Twickenham Riverside

Energy Statement

LONDON BOROUGH OF
RICHMOND UPON THAMES

July 2021

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Audit History

Rev	Date of Issue	Status	Issued By	Checked By	Summary of Changes
1.0	04/06/2021	Draft	LW	NA	-
2.0	11/06/2021	Planning	LW	NA	-
3.0	15/07/2021	Planning	LW	NA	Site plan updated / overheating

1. OVERVIEW

Introduction

This Energy Statement has been prepared by Skelly and Couch Ltd on behalf of London Borough of Richmond upon Thames ('the Applicant'), in support of one full planning application for the development of Twickenham Riverside (‘the Site’), situated in Twickenham on the northern embankment of the River Thames.

The proposed description of development is (hereafter referred to as the 'Proposed Development'):

Demolition of existing buildings and structures and redevelopment of the site comprising residential (Use Class C3), ground floor commercial/ retail/ cafe (Use Class E), and public house (Sui Generis), boathouse locker storage and floating pontoon with associated landscaping, restoration of Diamond Jubilee Gardens and other relevant works.

The development will provide 45 apartments from studios to 3 bedroom units over two separate buildings. A number of mixed-use commercial premises will be provided within the same buildings, as well as a café and pub/restaurant. The Site will provide flexible recreation space to reflect that which is currently provided by Diamond Jubilee Gardens. The Proposed Development will provide a number of accessible car parking spaces. Cycle parking shall be provided for the use of occupants’ use and for users of the commercial buildings and recreation ground.

This report outlines the energy strategies proposed for all aspects of the Proposed Development at Twickenham Riverside and following the energy assessment guidance provided by the New London Plan and London Borough of Richmond-upon-Thames (‘LBRuT’) Local Plan will demonstrate how regulated carbon emissions reductions will be met in line with all relevant planning policies.

The Site

The Site occupies a space on the northern bank of the River Thames, close to the centre of Twickenham in the LBRuT. The majority of the Site is currently occupied by Diamond Jubilee Gardens, and incorporates a café and a number of car parking spaces for Eel Pie Island residents.

It is bounded by retail units on King Street to the North; Water Lane to the east; Wharf Lane to the west and the River Thames to the south.

Figure 1: the Site aerial view and local points of interest

Figure 3: the Site aerial view (plan)

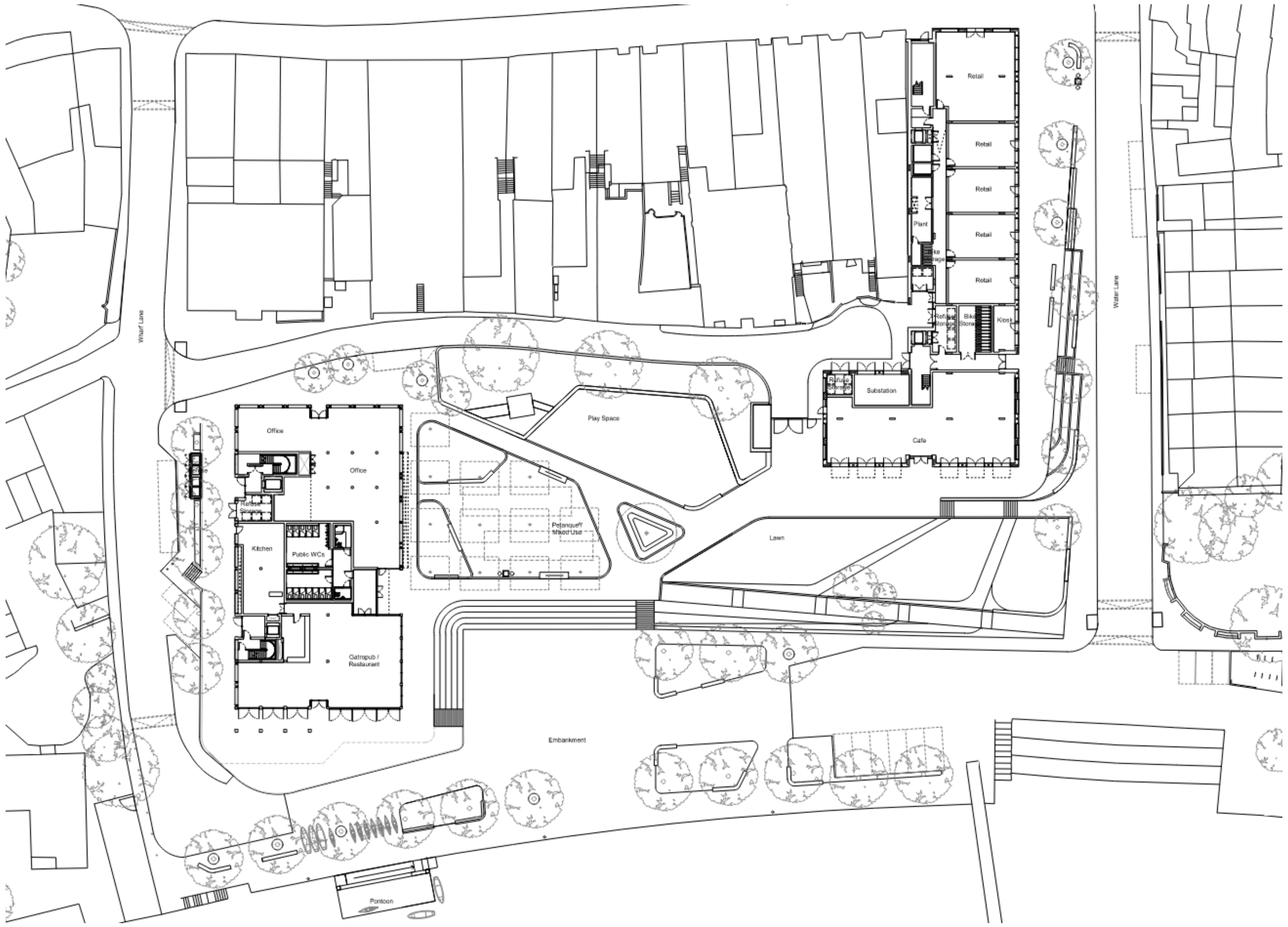


Figure 2: the proposed site layout

2. EXECUTIVE SUMMARY

This report outlines the Proposed Development's energy strategy. The report outlines how the Proposed Development follows the sustainability guidance provided by the LBRuT Local Plan and New London Plan.

The Proposed Development shall aim to comply with the LBRuT Local Plan and the New London Plan published in March 2021.

Full details of the requirements of these documents will be provided in Section 3, and a strategy for compliance demonstrated throughout this report.

Methodology

This report will demonstrate how site-wide notional carbon emissions will be reduced in accordance with local planning requirements.

Carbon emissions shall be reported in accordance with GLA document *Energy Assessment Guidance (2018)* and supporting worksheet *carbon emissions reporting spreadsheet v1.2.*

The strategy for developing the energy strategy for the Proposed Development shall be demonstrated in the form of the energy design hierarchy, following the LEAN, CLEAN, GREEN, SEEN approach.

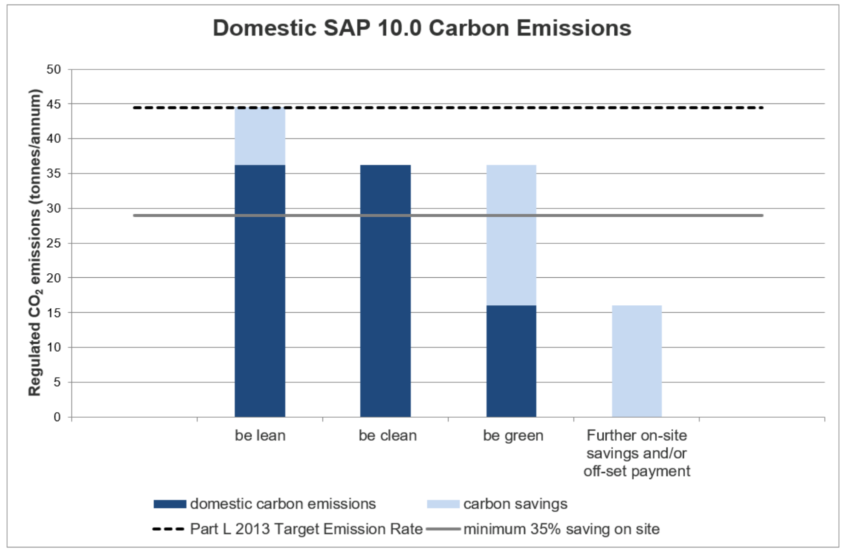
Energy Demand Assessment

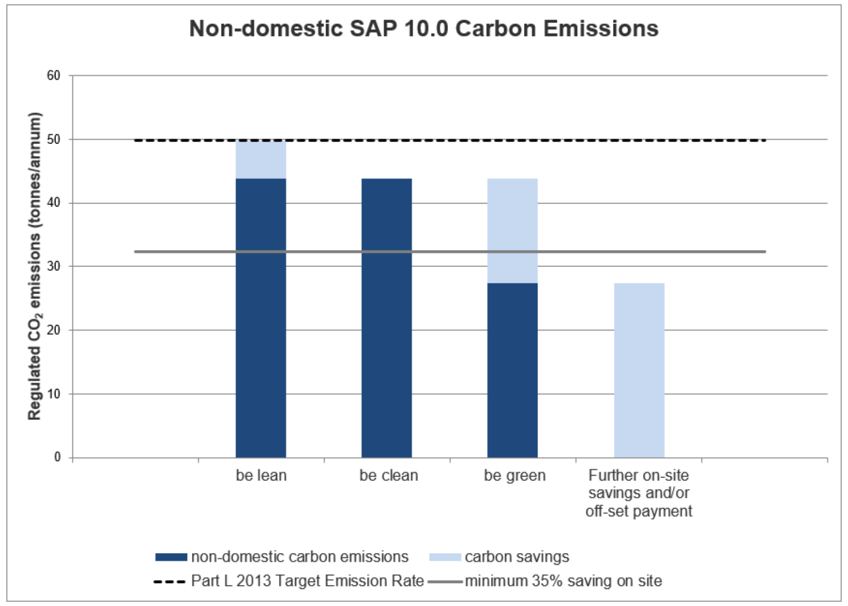
An energy demand assessment has been carried out employing the principles of the energy hierarchy set out above.

The energy demand assessment shows that the carbon saving measures outlined in the Environmental Design Strategy give an overall on-site reduction of 54% compared to Building Regulations Part L – exceeding the minimum 35% target for commercial and residential developments.

Individual development and combined site-wide energy assessments have been carried out using the GLA Carbon Emission Reporting Spreadsheet v1.2. This not only accounts for the new carbon emissions factors but is also a GLA requirement for planning applications.

This results in a carbon offset payment of £123,892.





	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	94.3		
Be lean	80.1	14.1	15%
Be clean	80.1	0.0	0%
Be green	43.5	36.7	39%
Total Savings	-	50.8	54%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,304.1**	-

Overheating Risk Analysis

Overheating shall be assessed in accordance with CIBSE technical memorandum TM52 for the commercial development and TM59 for the residential development

The Site is situated in a dense urban environment, as can be seen in Figure 1, and as such, may be subjected to high noise emissions from local businesses and recreation areas. As residential apartments and some commercial units shall rely on natural ventilation to prevent overheating in summer, noise levels experienced within apartments may be higher than would typically be expected.

The results from the Overheating Risk Analysis show that passive design measures successfully minimise overheating risk to a degree, but due to site constraints they are not substantial to meet TM52 and TM59 criteria in all cases.

This is especially true when natural ventilation openings have to remain closed for noise, pollution, wind or safety reasons. In these cases, tenant active cooling will be sufficient to prevent summertime overheating. These proposals take an integrated approach to noise, ventilation and overheating, without compromising good daylight levels and occupant control and comfort.

3. REGIONAL AND LOCAL POLICIES

The Proposed Development shall comply with the requirements of both the GLA's London Plan and LBRuT Local Plan. In many aspects, the requirements of both of policies within these documents are commensurate.

A summary of the relevant policies for each is given below.

LBRuT Local Plan (2018) (2020):

- LP22 (A) – Sustainable design & construction
- LP22 (B) - Zero carbon
- LP22 (C) - Energy hierarchy
- LP22 (D) - Decentralised energy

London Plan (2021)

- Policy SI 1 - Improving air quality
- Policy SI 2 - Minimising greenhouse gas emissions
- Policy SI 3 - Energy Infrastructure
- Policy SI 4 - Managing heat risk
- Policy SI 5 - Water Infrastructure

A comparison of the London Plan and LBRuT Local Plan policies is discussed below.

LBRuT Local Plan Policies

The London Borough of Richmond-upon-Thames encourages new developments to be energy and resource efficient.

