Sandycombe Road, Richmond

Energy Statement

Ensphere Group Ltd on behalf of Goldcrest

Ensphere Group Ltd
10 Greycoat Place, London, SW1P 1SB
+44 (0) 20 7960 6126
www.enspheregroup.com

ensphere

ensphere

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Energy Statement

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Contents

1. Executive Summary

1.1 This Energy Statement presents the energy strategy for a proposed scheme at Sandycombe Road, Richmond.

1.2 The proposed scheme includes the redevelopment of the site to provide residential flats with commercial space at ground and part of the first floor.

1.3 Consideration has primarily been given to the planning policy context and other requirements prior to establishing a strategy based upon the Energy Hierarchy; with a priority given to energy reduction and efficiency. Renewable and low carbon technologies have also been considered in the context of their technical feasibility and financial viability.

1.4 The following is therefore proposed:

- High performance building fabric and energy efficient lighting, services and equipment;
- Passive design measures to reduce energy demand for heating, cooling, ventilation and lighting;
- Combined Heat and Power (CHP) to provide the majority of hot water and space heating for the residential apartments.
- Air Source Heat Pump to provide heating to the commercial unit.

1.5 In line with Policy 5.2 of the London Plan and the Council's Sustainable Construction Checklist, an on-site carbon saving of ≥ 35% has been targeted for the entire development relative to Part L 2013 (equivalent to a 40% carbon saving relative to the 2010 version of Part L). The residential component will achieve "zero carbon" through an "Allowable Solution" contribution.

1.6 Overall, the proposed energy strategy is considered consistent with the National Planning Policy Framework and the policies of the GLA and local authority and, when implemented, will provide an efficient and low carbon building.

2. Introduction

2.1 Ensphere Group Ltd was commissioned by Goldcrest to produce an Energy Statement for a proposed development at Sandycombe Road, Richmond.

Site & Surroundings

Site

2.2 The site is located in the north east of Richmond. It is of an approximately triangular shape, roughly level topography and comprises almost entirely of a single building and hardstanding.

Surroundings

2.3 Access to the site is via Sandycombe Road, to the immediate west. A railway line flanks the eastern boundary and a two-storey commercial unit with Planning permission for a mixed use residential/commercial development is located to the immediate north. Lower Richmond Road (A316) is located to the immediate south.

2.4 The majority of the surrounding land uses are residential; however, commercial uses are evident to the southwest, south and southeast of the site. Recreation spaces can be found to the northeast and west.

Proposed Development

2.5 Development proposals include the redevelopment of the site to residential flats with commercial space at ground and part of the first floor.

Report Objective

2.6 The objective of the Energy Statement is to outline how energy efficiency, low carbon and renewable technologies have been considered as part of the energy strategy.

3. Assessment Methodology

Analysis Methodology

3.1 There is a broad consensus that the preferred approach to minimising carbon emissions from buildings is to firstly focus on reducing the demand for energy before reviewing efficient and renewable technology options.

3.2 However, priorities and performance targets can vary at a local level and the report therefore commences with a review of the planning policy and other considerations.

3.3 A site context appraisal is then undertaken to establish the site specific parameters for climatic conditions and available energy infrastructure. The subsequent sections follow the Energy Hierarchy (discussed below) and review the design proposals in relation to passive design and energy efficiency as well as the potential to incorporate low carbon and renewable technology.

Energy Hierarchy

3.4 The tiers of the Energy Hierarchy are:

Energy Hierarchy

1. Be Lean	Reduce Energy Demand
2. Be Clean	Use Energy More Efficiently
3. Be Green	Use Renewable Energy

3.5 The first principle of the Hierarchy is to reduce demand and the need for energy in the first place. Where opportunities to improve the efficiency of the design have been maximised, consideration is then given to the second principle whereby priority is given to the efficient use of energy. This is on the basis that low carbon technologies can be cost-effective and provide significant carbon savings when compared to conventional technologies.

3.6 The third principle of the hierarchy promotes the use of renewable technologies. Whilst these technologies can be relatively expensive to install, they do offer the potential to significantly reduce carbon emissions.

3.7 The summary section of the report presents an overview of the findings and the strategy.

4. Planning Policy Context

4.1 National and local planning policy relevant to sustainable development is considered in detail below:

National Planning Policy Framework

4.2 The Department for Communities and Local Government determines national policies on different aspects of planning and the rules that govern the operation of the system.

4.3 The transition to a low carbon economy is promoted in paragraphs 17, 93 through to 97 of the NPPF.

London Planning Policy Framework

The London Plan as Altered (March 2016)

4.4 The London Plan as Altered is the overall strategic plan for London. Chapter five details *London's Response to Climate Change* and include a number of policies that set the overarching principles for reducing carbon emissions in the built environment, predominant of which is Policy 5.2 which sets specific targets for development as follows:

Policy 5.2 – Minimising Carbon Dioxide Emissions

Planning Decisions

A) Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1) Be lean: use less energy;

2) Be clean: supply energy efficiently;

3) Be green: use renewable energy.

B) The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential Buildings:

Year	Improvement in 2010 Building Regs
2010-2013	25% (Code Level 4)

2013-2016	40%
2016-2031	Zero Carbon

Non-Residential Buildings:

Year	Improvement in 2010 Building Regs
2010-2013	25%
2013-2016	40%
2016-2019	As per building regulations requirements
2019-2031	Zero Carbon

C) Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emission reduction outlined above are to be met within the framework of the energy hierarchy.

D) As a minimum, energy assessments should include the following details:

a) Calculations of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the hierarchy;

b) Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services;

c) Proposals to reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP);

d) Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E) The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.3 – Sustainable Design & Construction

Strategic

A) The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.

Planning Decisions

B) Development proposals should demonstrate that sustainable design standards are integral to the proposals, including its construction and operation, and ensure that they are considered at the beginning of the design process.

C) Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles apply:

a) Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems);

b) Avoiding internal overheating and contributing to the urban heat island effect;

c) Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings;

d) Minimising pollution (including noise, air and urban run-off);

e) Minimising the generation of waste and maximising reuse or recycling;

f) Avoiding impacts from natural hazards (including flooding);

g) Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions;

h) Securing sustainable procurement of materials, using local supplies where feasible; and

i) Promoting and protecting biodiversity and green infrastructure.

D) Within LDFs boroughs should consider the need to develop more detailed policies and proposals based on the sustainable design principles outlined above and those which are outlined in the Mayor's supplementary planning guidance that are specific to their local circumstances.

Policy 5.5 – Decentralised Energy Networks

Strategic

A) The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target, the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

LDF Preparation

B) Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities. As a minimum, boroughs should:

a) Identify and safeguard existing heating and cooling networks;

b) Identify opportunities for expanding existing networks and establishing new networks. Boroughs should use the London Heat Map tool and consider any new developments, planned major infrastructure works and energy supply opportunities which may arise;

c) Develop energy master plans for specific decentralised energy opportunities which identify;

- Major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing);
- Major heat supply plant;
- Possible opportunities to utilise energy from waste;
- Possible heating and cooling network routes;
- Implementation options for delivering feasible projects, considering issues of procurement, finding and risk in the role of the public sector.

d) Require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

Policy 5.6 – Decentralised Energy in Development Proposals

Planning Decisions

A) Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B) Major development proposals should select energy systems in accordance with the following hierarchy:

1) Connection to existing heating or cooling networks;

2) Site wide CHP network;

3) Communal heating and cooling.

C) Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7 – Renewable Energy

Strategic

A) The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning Decisions

B) Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide through the use of on-site renewable energy generation, where feasible.

LDF Preparation

C) Within LDFs boroughs should, and other agencies may wish to develop more detailed policies and proposals to support the development of renewable energy in London – in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.

D) All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

Policy 5.9 – Overheating and Cooling

Strategic

A) The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning Decisions

B) Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this is in accordance with the following cooling hierarchy:

1) Minimise internal heat generation through energy efficient design;

2) Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;

3) Manage the heat within the building through exposed internal thermal mass and high ceilings;

4) Passive ventilation;

5) Mechanical ventilation;

6) Active cooling.

C) Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

LDF Preparations

D) Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.

