Sustainability & Energy Statement

Land at South Worple Way, East Sheen

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Executive Summary

This Statement has been prepared in support of a planning application for the construction of five dwellings on land at South Worple Way, East Sheen. The Statement includes an energy demand assessment showing how selected energy efficiency, low carbon and renewable energy measures have been considered and those that have been incorporated into the scheme.

Working drawings have yet to be produced but SAP calculations have been prepared for one of the dwellings, which is proposed as representative of all five. This has been based on the construction specification set out within the report and the detailed planning drawings and the calculations provide an accurate assessment of the carbon dioxide emissions arising from the site and allow the testing of differing technologies.

The site does not have sufficient baseload to efficiency sustain a communal heating system either with or without a combined heat and power unit and therefore neither is proposed.

It is proposed to enhance the fabric insulation standards of the houses above the minimum required by the Building Regulations. In addition it is proposed to install a photovoltaic array of 6.54 kW, which will be comprised of 15 x 450W photovoltaic panels. As a result of the compromised orientation the output of the panels has been discounted to 84% of the maximum. An indicative layout is attached as Appendix 2.

The reductions in emissions can be summarised as follows:

	Total Emissions	**% Reduction**
	kg CO_2 per year	
Baseline (Building Regulations TER)	**10,309**	-
Be Lean - emissions after energy efficiency	9,201	10.75%
Be Clean - emissions after low-carbon technologies	9,201	
Be Green – emissions after renewable technologies	**6,581**	**36.16%**

The houses will also achieve a water efficiency of 105 litres per person per day, which is the requirement set by the London Plan.

The London Borough of Richmond Sustainable Construction Checklist is attached as Appendix 1.

1) Introduction

This report provides a Sustainability and Energy Statement for the construction of one detached 2-bedroom house and a block of four 2-bedroom flats on land at South Worple Way, East Sheen.

The report describes the methodology used in assessing the development and the initiatives proposed.

The houses have been designed and will be constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once cost effective structures have been designed, low-carbon and/or renewable technologies have been considered to provide heat and/or electricity.

The following hierarchy has been followed:

- Lean reduce demand and consumption
- Clean increase energy efficiency
- Green provide low carbon renewable energy sources

2) Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework -

2021 Paragraph 152 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Regional and Local Policies

The Development Plan comprises the London Plan (2021) and the London Borough of Richmond Local Plan (2018).

London Plan, published March 2021 **–** the following policies are relevant to the application:

The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework

for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth. The Plan is part of the statutory development plan for London, meaning that the policies in the Plan should inform decisions on planning applications across the capital. Borough's Local Plans must be in 'general conformity with the London Plan, ensuring that the planning system for London operates in a joined-up way and reflects the overall strategy for how London can develop sustainably, which the London Plan sets out.

Policy SI 2 - Minimising greenhouse gas emissions

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

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

B. *Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*

C. *A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either: 1) through a cash-in-lieu contribution to the borough's carbon offset fund, or 2) off-site provided that an alternative proposal is identified, and delivery is certain.*

D. *Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ringfenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.*

E. *Major development proposals should calculate and minimize carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.*

F. *Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

Policy SI 3 – Energy Infrastructure

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

B. *Energy master plans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy master plans should identify:*

1) Major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2) Heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including opportunities to utilise heat from energy from waste plants
4) Secondary heat sources, including both environmental and waste heat
5) Opportunities for low and ambient temperature heat networks
6) Possible land for energy centres and/or energy storage
7) Possible heating and cooling network routes
8) Opportunities for future-proofing utility infrastructure networks to minimise the impact of road works
9) Infrastructure and land requirements for electricity and gas supplies
10) Implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11) Opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C. *Development Plans should:*

1) Identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2) Identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and interconnecting existing networks as well as establishing new networks.

D. Major development proposals within Heat Network Priority Areas should have a communal lowtemperature heating system:

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a. connect to local existing or planned heat networks
b. use zero-emission or local secondary heat sources (in conjunction with a heat pump, if required)
c. use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d. use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
3) where a heat network is planned but not yet in existence the development should be designed to allow for a cost-effective connection at a later date.

E. Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

GLA Energy Assessment Guidance (June 2022)

London Plan requires each major development proposal to submit a detailed energy assessment based on the GLA guidance.

This guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor as set out in London Plan Policy SI 2. It is for anyone involved, or with an interest, in developing energy assessments, including developers, energy consultants and local government officials. Although primarily aimed at strategic planning applications, London boroughs are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.

