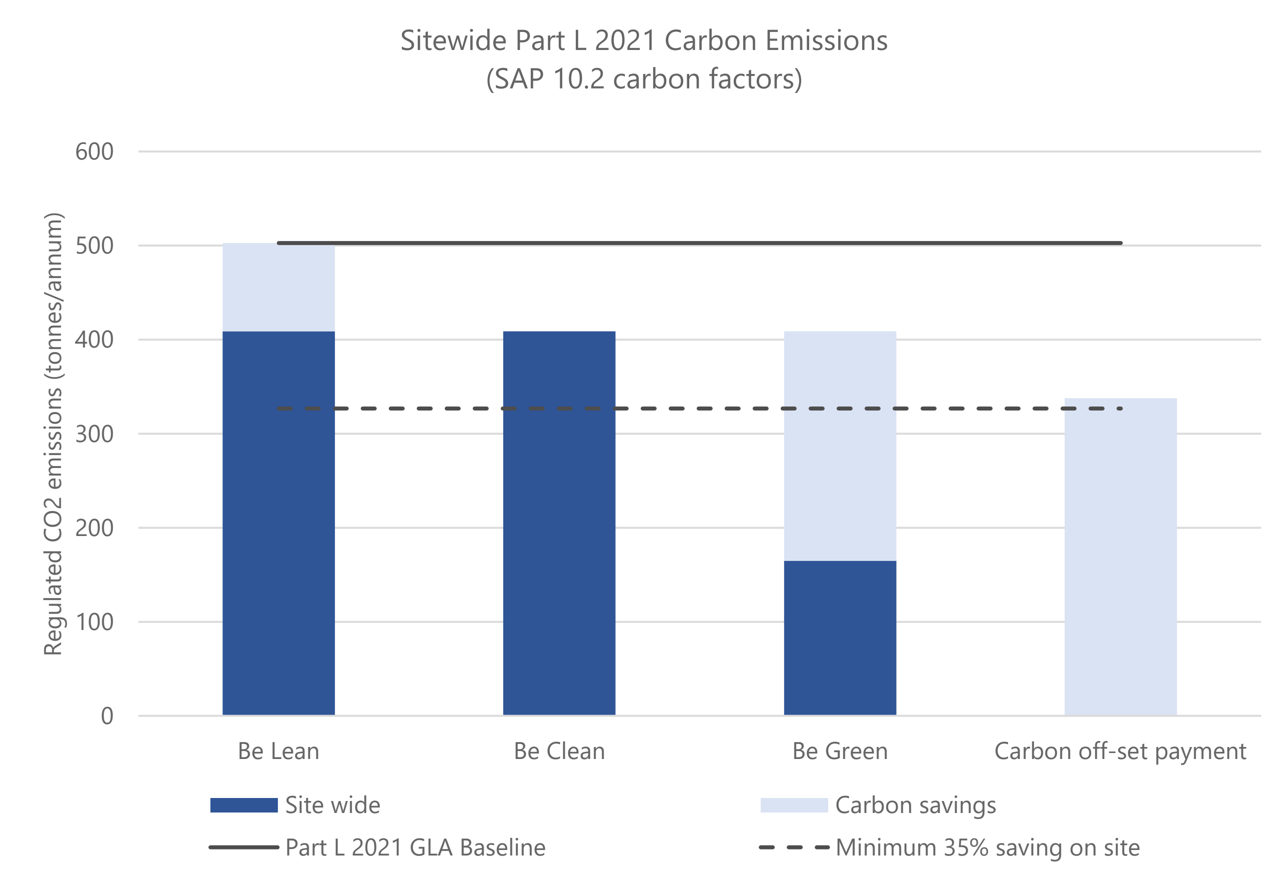


Figure 9-1 PGPS Carbon Savings throughout the energy hierarchy (Part L 2021)

Table 9-1 Predicted Site Wide regulated CO_2 emissions saving after each stage of the Energy Hierarchy (Part L 2021)

Part L 2021	**Total regulated emissions (Tonnes CO_2/year)**	**CO_2 savings (Tonnes CO_2/year)**	**Percentage saving (%)**
Part L 2021 Baseline	502.7	-	-
Be Lean: savings from energy demand reduction	408.7	93.9	19%
Be Clean: savings from heat network	408.7	0	0%
Be Green: savings from renewable energy	165.0	243.7	48%
Cumulative on-site savings	**-**	**337.6**	**67%**
		CO_2 savings off-set (Tonnes CO_2)	**CO_2 off-set payment (£)**
Total site wide off-set	**-**	**4,950.5**	**470,302**

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide.

10 Overheating

10.1 Overview

10.1.1 Overheating can be defined as a sensation of discomfort resulting from excessive temperature. The sensation of overheating is subjective; the conditions at which it occurs vary between people. Consequently, there are multiple metrics for assessing overheating.

The London Plan requires that major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. It also states that new development in London should be designed to avoid the need for energy intensive air conditioning systems as much as possible.

The Proposed Development has applied the cooling hierarchy in Policy SI 4 of the London Plan, providing measures to reduce the demand for cooling through the following categories:

Table 10—1 Overheating Strategy

Minimise internal gains	Reduce heat entering the building	Managing heat through materials	Passive ventilation	Mechanical ventilation	Active cooling
Energy efficient lighting, efficient domestic equipment, no communal heat sources will be specified. Heat gains from communal heating will therefore not be present in communal areas. Pipe lengths are consequently minimised.	Passive Design Principles in line with LETI have been prioritised across the scheme, including optimised U-values, y-values and g-values. A WWR 33% is proposed, alongside recess glazing and inset balconies to provide solar shading.	Building's thermal mass used to store heat in the day and release at night, heat storage in the day and release at night.	Openable windows and balcony doors have been designed to meet fresh air and ventilation requirements in line with Building Regulations Part O (dwellings). Due to acoustic constraints, residents will have the option to use natural ventilation for high levels of ventilation. However, comfort cooling and tempered cooling are provided to assure thermal comfort when the external noise level are of high risk.	Mechanical ventilation with heat recovery (MVHR) is proposed within the apartments and Fresh Air Ventilation with heat recovery through Air Handling Units (AHU) to flexible commercial; the heat recovery system will include a summer by-pass mode to allow for free cooling of the space using external air. MVHR systems will be designed and sized to meet whole unit background ventilation requirements ensuring that window opening is only required for purge scenarios.	Active cooling is considered only where alternative natural ventilation strategies do not provide sufficient temperatures and where noise levels are at risk. Comfort cooling (private development) and tempered air (affordable) are provided to dwellings due to acoustic constraints where windows are not feasible to be open at night. Tempered air is only provided as 'temperature lopping' to maintain internal temperatures at a comfortable range.

10.2 Acoustic Levels

Study undertaken by Acoustic Consultant (Ramboll) identified high noise levels around façade oriented towards Harrod and Edgware Road, resulting the reliance of openable windows for fresh air provision into exceeded internal noise levels within the dwellings.

Part O Building Regulation states that in locations where external noise may be an issue, the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am). Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB LAeq,T, averaged over 8 hours (between 11pm and 7am).

b. 55dB LAFmax, more than 10 times a night (between 11pm and 7am).

The noise levels on Site have led to different strategies being applied to all apartments, as presented within section 10-5.

10.3 Domestic Overheating Methodology

10.3.1 Part O 2021

Building Regulations Part O introduces a new requirement to assess and limit the risk of overheating in residential buildings. Following guidance from Approved Document O requires compliance with:

1. Either design limits under the new Simplified Method, OR comfort criteria under the dynamic thermal modelling route based on CIBSE TM59.

AND

- Requirements for "usability", including noise, pollution, safety (protection from falling and entrapment), and security, which apply to openings and features such as louvres and shading.

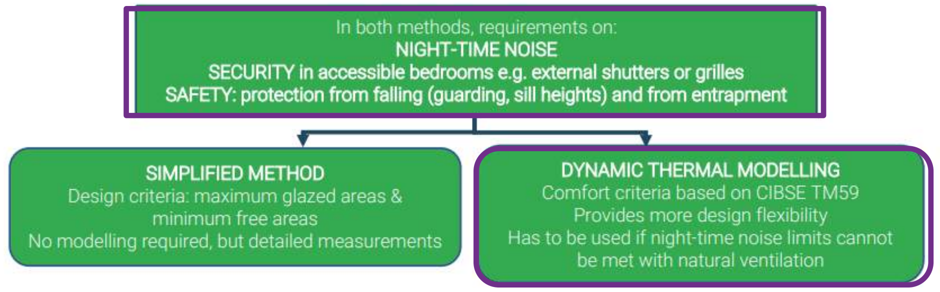


Figure 10-1 Part O Methodology routes

PGPS domestic overheating analysis was based on dynamic thermal modelling in IES VE 2022 software, following the comfort criteria based on CIBSE TM59, as well as it accounts for requirements, as represented on the diagram Methodology routes (Figure 10-1).

10.3.2 CIBSE TM59

The following criteria are specified by CIBSE TM59 for dynamic thermal modelling, which must be met in order to comply with Part O:

a) Criterion 1 – for living rooms, kitchens and bedrooms must not exceed the adaptive maximum acceptable temperature for more than 3% of occupied hours. This criterion is taken from CIBSE TM52 Crit. 1. This criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1°K or more during the occupied hours of a typical non-heating season (1st May to 30th September). The first requirement can be visually represented as:

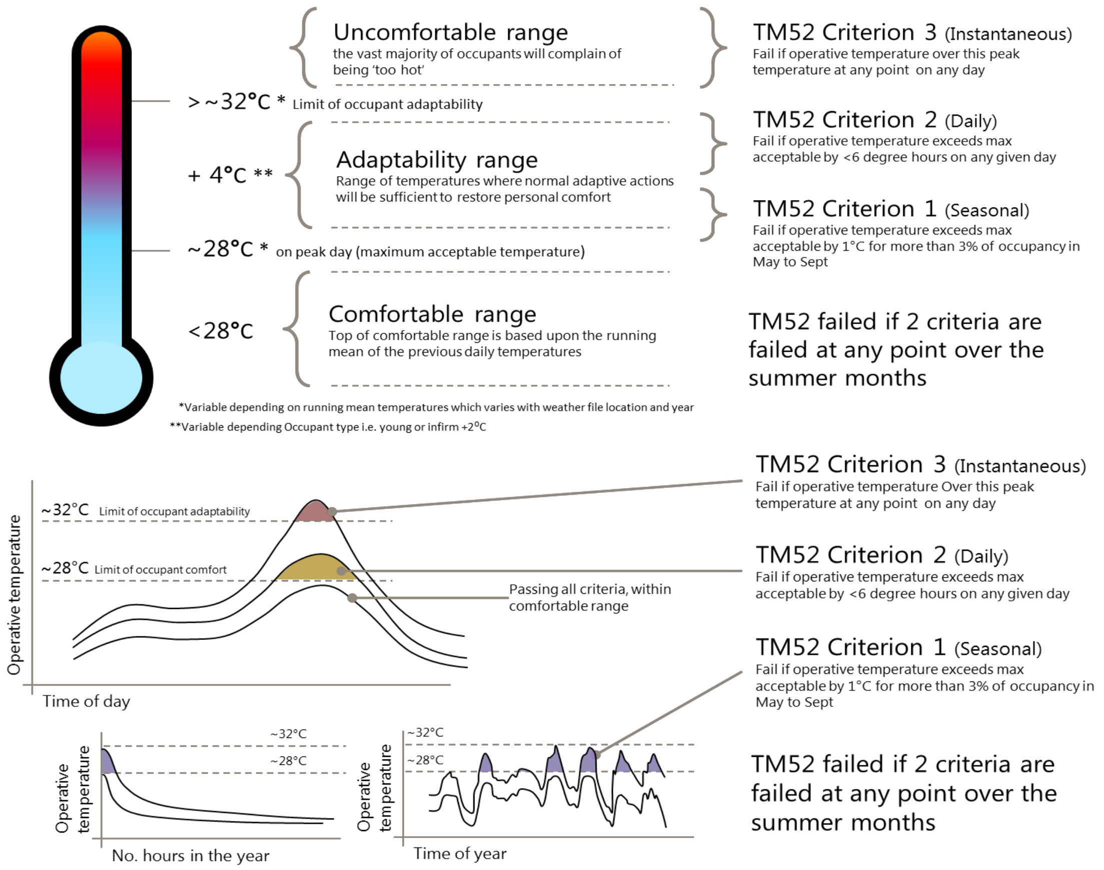


Figure 10-2 Visual representation of the TM52 Criterion 1, pass/fail.

b) Criterion 2 – for bedrooms only must have no more than 32 hours (1%) of night-time hours (22:00 to 07:00) above 26°C in the design year.

10.3.3 CIBSE A

Where design measures and the use of natural fresh air ventilation is not enough to guarantee the occupant's comfort (in line with the cooling hierarchy set out in London Plan) then the development should identify the cooling requirement of the different elements of the development.

For air-conditioned and mechanically ventilated spaces, the winter and summer operative temperatures should be assessed to ensure they fall within the upper and lower limits set by CIBSE Guide A (*CIBSE Guide A 2018 – Table 1.5: Recommended comfort criteria for specific applications*).

CIBSE Guide A reads: "*The predicted indoor temperature or values of PNV should not exceed the tabulated values for more than 3% of occupied hours*". CIBSE Guide A recommends that within educational spaces the operative temperature should not exceed 26°C for more than 3% the annual occupied hours.

10.4 Domestic Thermal Modelling Assumptions

The overheating assessment has been carried out using IES Virtual Environment software 2022. The overheating risk has been assessed using the CIBSE TM59 and CIBSE A criteria. Values for internal gains and occupancy profiles are aligned with CIBSE TM59 guidance and specifications.