Local Planning Policy Framework

4.5 The relevant planning authority is London Borough of Richmond upon Thames and planning policy for the area is detailed in a number of statutory documents.

Core Strategy (April 2009)

4.6 The London Borough of Richmond upon Thames Core Strategy is the key planning policy document of the local plan and was adopted in April 2009. The Core Strategy sets out the Council's vision and its guiding principles for planning in Richmond.

Policy CP2 Reducing Carbon Emissions

2.A The Borough will reduce its carbon dioxide emissions by requiring measures that minimise energy consumption in new development and promoting these measures in existing development, particularly in its own buildings.

2.B The Council will require the evaluation, development and use of decentralised energy in appropriate development.

2.C The Council will increase the use of renewable energy by requiring all new development to achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible, and by promoting its use in existing development.

Policy CP3 Climate Change – Adapting to the Effects [extract]

3.A Development will need to be designed to take account of the impacts of climate change over its lifetime, including:

[…]

- The need for summer cooling;

[…]

4.7 It is noted that the text beneath Policy CP2 and under the heading "Justification", regular reference is made to Combined Heat and Power (CHP), implying that the 20% target incorporates both low and zero carbon technologies.

Development Management Plan (November 2011)

4.8 The Development Management Plan (DMP) takes forward the Core Strategy's three inter-related themes of "A Sustainable Future", "Protecting Local Character" and "Meeting People's Needs" with more detailed policies for the control of development.

4.9 Policies considered pertinent to this report include:

Policy DM SD1 Sustainable Construction [extract]

All development in terms of materials, landscaping, standard of construction and operation should include measures capable of mitigating and adapting to climate change to meet future needs.

[…]

They also must achieve a minimum 25 per cent reduction in carbon dioxide emissions over Building Regulations (2010) in line with best practice from 2010 to 2013, 40 per cent improvement from 2013 to 2016, and “zero carbon” standards from 2016. It is expected that efficiency measures will be prioritised as a means towards meeting these targets. These requirements may be adjusted in future years to take into account the then prevailing standards and any other national guidance to ensure the standards are met or exceeded.

[…]

Policy DM SD2 Renewable Energy and Decentralised Energy Networks

New development will be required to conform with the Sustainable Construction Checklist SPD and:

a) Maximise opportunities for the micro-generation of renewable energy. Some form of low carbon renewable and / or decentralised energy will be expected in all new development; and

b) Developments of 1 dwelling unit or more, or 100sqm of non-residential floor space or more will be required to reduce their total carbon dioxide emissions by following a hierarchy that first requires an efficient design to minimise the amount of energy used, secondly by using low carbon technologies and finally, where feasible and viable, including a contribution from renewable sources.

c) Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where there is no over-riding adverse local impact.

d) All new development will be required to connect to existing or planned decentralised energy networks where one exists. In all major developments and large Proposals Sites identified in the (forthcoming) Site Allocations DPD, provision should be made for future connection to a local energy network should one become available.

Policy DM SD4 Adapting to Higher Temperatures and Need for Cooling

All new developments, in their layout, design, construction, materials, landscaping and operation, are required to take into account and adapt to higher temperatures, avoid and mitigate overheating and excessive heat generation to counteract the urban heat island effect, and meet the need for cooling.

All new development proposals should reduce reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. Minimise internal heat generation through energy efficient design;
2. Reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Passive ventilation;
5. Mechanical ventilation;
6. Active cooling systems (ensuring they are the lowest carbon options).

Opportunities to adapt existing buildings, places and spaces to manage higher temperatures should be maximised and will be supported.

5. Other Policy & Regulatory Considerations

5.1 This section comprises an overview of other considerations relevant to the Energy Statement.

Building Regulations

Update 2013 (Part L Conservation of Fuel & Power)

5.2 The Department for Communities and Local Government announced on 30 July 2013 that the update to Part L would include a further 6% carbon reduction for residential from 6 April 2014 and a further 9% reduction for non-residential.

National Planning Practice Guidance

Climate Change

5.3 Advises how planning can identify suitable mitigation and adaption measures in plan-making and the application process to address the potential for climate change.

Renewable and Low Carbon Energy

5.4 The guidance is intended to assist local councils in developing policies for renewable energy in local plans, and identifies the planning considerations for a range of renewable sources.

London Planning Practice Guidance

Sustainable Design and Construction Supplementary Planning Guidance (April 2014)

5.5 The Mayor has published supplementary planning guidance on Sustainable Design and Construction. The document provides guidance on the implementation of London Plan policy 5.3 as well as a range of policies, primarily in Chapters 5 and 7 that deal with matters relating to environmental sustainability.

Energy Planning Guidance (March 2016)

5.6 Policy 5.2 of the London Plan requires each major development proposal to submit a detailed energy assessment. The GLA provides guidance to developers and their advisors on preparing energy assessments to accompany strategic planning applications. With regards to the carbon reduction targets detailed in policy 5.2 of the London Plan, the mayor will apply a 35 per cent target beyond Part L 2013 of the Building Regulations. This is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010.

Local Planning Practice Guidance

Sustainable Construction Checklist Guidance Document (August 2011)

5.7 The Sustainable Construction Checklist SPD forms part of the assessment for planning applications for new build, conversion and retrofit properties within the London Borough of Richmond upon Thames. The Checklist includes consideration of Energy Use & Pollution.

6. Site Context Appraisal

6.1 Local climatic conditions, natural resources and energy infrastructure are addressed within this section.

Local Climate

6.2 An assessment of the local climate and natural resources has been compiled from Met Office, Department of Energy and Climate Change and British Geological Survey data. Consideration has been given to the data for Kew Gardens as the nearest climate station to the site.

Table 6.1 Averages Table (Climate Period 1981-2010)

Month	Max temp (ºC)	Min temp (ºC)	Days of air frost (days)	Sunshine (hours)	Rainfall (mm)	Days of rainfall ≥1mm (days)	Monthly mean wind speed at 10m (knots)
January	8.2	1.8	9.7	59.8	57.2	11.6	6.3
February	8.7	1.7	10	79.9	41.9	9	6.3
March	11.6	3.4	5.2	118.2	42.8	10	6.1
April	14.4	4.7	2.5	173.3	45.3	9.1	6.1
May	18	7.9	0.3	205.3	48.8	9	5.5
June	21	10.8	0	203.6	49.3	8.5	5.3
July	23.5	13	0	218.4	46.8	7.7	6
August	23.2	12.7	0	211.1	51.2	8.1	4.6
September	20	10.3	0.1	146.4	52.2	8.5	4.4
October	15.8	7.4	1.2	117.2	69.7	10.7	4.5
November	11.3	4.1	5.6	70.6	60.6	11.1	4.9
December	8.5	2.1	10.1	49.6	56.6	10.6	5.2
Annual	**15.4**	**6.7**	**44.8**	**1653.3**	**622.5**	**113.7**	**5.4**

Microclimate

6.3 The term “microclimate” refers to the climatic conditions at a certain area, which may differ from the surroundings. In the context of sustainability in urban developments, the interest lies at the microclimate within the development site and immediate surroundings as this will have an impact on the actual energy performance of the buildings, the potential for renewables exploitation, indoor/outdoor comfort and safety conditions for occupants and the public.

6.4 Given the complex interrelationship between building configuration and microclimatic variables (e.g. air temperature, humidity, wind speed/direction, solar radiation), the microclimatic analysis requires advanced modelling techniques and computational simulations which fall out of the scope of the standard approach towards the formulation of an overarching energy strategy.

