# Energy Statement

21 Broad Street, Teddington TW11 8QZ

Prepared on behalf of:
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| Issue | Issue Date | Written by | Notes |
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# Executive Summary

This report has been produced on behalf of VORBILD Architecture Ltd to demonstrate how the application for the conversion and extension of an existing building to produce three new homes at 21 Broad Street, Teddington TW11 8QZ can address the carbon reduction and sustainability requirements set by the Greater London Authority (GLA) and The London Borough of Richmond upon Thames. The energy assessment has been prepared in accordance with 'Energy Planning – Greater London Authority guidance on preparing energy assessments' and local guidance documents from The London Borough of Richmond upon Thames.

### *About the development*

The proposals consist of dormer and rear extensions to existing apartments above a ground floor commercial unit. This will allow for the creation of two 2 bed homes on the first and second storeys, as well as a 1 bed home at the ground floor to the rear of the site.

### *Key measures and $CO_2$ reductions*

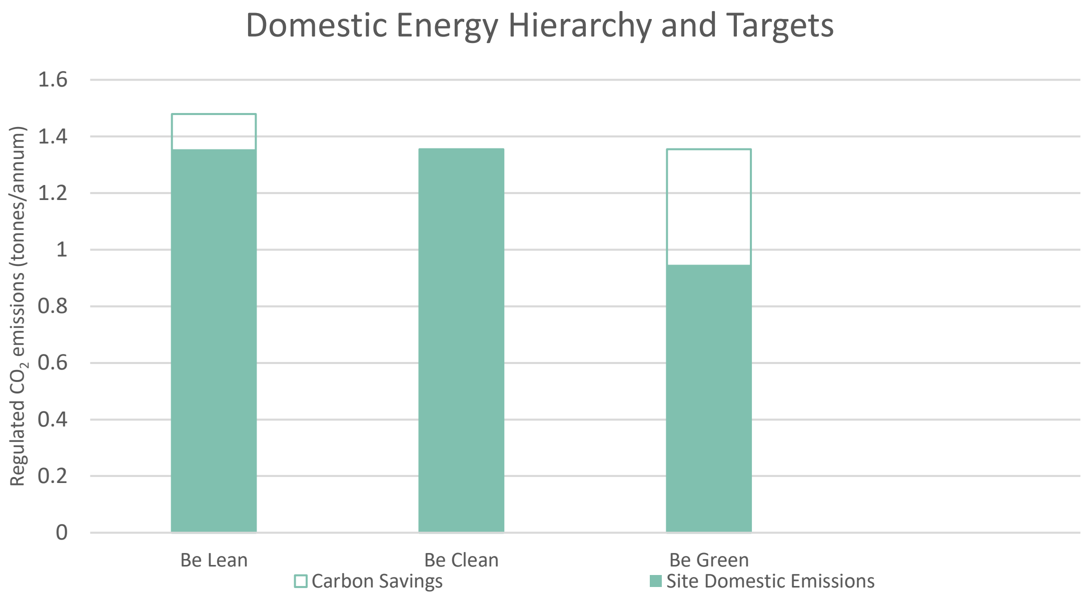
The report demonstrates that the given design and specification achieves a reduction of **36.03%** in on-site regulated emissions beyond Building Regulations requirements. This can be achieved by following the Energy Hierarchy:

- Demand reduction measures have been investigated including improved U-values.
- The energy systems for use at the development have been considered and selected in accordance with the order of preference described by the GLA.
- After full consideration of the suitability of renewable generation, air source heat pump technology has been incorporated into the design. In addition, solar PV panels are proposed.

All results and strategies are directly affected by the inputs listed in this document; any deviation from these is certain to output different results. Enforcement bodies must ensure that they are satisfied that the below inputs are an accurate reflection of the final building before using this reporting to demonstrate compliance.

The carbon savings achieved by the proposed development are shown at each stage of the Energy Hierarchy in the figures below. These have been calculated and presented in accordance with the guidance set by the GLA.

Domestic Energy Hierarchy and Targets




*GLA Figure 1: Domestic energy hierarchy - homes from refurbishment or change of use*

## *Next Steps*

Please contact Build Energy prior to RIBA Stage 4 or after planning permission is granted for advice on securing compliance with BREEAM and Building Regulations Part L at Design Stage and Post Construction. You can reach Sean at sean@buildenergy.co.uk or on 0330 055 34 05.

# Summary of Targets

The following reduction targets for regulated operational carbon emissions are applicable to the proposed development at 21 Broad Street, Teddington TW11 8QZ.

### *Targets set Nationally*

Part L of the Building Regulations sets requirements for the conservation of fuel and power in buildings within England and Wales. Among other requirements, new buildings are expected to meet or exceed a TER (Target Emission Rate), a maximum level of regulated emissions expressed in kg of $CO_2$ per $m^2$ per year. There is no TER for buildings created from refurbishment, extension or change of use.

