CGP | MEP

Guildford Plaza, Guildford - Surrey

Energy Statement

CGP14354

May 2021

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NAME	ORGANISATION
Duncan Tindale	Tiger Development
Lee Marsden	Coffey Architects

DOCUMENT CONTENT

SECTION A - EXECUTIVE SUMMARY

A.1 Executive Summary

This report reflects the sustainable design and construction philosophy to support a planning application for the proposed Guildford Plaza.

This high-quality development has placed strategic importance on its sustainable design and energy efficient features, and will aim to reduce impact upon the existing environment, it will also help to meet the strong growth in demand for this type of building, with strong collaboration between both client and project team sharing a collective long-term strategy in sustainable, responsible and efficient design standards for the benefit of building users and the local community.

This report establishes how the proposed development will achieve compliance with Building Regulations and Local Authority requirements. This has been achieved by following best practice procedures of the Energy Hierarchy: reduced energy use and improved building performance, centralised heating and cooling systems and use of low or zero carbon technologies.

We are adopting a fabric first approach to significantly reduce the energy consumption adopting better than notional fabric performance as highlighted further in this report. This coupled with use of LZC technology Air Source Heat Pumps to provide the heating and hot water needs. These measures ensure we meet Building Regulations.

Based on the robust energy hierarchy approach, the development will exceed the required 20% CO2 reduction against the Target Emission Rate (TER) and at least 10% of this CO2 reduction will be achieved through the use of on-site low and zero carbon technologies. Hence complying with Building Regulations and planning policies:

- Guildford Borough Local Plan: Policy D2: Climate Change, sustainable design, construction and energy
- Guildford Borough Supplementary Planning Document Section C guidance

For Policies relating to Sustainability elements please refer to the Ensphere Sustainability Report, document reference: 20-E141-001.

A1.1 Reducing carbon emissions through energy efficiency measures

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

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

A1.2 Reducing carbon emissions through district heating measures

The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It is considered that the installation of either of these options is not practicable for this development. Further narrative on this is provided in Section 4.0.

A.1.3 Reducing carbon emissions through LZC measures

A low or zero carbon (LZC) technology feasibility study has been carried out (section 5.0) as part of this Energy Assessment. This study compares the feasibility of different technologies. Based on this, it was identified that the most appropriate technology for the development to assure the sustainability and energy efficiency is the installation of an air source heat pump system to achieve a reasonable reduction in regulated CO_2 emissions from on-site renewable sources.

Based on the robust approach to the energy hierarchy, the development has exceeded the required sustainability and energy targets. The proposed strategy achieves a total 22.7% reduction of the regulated carbon dioxide emissions over Building Regulations 2013 Part L1A, which is above Guildford planning requirement.

Additionally, the adaptation measures for wider sustainable design and energy efficiency issues have been investigated, including water stress, extreme temperatures and district heating.

In overall, the energy efficiency measures and low carbon technology described above are expected to give 22.7% CO2 emissions reduction compared to the notional 'base case':

	Energy demand (kWh/annum)	Saving achieved on baseline energy demand (%)	Regulated CO2 emissions (kg per annum)	Saving achieved on baseline CO2 emissions (%)
Notional Building ("Baseline" energy demand & emissions)	609,369		408,972	
Proposed scheme after energy efficiency and renewable measures	536,244	12	316,135	22.7
Total savings		**12**		**22.7**

Table 7: Table denoting the energy demand and CO2 emissions for all options.

A.2 Aims and Objectives

This report sets out a sustainable design and construction philosophy in response to the following planning policies:

Current National level policies:

- National Planning Policy Framework – NPPF
- Climate Change Act 2008;
- Building Regulations 2013 Part L.

Current Regional and Local level policies:

- Surrey County Design Guide, Chapter 4 Principles:

  - All developments should be designed to be energy efficient
  - Water should be used efficiently
  - Existing landscape and habitats should be retained and wildlife enhanced
  - All developments should prevent water pollution and flooding
  - Buildings and building materials should be reused and recycled
  - Building materials should be sustainably sourced

- Guildford Borough Local Plan: Policy D2: Climate Change, sustainable design, construction and energy
- Guildford Borough Supplementary Planning Document Section C guidance

The aim of this document is to demonstrate a formal design response and commitment to achieve compliance with the policies defined above and set out the vision, strategy and core policies for the development and building specification.

Dynamic simulation analysis and recognised design calculations will be undertaken and provided for the proposed development at later design stages to demonstrate compliance.

Overall, this report aims to demonstrate that the proposed development gives thorough consideration to energy to meet the above-mentioned planning policy requirements.

A.2.1 Project Overview

The proposal seeks to comprehensively redevelop the site to provide a new Guildford Plaza Co-Living scheme in Guildford, Surrey. The building will provide c. 300 co-living studios.

The Applicant has developed proposals with the aim of delivering a high quality co-living development for young professionals.

The Applicant's vision for the Site is to deliver a vibrant and integrated community with studios and shared facilities.