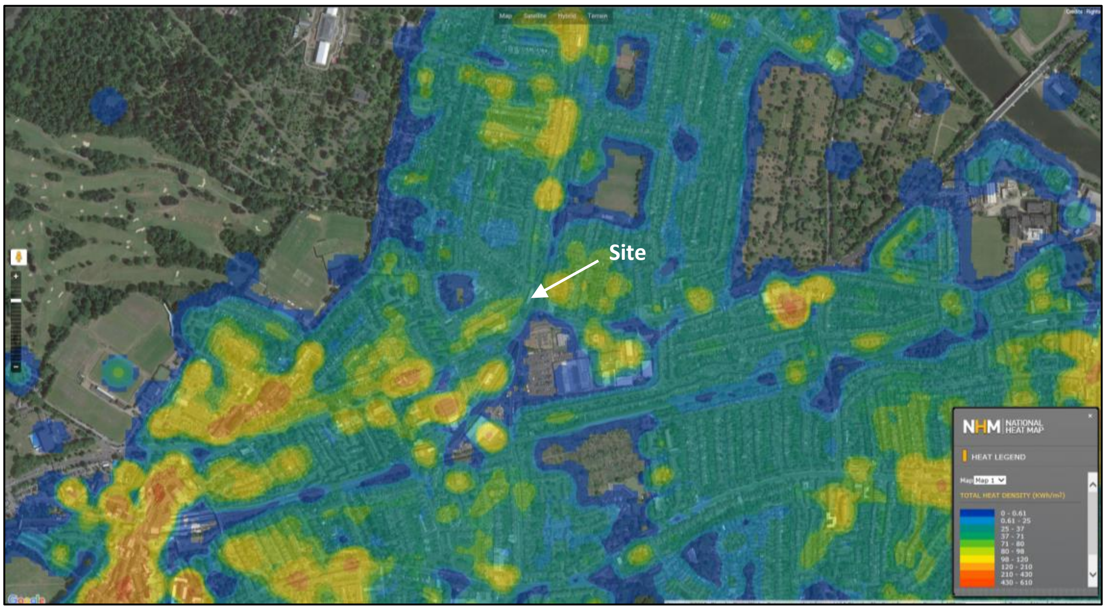
6.5 As a general trend, it can be expected that the air temperatures will be higher than assumed for the standard energy performance calculations (in line with National Calculation Methodology), as a result of the Urban Heat Island (UHI) effect; and solar radiation intensity (W/m^2) will present variations depending on elevation orientation. The wind profile will be substantially variant and altered within the dense urban context, with characteristically higher turbulence.

District Network Opportunities: The National & London Heat Maps

The National Heat Map

6.6 The National Heat Map has been reviewed to identify opportunities for connection to an existing district energy network. The purpose of the National Heat Map, which was commissioned by the Department of Energy and Climate Change and created by CSE, is to support the planning and deployment of local low-carbon energy projects in England.

Figure 6.2 The Site as Represented on The National Heat Map



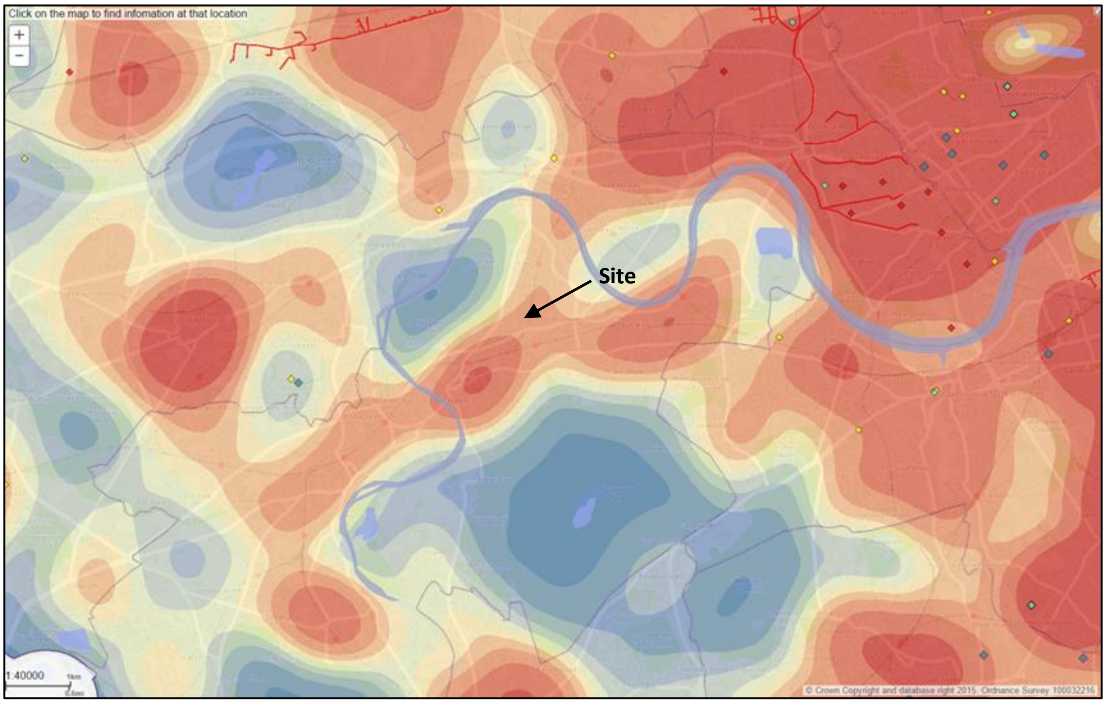
6.7 The above extract from The National Heat Map shows the site located in an area of relatively modest heat density.

London Heat Map

6.8 The London Heat Map is a tool provided by the Mayor of London to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

6.9 The image below illustrates the London Heat Map in the vicinity of the application site. It shows that the proposed scheme is located in an area with a higher heat density; although not within an opportunity area (opportunity area designated in purple).

Figure 6.3 Extract from the London Heat Map



6.10 The above extract from The London Heat Map shows the site located in an area identified as having an annual heating fuel use of between 87kWh/yr and 115kWh/yr. No major energy supply plant, existing district energy networks or proposed energy works are identified in the vicinity of the site.

7. Passive Design & Energy Efficiency

7.1 This section considers features of the proposed design relevant to passive energy savings and energy efficiencies.

Passive Design

Solar Gains & Daylight

7.2 The site is located in a relatively dense urban environment. In this context and the associated limitations imposed on the shape and layout of the buildings due to site constraints, the benefits from passive design measures can be limited. However, it is intended to incorporate good practice measures where feasible.

7.3 The design of the glazed areas shall seek to offer good access to natural daylight to reduce consumption of energy for artificial lighting. Overall, a balance shall be sought between achieving daylighting levels and winter solar gains, whilst minimising summer heat gains and cooling loads.

Energy Efficiency

7.4 Much of the fabric design will be undertaken at the detailed design stage; however, the following provides an indication as to the anticipated approach.

Heat Transfer Coefficients

7.5 Heat Transfer Coefficients, otherwise referred to as U-Values, are a measure of the rate of heat transfer through a building element over a given area, under standardised conditions (i.e. the rate at which heat is lost or gained through a fabric).

7.6 It is intended that the performance of the building fabric will incorporate relatively low U-Values to reduce the rate at which the buildings lose heat, preserving the heat within the space and reducing the requirement for mechanical heating.

7.7 The following U-values are provided as a guide for the basic building elements:

- External Walls ≤0.18W/m²K;
- Roof ≤0.14W/m²K;
- Ground Floor ≤0.18W/m²K;
- Windows ≤1.30W/m²K.

Air Leakage

7.8 A high level of air tightness is proposed and a level below $5m^3/h/m^2$ is targeted, meaning that air infiltration between the internal and the external environment will be largely controlled and space heating demand further reduced.

Thermal Mass

7.9 Thermal mass is the ability of the fabric of a building to absorb heat, store it, and at a later time release it. Similar to the Heat Transfer Coefficients, this is a detail that will be considered more fully as the design progresses.

7.10 Nevertheless, it is recognised that thermal mass has the potential to capture and release energy and help regulate requirements throughout the day. Typically, a higher thermal mass helps reduce the cooling requirements for buildings in the UK during summer months.

7.11 To maximise the benefits, consideration will be given to the specific climate and daytime occupation; particularly during winter months where the addition of thermal mass can increase winter heating. Furthermore, the removal of heat during summer months (e.g. night-time ventilation) is key to gains by having mass and the approach is not necessarily suited to buildings with 24 hour occupancy.

7.12 As a rule of thumb, the best place for thermal mass is inside the insulated building envelope and a better insulated envelope will mean more effective thermal mass. Furthermore, thermal mass should be left exposed internally to allow it to interact with the house interior.