### *Targets set by the GLA (Greater London Authority)*

For major developments, the GLA sets targets for reduction in carbon dioxide ($CO_2$) emissions beyond those required by Part L of the Building Regulations. A major development is defined in The Town and Country Planning (Development Management Procedure) (England) Order 2010 as one meeting any one of the following criteria:

- The number of dwellings provided is ten or more
- The floor space to be created by the development is 1,000 $m^2$ or more
- The development is carried out on a site having an area of 1 hectare or more

Since 2016, the target set by the GLA for new build dwellings within major developments is Zero Carbon (100% over Part L1A of the Building Regulations). Since 2021, this target is applicable to major non-domestic schemes also.

A minimum on site saving of 35% beyond the Building Regulations is required. Residential development should achieve 10%, and non-residential development should achieve 15% through energy efficiency measures ("Be Lean") alone. When the zero-carbon target cannot be fully achieved on-site, any shortfall must be provided through a cash in lieu contribution to the borough's carbon offset fund, or through certain off-site solutions in agreement with the borough.

There are no fixed targets for developments created through change of use, however applicants are still expected to demonstrate how individual elements of the Energy Hierarchy have been implemented, and how reductions in regulated $CO_2$ emissions have been achieved. The GLA states within their guidance on preparing energy assessments that *"…It is generally acknowledged that the level of carbon savings that can be achieved through a refurbishment can vary considerably, however every effort should be made to improve the energy performance of the building in line with London Plan carbon targets and to follow the energy hierarchy.".*

Certain additional criteria apply to developments which are referred to the Mayor. To be referable an application must meet one of three criteria outlined with the Mayor of London Order (2008):

- Include 150 domestic units or more.
- Be over 30 metres in height if outside of The City of London.
- Be on Green Belt or Metropolitan Open Land

The proposed 21 Broad Street scheme does not meet these criteria and is therefore not a referable application.

### *Targets set by The London Borough of Richmond upon Thames*

In the case of a minor development, it is the responsibility of the Local Authority to set a target, in this case The London Borough of Richmond upon Thames.

### *Targets Applicable to 21 Broad Street*

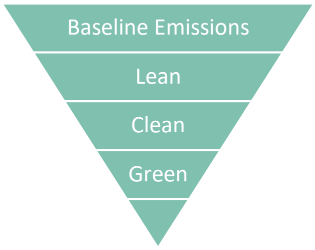
The proposed 21 Broad Street scheme is defined as a minor non-referable development under the criteria described above, and so targets set by the GLA and The London Borough of Richmond upon Thames apply. As such there is no fixed target reduction in $CO_2$ emissions over Part L of the Building Regulations through on-site solutions following the Energy Hierarchy. Instead, the largest amount of savings possible will be pursued.

# Establishing $CO_2$ Emissions

This assessment seeks to identify the carbon footprint of the development after each stage of the Energy Hierarchy. This includes regulated emissions and, separately, those emissions associated with uses not covered by Building Regulations i.e. unregulated emissions. The methodologies for calculating emissions in this report have been taken from the relevant guidance on preparing energy assessments.

The Energy Hierarchy can be described as follows:

- Baseline Emissions: Compliance with the relevant Part L 2013 Building Regulations only
- Be Lean: Use less energy
- Be Clean: Supply energy efficiently
- Be Green: Use renewable energy




The carbon footprint of 21 Broad Street at each stage of the Energy Hierarchy is demonstrated in the tables below:

| Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings created from refurbishment or change of use | Carbon dioxide emissions for domestic buildings (tonnes $CO_2$ / annum) | |
|---|---|---|
| | **Regulated** | **Unregulated** |
| Baseline: Part L 2013 of the Building Regulations compliant development | 1.48 | 1.12 |
| After energy demand reduction | 1.36 | 1.12 |
| After heat network / CHP | 1.36 | 1.12 |
| After renewable energy | 0.95 | 1.12 |

| Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings created from refurbishment or change of use | Regulated carbon dioxide savings | |
|---|---|---|
| | **(Tonnes $CO_2$ / annum)** | **(%)** |
| Be lean: Savings from energy demand reduction | 0.12 | 8.40 |
| Be clean: Savings from heat network | 0.00 | 0.00 |
| Be green: Savings from renewable energy | 0.41 | 27.63 |
| Cumulative on-site savings | 0.53 | 36.03 |

## Calculating Regulated $CO_2$ Emissions

At each stage of the assessment, regulated emissions have been calculated using Building Regulations approved compliance software. This is SAP 10 for dwellings. Reporting from approved software presents $CO_2$ emissions as kg/m$^2$/year. The methodology for converting these figures into tonnes of $CO_2$ per annum for comparisons is as follows:

- For each representative dwelling, the related Dwelling or Target Emission Rate (DER/TER) has been multiplied by the cumulative floor area for that dwelling type to establish the related regulated $CO_2$ emissions.