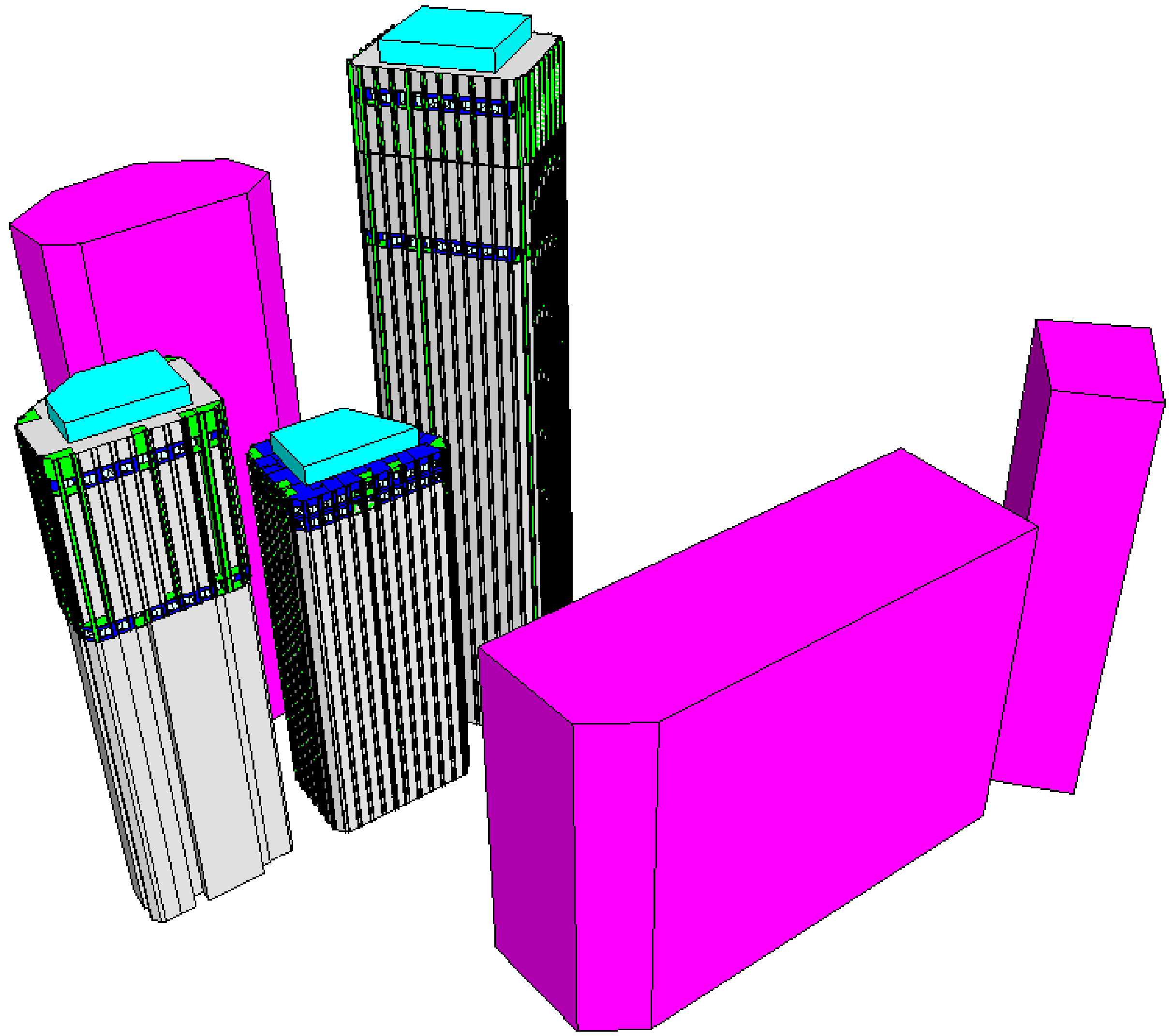
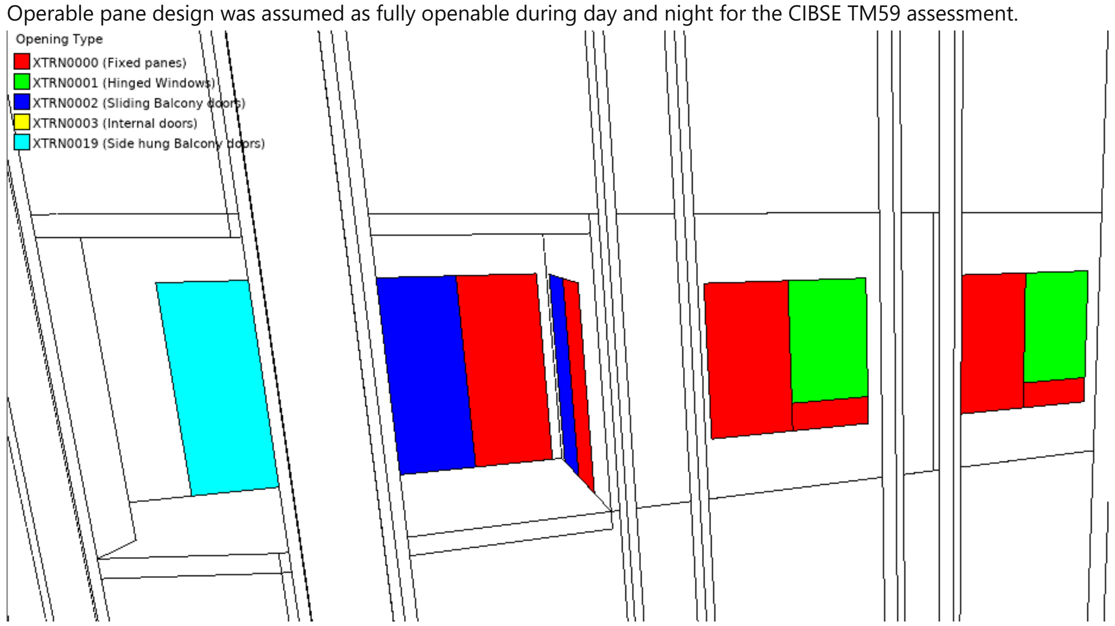
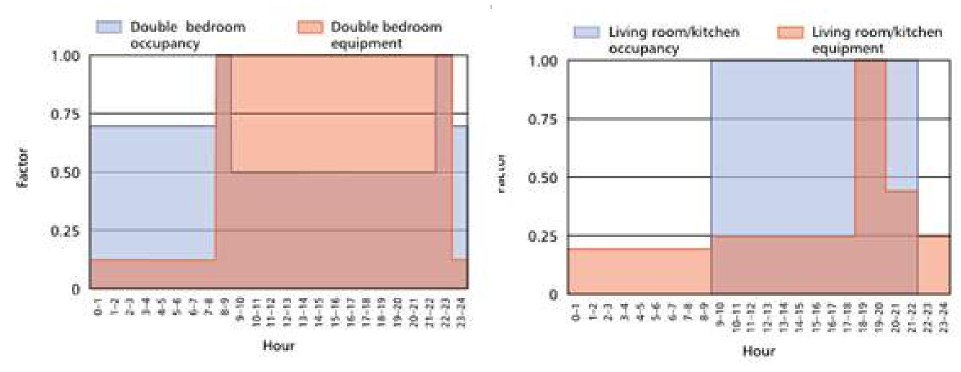


Figure 10-3 Computer model used for overheating analysis in IES-VE 2022

The core assumptions and inputs for domestic areas used in the modelling are detailed in Table 10-2.

Table 10-2 Thermal comfort modelling inputs

Item	Modelling input
Calculation	Software - IES Virtual Environment v. 2022 1.0.0 Calculation tool – ApacheSIM
Weather files	The compliance analysis has been carried out using the baseline Design Summer Year (DSY) for London Central, the most representative weather data for lower density urban and suburban areas, as described in CIBSE TM49 (2014). CIBSE TM49 sets out the DSY weather data sets for assessing overheating risk. The undertaken overheating assessment was based primarily on DSY1 file, representing a moderately warm summer. The weather data set for London Heathrow are listed below: • **DSY1** – Moderately warm summer (1989) • **DSY2** – Intense single warm spell (2003) • **DSY3** – Long period of persistent warmth (1976) For context, TM49 demonstrates the probability of a summer being as warm as or warmer than DSY1 is 1 in 9, for DSY2 this decreases to 1 in 19 and 1 in 27 for DSY 2 and 3 respectively (based on weighted cooling degree hours metric).
Fabric performance	As per Tables 6-2 and 6-3
Glazing opening strategy	Operable panes were modelled as operating manually. It is assumed that occupants close the windows when the outside air temperature exceeds the internal air temperature.
	Operable pane design was assumed as fully openable during day and night for the CIBSE TM59 assessment.  **Figure 10-4 Opening types**
Blinds	Blinds weren't incorporated to assess the scenarios following Part O recommendations
External shading	Façade details were incorporated to the thermal model as per Architect aspirations.
Internal door opening strategy	**All Internal doors** were modelled as being **open** during summer period
Internal Gains	Occupancy, Equipment and Lighting internal gains and profiles have been taken from CIBSE TM59 and had been applied for different size of apartments (1, 2, and 3 bedroom). Examples of occupancy profiles used are shown in Figure 10-5

Item	Modelling input
	 **Figure 10-5 CIBSE TM59 Internal gains templates**

10.5 Domestic Thermal Modelling Overheating Results

10.5.1 Modelling Scenarios

Given the input parameters described in section 10.6, the assessment was carried out as per the following scenarios.

Table 10-3 Dwellings assessed

Block	Level	Apartments Modelled
I	13	7
	22	6
J	15	6
	16	7
K	21	7
	37	6
Total	**6**	**39**

Table 10-4 Modelling scenarios

Scenario	Operability Profile Daytime	Operability Profile Night-time	Blinds	Comfort Cooling (Private Development) Tempered Cooling (Affordable)
1	100% open	100% open	No	No
2	Closed	Closed	No	Yes

10.5.2 Domestic Results

Based on the results shown in Tables 10-5, 10-6 and 10-7 for the occupied spaces at PGPS, all occupied rooms are considered of high overheating risk through natural ventilated means only without alternative mechanical or tempered cooling. As described in Section 10-2, high noise levels registered on Site represent occupiers' discomfort if natural ventilation is considered at night-time. Thus, mechanical and tempered cooling strategy are recommended to maintain adequate thermal comfort levels and without sleep disturbance.

- Natural ventilation strategies assessed under CIBSE TM59 demonstrate there are rooms under high overheating risk, as shown in Table 10-5
- Mechanical and tempered cooling were considered as shown in Table 10-7, with all rooms being compliant with CIBSE Guide A

- All the rooms failing CIBSE TM59 criteria via passive means only were incorporated with mechanical cooling (private development) and tempered cooling (affordable) to maintain adequate thermal comfort levels within the rooms during summer, and thus being compliant with CIBSE A overheating criteria for mechanical cooled spaces.

Table 10-5 describes the thermal comfort summary results against Design Summer Year 2020 scenario, assessing natural ventilation only. Table 10-6 describe the thermal comfort summary results against moderate and extreme current and future weather files, assessing natural ventilation only. Table 10-7 describe the thermal comfort summary results against current weather scenario, assessing tempered cooling.

Table 10-5 Thermal Comfort summary results – Natural Ventilation Only

Scenario	Natural Ventilation Only | Weather File DSY1 2020 50th			
	CIBSE Guide A Summer temp range (°C)	CIBSE TM59		
	±1-2C	Criteria a (%Hrs Top-Tmax>=1K)	Criteria b (Bedrooms)	CIBSE Guide TM59 Compliance
Scenario 1	24-28	FAIL	FAIL	FAIL
Scenario 2	24-28	PASS	PASS	PASS

Table 10-6 Thermal Comfort summary results Scenario 1 – Natural Ventilation Only

Scenario	Natural Ventilation Only | Moderate to Extreme Current and Future Weather Scenarios			
	CIBSE Guide A Summer temp range (°C)	CIBSE TM59		
	±1-2C	Criteria a (%Hrs Top-Tmax>=1K)	Criteria b (Bedrooms)	CIBSE Guide TM59 Compliance
Scenario 1 – DSY 2 2020 50th	24-28	FAIL	FAIL	FAIL
Scenario 1 – DSY 3 2020 50th	24-28	FAIL	FAIL	FAIL
Scenario 1 – DSY 1 2050 50th	24-28	FAIL	FAIL	FAIL
Scenario 1 – DSY 1 2080 50th	24-28	FAIL	FAIL	FAIL

Table 10-7 Thermal Comfort summary results Scenario 2 – Mechanical Cooling and Tempered Cooling

Space ID	Tempered Cooling | Moderate to Extreme Current and Future Weather Scenarios				
	CIBSE Guide A Summer temp range (°C)	CIBSE Guide A Compliance	CIBSE TM59		
	±1-2C		Criteria a (%Hrs Top-Tmax>=1K)	Criteria b (Bedrooms)	CIBSE Guide TM59 Compliance
Scenario 2 - DSY 1 2020 50th	24-28	PASS	PASS	PASS	PASS

10.5.3 Domestic Overheating Compliance Summary

Following Building Regulation Approved Document O (Overheating) and London Plan Policy SI 4, recommendations for reducing overheating risk and limiting solar gains by passive means were followed.

Scenario 1 assesses natural ventilation to sample dwellings with openable panes being operable at daytime and night-time without the incorporation of internal or external shading. The operative temperatures registered in summer overpassed CIBSE TM59 criteria a and b under current moderate weather files (DSY 1 2020 50th), more extreme weather scenarios (DSY 2 2020 50th and DSY 3 2020 50th) and under future weather files (DSY 1 2050 50th and DSY 1 2080 50th). Therefore, Scenario 1 failed to comply CIBSE TM59.

Scenario 2 assesses mechanical cooling (private development) and tempered cooling (affordable), with openable panes considered closed during daytime and night-time without the incorporation of internal or external shading. Scenario 2 complies with CIBSE Guide A and CIBSE TM59 overheating criteria and therefore considered as the suitable solution for maintaining adequate comfort temperature during summer period for current and future weather scenarios. Scenario 2 will therefore be implemented.

10.6 Non-domestic active cooling

The active cooling demand of the non-domestic areas were extracted from the BRUKL reports (HVAC Systems Performance) and is summarized in the table below:

Table 10-8 Active cooling demand for non-domestic spaces

	Building Cooling Demand (kWh/m^2)	
	Landlord Areas	Flexible Commercial
Actual Building (PGPS)	1.28	4.94
Notional Building (Baseline)	1.13	3.72

Cooling loads for commercial spaces at PGPS (actual building) are proven to be below the predicted from the notional building (baseline). This is a result of optimised envelope and highly efficient low carbon systems (ASHPs).

The following measures have been applied to reduce the cooling loads from outset:

1) The HVAC system design considers optimised SEER and EER for the air-cooled chiller and the heat recovery chiller on-site, being highly energy efficient;
2) Recessed glazing for the flexible commercial and landlord areas at ground floor reduce unwanted solar gains;
3) Shading from surrounding buildings to cast shadows at ground floor level.

Commercial spaces at PGPS demonstrated optimised cooling demand, following the glazing g-values recommendations as described in Table 6-1 and mechanical systems described in Table 6-5.

11 'Be Seen'

11.1 GLA Be Seen Background and Requirements

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. This means all new buildings must target net zero carbon. The Mayor's London Plan sets the targets and policies required to achieve this. It includes:

- A net zero-carbon target for all major developments
- A requirement for all major development to 'be seen'. In particular, to monitor and report its energy performance post-construction to ensure that the actual carbon performance is aligned with the Mayor's net zero-carbon target.
- A requirement for all referable planning applications to calculate and reduce whole life-cycle carbon emissions to fully capture a development's carbon impact.

To address the energy performance gap between design theory and measured reality, London Plan Policy introduces a 'Be Seen'. It requires monitoring and reporting of the actual operational energy performance for at least five years after construction via the Mayor's 'be seen' monitoring portal. Figure 1 illustrates the 'Be Seen' process and its underpinning responsibilities of the planning applicants, developers, and/or building owners.

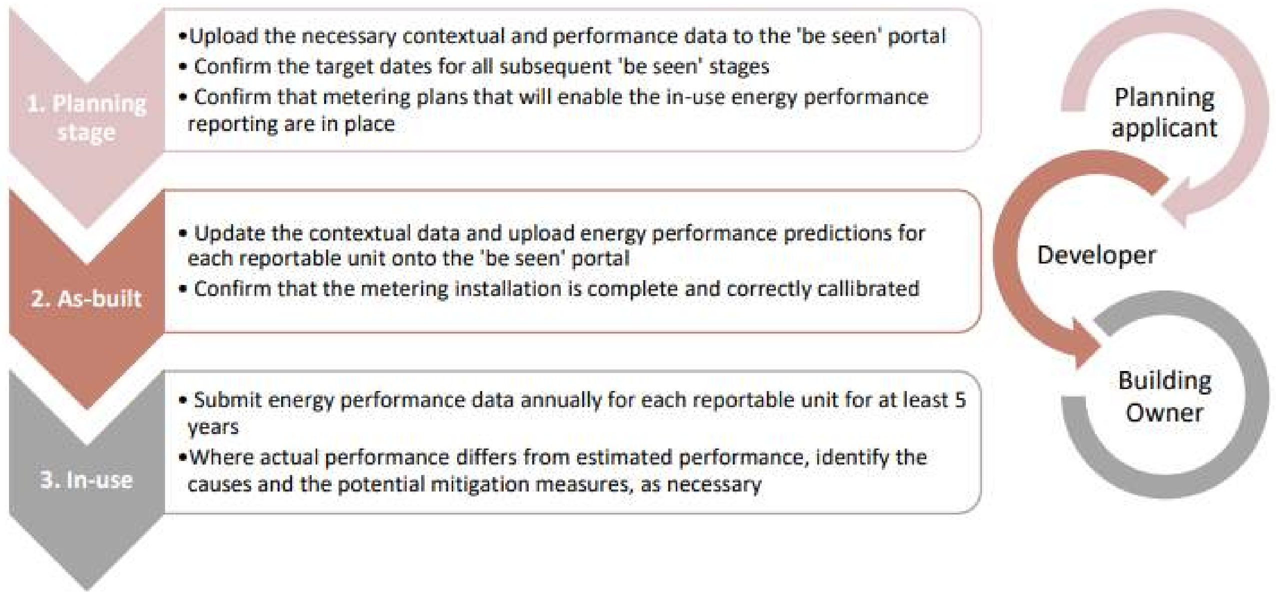


Figure 11-1 'Be Seen' process and responsibilities.