Thermal Bridging

7.13 Thermal bridging is the penetration of the insulation layer by a highly conductive non-insulating material allowing rapid heat transfer from an interior to exterior environment (and vice versa). In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges.

7.14 The building fabric shall be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements and it is proposed that construction joint details are calculated by a person with suitable expertise and experience. For the purposes of the proposed scheme, Y-values better than 0.08 W/m^2K shall be targeted where feasible.

Service Energy Efficiency

Building Services Equipment

7.15 The specific fan power of the centralised air supply systems shall be highly efficient and local extract fans shall have a specific fan power below 0.3W/l/s.

7.16 The air-conditioning system components shall have seasonal efficiencies within the upper spectrum of the range currently available on the market; heat recovery shall be employed in conjunction with centralised fresh air supply systems.

Metering

7.17 The major energy uses shall me monitored via separate energy meters and a Building Energy Management System (BEMS) will be installed, which will allow for optimum operational control and performance of complex building services in the development.

Lighting

7.18 At this stage, detailed lighting design calculations have not yet been undertaken, but lighting design is intended to be highly efficient and in excess of Building Standards requirements. In the domestic components it is intended that lighting efficacy shall be in excess of 60lumens/circuit Watt; in the non-domestic building parts a lighting efficacy above 70lumens/circuit Watt shall be targeted.

7.19 Lighting controls (e.g. PIR occupancy sensors) shall be employed throughout the non-residential components and zoned to suit the different space uses; the lighting control strategy shall work in conjunction with daylighting sensors in spaces with substantial glazing, to further reduce the energy consumption for artificial lighting.

7.20 External lighting shall be highly efficient and employ controls to avoid energy wastage from unnecessary operation during daytime.

Space Heating Control Systems

7.21 Advanced individual space heating controls shall be employed as appropriate for each space. The charging system will be linked to use; providing incentives to the occupants to efficiently manage consumption.

Domestic Appliances

7.22 Within the residential apartments, domestic appliances such as fridges, freezers and domestic dishwashers shall be specified in consideration of their energy performance; the EU energy label of these appliances shall be A+ or greater.

Overheating Mitigation

7.23 The issue of overheating will need detailed and considered assessment at a later stage of design on the basis that, as buildings become progressively better sealed and insulated, the potential for overheating increases.

7.24 Overheating can be caused by:

- External Heat Gains – e.g. sun shining through the windows;

- Internal Heat Gains – e.g. occupant activity, building services, inadequate ventilation, lighting and appliances;
- Construction Type & Layout – e.g. increased gains with lighter weight construction.
- Site Location – e.g. the ventilation strategy may be inhibited by other factors; such as reliance on openable windows in areas with noise / security concerns;
- Landscaping – e.g. if external surroundings are predominantly hard surfaces, the air available for ventilation may already be warm before it enters the property;
- Urban Heat Island – e.g. increased external temperatures due to thermal mass releasing heat during the night and the widespread use of refrigeration / cooling equipment.
- Orientation – e.g. certain orientations, especially west-facing homes, are difficult to protect against solar gain.

Limiting Summer External Gains

7.25 Solar control glazing shall be installed to the elevations most affected; the precise specification of glazing types for windows and glazed curtain walling is to be based upon further analysis at later stages so that the appropriate balance is found between limiting summer heat gains without compromising daylight harvesting and winter solar gains.

7.26 Thermal mass (discussed above) and internal occupant-controlled shading elements will be considered at the more detailed design stage along with heat reflective finishes of the external building surfaces.

7.27 The above shall be considered in conjunction and interrelationship with the ventilation strategy, to ensure thermal comfort for occupants and energy savings.

Limiting Internal Heat Gains

7.28 Heat losses from the Hot Water and Low Temperature Hot Water (LTHW) distribution network are considered to be a significant source of potential overheating in well insulated buildings. This issue can be a significant factor affecting comfort and will therefore need full consideration during the detailed design of the mechanical systems.

7.29 However, it is expected that attention will be given to:

- The positioning of the distribution network and its potential impact on surrounding spaces;
- The (mechanical) ventilation of spaces where heating pipework is distributed (e.g. corridors);
- The implementation of combined passive/active ventilation systems for air exhaust of spaces into corridors and to the outside;

- Maximising the natural ventilation potential of spaces;
- The performance of the insulation, with calculations undertaken assessing heat losses from the pipework relative to the heat losses from the spaces.

8. District Energy Appraisal

District Energy

8.1 District energy refers to the distribution of heat (normally as steam or hot water) and/or chilled water from a central energy centre to individual buildings to be used for space heating, domestic hot water and air conditioning. Energy is distributed via a network of pre-insulated pipework and the end-users connect to it via heat exchangers; networks can supply only heat ("district heating"), cool water ("district cooling") or both ("district heating and cooling").

8.2 The term "district energy" applies to the energy distribution network, rather than the origins of the energy, which is normally either:

1. Waste heat from power generation plants or other industrial processes;
2. Waste heat from CHP plants;
3. Conventional centralised systems (boilers).

8.3 The extent of any carbon savings will be largely determined by the energy source.

Table 8.1 District Energy Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists, which could be satisfied by a district energy system;
Limitations	• No district heating network is currently operational in the vicinity of the site;
Appraisal 	• Whilst technically feasible, the absence of district heating networks in the immediate vicinity of the site renders this option unfeasible in the short term;

9. Low Carbon Technologies Appraisal

9.1 Low carbon technologies are energy generation systems which offer the capability to make more efficient and effective use of primary energy resources, emitting significantly lower levels of carbon dioxide than conventional energy generation methods.

Combined Heat & Power (CHP)

9.2 Combined Heat & Power (CHP) systems generate electrical energy and provide the waste heat from the process to be used on site. They are typically gas-powered but can be run off alternative fuel sources. CHP is a highly efficient means to supply heat in developments, providing significant carbon savings and wider environmental benefits (the power generation is much less resource intensive and carbon emitting compared to grid electricity from the average UK power station).

9.3 Good practice CHP system design follows that engines are best sized to meet the base heating demand of a development. System sizing in response to the base load allows the CHP engine to run for the whole year without significant modulation, preventing engine wear, reduced life expectancy and efficiency drop.

Table 9.1 CHP Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists on site which the CHP system could supply; • A base load exists for hot water generation for the residential elements of the proposal.
Limitations	• The space heating demand presents a variable daily, weekly and seasonal trend; this potentially introduces design complexity and viability implications for the technology;
Appraisal 	• CHP is considered a potentially feasible and viable technology for the site; particularly if applied to the residential part and used in combination with backup gas-fired conventional boilers.

10. Renewable Technology Appraisal

10.1 Renewable technologies are those which take their energy from sources which are considered to be inexhaustible (e.g. sunlight, wind etc.). Emissions associated with renewables are generally considered to be negligible and the technologies are frequently referred to as "zero carbon".

Biomass Systems

10.2 Biomass systems are heating systems that use agricultural, forest, urban and industrial residues and waste to produce heat and (depending on the system) electricity. At the building scale, biomass boilers using wood pellets or woodchips are the norm. Biomass should be sourced locally to limit "embodied carbon" associated with transport and ideally be derived from waste wood products to limit the take-up of agricultural land for fuel crops.

Table 10.1 Biomass Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists, which the biomass system could supply;
Limitations	• The site is located in an urban environment and away from a readily available and diverse supply of biomass; • Transport, storage and maintenance requirements, would increase the managerial requirements of operation; and • Carbon emissions associated with cultivation, processing and transport of biomass are not normally considered in the context of planning or Building Regulations meaning that total carbon emissions are likely to be significantly higher than estimated.
Appraisal 	• Whilst technically feasible, the absence of a readily available and diverse local fuel source creates risk associated with security of fuel supply. This has implications for operational viability; • Biomass is therefore not a preferred technology for the scheme.

Heat Pumps

10.3 Heat pumps draw thermal energy from the air, water or ground ("source") and upgrade it to be used as useful heat at another location ("sink"). Heat pumps require electricity to operate (or gas in the case of Gas Absorption Heat Pumps) as mechanical input is required to convert harvested energy to useful heat and complete its transport to the "sink".