Major developments are required to achieve a minimum of 35 per cent on-site carbon reduction over Part L 2021. Residential developments are expected to be able to exceed this, and so an additional benchmark has been set that residential developments should be aiming to achieve. The benchmarks may be updated periodically to include additional building types and to reflect improvements in performance over time.

Building type	Minimum on-site improvement over Part L 2021(per cent)	Benchmark improvement over Part L 2021 (per cent)
Residential	35 per cent	50 per cent+

London Borough of Richmond

The Richmond Core Strategy was replaced in 2018 with the Adopted Local Plan 2018. Policy LP 22 has replaced that of Core Strategy Policy DM SD1. The development complies with the amended and Adopted Local Plan 2018 by achieving the following:

- 35% reduction in CO2 emissions
- Water consumption of less than 110 lites/person/day
- BREEAM Excellent to be achieved
- The proposed improved gas boiler is an ultra-low boiler with NOx emissions of 33mg/kWh

Policy LP 22 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. *Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.*
2. *Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).*
3. *New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.*

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. *All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.*
2. *All other new residential buildings should achieve a 35% reduction.*
3. *All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.*

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. *Be lean: use less energy*
2. *Be clean: supply energy efficiently*
3. *Be green: use renewable energy*

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. *All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.*

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

3) Assessment Methodology

The five dwellings are similar in design and the baseline carbon dioxide emissions for the site have been established by preparing a SAP calculation for one of the houses, which is proposed as representative of all and aggregating the results across all units.

These calculations have been based upon certain assumptions as to the building specification and these are clarified below. These are not design calculations but serve to establish the environmental, technical and economic viability of various renewable and low carbon technologies.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from the Building Regulation Approved Document L.

	kg CO_2/kWh
Natural Gas	0.216
Grid supplied electricity	0.519
Displaced electricity	0.519

In assessing this proposal we have also been informed by the following guidance:

- **BRE Green Guide to Specification**

  The Building Research Establishment Green Guide to Specification lists building materials and components and ranks their potential life cycle environmental impact.

4) Proposal

The proposal is for the construction of four, 2-storey, 2-bedroom flats and one, 2-storey, 2 bedroom house. The accommodation schedule in detail is;

Unit Type	Number	Area
		m^2
2-Bedroom flat	1	61.5
2-Bedroom flat	1	61.5
2-Bedroom flat	1	61.5
2-Bedroom flat	1	61.5
2-Bedroom detached house	1	83.4
Totals		**329.4**

5) Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L - 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. variable speed motors).

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

There is a railway line to the north of the site and consequently the houses have been designed to provide orientations towards the west, south and east with no openings on the northern elevation. They all therefore benefit from access to direct sunlight throughout the day and the benefit of solar gain is maximised.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the building's heating requirements.

Whilst the construction type has not been fixed the houses would suit the use of traditional materials within a load-bearing structure.

The following U-values have been based upon the use of a 350mm cavity wall with 150mm cavity fully filled with Rockwool or similar insulation, ground floors with 150mm PIR insulation under a cement screed and roofs with 500mm of mineral wool.

The performance ratings are set as the minimum requirement under the current Building Regulations Approved Document Part L, 2021;

Element	Value
	W/m^2K
External Walls	**0.18**
All Roofs	**0.11**
Floor	**0.13**

Party Walls	**0.00**
Windows, Roof Lights, Glazed Doors	**1.2**
Opaque Doors	**1.00**
Semi Glazed Doors	**1.2**

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building.

The Building Regulations set a minimum standard for air permeability of 10 m^3 of air per hour per m^2 of envelope area, at 50Pa. The air tightness standards at this site will target an improvement of 60% over Building Regulations and will seek to achieve a permeability of 4.0 $m^3/hr/m^2$ or less.

Thermal Bridging

Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

Accredited Construction Details (ACD's) have been developed (by MHCLG) to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations.

The bridging losses have been calculated using SAP Appendix K Table 1.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F was also revised in 2006 to address the possibility of overheating and poor air quality. It is assumed mechanical extract ventilation will be provided to all WCs, bathrooms and shower rooms.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings. The development will exceed this and all light fittings will be of a dedicated energy efficient type.

External lighting will be fitted with time controls and light sensors to ensure illumination is restricted to required times. External lighting will be limited to a maximum fitting output of 150w.

Heating

Space heating and hot water demand to the houses has been modelled using individual combination gas boilers. These are proposed to be low NOx and will have emissions of less than 40 mg/kWh.

5.2 Establishing Carbon Dioxide Emissions

The four flats are similar in scale and design and a single SAP calculation has been prepared for the house.