The brief for the project can be summarised as follows:

Development of the Guildford Plaza site to provide a new co-living community comprising of c 300 Co-living studio and associated communal living spaces inside and shared external landscape.

The focus is on sustainable communities and sustainable living with a largely car-free development and powered using renewable energy sources,

- Use Class: Sui Generis
- Approximate development Gross External Area: 30,000 sqm
- c. 300 co-living studios
- Shared communal living spaces
- Landscaped public routes
- Largely Car free development
- Target BREEAM rating ambition 'Excellent'

SECTION B – POLICY OBJECTIVES

B.1 POLICY OBJECTIVES

The relevant authority for this site is the Guildford Borough Council. The requirements of this Council and other relevant authorities have been taken into account within the preparation of this Sustainability Statement. The key planning framework applicable to the energy aspects of the development is outlined below:

B.1.1 National Level Policies

There are a number of national policies and regulations related to energy; those most relevant to the energy assessment of new developments are detailed below.

National Planning Policy Framework – NPPF

The National Planning Policy Framework (NPPF) was published in March 2019, and superseded the former planning policy statements (PPS) documents. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development. The three dimensions of sustainable development can be defined as the economic, social and environmental.

There are twelve core planning principles in the NPPF. Within these, there is a strong support for the transition to a low carbon future in a climate change context, taking full account of a number of different factors. There is also an aim to contribute to conserving and enhancing the natural environment and reducing pollution.

The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.

However, the NPPF also highlights that pursuing sustainable development requires careful attention to the viability and costs in plan-making and decision-taking. Plans should be deliverable. Therefore, the sites and the scale of development identified in the plan should not be subject to such a scale of obligations and policy burdens, that their ability to be developed viably is threatened.

Climate Change Act 2008

The Government has introduced legislation and a number of policies during recent years focusing on the reduction of CO_2 emissions. The Climate Change Act (2008) sets a legally binding target for the reduction in UK carbon dioxide emissions. Upon ratification of the Kyoto Protocol, the UK committed to a reduction in its CO_2 emissions by 80% compared to 1990 levels (by 2050). In addition, under the Climate Change Act an interim target of a 34% reduction by 2020 was set.

In order to enforce these targets, the Government is using the Building Regulations: Part L 2013 – (Conservation of fuel and power) which set the standards to which all new and existing buildings must comply.

Building Regulations 2013 Part L

Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.

Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

Part L is split into four sections:

- L1A New Dwellings;
- L1B Existing Dwellings;
- L2A New Buildings other than Dwellings;
- L2B Existing Buildings other than Dwellings

Due to the development being of a commercial type the proposed development needs to comply with Part L2A.

B.1.2 Regional Level Policies

Policy D2: Climate Change, sustainable design, construction and energy

Sustainable design and construction

1) Proposals for zero carbon development are strongly supported. Applications for development, including refurbishment, conversion and extensions to existing buildings should include information setting out how sustainable design and construction practice will be incorporated including (where applicable):

    (a) the efficient use of mineral resources and the incorporation of a proportion of recycled and/or secondary aggregates
    (b) waste minimisation and reusing material derived from excavation and demolition
    (c) the use of landform, layout, building orientation, massing and landscaping to reduce energy consumption
    (d) water efficiency that meets the highest national standard and
    (e) measures that enable sustainable lifestyles for the occupants of the buildings, including electric car charging points

2) When meeting these requirements, the energy and waste hierarchies should be followed except where it can be demonstrated that greater sustainability can be achieved by utilising measures further down the hierarchy.
3) Major development should include a sustainability statement setting out how the matters in this policy have been addressed. Smaller developments should include information proportionate to the size of the development in the planning application.

Climate Change Adaptation

4) All developments should be fit for purpose and remain so into the future. Proposals for major development are required to set out in a sustainability statement how they have incorporated adaptations for a changing climate and changing weather patterns in order to avoid increased vulnerability and offer high levels of resilience to the full range of expected impacts.

Climate change mitigation, decentralised, renewable and low carbon energy

The development of low and zero carbon and decentralised energy, including (C)CHP distribution networks, is strongly supported and encouraged.

5) Where (C)CHP distribution networks already exist, new developments are required to connect to them or be connection-ready unless it can be clearly demonstrated that utilizing a different energy supply would be more sustainable or connection is not feasible.
6) Proposals for development within Heat Priority Areas as shown on the Policies Map and all sufficiently large or intensive developments must demonstrate that (C)CHP has been given adequate consideration as the primary source of energy.
7) All (C)CHP systems are required to be scaled and operated in order to maximise the potential for carbon reduction.
8) New buildings must achieve a reasonable reduction in carbon emissions of at least 20 per cent measured against the relevant Target Emission Rate (TER) set out in the Building Regulations 2010 (as amended) (Part L). This should be achieved through the provision of appropriate renewable and low carbon energy technologies on site and/or in the locality of the development and improvements to the energy performance of the building. Where it can clearly be shown that this is not possible, offsite offsetting measures in line with the energy hierarchy should be delivered.
9) Retail units falling within Use Classes A1, A2, A3 and A4 in Guildford Town Centre are not subject to the carbon reduction requirement at paragraph.
10) Planning applications must include adequate information to demonstrate and quantify how proposals comply with the energy requirements at paragraphs 5-10 of this policy. For major development, this should take the form of an energy statement.