10.4 Heat pumps are generally considered as renewable (despite an electrical or gas requirement) because the source of the heat is the ambient temperature in the exterior environment, which is ultimately heated via the sun.

10.5 Reversible systems can provide air conditioning comfort cooling; however, when in cooling mode, the system is not considered renewable as it is not taking advantage of a renewable source of energy.

Table 10.2 Air Source Heat Pump Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists, which ASHPs could accommodate;
Limitations	• The performance of ASHPs typically varies more than other heat pump options due to greater fluctuations in air temperatures, relative to other heat sources; • Performance reduces when systems are required to achieve higher temperatures. Heat pumps are therefore normally better applied to space heating rather than hot water and specifically to low supply temperature systems (e.g. underfloor heating); • All heat pumps generate noise associated with the movement of refrigerant and (any) fans; • Whilst less expensive than other heat pump systems, relative to other technologies, capital and maintenance costs are high;

Appraisal 	• Air source heat pumps are considered a suitable technology for certain non-residential spaces, but will only be applied in a limited capacity.

Table 10.3 Ground Source Heat Pump Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists, which GSHPs could accommodate;
Limitations	• Site constraints and shading render a horizontal configuration non-feasible; • Capital costs for vertical installations are typically greater than for horizontal systems due to drilling costs; • Thermal properties of the ground will depend upon a number of factors including geology and depth. Desktop information suggests that thermal properties are below average and therefore deeper boreholes would likely be required; • Performance reduces when systems are required to achieve higher temperatures. Heat pumps are therefore normally better applied to space heating rather than hot water and specifically to low supply temperature systems (e.g. underfloor heating);
Appraisal 	• Installed vertically, a GSHP system would be technically feasible for supplying heat to part of the development; • However, uncertainties exist with regards to the thermal properties of the ground and performance; • GSHPs are not proposed; principally for financial viability reasons and on the basis that it would represent a relatively expensive means of reducing carbon.

Table 10.4 Water Source Heat Pump Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists, which WSHPs could accommodate;
Limitations	• There is no suitable surface water body available in the vicinity of the site and site constraints render the development of appropriate water basins non feasible;
Appraisal 	• WSHP is not considered an option for the site; primarily for technical feasibility considerations.

Micro Hydro Power

10.6 Micro hydro power systems harnesses energy from flowing water by using height differences (called "head"); the minimum allowable head is 1.5m and ideally not lower than 10m.

Table 10.5 Micro Hydro Power Appraisal

Criteria	
Opportunities	• A sufficient electricity demand exists, which micro hydro power could address.
Limitations	• No suitable water body is found in the vicinity of the site.
Appraisal 	• Micro hydro is therefore not considered an option for the site, for technical feasibility reasons.

Micro Wind Power

10.7 Wind turbines are used to generate electricity; with power production determined by the rotation of the blades and being proportionate to the speed of their rotation. The technology is most efficient for constant, low turbulence wind profiles.

Table 10.6 Micro Wind Power Appraisal

Criteria	
Opportunities	• A sufficient electricity demand exists, which micro wind power could contribute towards;
Limitations	• Due to the urban environment, the wind profile is expected to be highly turbulent, reducing the efficiency of the system; • The average wind speed is low and falls within the lower range for a viability case; • Roof mounted turbines would add height to the buildings with associated aesthetic and planning considerations; and • Moving plant on the roof potentially creates noise and vibration, with associated nuisance and structural considerations.
Appraisal 	• Whilst wind turbines are considered technically feasible in a limited capacity, wind speeds are relatively low and subject to turbulence. The technology is therefore likely to underperform; • On-site & real-time wind speed measurements for at least a year would be required prior to establishing a case for this technology (recommended should the end users wish to investigate further); • Given the uncertainty over performance, the fact that any contribution will likely be quite minor, micro wind turbines are not proposed for the development.

Solar Systems

10.8 Both solar thermal and photovoltaic (PV) systems convert energy from the sun into a form which can be applied within the building. Solar thermal generates energy for heating (usually for hot water) and PV generates electricity. Hybrid photovoltaic / solar thermal collectors are also available and co-generate heat and power.

10.9 To maximise the performance from the technology, the solar collectors should be pointed towards the sun; which in the UK is maximised when orientated to the south and at an angle of 30º.

Table 10.7 PV Panels Appraisal

Criteria	
Opportunities	• A sufficient electricity demand exists; which PV could partially address; • An extent of roof space exists on the site, which is not subject to significant overshading.
Limitations	• The area of roof space will limit the potential application of the technology; • The technology tends to have a high capital cost per unit of carbon saved.
Appraisal 	• The high capital costs compared to anticipated savings render this option financially unviable; • The limited availability of suitable roof space would mean that PV would not be able to satisfy the carbon reduction target in isolation and would need to be combined with other LZC technologies. • PV panels are therefore not a preferred option for the energy strategy

Table 10.8 PV-T Panels Appraisal

Criteria	
Opportunities	• A sufficient electricity and heating demand exists; which

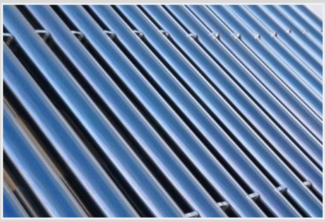
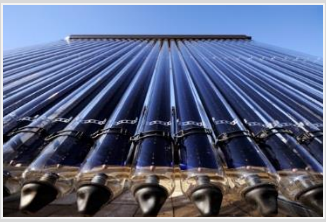
	PV-T could partially address; • An extent of roof space exists on the site, which is flat and not subject to significant overshading.
Limitations	• The technology tends to have a high capital cost per unit of carbon saved; • Potential carbon savings are jeopardised by auxiliary power needed to move the heat around the development; • Heating energy generation presents high seasonal variance and has therefore limited scope in efficiently supplying the base heating load (hot water); • The system would be conflicting with the preferred technology
Appraisal 	• Whilst technically feasible in a limited capacity, the potential maximum application of the technology is unlikely to provide significant carbon dioxide reductions for the development; • This technology would conflict with other preferred LZC technologies; • The high capital costs compared to anticipated savings render this option financially unviable; • The limited availability of suitable roof space would mean that PV-T would not be able to satisfy the carbon reduction target in isolation and would need to be combined with other LZC technologies. • PV-T panels are therefore not a preferred option for the energy strategy.

Table 10.9 Solar Thermal Panels Appraisal

Criteria	
Opportunities	• A sufficient heating demand exists; which Solar Thermal could partially address;

	• An extent of roof space exists on the site, which is flat and not subject to significant overshading.
Limitations	• The technology tends to have a high capital cost per unit of carbon saved; • Potential carbon savings are jeopardised by auxiliary power needed to move the heat around the development; • Heating energy generation presents high seasonal variance and has therefore limited scope in efficiently supplying the base heating load (hot water); • The system would be conflicting with the preferred technology.
Appraisal 	• Whilst technically feasible in a limited capacity, the potential maximum application of the technology is unlikely to provide significant carbon dioxide reductions for the development; • This technology would conflict with other preferred LZC technologies; • The high capital costs compared to anticipated savings render this option financially unviable; • Solar Thermal panels are therefore not a preferred option for the energy strategy.

11. Summary

11.1 This Energy Statement provides an overview of the energy strategy in consideration of the site context, anticipated energy requirements and local priorities and initiatives.

11.2 A review of the London Borough of Richmond upon Thames' planning policy has identified a number of requirements relating to energy. Of these, Core Strategy policies CP2 (*Reducing Carbon Emissions*) and CP3 (*Climate Change – Adapting to the Effects*) are considered of greatest pertinence along with Development Management Plan policies DM SD1 (*Sustainable Construction*), DM SD2 (*Renewable Energy and Decentralised Energy Networks*) and DM SD4 (*Adapting to Higher Temperatures and Need for Cooling*). Consideration has also been given to national and London policies as well as Richmond's Sustainable Construction Checklist.

11.3 The approach follows the Energy Hierarchy, with priority given to efficient design on the basis that it is preferable to reduce carbon emissions by reducing energy demand.