The Building Regulation Compliance Report is attached as Appendix 3 but the results from the baseline SAP calculation can be summarised as follows:

	CO_2 TER	CO_2 DER
	kg/m^2/yr	kg/m^2/yr
Space heating	9.95	8.90
Water heating	5.11	4.24
Electricity for pumps and fans	0.36	0.36
Electricity for lighting	2.07	2.11
Total	**17.49**	**15.61**

Using the results calculated above and aggregated them across all five units the total site emissions can be calculated as follows;

	Area	CO_2 TER	CO_2 DER
	m^2	kg/yr	kg/yr
Four 1 bed flats and 1 detached house	329.4	10,309	9,201
Total	**329.4**	**10,309**	**9,201**

The maximum carbon dioxide emissions (based on the TER) are assessed as;

10,309 kg CO2 per year

With the actual carbon dioxide emissions (based upon the DER) assessed as;

9,201 kg CO2 per year

The reduction in site CO2 emissions as a result of the energy efficiency measures incorporated into the building is assessed as;

1,108 kg CO2 per year, which equates to a reduction of 10.75%

5.3 Low Carbon and Renewable Technologies (Be Clean and Be Green)

This section determines the appropriateness of each low-carbon and renewable technology and considers the ability of that technology could assist the development comply with the planning requirements.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at South Worple Way to be 4.6 m/s at 10m above ground level and 5.4 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines. In addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the appearance of the building.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station. The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation.

Consequently CHP can demonstrate significant CO2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

For a CHP plant to be economic it needs to operate for as much of the time as possible (usually deemed to be in excess of 14 hours per day) and therefore the size of the unit are usually based upon the hot water load of the building (s) with additional boilers meeting the peak space heating demand.

Community heating schemes are similarly communal systems but seek to supply heat only without the electricity production. Therefore, unless using a biomass or biofuel a community heating system will not demonstrate significant CO_2 reductions

In order to optimise a combined heat and power system, the site needs is have a suitable minimum baseload. The baseload demand (hot water) for the houses is 11,570 kWh per year, which if using a CHP unit with an output of $15kW_{th}$ would run for 2.11 hours per day.

This is not viable and therefore the use of CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun's energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12º C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

Ground source heat pumps could be used subject to satisfactory ground investigation to establish whether the sub-strata is appropriate.

However, there is insufficient ground area for each unit to accommodate a 'slinky' system and a borehole system would be required to each, which would lead to prohibitive costs.

Consequently the use of ground source heat pumps is not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

The total hot water demand of the houses is **11,570 kWh** per year and assuming panels would reduce demand by 50% the reduction in CO2 emissions would be **1,250 kg CO2** per year, which when combined with energy efficiency measures equates to a total reduction of **22.87%.**

This is insufficient to meet the requirements of the planning policy and additional technologies would be required.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels.

The south orientated roof slope of each house is located on the front elevation and the installation of any panels would detrimentally impact on the aesthetic of the site. Panels could be installed on the west or east orientated roof slope of each house but the maximum output of the panels would need to be discounted to 84% and 82% respectively. Assuming the use of 327W PV panels, to achieve the 35% reduction in emissions required by the planning policy and assuming a discounted output of 84% (panels installed on the west elevation) a total of 20 panels would be required. These could be dispersed as four panels on each of the five houses.

Photovoltaic panels are an appropriate technology and when combined with the energy efficient measures incorporated into the design and specification an array of 20 panels would equate to a total reduction in emissions of **3,728 kg CO2 per year**, which would equate to a reduction of **36.16%.**

This assumes no other technologies are included.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

ASHP tend to have a lower coefficient of performance (CoP) than GSHP and with the emissions factor for electricity being 2.61 times that of gas (emissions factor is the weight of CO2 emitted per kWh) installations with CoPs of less than this figure show little real saving in CO_2 emissions.

The efficiency of ASHPs can be significantly reduced where there is a high hot water demand and therefore their use is not appropriate for the houses.

ASHPs are not proposed.

Other Technologies

New technologies are becoming available, which do not 'fit' into one of the above categories but which need to be considered and are regarded as low-carbon and/or renewable technologies.

Flue-Gas Heat Recovery (FGHR)

One such system is flue-gas heat recovery units. These devices are used in conjunction with gas-fired boilers and recover the heat exhausted through the boiler flue. Their use is appropriate with the heating system proposed for the houses.

A second SAP calculation has been prepared for the modelled house as assessed above but with the benefit of a flue-gas heat recovery system.