LBRuT provide requirements for new development within its Local Plan in the policies outlined above.

LP22 (A) Sustainable design and construction

> *Developments of 1 dwelling or more, or at least 100sqm of non-residential floorspace (including extensions) must complete the Sustainable Construction Checklist SPD and be submitted as part of the planning application.*

The Proposed Development will comply with this requirement through completion of the Sustainable Construction Checklist.

> *New residential dwellings, including conversions, change of use and extensions, must incorporate water conservation measures to achieve a maximum water consumption of 110 litres per person per day for homes.*

This water conservation target shall be met primarily through the use of water efficient fittings. 3 credits are being targeted for BREEAM credit Wat 01, which equates to approximately a 40% reduction in water consumption. In addition, the following measures are proposed to reduce water consumption and surface water run-off from the Site:

- Smart water metering
- Major water leak detection on major supplies to buildings
- Surface water drainage to minimise run-off rate

> *New non-residential buildings over 100sqm are required to meet BREEAM 'Excellent' standards.*

BREEAM 'Excellent' standard is currently being targeted for the commercial units within the Proposed Development.

LP22 (B) Zero carbon

Policy LP22(B) states that all new residential and new non-residential developments in excess of $100m^2$, shall achieve a minimum on-site carbon reduction of 35%, compared with UK Building Regulations 2013.

Further, non-residential developments should achieve a zero carbon standard. These requirements are commensurate with the London Plan Policy SI 2.

Where a development is not able to meet the net zero carbon target on-site, any shortfall should be provided, either:

> *1) through a cash in lieu contribution to the borough's carbon offset fund, or*
>
> *2) off-site provided that an alternative proposal is identified, and delivery is certain.*

LP22 (C) Energy hierarchy

Developments must show carbon emissions reduction through the energy hierarchy set out in the London Plan:

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

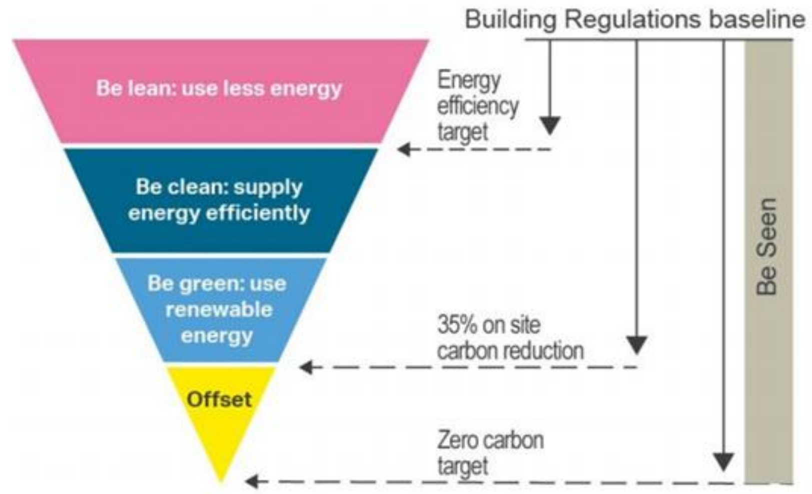


Figure 4: GLA New London Plan energy hierarchy

The strategy for complying with this requirement shall be demonstrated in Section 4 Environmental Design Strategy, which presents calculated carbon reductions for each step of the energy hierarchy.

These requirements are commensurate with the London Plan Policy SI 2.

LP22 (D) Decentralised energy

The requirements of LP22(D) can be summarised as follows:

> *Where feasible, new development will be required to connect to existing DE systems or where a DE network is planned and expected to be operational within 5 years of the development being completed.*
>
> *Proposals for new 50+ residential units or at least 1,000sqm of new non-residential development must provide an assessment of on-site DE networks and combined heat power provision.*
>
> *Where feasible, proposals for 50+ residential units or at least 1,000sqm of new non-residential development will be required to provide on-site DE and combined heat power, particularly in areas identified on the LBRuT Heat Mapping Study. Where this is not feasible, provision for future connection to a local DE network should be made.*

The London Heat Map provides information on existing, proposed and potential areas for district heat networks. Figure 5 shows an extract from the London Heat Map showing the Twickenham area and the nearest existing heat network. Currently, no district heating or cooling networks exist within a viable distance from the Site. Therefore, connection to an existing heat network is not feasible for the Proposed Development.

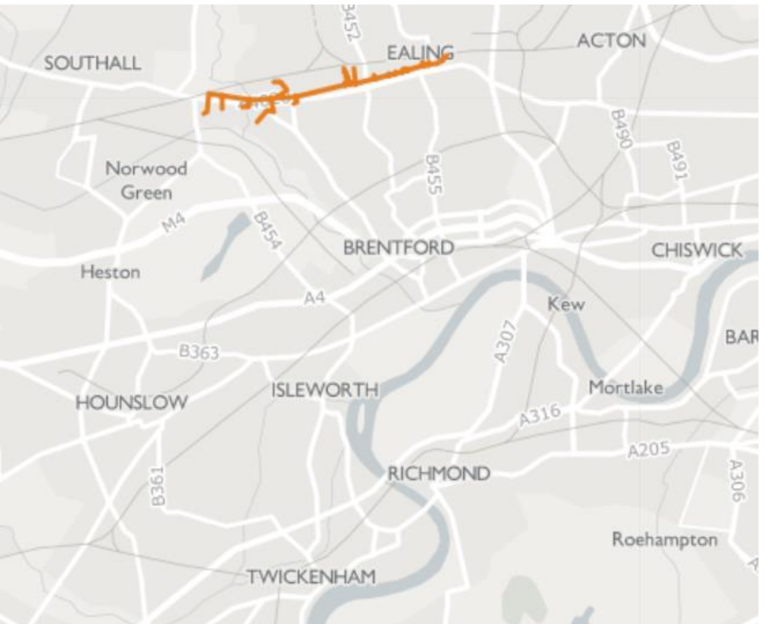


Figure 5: Nearest heat network to TRS site, from London Heat Map

Figure 6 below shows an extract from the London Heat Map showing the site location and nearby heat network priority areas. It can be seen that the Site lies outside of the heat network priority area shown.

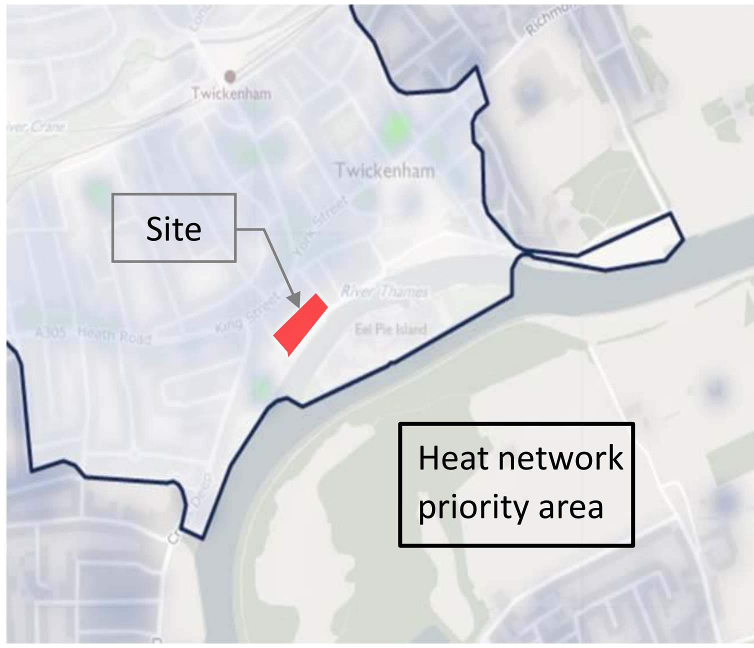
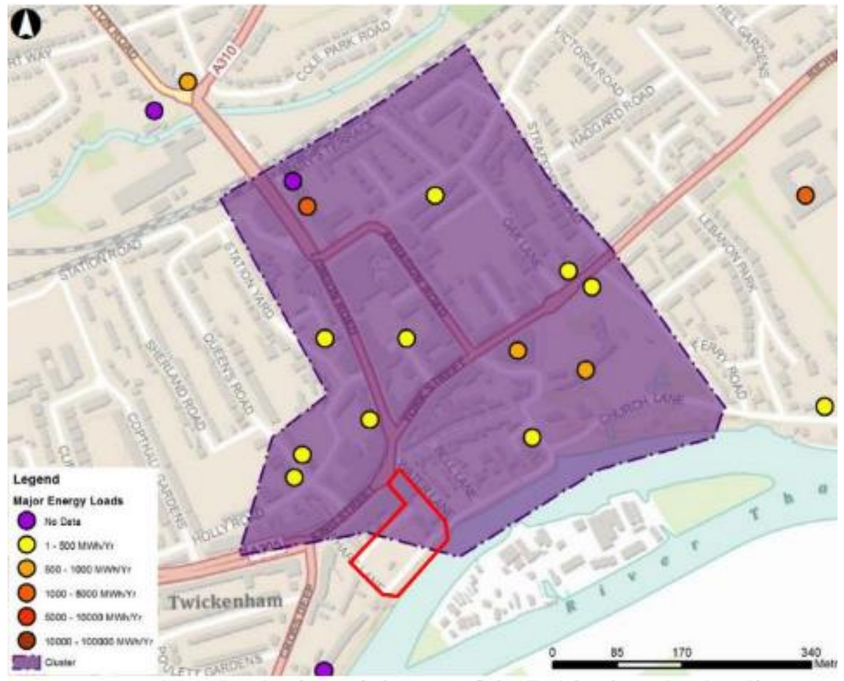


Figure 6: Map showing the heat network priority area, south and east of the site

An extract from the LBRuT heat mapping study is shown in Figure 7 below. This extract shows that a portion of the Site lies within the Twickenham Station cluster.



Heat Mapping Study and close up of the Twickenham Station Cluster (site outlined in red)

Figure 7: Extract from LBRuT heat mapping study, showing the site outline and Twickenham station heat cluster

London Plan (2021) Policies

Policy SI 1 Improving air quality

Policy SI1 requires that developments do not lead to deterioration of local air quality. This is deemed to be achieved by being at least air quality neutral. Large scale developments should further provide an air quality assessment and masterplans and major developments must consider how local air quality may be improved, and demonstrate:

> *a) how proposals have considered ways to maximise benefits to local air quality, and*
>
> *b) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this*

Compliance with this policy shall be demonstrated by the production of an air quality assessment, which addresses the requirements of SI 1.

Policy SI2 Minimising greenhouse gas emissions

Policy SI 2 is reflected in the LBRuT local plan policy LP22(B), as outlined previously.

In addition, the London Plan sets a target for carbon emissions reduction through energy efficiency measures alone, in an effort to reduce energy demand at the outset.

These targets are 10% for residential and 15% for non-residential developments.

Zero-carbon targets for major residential developments have been in place for London since October 2016 and will now apply to major non-residential developments also, via carbon offsetting.

Policy SI3 Energy Infrastructure

Policy SI 3 requires that boroughs and developers:

> *should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.*

Further, large scale developments should develop an energy masterplan that should identify:

> *1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)*
>
> *2) heat loads from existing buildings that can be connected to future phases of a heat network*
>
> *3) major heat supply plant including opportunities to utilise heat from energy from waste plants*
>
> *4) secondary heat sources, including both environmental and waste heat*
>
> *5) opportunities for low and ambient temperature heat networks*
>
> *6) possible land for energy centres and/or energy storage*
>
> *7) possible heating and cooling network routes*
>
> *8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works*
>
> *9) infrastructure and land requirements for electricity and gas supplies*

In the absence of an existing local district heat networks, it is proposed that a site-wide heating network is provided (as will be discussed in Section 4 Environmental Design Strategy). In order to facilitate connection to a district heat network at a future date, should one become available, heating systems shall incorporate capped connections for ease of connectivity, and plant space suitable for the installation of a heat exchanger and associated equipment.

Policy SI4 Managing heat risk

Policy SI 4 concerns the mitigation of heat risk both internally and externally to the building, and can be summarised as follows:

> *Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.*
>
> *B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:*
>
> *1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure*
>
> *2) minimise internal heat generation through energy efficient design*
>
> *3) manage the heat within the building through exposed internal thermal mass and high ceilings*
>
> *4) provide passive ventilation*
>
> *5) provide mechanical ventilation*
>
> *6) provide active cooling systems*

Dynamic building simulation (DSM) shall be carried out for the Proposed Development to determine heat risk in residential and commercial aspects of the development and to test mitigation measures.

Mitigation of heat risk shall be assessed through the cooling hierarchy, as set out above, refer to Section 6 THE COOLING HIERARCHY.