11.4 Section 7 highlights some of the proposed energy efficiency measures; and the feasibility study detailed in Sections 8, 9 and 10 identified Combined Heat and Power (CHP) as the preferred low carbon technology option.

11.5 The CHP central plant shall be used to supply the majority of the base hot water load and a similar proportion of the space heating requirement in the residential part. The system would be centralised and operate in parallel with an efficient and conventional back-up gas-fired boiler(s). This system is compatible with any future district energy network.

11.6 A reversible ASHP technology shall be used in a limited capacity and in spaces where mechanical cooling would be expected (e.g. commercial units).

Carbon Savings

11.7 Energy modelling has been undertaken and a sample of five residential units has been modelled using SAP; the commercial space has been modelled using SBEM. It is proposed to reduce carbon emissions on site by >35% relative to Part L 2013. The residential component of the development will satisfy the London Plan Policy 5.2 “zero carbon” requirement through the use of “Allowable Solutions”.

11.8 The following tables present the key findings:

Table 11.1 Indicative SAP & SBEM Results

Unit	Location	Area (m^2)	TER ($kgCO_2/m^2$)	DER/BER ($kgCO_2/m^2$)	Reduction (%)
1	Mid-floor/end	77.75	16.93	10.45	38.28%
7	Mid-floor/mid	67.98	15.90	9.50	40.25%
11	Mid-floor/end	73.97	15.89	9.57	39.77%
16	Mid-floor/mid	50.35	18.86	11.68	38.07%
17	Top-floor/end	63.42	18.08	11.61	35.79%
Commercial	Ground/First	534.32	21.00	13.50	35.71%

Table 11.2 Residential Carbon Emissions

Parameter	Value
Area Weighted Residential TER (based on sample of 5)	17.00$kgCO_2/m^2/yr$
Area Weighted target DER (including 35% reduction)	11.05$kgCO_2/m^2/yr$
Total Residential Area	1,253.40m^2
Total Residential Emissions (including 35% reduction)	13,850$kgCO_2/yr$

Table 11.3 Commercial Carbon Emissions

Parameter	Value
Commercial TER	21.00$kgCO_2/m^2/yr$
Target BER (including 35% reduction)	13.65$kgCO_2/m^2/yr$
Total Residential Area	534.32m^2
Total Commercial Emissions (including 35% reduction)	7,293$kgCO_2/yr$

Allowable Solutions

11.9 In line with London Plan Policy 5.2 and supporting GLA guidance, Allowable Solutions apply to the residential component only and are calculated on the basis of £60/tonne over a 30-year period.

Allowable Solutions Calculation

13.85 tonnes x £60 x 30 years = £24,930

11.10 Therefore, and subject to viability, a contribution of £24,930 may be required in response to the policy targets.

11.11 Overall, the proposed energy strategy is considered consistent with the National Planning Policy Framework and policies of the GLA and Council and, when implemented, will provide an efficient and low carbon development.

Appendix A Site Plans

ensphere

Scale 1:1250

0 25000 50000 75000 100000 125000

This line measures 100mm when this drawing is printed @ A3

IF IN DOUBT ASK.
Dimension to be verified on Site.

Rev	Date	Revision Description

Project: 1-9 Sandycombe Rd TW9 2EP

Scale: 1 : 1250@A3

Drawing Title: LocationPlan

Date: NOV 2016

Drawing #: P03 001

Status: Planning

GOLDCREST architects

3 Hurlingham Business Park
Sulivan Road SW6 3DU
T 0207 731 7111
F 0207 371 7782
E architects@goldcrestland.com

Appendix B Energy Modelling Outputs

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.15

Property Address: Unit 1

Address : 1-9 Sandycombe Road, Richmond, London

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	77.75	(1a) x	3	(2a) =	233.25	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	77.75	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	233.25	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.13	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.38	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.35	(21)

Infiltration rate modified for monthly wind speed

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

DER WorkSheet: New dwelling design stage

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

0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

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

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

c) If whole house extract ventilation or positive input ventilation from outside if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

d) If natural ventilation or whole house positive input ventilation from loft if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

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

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)
(24d)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(24d)
(25)m=	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Windows Type 1			3.25	x1/[1/(1.3)+ 0.04]	=	4.02			(27)
Windows Type 2			6.5	x1/[1/(1.3)+ 0.04]	=	8.03			(27)
Windows Type 3			2.4	x1/[1/(1.3)+ 0.04]	=	2.97			(27)
Windows Type 4			3.37	x1/[1/(1.3)+ 0.04]	=	4.16			(27)
Windows Type 5			3.37	x1/[1/(1.3)+ 0.04]	=	4.16			(27)
Walls	87.99	25.63	62.36	x 0.18	=	11.22			(29)
Total area of elements, m²			87.99						(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	42.9	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	9354	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		7.04	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	49.94	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	46.16	45.86	45.57	44.2	43.94	42.75	42.75	42.53	43.21	43.94	44.46	45	(38)

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

(39)m=	96.1	95.8	95.51	94.13	93.88	92.68	92.68	92.46	93.14	93.88	94.4	94.94	

Average = Sum(39)$_{1...12}$ /12= 94.13 (39)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.24	1.23	1.23	1.21	1.21	1.19	1.19	1.19	1.2	1.21	1.21	1.22	

Average = Sum(40)1…12 /12= 1.21 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 2.42 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 91.65 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	100.81	97.14	93.48	89.81	86.15	82.48	82.48	86.15	89.81	93.48	97.14	100.81	
											Total = Sum(44)1…12 =	1099.75	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	149.5	130.75	134.93	117.63	112.87	97.4	90.25	103.57	104.8	122.14	133.32	144.78	
											Total = Sum(45)1…12 =	1441.95	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	22.42	19.61	20.24	17.64	16.93	14.61	13.54	15.54	15.72	18.32	20	21.72	(46)

Water storage loss:

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

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

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

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

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

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

If community heating see section 4.3

Volume factor from Table 2a — 1.03 (52)

Temperature factor from Table 2b — 0.6 (53)

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

DER WorkSheet: New dwelling design stage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	204.78	180.68	190.2	171.12	168.15	150.89	145.53	158.84	158.3	177.42	186.82	200.06	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating) (add additional lines if FGHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	204.78	180.68	190.2	171.12	168.15	150.89	145.53	158.84	158.3	177.42	186.82	200.06	
											Output from water heater (annual)1…12	2092.79	(64)
Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
(65)m=	93.93	83.42	89.08	81.91	81.75	75.18	74.23	78.66	77.64	84.83	87.13	92.36	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	120.94	120.94	120.94	120.94	120.94	120.94	120.94	120.94	120.94	120.94	120.94	120.94	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.14	17	13.82	10.47	7.82	6.6	7.14	9.28	12.45	15.81	18.45	19.67	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	214.67	216.9	211.29	199.34	184.25	170.07	160.6	158.37	163.99	175.94	191.02	205.2	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	35.09	35.09	35.09	35.09	35.09	35.09	35.09	35.09	35.09	35.09	35.09	35.09	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	-96.75	(71)
Water heating gains (Table 5)													
(72)m=	126.25	124.13	119.74	113.76	109.88	104.42	99.77	105.72	107.84	114.02	121.01	124.14	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	419.34	417.31	404.13	382.84	361.24	340.38	326.79	332.65	343.56	365.05	389.76	408.3	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.54	x	3.25	x	10.63	x	0.6	x	0.9	=	9.07	(74)
North	0.9x	0.54	x	3.25	x	20.32	x	0.6	x	0.9	=	17.33	(74)
North	0.9x	0.54	x	3.25	x	34.53	x	0.6	x	0.9	=	29.45	(74)
North	0.9x	0.54	x	3.25	x	55.46	x	0.6	x	0.9	=	47.31	(74)
North	0.9x	0.54	x	3.25	x	74.72	x	0.6	x	0.9	=	63.73	(74)

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DER WorkSheet: New dwelling design stage