<table>
<tr><th>The energy hierarchy</th><th>The waste hierarchy</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Step 1: Eliminate energy need
Developments should be designed to eliminate the need for energy through measures including:
▪ design of the scheme layout
▪ thermally efficient construction methods and materials
• design features that eliminate the need for appliances
• making optimal use of passive heating and cooling systems

Step 2: Use energy efficiently
Developments should incorporate energy efficient systems, equipment and appliances to reduce the remaining energy demand.</td><td>Step 1: Eliminate waste
Construction practice and design should reduce waste wherever possible through measures including:
• efficient procurement avoiding oversupply and excessive packaging
• eliminating waste at the design stage.

Step 2: Reuse waste materials
Reuse waste materials, ideally in its current location, avoiding the energy costs associated with transport and recycling.

Step 3: Recycle/compost waste materials
Recover materials through recycling and substitute for primary materials. Compost</td></tr>
</table>

Energy storage devices may improve efficiency. **Step 3: Supply energy from renewable and low carbon sources** The remaining energy need should be met from renewable and low carbon sources. **Step 4: Offset carbon emissions** As a final step, remaining emissions should be offset, for example through off-site measures that reduce carbon emissions or remove carbon from the atmosphere.	organic material to produce rich soils that replace fertilisers, ideally in a closed system to avoid the emissions released by organic material in landfill. **Step 4: Recover energy** If it cannot be reused or recycled, use waste instead of fossil fuels in energy generation to recover embodied energy. **Step 5: Disposal to landfill** Usually the last resort. Disposal to landfill wastes materials and embodied energy.

Supplementary Planning Document Section B: BREEAM Assessments

The Council will require non-residential developments of 1000 sqm or more (net) floorspace to achieve a BREEAM Very Good assessment rating as a minimum. Developers will be required by planning condition to submit an interim certificate at the design stage and, a final assessment and certification once construction is complete.

Supplementary Planning Document Section C: On site low and zero carbon technologies

The Council requires:

Residential developments of 1 or more (gross) studios to achieve a 10 percent reduction in carbon emissions through the use of on site low and zero carbon technologies.

Non residential developments of 1,000sqm or more (gross) floorspace to achieve a 10 percent reduction in carbon emissions through the use of on site low and zero carbon technologies

SECTION C – ENERGY EFFICIENCY

C.1 Energy Efficiency

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

C.2 Energy Modelling

In order to maximise carbon efficiency, all homes are required to meet the strengthened on-site energy performance standards of Building Regulations, and any subsequent increased requirements.

Methodology

The energy/CO2 emissions strategy for the proposed apartments block has been calculated via a three-stage process using FSAP modelling software:

1. Baseline energy (Target Fabric Energy Efficiency (TFEE)) and CO2 (Target Emission Rate (TER)) benchmarks have been established using Notional Building parameters. The ‘notional’ building has got the same geometry as the proposed building. In this ‘notional’ building pre-defined areas of glazing and doors are included, and the plant and fabric elements are assigned standard performance standards for efficiencies, U-values, etc. (section 4.1);

2. Several energy efficient measures and low and zero carbon technology have been incorporated into the Actual Building. The CO2 emissions (Dwelling Emission Rate (DER)) of the Actual Building has then been compared with the Notional Building baseline, and resulting CO2 savings have been calculated (section 4.2 and 4.3);

3. The possibility of connecting to the District Heating Network has been investigated (section 4.4).

This section of the report aims to demonstrate the model-building and baseline CO2 emissions establishment processes.

Stroma FSAP 2012 software has been used for the analysis as the development will be assessed against the 2013 version of the Building Regulations. The development comprises a mix of 1, 2 and 3 bed apartments. Sample typical units for different apartment types have been selected and modelled using Stroma FSAP 2012 software Version 1.0.4.20. Typical apartments were modelled;

Sample representative calculations have been undertaken to establish a suitable strategy for the planning purposes and are not intended for submission to Building Control. It should be noted that in total 65 apartments have been proposed, therefore only several have been selected and used to represent the whole block of apartments. This has been done to cater for the worst case energy use and CO2 emissions scenario, which is frequently for the rooms with large exposed envelope area and considerable amount of glazing. For further guidance please refer to Appendices A and B.

In order to benchmark the development, a base case has been established, using the Building Regulations 2013 notional apartments with which the actual apartments are compared. The assumptions (pre-defined by Building Regs) in the base case are as follows:

- A gas fired combination boiler, supplying heating and hot water. Efficiency as per the Domestic Building Services Compliance Guide 2013 (i.e. Building Regulations 2013);
- A natural ventilation strategy;
- Building fabric parameters, including the U values and air tightness as per the notional building values as detailed in AD L1A (i.e. Building Regulations 2013). Please see the below comparison with the proposed U-values for the development for details;
- All other building services efficiencies are as detailed in the Domestic Building Services Compliance Guide 2013 (i.e. Building Regulations 2013).