Samples representing all proposed residential plots have been modelled for the purposes of this report. The appendix of the energy assessment includes the summary output sheets from the modelling work of the baseline and each stage of the hierarchy.

The GLA have provided additional guidance for projects where an existing building or group of buildings is refurbished. Here it is still expected that developers provide an energy assessment demonstrating how the individual elements of the Energy Hierarchy have been implemented and how reductions in regulated $CO_2$ emissions have been achieved. The BER/DER of the refurbished building should also be determined at each stage of the energy hierarchy using building regulations compliance software.

Under Part L of the Building Regulations, new build homes and non-domestic properties are expected to be designed such that the BER/DER falls below the TER. There are no such requirements for refurbishments or properties created by change of use, and as such there is no TER or baseline for regulated emissions.

Instead, the baseline performance is calculated using either the 'Notional specification for existing buildings" given within Appendix 4 of the GLA's 'Energy Assessment Guidance', or existing performance, whichever is greater. This is to provide a consistent baseline across all refurbishments and clearly distinguish the improvements in $CO_2$ emissions that are over and above what would ordinarily be undertaken through meeting Building Regulation requirements. The specification modelled at this stage is shown below. This baseline DER is substituted for the TER described above. Heating is assumed to be provided by a default air source heat pump.

**Specification at 'Baseline' Stage for Domestic Units in Existing Buildings**

| **Elements** | **Specification** |
|---|---|
| *Building Fabric - U-Values (W/m²K)* | |
| Walls | 0.55 – 0.30 |
| Floors | 0.25 |
| Roofs | 0.18 |
| External opaque doors (whole frame) | 1.6 |
| Glazing (glazed doors, windows & rooflights (whole frame) | 1.6 (G-value 0.63) |
| *Building Fabric - Other* | |
| Air Permeability (m³/hm²) | Default of 15 |
| Thermal Bridging | Default values |
| *Services* | |
| Ventilation | Natural |
| Low Energy Lighting | 75% of fittings |

The baseline emissions for the project are shown below:

| Baseline emissions | (Tonnes $CO_2$ / year) | | | |
|---|---|---|---|---|
| | Baseline | Be lean | Be clean | Be green |
| Domestic from refurbishment or change of use | 1.48 | - | - | - |

## Unregulated $CO_2$ Emissions

Unregulated operation emissions are those which are not assessed under Part L of the Building Regulations. In dwellings, these typically result from cooking or use of appliances. Unregulated emissions for the proposed homes have been calculated using the BREDEM methodology.

These have been converted from kWh/m$^2$/year to tonnes per year for comparison with the regulated emissions presented above. Unregulated emissions are not included in methods for calculating baseline emissions, targets or reductions, but instead presented separately as follows:

**Unregulated emissions**

| Type | Total (tonnes $CO_2$ / year) |
|---|---|
| Domestic conversion | 1.12 |

# Demand Reduction (Be Lean)

The following section of the report outlines measures which have been taken to reduce the energy demand of the proposal. This includes both architectural and building fabric measures (passive design) and energy efficient services (active design), considered at the earliest design stage.

## Demonstrating $CO_2$ Savings from Demand Reduction Measures

According to the guidance from the GLA, passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading must be set out in the Design and Access statement. The impact of these factors is also accounted for within the energy calculations.

Active design measures to reduce energy can include high efficiency lighting and ventilation. Other possible measures include enhanced U-values, air tightness improvement and the development's approach to limiting thermal bridges. The specification for these items as proposed for the project is outlined below:

Specification at 'Be Lean' Stage

| **Demand Reduction Measures** | **Specification** |
|---|---|
| *Building Fabric - U-Values (W/m²K)* | |
| Walls | Existing walls improved to 0.18, new walls constructed to 0.16. |
| Floors | 0.13 |
| Roofs | 0.13 |
| External opaque doors (whole frame) | 1.0 |
| Glazing (glazed doors, windows & rooflights (whole frame) | 1.0 (g-value 0.4) |
| | |
| *Services* | |
| Ventilation | Natural |
| Low Energy Lighting | 100% of fittings |

The glazing areas of the project are shown within the energy modelling documents which are included within the appendices of this report.