North	0.9x	0.54	x	3.25	x	79.99	x	0.6	x	0.9	=	68.22	(74)
North	0.9x	0.54	x	3.25	x	74.68	x	0.6	x	0.9	=	63.69	(74)
North	0.9x	0.54	x	3.25	x	59.25	x	0.6	x	0.9	=	50.53	(74)
North	0.9x	0.54	x	3.25	x	41.52	x	0.6	x	0.9	=	35.41	(74)
North	0.9x	0.54	x	3.25	x	24.19	x	0.6	x	0.9	=	20.63	(74)
North	0.9x	0.54	x	3.25	x	13.12	x	0.6	x	0.9	=	11.19	(74)
North	0.9x	0.54	x	3.25	x	8.86	x	0.6	x	0.9	=	7.56	(74)
East	0.9x	3	x	3.37	x	19.64	x	0.6	x	0.9	=	52.11	(76)
East	0.9x	3	x	3.37	x	38.42	x	0.6	x	0.9	=	101.94	(76)
East	0.9x	3	x	3.37	x	63.27	x	0.6	x	0.9	=	167.88	(76)
East	0.9x	3	x	3.37	x	92.28	x	0.6	x	0.9	=	244.84	(76)
East	0.9x	3	x	3.37	x	113.09	x	0.6	x	0.9	=	300.07	(76)
East	0.9x	3	x	3.37	x	115.77	x	0.6	x	0.9	=	307.17	(76)
East	0.9x	3	x	3.37	x	110.22	x	0.6	x	0.9	=	292.44	(76)
East	0.9x	3	x	3.37	x	94.68	x	0.6	x	0.9	=	251.2	(76)
East	0.9x	3	x	3.37	x	73.59	x	0.6	x	0.9	=	195.25	(76)
East	0.9x	3	x	3.37	x	45.59	x	0.6	x	0.9	=	120.96	(76)
East	0.9x	3	x	3.37	x	24.49	x	0.6	x	0.9	=	64.98	(76)
East	0.9x	3	x	3.37	x	16.15	x	0.6	x	0.9	=	42.85	(76)
Southwest	0.9x	0.54	x	2.4	x	36.79		0.6	x	0.9	=	23.17	(79)
Southwest	0.9x	0.54	x	3.37	x	36.79		0.6	x	0.9	=	32.54	(79)
Southwest	0.9x	0.54	x	2.4	x	62.67		0.6	x	0.9	=	39.48	(79)
Southwest	0.9x	0.54	x	3.37	x	62.67		0.6	x	0.9	=	55.43	(79)
Southwest	0.9x	0.54	x	2.4	x	85.75		0.6	x	0.9	=	54.01	(79)
Southwest	0.9x	0.54	x	3.37	x	85.75		0.6	x	0.9	=	75.84	(79)
Southwest	0.9x	0.54	x	2.4	x	106.25		0.6	x	0.9	=	66.92	(79)
Southwest	0.9x	0.54	x	3.37	x	106.25		0.6	x	0.9	=	93.97	(79)
Southwest	0.9x	0.54	x	2.4	x	119.01		0.6	x	0.9	=	74.96	(79)
Southwest	0.9x	0.54	x	3.37	x	119.01		0.6	x	0.9	=	105.26	(79)
Southwest	0.9x	0.54	x	2.4	x	118.15		0.6	x	0.9	=	74.42	(79)
Southwest	0.9x	0.54	x	3.37	x	118.15		0.6	x	0.9	=	104.49	(79)
Southwest	0.9x	0.54	x	2.4	x	113.91		0.6	x	0.9	=	71.75	(79)
Southwest	0.9x	0.54	x	3.37	x	113.91		0.6	x	0.9	=	100.74	(79)
Southwest	0.9x	0.54	x	2.4	x	104.39		0.6	x	0.9	=	65.75	(79)
Southwest	0.9x	0.54	x	3.37	x	104.39		0.6	x	0.9	=	92.33	(79)
Southwest	0.9x	0.54	x	2.4	x	92.85		0.6	x	0.9	=	58.48	(79)
Southwest	0.9x	0.54	x	3.37	x	92.85		0.6	x	0.9	=	82.12	(79)
Southwest	0.9x	0.54	x	2.4	x	69.27		0.6	x	0.9	=	43.63	(79)
Southwest	0.9x	0.54	x	3.37	x	69.27		0.6	x	0.9	=	61.26	(79)
Southwest	0.9x	0.54	x	2.4	x	44.07		0.6	x	0.9	=	27.76	(79)
Southwest	0.9x	0.54	x	3.37	x	44.07		0.6	x	0.9	=	38.98	(79)

DER WorkSheet: New dwelling design stage

Southwest	0.9x	0.54	x	2.4	x	31.49		0.6	x	0.9	=	19.83	(79)
Southwest	0.9x	0.54	x	3.37	x	31.49		0.6	x	0.9	=	27.85	(79)
West	0.9x	0.77	x	6.5	x	19.64	x	0.6	x	0.9	=	47.77	(80)
West	0.9x	0.77	x	6.5	x	38.42	x	0.6	x	0.9	=	93.46	(80)
West	0.9x	0.77	x	6.5	x	63.27	x	0.6	x	0.9	=	153.91	(80)
West	0.9x	0.77	x	6.5	x	92.28	x	0.6	x	0.9	=	224.46	(80)
West	0.9x	0.77	x	6.5	x	113.09	x	0.6	x	0.9	=	275.09	(80)
West	0.9x	0.77	x	6.5	x	115.77	x	0.6	x	0.9	=	281.6	(80)
West	0.9x	0.77	x	6.5	x	110.22	x	0.6	x	0.9	=	268.1	(80)
West	0.9x	0.77	x	6.5	x	94.68	x	0.6	x	0.9	=	230.29	(80)
West	0.9x	0.77	x	6.5	x	73.59	x	0.6	x	0.9	=	179	(80)
West	0.9x	0.77	x	6.5	x	45.59	x	0.6	x	0.9	=	110.89	(80)
West	0.9x	0.77	x	6.5	x	24.49	x	0.6	x	0.9	=	59.57	(80)
West	0.9x	0.77	x	6.5	x	16.15	x	0.6	x	0.9	=	39.29	(80)

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

(83)m=	164.67	307.63	481.09	677.51	819.1	835.91	796.72	690.1	550.27	357.38	202.47	137.38	(83)

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

(84)m=	584.01	724.95	885.22	1060.36	1180.33	1176.28	1123.51	1022.76	893.82	722.43	592.23	545.68	(84)

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.95	0.86	0.69	0.5	0.36	0.41	0.67	0.93	0.99	1	(86)

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

(87)m=	19.78	20.01	20.36	20.72	20.92	20.99	21	21	20.95	20.63	20.13	19.75	(87)

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

(88)m=	19.89	19.89	19.9	19.91	19.91	19.93	19.93	19.93	19.92	19.91	19.91	19.9	(88)

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

(89)m=	0.99	0.98	0.94	0.82	0.62	0.42	0.27	0.32	0.58	0.9	0.98	0.99	(89)

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

(90)m=	18.29	18.63	19.12	19.62	19.85	19.92	19.93	19.93	19.89	19.52	18.81	18.25	(90)

fLA = Living area ÷ (4) = | 0.34 | (91)

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

(92)m=	18.81	19.11	19.54	20	20.22	20.29	20.3	20.3	20.25	19.9	19.27	18.76	(92)

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

(93)m=	18.81	19.11	19.54	20	20.22	20.29	20.3	20.3	20.25	19.9	19.27	18.76	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.93	0.82	0.64	0.44	0.3	0.35	0.61	0.9	0.98	0.99	(94)

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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	578.51	707.56	826.86	871.71	755.96	521.28	341.75	358.76	547.55	647.87	580.14	541.82	(95)

Monthly average external temperature from Table 8

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

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	1393.91	1360.99	1245.75	1044.74	799.76	527.1	342.47	360.18	573.1	873.28	1148.56	1382.7	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	606.66	439.1	311.65	124.59	32.59	0	0	0	0	167.7	409.26	625.61	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 2717.16 (98)

Space heating requirement in kWh/m²/year 34.95 (99)