Policy SI5 Water Infrastructure

Policy SI 5 concerns the management of water consumption to mitigate water-stress, given projections for increased water consumption within London. The relevant aspects of this policy are extracted below:

> *Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.*
>
> *Development proposals should:*
>
> *1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
>
> *2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category164 or equivalent (commercial development)*

> *3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*
>
> *D In terms of water quality, Development Plans should:*
>
> *1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans*

Water efficiency is proposed to be achieved through a fittings-based approach, along with metering and other water-saving measures, see discussion for LBRuT local Plan policy LP22(A) above.

Building Regulations

Building Regulations apply to all developments, and are in place to ensure buildings meet health, safety, welfare, convenience and sustainability standards; they focus on the technical aspects of designing and constructing a building.

The Proposed Development at Twickenham Riverside will be fully compliant with all revisions of the Building Regulations relevant to MEPH design. The most relevant documents are the Part L Approved Documents:

Part L1A: Conservation of Fuel and Power in New Dwellings

Compliance at the design stage is demonstrated by calculating and comparing the CO_2 emissions rate for the proposed dwellings and commercial building, known as the Dwelling Emissions rate (DER) and an equivalent notional building of the same geometry but with a set of benchmark performance characteristics as specified in the 2010 NCM modelling guide, known as the Target Emissions Rate (TER).

The government approved Standard Assessment Procedure (SAP) methodology were employed to demonstrate compliance with these regulations.

Part L2A: Conservation of Fuel and Power in New Buildings other than Dwellings.

Compliance at the design stage is demonstrated through the use of approved software that calculates the CO_2 emissions rate for the proposed development, (BER) and an equivalent notional building of the same geometry but with a set of benchmark performance characteristics as specified in the 2010 NCM modelling guide (TER).

The government approved Dynamic Simulation Modelling (DSM) methodology is employed to demonstrate compliance with these regulations.

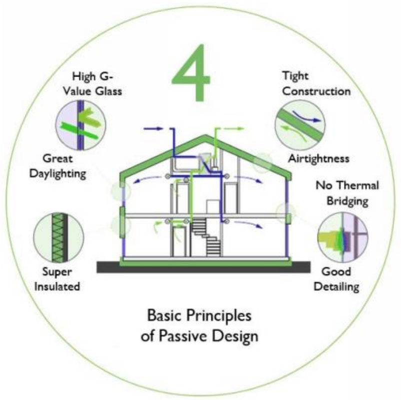
4. ENVIRONMENTAL DESIGN STRATEGY

Residential apartments

Be Lean

The first step of the adopted energy hierarchy is to reduce energy use through both passive and active lean design measures. The basic principles of passive design are as follows:

- Balanced G-value and light transmittance (LT) glazing to optimise solar gains and internal daylight levels
- Super insulated fabric
- Tight construction
- No thermal bridging/ Good detailing



Building Fabric

A large proportion of energy used within commercial and residential buildings comes directly from heating. A high-quality thermal envelope and airtight building will ensure that fabric heat loss and cold bridges are minimised.

The residential fabric performance looks to significantly improve on the requirements set out in the Building Regulations Approved Document Part L1A, as shown below.

Building Element	B' Regs Limiting U-Values (W/m2K)	Notional U-values (W/m2K)	Target U-values (W/m2K)
Roof	0.20	0.13	0.10
Walls	0.30	0.18	0.15
Floors	0.25	0.13	0.10
Windows	2.00	1.40	1.20
Airtightness (m3/hr/m2)	10	5	3
Thermal Bridging y-value (average)	0.15	0.15	0.10

Table 1: Fabric thermal performance parameters for residential apartments

Limit Overheating

To reduce the requirement for active cooling within the apartments it is important to reduce the risk of overheating. Measures have been taken to achieve this including utilising high-performance solar glazing (G-value = 0.35).

Daylight

The maximisation of daylight is one of the most important environmental factors for buildings. Artificial lighting contributes up to 25% of the energy costs of a typical building, despite operation largely within daylight hours. Anecdotal evidence also suggests that the provision of good levels of natural light can contribute to enhanced health and well-being.

The apartments will benefit from a high percentage of glazing, with a LT value of 0.65 to allow a good level of daylight. The design will be developed to provide an average daylight factor of 1.5% in the majority of spaces, which means that artificial light should not be needed for a large proportion of daylight hours.

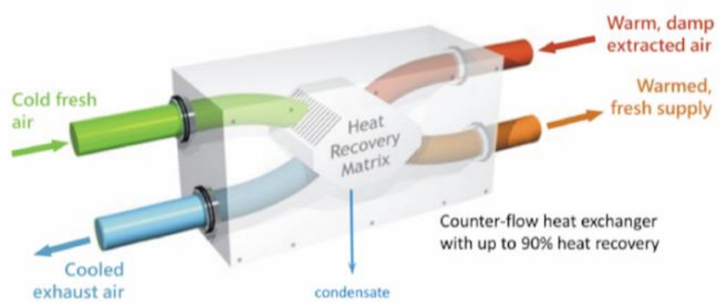
Efficient Ventilation

Openable windows will allow sufficient natural ventilation during occupied hours, and when acoustic requirements allow, to prevent overheating.

Local MVHR units in each apartment will also provide continuous mechanical ventilation and a background ventilation rate in line with Part F minimum whole dwelling ventilation rates.

The units extract air from all "wet" rooms (kitchens/bathrooms/utility rooms) and supply filtered fresh air from outside to the living areas. Maintaining a minimum ventilation rate improves air quality within the dwelling without opening windows or relying on trickle vents.

The heat exchanger within the MVHR units recover up to 95% of the heat from the extracted stale air that would normally be wasted, reducing overall heat loads.



Mechanical Ventilation with Heat Recovery

Minimising Water Usage

The design shall incorporate water saving strategies, such as low flush toilets, low flow showers and non-concussive spray taps in order to keep the maximum water usage to 105 litres/person per day.

Water consumption will be monitored, and each apartment individually metered. Other features shall include mains leak detection and sanitary shut-off.

Other Efficiency Measures

The design shall utilise efficient state of the art services and controls.

These will include:

- Grade A efficiency electrical appliances throughout
- Sub-metering on all major energy consuming loads
- Variable speed control on fans and pumps
- LED lights and high efficiency lamps for light fittings.

Be Clean

There is currently no district energy infrastructure within the vicinity of the Site, therefore connection to a district heating network is not currently feasible.

The Proposed Development will utilise electric air-source heat pumps (ASHP) to generate heat and hot water. This is also advantageous for the local air quality of the surrounding area and its users as heat pumps do not emit and pollutants into the atmosphere. Heat pumps will be assessed under the 'be green' heading, as these are a recognised renewable technology.

A CHP system has been assessed for the Proposed Development and determined not to be advantageous as it will result in lower overall carbon emissions.

Be Green

The final reductions in energy consumption and related carbon emissions should be through the use of on-site renewable energy sources in the bid to reaching net zero carbon.

ASHPs are a highly efficient way to generate hot water and heating and will cover a large proportion of the carbon savings for the residential development.

The energy assessment results (see Section 7) shows how the carbon reduction measures described above were employed to achieve a carbon reduction of 64% compared with Part L over the residential development.

Commercial units

Be Lean

Building Fabric

A large proportion of energy used within commercial and residential buildings comes directly from heating. A high-quality thermal envelope and airtight building will ensure that fabric heat loss and cold bridges are minimised.

The fabric performance looks to improve on the requirements set out in the Building Regulations Approved Document Part L2A, as shown below.

Building Element	B' Regs Limiting U-Values (W/m2K)	Notional U-values (W/m2K)	Target U-values (W/m2K)
Roof	0.25	0.18	0.16
Walls	0.35	0.26	0.23
Entrance Door	2.20	2.20	1.44
Floors	0.25	0.22	0.20
Windows	2.20	1.60	1.20
Airtightness (m3/hr/m2)	10	5	3

Table 2: Fabric thermal performance parameters for commercial units

Limit Overheating

To reduce the office/retail cooling loads it is important to eliminate the risk of overheating. Measures shall be taken through the design to mitigate overheating including utilising high-performance solar glazing (G-value = 0.35), exposed thermal mass where possible and self-shading deep window reveals.

Daylight

Artificial lighting contributes up to 25% of the energy costs of a typical building, despite operation largely within daylight hours. Anecdotal evidence also suggests that the provision of good levels of natural light can contribute to enhanced health and well-being.

The office will benefit from a high percentage of glazing, with a high LT value of 0.65 to maximising daylight.

Ventilation

It is currently anticipated that the commercial units shall be ventilated naturally or via a hybrid natural/mechanical system.

Natural ventilation will be provided through opening ventilation panels at high level, where possible providing openings on opposite facades to ensure good cross-ventilation is possible. It should be noted that this will not be possible on the Water Lane building, which is single aspect only.

Mechanical ventilation would be provided by local high efficiency mechanical ventilation heat recovery (MVHR) units within each of the commercial units, café, and pub.

The pub/restaurant shall incorporate a commercial kitchen which shall require a dedicated supply and extract ventilation system. Filtration shall be allowed as required to comply with local air quality requirements.

Minimising Water Usage

The design shall incorporate water saving strategies, such as low flush toilets and non-concussive spray taps. Other features shall include sanitary shut-off. Water will be monitored, and a leak detection system installed.

Other Efficiency Measures

The design shall utilise efficient state of the art services and controls.

These will include:

- Lighting controls linked to occupancy and daylight levels
- Grade A efficiency electrical appliances throughout
- Sub-metering on all major energy consuming loads
- Use of an intuitive Building Management System
- Variable speed control on pumps and fans, etc.
- Optimised and compensated heating controls.
- High frequency LED lights and high efficiency lamps for light fittings.

Be Clean

The Proposed Development shall be utilising heat pumps to generate heating and cooling. This is advantageous for the local air quality of the surrounding area and its users.

However, the carbon reduction of this heat pump system will be assessed under the Be Green heading as a renewable energy source, and therefore no additional carbon reduction strategies are proposed for the 'be clean' stage.

A CHP system has been assessed for the Proposed Development and determined not to be advantageous as it will result in lower overall carbon emissions.

Be Green

Air-Source Heat pumps

Heat Pumps are a very efficient way to generate hot water and heating and will cover a large proportion of the carbon savings for the commercial units within the Proposed Development.

Solar photovoltaic (PV)

In addition to the provision of heat pumps as a low or zero carbon technology, PV panels are also proposed to effect a further reduction of site CO_2 emissions. PV panels work well with heat pump installations to offset the higher electrical demands. Moreover, installation of PV panels can be cost effective over their lifetime; their payback period is typically less than 10 years, and installing PV as part of the Proposed Development would reduce the annual carbon offset payment, payable over 30 years from completion date.

The energy assessment results (see Section 7) shows how the carbon reduction measures described above were employed to achieve a carbon reduction of 45% compared with Part L over the combined commercial development.

5. CARBON EMISSION FACTORS

An update to Part L of the Building Regulations was due to be released in 2020 and as such, it is not yet known under which version of the building regulations the Proposed Development will be assessed.

In advance of the Part L update, new carbon intensity figures were released in 2019, which have significantly reduced the carbon intensity of grid-supplied electricity, in an effort to more closely reflect the decarbonisation of the grid due to increased employment of renewable energy sources, and a phase out of carbon

A summary of the current SAP2012 and future SAP10 figures is provided in Table 3 below.

	Fuel Carbon Factor (kgCO_2/kWh)	
	Current SAP 2012	Future SAP10
Mains Gas	0.216	0.210
Grid Electricity	0.519	0.233

Table 3: Carbon intensity factors for SAP2012 and SAP10 (proposed)

The results of this change on a proposed building's regulated carbon emissions are multiple, some of which are noted below:

- Overall regulated carbon emissions are reduced
- Electrical sources of heat generation perform more favourably
- CHP is less viable as a carbon saving technology due to the lower carbon offset through grid-supplied electricity
- PVs have a reduced carbon offset effect

The GLA Energy Assessment Guidance encourages the use of updated carbon emission factors to assess performance against planning policy targets.

Therefore, as part of the planning policy energy assessment, the outputs from the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements have been manually converted for the SAP 10 emission factors

Carbon emissions have been converted and will be reported by using the GLA carbon emissions reporting spreadsheet, v1.2.

6. THE COOLING HIERARCHY

All parts of the Proposed Development have been designed with best practice in mind to minimise overheating and the requirement for cooling now and into the future.

Some of these points have already been discussed in the Lean design sections of the Environmental Design Strategy in Section 4 but will be included again here for completion.

Minimising internal heat gains

Communal heating pipework shall be insulated using insulation at least 50mm thick, which shall mitigate heat gains.

High efficiency LED light fittings will also help to reduce excess heat gains from artificial lighting.

Reducing heat entering the building

The approach to the design of the façade will also work to limit summer solar gains. A high performing building fabric (see U-values in Section 4: Environmental Design Strategy) and solar glazing (G-value = 0.35) with self-shading deep window reveals will obviate the requirement for active cooling within apartments.