The notional building 'base case' gives the following energy consumption and CO2 emissions which are taken as the minimum benchmarks:

	Energy demand (kWh/annum)	Saving achieved on baseline energy demand (%)	Regulated CO2 emissions (kg per annum)	Saving achieved on baseline CO2 emissions (%)
Notional Building ("Baseline" energy demand & emissions)	609,369		408,972	

Table 2: Total predicted annual energy demand and CO2 emissions for the base case scenario.

C.3 Building Fabric

New buildings are currently subject to Building Regulations requirements on energy efficiency which are set out in the 2013 edition approved document L2A. This requires that new buildings meet a minimum Target Emission Rate (TER) for CO_2 emissions.

For the proposed building, improvements on the minimum values have been proposed to minimise operational energy use and carbon dioxide emissions, as well as further exceed Part L requirements. The table below demonstrates that fabric elements for the proposed building are surpassing both the minimum Building Regulation standards and the Notional Building values. The final U-values are still subject to further energy modelling results and might be improved, if required, to comply with Building Regulations and Local Policies.

U-values (W/(m^{2}K))	Building Regulations Part L (max)	Notional Building	Proposed Building (likely)
Roof	0.25	0.18	0.10
Wall	0.35	0.26	0.15
Curtain wall	2.2	1.6	1.2
Floor	0.25	0.22	0.10
Doors	2.2	2.2	2.2
Glazing elements/rooflight (including frame)	2.2	Windows: 1.6; g-value=0.4 Rooflights: 1.8; g-value=0.55	Windows: 1.2; g-value=0.4 Rooflights: 1.6; g-value=0.4

Table 1: Comparison of building fabric parameters for Part L 2013 and the proposed design standards.

It should be noted that in buildings with high internal heat gains and long occupancy hours, similar to the proposed building, the effect of insulation on total energy use and occupant comfort should be carefully evaluated. It is recognised that low U-values are beneficial for winter periods as they prevent heat loss, however it's a delicate balance as increased thermal performance and air tightness can also lead to internal overheating issues which is currently a wide spread problem in the UK construction industry. In many cases over-insulation of the building retains high amounts of warm air, limits air extraction and leads to higher internal temperatures – in most cases creating an increased need for mechanical cooling systems.

C.3.1 Glazing

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

The proposed building design will include glazing with a U-value of 1.2 W/(m^{2}K), which is lower than the Building Regulation minimum value of 2.2 W/(m^{2}K), and lower than the Notional Building value of 1.6 W/(m^{2}K).

A low g-value glazing (0.4) will be utilised for the glazing elements to reduce solar gains.

C.3.2 Thermal bridging

As per minimum Building Regs requirements, the building fabric will be constructed so that there are no reasonably avoided thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements and at the edges of elements such as those around window and door openings. Non-repeating thermal bridge heat losses for each element will be allowed for by a method that satisfies BS EN 14683 and Part L Building Regulations.

C.4 Air Permeability

The air tightness of a building impacts on its energy consumption and hence the CO_2 emissions. The lower the air tightness, the more heated warm air is retained within the occupied spaces of the building, therefore less energy is required to heat the building in winter. Part L of Building Regulations identifies that air permeability of less than $10m^3/hr$ per m^2 @ 50Pa should be achieved. However, as 'a rule of thumb' it is usually necessary to make improvements on the statutory limit to achieve CO_2 emissions compliance. A new build should generally target a value no higher than $5m^3/hr$ per m^2 @ 50Pa.

The target for the proposed building is $5m^3/hr$ per m^2 @ 50Pa. This demonstrates an improvement over the current Part L Building Regulations value of 50%.

C.5 Building Services

In addition to upgrading the insulation and air tightness standards, it is important that the energy used within the building is efficient. Therefore, the building services systems should be designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will meet or exceed the requirements of Part L2A: 2013 Non-Domestic Building Services Compliance Guide.

System type	Building Regs/Notional minimum requirements	Proposed Building
Space heating	LTHW condensing boilers with a seasonal efficiency=91%	Heating via ASHP
Air distribution systems	Central balanced supply and extract ventilation system with heat recovery; SFP=1.8 HR=65%	Central balanced MVHCR supply and extract ventilation system with heat recovery; <SFP=1.6 >HR=80%
Cooling	n/a	n/a
Domestic Hot Water	Central plate heat exchanger and a storage vessel (seasonal efficiency=90%)	Heating via ASHP (min 60% demand) and electric top up (max 40% demand)
Internal lighting systems	Luminous efficacy - lumens per circuit watt >60 lm/W	Luminous efficacy - lumens per circuit watt >100 lm/W

Table 2: Comparison of building services parameters for Part L 2013 and Be Lean design standards.

It is recognised that the levels of pollutants will be affected by more frequent summer temperature inversions expected in the future, while the amount of dust is likely to increase in summers, as they become hotter and drier.