9b. Energy requirements – Community heating scheme

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

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

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

Fraction of heat from Community CHP		0.85	(303a)
Fraction of community heat from heat source 2		0.15	(303b)
Fraction of total space heat from Community CHP	(302) x (303a) =	0.85	(304a)
Fraction of total space heat from community heat source 2	(302) x (303b) =	0.15	(304b)
Factor for control and charging method (Table 4c(3)) for community heating system		1	(305)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)
Space heating		**kWh/year**	
Annual space heating requirement		2717.16	
Space heat from Community CHP	(98) x (304a) x (305) x (306) =	2425.06	(307a)
Space heat from heat source 2	(98) x (304b) x (305) x (306) =	427.95	(307b)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308
Space heating requirement from secondary/supplementary system	(98) x (301) x 100 ÷ (308) =	0	(309)
Water heating			
Annual water heating requirement		2092.79	
If DHW from community scheme: Water heat from Community CHP	(64) x (303a) x (305) x (306) =	1867.81	(310a)
Water heat from heat source 2	(64) x (303b) x (305) x (306) =	329.61	(310b)
Electricity used for heat distribution	0.01 × [(307a)...(307e) + (310a)...(310e)] =	50.5	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		0	(330a)
warm air heating system fans		0	(330b)

DER WorkSheet: New dwelling design stage

pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	0	(331)
Energy for lighting (calculated in Appendix L)		337.99	(332)

12b. CO2 Emissions – Community heating scheme

Electrical efficiency of CHP unit		31.25	(361)
Heat efficiency of CHP unit		53.13	(362)

		Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating from CHP)	(307a) × 100 ÷ (362) =	4564.4	x	0.22		985.91	(363)
less credit emissions for electricity	–(307a) × (361) ÷ (362) =	1426.37	x	0.52		-740.29	(364)
Water heated by CHP	(310a) × 100 ÷ (362) =	3515.56	x	0.22		759.36	(365)
less credit emissions for electricity	–(310a) × (361) ÷ (362) =	1098.61	x	0.52		-570.18	(366)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel					93	(367b)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x			0.22	=	175.95	(368)
Electrical energy for heat distribution	[(313) x			0.52	=	26.21	(372)
Total CO2 associated with community systems	(363)...(366) + (368)...(372)				=	636.97	(373)
CO2 associated with space heating (secondary)	(309) x			0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x			0.22	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =					636.97	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x			0.52	=	0	(378)
CO2 associated with electricity for lighting	(332))) x			0.52	=	175.42	(379)
Total CO2, kg/year	sum of (376)...(382) =					812.38	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =					10.45	(384)
El rating (section 14)						91.13	(385)

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SBEM Main Calculation Output Document

Wed Oct 19 16:02:12 2016 v5.2.g.3

Building name

Sandycombe B1 Offices (P02)

Building type: B1 Offices and Workshop businesses

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, **SBEM is not intended as a building design tool.**

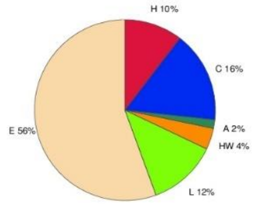
Building Energy Performance and CO2 emissions

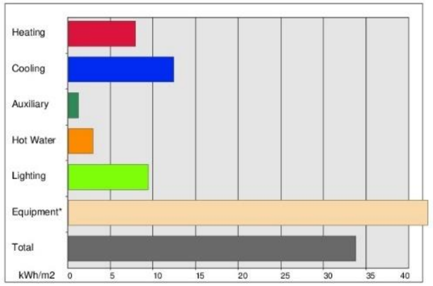
0 kgCO2/m2 displaced by the use of renewable sources.

Building area is 548.28 m2

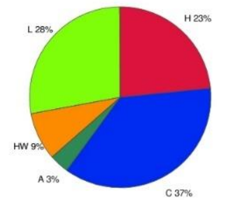
Annual Energy Consumption

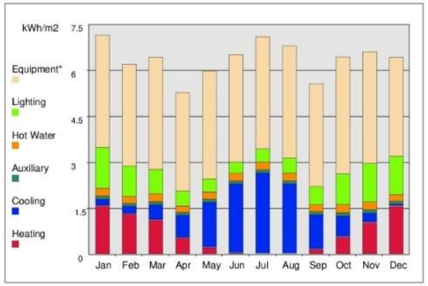
(Pie chart including Equipment end-use)





(Pie chart excluding Equipment end-use)





(*) Although energy consumption by equipment is shown in the graphs, the CO2 emissions associated with this end-use have not been taken into account when producing the rating.

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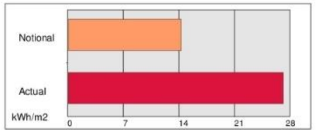
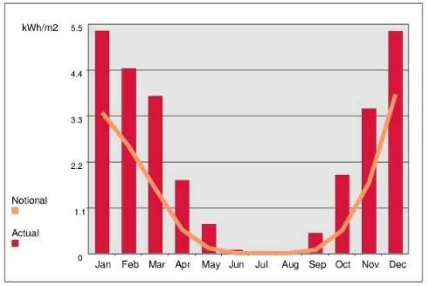
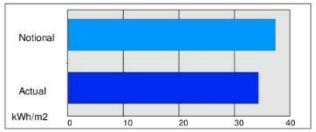
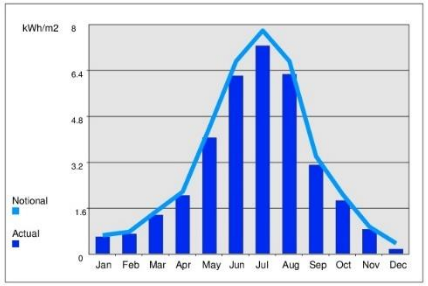
Annual Heating Demand





Annual Cooling Demand





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BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name — **Shell and Core**

Sandycombe B1 Offices (P02)

As built

Date: Wed Oct 19 16:02:12 2016

Administrative information

Building Details

Address: 1-9 Sandycombe Road, Richmond, London,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.6

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	21
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	21
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	13.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.2	0.2	B1000000_W1
Floor	0.25	0.18	0.18	B1000000_F
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.4	1.4	B1000000_W1_O0
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

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

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	7

Building services

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

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

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.5	4	-	-	-
Standard value	2.5*	1	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

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

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

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

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
B1 Office	-	0.3	-	-	-	-	-	-	-	-	N/A
B1 Office	-	0.3	-	-	-	-	-	-	-	-	N/A
B1 Office	-	0.3	-	-	-	-	-	-	-	-	N/A

Shell and core configuration

Zone	Excluded from calculation?
B1 Office	NO
B1 Office	NO
B1 Office	NO

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1 Office	70	-	-	2861
B1 Office	70	-	-	615

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
B1 Office	70	-	-	1376

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1 Office	YES (+23.9%)	YES
B1 Office	NO (-44.8%)	YES
B1 Office	NO (-60.2%)	YES

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	548.3	548.3
External area [m^2]	956.9	956.9
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	7	3
Average conductance [W/K]	441.69	472.76
Average U-value [W/m^{2}K]	0.46	0.49
Alpha value* [%]	19.57	15.02

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

Building Use

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

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

	Actual	Notional
Heating	7.89	5.86
Cooling	12.37	10.34
Auxiliary	1.18	2.7
Lighting	9.38	20.49
Hot water	2.89	3.34
Equipment*	42.19	42.19
TOTAL**	**33.71**	**42.73**

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

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	220.66	185.3
Primary energy* [kWh/m^2]	78.97	121.57
Total emissions [kg/m^2]	13.5	21

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Natural Gas										
	Actual	97.5	123.1	7.9	12.4	1.2	3.43	2.77	3.5	3.7
	Notional	51.3	134	5.9	10.3	2.7	2.43	3.6	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.2	B1000000_W1
Floor	0.2	0.18	B1000000_F
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.4	B1000000_W1_O0
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	7

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Appendix C General Notes

The report is based on information available at the time of the writing and discussions with the client during any project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by Ensphere Group Ltd for inaccuracies in the data supplied by any other party.

The review of planning policy and other requirements does not constitute a detailed review. Its purpose is as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.

No site visits have been carried out, unless otherwise specified.

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Ensphere Group Ltd
10 Greycoat Place, London, SW1P 1SB
+44 (0) 20 7960 6126
www.enspheregroup.com