The carbon produced and reductions achieved by the project when the above specification is applied are shown below.

| Cumulative savings after 'be lean' | (Tonnes $CO_2$ / year) | | | | Cumulative Improvement (%) |
|---|---|---|---|---|---|
| | **Baseline** | **Be lean** | **Be clean** | **Be green** | |
| Domestic from refurbishment or change of use | 1.48 | 1.36 | - | - | 8.40% |

# Heating Infrastructure (Be Clean)

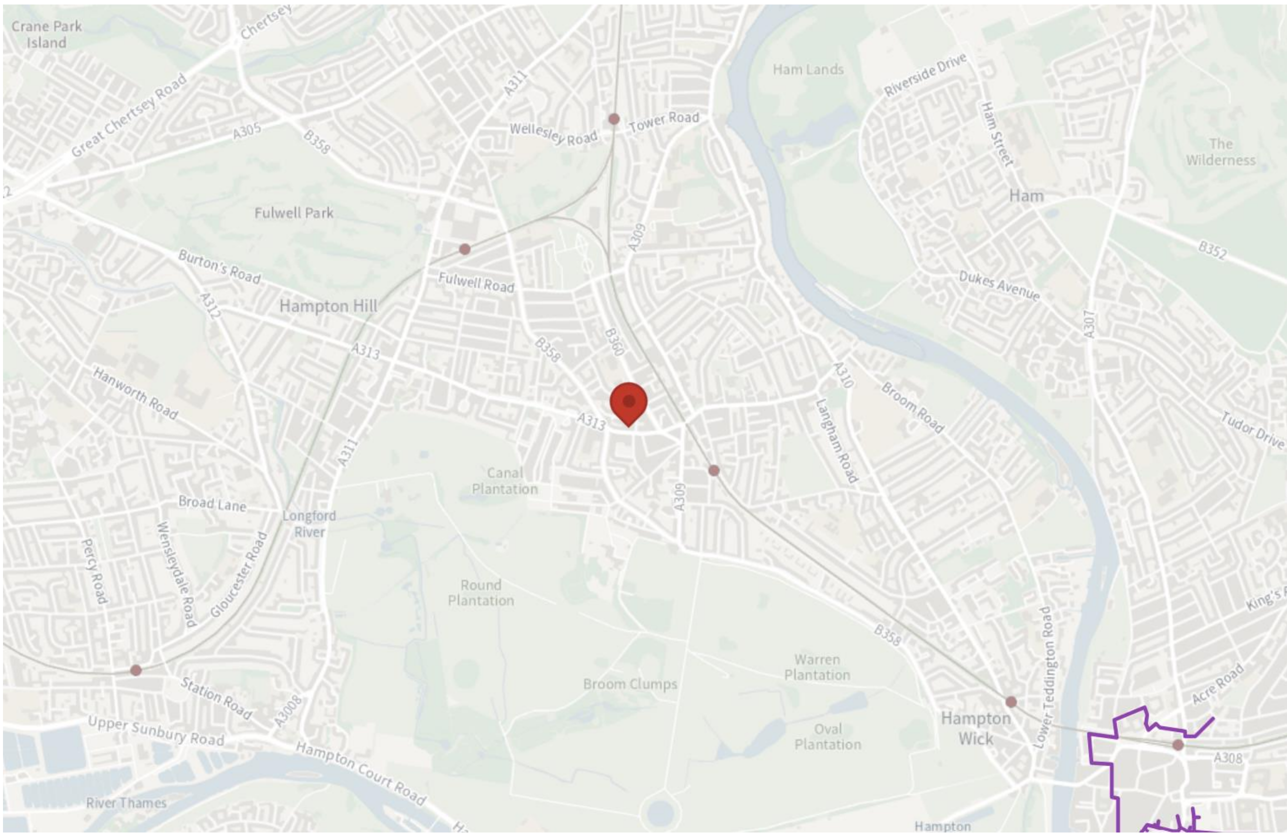
## The Heating Hierarchy

The energy systems for use at the development have been considered and selected in accordance with the order of preference within 'Energy Assessment Guidance Greater London Authority guidance on preparing energy assessments as part of planning applications. The hierarchy is as follows:

- **Connection to an area wide heat network**. Where proposed developments are located near to existing or planned networks, connection must be prioritised.
- **Communal heating system**
    - **Site-wide heat network**. Where proposed developments are located in areas of decentralised energy potential, but no heat networks currently exist or are planned, developers should provide a site-wide heat network served by a single energy centre to future proof the development for easy connection to a wider heat network in the future.
    - **Building-level heating system**. Appropriate for single building applications or low density developments with domestic blocks, where no district heating networks are planned or feasible.
- **Individual heating system**. Appropriate for low density individual housing, where no district heating networks are planned or feasible, and where evidence is provided that a site-wide heat network is uneconomic.