Therefore, ventilation should be designed so as not to compromise security, ambient noise levels and air quality. This will be achieved though the incorporation of Eltra Fans MVHCR units, which simultaneously extract air from wet rooms while supplying fresh, warm or cool, filtered air to the habitable rooms to maintain the internal environmental conditions.

Mechanical Ventilation with Heating Recovery (MVHR) is a well-known option that works best in the colder months when the outside temperature is low with incoming air passed over a heat exchanger.

C.5.1 Internal lighting systems

The project team have incorporated energy-efficient LED lighting for the proposed building. According to the non-domestic building services compliance guide, the average initial efficacy should be not less than 60 luminaire lumens per circuit watt. Currently, the proposed lighting represents an improvement over and above the 2013 Part L Building Regulations with 100 luminaire lumens per circuit watt (lm/cw) as a minimum.

Energy efficient LED lighting in combination with lighting controls will be used throughout the proposed buildings, as opposed to merely standalone LED lighting. Lighting control systems will include daylight sensing and PIR (passive infrared sensors) detection to assure that the energy use and associated carbon emissions of the building lighting installation are as low as possible.

C.6 Responsive Heating Controls

One of the most cost-effective ways to reduce fuel is to use responsive heating / weather controls. These controls are an electronic energy management system that utilises a computer chip to balance heating system water temperature with outdoor temperature. By constantly measuring outside temperature, controls determine the optimum temperature needed to heat the building. The controls possess a sensor on the north side of the building and a sensor mounted at the boiler/heating system to sense water temperature. Additional sensors can also be incorporated into the system to detect internal heat gains from solar or extreme heat losses.

These systems are still to be to fully investigated during the detail design stage but the potential advantages of these technologies could lead to further efficiencies within the energy strategy.

C.7 Building Management Systems

Energy metering systems will be installed enabling at least 90% of the estimated annual energy consumption of each fuel type to be assigned to the various end-use categories of energy consuming systems. The energy consuming systems will be monitored using an appropriate energy monitoring system, such as a Building Management System (BMS). The BMS will be appropriately commissioned and the occupier/facilities team will be fully trained in the operation of the system. This will include meters and sub-metres installed in line with CIBSE TM39.

C.8 Energy Storage

Energy storage works by capturing electricity produced by both renewable and non-renewable resources and storing it for discharge when required. The solution allows users to come off the grid and switch to stored electricity, at a time most beneficial, giving greater flexibility and control of electrical usage.

Energy storage can efficiently smooth out the supply from the energy sources to provide a more reliable supply that matches demand. This allows organisations to maximise renewable generation, therefore energy storage can play an integral role in a business' journey towards carbon neutrality.

At times of unexpected increases in demand on the grid, energy storage can be used to discharge power back to the electrical supply network very quickly to provide additional supply to help meet demand. By businesses contributing to this process of balancing the demand it alleviates the pressure from the grid and for this assistance contracts are offered.

Energy storage can also provide flexibility in electricity supply and opportunities for significant cost savings by enabling a switch to stored electricity during peak-tariff periods. It eliminates the risk of network interruption by providing full UPS capabilities, reducing the likelihood of energy related failures which can total as much as 17% of annual revenues and maximises the investment into renewable generation.

The design team will investigate the potential of this technology at further design stages.

C.9 Water Efficiency

In England the average person uses about 150 litres of water a day for a range of uses including sanitation, where significant savings are possible. Given that climate projections forecast half as much rainfall in summer in the South East of England by 2080, it is important to build water efficiency in to our building stock and minimise the need for major infrastructure enhancements to meet these pressures as well as growing demands. Under these scenarios and with the expected high population growth, deficits are expected to be already widespread by the 2050s. The UK is expected to be in deficit by up to 16% of the total water demand in the 2050s and of up to 29% in the 2080s leading to major impacts on cost and resource levels.

As per the local planning policies, the fittings below (Table 3) will be procured to meet a water consumption figure of no more than 110 litres/person/day:

WATER FITTING	MAXIMUM CONSUMPTION
WC	4/2.6 litre dual flush
Shower	8 litres/min
Bath	170 litres
Wash hand basin taps	5 litres/min
Sink taps	6 litres/min
Dishwasher	1.25 litres/place setting
Washing machine	8.17 litres/kilogram

Table 3: Proposed water efficient fittings.

Rainwater harvesting or greywater recycling is not proposed as part of this development, as the required level can be achieved through efficient fittings. There are no major water consuming external areas with simple planting, which reduce the need for potable water to be used externally.

WWHR is one of the fastest growing energy efficient products in the UK. This is because it is the perfect eco-solution for so many reasons, be it used for new build compliance through SAP, SBEM or BREEAM, or for retrofitting existing constructions such as homes, hotels or commercial buildings, which in turn reduce the hot water costs of high traffic areas or hard to treat homes.

