



**Former Royal Mail Sorting Office
& Distribution Centre**
80 Caversham Road, Reading, RG1 1AA
Energy Statement

CHBS-PB-17022-4-B

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Executive Summary

The purpose of this report is to demonstrate in support of the Outline Planning Application that the proposed development has been designed in accordance with low carbon design principles. The main objective of the study is to present results from a Building Energy Modelling exercise to demonstrate that the Reading Borough Council New Local Plan 2019 targets for zero-carbon homes, decentralised and electrified thermal energy, and on-site renewable energy shall be met by the proposed energy strategy.

A fabric-first approach to the project, alongside a site layout and building design developed around passive-principles and energy-efficient building services, allows Building Regulations Part L compliance to be achieved through energy-efficiency alone.

A communal heat distribution network is proposed to serve dwellings from a heat pump. Additional feasibility investigations for open-loop ground source and water source heat pump shall be carried out at detailed design stage, air source heat pumps are the fall-back option if no other systems prove to be feasible. Calculations have been based on the air source heat pump fall-back option as Coefficients of Performance are expected to be lower for this system. The site-wide network shall have provision for the future connection to a wider district energy scheme. Rooftop solar photovoltaics shall generate renewable electricity, a site-wide capacity in the region of 117kW is expected.

The proposed domestic energy strategy has been calculated to reduce regulated CO₂ emissions by 37% against a Part L 2013 baseline (SAP 2012 emission factors), this would increase to 80% under the consideration of SAP10.1 emissions factors. This exceeds the 35% minimum target set by Policy H5: Housing and confirmed within the Sustainable Design and Construction SPD as shown in Figure 1.

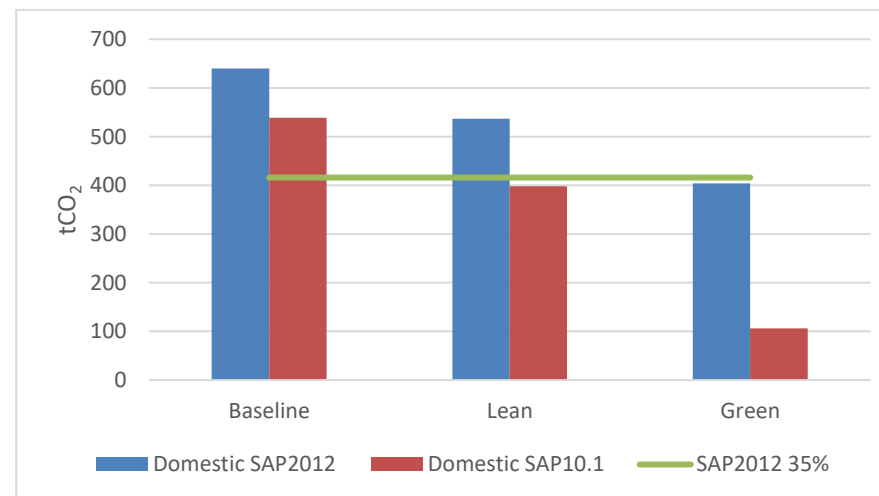


Figure 1: Domestic regulated CO₂ at each stage of Energy Hierarchy.

The residual domestic regulated emissions shall be offset to achieve the zero-carbon target, this is required for a 30-year period at a rate of £60/t.CO₂.

The non-domestic buildings shall also benefit from heat pump technology to reduce emissions, alongside a range of passive design principles. The Energy Modelling results shown in Figure 2 demonstrate that the whole development site is expected to emit 35% (SAP 2012) less CO₂ emissions than if it were designed to just meet the minimum requirements of Building Regulations Approved Document Part L, this would increase to 73% when corrected with SAP10.1 emissions factors.

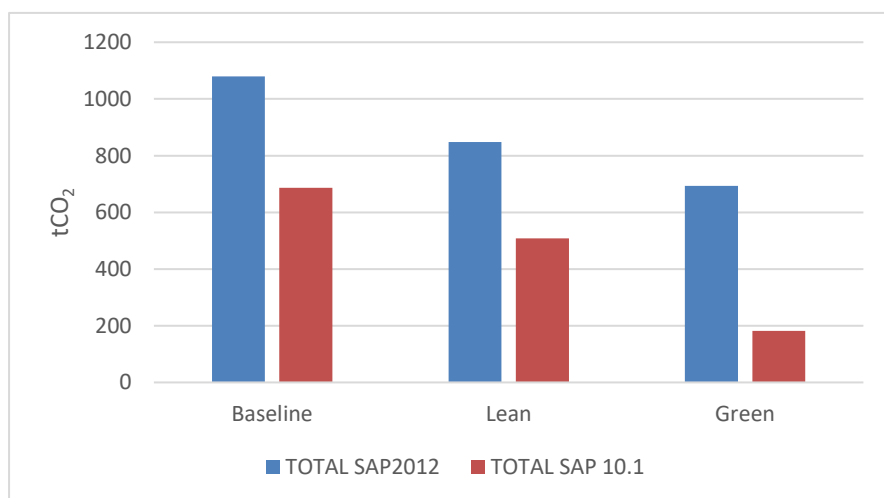


Figure 2: Total (Domestic & Non-Domestic) regulated CO₂ at each stage of Energy Hierarchy.

Introduction

Purpose

CHB Sustainability have prepared this Energy & Sustainability Statement in support of the Outline Planning Application for the proposed redevelopment of the Former Royal Mail Sorting Office & Distribution Centre at 80 Caversham Road, Reading.

The Energy Strategy has been developed in response to the 2019 Local Planning Policy and any other relevant drivers for reduction of carbon emissions within the built environment. This report presents the proposed Energy Strategy and details the related specification assumptions to inform future design development.

The objectives of the report are:

- to understand the regulatory and planning policy drivers for sustainable design and construction,
- present the proposed site-wide energy strategy,
- to demonstrate the principles for the site-wide energy strategy design,
- to report results of Energy Modelling to show compliance with the project carbon emissions drivers,
- to record building performance specifications required to achieve energy performance.

Scope

The modelling has been completed in line with CIBSE AM11 utilising the UK National Calculation Method (NCM) for Non-Domestic Buildings Simplified Building Energy Method (SBEM) and the Domestic Standard Assessment Procedure (SAP). The scope of the energy modelling includes regulated energy due to Heating, Cooling, Auxiliary (Pumps & Fans), Lighting and Domestic Hot Water end-uses.

Detailed Energy Models of the Phase 1 Office, Retail and Health/Community areas have been used to gain results representative of the proposed non-domestic building types within the development. SAP calculations have been produced for sample studio, 1 bed, 2 bed, 3 bed and townhouse dwellings. The results of the detailed energy modelling are able to be scaled-up to give an overall estimation of the site-wide energy performance for all phases of the proposed development.

Sustainable Design & Construction Drivers

Reading Borough Council New Local Plan was adopted in November 2019. The key policies relevant to this document are:

- CC2: Sustainable Design and Construction
- CC3: Adaption to Climate Change
- CC4: Decentralised Energy
- H5: Standards for New Housing

Policy CC2 requires that all new developments must design buildings and site layouts to use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and account for the effects of climate change. This Policy includes a requirement for Major developments to meet BREEAM Excellent where possible. All developments should include greywater and rainwater harvesting where systems are energy and cost effective.