## Connection to Area Wide Low Carbon Heat Distribution Networks

Using the London Heat Map as a guide, there are no existing or planned heat networks near the development and the scheme is outside of the London Heat Map's areas of 'Heat Mapping Decentralised Energy Potential'. The screenshot below shows the location of the development.



*London heat map results for 21 Broad Street*

## Communal Heating Systems

A site-wide heat network is defined in the relevant guidance as "a set of flow and return pipes circulating hot water to the apartment blocks (and apartments contained therein) and non-domestic buildings on a development." This must be explored where "proposed developments are located in areas of decentralised energy potential, but no heat networks currently exist or are planned".

The London Heat Map demonstrates that the proposed development is not within an area of decentralised energy potential and that an area wide heat network is not proposed.

The suitability of Combined Heat and Power (CHP) systems, formally recommended within the relevant guidance, is addressed within Appendix A.

### *Proposed Heating and Cooling Specification*

Individual heating systems have been found to be viable in accordance with the guidance from the GLA and as such form part of the proposed specification.

The proposed systems are **i**ndividual ASHP (air source heat pumps) providing heating and hot water. As in previous stages and in lieu of full Stage 4 design information, a default system has been modelled. The carbon produced by the project when this specification is applied is shown again below.

| Cumulative savings after 'be clean' | (Tonnes $CO_2$ / year) | | | | Cumulative Improvement (%) |
|---|---|---|---|---|---|
| | **Baseline** | **Be lean** | **Be clean** | **Be green** | |
| Domestic from refurbishment or change of use | 1.48 | 1.36 | 1.36 | - | 8.40% |

## Air Quality

All combustion processes can emit oxides of Nitrogen ($NO_x$), which can contribute to poor air quality and can have detrimental impacts on the health of local residents and future occupants of the development. The GLA has set emission limits for boilers, gas engines, turbines and solid and liquid biomass which need to be met in all developments.

As the proposed systems are electric, no fossil fuels are consumed on site. As such there are no local emissions of $NO_x$.

## Renewable Energy (Be Green)

The use of renewable technology in the proposed design of the development has been fully considered as outlined in Appendix A.

Photovoltaic solar panels have been identified as a suitable technology for incorporation into the design. The proposal is for a 2.0kWp, facing west along the roof pitch. Drawings of the proposed array will be available when finalised by the design team. The carbon produced by the project when this specification is applied is shown below. The results of these improvements show a **36.03%** reduction in emissions over the Part L compliant base case, exceeding the target.

| Cumulative final savings | (Tonnes $CO_2$ / year) | | | | Cumulative Improvement (%) |
|---|---|---|---|---|---|
| | Baseline | Be lean | Be clean | Be green | |
| Domestic from refurbishment or change of use | 1.48 | 1.36 | 1.36 | 0.95 | 36.03% |

## Internal Water Use

It is the intention of the applicant to reduce the consumption of potable water within the proposed dwellings from all sources, using efficient fittings and flow restrictors where required. Performance in domestic properties is assessed under the methodologies set out in Part G of the Building Regulations. Although a variety of specifications are available to meet this target, the proposed flow rate criteria for dwellings at the development is outlined in Appendix B. This achieves an internal water use of **105 L/p/d** (litres per person per day) by design. This is compliant with Policy 5.15 B (Water Use and Supplies) of the London Plan, which states that developers should minimise the use of mains water by:

A. Incorporating water saving measures and equipment.
B. Designing domestic development so that mains water consumption would meet a target of 105 litres or less per head per day (excluding an allowance of 5 litres or less per head per day for external water consumption).

## Conclusion

This report outlines how a variety of sustainability criteria have been considered alongside the proposed design. Based on the modelling undertaken, it has been demonstrated that it is possible to reduce regulated on-site carbon dioxide emissions of the proposed 21 Broad Street development by **36.03%** beyond the requirements of Part L of the Building Regulations, where the building and services specification described in this report is implemented. This specification is therefore compliant with the carbon reduction policies of The London Borough of Richmond upon Thames.

# Appendices

## Appendix A – Consideration of Renewable and Alternative Technology

### *Photovoltaic Solar Panels*

Photovoltaic panel systems convert energy from the sun into electricity through semi-conductor cells mounted in collector panels. The panels are connected to an inverter to turn the DC output into AC for use in the building to which they are attached and to be fed back into the grid when not required. Photovoltaic arrays provide a quiet and effective renewable energy source with a relatively low aesthetic impact. The major benefit of PV systems is the significant reductions they can achieve in comparison to other technologies, in terms of $CO_2$ and energy use.