Typically, a wastewater heat recovery system works by extracting the heat from the shower or bath and sending down the drain. This heat is used to warm the incoming mains water, reducing the strain on the boiler and the energy required to heat the water up to temperature. A system normally takes the form of a long vertical copper pipe, where the warm water runs alongside the colder mains water to exchange the heat.

The devices are typically around 40% efficient, so they convert 40% of the potential energy in the wastewater back into heat for the incoming water. This saves money on the bills, especially for domestic developments, where a large amount of water is utilised.

This system will be further investigated and will likely be incorporated into the design.

C.10 Orientation and Layout

Visual comfort is an important part of ensuring building occupant health, comfort and wellbeing. Maximising exposure to natural daylight and providing an external view out provides users with a connection to nature. This can in turn support mental wellbeing, for example by improving people's mood and reducing the symptoms of depression. Increasing the level of daylight within the building also reduces the need for artificial lighting, which can reduce operational costs and environmental impacts of the building. Further to this, naturally lit environments increase occupant productivity and support the regulation of circadian rhythms. For these reasons, a good level of daylight through the windows will be provided.

A combination of the expected increase in external temperatures and the extensive glazing within the building could potentially put these areas at risk of overheating. However, a number of features have been included within the building design to prevent this. As such, the four buildings will favour from shading from each other.

C.11 Use of Materials

The use of construction products leads to a wide range of environmental and social impacts across the life cycle through initial procurement, wastage, maintenance and replacement. Taken together, construction products make a significant contribution to the overall life cycle impacts of a building. In some cases they may even outweigh operational impacts (such as energy consumption).

Surface materials that are often used for landscaping and paving, and even the external finishes of surrounding buildings can affect the temperature of the surrounding air. Hard and dark coloured materials like concrete, brick and macadam have the tendency to absorb the sun's energy and heat generated during the day and re-radiate this at night. As a result of this, the night-time air temperature remains high. Elevation drawings denote that building's finishes colour will vary from white to medium brown colours, which will reflect 40-50% of Sun's radiation and will not significantly contribute to urban heat island effect.

All materials specified will be of a robust and durable nature. A detailed assessment of the maintenance and end of life strategies will be considered for material components at risk of damage, heavy use and exposure to weather conditions. Where feasible, a proportion of recycled and/or secondary aggregates will be incorporated into the design. Waste minimisation and reusing material from excavation will also be considered.

C.12 Climate Change Adaptation

The proposed development will be fit for purpose and will remain so into the future due to the measures denoted below.

An increase of hotter summers/heat waves could lead to increases in internal temperature of the building and potentially have an impact on thermal comfort of the occupants. The technical control measure for this risk will be in place with MVHCR units in all bedrooms/studios.

Additionally, the risk of overheating will be controlled through a number of passive and active design measures. Passive: the proposed building will incorporate effective low g-value glazing (0.40) and blinds, which will considerably decrease solar radiation. Active: as mentioned, MVHCR units to be incorporated, which act in reverse to MVHR systems as outgoing cooler air is passed over the heat exchanger instead, ensuring the building temperature remains comfortable from January, right through to December

The overheating model, for the purposes of BREEAM HEA04 Thermal Comfort credits, will cover Current and Future Climate comfort modelling. The building will have installed MVHCR hence overheating is unlikely to happen. This will be further evidenced by TM52 analysis to be carried out.

An increase of droughts and reduced water availability could lead to restrictions on water availability and usage. The technical control measure for this risk will be in place through a specification of water efficient equipment including low flow sanitary fittings. Metering of incoming water supply will also be provided to quantify the amount of water used and means to reduce this usage. Water leak detection with automatic flow shutoff will be provided.

An increase of colder events (unlikely) could potentially result in increased space and DHW heating plant utilisation leading to increased CO_2 emissions and energy consumption. To prevent this, CIBSE approved weather files will be used for plant room sizing, which should ensure that heating and domestic hot water systems will be designed to provide sufficient heating and hot water. It is proposed that energy-efficient ASHP will provide minimum 60% of heating and domestic hot water demand. Utilisation of ASHP will help to reduce CO_2 emissions and energy consumption even when at peak heating and hot water load due to high efficiency (SCoP=3).

C.13 BREEAM

The design team will aim to achieve BREEAM ‘Very Good’ as a minimum with the aspiration to achieve ‘Excellent’.

For the purposes of BREEAM, a wide range of reports will be provided to cover the issues below:

- Management
- Health and Wellbeing
- Energy
- Transport
- Water

- Waste
- Pollution
- Land use and Ecology
- Materials

BREEAM ENE-04 Passive Design report to be provided at Stage 2 and will demonstrate how the use of landform, layout, building orientation, massing and landscaping can reduce energy consumption.

BREEAM TRA01/TRA02 reports to be provided by the Travel Consultants at later design stage will denote the measures, which will enable sustainable lifestyles for the occupants of the building, including electric car charging points, cycling facilities, etc.

SECTION D – DECENTRALISED ENERGY

D.1 Decentralised Energy

Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. Guildford Borough Development Strategy encourages the development proposals to explore the opportunities to link into an existing or planned decentralised energy network as per below.