Policy CC3 focuses on adaption to climate change and requires that new buildings should maximise opportunities for passive heating and ventilation, as well as design to reduce exposure to wind. Buildings should also have passive measure for reduction of overheating including solar shading, thermal mass, appropriately coloured materials and green or brown roofs. Other climate adaptation measures include planting for a changing climate in the landscape design alongside management of surface water and flood resilience.

Policy CC4 requires consideration of decentralised energy for developments over 1,000m²/20 dwellings. Although the Local Plan (2019) notes CHP as a possible technology there is a clear preference for heat pump energy centres over Combined Heat and Power (CHP), as following grid electricity decarbonisation these technologies are now less carbon intensive and do not impact on local air quality.

Policy H5 includes requirements for sustainable design and construction of houses. This includes complying with Building Regulations higher water efficiency standards, achieving 'zero carbon homes' standards and incorporating renewable energy generation technologies.

The Sustainable Design and Construction SPD (December 2019) states that if true 'zero carbon' standards cannot be achieved for major developments then a minimum 35% reduction on Building Regulations Part L 2013 is required with the residual emissions offset via a planning contribution (£1800/t.CO₂). The SPD states that the H5 targets should be calculated using the current Building Regulations methodology with a manual conversion to use the SAP 10 emission factors.

The SPD highlights that the redevelopment of the Former Royal Mail Site has potential to be the centre of a cluster of town centre district heating.

Project Description

The proposed development site is directly to the north of Reading Station and currently contains the former Royal Mail Sorting Office, a workshop, office building and hardstanding. As shown in figure 2.

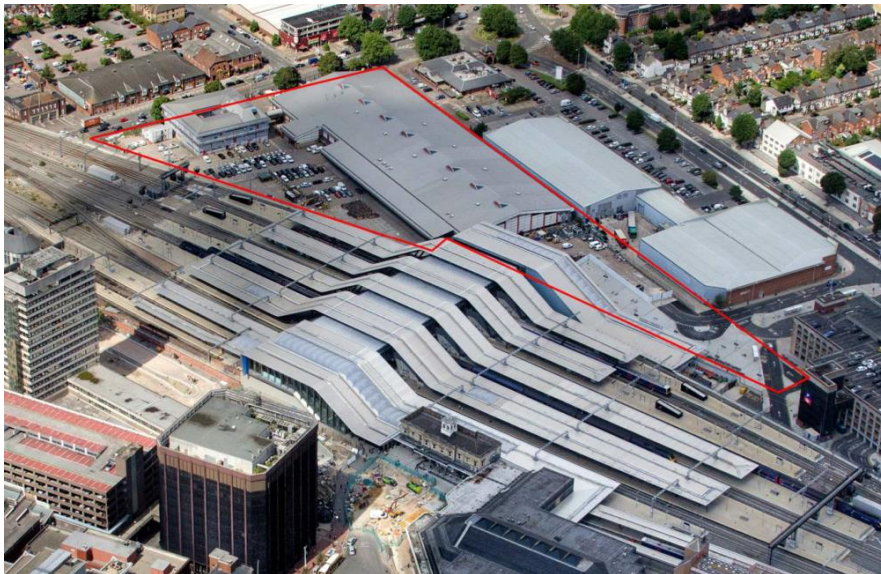


Figure 2: Existing site of proposed development (boundary in red-line)

The proposed redevelopment of the application site is for a mix of uses including employment and business uses (Class B1), residential accommodation (Class C3), retail floorspace (Class A1), food and drink (Classes A3, A4 and A5), leisure uses (Class D2), car parking, public and private open space, landscaping works, highways, access and associated works.

The residential development consists of two high-rise towers to the east of the site above office and retail functions. There are two lower residential towers to the middle of the site and a curved mixed-use block the west of the site, as shown in Figure 3.

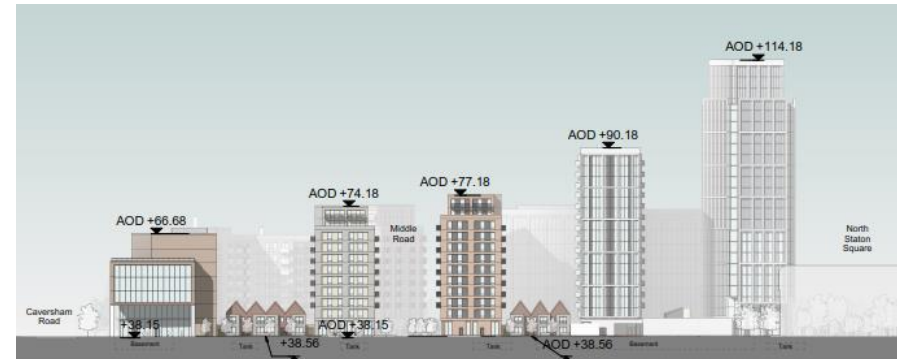


Figure 3: Proposed south elevations (Source: A11113 C 2 200 P4)

The development is expected to be constructed in 3 phases as shown in figure 4.

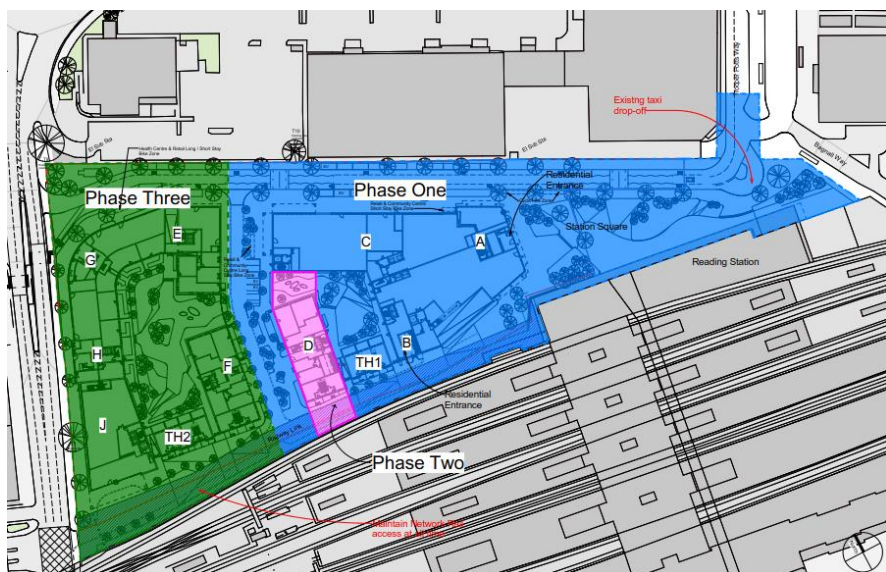


Figure 4: Phasing diagram (Source: A11113 C 2 022 P2)

Resources

This assessment has been based on information provided in the following documents:

A11113 C 2 001 P1	A11113 C 2 116 P4
A11113 C 2 002 P2	A11113 C 2 117 P3
A11113 C 2 003 P2	A11113 C 2 118 P3
A11113 C 2 010 P2	A11113 C 2 119 P3
A11113 C 2 020 P2	A11113 C 2 120 P3
A11113 C 2 021 P2	A11113 C 2 121 P3
A11113 C 2 022 P2	A11113 C 2 122 P3
A11113 C 2 025 P5	A11113 C 2 123 P4
A11113 C 2 050 P10	A11113 C 2 124 P3
A11113 C 2 099 P9	A11113 C 2 200 P4
A11113 C 2 100 P14	A11113 C 2 201 P4
A11113 C 2 101 P5	A11113 C 2 202 P5
A11113 C 2 102 P5	A11113 C 2 203 P4
A11113 C 2 103 P5	A11113 C 2 204 P5
A11113 C 2 104 P5	A11113 C 2 205 P4
A11113 C 2 105 P5	A11113 C 2 206 P3
A11113 C 2 106 P5	A11113 C 2 207 P3
A11113 C 2 107 P5	A11113 C 2 208 P3
A11113 C 2 108 P6	A11113 C 2 209 P3
A11113 C 2 109 P5	A11113 C 2 210 P3
A11113 C 2 110 P4	A11113 C 2 211 P2
A11113 C 2 111 P4	A11113 C 2 300 P6
A11113 C 2 112 P4	A11113 C 2 301 P4
A11113 C 2 113 P4	A11113 C 2 302 P5
A11113 C 2 114 P3	A11113 C 2 303 P3
A11113 C 2 115 P3	A11113 AS 0 002 P9

Proposed Energy Strategy

The proposed domestic energy strategy follows the Energy Hierarchy (Figure 5) in order to achieve the zero carbon targets, the non-domestic buildings shall also incorporate energy efficient fabric and low carbon heating to minimise the site-wide carbon emissions of the whole development.

The key elements of the strategy are a 'fabric-first' energy efficient design, a site-wide energy network fed by a heat pump energy centre with the potential for future connections to a town district heat network, and renewable energy generation. The proposals utilise a high thermal performance building fabric to reduce heat loss and solar gains alongside a building layout to control solar gains and optimise daylight provision.

It is proposed that a community heat distribution network shall serve the residential units. The proposed Energy Centre location within the Phase 1 basement is shown in Figure 6. The Energy Centre shall have provision for the future connection to a wider district energy scheme. Subject to design development Phase 3 may also be served from the same energy centre, or a second energy centre linked to the first for site-wide resilience may be included in the later phases.

Where non-domestic elements of the development are to be fitted-out within the base-build (Offices), they shall utilise heat recovery and heat pump technologies alongside energy efficient building services.

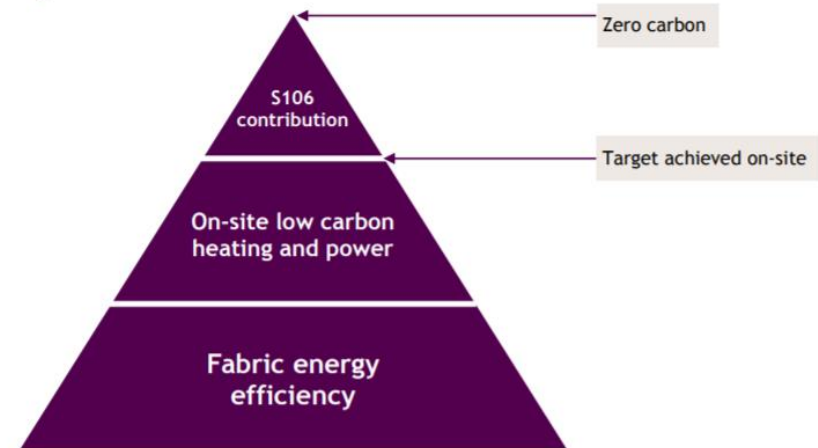


Figure 5: The Domestic Energy Hierarchy (Extract from Sustainable Design and Construction SPD)

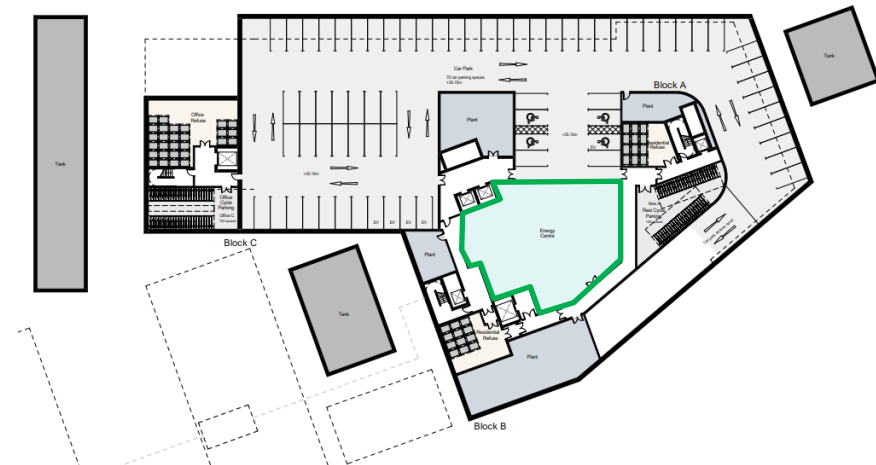


Figure 6: Phase 1 Basement level drawing showing Energy Centre location highlighted green (Source: A1113 C 2 099 P9)

Energy Efficient Design

The form and layout of the development has been designed with consideration for energy efficiency. The individual blocks are located around four south facing courtyards as shown in figure 7, this maximises the area of building facades facing east, south and west and minimises north facing facades. This site layout maximises opportunities for beneficial solar and daylight gains.

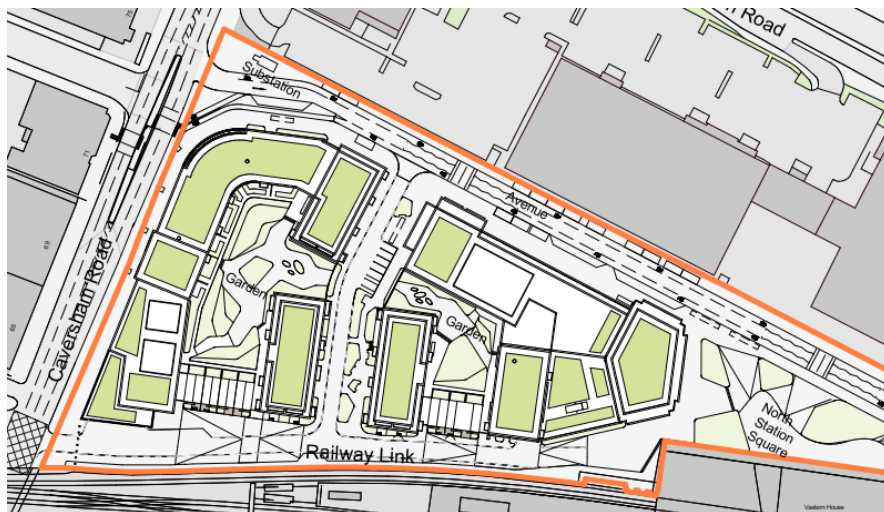


Figure 7: Site layout (Source: A11113 C 2 003 P2).

The retail and office areas are located around the site boundaries to the north, east and west (figure 8). These orientations offer the optimal potential for daylight benefits whilst reducing the risk of excessive solar gains and minimizing cooling demands.

