Energy Strategy Report

Stage 2

Southampton Row
London Borough of Camden

Issue No. 1.1
Ref: 8031 – Southampton Row
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1. Issue Register

Rev	Reason for Issue	Date	Issued By	Checked By
1.0	Stage 2	12/04/19	MO'G	KH
1.1	Stage 2 – following comments	14/05/19	MO'G	KH

This document was checked by

Keith Harding

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2. Contents

3. Executive Summary

The Southampton Row development is considered to be a refurbishment of an existing building with a new extension with regards to Building Regulations and local planning. The refurbishment and part of the new build area will become a hotel, while the remaining area of the new build will consist of 9 residential units. An overview of the Stage 2 Energy Strategy is outlined below.

'Base Case'

Base Case for a new build scheme refers to the carbon emissions Target Emission Rate (TER) from Part L of the Building Regulations (2013).

For a new build development, Base Case refers to an energy performance compliant with Part L of the Building Regulations, called the Target Emission Rate (TER), as dictated by the London Plan. For the new build extension of the Southampton Row development, this is the TER that is used for this study.

However, for the existing building utilising the TER as the Base Case is not appropriate as the TER is intended for use as a target against which a new build is compared and would not be achievable for an existing building. For the existing building, and in line with GLA guidance, a more appropriate target is to calculate the energy consumption and carbon dioxide emissions for the existing building. As the existing building has been stripped and in lieu of installed existing systems information minimum Part L standards have been utilised with the thermal envelope of the building being as per the existing structure.

Development TER = 380,842kgCO_2/year

'Be Lean'

Be Lean refers to all the energy efficiency measures employed to improve the energy performance of the development and includes the following:

- Improved U-Values
- Infiltration rate of 15 $m^3/h.m^2$ (averaged)
- Improved lighting efficiency
- Improved systems performance

"Be Lean" Overall Emissions = 365,046 kgCO_2/year
The carbon emissions presented are greater than the base case.

'Be Clean'

Be Clean refers to community heating, CHP incorporated into the building design to improve the development's energy performance. For this development, CHP is incorporated to provide DHW to the hotel.

"Be Clean" Overall Emissions = 305,603 kgCO_2/year

'Be Green'

It is proposed to provide space heating via ASHP and roof mounted solar PV panels with a total approximate area of 16.3m^2 to generate on site renewable electricity.

"Be Green" Overall Emissions = 287,415 kgCO_2/year = 24.53% decrease on Base Case.

Summary of Overall Carbon Emission Performance:

Whole Development	Emissions (kg CO_2/year)	Carbon reduction to previous stage (kg CO_2)	% carbon reduction compared to previous stage
Base Case	380,842	N/A	N/A
Be Lean	365,046	15,796	4.15%
Be Clean	305,603	59,443	16.28%
Be Green	287,415	18,188	5.95%
Renewable contribution	5.95%		
Overall reduction compared to Part L 2013 target	24.53%		