11.2 Metering Guidance & Legislation

Effective energy metering in line with the Be Seen requirements will be enabled by the provision of suitable infrastructure within the buildings services systems. The methodology used broadly follows the recommendations set out, for non-domestic buildings, in CIBSE TM39: 2009 Building Energy Metering, BREEAM 2018 NC, as well as the principles set out in NABERS-UK Rules for Metering and Consumptions (May 2022).

The Metering and monitoring of residential areas will consider the same concepts as well as the Heat Network Metering and Billing Regulations (2014) to allow for accurate billing of the apartments connected to the communal ambient loop system.

11.2.1 Domestic Legislation and Guidance

- Electricity and Gas "if needed"- approved tariff-based meters, meeting standards set out by OFGEM, are required for energy monitoring and billing purposes.
- Water – approved meters for the monitoring and billing of the water consumed are required to meet standards set out by OFWAT.
- Heat Networks – regulations developed by the Department for Business, Energy & Industrial Strategy apply (Heat Network (Metering and Billing) Regulations 2014.
- Part L1A -2021– Building Regulations specific to domestic buildings.
- CIBSE TM 39 :2009 Building Energy Metering – although written for non-domestic buildings, the principles of metering strategies can be adapted for residential buildings.
- BRE Home Quality Mark for Energy and Water
- LETI Climate Emergency Design Guide (pages 98-107)

11.2.2 Non-Domestic Legislation and Guidance

- Electricity and Gas "if needed" - approved tariff-based meters, meeting standards set out by the Office of Gas and Electricity Markets (OFGEM) are required for energy monitoring and billing purposes;
- Water – approved meters for the monitoring and billing of the water consumed are required to meet standards set out by the Office of Water Services (OFWAT);
- Heat Networks – regulations developed by the Department for Business, Energy & Industrial Strategy apply (Heat Network (Metering and Billing) Regulations 2014;
- Part L2A -2013 – Building Regulations specific to non-domestic buildings;
- CIBSE TM 39:2009 Building Energy Metering
- BREEAM 2018 – Ene02 Energy Monitoring;
- CIBSE TM 22 - Energy assessment and reporting method;
- The European Measuring Instruments Directive (MID) 2004/22/EC, Measuring Instruments Directive.
- GLA "Be Seen" Energy Monitoring Guidance – October 2020
- NABERS-UK Rules for Metering and Consumptions (May 2022).

11.3 Proposed Metering Strategy

The proposed metering strategy of the building by the MEP consultant will include the following:

- Additional meter on the main resident's supply (or residents meter readings need to be collected and collated individually)
- Renewables are sub-metered for generation
- Special uses such as electric vehicle charging is sub-metered
- Individual bi-directional heat meters per dwelling
- Provide a visual energy display device to raise awareness and make users responsible for their energy consumption
- Meter and report landlord areas separately
- Commercial areas metered and reported separately
- Ensure OFGEM compliant meters
- Upload data to publicly accessible platform for five years

11.4 'Be Seen'

Following the 'Be Seen' Energy Monitoring Guidance (October 2020), and as per GLA monitoring requirement stated in Policy SI2 of the London Plan (March 2021), PGPS will demonstrate a commitment to monitor, verify and report on the energy performance post-construction of the scheme.

The methodology used for reporting the energy consumption (kWh/yr) and carbon emissions (tonnes CO_2/ry) estimates follows the CIBSE TM54 recommendations on regulated and unregulated loads. For commercial areas, advanced dynamic thermal modelling simulations were carried out to estimate the space heating, cooling, ventilation and fan power demand, alongside overall best practice benchmarks based on CIBSE Guide F to estimate the additional energy use for the scheme (e.g. IT loads, lighting and lifts). For residential areas, SAP calculations were carried out to estimate the space heating, cooling, ventilation and fan power demand, alongside overall best practice benchmarks to estimate the additional energy use for the scheme (e.g., appliances and lighting). As the technical design progresses, the energy prediction for the scheme will be estimated based on further dynamic and steady simulation model and energy metering aspirations.

The energy consumption and carbon emissions estimations for the development are described in Table 11-1 and 11-2.

11.5 'Be Seen' Results

Tables 11-1 and 11-2 summarise the Be Seen estimations of the current Stage of the project. It presents the predicted annual energy use from the BRUKL reports (Appendix A), SAP reports (Appendix B) and CIBSE TM54 and F calculations based on energy density benchmark values.

Table 11-1 'Be Seen' summary – Non-Domestic

Performance Indicator Group	Indicator	Unit	Part L2 Calculations	CIBSE TM54 Calculations
Contextual Data	Address	Harrow Road, London, W2		
	Site Plan	Included in the planning documentation		
	Planning Use Class	Flexible Commercial (Class E/F)		
	Anticipated target dates for each 'Be Seen'	Planning Stage	November 2022	
		As built	-	
		In-use	-	
	GIA	m^2	2,598	11,838
Building Energy Use	Grid electricity	kWh/year	86,700	906,000
	Fuel	kWh/year	0	0
	Other fuels	kWh/year	0	0
	Energy generation	kWh/year	0	0
	District heating consumption	kWh/year	0	0
Carbon Emissions	Predicted annual carbon emissions	tCO_2/year	9.2	122
	Estimated carbon offset amount	£ /year	874.6	

Table 11-2 'Be Seen' summary – Domestic

Performance Indicator Group	Indicator	Unit	Part L1 Calculations
Contextual Data	Address	Harrow Road, London, W2	
	Site Plan	Included in the planning documentation	
	Planning Use Class	Residential (Class C3)	
	Anticipated target dates for each 'Be Seen'	Planning Stage	November 2022
		As built	-
		In-use	-
	GIA	60,465 m^2	
	Number of flats	556	
Building Energy Use	Grid electricity	kWh/year	1,386,206
	Fuel	kWh/year	0
	Other fuels	kWh/year	0
	Energy generation	kWh/year	0
	District heating consumption	kWh/year	0
Carbon Emissions	Predicted annual carbon emissions	tCO_2/year	153
	Estimated carbon offset amount	£ /year	14,569

12 Conclusions

This Energy Strategy report has been compiled by Buro Happold on behalf of Berkeley Homes (Central London) (the Applicant) with respect to PGPS (the Site).

The scheme was assessed following compliance with the London Plan energy hierarchy described as Lean, Clean, and Green. The following measures have been incorporated into the development:

Lean - Energy efficiency measures	Improved energy efficient model, with the following features: - Improved building fabric and air tightness over notional - Energy efficiency measures as required to achieve 10% reduction for residential areas, on Part L 2021 (SAP) compliance - Highly energy efficient lighting fittings and controls
Clean - Connecting to CHP District Heat Network (DHN)	- Not applicable. Therefore, Be Clean is the same as Be Lean model
Green -Renewable Energy Technology	Improved model, with the following features: - Heat pumps - PV panels
Be Seen	A suitable operational energy assessment was carried out as described within Section 11 in this report

Through the application of the energy hierarchy, the development achieves a carbon dioxide emissions reduction of **67%** below the Building Regulations 2021 TER (ASHP heating system). This is a significant reduction considering the stringent NCM and SAP methodologies (2022) for assessing new schemes under Part L 2021. A total one-off carbon off-set payment of **£470,302** is required to achieve the "Zero Carbon" target.

12.1 Overheating

Dynamic thermal modelling was carried out for predicting the overheating risk for domestic occupied spaces. The assessment demonstrated compliance with CIBSE TM59 and CIBSE A, following mechanical ventilation strategies, with summer operative temperatures falling within the upper and lower acceptable limits for occupant's adequate thermal comfort.

12.2 'Be Seen'

Berkeley Homes (Central London) will demonstrate a commitment to monitor, verify and report on the energy performance post-construction of the scheme.

Advanced dynamic thermal simulation and steady calculations, along with CIBSE Guide F benchmarks were used to estimate the regulated and unregulated energy consumption for the scheme, based on CIBSE TM54 recommendations. The energy demand for PGPS is predicted to be of 898,100 kWh/yr for commercial and common areas and 1,464,303 for residential areas with an energy generation from renewables of 61,057 kWh/yr.

As the technical design progresses, the energy prediction for the scheme will be estimated based on further dynamic simulation model and energy metering aspirations.

11 Appendix A – BRUKL Reports

1.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Paddington Green Police Station - Landlord areas - GREEN

As designed

Date: Tue Nov 15 16:08:38 2022

Administrative information

Building Details

Address:

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

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

Foundation area [m²]: 580.5

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	2.71	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	2.51	
Target primary energy rate (TPER), $kWh/m^2.annum$	29.29	
Building primary energy rate (BPER), $kWh/m^2.annum$	27.09	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.2	RF000005:Surf[1]
Floors	0.18	0.13	0.13	BS000003:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	-	-	No Flat roofs in building
Windows** and roof windows	1.6	1.2	1.2	BL00000A:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Rads

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.07	-	0	-	-
Standard value	2.5*	N/A	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.					

2- FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.07	5	0	1.4	0.85
Standard value	2.5*	4.5**	N/A	2^	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. ** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4. ^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

3- Rads + Extract only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.07	-	0	-	-
Standard value	2.5*	N/A	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.					

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

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	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Block I PD Management Office	-	-	-	-	-	-	-	0.2	-	-	N/A

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Block K Store	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K Estate Mgmt Office	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Storage_1	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K PD Entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
000 Block K Storage_2	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K Residential Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I PD Entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I Community Space	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Block I East Stairwell	120	-	-
Block I PD Management Office	120	-	-
Block I Corridor_2	120	-	-
Block J West Stairwell	120	-	-
Block J Egress	120	-	-
Block J Cycle Ent	120	-	-
Block J Fire Service & SR Ent.	120	80	1.688
Block J East Stairwell	120	-	-
Block J Corridors_1	120	-	-
Block J Corridors_2	120	-	-
Block K Store	120	-	-
Block K Corridor	120	-	-
Block I Plant	120	-	-
Block I Cycle Ent	120	-	-
Block J Plant (small)	120	-	-
Block J Plant	120	-	-
Block K Fire Service & Egress (small)	120	-	-
Block K Estate Mgmt Office	120	-	-
Block K Stairwell	120	-	-
Block K Stairwell from Ground	120	-	-
Block K Plant	120	-	-
Block I West Stairwell	120	-	-
Block K North Lobby	120	-	-
Block K Storage_1	120	-	-
Block K PD Entrance	120	80	1.688
B1 Refuge 2	120	-	-
B1 Refuge 3	120	-	-
B1 Plant 1	120	-	-
B1 Stair 1 to Ground	120	-	-
B1 Refuge 4	120	-	-
B1 Basement Stair to Ground	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1 Basement Stair 1 to B2	120	-	-
B1 Basement Stair 2 to B2	120	-	-
B2 Refuge	120	-	-
B2 Basement Stair to Ground_2	120	-	-
B2 Basement Stair_1 to Ground	120	-	-
000 Block K Storage_2	120	-	-
Block K Residential Amenity	120	-	-
B1 Refuge 1	120	-	-
Block I Corridor_1	120	-	-
Block K Cycle Ent	120	-	-
Block I PD Entrance	120	80	1.688
Block I East Egress	120	-	-
Block I Community Space	120	-	-
Block I West Egress	120	-	-
Block K Fire Service & Egress	120	-	-
Block K Lobby	120	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block I PD Management Office	N/A	N/A
Block J Fire Service & SR Ent.	NO (-40.3%)	NO
Block K Estate Mgmt Office	NO (-40.3%)	NO
Block K PD Entrance	NO (-43%)	NO
Block K Residential Amenity	NO (-56.1%)	NO
Block I PD Entrance	NO (-48.7%)	NO
Block I Community Space	YES (+36.8%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1581.6	1581.6
External area [m²]	9724	4052.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	19557	914.95
Average U-value [W/m²K]	2.01	0.23
Alpha value* [%]	6.32	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m²]

	Actual	Notional
Heating	3.12	2.77
Cooling	1.28	1.13
Auxiliary	4.37	3.73
Lighting	4.31	5.58
Hot water	5.2	6.57
Equipment*	55.36	55.36
TOTAL**	**18.28**	**19.78**

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	50.59	48.87
Primary energy [kWh/m²]	27.09	29.29
Total emissions [kg/m²]	2.51	2.71

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] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	24.7	47.3	2.5	3.3	10.3	2.78	4.04	3.07	5
	Notional	4.1	54.3	0.4	3.3	6.3	3.01	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	71.3	0	6.9	0	1.8	2.88	0	3.07	0
	Notional	47.9	0	4.4	0	2.2	3.01	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	67.7	0	6.5	0	1	2.88	0	3.07	0
	Notional	78	0	7.2	0	1	3.01	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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Paddington Green Police Station - Landlord areas - LEAN

As designed

Date: Tue Nov 15 15:29:47 2022

Administrative information

Building Details

Address:

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

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

Foundation area [m²]: 580.5

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	2.71	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	2.69	
Target primary energy rate (TPER), $kWh/m^2.annum$	15.34	
Building primary energy rate (BPER), $kWh/m^2.annum$	14.61	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.2	RF000005:Surf[1]
Floors	0.18	0.13	0.13	BS000003:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	-	-	No Flat roofs in building
Windows** and roof windows	1.6	1.2	1.2	BL00000A:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Rads

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.66	-	0	-	-
Standard value	2.5*	N/A	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.					

2- FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.66	5	0	1.4	0.85
Standard value	2.5*	4.5**	N/A	2^	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. ** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4. ^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.					

3- Rads + Extract only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.66	-	0	-	-
Standard value	2.5*	N/A	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.					