Passive ventilation

Openable windows and doors in the apartments will allow natural ventilation during occupied hours, and when acoustic requirements allow, to prevent overheating. Where possible, owing to the constraints of the building form, cross-ventilation will be provided to maximise the ventilation cooling effect. A number of apartments are single aspect, precluding cross ventilation; in such cases ventilation openings will be sized to provide adequate ventilation for passive cooling.

Opening windows are currently proposed for all rooms in apartments to allow natural ventilation. Rooflights and AOVs (in communal corridors) will be installed with rain sensors to allow them to be left open whilst unoccupied.

Commercial office units and the pub/restaurant in Wharf Lane have currently been assumed to be part naturally ventilated for passive cooling.

Mechanical ventilation

Mechanical ventilation will be used throughout the building to provide a constant supply of fresh air and some free cooling.

Local MVHR units in the apartments will provide continuous mechanical ventilation at a rate in line with Approved Document F minimum whole dwelling ventilation rates.

There will also be a summer bypass on the MVHR units, which will allow outside air to be provided without heat recovery. This may be used in conjunction with a purge setting on the MVHR units to run at a high speed, thus maximising the ventilation cooling effect of fresh air (as external ambient air is often cooler than internal air during peak summer conditions).

Due to noise and security constraints, as well as the requirement for good daylighting It is expected that mechanical ventilation will be considered in conjunction with mechanical cooling as part of the retail and commercial unit fit-out, which has been assumed for the current energy and overheating analyses.

Active cooling

The overheating risk analysis in Section 8 outlines the requirement for active cooling systems in the following areas:

Pub

The commercial kitchen within the pub is likely to experience very high heat gains from cooking activities and become very warm. In summer months, opportunities for cooling from outside air will have little effect and future tenants may wish to provide cooling to fresh air supplied to the kitchen. Building Engineering Services Associated (BESA) guide *DW/172 Specification for Kitchen Ventilation systems* recommends supplying fresh air at 18°C in commercial kitchens.

It should be noted that it is not envisaged that cooling be provided to offset the total internal gains within the kitchen, but rather to provide a nominal amount of cooling for the comfort of kitchen staff. Fresh air supplied to commercial kitchens would generally be supplied by ventilations canopies and may be directed and controlled by kitchen staff at the canopies.

The front of house areas within the pub have been assumed to be naturally ventilated. Cooling may be considered for these areas to increase thermal comfort.

Commercial

The commercial offices are envisaged to be primarily naturally ventilated. However as the office is located on the ground floor, passive design measures alone are not enough to prevent overheating in peak summertime conditions.

It should therefore be considered that tenants may wish to install mechanical cooling as part of their fit-out to enhance thermal comfort of occupants.

In the retail units and café it is also assumed that mechanical ventilation will be considered in conjunction with mechanical cooling as part of the fit-out.

These proposals take an integrated approach to noise, ventilation and overheating.

7. ENERGY & CARBON ASSESSMENT

An energy assessment has been carried out to demonstrate how the targets for regulated CO2 emissions reduction over and above 2013 Building Regulations will be met.

As part of planning policy, the following criteria apply:

- Residential developments should achieve an energy efficiency value at least 10% greater than Part L
- Non-residential developments should achieve an energy efficiency value at least 15% greater than Part L
- All aspects of major developments should achieve a minimum 35% CO_2 emissions reduction over Part L 2013
- Developments should achieve net zero carbon (via carbon offsetting where not possible on site)

For the purpose of this energy assessment the current SAP10 carbon factors shown in Section 5 have been used, and energy demand has been calculated using the following approved methods:

- Residential (SAP) - using Stroma FSAP v2012
- Non-Residential (DSM) - using IES VE2021

For the purpose of comparison of SAP2012 vs. SAP10 carbon intensity figures, energy use has been converted to carbon emissions using the GLA Carbon Emission Reporting Spreadsheet (version 1.2) for the purpose of this energy assessment.

Residential

The energy and carbon emissions for the residential dwellings have been calculated using the Standard Assessment Procedure (SAP).

Stroma FSAP 2012 software has been used to output a Target Emissions Rate (TER) based on the notional building and a Dwelling Emissions Rate (DER) for the lean and green stages of the energy hierarchy outlined below:

- ○ Lean – energy efficiency measures. Compared against a notional building with individual gas boilers for hot water and heat generation
- ○ Clean – will not be reported as a heat network is not available
- ○ Green – heat pumps only

Typical unit types

A total of 10 apartment types have been modelled that are representative of the residential apartments as a whole. These are shown in Table 4 below.

Wharf Lane	Water Lane
Studio type A	
1 bed type A	1 bed type A
1 bed duplex type A	1 bed type B
2 bed type A	2 bed type A
2 bed duplex type A	2 bed duplex type A
	3 bed wheelchair

Table 4: summary of typical apartment types modelled

Unregulated Energy

The unregulated energy demands of the residential apartments were calculated using BREDEM 2012 methodology for light, appliances, and cooking.

Annual appliance energy	83578	kWh
Annual cooking energy	19195	kWh
Annual communal lighting	16765	kWh
Annual lift energy	1343	kWh
Total Unregulated Energy Load	**120.88**	**MWh**

	SAP 2012	SAP 10
Unregulated energy associated carbon (tonnes CO2)	62.7	28.2

Be lean – energy efficiency measures

The Proposed Development targets a 10% improvement upon the baseline through energy efficiency measures alone.

Table 5 below shows that the apartments modelled achieve an overall CO_2 reduction of 19%, with a 4% improvement achieved through improved fabric efficiencies.

The additional reduction may be attributed to efficient equipment, including pumps, heat exchanger, fans and lighting.

	Fabric energy efficiency rating (FEER) (kWh/m²)	Emissions Rate (CO_2, tonnes / year)
Notional Target	36.68	44.5
'Lean' Dwelling	37.13	36.3
% Improvement	**4%**	**19%**

Table 5: CO2 reduction through fabric efficiency and overall energy efficiency measures

Be green – use heat pump

'Green' measures result in a predicted carbon emissions reduction of 20.3 tonnes, equivalent to a 46% reduction, compared to the baseline.

These data are presented in Table 6.

	Emissions Rate (CO_2, tonnes / year)
'Green' Dwelling	16.0
% Improvement	**46%**

Table 6: CO2 reduction through 'green' measures – ASHP

Summary

The energy demand assessment shows that the carbon saving measures outlined in the Environmental Design Strategy give an overall reduction of **64%** compared to Building Regulations Part L through the use of lean and green carbon reduction measures, excluding a PV array installation – meeting the target for residential developments.

The Proposed Development also meets the aim of achieving a 10% reduction in carbon emissions through efficient design alone.

This results in a carbon offset payment of **£45,614**.

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings	**Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)**	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	44.5	28.2
After energy demand reduction (be lean)	36.3	28.2
After heat network connection (be clean)	36.3	28.2
After renewable energy (be green)	16.0	28.2

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	8.2	19%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	20.3	46%
Cumulative on site savings	**28.5**	**64%**
Annual savings from off-set payment	16.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**480**	-
Cash in-lieu contribution (£)	**45,614**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Table 7: GLA carbon reporting spreadsheet Tables 1 and 2 (SAP10.0)

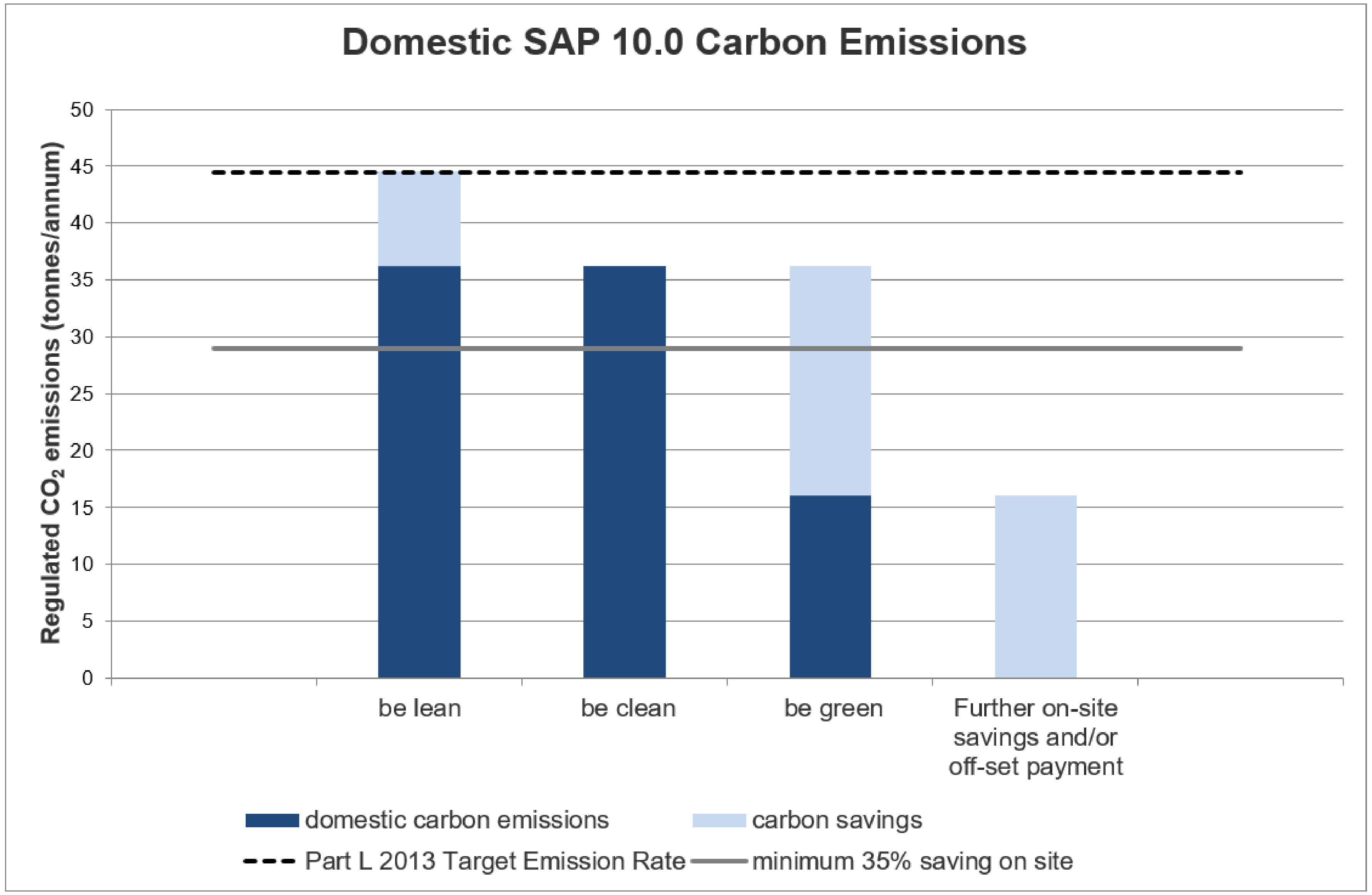


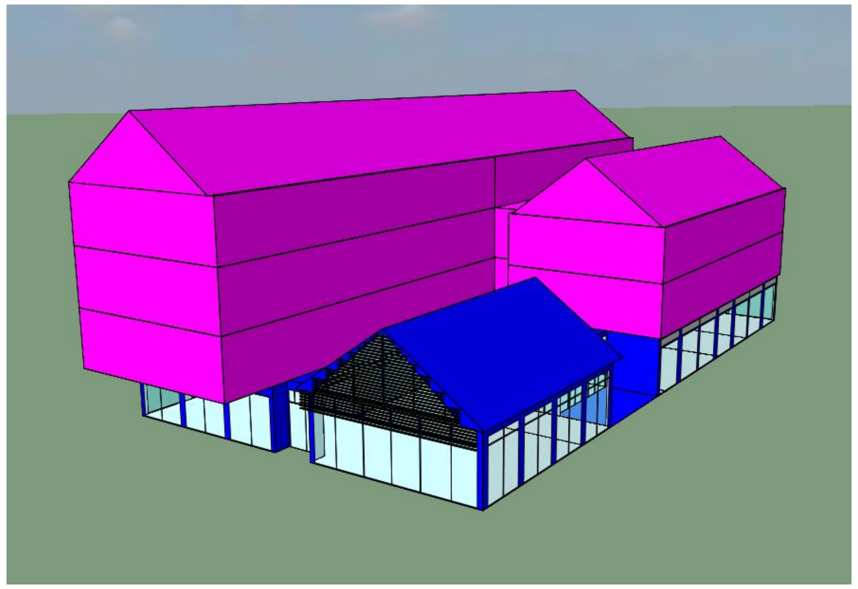
Figure 8: Domestic Carbon Emissions for the Twickenham Riverside Development as reported in the GLA carbon reporting spreadsheet v1.2