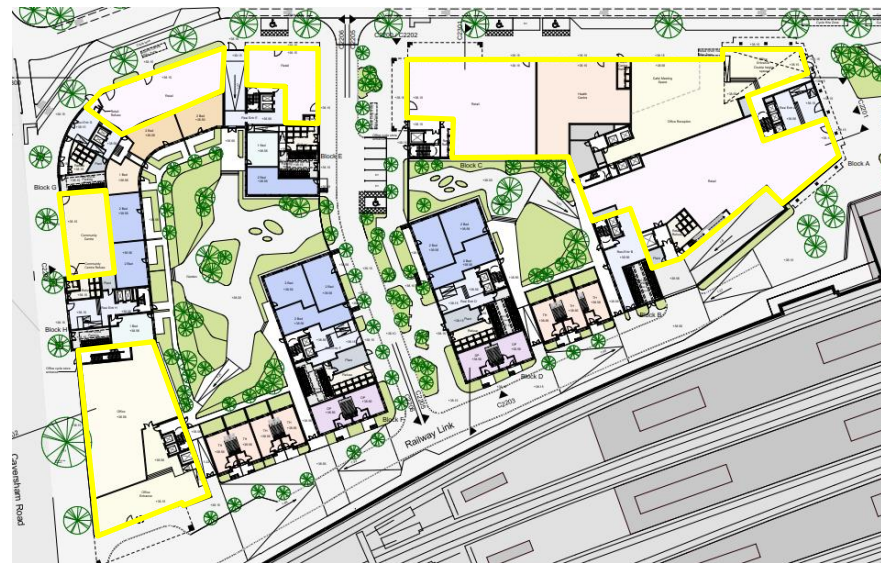


Figure 8: Ground floor plan non-domestic uses highlighted in yellow (Source: A11113 C 2 100 P14)

The proposed building fabric specification far exceeds the minimum performance standards required by Building Regulations Part L in order to reduce heat demands and have been guided by the relevant LETI (London Energy Transformation Initiative) Climate Emergency Design Guides.

Building services specification shall further reduce heat demands by utilising heat recovery ventilation. Summertime over heating risks shall be minimised through solar control glazing and low energy lighting.

The assumed building performance specification is detailed fully in Appendix A.

Principles of Energy Strategy Design: Low Carbon Heat

The Local Plan states that Heat Pumps are the preferred approach for decentralised heat networks, the feasibility of each heat pump type is reviewed within this section to select the most appropriate low carbon heat technology for the development.

Air Source Heat Pump

Air source heat pumps generally have the lowest efficiency as the average air temperature across the year is lower than that from ground or water. However, the up-front costs of such systems are lower when compared to ground or water-source systems. There would need to be a suitable location for the external condensing units, which could be either at roof level or located in a well-ventilated plant enclosure at ground (or basement) level. There are not considered to be any significant technical barriers to the feasibility of this technology, should there be no feasible higher efficiency alternative heat pump system, then air source heat pumps may be used.

Water Source Heat Pump

Water source heat pumps require a suitable body of water, in this case the adjacent River Thames has been highlighted as having potential to be a heat source for a district scheme. Figure 9 shows that the basement energy centre is approximately 350m from the River Thames across a major road.

The development site does not have direct access or ownership of the riverbank and therefore the technical, legal, practical, and cost impacts of this technology could be considered to be a barrier without a wider development partner to drive such a scheme forward for multiple development sites. As such there shall be further liaison with Reading Borough Council at the detailed design stage to investigate land ownership and fully understand the potential barriers to utilising this technology.

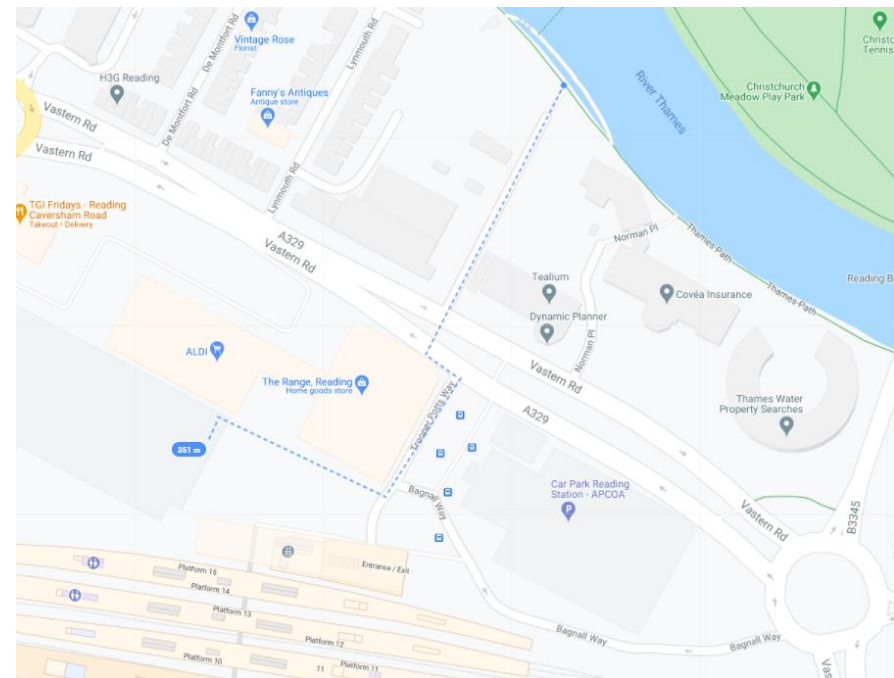


Figure 9: Potential route measured from site energy centre to River Thames (Source: GoogleMap).

Ground Source Heat Pump: Closed Loop

A closed-loop ground source heat pump could be in the form of a horizontal ground array with the collector laid in a series of trenches or a vertical installation using boreholes, boreholes are a more space efficient solution. A ground source heat pump would incur additional construction costs for laying the ground collector but would provide a more stable heat source and hence better efficiencies than an air source heat pump.

The main feasibility consideration is whether there is suitable external area on-site for the ground collector. Peak domestic heat demands for the development have been calculated to be 1677 kW (*based on 30/35 kW DHW HIUs & 25 W/m² space heat and diversity in accordance with Heat Networks Draft Code of Practice CP1.2*).

Each borehole should be at least 7m apart (*GSHP Association CE82*), this is especially important in small complex spaces with a high density of boreholes to avoid depleting the ground heat resource. Figure 10 shows an analysis of the maximum number of boreholes that may be feasible, a total maximum of 90 could be fitted in when existing buried services and the expected no-build zone adjacent to railway line is considered. Boreholes under buildings have been avoided as they would reduce temperatures under the building, increasing ground floor heat loss and ground temperatures could not be topped up from solar gains in these locations.

At a maximum borehole depth of 200m a heat availability of about 90 W/m would be required to meet the peak load, which is well above the 20-55 W/m that can be expected for vertical indirect collectors (*CIBSE TM51:2013*). Therefore, we can conclude that there is not sufficient space available for a closed loop ground source heat pump to meet the domestic space heating and hot water demands of the development.



Figure 10: Analysis of available space for borehole field

Ground Source Heat Pump: Open Loop

Unfortunately, due to the current COVID-19 crisis we are unable to utilise the British Geological Society services to further investigate the potential for an Open Loop system as these are currently suspended, see screenshots in figure 11.