The results are summarised as follows;

	Area	CO_2 DER With FGHR	CO_2 DER With FGHR
	m^2	$kg/m^2/yr$	kg/yr
Four 1 bed flats and 1 detached house	329.4	14.82	8,735
Total	**329.4**		**8,735**

The total reduction in emissions is therefore 466 kg CO_2 per year, which when combined with the reduction from the energy efficiency measures incorporated into the houses equates to a total reduction in TER emissions of **15.27%**.

The use of flue-gas heat recovery systems is feasible but additional measures would be required to achieve the planning policy target.

Waste-water Heat Recovery (WWHR)

A further system is waste-water heat recovery systems. These devices recover heat from shower wastes and reuse it to preheat the hot water required in the home. Their use is appropriate with the design of the houses.

A further SAP calculation has been prepared for the modelled house as assessed above but with the benefit of a flue-gas heat recovery system AND waste-water heat recovery system.

The results are summarised as follows;

	Area	CO_2 DER With FGHR AND WWHR	CO_2 DER With FGHR AND WWHR
	m^2	$kg/m^2/yr$	kg/yr
Four 1 bed flats and 1 detached house	329.4	13.72	8,086
Total	**329.4**		**8,086**

The total reduction in emissions is therefore 1,115 kg CO_2 per year, which when combined with the reduction from the energy efficiency measures incorporated into the dwellings equates to a total reduction in TER emissions of 21.56%.

The use of waste-water heat recovery systems is feasible but additional measures would be required to achieve the planning policy target.

5.4 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

The total site maximum carbon dioxide emissions (TER) are calculated as **10,309 kg CO_2 per year** with DER CO_2 emissions of **9,201 kg CO_2 per year.**

The planning policy requires a 35% reduction in the TER emissions.

Various technologies are considered above and whilst wind turbines, combined heat and power, ground source or air source heat pumps are not considered appropriate the use of solar hot water heating panels, photovoltaic panels, flue-gas and waste-water heat recovery systems are considered feasible and appropriate, albeit it is only the use of photovoltaic panels, which could achieve the policy requirements without other technologies.

Be Lean

The construction standards proposed include U-values, which demonstrate good practice and improve upon those required by the Building Regulations. Air tightness standards are targeted at a 60% improvement upon the minimum required by the Building Regulations.

The emissions are reduced from the maximum by **1,108 kg CO_2 per year** as a result of the energy efficiency measures. This equates to a reduction of **10.75%.**

Be Green

In addition it is proposed to install a photovoltaic array of 6.540 kW. This array will be comprised of 15 x 450W photovoltaic panels, which will be dispersed as 11 panels on the block of flats and four panels on the detached hous and will be installed on the south and west orientated elevations respectively. The output of the panels has been discounted to 84% of the maximum to account for the compromised orientation. The panels will reduce carbon dioxide emissions by a total of **2,620 kg CO_2 per year**. The panels will not impact on the aesthetic of the site and an indicative layout of the panels in attached as Appendix 2.

The total reduction in emissions from energy efficiency measures (Be Lean) and renewable technologies (Be Green) is therefore calculated as; 3,728 kg CO_2 per year, which equates to a reduction of 36.16% (% of TER).

6) Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The Environment Agency flood maps show the site is within Flood Zone 1 and therefore of low risk of flooding.

Surface Water Management

Consideration has been given to the use of grey water recycling. However, customer's resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK's water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included in the houses will ensure that the water use target of 105 litres per person per day is achieved.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the houses:

- Water efficient taps.
- Water efficient toilets.
- Low output showers.
- Flow restrictors to manage water pressures to achieve optimum levels.
- Water meters with guidance on water consumption and savings.

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling, although this is largely dependent on the way on which occupants use their homes.

Below is a typical specification, which would achieve the 105 Litres per person per year target.

Schedule of Appliance Water Consumption		
Appliance	Flow rate or capacity	Total Litres
WC	4/2.6 litres dual flush	14.00
Basin	1.7 litres/min.	5.00
Shower	8 litres/min	24.00
Bath	160 litres	25.00
Sink	4 litres/min	15.00
Washing Machine	Default used	17.00
Dishwasher	Default used	5.00
		105.00

7) Materials and Waste

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials will have a zero-ozone depleting potential.