The PV panels should ideally be orientated between southeast and southwest (optimally south). The optimal tilt angle (inclination of panel from horizontal) should be calculated to ensure the best possible output of the system during the year. In the UK, the angles of most pitched roofs are suitable for mounting PV panels. Panels can also be mounted on A-frames on flat roofed buildings. PV technology comes in a range of forms: PV panels that can be retrofitted to the roof of an existing building or equally, sunk to fit flush with the roof line; PV cells that are 'laminated' between sheets of glass to provide shading in a glazed area, and PV cladding. PV systems are low maintenance as they have no moving parts and panels generally have 25 year warranties, although the lifetime of the panel can be expected to be beyond this time. The PV systems should not be shaded. Shading caused by other buildings, greenery and roof 'furniture' such as chimneys or satellite dishes, even over a small area of the panel, can significantly reduce performance. Excess energy can be exported to the grid. Although the Feed-in Tariffs are generally not high, exporters can negotiate with their utility company. Future consideration may be given to the benefits of battery storage. Payback times for this technology are usually approximately twenty years; but this is reducing year on year as the technology matures and are set to reduce further as fuel prices increase. Integrating PV into a building and replacing other building materials can further offset the cost.

### *Solar Hot Water Systems*

Solar water heating systems use the energy from the sun to heat water stored in a hot water cylinder inside the building. A solar collector comprises a housing that contains piping, through which the carrier fluid circulates, and a glass panel to retain the radiation from the sun. The temperature inside the collector increases and this heat is then transferred to a carrier fluid. In an open loop system, the hot water is heated directly. Solar thermal panels are generally black in appearance for maximising energy absorption and the glass panels have a special coating in order to retain as much heat as possible. Two types of collector exist: flat plate and evacuated tube. Flat plate collectors can be mounted on or flush with the roof. The air in the collection tubes can be evacuated to reduce heat losses within the frame by convection. Evacuated tube collectors need to be re-evacuated every few years. They are more difficult to install but are more efficient and allow higher temperature heating.

Solar thermal collectors offer a good price-performance ratio. Solar hot water systems are best suited to developments with high hot water requirements, such as hotels, care homes and leisure centres. Many systems have been installed in the UK and they work well, even without direct sunlight. Solar thermal systems should be sized to the hot water requirements of the user since any excess heat that is generated cannot be exported elsewhere. The optimal angle for mounting depends on when the water demand is greatest. Ideally, the collectors should be mounted onto a non-shaded, south-facing roof. Solar thermal technology is a cost effective way to reduce carbon emissions, especially if it is replacing electric water heating. Due to limited roof space, solar hot water cannot be used effectively alongside photovoltaic arrays. Accordingly, it is considered preferable to install photovoltaic panels as these represent a greater carbon saving.

*Biomass Heating*

With the long term availability of fossil fuels such as oil and gas, and the persistent number of price rises of oil and natural gas a growing concern in the UK, alternative heating methods such as wood burning boilers are becoming more popular. Due to technical advances in wood burning technology, and improvements in the preparation of wood fuels, efficiencies of new wood pellet burning boilers have increased to around 90%, with carbon monoxide emissions dropping dramatically. There are three types of wood burning boiler - logs, woodchips and wood pellets. Wood logs are the most readily available, generally produced as a by-product from forestry and woodland from sawmills, tree surgery and wind damage. Wood chips have a high moisture content which tends to restrict their efficiency to only 50% and they tend to suffer from blockages hence we would be cautious about their use on this site. Storage space requirements are also high due to the irregularity of the chips. Wood pellets are made from dry waste wood, such as used pallets and off-cuts/sawdust from furniture manufacturers. The waste wood is compressed into uniform, high density pellets that are easier to transport, handle and store than other forms of wood fuel.

Biomass combustion systems (BCS) are generally more mechanically complex than conventional boiler heating systems, especially when it comes to fuel delivery, storage, handling and combustion. The complexity is necessary because of the different combustion characteristics of biomass as compared to conventional fossil fuels. The increased complexity means higher capital costs than for conventional systems. BCSs typically require more frequent maintenance and greater operator attention than conventional systems. As a result, the degree of operator dedication to the system is critical to its success. They often require special attention to fire insurance premiums, air quality standards, ash disposal options and general safety issues. Domestic scale boilers such as Woodchip-fed systems remain very costly and the requirements for siting both the boiler and the fuel source were considered impractical for this development. There are also some concerns on current availability of suitable fuel within a reasonable distance of the development as well as the additional traffic that would be associated with it. The use of efficient heat pumps is considered more suitable.

Biomass can be burnt directly to provide heat in buildings using wood from forests, urban tree pruning, and farmed coppices or as liquid biofuel, such as bio diesel. In non-domestic applications, biomass boilers replace conventional fossil fuel boilers and come with automated features to enable reduced user intervention. Due to the size of the proposed project, biomass energy has not been considered as an economically suitable technology for this development.