Table 1 - Summary of Carbon Emissions Performance

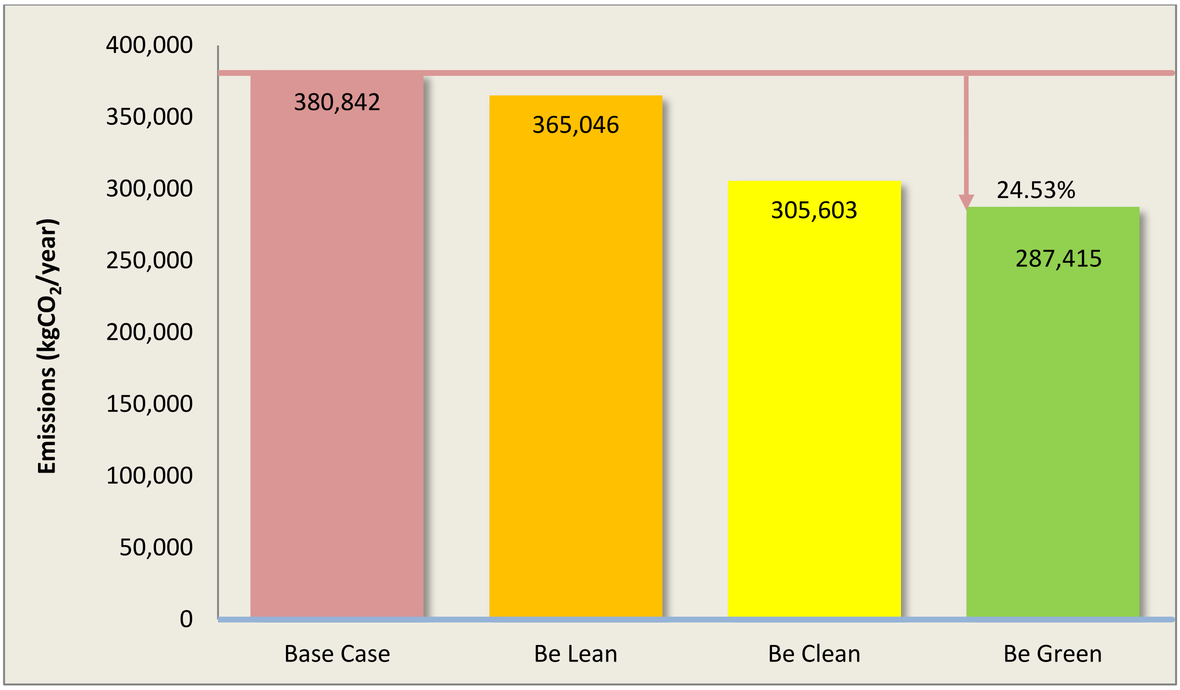

Figure 1 - Summary of Overall Carbon Emission Performance

The results above demonstrate that the annual CO_2 emissions are predicted to be 24.53% below the regulated Target Emission Rate (TER) for the whole development.

4. Introduction

4.1. Aim of the Analysis

This report forms part of the Stage 2 submission. Its aim is to document the design considerations and processes undertaken during Stage 2 regarding the Energy Strategy for the development.

The analysis looks to assess feasibility and incorporate passive design measures, efficient conditioning strategy and Low and Zero Carbon (LZC) technologies.

This analysis is within the context of current building regulations and planning requirements.

4.2. The Development

The Southampton Row development will consist of both new build and existing spaces. The existing building is Carlisle House, a Grade II listed building. Carlisle House will be redeveloped into a hotel with restaurant, reception, and bedroom and back of house areas. The new build extension on the east side of Carlisle House will contain further bedroom spaces and residential units. The listed status of Carlisle House places limitations on the improvements that can be made to the building envelope.

4.3. Planning Policy Context

4.3.1. National Policy

Climate Change Act 2008
The Climate Change Bill was introduced into Parliament on 14 November 2007 and became law on 26 November 2008.The two key aims of the Act are as follows:

Improve carbon management, helping the transition towards a low-carbon economy in the UK.
Demonstrate UK leadership internationally, signalling we are committed to taking our share of responsibility for reducing global emissions in the context of developing negotiations on a post-2012 global agreement at Copenhagen in December 2009.

The key provision of the Act is a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050, to be achieved through action in the UK and abroad, including a reduction in emissions of at least 34% by 2020. Both targets are against a 1990 baseline. This provision is to be achieved via a carbon budgeting system that caps emissions over five-year periods, with three budgets set at a time, to help us stay on track for our 2050 target. The first three Carbon budgets will run from 2008-12, 2013-17 and 2018-22, and were set in May 2009. The Government must report to Parliament its policies and proposals to meet the budgets. This requirement is fulfilled by the UK Low Carbon Transition Plan. Further measures to reduce emissions are included in the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme.

National Planning Policy Framework (NPPF)
NPPF states that planning should support the "delivery of renewable and low carbon energy and associated infrastructure" (Paragraph 93). More specifically, paragraph 95 requires local planning authorities to:

Plan for new development in locations and ways which reduce greenhouse gas emissions;
Actively support energy efficiency improvements to existing buildings; and when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.

Paragraph 97 of the NPPF requires local planning authorities to:

Have a positive strategy to promote energy from renewable and low carbon sources;
Design their policies to maximise renewable and low carbon energy development while ensuring that adverse impacts are addressed satisfactorily, including cumulative landscape and visual impacts.
Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;
Support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning; and
Identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

4.3.2. Regional Policy

The sustainability policies for London Borough of Camden are contained within the Camden Planning Guidance 3 (CPG3).

This document broadly follows the Be Lean, Be Clean and Be Green approach of the London Plan by requiring that energy efficient façade design is firstly used to minimise energy consumption by considering the effect that items such as passive solar gain, external shading, daylight and natural ventilation have on both occupancy comfort and on the reduction of energy consumption. The design of the building envelope should also utilise high levels of thermal efficiency, low thermal bridging and low air permeability to minimise energy consumption. Other measures such as low energy lighting, lighting control and mechanical ventilation heat recovery should also be considered.