We were unable to fully assess the potential for Open Loop Ground Source Heat at this stage due to COVID-19 restrictions at the British Geological Society. However, this technology may be considered further at detailed design stage where site investigations may be carried out.

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In light of UK Government guidance concerning the Coronavirus (Covid-19) the BGS Geology Shops at Keyworth, Edinburgh and London are closed and many GeoReports are temporarily unavailable due to the limitations associated with our report writers needing to work from home.

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- Radon: England and Wales GeoReport
- Radon: Scotland GeoReport
- Natural subsidence GeoReport
- Geological map extracts GeoReport
- Infiltration SuDS GeoReport
- Water borehole : Less than 20m/day GeoReport*
- Water borehole : Greater than 20m/day GeoReport*
- Building stone assessment

** All reports for areas of complex geology are temporarily unavailable. This is because of the limitations associated with our report writers needing to work from home.

* The Engineering module is temporarily unavailable for this report. This is because of the limitations associated with our report writers needing to work from home.

We apologise for any inconvenience this causes. If you need any further information please contact enquiries@bgs.ac.uk

Ground source heat pump

Ground source heat pump : Vertical closed loop

This report is designed for users proposing ground source heating using a closed vertical loop. It contains an evaluation of the geological formations beneath the site including the hydrogeology and thermal properties for the geological units at depth.

Ground source heat pump : Open loop

This report is designed for users proposing ground source heating using an open vertical loop. It contains an evaluation of the geological formations beneath the site in terms of aquifer potential including water levels, groundwater yields and quality.

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Figure 11: Screenshots from British Geological Society showing suspension of Heat Pump studies due to Covid Crisis.

Proposed Low Carbon Heat Generation

Following early feasibility analysis of the potential heat pump systems to feed into the site wide energy network, it can be concluded that Air Source Heat Pump technology is appropriate and further investigations shall be carried out into Open Loop Ground Source and Water-Source Heat Pumps at detailed design stage to determine if they are also suitable technologies.

In terms of carbon emissions reduction, the worst-case scenario is Air Source Heat Pumps and, having concluded that this technology is suitable without further investigation, then we shall proceed on this basis to demonstrate that the planning targets may be met utilising the lowest efficiency heat pump technology as a fall-back option if neither Open-Loop Ground Source or Water Source Heat pumps prove feasible.

An air source heat pump system in the region of 1.7 MW would be required, the commercial availability of systems of this scale are limited so a modular approach would be required. Each phase of the development would be provided with a roof mounted plant area to locate the external condenser units, these systems would be linked to a plant room in each block with a thermal store, pumps etc. The wet distribution network for each phase would be linked together to form a resilient site-wide network with the potential to be linked up to a district-wide system.

The Coefficient of Performance of an air source heat pump is more efficient when operating at lower temperatures, therefore a lower temperature distribution network would be required with a low return temperature

(60/30) to take best advantage of the heat pump technologies operating in their most efficient range. A COP of 2.8 is assumed to best represent seasonal performance in these conditions and this includes a consideration of a small amount of electric top-up heating to optimise the ASHP system sizing.

Individual air source heat pump systems are expected to be utilised within the non-domestic development. A Variable Heat Volume/Flow (VRV/F) heat pump system would be well suited to the office energy profile. VRV/F systems allow heat to be transferred throughout the building between different rooms and orientations where there may be simultaneous heating and cooling demands. A hot water module may also be used which uses waste heat extracted from the cooling demands in order to heat domestic hot water.

Preparedness for District Heating Connection

The development shall be designed with a domestic site-wide wet space heating and hot water distribution network, this would allow the provision for future district heat connections at the energy centre to connect up all buildings on the site to interact with any future town district heat network.

Suitable provision for preparedness for a future connection shall include wall penetrations for DH pipework into the plant room and reserved plinths for plate heat exchangers with sufficient space provided to accommodate the heat transfer equipment in an N+1 redundancy arrangement for future interconnection with the proposed district heating network.

Assuming that the location of the Energy Centre in Phase 1 would be used to allocate the internal plant for this phase there would be a potential route north through the basement car park to Trooper Potts Way from which the ongoing connection could be easily excavated to provide a future connection on the site boundary close to the route highlighted in the Sustainable Design and Construction SPD (Figure 12 & Figure 13).

As such it is not considered necessary to provide buried and capped-off DH pipework from the development's plant room as this could be added relatively easily as wall penetrations for this shall be provided.

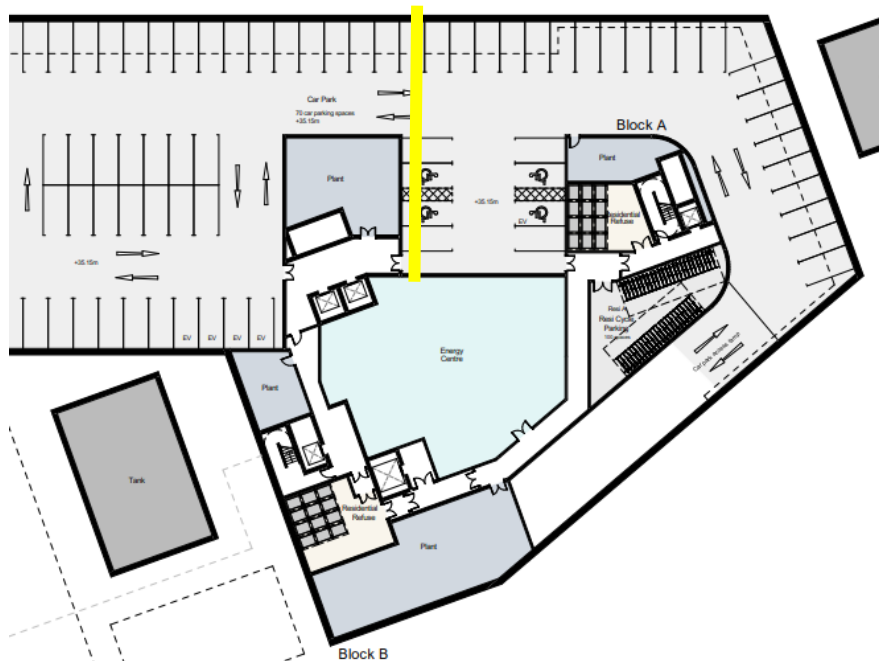


Figure 12: Potential route (yellow) for district heat pipework connection in basement level car park to Trooper Potts Way (Source: A1113 C 2 099 P9).