## *Heat Pumps*

Heat pumps transfer heat from a lower temperature source to one of a higher temperature. These are split into three main categories:

- Air source heat pumps operate by converting the energy of the outside air into heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system. Air-to-water systems provide hot water for direct use or to supply 'wet' heating through underfloor heating or radiators. Air-to-air systems provide hot air, either directly into an internal space, or to be distributed by fans.
- Ground source heat pumps apply the same principle to heat energy stored underground. In this case a circuit of piping is buried horizontally or via a bore hole.
- Water source heat pumps absorb heat from a local water source, such as a lake, river, well, or borehole.

The most prevalent system is an air source heat pump. As with all heat pumps, air source models are most efficient when supplying low temperature systems such as underfloor heating.

An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C. Cold water or another fluid is circulated through pipes, picking up the ambient temperature and then passing through the heat exchanger (the evaporator) in the heat pump unit. The heat exchanger extracts heat from the fluid, using a refrigerant compression cycle to upgrade the heat to a usable temperature (+55°C). This heat is then transferred to the heating system via another heat exchanger, the condenser of the heat pump.

Accordingly, ASHP heating systems generally run at a lower temperature than conventional heating systems. There are two main types of air source heat pumps. An air-to-water system uses the heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system would, so they are better suited to underfloor heating systems than radiator systems. An air-to-air system produces warm air, which is circulated by fans to heat the building. Whilst heat pumps are not a wholly renewable energy source due to use of electricity, the renewable component is considered as the heat is extracted from the air. It is measured as the difference between heat outputs, less the primary electrical energy input. Using this heat, for every Watt of electrical energy supplied to the system, 4 Watts or more of heating energy can be supplied to a heating system. This 'Coefficient of Performance' (CoP) of 4 is effectively an 'efficiency' of 400% for the system and compares very favourably with even the best gas condensing boiler's efficiency of around 85%. The smaller the temperature difference between the source and the output temperature of the heat pump (i.e. the temperature of the distribution system) the higher the heat pump's CoP. Unlike boilers, there is no pollution on-site and as the mix of power stations used to supply the electricity grid gets 'cleaner', with more renewable electricity generation being brought on line, so the carbon emissions from the heat pumps system will decrease even further. The key operational benefit of air source heat pumps for the user is the reduction in fuel bills. In addition, space savings can be made over other plant types as an air source heat pump unit is compact, and requires no storage space for fuel.

Since air source heat pumps produce less heat than traditional boilers, it is essential that the building where the air source heat pump is proposed is well insulated and draught proofed for the heating system to be effective. Fans and compressors integral to the air source heat pump unit generate some noise, but this is generally acceptable especially where outdoor units can be located away from windows and adjacent buildings. By selecting a heat pump with an outdoor sound rating of 7.6 dB or lower and mounting the unit on a noise-absorbing base these issues can be resolved for the site. Costs for installing a typical system vary but they are considerably more economical to install than an equivalent capacity ground source heat system and can produce similar levels of energy and carbon savings. Actual running costs and savings for space heating will vary depending on several factors - including the size and use pattern of the building and how well insulated it is.

## *Combined Heat and Power (CHP)*

A Combined Heat and Power system (CHP) or cogeneration is the simultaneous generation of both heat and power (thermal energy and electricity). This is achieved through recovering heat generated in the production of electricity, which can be utilised in providing space heating and hot water. The most common fuel used in the UK to power a CHP engine is natural gas although LPG, biogas, ethanol, methane, hydrogen, biofuel, oil or any fuel that can drive an engine can be used. A CHP operating on fossil fuels, e.g. gas, diesel, is not considered a renewable technology. A biomass CHP, however, is considered to be a renewable energy technology but it is only suitable for developments with larger heat and electricity demands.

A CHP system uses on average 35% less primary energy compared to conventional heat-only boilers and power stations approaching efficiencies as high as 75%. Although not a renewable technology, except if biomass is being used, CHP is considered very efficient, reducing carbon emissions related to a site's energy consumption while providing electricity and heat to occupiers.

The GLA does not recommend CHP for use in developments consisting of 500 units or less, as 'at this scale it is generally not economical'. CHP has also been removed from the GLAs hierarchy for selecting energy systems with the publication of 'Energy Assessment Guidance Greater London Authority guidance on preparing energy assessments as part of planning applications - October 2018'.

CHP installed at the development to meet the base heat load would require the export of electricity to the national grid as it would likely exceed demand. The GLA continues to state that '…the administrative burden of managing CHP electricity sales at this small scale where energy service companies (ESCOs) are generally not active, and the low unit price available for small volumes of exported CHP electricity, means it is generally uneconomic for developers to pursue'.