Following Be Lean design measures, the mechanical design should be undertaken to further reduce energy consumption. The preference is to connect to a local district heat network with an onsite community heating system, possibly containing CHP, being an additional consideration.

Finally, on-site renewable are to be included where feasible.

4.3.3. Part L Building Regulations

Part L 2013 with 2016 amendments of the Building Regulations refers to the Conservation of Fuel and Power. Part L1 relates to residential development and Part L2 to non-domestic.

The suffix A relates to new construction and B to existing buildings. The proposed development contains both new build non-domestic areas and refurbished existing non-domestic areas and therefore is required to adhere to Part L2A:2013 with 2016 amendments for the new build areas and Part L2B:2013 with 2016 amendments for the refurbished non-domestic areas

5. Methodology

5.1. Energy Hierarchy

This report sets out the approach the design of the development is to take in terms of energy efficiency. In order to prioritise energy efficiency and passive design measures to reduce carbon, the development will be designed according to a three stage process of “Be Lean, Be Clean, and Be Green”.

The aim of the report is carbon dioxide reduction, first by reduction of energy consumption through passive measures and good architectural design, then through employing efficient plant and equipment to provide for the energy demands, and finally by employing Low or Zero Carbon Technologies for energy generation.

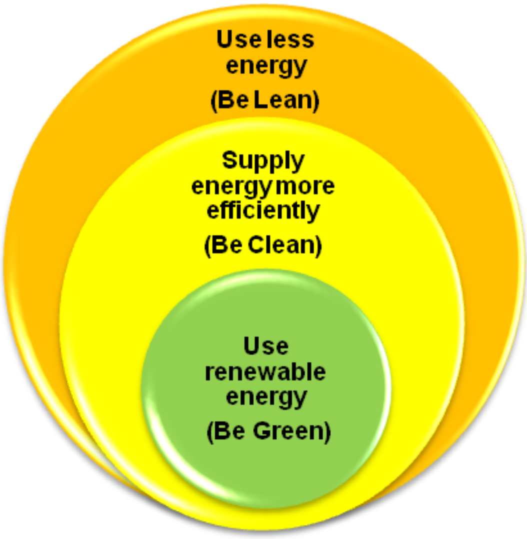

Figure 2 -The Energy Hierarchy

‘Base Case’

For a new build development, Base Case refers to an energy performance compliant with Part L of the Building Regulations, called the Target Emission Rate (TER), as dictated by the London Plan. For the new build extension of the Southampton Row development, this is the TER that is used for this study.

However, for the existing building utilising the TER as the Base Case is not appropriate as the TER is intended for use as a target against which a new build is compared and would not be achievable for an existing building. For an existing building, a more appropriate target is to calculate the energy consumption and carbon dioxide emissions for the existing building and to account for all proposed works to the thermal envelope and systems as though these works were to be completed utilising the minimum performance values required by Part L.

Therefore, to obtain a Base Case emissions rate of the existing areas of the Southampton Row development, the thermal model utilises Part L minimum performance standards for systems performances and lighting efficiencies and gains. The thermal envelope of the building is unaltered due to its listed status, so the construction values of the building at the Base Case stage are that of the existing building.

Further information is presented in Section 6.

'Be Lean'

Various energy-saving measures are considered in terms of technical feasibility and their effect on energy usage in Section 6. A package of energy-saving measures is proposed that attempts to meet the minimum Part L standard, without reliance on the contribution of CHP or renewables.

The detailed calculations are presented in Section 7.

'Be Clean'

Be Clean is the consideration of centralised energy systems, district heating networks and combined heat and power (CHP) systems.

Additional information presented in Section 8.

'Be Green'

A renewable energy assessment has been undertaken based upon the results of the Dynamic Thermal Modelling process (detailed below) and renewable technology data from manufacturers. The strategic issues relating to each technology are also considered in the context of the proposed development, and preferred options are short-listed. These are then considered in more detail in terms of technical feasibility and its effect on energy reduction.

The detailed calculations are presented in Section 9.

5.2. Energy Modelling

A simulation model of the design proposal has been constructed to investigate the response of the building system to its surrounding environment.

The energy use and carbon performance analysis for the commercial units and landlord areas have been calculated using IES VE 2018, a dynamic thermal modelling tool.

The results contained in this report are based on a full dynamic thermal simulation of the development.

6. 'Base Case'

For a new build development, Base Case refers to an energy performance compliant with Part L of the Building Regulations, called the Target Emission Rate (TER), as dictated by the London Plan. For the new build extension of the Southampton Row development, this is the TER that is used for this study.