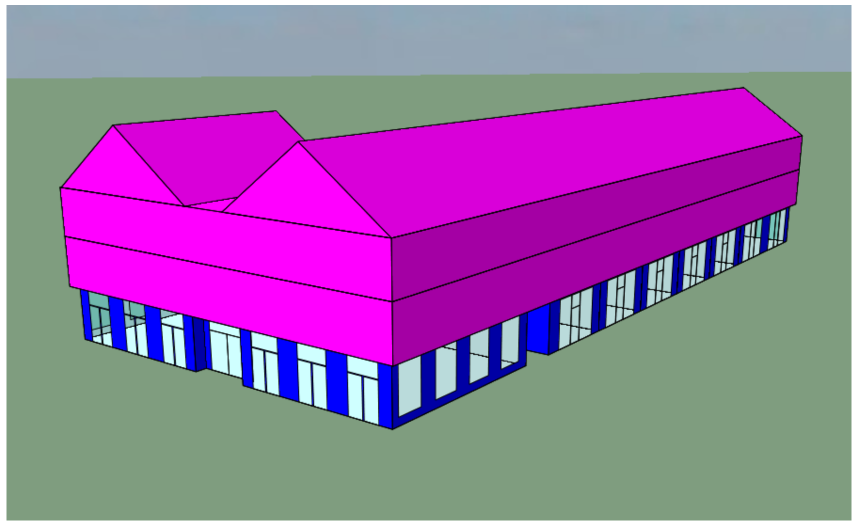
Commercial

IES VE2021 has be used to output a Target Emissions Rate (TER) based on the notional building and a Building Emissions Rate (BER) for the lean and green stages of the energy hierarchy outlined below:

- Lean – energy efficiency measures. Compared against a notional building with individual gas boilers for hot water and heat generation
- Clean – will not be reported as a heat network is not available
- Green – heat pumps and PVs

For the purpose of demonstrating Building Regulations Part L (BRUKL) compliance, each building has been modelled as one development with different uses. Usage classifications are assigned as appropriate to each space, as summarised in Figure 9 below.





Wharf Lane:

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
40	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
60	B1 Offices and Workshop businesses

Water Lane:

% Area	Building Type
70	A1/A2 Retail/Financial and Professional services
30	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses

Figure 9: Usage classification by % area

Direct outputs from the BRUKL reports are provided, however, for carbon reporting purposes, this data has been converted to account for SAP10 carbon intensity figures, as per the GLA's requirements.

These figures are reported separately using outputs from the GLA carbon reporting spreadsheet.

Be Lean – use less energy

For the Lean assessment, the commercial and retail units have been assigned the NCM system type for fan coil units. Heating and domestic hot water are provided by a gas boiler system to match the efficiency of the notional system. Cooling efficiency, system and local specific fan power along with heat recovery all reflect that of the proposed system using typical manufacturer's data.

Cooling has been included within the model as it assumed to be part of a tenant fit-out.

These parameters result in a saving of 5.9 tCO_2 per annum, which equates to a 12% reduction compared to the notional building.

Wharf Lane:

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	110.34	124.13
Primary energy* [kWh/m^2]	180.2	206.62
Total emissions [kg/m^2]	30.8	35.2

Water Lane:

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	91.72	116.84
Primary energy* [kWh/m^2]	222.35	273.72
Total emissions [kg/m^2]	38.1	46.7

Figure 10: BRUKL report table showing TER and BER for the Lean stage

Wharf Lane:

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

	Actual	Notional
Heating	3.72	1.94
Cooling	11.37	11.54
Auxiliary	24.19	24.34
Lighting	11.57	21.53
Hot water	26.57	26.57
Equipment*	126.03	126.03
TOTAL**	**77.42**	**85.91**

Water Lane:

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

	Actual	Notional
Heating	7.53	6.92
Cooling	8.97	9.32
Auxiliary	21.88	21.7
Lighting	22.91	40.98
Hot water	40.8	40.8
Equipment*	61.76	61.76
TOTAL**	**102.09**	**119.72**

Figure 11: BRUKL report table showing energy consumption by end use

Be Green – use renewable and LZC technology

For the green assessment, heating and domestic hot water are provided by an electric air-sourced heat pump.

PV panels were applied with an equivalent array size of 58m^2 per building.

Wharf Lane:

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	4.08	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Water Lane:

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	6.44	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Figure 12: BRUKL report table showing energy production by technology

These two measures resulted in a reduction in CO_2 emissions of 16.4 tCO_2, equivalent to a 45% reduction.

Wharf Lane:

Energy & CO_2 Emissions Summary

	Actual
Heating + cooling demand [MJ/m^2]	110.34
Primary energy* [kWh/m^2]	160.15
Total emissions [kg/m^2]	25

Water Lane:

Energy & CO_2 Emissions Summary

	Actual
Heating + cooling demand [MJ/m^2]	91.72
Primary energy* [kWh/m^2]	197.03
Total emissions [kg/m^2]	30

Figure 13: BRUKL report table showing calculated regulated CO_2 emissions (BER)

1- ASHP heating (VRF cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.19	4.5	0	1.1	0.85
Standard value	2.5*	2.6	N/A	1.1^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

Figure 14: Assumed system efficiencies based on manufacturer's data

Unregulated Energy

The unregulated energy load is calculated in IES DSM under Equipment loads.

This is given as 126.03 kWh/m² and 61.76 kWh/m²

Total Unregulated Energy Load	197172	kWh

	SAP 2012	SAP 10
Unregulated energy associated carbon (tonnes CO2)	102.3	45.9

Summary

It has been demonstrated through the combined assessment of all commercial spaces, that the minimum on-site CO_2 reduction of 35% can be achieved. This reduction is achieved by a combination of passive measures to reduce energy consumption (lean), the use of a heat pump for heating and cooling (green), and PV electricity generation (green). When considering the commercial spaces together, a combined CO_2 saving of 22.3 tCO_2 is achieved, equivalent to **45% CO_2 reduction**.

This results in a carbon offset payment of **£78,278.**

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	49.8	45.9
After energy demand reduction (be lean)	43.9	45.9
After heat network connection (be clean)	43.9	45.9
After renewable energy (be green)	27.5	45.9

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	5.9	12%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	16.4	33%
Total Cumulative Savings	**22.3**	**45%**
Annual savings from off-set payment	27.5	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**824**	-
Cash in-lieu contribution (£)	**78,278**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Table 8: GLA carbon reporting spreadsheet Table 3 and 4 (SAP10.0)

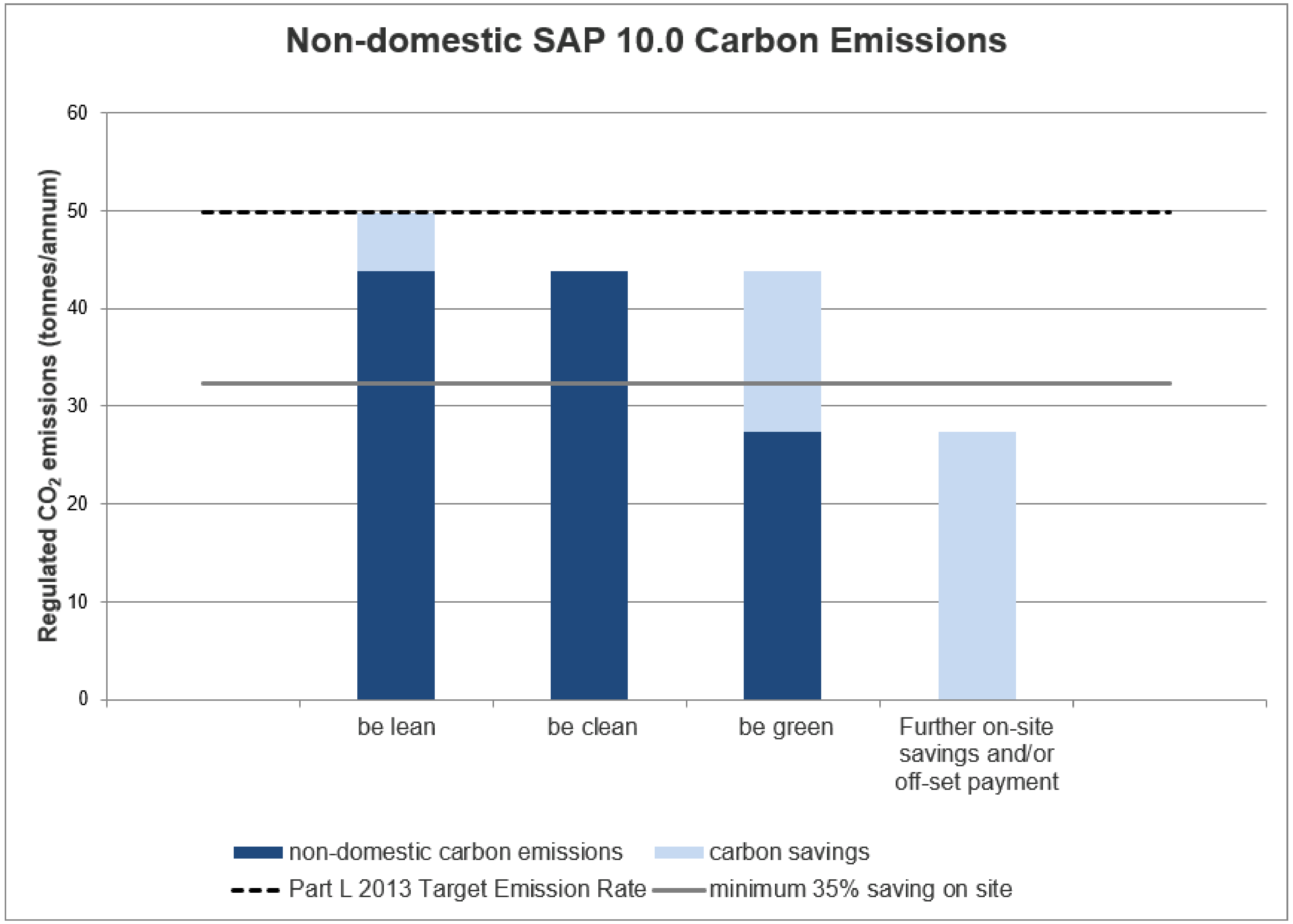


Figure 15: Non-domestic Carbon Emissions for the Twickenham Riverside Development as reported in the GLA carbon reporting spreadsheet v1.2

Site Wide

Combined Site Energy Assessment

A combined energy assessment has also been carried out using the GLA Carbon Emission Reporting Spreadsheet.

This combines the energy loads and savings of both the domestic and non-domestic elements of the Twickenham Riverside development.

Summary

The energy demand assessment shows that the carbon saving measures outlined in the Environmental Design Strategy give an overall reduction of 54% compared to Building Regulations Part L – exceeding the minimum 35% target for commercial and residential developments.

This results in a total carbon offset payment of £123,892.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	94.3		
Be lean	80.1	14.1	15%
Be clean	80.1	0.0	0%
Be green	43.5	36.7	39%
Total Savings	-	50.8	54%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,304.1**	-

Figure 16: Site-wide carbon emissions

8. OVERHEATING RISK ANALYSIS

Relevant Policies

The LBRuT Local Plan and London plan require the Proposed Development to mitigate the contribution to, and provide resilience to the effects of climate change. The second part of this shall be demonstrated through the overheating risk analysis presented in this section.

To demonstrate this, the overheating analysis for the residential apartments has been carried out in accordance with **CIBSE TM59: Design methodology for the assessment of overheating risk in homes**.

For the non-residential units, the typical analysis follows CIBSE **TM52 The Limits of Thermal Comfort- Avoiding Overheating in European Buildings**, outlined below. However, due to the noise and security constraints of the site, passive design measures outlined in the Cooling Hierarchy in section 6 are not enough to prevent overheating in peak summertime conditions.

Therefore it has been assumed that tenants will wish to install mechanical cooling as part of their fit-out to enhance thermal comfort of occupants, in which case the TM52 analysis is defunct.

Residential

As defined in CIBSE TM59, compliance is based on passing both of the following two criteria:

1. The number of hours during which ΔT of indoor air temperature to outdoor is greater than or equal to one degree (K) during the period of May to September shall not exceed 3% of occupied hours.
2. For bedrooms only: to guarantee comfort during the sleeping hours, the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours.