D.2 Heat Network

Consideration was given to the possible connection to an existing or proposed area wide decentralised energy network. The UK CHP Development Map is an interactive tool, using an interactive GIS system, which allows users to identify opportunities for decentralised energy projects in the UK. This tool details the existing heat loads and supplies within the UK as well as existing heat distribution networks.

Following a review of Heat Map, it has been established that there are currently no existing district heating networks located in the vicinity, that the proposed development could link to (see Figure 1 below).

Figure 1: District Heating connections.

Following additional review of total heat load and Guildford Policies Map, it has been established that:

1) The proposed development is located in an area with only a medium head load rather than high heat load (Figure 2); medium heat load and demand might not be sufficient to justify the installation of CHP, as CHP only generates carbon and financial savings when it is running at high heat load and demand, and the more it runs, the more energy efficient and cost-effective it will be.
2) The development does not lie within a district heating priority area, but is located near two of these (Figure 2)

An allowance will be made within the building services design to allow for a future district network connection. By ensuring the necessary infrastructure is in place and providing a single point of connection within each block (ASHP heat network within each block), will help to facilitate later connection of the development to an area wide district heating network. Although the development does not lie within a District Heat Priority Area (Figure 3) for having potential to develop an area wide heat network, it is still in close proximity to two heat priority areas where an area wide heat network could be being investigated and is also close to other emerging developments that could potentially be connected in the future. The focus area can be seen in Figure 2.

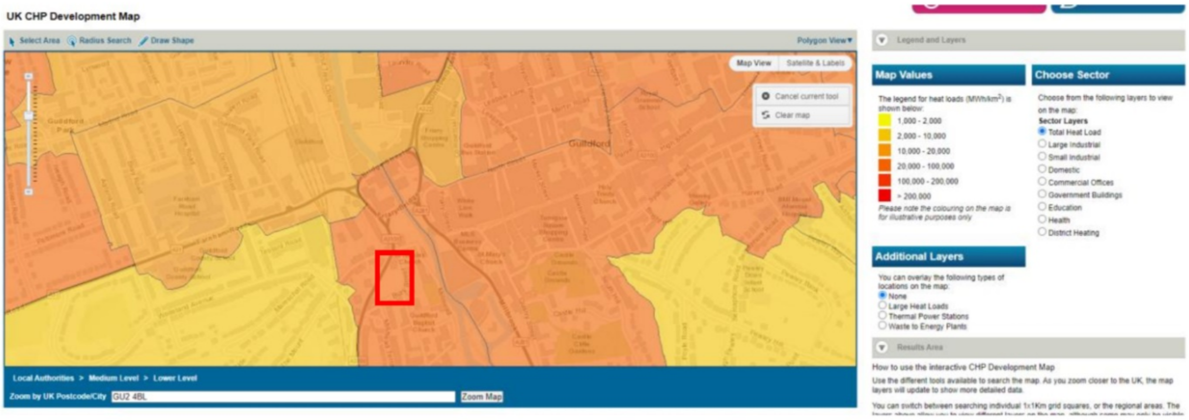

Figure 2: Total heat load.

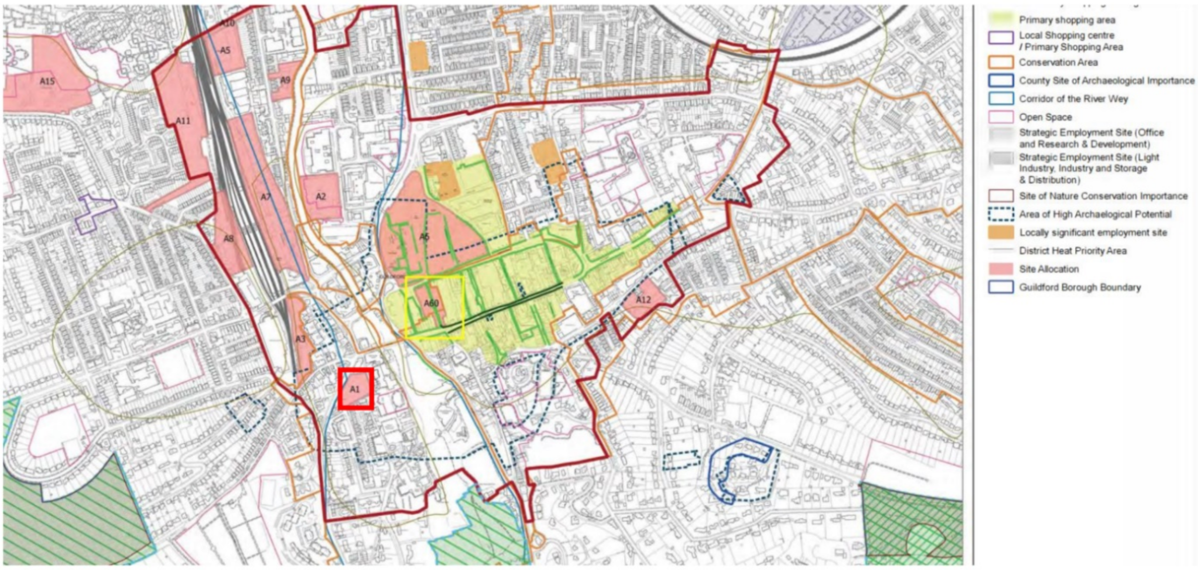

Figure 3: Guildford Town Centre policies.