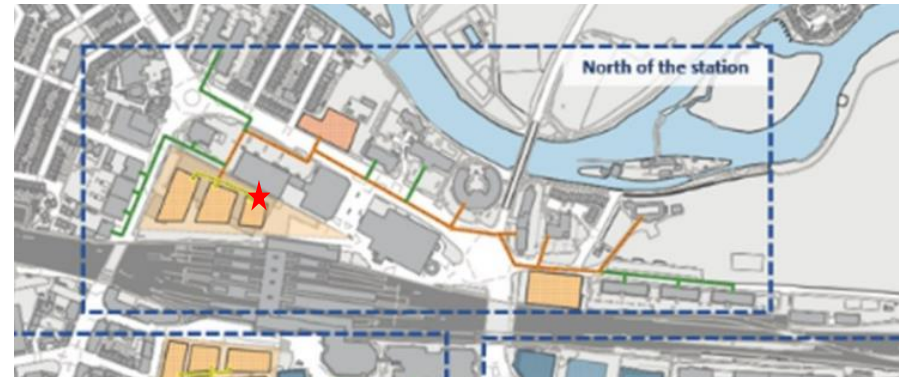


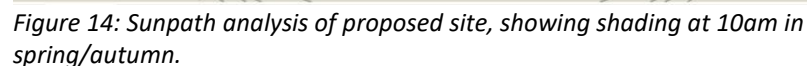
Figure 13: Potential district heat cluster with approximate location building penetration of district heat future connection (red star) (Extract: Sustainable Design and Construction SPD Figure 8.1)

Principles of Energy Strategy Design: Renewable Energy Generation

Solar energy generation would be the most appropriate renewable energy technology for the site but there are multiple demands on roof space for building services plant and low carbon heating systems as well as roof areas where there are localised shading effects.

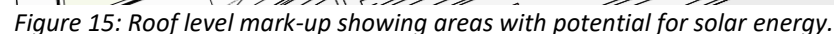
An analysis of the development roof space has been conducted to ascertain the available space for solar energy generation. The sunpath analysis (figure 14) shows that the roof of the blocks on the northside of the development are shaded by the adjacent taller blocks during the morning. The lower roofs on the south-side of the site, such as the townhouses, with

The findings of the assessment are shown in figure 15 with the roof space required for plant or overshadowed greyed out, potential locations for the low carbon heat air source heat pump units are also shown, which the remaining available roof space shown with an indicative solar array. If ground source open loop or water source heat pumps prove feasible then additional roof space for solar may be available.



that the electricity generated can be used for a variety of end uses, and any excess generated on-site can easily be fed back into the National Grid to be used off-site. There is potential for a site-wide solar PV array of approximately 117kW, however, this would be dependent on the detailed design layout.

Solar thermal is a beneficial technology to integrate with heat pumps in a district heat network, however, for this development it is considered that there is not sufficient area available for solar thermal to make a significant impact and to justify a combined solar thermal/heat pump system with seasonal thermal storage to make the most of the solar heat when heat demands are highest. Therefore, solar PV is proposed.



Energy Modelling

Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM) calculations have been performed to inform this Energy Statement.

This involves creating a geometric model of the proposed building (Figure 16) and then populating the model with the building fabric and building services specification. The energy simulation model is then run to calculate the building energy consumption and resultant carbon dioxide emissions due to the predicted operation of the building over a typical year. The Energy Performance Specification used as the inputs for the energy model is detailed within Appendix A.

The Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM) results have been corrected using the SAP 10.1 emissions factors as required in accordance with the Sustainable Design and Construction SPD (December 2019). The conversion calculation sheet is provided in Appendix C.

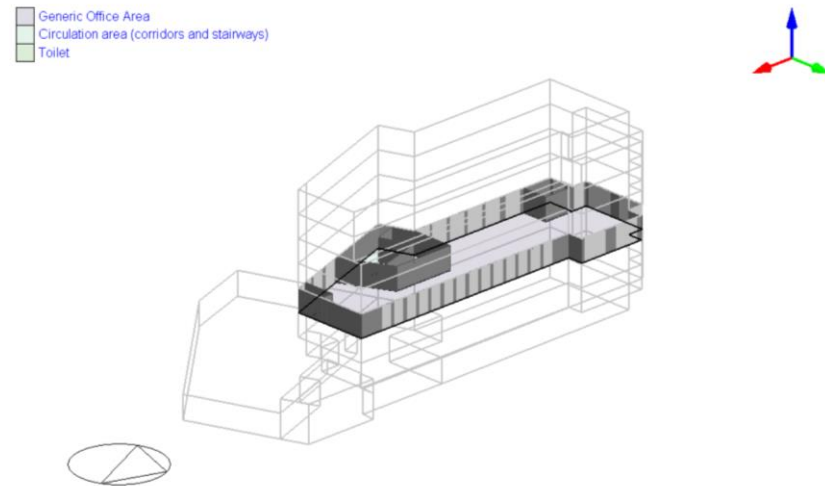


Figure 16: Internal wireframe view showing typical mid-floor phase 1 office Designbuilder 3D Model

Energy Modelling Results

The modelling demonstrated that the proposed Energy Performance Specification (see Appendix A) is sufficient to exceed the minimum requirements of Building Regulations Approved Documents Part L1A and L2A (2013) for the Lean Energy Efficient stage of the Energy Hierarchy. The sample SAP worksheets are provided in Appendix B.

The breakdown of results for end-use energy within the proposed Energy Efficient design is shown in figure 17 split to domestic and non-domestic buildings.

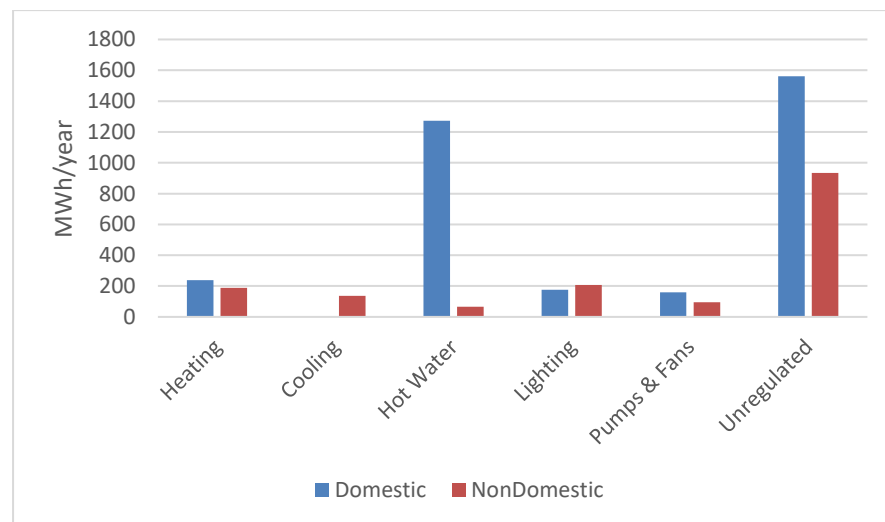


Figure 17: Development domestic energy use profile to regulated end-uses.

Figure 17 shows that the domestic hot water and unregulated appliance usage dominates the site-wide energy demands. Therefore, for the energy strategy to focus on domestic low carbon heating and renewable electricity generation is entirely appropriate.