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

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	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Block I PD Management Office	-	-	-	-	-	-	-	0.2	-	-	N/A

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Block K Store	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K Estate Mgmt Office	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Storage_1	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K PD Entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
000 Block K Storage_2	-	-	0.4	-	-	-	-	-	-	-	N/A
Block K Residential Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I PD Entrance	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I Community Space	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Block I East Stairwell	120	-	-
Block I PD Management Office	120	-	-
Block I Corridor_2	120	-	-
Block J West Stairwell	120	-	-
Block J Egress	120	-	-
Block J Cycle Ent	120	-	-
Block J Fire Service & SR Ent.	120	80	1.688
Block J East Stairwell	120	-	-
Block J Corridors_1	120	-	-
Block J Corridors_2	120	-	-
Block K Store	120	-	-
Block K Corridor	120	-	-
Block I Plant	120	-	-
Block I Cycle Ent	120	-	-
Block J Plant (small)	120	-	-
Block J Plant	120	-	-
Block K Fire Service & Egress (small)	120	-	-
Block K Estate Mgmt Office	120	-	-
Block K Stairwell	120	-	-
Block K Stairwell from Ground	120	-	-
Block K Plant	120	-	-
Block I West Stairwell	120	-	-
Block K North Lobby	120	-	-
Block K Storage_1	120	-	-
Block K PD Entrance	120	80	1.688
B1 Refuge 2	120	-	-
B1 Refuge 3	120	-	-
B1 Plant 1	120	-	-
B1 Stair 1 to Ground	120	-	-
B1 Refuge 4	120	-	-
B1 Basement Stair to Ground	120	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
B1 Basement Stair 1 to B2	120	-	-
B1 Basement Stair 2 to B2	120	-	-
B2 Refuge	120	-	-
B2 Basement Stair to Ground_2	120	-	-
B2 Basement Stair_1 to Ground	120	-	-
000 Block K Storage_2	120	-	-
Block K Residential Amenity	120	-	-
B1 Refuge 1	120	-	-
Block I Corridor_1	120	-	-
Block K Cycle Ent	120	-	-
Block I PD Entrance	120	80	1.688
Block I East Egress	120	-	-
Block I Community Space	120	-	-
Block I West Egress	120	-	-
Block K Fire Service & Egress	120	-	-
Block K Lobby	120	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block I PD Management Office	N/A	N/A
Block J Fire Service & SR Ent.	NO (-40.3%)	NO
Block K Estate Mgmt Office	NO (-40.3%)	NO
Block K PD Entrance	NO (-43%)	NO
Block K Residential Amenity	NO (-56.1%)	NO
Block I PD Entrance	NO (-48.7%)	NO
Block I Community Space	YES (+36.8%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1581.6	1581.6
External area [m²]	9724	4052.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	19557	914.95
Average U-value [W/m²K]	2.01	0.23
Alpha value* [%]	6.32	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m²]

	Actual	Notional
Heating	3.6	2.77
Cooling	1.28	1.13
Auxiliary	4.37	3.73
Lighting	4.31	5.58
Hot water	6	6.57
Equipment*	55.36	55.36
TOTAL**	**19.56**	**19.78**

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	50.59	48.87
Primary energy [kWh/m²]	14.61	15.34
Total emissions [kg/m²]	2.69	2.71

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] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	24.7	47.3	2.8	3.3	10.3	2.41	4.04	2.66	5
	Notional	4.1	54.3	0.4	3.3	6.3	3.01	4.63	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	71.3	0	7.9	0	1.8	2.5	0	2.66	0
	Notional	47.9	0	4.4	0	2.2	3.01	0	----	----
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	67.7	0	7.5	0	1	2.5	0	2.66	0
	Notional	78	0	7.2	0	1	3.01	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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Paddington Green Police Station - Retails - GREEN

As designed

Date: Tue Nov 15 15:53:53 2022

Administrative information

Building Details

Address:

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

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

Foundation area [m²]: 1047.06

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	5.68	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.16	
Target primary energy rate (TPER), $kWh/m^2.annum$	61.98	
Building primary energy rate (BPER), $kWh/m^2.annum$	56.18	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.13	0.13	BL00001E:Surf[1]
Floors	0.18	0.13	0.13	BL0000A3:Surf[16]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	-	-	No Flat roofs in building
Windows** and roof windows	1.6	1.2	1.2	BL00001E:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.07	5	0	1.4	0.85
Standard value	2.5*	4.5**	N/A	2^	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.

** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Block I Flexible Commercial Unit 09	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 07	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 05	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 01	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 2	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I Flexible Commercial Unit 08	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 06	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 03	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 04	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Block I Flexible Commercial Unit 09	120	80	1.875

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Block J Flexible Commercial Unit 07	120	80	1.875
Block J Flexible Commercial Unit 05	120	80	1.875
Block K Flexible Commercial Unit 01	120	80	1.875
Block K Flexible Commercial Unit 2	120	80	1.875
Block I Flexible Commercial Unit 08	120	80	1.875
Block J Flexible Commercial Unit 06	120	80	1.875
Block K Flexible Commercial Unit 03	120	80	1.875
Block K Flexible Commercial Unit 04	120	80	1.875

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block I Flexible Commercial Unit 09	YES (+20.4%)	NO
Block J Flexible Commercial Unit 07	NO (-49.6%)	NO
Block J Flexible Commercial Unit 05	NO (-12.2%)	NO
Block K Flexible Commercial Unit 01	NO (-1.5%)	NO
Block K Flexible Commercial Unit 2	YES (+39.5%)	NO
Block I Flexible Commercial Unit 08	NO (-44.7%)	NO
Block J Flexible Commercial Unit 06	YES (+15.8%)	NO
Block K Flexible Commercial Unit 03	YES (+48%)	NO
Block K Flexible Commercial Unit 04	NO (-34.7%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1016.5	1016.5
External area [m²]	648.2	1690.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	731.6	517.92
Average U-value [W/m²K]	1.13	0.31
Alpha value* [%]	18.64	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m²]

	Actual	Notional
Heating	3.64	1.57
Cooling	4.94	3.72
Auxiliary	13.93	12.45
Lighting	14.97	23.73
Hot water	0.58	0.56
Equipment*	20.26	20.26
TOTAL**	**38.06**	**42.03**

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	108.29	79.01
Primary energy [kWh/m²]	56.18	61.98
Total emissions [kg/m²]	5.16	5.68

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] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	36.4	71.8	3.6	4.9	13.9	2.78	4.04	3.07	5
	Notional	17.1	62	1.6	3.7	12.5	3.01	4.63	----	----
[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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Paddington Green Police Station - Retails - LEAN

As designed

Date: Tue Nov 15 15:37:51 2022

Administrative information

Building Details

Address:

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

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

Foundation area [m²]: 1047.06

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

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	5.68	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.26	
Target primary energy rate (TPER), $kWh/m^2.annum$	58.72	
Building primary energy rate (BPER), $kWh/m^2.annum$	49.73	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.13	0.13	BL00001E:Surf[1]
Floors	0.18	0.13	0.13	BL0000A3:Surf[16]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	-	-	No Flat roofs in building
Windows** and roof windows	1.6	1.2	1.2	BL00001E:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

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

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

** Display windows and similar glazing are excluded from the U-value check.
*** Values for rooflights refer to the horizontal position.

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

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- FCU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.66	5	0	1.4	0.85
Standard value	2.5*	4.5**	N/A	2^	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.

** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Block I Flexible Commercial Unit 09	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 07	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 05	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 01	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 2	-	-	-	-	-	-	-	0.2	-	-	N/A
Block I Flexible Commercial Unit 08	-	-	-	-	-	-	-	0.2	-	-	N/A
Block J Flexible Commercial Unit 06	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 03	-	-	-	-	-	-	-	0.2	-	-	N/A
Block K Flexible Commercial Unit 04	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Block I Flexible Commercial Unit 09	120	80	1.875

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Block J Flexible Commercial Unit 07	120	80	1.875
Block J Flexible Commercial Unit 05	120	80	1.875
Block K Flexible Commercial Unit 01	120	80	1.875
Block K Flexible Commercial Unit 2	120	80	1.875
Block I Flexible Commercial Unit 08	120	80	1.875
Block J Flexible Commercial Unit 06	120	80	1.875
Block K Flexible Commercial Unit 03	120	80	1.875
Block K Flexible Commercial Unit 04	120	80	1.875

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Block I Flexible Commercial Unit 09	YES (+20.4%)	NO
Block J Flexible Commercial Unit 07	NO (-49.6%)	NO
Block J Flexible Commercial Unit 05	NO (-12.2%)	NO
Block K Flexible Commercial Unit 01	NO (-1.5%)	NO
Block K Flexible Commercial Unit 2	YES (+39.5%)	NO
Block I Flexible Commercial Unit 08	NO (-44.7%)	NO
Block J Flexible Commercial Unit 06	YES (+15.8%)	NO
Block K Flexible Commercial Unit 03	YES (+48%)	NO
Block K Flexible Commercial Unit 04	NO (-34.7%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	1016.5	1016.5
External area [m²]	648.2	1690.8
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	731.6	517.92
Average U-value [W/m²K]	1.13	0.31
Alpha value* [%]	18.64	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m²]

	Actual	Notional
Heating	4.19	1.57
Cooling	4.94	3.72
Auxiliary	13.93	12.45
Lighting	14.97	23.73
Hot water	0.67	0.56
Equipment*	20.26	20.26
TOTAL**	**38.71**	**42.03**

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	108.29	79.01
Primary energy [kWh/m²]	49.73	58.72
Total emissions [kg/m²]	5.26	5.68

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] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	36.4	71.8	4.2	4.9	13.9	2.41	4.04	2.66	5
	Notional	17.1	62	1.6	3.7	12.5	3.01	4.63	----	----
[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

12 Appendix B – SAP Reports

A.1

TER WORKSHEET

Dwelling Reference: K_12_01
Dwelling Type: New Dwelling Design Stage

BE LEAN

2-4 Harrow Road
London
W2 1XJ

1. Overall dwelling dimensions

	Area(m²)		Av. Height(m)			Volume(m³)	
Ground Floor	78.64 (1a)	x	2.5	(2a)	=	196.6	(3a)
Total floor area TFA						78.64	(4)
Dwelling volume						196.6	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80	=	0	(6a)
Open chimneys	0	x	20	=	0	(6b)
Chimneys / flues attached to closed fire	0	x	10	=	0	(6c)
Flues attached to solid fuel boiler	0	x	20	=	0	(6d)
Flues attached to other heater	0	x	35	=	0	(6e)
Number of blocked chimneys	0	x	20	=	0	(6f)
Number of intermittent extract fans	2	x	10	=	20	(7a)
Number of passive vents	0	x	10	=	0	(7b)
Number of flueless gas fires	0	x	40	=	0	(7c)

Air changes per hour

Number of storeys in the dwelling (ns)	0.1	0.1	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, (m³/h/m²)	5	5	(17)
Air permeability value, AP4, (m³/h/m²)	0	0	(17a)
Air permeability value)	0.35	0.35	(18)
Number of sides on which dwelling is sheltered	2	2	(19)
Shelter factor		0.85	(20)

Infiltration rate incorporating shelter factor													0.3	(21)
Infiltration rate modified for monthly wind speed														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(22)
Monthly average wind speed from Table U2	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor	1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)	0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35	3.92	(22b)
Calculate effective air change rate for the applicable case:													0	(23a)
													0	(23b)
													0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If balanced mechanical ventilation without heat recovery (MV)	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house extract ventilation or positive input ventilation from outside	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilation or whole house positive input ventilation from loft	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56		(24d)
Effective air change rate	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56		(25)
Effective air change rate from PCDB:	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Solid door					0			(26)
Semi-glazed door					0			(26a)
Window					23.2			(27)
Roof window					0			(27a)
Basement floor			0		0			(28)
Ground floor			0		0			(28a)
Exposed floor			0		0			(28b)
Basement wall			0		0			(29)
External wall			4206.64		6.43			(29a)
Roof			0		0			(30)

Total area of external elements ∑A, m²	54.85	(31)
Party Wall	0	(32)
Party floor	6291.2	(32a)
Party ceiling	7864	(32b)
Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = ∑ (A x U)	29.63	(33)
Heat capacity Cm = ∑(A x k)	25189.64	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	100	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K	2.63	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available	2.63	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ	32.26	(37)

Ventilation heat loss calculated monthly

37.15	36.97	36.79	35.95	35.79	35.06	35.06	34.92	35.34	35.79	36.11	36.44		(38)

Heat transfer coefficient, W/K

69.41	69.23	69.05	68.2	68.05	67.31	67.31	67.18	67.59	68.05	68.36	68.7		(39)

Heat loss parameter (HLP), W/m²K

0.88	0.88	0.88	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.87	0.87		(40)

Number of days in month (Table 1a)

31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.44	(42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

0	0	0	0	0	0	0	0	0	0	0	0		(42a)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

75.03	73.92	72.35	69.45	67.29	64.89	63.59	65.15	66.84	69.41	72.37	74.78		(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

39.58	38.14	36.7	35.26	33.83	32.39	32.39	33.83	35.26	36.7	38.14	39.58		(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J)	105.55	(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

114.61	112.06	109.05	104.72	101.11	97.27	95.97	98.97	102.11	106.12	110.51	114.36	1266.87	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

181.52	159.57	167.61	143.36	136.12	119.61	116.07	122.55	125.91	144	157.44	179.06	1752.82	(45)

Distribution loss (46) = 0.15 x (45)

27.23	23.94	25.14	21.5	20.42	17.94	17.41	18.38	18.89	21.6	23.62	26.86		(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)

Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer’s declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0	(55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

0 0 0 0 0 0 0 0 0 0 0 0 (56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m ⍰ [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

0 0 0 0 0 0 0 0 0 0 0 0 (57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

0 0 0 0 0 0 0 0 0 0 0 0 (59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

50.96 46.03 50.96 49.32 50.96 47.97 48.91 50.43 49.32 50.96 49.32 50.96 (61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

232.48 205.6 218.57 192.67 187.08 167.58 164.98 172.98 175.22 194.96 206.76 230.02 2348.9 (62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0 0 0 0 0 0 0 0 0 0 0 0 (63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0 0 0 0 0 0 0 0 0 0 0 0 (63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0 0 0 0 0 0 0 0 0 0 0 0 (63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0 0 0 0 0 0 0 0 0 0 0 0 (63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

232.48 205.6 218.57 192.67 187.08 167.58 164.98 172.98 175.22 194.96 206.76 230.02 2348.9 (64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0 0 0 0 0 0 0 0 0 0 0 0 (64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

73.1 64.56 68.47 59.99 58 51.76 50.82 53.36 54.19 60.62 64.68 72.28 (65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

5. Internal gains (see Tables 5 and 5a)

Metabolic gains (Table 5), watts

121.83 121.83 121.83 121.83 121.83 121.83 121.83 121.83 121.83 121.83 121.83 121.83 (66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

109.24	120.94	109.24	112.88	109.24	112.88	109.24	109.24	112.88	109.24	112.88	109.24	(67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

216.57	218.82	213.16	201.1	185.88	171.58	162.02	159.78	165.44	177.5	192.71	207.02	(68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	(69)

Pumps and fans gains (Table 5a)

3	3	3	3	3	0	0	0	0	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5

-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	(71)

Water heating gains (Table 5)

98.25	96.08	92.03	83.33	77.96	71.89	68.31	71.71	75.27	81.48	89.83	97.15	(72)

Total internal gains

486.61	498.39	476.97	459.85	435.62	415.9	399.12	400.28	413.13	430.76	457.97	475.95	(73)

6. Solar gains

Solar gains in watts, calculated for each month

131.61	236.45	356.1	495.84	605.23	622.78	591.3	506.34	403.97	270.11	159.87	111.19	(83)

Total gains – internal and solar (watts)

618.22	734.84	833.07	955.7	1040.86	1038.68	990.42	906.62	817.1	700.87	617.85	587.14	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, 1,m (see Table 9a)

0.93	0.89	0.82	0.7	0.55	0.4	0.29	0.33	0.52	0.76	0.89	0.94	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

19.33	19.67	20.09	20.55	20.83	20.95	20.99	20.98	20.89	20.5	19.85	19.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

20.18	20.18	20.19	20.2	20.2	20.21	20.21	20.21	20.2	20.2	20.19	20.19	(88)

Roof Utilisation factor for gains for rest of dwelling, 2,m (see Table 9a)

0.92	0.87	0.8	0.67	0.51	0.35	0.24	0.28	0.47	0.73	0.88	0.93	(89)