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

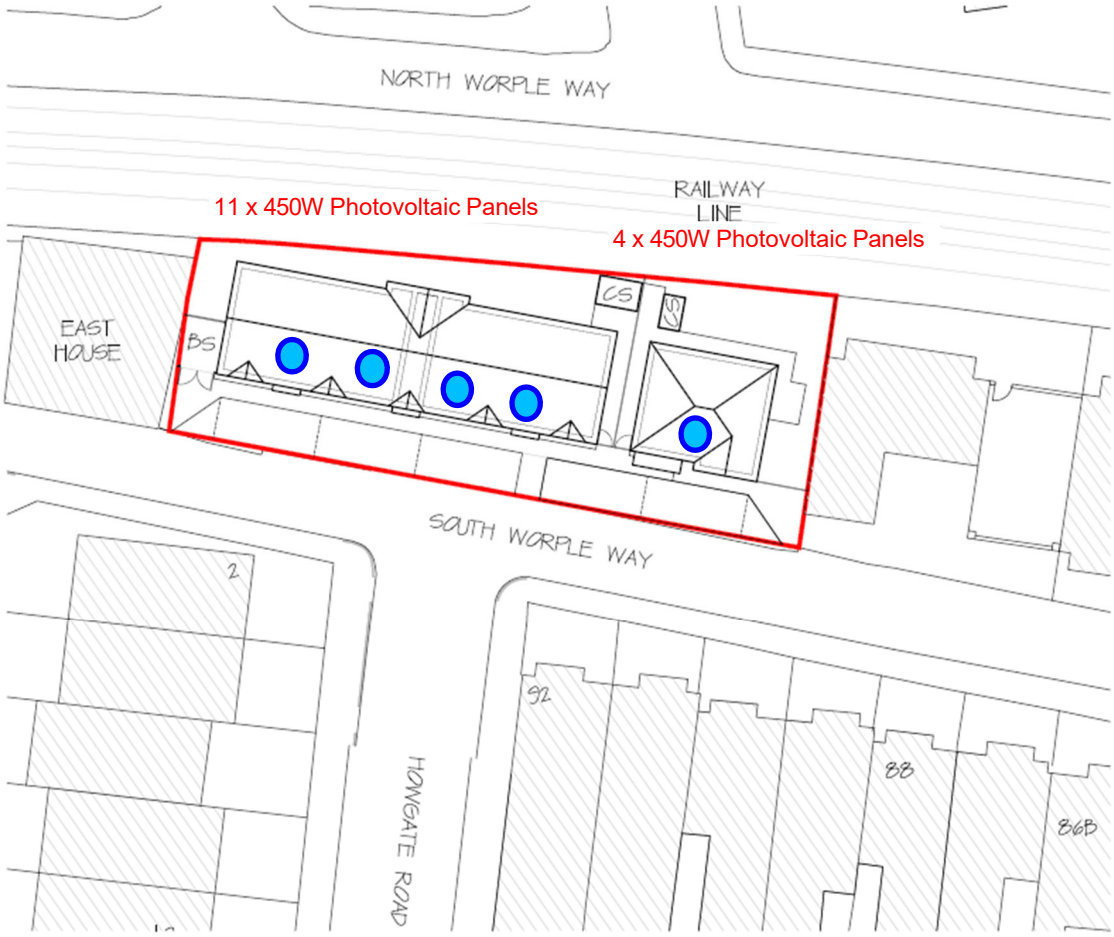
The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage;
- Efficient purchasing arrangements to minimise over ordering;
- Segregation of construction waste to maximise potential for reuse/recycling;
- Suppliers who collect and reuse/recycle packaging materials.

Appendix 1 –Site Layout showing Indicative Location of Photovoltaic Panels



Appendix 3 – Building Regulation Compliance Report

Regulations Compliance Report

Approved Document L1A, 2021 Editon
23 January 2022

Project Information:

Assessed By: ()
Building Type: Detached House

Dwelling Details:

NEW DWELLING DESIGN STAGE
Total Floor Area: 83 m²
Site Reference : South Worple Way, East Sheen
Plot Reference: South Worple 2 Bed DET
Address :

Client Details:

Name:
Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	17.49 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.61 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	55.5 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	44.6 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	**OK**
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	**OK**
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	**OK**
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	**OK**

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system: Database: (rev 397, product index 016661):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Alpha
Model: InTec 34C
Model qualifier:
(Combi)
Efficiency 88.8 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	Time and temperature zone control by device in database	OK
Hot water controls:	No cylinder	
Boiler interlock:	Yes	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: South	2.44m²
Windows facing: South	2.44m²
Windows facing: West	0.63m²
Windows facing: South	0.81m²
Windows facing: West	0.9m²
Windows facing: South	2.7m²
Windows facing: East	1.35m²
Windows facing: South	2.7m²
Windows facing: East	3.78m²
Ventilation rate:	4.00
Blinds/curtains:	None
	Closed 100% of daylight hours

10 Key features

Roofs U-value	0.1 W/m²K
Floors U-value	0.11 W/m²K