The site-wide results in terms of Building Regulations 2013 (SAP2012) are presented in Table 1 and Table 2 show these results corrected with a manual conversion to SAP 10.1 emissions factors.

tCO ₂ Total	Domestic	Non-Domestic	Total
Baseline	640	440	1080
Lean	537	311	848
Green	404	289	693
tCO ₂ Reduction			
Lean	102	129	231
Green	134	22	156
Cumulative	236	151	387
% CO ₂ Reduction			
Lean	16%	29%	21%
Green	21%	5%	14%
Cumulative	37%	34%	35%
tCO ₂ Offset			
Annual	404		
30 Year	12,120		

Table 1: Results of total estimated regulated carbon dioxide emissions & reductions SAP 2012 emissions rate

tCO ₂ Total	Domestic	Non-Domestic	Total
Baseline	539	148	686
Lean	398	110	508
Green	106	76	182
tCO ₂ Reduction			
Lean	141	38	178
Green	292	34	326
Cumulative	433	72	504
% CO ₂ Reduction			
Lean	26%	26%	26%
Green	54%	23%	48%
Cumulative	80%	49%	73%
tCO ₂ Offset			
Annual	106		
30 Year	3,180		
Offset Payment @£60/t.Co2	£190,800		

Table 2: Results of total estimated regulated carbon dioxide emissions & reductions SAP 10.1 emissions rate

The domestic and total site emissions for each stage of the energy hierarchy are shown in figures 18 and 19 showing the difference between the results when using the outdated SAP 2012 emissions or the emerging more realistic SAP 10.1 emissions factors.

The policy requirement to demonstrate compliance with both the SAP 10.1 and SAP 2012 carbon emission factors is to avoid strategies employing direct electric heating or gas-fired CHP. Given the energy strategy does not

employ either of these technologies the SAP 2012 results can be ignored and hence the domestic carbon offset payment stated in Table 2 based on SAP 10.1 emission rates of £190,800.

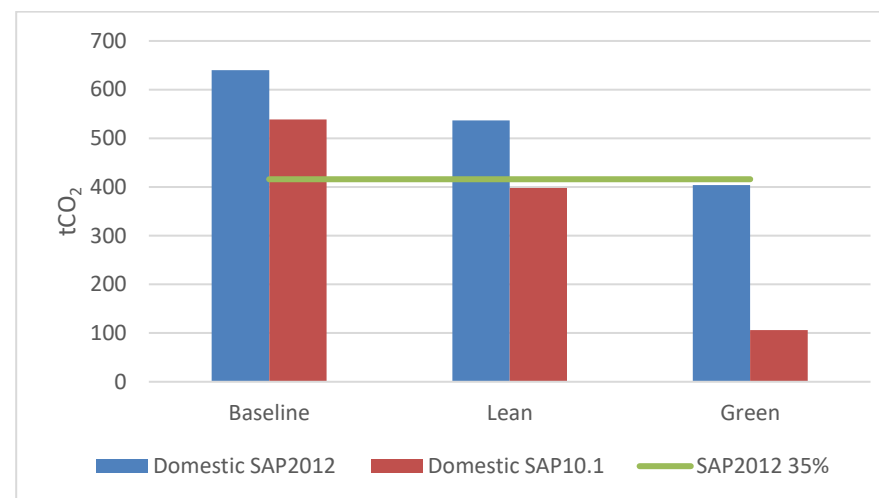


Figure 18: Domestic regulated CO₂ at each stage of Energy Hierarchy.

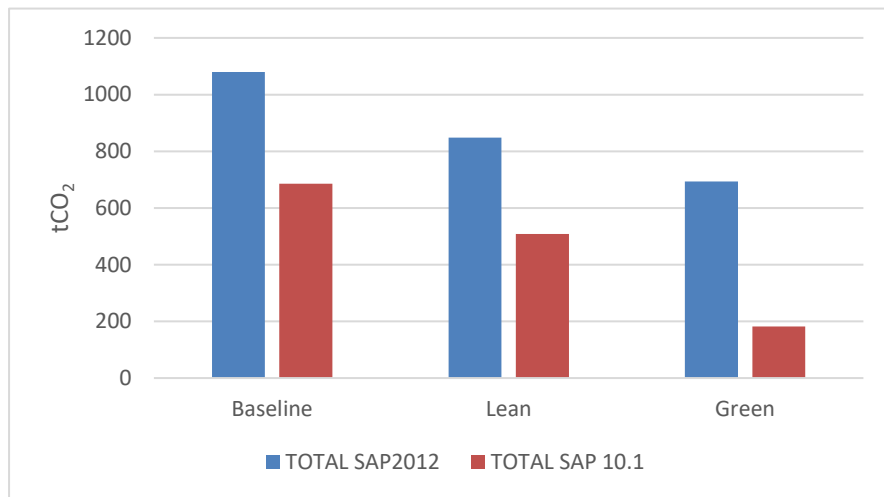


Figure 19: Total regulated CO₂ at each stage of Energy Hierarchy.

Conclusions

The Energy Statement has considered the regulatory framework for energy efficient design and application of low and zero carbon technologies. An Energy Strategy has been derived following the principles laid out within the relevant Local Planning Policy.

On the basis of the representative building energy modelling performed it can be concluded that the proposed Energy Performance Specification is sufficient to achieve Building Regulations Approved Document Part L compliance with energy efficiency improvements in the region of 21-24% (SAP2012-SAP10.1).

The development is designed to be energy efficient and utilise passive measures to reduce energy demands in accordance with Policy CC2: Sustainable Design and Construction and CC3: Adaption to Climate Change.

A communal heat network is proposed to serve the dwellings from a heat pump technology, and suitable available roof space shall be utilised for Solar PV. The calculations presented are based on use of an air source heat pump as the worst-case and feasible scenario, open-loop ground source and water-source heat pumps shall be explored further at detailed design stage. The site-wide energy network shall be designed to be prepared for a future district heat network connection. This strategy is in accordance with Policy CC4: Decentralised Energy and H5: Housing.

The proposed domestic energy strategy has been calculated to reduce regulated CO₂ emissions by 37% against a Part L 2013 baseline (SAP2012 factors) and this would improve to 80% utilising SAP10.1 emissions factors. This exceeds the 35% minimum target set by Policy H5: New Housing and confirmed within the Sustainable Design and Construction SPD.

The SAP 10.1 residual domestic regulated emissions of 106 t.CO₂ per year shall be offset to achieve the zero-carbon target, this is required for a 30-year period at a rate of £60/t.CO₂ so a total of £190,800.

The non-domestic buildings within the proposed development also benefit from energy efficient design measures in terms of layout, form, and fabric specification. Further reductions are achieved through an energy efficient fit-out utilising low energy lighting, advanced controls, and heat recovery technologies. It is also proposed that the non-domestic buildings shall benefit from low carbon heat utilising heat pump technology for space heating, and also hot water for the office areas as part of an advanced VRF heat recovery system.

The total site-wide regulated emissions are calculated to be reduced by 35% against a Part L 2013 baseline (SAP 2012 factors) and this would increase to 73% utilising SAP10.1 emissions factors.