Roof Mean internal temperature in the rest of dwelling T2

18.22	18.66	19.17	19.72	20.03	20.17	20.2	20.19	20.11	19.68	18.89	18.15	(90)

Living area fraction 0.38 (91)

Mean internal temperature (for the whole dwelling)

18.64	19.04	19.52	20.03	20.33	20.47	20.5	20.49	20.4	19.99	19.25	18.57	(92)

Adjusted mean internal temperature:

18.64	19.04	19.52	20.03	20.33	20.47	20.5	20.49	20.4	19.99	19.25	18.57	(93)

8. Space heating requirement

Utilisation factor for gains,

0.9	0.85	0.78	0.67	0.52	0.37	0.26	0.3	0.49	0.72	0.86	0.91		(94)

Useful gains, mGm , W

555.79	626.07	653.61	635.74	540.62	383.11	259.31	270.43	398.11	506.2	529.04	533.87		(95)

Monthly average external temperature from Table U1

4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)

Heat loss rate for mean internal temperature

995.35	978.85	898.83	759.37	587.47	394.79	262.2	274.82	426.14	638.85	830.81	987.5		(97)

Space heating requirement for each month

327.03	237.07	182.45	89.01	34.86	0	0	0	0	98.69	217.28	337.5		(98a)

Solar space heating calculated using Appendix H (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0		(98b)

Space heating requirement for each month after solar contribution

327.03	237.07	182.45	89.01	34.86	0	0	0	0	98.69	217.28	337.5		(98c)

Space heating requirement in kWh/m²/year 19.38 (99)

8c. Space Cooling requirement

Heat loss rate,

0	0	0	0	0	0	0	0	0	0	0	0		(100)

Utilisation factor for loss

0	0	0	0	0	0	0	0	0	0	0	0		(101)

Useful loss, mLm (watts)

0	0	0	0	0	0	0	0	0	0	0	0		(102)

Gains

0	0	0	0	0	0	0	0	0	0	0	0		(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

0	0	0	0	0	0	0	0	0	0	0	0		(104)

Cooled fraction 0 (105)

Intermittency factor

0	0	0	0	0	0	0	0	0	0	0	0		(106)

Space cooling requirement for month 0 0

0	0	0	0	0	0	0	0	0	0	0	0		(107)

Space cooling requirement in kWh/m²/year 0 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

9a. Energy requirements – Individual heating systems including micro-CHP

Fraction of space heat from secondary/supplementary system,								0					0	(201)
Fraction of space heat from main system(s),													1	(202)
Fraction of main heating from main system 2,													0	(203)
Fraction of total space heat from main system 1,													1	(204)
Fraction of total space heat from main system 2,													0	(205)
Efficiency of main space heating system 1 (in %),													92.4	(206)
Efficiency of main space heating system 2 (in %),													0	(207)
Efficiency of secondary/supplementary heating system, %,													0	(208)
Cooling System Seasonal Energy Efficiency Ratio,								0					0	(209)
Space heating requirement (calculated above),														
	0	0	0	0	0	0	0	0	0	0	0	0		(210)
Space heating fuel (main heating system 1), kWh/month								0					0	
	353.93	256.57	197.45	96.33	37.73	0	0	0	0	106.81	235.15	365.26		(211)
Space heating fuel (main heating system 2), kWh/month								0					0	
	0	0	0	0	0	0	0	0	0	0	0	0		(213)
Space heating fuel (secondary), kWh/month								0					0	
	0	0	0	0	0	0	0	0	0	0	0	0		(215)
Output from water heater),								0					80.3	(216)
Efficiency of water heater														
	85.11	84.69	84	82.83	81.54	80.3	80.3	80.3	80.3	83	84.49	85.2		(217)
Fuel for water heating														
	273.14	242.78	260.21	232.6	229.43	208.69	205.45	215.42	218.21	234.9	244.72	269.97	2835.53	(219)
Space Cooling														
	0	0	0	0	0	0	0	0	0	0	0	0		(221)
Annual totals								kWh/year		kWh/year				
Space heating fuel used, main system 1													1649.23	(211)
Space heating fuel used, main system 2													0	(213)
Space heating fuel used, secondary													0	(215)
Water heating fuel used													2835.53	(219)
Electricity for instantaneous electric shower(s)													0	(64a)
Space cooling fuel used													0	(221)
Electricity for pumps, fans and electric keep-hot														
Mechanical vent fans - balanced, extract or positive input from outside								0		0			0	(230a)
warm air heating system fans													0	(230b)
Heating circulation pump or water pump within warm air heating unit													41	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)													0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)													45	(230e)
Maintaining electric keep-hot facility for gas combi boiler													0	(230f)
Pump for solar water heating													0	(230g)
Pump for storage WWHRS													0	(230h)
Total electricity for the above													86	(231)
Electricity for lighting													183.18	(232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

Electricity generated by PVs (Appendix M) (negative quantity)

2.74	4.39	7.15	9.15	10.9	10.57	10.44	9.32	7.57	5.46	3.19	2.31	83.2	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

Electricity generated by PVs (Appendix M) (negative quantity)

0.29	0.64	1.35	2.14	2.94	3	2.96	2.46	1.73	0.95	0.4	0.23	19.09	(233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			4651.64	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		60.03	(240a)
Low-rate fraction	0		60.03	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		60.03	(241a)
Low-rate fraction	0		60.03	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		60.03	(242a)

Low-rate fraction	0		60.03	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		103.21	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		30.21	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		-14.79	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		284.84	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.83	(257)
SAP rating	86.56	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			346.34	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			595.46	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating			941.8	(265)
Space cooling			0	(266)
Electricity for pumps, fans and electric keep			11.93	(267)
Electricity for lighting			26.44	(268)
energy saved or generated	0		-13.36	(269b)
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(270b)
energy used			0	(271b)
Total CO2, kg/year			966.8	(272)
Dwelling CO2 Emission Rate			12.29	(273)
EI rating			90	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			1863.63	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			3204.14	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			5067.77	(279)
Space cooling			0	(280)
Electricity for pumps, fans and electric keep			130.1	(281)
Electricity for lighting			280.97	(282)
energy saved or generated	0		-132.51	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			5346.33	(286)
Dwelling PE Rate			67.98	(287)

Dwelling Reference:	K_12_01	BE LEAN
Dwelling Type:	New Dwelling Design Stage	

2-4 Harrow Road
London
W2 1XJ

1. Overall dwelling dimensions

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground Floor	78.64 (1a)	x	2.5	(2a) =	196.6	(3a)
Total floor area TFA					78.64	(4)
Dwelling volume					196.6	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80	=	0	(6a)
Open chimneys	0	x	20	=	0	(6b)
Chimneys / flues attached to closed fire	0	x	10	=	0	(6c)
Flues attached to solid fuel boiler	0	x	20	=	0	(6d)
Flues attached to other heater	0	x	35	=	0	(6e)
Number of blocked chimneys	0	x	20	=	0	(6f)
Number of intermittent extract fans	0	x	10	=	0	(7a)
Number of passive vents	0	x	10	=	0	(7b)
Number of flueless gas fires	0	x	40	=	0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0	0	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, (m³/h/m²)	3	3	(17)
Air permeability value, AP4, (m³/h/m²)	0	0	(17a)
Air permeability value)	0.15	0.15	(18)
Number of sides on which dwelling is sheltered	2	2	(19)
Shelter factor		0.85	(20)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Infiltration rate incorporating shelter factor													0.13	(21)
Infiltration rate modified for monthly wind speed														(22)
Monthly average wind speed from Table U2	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor	1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	1.67	(22b)
Calculate effective air change rate for the applicable case:													0.5	(23a)
													0.5	(23b)
													44	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)	0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43		(24a)
b) If balanced mechanical ventilation without heat recovery (MV)	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If whole house extract ventilation or positive input ventilation from outside	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If natural ventilation or whole house positive input ventilation from loft	0	0	0	0	0	0	0	0	0	0	0	0		(24d)
Effective air change rate	0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43		(25)
Effective air change rate from PCDB:	0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K		A X k kJ/K	
Solid door							0		(26)
Semi-glazed door							0		(26a)
Window							15.95		(27)
Roof window							0		(27a)
Basement floor				0			0		(28)
Ground floor				0			0		(28a)
Exposed floor				0			0		(28b)
Basement wall				0			0		(29)
External wall				4206.64			17.7		(29a)
Roof				0			0		(30)

Total area of external elements ∑A, m²												54.85	(31)
Party Wall												0	(32)
Party floor												6291.2	(32a)
Party ceiling												7864	(32b)
Internal wall **												0	(33c)
Internal floor												0	(32d)
Internal ceiling floor												0	(32e)
Fabric heat loss, W/K = ∑ (A x U)												33.65	(33)
Heat capacity Cm = ∑(A x k)												25189.64	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K												100	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K												0.17	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available												0.17	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ												33.82	(37)
Ventilation heat loss calculated monthly													
28.71	28.51	28.3	27.26	27.06	26.02	26.02	25.82	26.44	27.06	27.47	27.89		(38)
Heat transfer coefficient, W/K													
62.54	62.33	62.12	61.09	60.88	59.85	59.85	59.64	60.26	60.88	61.3	61.71		(39)
Heat loss parameter (HLP), W/m²K													
0.8	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.78		(40)
Number of days in month (Table 1a)													
31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N												2.44	(42)
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)													
0	0	0	0	0	0	0	0	0	0	0	0		(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)													
75.03	73.92	72.35	69.45	67.29	64.89	63.59	65.15	66.84	69.41	72.37	74.78		(42b)
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)													
39.58	38.14	36.7	35.26	33.83	32.39	32.39	33.83	35.26	36.7	38.14	39.58		(42c)
Annual average hot water usage in litres per day Vd,average (from Appendix J)												105.55	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)													
114.61	112.06	109.05	104.72	101.11	97.27	95.97	98.97	102.11	106.12	110.51	114.36	1266.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)													
181.52	159.57	167.61	143.36	136.12	119.61	116.07	122.55	125.91	144	157.44	179.06	1752.82	(45)
Distribution loss (46) = 0.15 x (45)													
27.23	23.94	25.14	21.5	20.42	17.94	17.41	18.38	18.89	21.6	23.62	26.86		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel												0	(47)
Water storage loss (or HIU loss)													
a) If manufacturer's declared loss factor is known (kWh/day):												0	(48)

Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0	(55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

0	0	0	0	0	0	0	0	0	0	0	0		(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m □ [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

0	0	0	0	0	0	0	0	0	0	0	0		(57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

0	0	0	0	0	0	0	0	0	0	0	0		(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

50.96	46.03	50.96	49.32	50.96	47.97	48.91	50.43	49.32	50.96	49.32	50.96		(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

232.48	205.6	218.57	192.67	187.08	167.58	164.98	172.98	175.22	194.96	206.76	230.02	2348.9	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0		(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

232.48	205.6	218.57	192.67	187.08	167.58	164.98	172.98	175.22	194.96	206.76	230.02	2348.9	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0		(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

73.1	64.56	68.47	59.99	58	51.76	50.82	53.36	54.19	60.62	64.68	72.28		(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

5. Internal gains (see Tables 5 and 5a)

Metabolic gains (Table 5), watts

121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

109.24	120.94	109.24	112.88	109.24	112.88	109.24	109.24	112.88	109.24	112.88	109.24	(67)

Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5

216.57	218.82	213.16	201.1	185.88	171.58	162.02	159.78	165.44	177.5	192.71	207.02	(68)

Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	(69)

Pumps and fans gains (Table 5a)

0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5

-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	(71)

Water heating gains (Table 5)

98.25	96.08	92.03	83.33	77.96	71.89	68.31	71.71	75.27	81.48	89.83	97.15	(72)

Total internal gains

483.61	495.39	473.97	456.85	432.62	415.9	399.12	400.28	413.13	427.76	454.97	472.95	(73)

6. Solar gains

Solar gains in watts, calculated for each month

150.54	271.72	412.41	579.11	710.82	733.03	695.34	592.9	469.48	311.26	183.09	127.03	(83)

Total gains – internal and solar (watts)

634.14	767.11	886.39	1035.97	1143.45	1148.93	1094.46	993.17	882.62	739.02	638.07	599.98	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, □1,m (see Table 9a)

0.92	0.86	0.78	0.63	0.47	0.33	0.24	0.27	0.45	0.71	0.87	0.93	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

19.63	19.98	20.37	20.74	20.92	20.98	21	20.99	20.95	20.68	20.11	19.57	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)

Roof Utilisation factor for gains for rest of dwelling, □2,m (see Table 9a)

0.91	0.85	0.76	0.6	0.44	0.29	0.2	0.23	0.41	0.68	0.85	0.92	(89)

Roof Mean internal temperature in the rest of dwelling T2

18.65	19.09	19.56	20	20.2	20.27	20.28	20.28	20.24	19.94	19.27	18.59	(90)

Living area fraction 0.38 (91)

Mean internal temperature (for the whole dwelling)

19.02	19.43	19.86	20.28	20.47	20.54	20.55	20.55	20.51	20.22	19.59	18.96	(92)

Adjusted mean internal temperature:

19.02	19.43	19.86	20.28	20.47	20.54	20.55	20.55	20.51	20.22	19.59	18.96	(93)

8. Space heating requirement

Utilisation factor for gains,

	0.89	0.83	0.74	0.6	0.45	0.31	0.22	0.25	0.42	0.68	0.84	0.9		(94)

Useful gains, mGm , W

	562.89	635.66	659.48	623.37	511.62	351.15	235.61	246.08	372.83	499.31	533.43	539.87		(95)

Monthly average external temperature from Table U1

	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)

Heat loss rate for mean internal temperature

	920.59	905.46	830.24	695.13	533.9	355.55	236.58	247.65	386.05	585.54	765.34	910.77		(97)

Space heating requirement for each month

	266.13	181.31	127.05	51.67	16.58	0	0	0	0	64.15	166.97	275.95		(98a)

Solar space heating calculated using Appendix H (negative quantity)

	0	0	0	0	0	0	0	0	0	0	0	0		(98b)

Space heating requirement for each month after solar contribution

	266.13	181.31	127.05	51.67	16.58	0	0	0	0	64.15	166.97	275.95		(98c)

Space heating requirement in kWh/m²/year 14.62 (99)

8c. Space Cooling requirement

Heat loss rate,

	0	0	0	0	0	562.57	442.88	453.27	0	0	0	0		(100)

Utilisation factor for loss

	0	0	0	0	0	0.97	0.98	0.97	0	0	0	0		(101)

Useful loss, mLm (watts)

	0	0	0	0	0	543.92	434.36	440.96	0	0	0	0		(102)

Gains

	0	0	0	0	0	1294.71	1233.55	1116.83	0	0	0	0		(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) (104)

	0	0	0	0	0	540.57	594.6	502.85	0	0	0	0		(104)

Cooled fraction 0.81 (105)

Intermittency factor

	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0		(106)

Space cooling requirement for month 0 0

	0	0	0	0	0	109.36	120.3	101.73	0	0	0	0		(107)

Space cooling requirement in kWh/m²/year 4.21 (108)

8f. Space heating requirement

Fabric Energy Efficiency, 0 0 (109)