Additionally, communal corridors with community heating pipework present should not exceed the following criteria for TM59:

1. Operative temperature should not exceed 28°C for more than 3% of total annual hours.

Commercial

For the parts of the Proposed Development that are classified as non-residential, overheating analysis would normally be carried out in accordance with CIBSE TM52 in which at least two of the following criteria need to be met:

1. The number of hours during which ΔT of indoor air temperature to outdoor is greater than or equal to one degree (K) during the period of May to September shall not exceed 3% of occupied hours.
2. The weighted exceedance (W_e) shall be less than or equal to 6 in any one day.
3. ΔT of indoor air temperature to outdoor shall not exceed 4K.

Climate Data

The current design summer years (DSY) for London, published by CIBSE, have been used as the basis for the assessment of overheating of the residential and commercial buildings.

The TM49 Design Summer Years for London and the accompanied datasets for building thermal simulation, introduce the concept of incorporating the UHI effect and the severity of hot events in the design of buildings. Specifically, instead of having a single DSY for London (using observed data from Heathrow), three DSYs are now available capturing the local climate in three different London sites (urban, semi-urban, and rural) and for three years of varying severity of hot events.

The design summer years for London have been created from three distinct years of historical weather data. These are summarised as:

- DSY-1: 1989 – a moderately warm summer
- DSY-2: 2003 - a year with a long period of persistent warmth
- DSY-3: 1976 – a year with an intense single warm spell.

DSY1 is the current DSY for London, the latter two represent more extreme summer years, in which the criteria of CIBSE TM52 and TM59 will be more difficult to satisfy.

In line with planning policy and TM52/TM59 the 2020 weather files for DSY1, DSY2, and DSY3 have been used to assess overheating.

Residential analysis

The residential apartments need to comply with CIBSE TM59 criteria 1 and 2, identified above.

To produce results representative of all apartments, a selection were identified as the most likely to suffer from overheating based on orientation and exposure to sunlight.

The apartments modelled are shown in Figure 19 and Figure 20 for Wharf Lane and Water Lane, respectively.

A total of 10 units were modelled in total, 4 in Water Lane and 6 in Wharf Lane, totalling 26 occupied spaces (15 bedrooms, 11 Living/Kitchen/Dining), as well the top floor of each of the 3 communal corridors.

Please note: IES model may not be indicative of final planning application, notably the addition of brise soleil at the gable ends of Water Lane. Overheating results displayed are worst case.

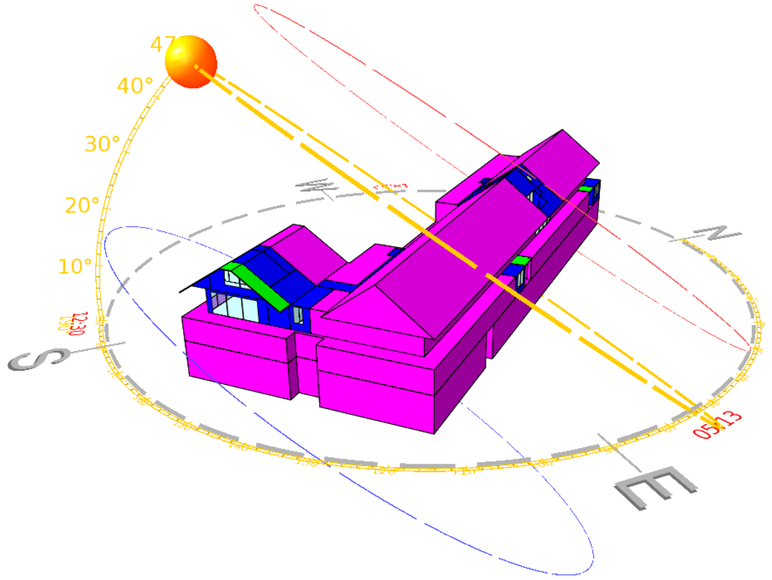


Figure 17: Water Lane IES thermal model

Ventilation

Both the bedrooms and living rooms tested against TM59 have large window openings for natural ventilation and night-time purging, along with deep window reveals which act to reduce direct solar gains.

Bedroom skylights (and AOVs used for some ventilation and temperature regulation) are to be fitted with rain sensors to allow them to be left open whilst unoccupied. Sheltered openings have been modelled with the capability to provide 100mm locked securely open.

All natural ventilation openings have been tested as designed and with a 20° opening.

Mechanical ventilation is provided to each unit for background ventilation in line with Approved Document F minimum whole dwelling ventilation rates, meaning natural ventilation openings will only be required to overcome overheating in the summer period.

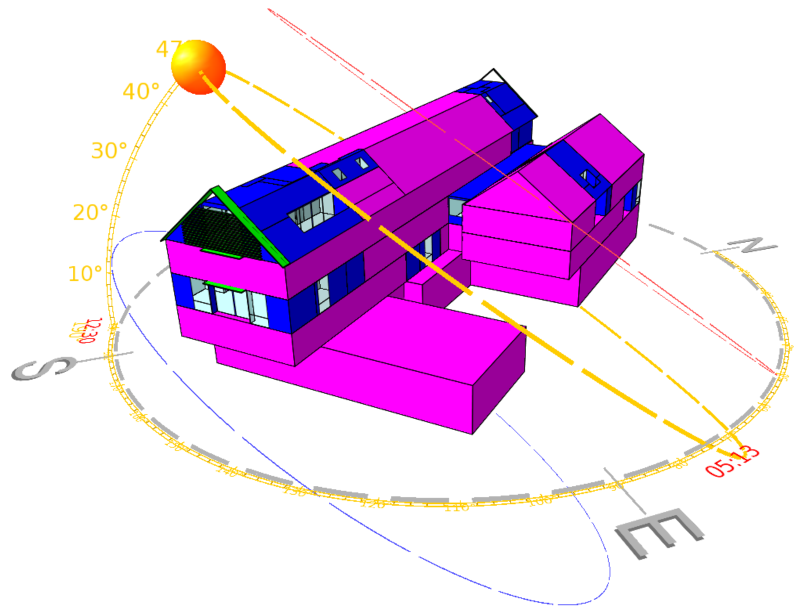


Figure 18: Wharf Lane IES thermal model

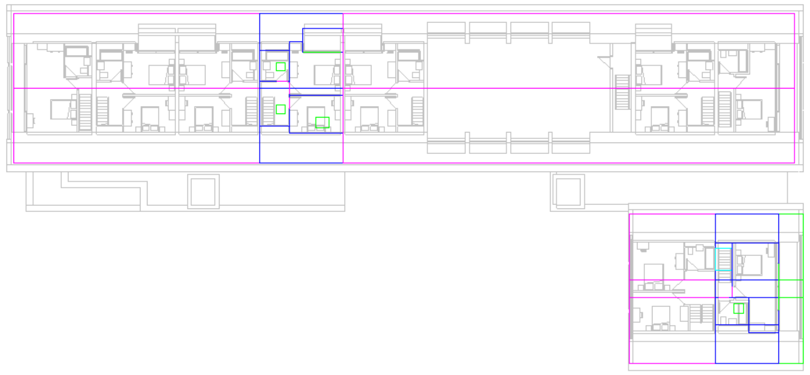
Glazing

Glazing was modelled using the values defined below.

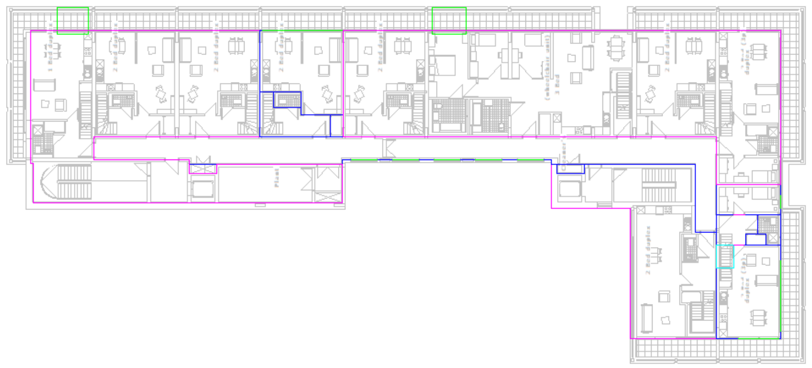
Glazing	Total U-value incl. Frame (W/m2 K)	G-value	LT-value
External glazing	1.2	0.35	0.65

Figure 19: Wharf Lane apartments modelled for overheating

Third Floor:



Second floor:



First floor:

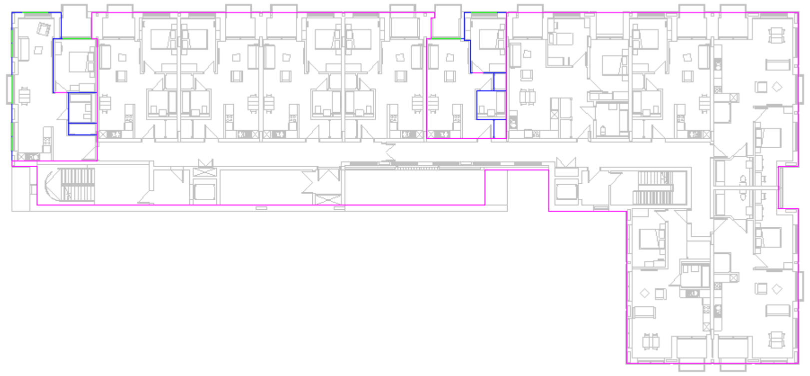
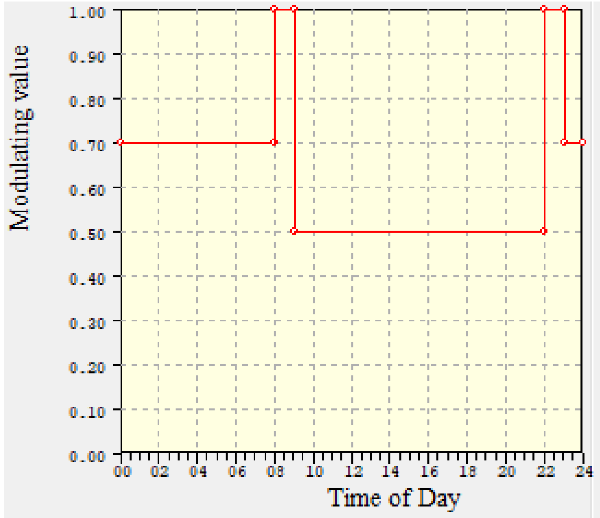


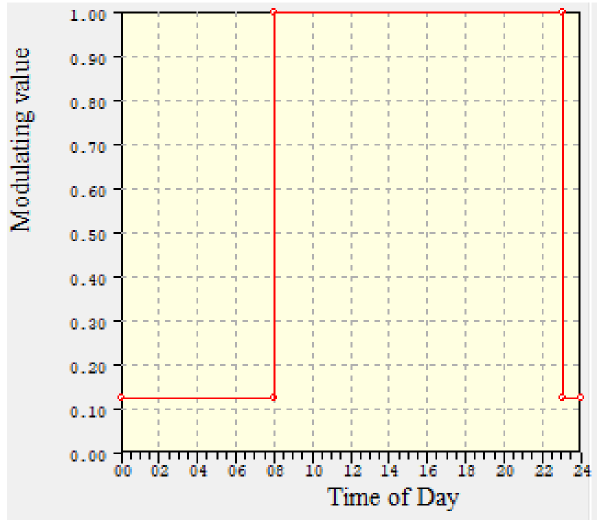
Figure 20: Water Lane apartments modelled for overheating

Occupancy and equipment profiles

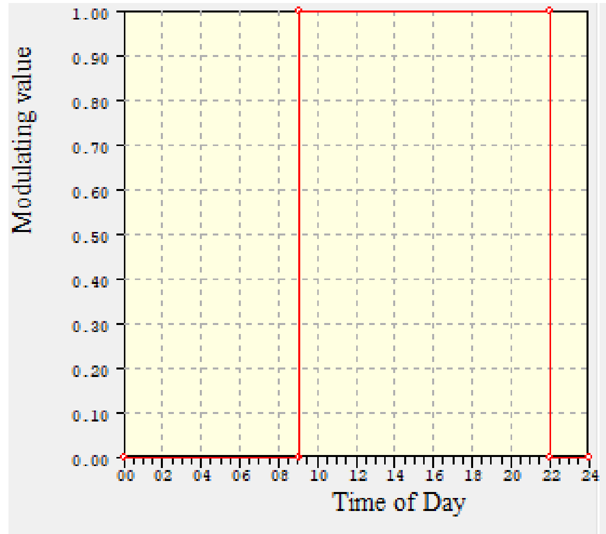
Occupancy and equipment gain profiles were applied as per the profiles below.