As a result of a comprehensive research it can be concluded that at this stage no firm plans exist for this particular focus area to confirm the timescale for the potential network. Thus, as there is no heating network in the area to connect to and it is unclear when any potential networks will be completed, the proposed development will not be connected to the district heating network.

D.3 Combined Heat and Power

The installation of a Combined Heat and Power (CHP) unit for the development has also been considered. CHP units can achieve considerable savings in CO_2 emissions when installed and utilised correctly. To maximise the performance of a CHP, long operating hours are required and the heating demand of the development needs to match the power generation. According to the 'rule of thumb' non-residential developments with simultaneous demand for heat and power of less than 5,000hrs/yr are not expected to install on-site CHP. The minimum hours of simultaneous demand for heat and power can be achieved on this project.

However, it has been decided not to implement CHP system. This is due to the fact that Building Regulations are to be revised in the impending revision, where new carbon factors will be introduced. Based on that revised approach gas carbon factor will change from 0.216 $kgCO_2/kWh$ to 0.210 and electricity factor from 0.519 $kgCO_2/kWh$ to 0.233, which means that electrically powered equipment will have a similar or even lower carbon emissions impact when compared to the gas-powered equipment.

CIBSE experts claim that CHP is still the most economic, but it is increasingly falling down on CO_2 emissions, particularly when updated carbon factors for electricity are utilised. The lower carbon factors mean heat pumps only need a coefficient of performance (COP) of 1.1 to have CO_2 emissions lower than a gas system.

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

SECTION E – LOW AND ZERO CARBON TECHNOLOGIES

E.1 Low and Zero Carbon Technologies

This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme.

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

E.1.1 Biomass Boiler – Not Adopted

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

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

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

E.1.2 Biomass CHP – Not Adopted

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

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

E.1.3 Wind Energy – Not Adopted

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

Based on the current design of the development, any roof-mounted wind turbine would need to be located above the highest residential studios. Therefore, only one turbine could be installed on site. This results in very low CO_2 savings. In addition, a roof-mounted wind turbine would have a significant visual impact.

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

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

E.1.4 Photovoltaic Panels – Not Adopted

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

This technology will not be considered for this type of the building.

E.1.5 Solar Thermal Panels – Not Adopted

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

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

Solar thermal arrays would require additional plumbing which is likely to incur additional financial costs and solar PV would likely offer greater CO_2 emission reductions with the same area. Solar thermal technology and PV panels are in direct competition for the same roof space.

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

E.1.6 Ground Source Heat Pumps (GSHP) - Not Adopted

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

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

The site is constrained with little room for a shallow ground source heat pump. Deep bore hole ground source heat pumps require a long-term balance of heating and cooling to avoid a long term altering of the ground temperature and a resulting long-term decline in system efficiency. As the development is predominantly domestic, the demand for heating and cooling are not balanced. Demand for space heating and water heating is predicted to be around order of magnitude higher than demand for cooling.

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

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

E.1.7 Air Source Heat Pumps (ASHP) – Adopted

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However,

instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

Air source heat pumps use fuel efficiently compared to the gas-powered systems and have a relatively low capital cost. Additionally, this type of system is beneficial for this type of development as this technology can provide both space heating and domestic hot water heating.

SECTION F – CONCLUSION

F.1 Conclusion

This report reflects the sustainable design and construction philosophy for the proposed Guildford Plaza development.

This report denotes how the proposed development will achieve compliance with Building Regulations, and National and Local Authority requirements. This has been achieved by following best practice procedures of the Guildford Energy Hierarchy: improved building performance and the use of low or zero carbon technologies.

Based on the robust approach to the energy hierarchy, the development has exceeded the required sustainability and energy targets. The proposed strategy achieves a total 22.7% reduction of the regulated carbon dioxide emissions over Building Regulations 2013 Part L1A, which is above the Guildford planning requirement.

Additionally, the adaptation measures for wider sustainable design and energy efficiency issues have been investigated, including water stress, extreme temperatures and district heating.

In overall, the energy efficiency measures and low carbon technology described above are expected to give 22.7% CO_2 emissions reduction compared to the notional 'base case'.

	Energy demand (kWh/annum)	Saving achieved on baseline energy demand (%)	Regulated CO2 emissions (kg per annum)	Saving achieved on baseline CO2 emissions (%)
Notional Building ("Baseline" energy demand & emissions)	609,369		408,972	
Proposed scheme after energy efficiency and renewable measures	536,244	12	316,135	22.7
Total savings		**12**		**22.7**

Table 8: Table denoting the energy demand and CO_2 emissions for all options.