9a. Energy requirements – Individual heating systems including micro-CHP

Fraction of space heat from secondary/supplementary system,													0		0	(201)
Fraction of space heat from main system(s),															1	(202)
Fraction of main heating from main system 2,															0	(203)
Fraction of total space heat from main system 1,															1	(204)
Fraction of total space heat from main system 2,															0	(205)
Efficiency of main space heating system 1 (in %),															89.7	(206)
Efficiency of main space heating system 2 (in %),															0	(207)
Efficiency of secondary/supplementary heating system, %,															0	(208)
Cooling System Seasonal Energy Efficiency Ratio,													0		3.13	(209)
Space heating requirement (calculated above),																
	0	0	0	0	0	0	0	0	0	0	0	0				(210)
Space heating fuel (main heating system 1), kWh/month													0		0	
	296.69	202.13	141.64	57.6	18.48	0	0	0	0	71.52	186.14	307.64				(211)
Space heating fuel (main heating system 2), kWh/month													0		0	
	0	0	0	0	0	0	0	0	0	0	0	0				(213)
Space heating fuel (secondary), kWh/month													0		0	
	0	0	0	0	0	0	0	0	0	0	0	0				(215)
Output from water heater),													0		80.4	(216)
Efficiency of water heater																
	85.11	84.51	83.59	82.2	81.08	80.4	80.4	80.4	80.4	82.52	84.31	85.22				(217)
Fuel for water heating																
	273.15	243.3	261.49	234.39	230.72	208.43	205.2	215.15	217.94	236.26	245.25	269.92			2841.19	(219)
Space Cooling																
	0	0	0	0	0	34.94	38.43	32.5	0	0	0	0				(221)
Annual totals													kWh/year	kWh/year		
Space heating fuel used, main system 1															1281.83	(211)
Space heating fuel used, main system 2															0	(213)
Space heating fuel used, secondary															0	(215)
Water heating fuel used															2841.19	(219)
Electricity for instantaneous electric shower(s)															0	(64a)
Space cooling fuel used															105.88	(221)
Electricity for pumps, fans and electric keep-hot																
Mechanical vent fans - balanced, extract or positive input from outside													0	0	320.8	(230a)
warm air heating system fans															0	(230b)
Heating circulation pump or water pump within warm air heating unit															41	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)															0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)															45	(230e)
Maintaining electric keep-hot facility for gas combi boiler															0	(230f)
Pump for solar water heating															0	(230g)
Pump for storage WWHRS															0	(230h)
Total electricity for the above															406.8	(231)
Electricity for lighting															187.42	(232)

Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling

Electricity generated by PVs (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)

Energy saving/generation technologies (Appendices M, N) - Energy exported

Electricity generated by PVs (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)

Electricity generated by hydro-electric generators

0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)

Electricity used or net electricity generated by micro-CHP

0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)

Appendix Q items: annual energy

Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved			0	(236a)
energy used			0	(237a)
Total delivered energy for all uses			4823.13	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		46.66	(240a)
Low-rate fraction	0		46.66	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		46.66	(241a)
Low-rate fraction	0		46.66	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		46.66	(242a)

Low-rate fraction	0		46.66	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		103.42	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		17.46	(248)
Pumps, fans And electric keep-hot	0		67.08	(249)
Energy For lighting	0		30.91	(250)
Additional standing charges	0		184	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1 description>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		449.52	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.31	(257)
SAP rating	78.78	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissions kg CO2/year	
Space heating - main system 1			269.18	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			386.4	(264)
Energy for instantaneous electric shower(s)			0	(264a)

Space and water heating			655.59	(265)
Space cooling			12.1	(266)
Electricity for pumps, fans and electric keep			56.43	(267)
Electricity for lighting			27.05	(268)
energy saved or generated	0		0	(269b)
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(270b)
energy used			0	(271b)
Total CO2, kg/year			751.17	(272)
Dwelling CO2 Emission Rate			9.55	(273)
EI rating			92	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy KWh/year	Emission factor kg	Emissionsr kg CO2/year	
Space heating - main system 1			1448.47	(275)
Space heating - main system 2			0	(276)
Space heating - secondary			0	(277)
Energy for water heating			4264.63	(278)
Energy for instantaneous electric shower(s)			0	(278a)
Space and water heating			5713.1	(279)
Space cooling			150.47	(280)
Electricity for pumps, fans and electric keep			615.41	(281)
Electricity for lighting			287.48	(282)
energy saved or generated	0		0	
Appendix Q items				
energy saved	0		0	
energy used	0		0	
energy saved	0		0	(284b)
energy used			0	(285b)
Total PE, kWh/year			6766.46	(286)
Dwelling PE Rate			86.04	(287)

TER WORKSHEET

Dwelling Reference: K_12_01
Dwelling Type: New Dwelling Design Stage

BE GREEN

2-4 Harrow Road
London
W2 1XJ

1. Overall dwelling dimensions

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground Floor	78.64	(1a)	x	2.5	(2a)	=	196.6	(3a)
Total floor area TFA							78.64	(4)
Dwelling volume							196.6	(5)

2. Ventilation Rate

Chimneys/Flues	0	x	80	=	0	(6a)
Open chimneys	0	x	20	=	0	(6b)
Chimneys / flues attached to closed fire	0	x	10	=	0	(6c)
Flues attached to solid fuel boiler	0	x	20	=	0	(6d)
Flues attached to other heater	0	x	35	=	0	(6e)
Number of blocked chimneys	0	x	20	=	0	(6f)
Number of intermittent extract fans	2	x	10	=	20	(7a)
Number of passive vents	0	x	10	=	0	(7b)
Number of flueless gas fires	0	x	40	=	0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0.1	0.1	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0	0	(9)
Additional infiltration	0	0	(10)
Structural infiltration	0	0	(11)
Suspended wooden ground floor	0	0	(12)
No draught lobby	0	0	(13)
Percentage of windows and doors draught proofed	0	0	(14)
Window infiltration	0	0	(15)
Infiltration rate	0	0	(16)
Air permeability value, AP50, (m³/h/m²)	5	5	(17)
Air permeability value, AP4, (m³/h/m²)	0	0	(17a)
Air permeability value)	0.35	0.35	(18)
Number of sides on which dwelling is sheltered	2	2	(19)
Shelter factor		0.85	(20)

Infiltration rate incorporating shelter factor	0.3	(21)
Infiltration rate modified for monthly wind speed		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	(22)
Monthly average wind speed from Table U2	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Wind Factor	1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed)	0.38	0.37	0.37	0.33	0.32	0.28	0.28	0.28	0.3	0.32	0.34	0.35	3.92	(22b)

Calculate effective air change rate for the applicable case:

	0	(23a)
	0	(23b)
	0	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR)	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
b) If balanced mechanical ventilation without heat recovery (MV)	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
c) If whole house extract ventilation or positive input ventilation from outside	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
d) If natural ventilation or whole house positive input ventilation from loft	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(24d)
Effective air change rate	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)
Effective air change rate from PCDB:	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K	A X U (W/K)	k-value kJ/m²·K		A X k kJ/K	
Solid door							0		(26)
Semi-glazed door							0		(26a)
Window							23.2		(27)
Roof window							0		(27a)
Basement floor				0			0		(28)
Ground floor				0			0		(28a)
Exposed floor				0			0		(28b)
Basement wall				0			0		(29)
External wall				4206.64			6.43		(29a)
Roof				0			0		(30)

Total area of external elements ∑A, m²	54.85	(31)
Party Wall	0	(32)
Party floor	6291.2	(32a)
Party ceiling	7864	(32b)
Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = ∑ (A x U)	29.63	(33)
Heat capacity Cm = ∑(A x k)	25189.64	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	100	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K	2.63	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available	2.63	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ	32.26	(37)

Ventilation heat loss calculated monthly

37.15	36.97	36.79	35.95	35.79	35.06	35.06	34.92	35.34	35.79	36.11	36.44	(38)

Heat transfer coefficient, W/K

69.41	69.23	69.05	68.2	68.05	67.31	67.31	67.18	67.59	68.05	68.36	68.7	(39)

Heat loss parameter (HLP), W/m²K

0.88	0.88	0.88	0.87	0.87	0.86	0.86	0.85	0.86	0.87	0.87	0.87	(40)

Number of days in month (Table 1a)

31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

Assumed occupancy, N	2.44	(42)

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

0	0	0	0	0	0	0	0	0	0	0	0	(42a)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

75.03	73.92	72.35	69.45	67.29	64.89	63.59	65.15	66.84	69.41	72.37	74.78	(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

39.58	38.14	36.7	35.26	33.83	32.39	32.39	33.83	35.26	36.7	38.14	39.58	(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J)	105.55	(43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

114.61	112.06	109.05	104.72	101.11	97.27	95.97	98.97	102.11	106.12	110.51	114.36	1266.87	(44)

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

181.52	159.57	167.61	143.36	136.12	119.61	116.07	122.55	125.91	144	157.44	179.06	1752.82	(45)

Distribution loss (46) = 0.15 x (45)

27.23	23.94	25.14	21.5	20.42	17.94	17.41	18.38	18.89	21.6	23.62	26.86	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	0.21	(48)

Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0.12	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)
Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0.12	(55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

3.57	3.23	3.57	3.46	3.57	3.46	3.57	3.57	3.46	3.57	3.46	3.57		(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,
(57)m = (56)m □ [(47) – Vs] ÷ (47), else (57)m = (56)m
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

3.57	3.23	3.57	3.46	3.57	3.46	3.57	3.57	3.46	3.57	3.46	3.57		(57)

Primary circuit loss for each month from Table 3
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)

Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)

0	0	0	0	0	0	0	0	0	0	0	0		(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

208.35	183.81	194.44	169.32	162.95	145.58	142.91	149.38	151.88	170.83	183.41	205.9	2068.76	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)

0	0	0	0	0	0	0	0	0	0	0	0		(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating)

0	0	0	0	0	0	0	0	0	0	0	0		(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

208.35	183.81	194.44	169.32	162.95	145.58	142.91	149.38	151.88	170.83	183.41	205.9	2068.76	(64)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

0	0	0	0	0	0	0	0	0	0	0	0		(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

81.82	72.45	77.2	68.44	66.73	60.54	60.06	62.21	62.64	69.35	73.12	81		(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

5. Internal gains (see Tables 5 and 5a)

Metabolic gains (Table 5), watts

121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83		(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5												
109.24	120.94	109.24	112.88	109.24	112.88	109.24	109.24	112.88	109.24	112.88	109.24	(67)
Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5												
216.57	218.82	213.16	201.1	185.88	171.58	162.02	159.78	165.44	177.5	192.71	207.02	(68)
Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5												
35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	(69)
Pumps and fans gains (Table 5a)												
3	3	3	3	3	0	0	0	0	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5												
-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	(71)
Water heating gains (Table 5)												
109.98	107.81	103.76	95.06	89.69	84.09	80.73	83.62	87	93.21	101.56	108.88	(72)
Total internal gains												
498.34	510.12	488.7	471.58	447.35	428.09	411.54	412.18	424.87	442.49	469.7	487.68	(73)

6. Solar gains

Solar gains in watts, calculated for each month												
131.61	236.45	356.1	495.84	605.23	622.78	591.3	506.34	403.97	270.11	159.87	111.19	(83)
Total gains – internal and solar (watts)												
629.95	746.57	844.81	967.43	1052.59	1050.88	1002.84	918.52	828.83	712.6	629.58	598.87	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)												21	(85)
Utilisation factor for gains for living area, η1,m (see Table 9a)													
0.92	0.88	0.82	0.69	0.55	0.4	0.29	0.33	0.52	0.76	0.89	0.93		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)													
19.35	19.7	20.11	20.56	20.83	20.96	20.99	20.98	20.89	20.51	19.87	19.29		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)													
20.18	20.18	20.19	20.2	20.2	20.21	20.21	20.21	20.2	20.2	20.19	20.19		(88)
Roof Utilisation factor for gains for rest of dwelling, η2,m (see Table 9a)													
0.92	0.87	0.8	0.67	0.51	0.35	0.24	0.27	0.47	0.72	0.87	0.93		(89)
Roof Mean internal temperature in the rest of dwelling T2													
18.26	18.68	19.19	19.73	20.04	20.17	20.2	20.19	20.11	19.69	18.92	18.19		(90)
Living area fraction												0.38	(91)
Mean internal temperature (for the whole dwelling)													
18.67	19.06	19.54	20.04	20.34	20.47	20.5	20.49	20.41	20	19.28	18.6		(92)
Adjusted mean internal temperature:													
18.67	19.06	19.54	20.04	20.34	20.47	20.5	20.49	20.41	20	19.28	18.6		(93)

8. Space heating requirement

Utilisation factor for gains,														
	0.9	0.85	0.78	0.66	0.51	0.36	0.26	0.29	0.48	0.72	0.85	0.91		(94)
Useful gains, mGm , W														
	564.02	633.05	659.01	638.92	542.01	383.53	259.44	270.62	399.22	510.33	536.09	542.39		(95)
Monthly average external temperature from Table U1														
	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature														
	997.38	980.56	900.11	760.07	587.75	394.87	262.23	274.86	426.36	639.79	832.52	989.58		(97)
Space heating requirement for each month														
	322.41	233.53	179.38	87.23	34.03	0	0	0	0	96.32	213.43	332.71		(98a)
Solar space heating calculated using Appendix H (negative quantity)														
	0	0	0	0	0	0	0	0	0	0	0	0		(98b)
Space heating requirement for each month after solar contribution														
	322.41	233.53	179.38	87.23	34.03	0	0	0	0	96.32	213.43	332.71		(98c)
Space heating requirement in kWh/m²/year													19.06	(99)

8c. Space Cooling requirement

Heat loss rate,														
	0	0	0	0	0	0	0	0	0	0	0	0		(100)
Utilisation factor for loss														
	0	0	0	0	0	0	0	0	0	0	0	0		(101)
Useful loss, mLm (watts)														
	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Gains														
	0	0	0	0	0	0	0	0	0	0	0	0		(103)
Space cooling requirement for month, whole dwelling, continuous (kWh)														(104)
	0	0	0	0	0	0	0	0	0	0	0	0		(104)
Cooled fraction													0	(105)
Intermittency factor														
	0	0	0	0	0	0	0	0	0	0	0	0		(106)
Space cooling requirement for month								0					0	
	0	0	0	0	0	0	0	0	0	0	0	0		(107)
Space cooling requirement in kWh/m²/year													0	(108)

8f. Space heating requirement

Fabric Energy Efficiency,	0	0	(109)

9b. Energy requirements – Heat networks

Fraction Of space heat from secondary/supplementary heating	0	(301)
Fraction Of space heat from heat network	0	(302)
Where the heat network Is Not listed In the PCDB:	0	
Fraction of heat from CHP	0	(303a)
Fraction of heat from heat source 2	0	(303b)
Fraction of heat from heat source 3	0	(303c)
Fraction of heat from heat source 4	0	(303d)
Fraction of heat from heat source 5	0	(303e)
Whether the heat network is listed in the PCDB or not:	0	
Factor for control and charging method (Table 4c(3)) for space heating	0	(305)
Factor for charging method (Table 4c(3)) for water heating	0	(305a)
Distribution loss factor (Table 12c) for heat network - set to 1 if HN listed in PCDB	0	(306)
Annual space heating requirement		
Heat required from heat network		
Where the heat network is not listed in the PCDB:		
Space heat from CHP	0	(307a)
Space heat from heat source 2	0	(307b)
Space heat from heat source 3	0	(307c)
Space heat from heat source 4	0	(307d)
Space heat from heat source 5	0	(307e)
Whether the heat network is listed in the PCDB or not:		(302)
Efficiency of secondary/supplementary heating system in %	0	(308)
Space heating fuel for secondary/supplementary system	0	(309)
Water heating		
Annual water heating requirement		
If DHW from heat network:		
Heat required from heat network	0	(310)
Where the heat network is not listed in the PCDB:		
Water heat from CHP	0	(310a)
Water heat from heat source 2	0	(310b)
Water heat from heat source 3	0	(310c)
Water heat from heat source 4	0	(310d)
Water heat from heat source 5	0	(310e)
If DHW by immersion or instantaneous heater within dwelling:		
Efficiency of water heater	0	(311)
Water heated by immersion or instantaneous heater	0	(312)
Electricity used for instantaneous electric shower(s)	0	(312a)
Electrical pumping energy as proportion of heat supplied	0	(313a)
Electricity used for heat distribution	0	(313)
Cooling System Seasonal Energy Efficiency Ratio	0	(314)
Space cooling (if there is a fixed cooling system	0	(315)
Electricity for pumps and fans within dwelling		

mechanical ventilation - balanced, extract or positive input from outside													0	(330a)
warm air heating system fans													0	(330b)
pump for solar water heating													0	(330g)
pump for storage WWHRS (see section G3.3)													0	(330h)
electricity use by heat interface unit													0	(330i)
Total electricity for pumps and fans													0	(331)
Electricity for lighting (calculated in Appendix L)													0	(332)
Energy generation (Appendixs M, negative quantity) - Energy used in dwelling														
PV	0	0	0	0	0	0	0	0	0	0	0	0	0	(333a)
Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	(334a)
Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	(335a)
Energy generation (Appendixs M, negative quantity) - Energy used exported														
PV	0	0	0	0	0	0	0	0	0	0	0	0	0	(333b)
Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	(334b)
Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	(335b)
Appendix Q items: annual energy													0	
energy saved													0	(336b)
energy used													0	(337b)
Total delivered energy for all uses													0	