CHP requires significant infrastructure and a substantial heat demand. In order to obtain maximum efficiency, it is necessary to have an energy demand profile which is evenly spread throughout the day and night. A CHP unit will operate efficiently when running continuously and so requires its energy to be used continuously to avoid wastage.

# Appendix B – Water Calculations

## *Summary of Requirements*

This appendix addresses water consumption for the proposed development. The approved document Part G gives two options to demonstrate compliance. These are as follows:

- **Fittings Approach.** Within the approved document, tables 2.1 and 2.2 describe the maximum rates for fittings to achieve 125/p/d or the 'optional' 110 l/p/d. The specifier may choose fittings which do not exceed these limits in order to attain compliance.

- **The Water Efficiency Calculator.** If any fittings exceed the amounts described within tables 2.1 or 2.2, then the water efficiency calculator must be completed to demonstrate compliance. Similarly, where a shower is not to be provided or where a waste disposal unit, a water softener or water re-use is to be provided the water efficiency calculator must be completed.

The standard required by default is **125 litres/person/day**. The 2015 edition of Approved Document G includes an 'optional' standard of **110 litres/person/day** which may be required by planning permission. This is intended to supersede the ability of planning authorities to require the Code for Sustainable Homes. The optional standard is equivalent to the minimum water use permitted under CSH Level 4.

By following the Government's national calculation methodology for assessing water efficiency in new dwellings for the project as designed, it is possible to achieve a water consumption of less than 110 litres per person per day using the fittings approach. Compliance with Building Regulation 36(1) can therefore be demonstrated.

This is compliant with Policy 5.15 B (Water Use and Supplies) of the London Plan, which states that developers should minimise the use of mains water by:

C. Incorporating water saving measures and equipment.
D. Designing domestic development so that mains water consumption would meet a target of 105 litres or less per head per day (excluding an allowance of 5 litres or less per head per day for external water consumption).

## *Compliant Design Specification*

The fittingss approach can be adopted to demonstrate compliance as follows. Fittings must not exceed the given the rates during design and construction:

| **Fitting** | **Maximum Consumption** |
|---|---|
| WC flush | 4/2.6 litres dual flush |
| Basin taps (in WCs and bathrooms) | 5 l/min |
| Sink taps (kitchen and utility) | 6 l/min |
| Showers | 8 l/min |
| Baths | 170 litres to overflow |
| Dishwasher | 1.25 l/place setting |
| Washing machine | 8.17 l/kilogram |
| Waste disposal unit | None fitted |
| Water softener | None fitted |
| **Total consumption:** | **110 litres/person/day (105 internal)** |

*Further Guidance for Specifiers on Achieving the Required Flowrates*

**Taps and showers** will **require flow limiters** to meet these values. Please ensure these are installed along with the tap and shower fittings as these must be checked by Building Control prior to sign off.

Some taps and showers may already have built in limiters. Flow limiters are almost needed to meet the shower and tap values. You could alternatively check the flow rate with the manufacturer. For high pressure water systems (above 1 bar) it's the flow rates measured at 3 bar that is required. If it's a low-pressure water system (less than 0.3 bar), the flow rate at 0.1 bar is required. Tap values should be the maximum flow rate and showers should be the cold flow rate.

**What if a waste disposal unit or water softener system is being used?** These use additional water so may need to be compensated with lower values elsewhere. Please provide details of the waste disposal and softener systems being used. This report assumes that no such system is present.

**What if any values are exceeded?** It may be possible to compensate for them by further reducing values elsewhere. If you'd like us to look at this, please let us know. Grey water recycling or rainwater harvesting for internal use can also compensate for exceeding values.

**WC Flush and Baths.** The flush volume and capacity to overflow is often displayed on the manufacturer website or can be requested from them.

**Dishwashers** must achieve a water use of 1.25 l/place setting. This can be found by dividing the water consumption of a standard cycle by the number of place settings. If only the annual water consumption is given, divide this by 280 to get the water consumption of a single cycle. Where a dishwasher is not being fitted, 1.25 l/place setting is used as a default.

**Washing machines** need to achieve a water use of 8.17 l/kg dry load. This can be found by dividing the water consumption of a standard cycle by the dry load capacity in kg. If only the annual water consumption is given, divide this by 220 to get the water consumption of a single cycle. Where a washing machine is not being fitted, 8.17 l/place setting is used as a default.

**External Water Use.** Both the 125l and 110l target include a 5l allowance for external water use, e.g. to water a garden. This is not influenced by the building specification or fittings. It is common to see these targets described as 120l or 105 targets for internal water use. For example, the Greater London Authority require "mains water consumption would meet a target of 105 litres or less per head per day (excluding an allowance of 5 litres or less per head per day for external water consumption)".

## Appendix C – Energy Model Output Documents

Energy model output documents reflecting each stage of the energy hierarchy accompany this report separately.