Appendix A: Energy Performance Specification

Building Fabric Element	Energy Performance Specification	Units
Ground & Exposed Floors	0.10	W/m ² .K
External Walls	0.15	W/m ² .K
Semi-Conditioned Walls (To unheated areas)	0.15	W/m ² .K
Roof	0.12	W/m ² .K
Domestic Window	0.9	W/m ² .K
	0.5	G-value solar transmittance ratio
Commercial Window	1.2	W/m ² .K
	0.25	G-value solar transmittance ratio
	0.5	Light transmittance ratio
Air Tightness	2	m ³ /m ² .hr @ 50 Pa
Thermal Bridging Details	<i>To accredited details (where available)</i>	

Building Services Element	Energy Performance Specification		
	Domestic	Non-Domestic Office (Fully-Fitted)	Non-Domestic Retail (Shell Only)
Ventilation	Mechanical Ventilation Heat Recovery (MVHR) 0.9 W/l/s 90% HR	Mechanical Ventilation Heat Recovery (MVHR) 1.6 W/l/s 90% HR + WC extract	Natural
Space Heating	Energy Centre & Heat Distribution Network: Communal Heat Network Air Source Heat Pump – COP 2.8	A+++ Rated VRF/V Electric Heat Pump Electric Heating to cores	A-Rated Split-Multi-Split
Domestic Hot Water	From Communal Low Carbon Heat Distribution Network	VRF/V Electric Heat Pump Module	Direct Electric
Lighting	Low Energy	130 Lumens/Watt Daylight sensing & occupancy control	100 Lumens/Watt Daylight sensing & occupancy control
Cooling	N/A	A+++ Rated VRF/V Electric Heat Pump	A-Rated Split-Multi-Split
Additional Features	117kW Solar PV Array	Power Factor Correction Automatic Metering with Alarms for Out of Range	N/A

Appendix B: Sample SAP DER Worksheets

<https://www.dropbox.com/s/cm679w685ae220z/APPENDIX%20B%20DER%20WORKSHEETS.pdf?dl=0>

Appendix C: SAP 2012/SAP 10.1 Conversion Calculations

CARBON FACTORS

	SAP2012	SAP10.1
Gas	0.216	0.21
Elec	0.519	0.136

SAP10.1 TOTALS

	DOMESTIC NONDOMI TOTAL		
BASE	539	148	686
LEAN	398	110	508
GREEN	106	76	182

DOMESTIC

BASELINE

	area	no	model area
Studio	49	74	3626
1 bed	50	194	9700
2 bed	72	320	23040
3 bed	90	25	2250
townhouse	83	7	581

SAP2012 - Energy Consumption kWh

Space Hea	DHW	Lighting	Aux	PV
1339.79	2057.67	228.58		75
1151.4	2076.85	245.04		75
1985.04	2330.74	317.98		75
2090.32	2479.33	404.52		75
4232.14	2389.26	370.45		75

SAP2012-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate	CHECK
289	444	119	39		891	18.2	18.2
249	449	127	39		863	17.3	17.3
429	503	165	39		1136	15.8	15.8
452	536	210	39		1236	13.7	13.7
914	516	192	39		1661	20.0	20

SAP10.1-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate
281	432	31	10		755	15.4
242	436	33	10		721	14.4
417	489	43	10		960	13.3
439	521	55	10		1025	11.4
889	502	50	10		1451	17.5

SITE TOTAL t.CO2 539

LEAN

	area	no	model area
Studio	49	74	3626
1 bed	50	194	9700
2 bed	72	320	23040
3 bed	90	25	2250
townhouse	83	7	581

SAP2012 - Energy Consumption kWh

Space Hea	DHW	Lighting	Aux	PV
301.4778	2111.1	227.72	206.26	
146.4111	2123.911	238.72	193.8	
592.6	2387.056	317.91	298.55	
364.3444	2531.8	393.32	338.24	
2352.589	2484.544	361.8	390.13	

SAP2012-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate	CHECK
65	456	118	107		746	15.2	15.2
32	459	124	101		715	14.3	14.2
128	516	165	155		964	13.4	13.3
79	547	204	176		1005	11.2	11.1
508	537	188	202		1435	17.3	17.2

SAP10.1-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate
63	443	31	28		566	11.5
31	446	32	26		536	10.7
124	501	43	41		710	9.9
77	532	53	46		708	7.9
494	522	49	53		1118	13.5

SITE TOTAL t.CO2 398

GREEN

	area	no	model area
Studio	49	74	3626
1 bed	50	194	9700
2 bed	72	320	23040
3 bed	90	25	2250
townhouse	83	7	581

SAP2012 - Energy Consumption kWh

Space Hea	DHW	Lighting	Aux	PV
96.90357	678.5679	227.72	208.35	-129.54
47.06071	682.6857	238.72	195.65	-129.54
190.4786	767.2679	317.91	301.95	-181.36
117.1107	813.7929	393.32	341.73	-233.18
756.1893	798.6036	361.8	397.99	-215.9

SAP2012-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate	CHECK
50	352	118	108	-67	562	11.5	11.4
24	354	124	102	-67	537	10.7	10.7
99	398	165	157	-94	725	10.1	10
61	422	204	177	-121	744	8.3	8.2
392	414	188	207	-112	1089	13.1	13

SAP10.1-CO2

Space Hea	DHW	Lighting	Aux	PV	Total	Rate
13	92	31	28	-18	147	3.0
6	93	32	27	-18	141	2.8
26	104	43	41	-25	190	2.6
16	111	53	46	-32	195	2.2
103	109	49	54	-29	285	3.4

SITE TOTAL t.CO2 106

NON-DOMESTIC

BASELINE

	area	no	model area
Office	18907	1	18907
Retail	1712	1	1712
Health	677	1	677

SBEM2012 - Energy Consumption kWh/m2

Space Hea	DHW	Lighting	Aux	Cool	Gas	Elec
6.4	3.22	19.85	2.31	7.85	9.62	30
5.78	1.81	59.11	0	45.03	7.59	102
18.84	3.91	22.71	0	4.19	22.75	27

SBEM2012-CO2

Gas	Elec	Total	Rate	CHECK
39287	294480.1	333767	17.7	17.7
2807	90680.68	93487	54.6	54.5
3327	9451.665	12778	18.9	18.9

SAP10.1-CO2

Gas	Elec	Total	Rate
38196	77166	115362	6.1
2729	23762	26491	15.5
3234	2477	5711	8.4

SITE TOTAL t.CO2 148

LEAN

	area	no	model area
Office	18907	1	18907
Retail	1712	1	1712
Health	677	1	677

SBEM2012 - Energy Consumption kWh/m2

Space Hea	DHW	Lighting	Aux	Cool	Gas	Elec
9.53	3.57	7.95	5	3.73	8.4	21
8.75	1.57	27.85	0	36.72	8.75	66
19.3	3.38	12.68	0	4.58	19.3	21

SBEM2012-CO2

Gas	Elec	Total	Rate	CHECK
34305	204551.3	238856	12.6	12.6
3236	58767.24	62003	36.2	36.2
2822	7252.132	10074	14.9	14.9

SAP10.1-CO2

Gas	Elec	Total	Rate
33352	53601	86953	4.6
3146	15400	18545	10.8
2744	1900	4644	6.9

SITE TOTAL t.CO2 110

GREEN

	area	no	model area
Office	18907	1	18907
Retail	1712	1	1712
Health	677	1	677

SBEM2012 - Energy Consumption kWh/m2

Space Hea	DHW	Lighting	Aux	Cool	Gas	Elec
5.56	0.64	7.95	2.31	3.73	0	22
2.34	1.57	27.85	0	36.72	0	68
5.17	3.38	12.68	0	4.38	0	26

SBEM2012-CO2

Gas	Elec	Total	Rate	CHECK
0	218902.4	218902	11.6	11.6
0	60846.4	60846	35.5	35.5
0	9065.165	9065	13.4	13.4

SAP10.1-CO2

Gas	Elec	Total	Rate
0	57362	57362	3.0
0	15944	15944	9.3
0	2375	2375	3.5

SITE TOTAL t.CO2 76