10b. Fuel costs – Individual heating systems including micro-CHP

Where the heat network is not listed in the PCDB:				
Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating from CHP	0		0	(340a)
Space heating from heat source 2	0		0	(340b)
Space heating from heat source 3	0		0	(340c)
Space heating from heat source 4	0		0	(340d)
Space heating from heat source 5	0		0	(340e)
Where the heat network is not listed in the PCDB:				
Space heating from PCDB heat network	0		0	(340)
Space heating fuel for secondary/supplementary system	0		0	(341)
If DHW from heat network:				
Where the heat network Is Not listed in the PCDB:				
Water heating from CHP	0		0	(342a)
Water heating from heat source 2	0		0	(342b)
Water heating from heat source 3	0		0	(342c)
Water heating from heat source 4	0		0	(342d)
Water heating from heat source 5	0		0	(342e)
Water heating from PCDB heat network			0	(342)
If water heated by immersion heater:				
High-rate fraction (Table 13)	0		0	(343)

Low-rate fraction	0	0	(344)
High-rate cost, or cost for single immersion	0	0	(345)
Low-rate cost	0	0	(346)
If water heated by instantaneous water heater	0	0	(347)
Energy used by instantaneous electric shower(s)	0	0	(347a)
Space cooling	0	0	(348)
Pumps and fans	0	0	(349)
Electricity for lighting	0	0	(350)
Additional standing charges (Table 12)		0	(351)
energy saved or generated		0	
energy saved	0	0	(353)
energy used	0	0	(354)
Total energy cost	0	0	(355)

11b. SAP SAP rating – Heat networks

Energy cost deflator	0	(356)
Energy cost factor (ECF)	0	(357)
SAP rating	0	(358)

12b. CO_2 emissions – Individual heating systems

Where the heat network is not listed in the PCDB

CO_2 from CHP (space and water heating):

	Energy KWh/year	Emission factor kg	Emissions kg CO_2/year	
Power efficiency of CHP unit (e.g. 25%)			0	(361)
Heat efficiency of CHP unit (e.g. 50%)			0	(362)
Space heating from CHP			0	(363)
less credit emissions for electricity			0	(364)
Water heated by CHP			0	(365)
less credit emissions for electricity			0	(366)
CO_2 from other sources of space and water heating (not CHP):				
Efficiency of heat source 2 (%)			0	(367b)
Efficiency of heat source 3 (%)			0	(367c)
Efficiency of heat source 4 (%)			0	(367d)
Efficiency of heat source 5 (%)			0	(367e)
CO_2 associated with heat source 2			0	(368)
CO_2 associated with heat source 3			0	(369)
CO_2 associated with heat source 4			0	(370)
CO_2 associated with heat source 5			0	(371)

	Energy used kWh/year	Emission factor from PCDB	CO2/year kgCO2/year	
Where the heat network is listed in the PCDB:				
Space and water heating supplied by heat network			0	(371a)

	Energy used KWh/year	Emission factor from PCDB	CO2/year kgCO2/year	
Where the heat network is listed in the PCDB:				
Electrical energy for heat distribution			0	(372)
Total CO2 associated with heat networks			0	(373)
Space heating (secondary)			0	(374)
Water heating by immersion heater or instantaneous heater			0	(375)
Energy used by instantaneous electric shower(s)			0	(375a)
Total CO2 associated with space and water heating			0	(376)
Space cooling			0	(377)
Electricity for pumps and fans within dwelling			0	(378)
Electricity for lighting			0	(379)
energy saved or generated				
energy saved or generated			System.Double[]	(380)
Appendix Q items				
energy saved			0	(381)
energy used			0	(382)
energy used			0	(383)
Total CO2, kg/year			0	(384)
EI rating (section 14)			0	(385)
Overall CO2 factor for heat network			0	(386)

13b. Primary Energy – Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor from table 12	CO2/yearr kgCO2/year	
Where the heat network is not listed in the PCDB				
CO2 from CHP (space and water heating):				
Power efficiency of CHP unit (e.g. 25%)			0	(461)
Heat efficiency of CHP unit (e.g. 50%)			0	(462)
Space heating from CHP			0	(463)
less credit emissions for electricity			0	(464)
Water heated by CHP			0	(465)
less credit emissions for electricity			0	(466)
CO2 from other sources of space and water heating (not CHP):				
Efficiency of heat source 2 (%)			0	(467b)
Efficiency of heat source 3 (%)			0	(467c)
Efficiency of heat source 4 (%)			0	(467d)
Efficiency of heat source 5 (%)			0	(467e)

CO2 associated with heat source 2			0	(468)
CO2 associated with heat source 3			0	(469)
CO2 associated with heat source 4			0	(470)
CO2 associated with heat source 5			0	(471)
Where the heat network is listed in the PCDB:	Energy used kWh/year	Emission factor from PCDB	CO2/year kgCO2/year	
Space and water heating supplied by heat network			0	(371a)
	Energy kWh/year	Emission factor from Table 12	CO2/year kgCO2/year	
Electrical energy for heat distribution			0	(472)
Total CO2 associated with heat networks			0	(473)
Space heating (secondary)			0	(474)
Water heating by immersion heater or instantaneous heater			0	(475)
Energy used by instantaneous electric shower(s)			0	(475a)
Total CO2 associated with space and water heating			0	(476)
Space cooling			0	(477)
Electricity for pumps and fans within dwelling			0	(478)
Electricity for lighting			0	(479)
energy saved or generated				
energy saved or generated	0		0	(480)
Appendix Q items				
energy saved	0		0	(481)
energy used			0	(482)
Total CO2, kg/year			0	(383)
Dwelling CO2 Emission Rate			0	(274)
Overall CO2 factor for heat network			0	(386)

K_12_01 DER worksheet
BE GREEN
(Snapshots taken due to software error)

1. Overall dwelling dimensions

	Area (m²)		Average storey height (m)		Volume (m³)
Basement	78.64 (1a)	x	2.5 (2a)	=	196.6 (3a)
Total floor area TFA	78.64 (4)				
Dwelling volume				=	196.6 (5)

2. Ventilation Rate

Number of chimneys / flues:	Total				m³ per hour	
- open flues	0	x	80	=	0.0	(6a)
- open chimneys	0	x	20	=	0.0	(6b)
- chimneys / flues attached to closed fire	0	x	10	=	0.0	(6c)
- flues attached to solid fuel boiler	0	x	20	=	0.0	(6d)
- flues attached to other heater	0	x	35	=	0.0	(6e)
Number of blocked chimneys	0	x	20	=	0.0	(6f)
Number of intermittent extract fans	0	x	10	=	0.0	(7a)
Number of passive vents	0	x	10	=	0.0	(7b)
Number of flueless gas fires	0	x	40	=	0.0	(7c)

	Air changes per hour		
Number of storeys in the dwelling (ns)	0.0	0.0	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc	0.0	0.0	(9)
Additional infiltration	0.0	0.0	(10)
Structural infiltration	0.0	0.0	(11)
Suspended wooden ground floor	0.0	0.0	(12)
No draught lobby	0.0	0.0	(13)
Percentage of windows and doors draught proofed	0.0	0.0	(14)
Window infiltration	0.0	0.0	(15)
Infiltration rate	0.0	0.0	(16)
Air permeability value, AP50, (m³/h/m²)	3.0	3.0	(17)
Air permeability value, AP4, (m³/h/m²)	0.0	0.0	(17a)
Air permeability value	0.15	0.15	(18)
Number of sides on which dwelling is sheltered	2.0	2.0	(19)
Shelter factor	0.85	0.85	(20)
Infiltration rate incorporating shelter factor	0.13	0.13	(21)

Infiltration rate modified for monthly wind speed:

Monthly average wind speed from Table U2

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	
5.1	5.0	4.9	4.4	4.3	3.8	3.8	3.7	4.0	4.3	4.5	4.7	(22)
											Total =	52.5

Wind Factor

1.28	1.25	1.23	1.1	1.08	0.95	0.95	0.93	1.0	1.08	1.13	1.18	(22a)
											Total =	13.12

Adjusted infiltration rate (allowing for shelter and wind speed)

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)
											Total =	1.67

Calculate effective air change rate for the applicable case:

0.5	0.5	(23a)
0.5	0.5	(23b)
44.0	44.0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR)

0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43	(24a)

b) If balanced mechanical ventilation without heat recovery (MV)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(24d)

Effective air change rate

0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43	(25)

For mechanical ventilation systems providing variable air change rates, the monthly rate held in the PCDB or Appendix Q data and should instead be used:

Effective air change rate from PCDB:

0.44	0.44	0.44	0.42	0.42	0.4	0.4	0.4	0.41	0.42	0.42	0.43	(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value is the heat capacity per unit area, see Table 1h

Element	Gross area, m²	Openings m ²	Net area A, m²	U-value W/m2 K	A x U W/K	k-value kJ/m ²·K	A x k kJ/K			
Solid door					0.0			(26)		
Semi-glazed door					0.0			(26a)		
Window					15.95			(27)		
Roof window					0.0			(27a)		
Basement floor					0.0	0.0		(28)		
Ground floor					0.0	0.0		(28a)		
Exposed floor					0.0	0.0		(28b)		
Basement wall					0.0	0.0		(29)		
External wall					17.7	4206.64		(29a)		
Roof					0.0	0.0		(30)		
Total area of external elements ∑A, m²	54.85 +									(31)
Party Wall					6827.8	0.0		(32)		
Party floor						6291.2		(32a)		
Party ceiling						7864.0		(32b)		
Internal wall **						0.0		(32c)		
Internal floor						0.0		(32d)		
Internal ceiling floor						0.0		(32e)		
Fabric heat loss, W/K = ∑ (A x U)							33.65	(33)		
Heat capacity Cm = ∑(A x k)							25189.64	(34)		
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K							100.0		100.0	(35)
Linear Thermal bridges: ∑ (L x Ψ) calculated using Appendix K							0.17		0.17	(36)
Point Thermal bridges: ∑χ (W/K) if significant point thermal bridge present and values available							0.17		0.17	(36a)
Total fabric heat loss H = ∑(A × U) + ∑(L × Ψ) +∑χ							33.82		33.82	(37)

Ventilation heat loss calculated monthly

28.71	28.51	28.3	27.27	27.06	26.02	26.02	25.82	26.44	27.06	27.47	27.89	(38)

Heat transfer coefficient, W/K

62.54	62.33	62.12	61.09	60.88	59.85	59.85	59.64	60.26	60.88	61.3	61.71	(39)

Heat loss parameter (HLP), W/m²K

0.8	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.77	0.77	0.78	0.79	(40)

Number of days in month (Table 1a)

31.0	28.0	31.0	30.0	31.0	30.0	31.0	31.0	30.0	31.0	30.0	31.0	(41)

4. Water heating energy requirement

Assumed occupancy, N	2.44	2.44

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(42a)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

75.03	73.92	72.35	69.46	67.29	64.89	63.59	65.15	66.84	69.41	72.37	74.78	(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

39.58	38.14	36.7	35.27	33.83	32.39	32.39	33.83	35.27	36.7	38.14	39.58	(42c)

Hot water usage in litres per day for baths, Vd,bath (from Appendix J)

75.03	73.92	72.35	69.46	67.29	64.89	63.59	65.15	66.84	69.41	72.37	74.78	(42b)

Hot water usage in litres per day for other uses, Vd,other (from Appendix J)

39.58	38.14	36.7	35.27	33.83	32.39	32.39	33.83	35.27	36.7	38.14	39.58	(42c)

Annual average hot water usage in litres per day Vd,average (from Appendix J) 105.55 105.55 (43)

Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)

114.61	112.06	109.05	104.72	101.11	97.27	95.97	98.97	102.11	106.12	110.51	114.36	(44)

Total = 1266.87

Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)

181.52	159.57	167.61	143.36	136.12	119.61	116.07	122.55	125.91	144.0	157.44	179.06	(45)

Total = 1752.82

Distribution loss (46) = 0.15 x (45)

27.23	23.94	25.14	21.5	20.42	17.94	17.41	18.38	18.89	21.6	23.62	26.86	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	0.0	0.0	(47)
Water storage loss (or HIU loss):			
a) If manufacturer's declared loss factor is known (kWh/day):	1.46	1.46	(48)
Temperature factor from Table 2b	0.6	0.6	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0.88	0.88	(50)
b) If manufacturer's declared loss factor is not known :			
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0	0.0	(51)
Volume factor from Table 2a	0.0	0.0	(52)
Temperature factor from Table 2b	0.0	0.0	(53)
Energy lost from water storage, kWh/day	0.0	0.0	(54)
Enter (50) or (54) in (55)	0.88	0.88	(55)

Water storage (or HIU) loss calculated for each month (56) = (55) × (41)

27.16	24.53	27.16	26.28	27.16	26.28	27.16	27.16	26.28	27.16	26.28	27.16	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS storage,

(57)m = (56)m □ [(47) – Vs] ÷ (47), else (57)m = (56)m

where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).