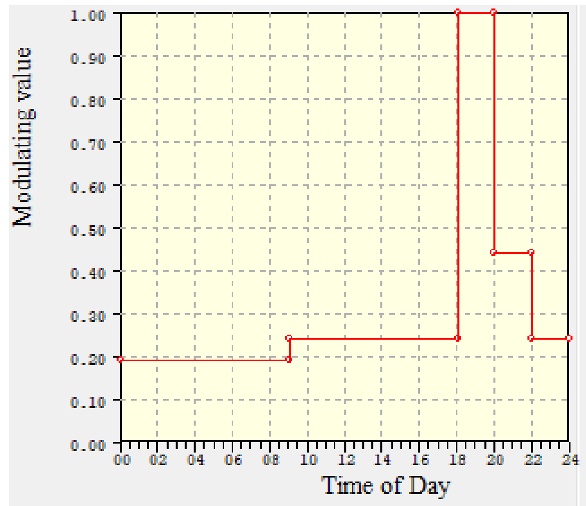
TM59 Bedroom Occupancy Gain Profile



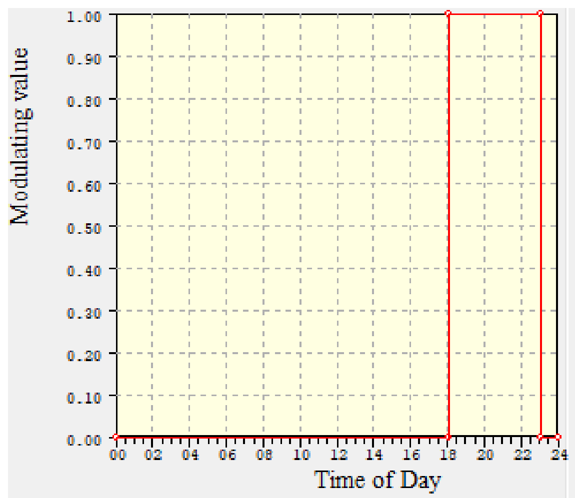
TM59 Bedroom Equipment Gain Profile



TM59 Living/Kitchen Occupancy Gain Profile



Living/Kitchen Equipment Gain Profile



TM59 Lighting Gain Profile

Results

The results of the residential overheating analysis carried out in IES are presented in Table 9 and Table 10.

The summary of results shown in Table 9 show that all rooms pass the overheating criteria for the current design summer year (DSY1). The extreme design summer years, DSY2 and DSY3, both fail the overheating test in some rooms.

The analysis carried out to date incorporates a number of measures to mitigate overheating including:

- Low g-values
- Large natural ventilation openings
- Brise soleil

These measures have been selected as they are appropriate, practical and may be integrated into the building fabric with an acceptable impact on the building form.

	DSY 1		DSY 2		DSY 3	
	Crit. 1	Crit. 2	Crit. 1	Crit. 2	Crit. 1	Crit. 2
WAT 01 1BS 2 Bedroom	Pass	Pass	Pass	Pass	Pass	Fail
WAT 01 1BS 2 Living/Kitchen	Pass	-	Pass	-	Fail	-
WAT 01 1BS Bedroom	Pass	Pass	Pass	Fail	Pass	Fail
WAT 01 1BS Living/Kitchen	Pass	-	Pass	-	Pass	-
WAT 02 2BD 2 Bedroom 1	Pass	Pass	Pass	Fail	Fail	Fail
WAT 02 2BD 2 Bedroom 2	Pass	Pass	Pass	Pass	Pass	Fail
WAT 02 2BD 2 Living/Kitchen	Pass	-	Fail	-	Fail	-
WAT 02 2BD Bedroom	Pass	Pass	Pass	Pass	Pass	Fail
WAT 02 2BD Living/Kitchen	Pass	-	Fail	-	Fail	-
WAT 02 2BD Single Bedroom	Pass	Pass	Pass	Fail	Pass	Fail
WHA 01 E 1BS Bedroom	Pass	Pass	Pass	Pass	Pass	Fail
WHA 01 E 1BS Living/Kitchen	Pass	-	Pass	-	Fail	-
WHA 01 W 2BS Bedroom	Pass	Pass	Pass	Fail	Pass	Fail
WHA 01 W 2BS Living/Kitchen	Pass	-	Fail	-	Fail	-
WHA 01 W 2BS Single Bedroom	Pass	Pass	Pass	Fail	Fail	Fail
WHA 02 E 1BD Bedroom	Pass	Pass	Pass	Pass	Pass	Fail
WHA 02 E 1BD Living/Kitchen	Pass	-	Pass	-	Pass	-
WHA 02 W 2BS Bedroom 1	Pass	Pass	Pass	Fail	Fail	Fail
WHA 02 W 2BS Bedroom 2	Pass	Pass	Pass	Fail	Pass	Fail
WHA 02 W 2BS Living/Kitchen	Pass	-	Fail	-	Fail	-
WHA 03 W 2BD Bedroom 1	Pass	Pass	Pass	Pass	Fail	Fail
WHA 03 W 2BD Bedroom 2	Pass	Pass	Pass	Pass	Fail	Fail
WHA 03 W 2BD Living/Kitchen	Pass	-	Fail	-	Fail	-
WHA 04 W 1BS Bedroom	Pass	Pass	Pass	Pass	Fail	Fail
WHA 04 W 1BS Living/Kitchen	Pass	-	Fail	-	Fail	-

Table 9: Residential overheating analysis

Area	DSY 1	DSY 2	DSY 3
WAT 02 Communal Corridor	Pass	Pass	Pass
WHA 02 Communal Corridor	Pass	Pass	Fail
WHA 04 Communal Corridor	Pass	Pass	Fail

Table 10: Corridor overheating analysis

Summary

An overheating analysis has been carried out for the residential aspects of the Twickenham Riverside development.

Various measures have been tested to alleviate overheating risks. Cross ventilation has been provided where possible; low g-value glazing has been incorporated and ventilation free areas optimised to improve ventilation.

The combination of measures listed above have improved the performance of the residential units and have resulted in the buildings satisfying the relevant criteria for the overheating assessment.

The results from the analysis show that passive design measures successfully minimise overheating risk to a degree, but due to site constraints they are not substantial to meet TM59 criteria in all cases.

Further mitigation for future weather scenarios are proposed as follows:

- Enhanced solar control glazing
- Retrofitted additional brise soleil

The above measures also apply to the commercial units and will help reduce the requirement for active cooling.

9. WATER CONSUMPTION

Water efficiency measures will be incorporated into the design to reduce are consumption as far as reasonably practical.

Reducing Consumption

The design shall incorporate water saving strategies primarily through the provision of water efficient fittings-based approach, such as low flush toilets, low flow showers and non-concussive spray taps in an effort to keep the maximum water usage to 105 litres per person per day.

Monitoring

Water meters will be provided on all supplies to residential apartments. All new meters will be billing meters which shall incentivise occupants to reduce their water consumption.

The feasibility of linking water meters to an in-house energy display will be investigated at the next design stage. Although it is not possible to limit water consumption associated with private residences, it is anecdotally reported that by giving people visibility of their consumption that they may take measures to reduce their consumption.

All landlord supplies to the residential and commercial buildings will be sub-metered to enable usage to be monitored

Leak Detection

Major water leak detection equipment will be fitted to the incoming supplies, which shall be capable of detecting any major uses of water and cutting off the water supply if a usage indicative of a leakage is detected.

Rainwater recycling

An assessment of rainwater and greywater recycling has been carried out and it has been concluded that this is not feasible for the Proposed Development.

BREEAM

The measures outlined above have been identified within the BREEAM assessment as being commensurate with the requirements to achieve 3 credits for Wat 01, as required to achieve an ‘Excellent’ standard, and equates approximately to a 40% reduction in water consumption.

10. METERING STRATEGY

Precise data on energy performance helps meet the need for accountability and environmental best practice and can form the basis of energy efficiency strategies.

Public displays showing energy performance can help raise awareness and encourage behavioural change, while the plentiful data on energy use can provide inspiration a wide range of learning activities.

Local monitoring will be available to tenants of apartments to encourage lean energy use.

The following metering/billing strategy has been proposed.

Electrical metering

Residential

There is to be a single incoming primary electrical supply from the substation to the main switch room of each building. This shall then feed a combined residential and landlord switchboards which shall in turn serve dedicated separate landlord and tenant boards located in the risers.

Landlord

- A metered supply specifically for the residential building; including all plant, ancillary areas, lifts, and external lighting, and used for billing.
- This utility meter will be located on the main LV panel (housed in a dedicated room) and can be accessed by the landlord and the utility company by appointment.
- All landlord supplies are to be fitted with multifunction sub-meters with a BEMS link for energy monitoring and information purposes.

Apartments

- Individual MID approved utility smart electrical meters located in the electrical riser cupboard for billing purposes direct to the residents.

Commercial units

- A utility metered supply specifically for each office and retail units located within the main switchboard in the LV switchroom associated with the commercial building.
- All plant areas, lifts, and external lighting supplies, including the supply to each floor and amenity areas, are to be fitted with multifunction meters (non-utility) with a BMS link for energy monitoring and information purposes.
- Sub-meters would be accessible to the Landlord only.

Pub/restaurant & cafe

- A utility metered supply specifically for the pub/restaurant and café space located within the main switchboard in the LV switchroom associated with the commercial building.

Water Meters

The Site will require a number of utility bulk metered incoming supplies for the residential and commercial parts of the Proposed Development comprising:

- Residential apartments (one per building)
- Wharf Lane commercial units (multiple)
- Pub/restaurant
- Café
- Water Lane retail units

Any fire supplies (wet riser) are assumed not be metered, which shall need to be confirmed with the local water authority, Thames Water.

Apartments

- Individual internal fit water meters located within the riser on each floor for billing direct to residents.
- Can be accessed by the Landlord and utility company only.

Commercial & retail

- Individual sub-metered supply from the combined cold water storage tank.

Pub/restaurant

- Individual sub-metered supply from the combined cold water storage tank.

Café

- Individual sub-metered supply from the combined cold water storage tank.

Energy display

An energy display shall be provided in each of the residential and commercial units that shall be linked to the energy and water meters to clearly display the current and historic energy and water consumption of heat, electrical power and water.

11. CONCLUSION

This Energy Statement outlines the Environmental Design Strategy measures, which have been adopted to achieve the required on-site carbon reductions for planning.

The energy and carbon assessment results show overall improvements and give an estimated carbon reduction compared to Part L 2013 Building regulations, as demonstrated in Table 11 below.

Currently, estimates are only available for the residential apartments, which have been estimated to achieve an annual CO_2 reduction of 36%, relative to the Part L notional building, utilising ground source heat pumps as a heating source. Further reductions are achievable through the use of PV panels. It has been estimated that a PV array of 100m^2 would achieve a CO_2 reduction of around 10% for the residential buildings only.

	Carbon reduction	
	tCO_2	%
Residential	**28.5**	**64%**
Commercial	**22.3**	**45%**

Table 11: Overall carbon reductions achieved

The results from the Overheating Risk Analysis show that passive design measures successfully minimise overheating risk to a degree, but due to site constraints they are not substantial to meet TM52 and TM59 criteria in all cases.

This is especially true when natural ventilation openings have to remain closed for noise, pollution, wind or safety reasons. In these cases, tenant active cooling will be sufficient to prevent summertime overheating. The Proposed Development takes an integrated approach to noise, ventilation and overheating, without compromising good daylight levels and occupant control and comfort.

APPENDICES

APPENDIX 1 – Sample SAP Worksheets

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: WAT 1B2P A

Address : Twickenham Riverside, London

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.07	(1a)	x	2.6	(2a)	=	130.18	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.07	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	130.18	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent 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	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.14	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	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

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	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

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28	(25)

3. Heat losses and heat loss parameter:

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	
Windows Type 1			3.55	x1/[1/(1.2)+ 0.04]		=	4.06			(27)
Windows Type 2			6.24	x1/[1/(1.2)+ 0.04]		=	7.15			(27)
Walls Type1	7.07	6.24	0.83	x	0.15	=	0.12			(29)
Walls Type2	3.64	0	3.64	x	0.15	=	0.55			(29)
Walls Type3	7.48	3.55	3.93	x	0.15	=	0.59			(29)
Total area of elements, m²			18.19							(31)
Party wall			21.36	x	0	=	0			(32)
Party wall			11.86	x	0	=	0			(32)
Party floor			54.93							(32a)
Party ceiling			54.93							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 12.47 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 4627.84 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 1.82 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 14.29 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

DER WorkSheet: New dwelling design stage

(38)m=	12.65	12.5	12.35	11.6	11.46	10.71	10.71	10.56	11.01	11.46	11.75	12.05	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	26.94	26.79	26.64	25.89	25.74	25	25	24.85	25.3	25.74	26.04	26.34	

Average = Sum(39)$_{1…12}$ /12= 25.86 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.54	0.54	0.53	0.52	0.51	0.5	0.5	0.5	0.51	0.51	0.52	0.53	

Average = Sum(40)$_{1…12}$ /12= 0.52 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.69 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.39 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	81.83	78.85	75.88	72.9	69.93	66.95	66.95	69.93	72.9	75.88	78.85	81.83	

Total = Sum(44)$_{1…12}$ = 892.67 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.35	106.13	109.52	95.48	91.62	79.06	73.26	84.07	85.07	99.14	108.22	117.52	

Total = Sum(45)$_{1…12}$ = 1170.43 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.2	15.92	16.43	14.32	13.74	11.86	10.99	12.61	12.76	14.87	16.23	17.63	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage 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/year (48) x (49) = 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

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

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	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 calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

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

(62)m=	176.62	156.06	164.8	148.97	146.89	132.55	128.54	139.34	138.56	154.42	161.71	172.8	(62)

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

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.62	156.06	164.8	148.97	146.89	132.55	128.54	139.34	138.56	154.42	161.71	172.8	

Output from water heater (annual)$_{1...12}$ 1821.27 (64)

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

(65)m=	84.57	75.23	80.64	74.54	74.68	69.08	68.58	72.17	71.08	77.19	78.78	83.3	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.61	84.61	84.61	84.61	84.61	84.61	84.61	84.61	84.61	84.61	84.61	84.61	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	13.15	11.68	9.5	7.19	5.37	4.54	4.9	6.37	8.55	10.86	12.67	13.51	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	147.42	148.95	145.09	136.88	126.52	116.79	110.28	108.75	112.61	120.82	131.18	140.91	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	31.46	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	-67.69	(71)

Water heating gains (Table 5)

(72)m=	113.67	111.95	108.38	103.53	100.38	95.95	92.18	97.01	98.72	103.74	109.41	111.96	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	322.61	320.95	311.35	295.99	280.66	265.65	255.75	260.52	268.27	283.8	301.65	314.76	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.55	x	11.28	x	0.35	x	0.9	=	8.74	(75)
Northeast	0.9x	0.54	x	6.24	x	11.28	x	0.35	x	0.9	=	10.78	(75)

Northeast 0.9x	0.77	x	3.55	x	22.97	x	0.35	x	0.9	=	17.8	(75)
Northeast 0.9x	0.54	x	6.24	x	22.97	x	0.35	x	0.9	=	21.94	(75)
Northeast 0.9x	0.77	x	3.55	x	41.38	x	0.35	x	0.9	=	32.07	(75)
Northeast 0.9x	0.54	x	6.24	x	41.38	x	0.35	x	0.9	=	39.53	(75)
Northeast 0.9x	0.77	x	3.55	x	67.96	x	0.35	x	0.9	=	52.66	(75)
Northeast 0.9x	0.54	x	6.24	x	67.96	x	0.35	x	0.9	=	64.92	(75)
Northeast 0.9x	0.77	x	3.55	x	91.35	x	0.35	x	0.9	=	70.79	(75)
Northeast 0.9x	0.54	x	6.24	x	91.35	x	0.35	x	0.9	=	87.26	(75)
Northeast 0.9x	0.77	x	3.55	x	97.38	x	0.35	x	0.9	=	75.47	(75)
Northeast 0.9x	0.54	x	6.24	x	97.38	x	0.35	x	0.9	=	93.03	(75)
Northeast 0.9x	0.77	x	3.55	x	91.1	x	0.35	x	0.9	=	70.6	(75)
Northeast 0.9x	0.54	x	6.24	x	91.1	x	0.35	x	0.9	=	87.03	(75)
Northeast 0.9x	0.77	x	3.55	x	72.63	x	0.35	x	0.9	=	56.28	(75)
Northeast 0.9x	0.54	x	6.24	x	72.63	x	0.35	x	0.9	=	69.38	(75)
Northeast 0.9x	0.77	x	3.55	x	50.42	x	0.35	x	0.9	=	39.07	(75)
Northeast 0.9x	0.54	x	6.24	x	50.42	x	0.35	x	0.9	=	48.17	(75)
Northeast 0.9x	0.77	x	3.55	x	28.07	x	0.35	x	0.9	=	21.75	(75)
Northeast 0.9x	0.54	x	6.24	x	28.07	x	0.35	x	0.9	=	26.81	(75)
Northeast 0.9x	0.77	x	3.55	x	14.2	x	0.35	x	0.9	=	11	(75)
Northeast 0.9x	0.54	x	6.24	x	14.2	x	0.35	x	0.9	=	13.56	(75)
Northeast 0.9x	0.77	x	3.55	x	9.21	x	0.35	x	0.9	=	7.14	(75)
Northeast 0.9x	0.54	x	6.24	x	9.21	x	0.35	x	0.9	=	8.8	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	19.52	39.74	71.59	117.58	158.05	168.5	157.63	125.66	87.24	48.56	24.56	15.94	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	342.14	360.69	382.95	413.57	438.71	434.15	413.37	386.18	355.51	332.36	326.21	330.71	(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, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.91	0.75	0.55	0.37	0.27	0.3	0.49	0.79	0.95	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.76	20.82	20.92	20.99	21	21	21	21	21	20.99	20.89	20.75	(87)

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

(88)m=	20.49	20.49	20.49	20.51	20.51	20.52	20.52	20.52	20.52	20.51	20.5	20.5	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.89	0.72	0.52	0.34	0.24	0.27	0.46	0.75	0.94	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	20.17	20.27	20.4	20.49	20.51	20.52	20.52	20.52	20.52	20.49	20.37	20.17	(90)

fLA = Living area ÷ (4) = 0.65 (91)

DER WorkSheet: New dwelling design stage

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.55	20.63	20.74	20.82	20.83	20.83	20.83	20.83	20.83	20.81	20.71	20.55	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	20.55	20.63	20.74	20.82	20.83	20.83	20.83	20.83	20.83	20.81	20.71	20.55	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.96	0.9	0.74	0.54	0.36	0.26	0.29	0.48	0.77	0.94	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	334.59	346.38	345.47	304.14	234.79	155.83	105.83	110.19	170.23	257.26	306.99	324.59	(95)
Monthly average external temperature from Table 8													
(96)m=	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, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	437.85	421.37	379.29	308.57	235	155.83	105.83	110.19	170.28	262.97	354.35	430.68	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	76.83	50.39	25.16	3.19	0.16	0	0	0	0	4.25	34.1	78.93	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 273 (98)

Space heating requirement in kWh/m²/year 5.45 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none		0	(301)
Fraction of space heat from community system 1 – (301) =		1	(302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump		1	(303a)
Fraction of total space heat from Community heat pump	(302) x (303a) =	1	(304a)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		273	
Space heat from Community heat pump	(98) x (304a) x (305) x (306) =	286.65	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		1821.27	
If DHW from community scheme: Water heat from Community heat pump	(64) x (303a) x (305) x (306) =	1912.33	(310a)
Electricity used for heat distribution	0.01 × [(307a)…(307e) + (310a)…(310e)] =	21.99	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)

DER WorkSheet: New dwelling design stage

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside		105.22	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	105.22	(331)
Energy for lighting (calculated in Appendix L)		232.16	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		2536.36	(338)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)						
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				319	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	357.76	(367)
Electrical energy for heat distribution	[(313) x		0.52	=	11.41	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	369.18	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				369.18	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	54.61	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	120.49	(379)
Total CO2, kg/year	sum of (376)…(382) =				544.28	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				10.87	(384)
EI rating (section 14)					92.33	(385)

APPENDIX 2 – Sample BRUKL Documents

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name — **Shell and Core**

1486-TRS

As designed

Date: Thu May 27 14:09:07 2021

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	33.9
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	33.9
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	25
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.23	0.23	WH000002:Surf[1]
Floor	0.25	0.2	0.2	WH000000:Surf[0]
Roof	0.25	0.16	0.16	WH000004:Surf[3]
Windows***, roof windows, and rooflights	2.2	1.22	1.44	WH00001C:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- ASHP heating (VRF cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.19	4.5	0	1.1	0.85
Standard value	2.5*	2.6	N/A	1.1^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

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

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
WHA B1 N Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 N Shared Stairs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant Electrical	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant Pub	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant Sprinkler Pump	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant Sprinkler Tank	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 Plant Water Tank	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA B1 S Shared Stairs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA N Shared Lift Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA N Shared Stairs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Office WCs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Pub Bar	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Pub Entrance Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Pub Kitchen	-	-	-	-	-	-	-	0.5	0.5	-	N/A
WHA S Shared Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I	Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
WHA S Shared Stairs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA WC Lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA WCs	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Office/Retail	-	-	-	-	-	-	-	0.3	-	-	N/A
WHA Pub Eating/Drinking	-	-	-	-	-	-	-	0.3	-	-	N/A

Shell and core configuration

Zone	Assumed shell?
WHA B1 N Lobby	NO
WHA B1 N Shared Stairs	NO
WHA B1 Plant	NO
WHA B1 Plant Electrical	NO
WHA B1 Plant Pub	NO
WHA B1 Plant Sprinkler Pump	NO
WHA B1 Plant Sprinkler Tank	NO
WHA B1 Plant Water Tank	NO
WHA B1 S Shared Stairs	NO
WHA N Shared Lift Lobby	NO
WHA N Shared Stairs	NO
WHA Office WCs	YES
WHA Pub Bar	YES
WHA Pub Entrance Lobby	NO
WHA Pub Kitchen	YES
WHA S Shared Lobby	NO
WHA S Shared Stairs	NO
WHA WC Lobby	NO
WHA WCs	NO
WHA Office/Retail	YES
WHA Pub Eating/Drinking	YES

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
WHA B1 N Lobby	-	100	-	25
WHA B1 N Shared Stairs	-	100	-	55
WHA B1 Plant	100	-	-	469
WHA B1 Plant Electrical	100	-	-	93
WHA B1 Plant Pub	100	-	-	171
WHA B1 Plant Sprinkler Pump	100	-	-	204
WHA B1 Plant Sprinkler Tank	100	-	-	460
WHA B1 Plant Water Tank	100	-	-	150
WHA B1 S Shared Stairs	-	100	-	40
WHA N Shared Lift Lobby	-	100	-	18

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
WHA N Shared Stairs	-	100	-	52
WHA Office WCs	-	100	-	108
WHA Pub Bar	-	100	22	69
WHA Pub Entrance Lobby	-	100	-	39
WHA Pub Kitchen	-	100	-	686
WHA S Shared Lobby	-	100	-	25
WHA S Shared Stairs	-	100	-	37
WHA WC Lobby	-	100	-	33
WHA WCs	-	100	-	286
WHA Office/Retail	100	-	-	1852
WHA Pub Eating/Drinking	-	100	22	556

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
WHA B1 N Lobby	N/A	N/A
WHA B1 N Shared Stairs	N/A	N/A
WHA B1 Plant	N/A	N/A
WHA B1 Plant Electrical	N/A	N/A
WHA B1 Plant Pub	N/A	N/A
WHA B1 Plant Sprinkler Pump	N/A	N/A
WHA B1 Plant Sprinkler Tank	N/A	N/A
WHA B1 Plant Water Tank	N/A	N/A
WHA B1 S Shared Stairs	N/A	N/A
WHA N Shared Lift Lobby	NO (-14.6%)	NO
WHA N Shared Stairs	N/A	N/A
WHA Office WCs	N/A	N/A
WHA Pub Bar	N/A	N/A
WHA Pub Entrance Lobby	NO (-17.2%)	NO
WHA Pub Kitchen	N/A	N/A
WHA S Shared Lobby	NO (-3.7%)	NO
WHA S Shared Stairs	N/A	N/A
WHA WC Lobby	N/A	N/A
WHA WCs	N/A	N/A
WHA Office/Retail	NO (-19%)	NO
WHA Pub Eating/Drinking	NO (-12.8%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1392.3	1392.3
External area [m²]	2087.3	2087.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	743.34	754.68
Average U-value [W/m²K]	0.36	0.36
Alpha value* [%]	10.15	10

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	1.12	0.65
Cooling	7.84	11.54
Auxiliary	24.19	24.34
Lighting	11.57	21.53
Hot water	7.98	8.95
Equipment*	126.03	126.03
TOTAL**	**52.69**	**67.02**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	4.08	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	110.34	124.13
Primary energy* [kWh/m²]	160.15	200.6
Total emissions [kg/m²]	25	33.9

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	10.9	99.5	1.1	7.8	24.2	2.7	3.53	3.19	4.5
	Notional	6	118.1	0.7	11.5	24.3	2.56	2.84	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

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

Key Features

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

Building fabric

Element	U_{i-Typ}	U_{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.23	WH000002:Surf[1]
Floor	0.2	0.2	WH000000:Surf[0]
Roof	0.15	0.16	WH000004:Surf[3]
Windows, roof windows, and rooflights	1.5	1.2	WH00000D:Surf[0]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

U_{i-Typ} = Typical individual element U-values [W/(m²K)]

U_{i-Min} = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3