27.16	24.53	27.16	26.28	27.16	26.28	27.16	27.16	26.28	27.16	26.28	27.16	(57)

Primary circuit loss for each month from Table 3

modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only heat networks)

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter "0" if not a combi boiler)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(61)

Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)

231.94	205.11	218.03	192.15	186.54	168.4	166.49	172.97	174.7	194.42	206.23	229.48	(62)

CWWHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no WWHRS contribution to water heating)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(63a)

PV diverter DHW input calculated using Appendix G (negative quantity) (enter "0" if no PV diverter contribution)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(63b)

Solar DHW input calculated using Appendix H (negative quantity) (enter "0" if no solar contribution to water heating)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(63c)

FGHRS DHW input calculated using Appendix G (negative quantity) (enter "0" if no FGHRS contribution to water heating)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(63d)

Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)

231.94	205.11	218.03	192.15	186.54	168.4	166.49	172.97	174.7	194.42	206.23	229.48	(64)

Total = 2346.45

if (64) m < 0 then set to 0 Energy used by instantaneous electric shower(s), kWh/month (from Appendix J)

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(64a)

Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]

78.97	69.87	74.34	65.68	63.87	57.78	57.2	59.36	59.87	66.49	70.36	78.15	(65)

include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network

5. Internal gains (see Tables 5 and 5a)

Metabolic gains (Table 5), watts

121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	121.83	(66)

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5

109.24	120.94	109.24	112.88	109.24	112.88	109.24	109.24	112.88	109.24	112.88	109.24

Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5												
109.24	120.94	109.24	112.88	109.24	112.88	109.24	109.24	112.88	109.24	112.88	109.24	(67)
Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5												
216.58	218.82	213.16	201.1	185.88	171.58	162.02	159.78	165.44	177.5	192.72	207.02	(68)
Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5												
35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	35.18	(69)
Pumps and fans gains (Table 5a)												
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	-97.46	(71)
Water heating gains (Table 5)												
106.14	103.97	99.92	91.22	85.85	80.25	76.89	79.78	83.16	89.37	97.72	105.04	(72)
Total internal gains												
491.5	503.28	481.86	464.75	440.51	424.25	407.7	408.34	421.03	435.65	462.86	480.84	(73)

6. Solar gains

Solar gains in watts, calculated for each month

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	
150.54	271.72	412.41	579.11	710.82	733.03	695.34	592.9	469.48	311.26	183.09	127.03	(83)
Total gains – internal and solar (watts)												
642.03	775.0	894.28	1043.86	1151.34	1157.28	1103.04	1001.24	890.51	746.91	645.96	607.87	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21.0 21.0 (85)

Utilisation factor for gains for living area, □1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	
0.91	0.86	0.77	0.63	0.47	0.33	0.24	0.27	0.45	0.71	0.87	0.92	(86)

Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

0.91 0.86 0.77 0.63 0.47 0.33 0.24 0.27 0.45 0.71 0.87 0.92
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)

19.65	20.0	20.38	20.74	20.92	20.98	21.0	20.99	20.95	20.68	20.13	19.59	(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)												
20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)
Utilisation factor for gains for rest of dwelling, □2,m (see Table 9a)												
0.9	0.84	0.75	0.6	0.44	0.29	0.2	0.23	0.41	0.67	0.85	0.92	(89)
Mean internal temperature in the rest of dwelling T2												
19.02	19.36	19.72	20.06	20.22	20.28	20.29	20.29	20.25	20.02	19.5	18.98	(90)
Living area fraction										0.38	0.38	(91)
Mean internal temperature (for the whole dwelling)												
19.26	19.6	19.97	20.32	20.48	20.54	20.55	20.55	20.51	20.27	19.74	19.21	(92)
Adjusted mean internal temperature:												
19.26	19.6	19.97	20.32	20.48	20.54	20.55	20.55	20.51	20.27	19.74	19.21	(93)

8. Space heating requirement

Utilisation factor for gains, □m:

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	
0.89	0.83	0.74	0.6	0.45	0.3	0.21	0.25	0.42	0.67	0.84	0.9	(94)
Useful gains, □mGm , W												
570.46	642.61	664.99	626.29	512.65	351.37	235.66	246.17	373.53	502.94	539.98	547.47	(95)
Monthly average external temperature from Table U1												
4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature												
935.4	916.28	836.79	697.67	534.63	355.68	236.61	247.69	386.48	588.71	774.61	926.06	(97)
Space heating requirement for each month												
271.51	183.91	127.82	51.39	16.36	0.0	0.0	0.0	0.0	63.82	168.94	281.67	(98a)
											Total =	1165.41
Solar space heating calculated using Appendix H (negative quantity)												
271.51	183.91	127.82	51.39	16.36	0.0	0.0	0.0	0.0	63.82	168.94	281.67	(98b)

[illegible]												(98b)
											Total =	1165.41

Space heating requirement for each month after solar contribution

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(98c)

Space heating requirement in kWh/m²/year	14.82	14.82	(99)

8c. Space cooling requirement

Heat loss rate

Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	(100)
0.0	0.0	0.0	0.0	0.0	562.57	442.88	453.27	0.0	0.0	0.0	0.0	

Utilisation factor for loss □m

0.0	0.0	0.0	0.0	0.0	0.97	0.98	0.97	0.0	0.0	0.0	0.0	(101)

Useful loss, □mLm (watts)

0.0	0.0	0.0	0.0	0.0	544.25	434.53	441.21	0.0	0.0	0.0	0.0	(102)

Gains

0.0	0.0	0.0	0.0	0.0	1303.07	1242.13	1124.89	0.0	0.0	0.0	0.0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh)

0.0	0.0	0.0	0.0	0.0	546.35	600.85	508.66	0.0	0.0	0.0	0.0	(104)
											Total =	1655.86

Cooled fraction	0.81	0.81	(105)

Intermittency factor

0.0	0.0	0.0	0.0	0.0	0.25	0.25	0.25	0.0	0.0	0.0	0.0	(106)

Space cooling requirement for month

0.0	0.0	0.0	0.0	0.0	110.53	121.56	102.91	0.0	0.0	0.0	0.0	(107)
											Total =	335

Space cooling requirement in kWh/m²/year	4.26	4.26	(108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency	0.0	0.0	(109)

9b. Energy requirements – Heat networks

Fraction of space heat from secondary/supplementary heating
0.0
(301)

Fraction of space heat from heat network
1.0
(302)

Where the heat network is not listed in the PCDB:

Fraction of heat from CHP
1.0
(303a)

Fraction of heat from heat source 2
0.0
(303b)

Fraction of heat from heat source 3
0.0
(303c)

Fraction of heat from heat source 4
0.0
(303d)

Fraction of heat from heat source 5
0.0
(303e)

Whether the heat network is listed in the PCDB or not:

Factor for control and charging method (Table 4c(3)) for space heating
1.05
(305)

Factor for charging method (Table 4c(3)) for water heating

(305)

Factor for charging method (Table 4c(3)) for water heating
1.0
(305a)

Distribution loss factor (Table 12c) for heat network - set to 1 if HN listed in PCDB
1.5
(306)

Space heating
kWh/year

Annual space heating requirement
0.0

Heat required from heat network
0.0

Where the heat network is not listed in the PCDB:

Space heat from CHP
1835.52
(307a)

Space heat from heat source 2
0.0
(307b)

Space heat from heat source 3
0.0
(307c)

Space heat from heat source 4
0.0
(307d)

Space heat from heat source 5
0.0
(307e)

Whether the heat network is listed in the PCDB or not:

Efficiency of secondary/supplementary heating system in %
0.0
(308)

Space heating fuel for secondary/supplementary system
0.0
(309)

Water heating

Annual water heating requirement
2346.45

If DHW from heat network:

Heat required from heat network
0.0
(310)

Where the heat network is not listed in the PCDB:

Water heat from CHP
3519.68
(310a)

Water heat from heat source 2
0.0
(310b)

Water heat from heat source 3
0.0
(310c)

Water heat from heat source 4
0.0
(310d)

Water heat from heat source 5
0.0
(310e)

If DHW by immersion or instantaneous heater within dwelling:

Efficiency of water heater
0.0
(311)

Water heated by immersion or instantaneous heater
0.0
(312)

Electricity used for instantaneous electric shower(s)

(312)

Electricity used for instantaneous electric shower(s)
0.0
(312a)

Electrical pumping energy as proportion of heat supplied
53.55
(313)

Electricity used for heat distribution
53.55
(313)

Cooling System Seasonal Energy Efficiency Ratio
0.0
(314)

Space cooling (if there is a fixed cooling system
∞
(315)

Electricity for pumps and fans within dwelling

mechanical ventilation - balanced, extract or positive input from outside
320.8
(312a)

warm air heating system fans
0.0
(312a)

pump for solar water heating
0.0
(312a)

Total electricity for pumps and fans
320.8
(331)

Electricity for lighting
187.42
(332)

EnergyRequirements - Energy used in dwelling

PV	0.0	0.0
Wind	0.0	0.0
Hydro		

EnergyRequirements - Energy used exported

PV	0.0	0.0
Wind	0.0	0.0
Hydro		

Appendix Q items: annual energy

	kWh/year	kWh/year	
energy saved	0.0	0.0	(336a)
energy used	0.0	0.0	(337a)
energy saved	0.0	0.0	(336b)
energy used	0.0	0.0	(337b)
Total delivered energy for all uses	∞	∞	

10b. Fuel costs – Individual heating systems including micro-CHP

Where the heat network is not listed in the PCDB:

	Heat or Fuel required kWh/year	Fuel price (Table 12)		Fuel cost £/year	
Space heating from CHP	x 1835.52	4.44	x 0.01 =	81.5	(340a
Space heating from heat source 2	x 0.0	0.0	x 0.01 =	0.0	(340b
Space heating from heat source 3	x 0.0	0.0	x 0.01 =	0.0	(340c
Space heating from heat source 4	x 0.0	0.0	x 0.01	0.0	(340d

Space heating from heat source 5	x 0.0	0.0	x 0.01 =	0.0	(340e
Where the heat network is not listed in the PCDB:					
Space heating from PCDB heat network			x 0.01 =		(340)
Space heating fuel for secondary/supplementary system		0.0	x 0.01 =	0.0	(341)
If DHW from heat network:					
Where the heat network is not listed in the PCDB:					
Water heating from CHP	x 3519.68	4.44	x 0.01 =	156.27	(342a
Water heating from heat source 2	x 0.0	0.0	x 0.01 =	0.0	(342b
Water heating from heat source 3	x 0.0	0.0	x 0.01 =	0.0	(342c)
Water heating from heat source 4	x 0.0	0.0	x 0.01 =	0.0	(342d
Water heating from heat source 5	x 0.0	0.0	x 0.01 =	0.0	(342e
Water heating from PCDB heat network			x 0.01 =		(342)
If water heated by immersion heater:					
High-rate fraction (Table 13)				0.0	(343)
Low-rate fraction				0.0	(344)
High-rate cost, or cost for single immersion			x 0.01 =	0.0	(345)
Low-rate cost			x 0.01 =	0.0	(346)
If water heated by instantaneous water heater			x 0.01 =	0.0	(347)
Energy used by instantaneous electric shower(s)			x 0.01 =	0.0	(347a
Space cooling			x 0.01 =	0.0	(348)
Pumps and fans			x 0.01 =	52.9	(349)
Electricity for lighting			x 0.01 =	30.91	(350)
Additional standing charges (Table 12)				92.0	(351)
energy saved or generated		0.0	x 0.01 =	0.0	
energy saved		energySavedPrice	x 0.01 =	0.0	
energy used		energyUsedPrice	x 0.01 =	0.0	
energy saved		energySavedPrice	x 0.01 =	0.0	(353b
energy used		energyUsedPrice	x	0.0	(354b

Total energy cost	= 413.58	413.58	(355)

11a. SAP rating – Individual heating systems including micro-CHP

Energy cost deflator	0.36	0.36	(356)
Energy cost factor (ECF)	1.2	1.2	(357)
SAP rating	80.48	80.48	(358)

12b. CO2 emissions – Individual heating systems

Where the heat network is not listed in the PCDB

CO2 from CHP (space and water heating):

Power efficiency of CHP unit (e.g. 25%)	0.0	0.0	(361)
Heat efficiency of CHP unit (e.g. 50%)	0.0	0.0	(362)

	Energy used kWh/year	Emission factor from Table 12	CO2/year kgCO2/year	
Space heating from CHP			= 0.0	(363)
less credit emissions for electricity			= 0.0	(364)
Water heated by CHP			= 0.0	(365)
less credit emissions for electricity			= 0.0	(366)
CO2 from other sources of space and water heating (not CHP):				
Efficiency of heat source 2 (%)			= 0.0	(367b)
Efficiency of heat source 3 (%)			= 0.0	(367c)
Efficiency of heat source 4 (%)			= 0.0	(367d)
Efficiency of heat source 5 (%)			= 0.0	(367e)
CO2 associated with heat source 2			= 0.0	(368)
CO2 associated with heat source 3			= 0.0	(369)
CO2 associated with heat source 4			= 0.0	(370)
CO2 associated with heat source 5			= 0.0	(371)
Where the heat network is listed in the PCDB:	Energy used kWh/year	Emission factor from PCDB	CO2/year kgCO2/year	
Space and water heating supplied by heat network			= 0.0	(371a)
Where the heat network is listed in the PCDB:	Energy used kWh/year	Emission factor from Table 12	CO2/year kgCO2/year	
Electrical energy for heat distribution			= 7.84	(372)
Total CO2 associated with heat networks			= 223.31	(373)
Space heating (secondary)			= 0.0	(374)
Water heating by immersion heater or instantaneous heater			= 0.0	(375)
Energy used by instantaneous electric shower(s)			= 0.0	(375a)
Total CO2 associated with space and water heating			= 223.31	(376)
Space cooling			= 0.0	(377)

			0.0		
Electricity for pumps and fans within dwelling			= 44.5		(378)
Electricity for lighting			= 27.05		(379)
energy saved or generated	x	0.0	=	0.0	
Appendix Q items					
energy saved	x	0.0	=	0.0	
energy used	x	0.0	=	0.0	
energy saved	x	0.0	=	0.0	(381b)
energy used	x	0.0	=	0.0	(382b)
Total CO2, kg/year		3.65		3.65	(384)
Dwelling CO2 Emission Rate		96.89		96.89	(273)
Overall CO2 factor for heat network		Emission factor			
Overall CO2 factor for heat network					(386)

13b. Primary Energy – Individual heating systems including micro-CHP

Where the heat network is not listed in the PCDB

CO2 from CHP (space and water heating):

Power efficiency of CHP unit (e.g. 25%)	0.0		0.0	(461)
Heat efficiency of CHP unit (e.g. 50%)	0.0		0.0	(462)

	Energy used kWh/year	Emission factor from Table 12	CO2/year kgCO2/year	
Space heating from CHP			= 0.0	(463)
less credit emissions for electricity			= 0.0	(464)
Water heated by CHP			= 0.0	(465)
less credit emissions for electricity			= 0.0	(466)
CO2 from other sources of space and water heating (not CHP):				
Efficiency of heat source 2 (%)			= 0.0	(467b)
Efficiency of heat source 3 (%)			= 0.0	(467c)
Efficiency of heat source 4 (%)			= 0.0	(467d)
Efficiency of heat source 5 (%)			= 0.0	(467e)
CO2 associated with heat source 2			= 0.0	(68)
CO2 associated with heat source 3			= 0.0	(69)
CO2 associated with heat source 4			= 0.0	(70)
CO2 associated with heat source 5			= 0.0	(71)
Where the heat network is listed in the PCDB:	Energy used kWh/year	Emission factor from PCDB	CO2/year kgCO2/year	
Space and water heating supplied by heat network			= 0.0	(371a)
Where the heat network is listed in the PCDB:	Energy used kWh/year	Emission factor from Table 12	CO2/year kgCO2/year	
Electrical energy for heat distribution			= 82.54	(472)
Total CO2 associated with heat networks			= 2460.69	(473)
Space heating (secondary)			= 0.0	(474)
Water heating by immersion heater or instantaneous heater			= 0.0	(475)

			0.0		
Energy used by instantaneous electric shower(s)			= 0.0		(475a)
Total CO2 associated with space and water heating			= 2460.69		(476)
Space cooling			= 0.0		(477)
Electricity for pumps and fans within dwelling			= 485.31		(478)
Electricity for lighting			= 287.48		(479)
energy saved or generated	x	0.0	=	0.0	
Appendix Q items					
energy saved	x	0.0	=	0.0	
energy used	x	0.0	=	0.0	
energy saved	x	0.0	=	0.0	481b
energy used	x	0.0	=	0.0	482b
Total CO2, kg/year		3155.38		3155.38	(383)
Dwelling CO2 Emission Rate		40.12		40.12	(274)
Overall CO2 factor for heat network		Emission factor			
Overall CO2 factor for heat network					(386)

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