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6.1. Existing Building 'Base Case' Specification

Data	Unit	Value
Construction[1]		
Wall U-Value	$W/m^2.K$	3.20 (Existing Basement) 1.38 (Existing External Wall)
Roof U-Value	$W/m^2.K$	0.45 (Existing Roof)
Ground Floor U-Value	$W/m^2.K$	3.37 (Existing Basement and Ground Floor)
Exposed Floor	$W/m^2.K$	3.37 (Existing Basement and Ground Floor)
Glazing U-Value (glass and frame)	$W/m^2.K$	1.8 (Existing, Secondary)
Glazing G-Value	%	72
Glazing Light Transmittance	%	80
Ventilation		
Air Permeability	$m^3/m^2.h$	25.0 (from EPC Conventions)

[1] All construction values for the 'Base Case' model are not Part L minimum standards, but the existing building's construction values. This is due to the fact that the existing building is not undergoing any alterations to its thermal envelope.

Type of Ventilation	-	Mechanical Ventilation
Central System SFP	W/l/s	2.5
Terminal Unit SFP	W/l/s	0.5
Heat Recovery	%	73
Primary Heating		
Heating Source	-	Gas Boiler
Heat emitters	-	FCU
Boiler seasonal efficiency	%	92.0
Primary Cooling		
Cooling System	-	Air Cooled Chillers
Cooling Emitters	-	FCU
EER/SEER	-	2.6/2.6
Lighting		
General Details	-	No PIR or daylight controls
Office Lighting efficiency	Lumens/cW	60 to all spaces

Table 2 - 'Base Case' Specification

6.2. Results

The results from the “Base Case” stage calculation are presented in the graph below:

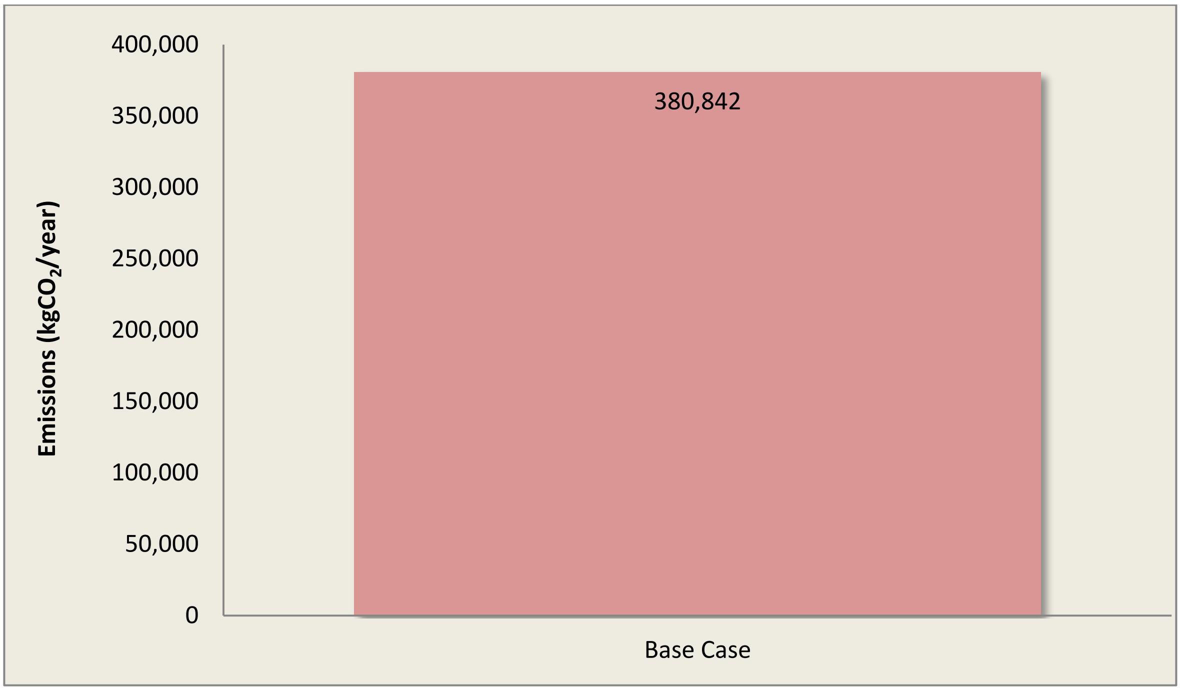


Figure 3 - 'Base Case' Emissions

Development TER = 380,842$kgCO_2$/year.

7. 'Be Lean'

7.1. Passive Design and Energy Efficiency Measures

'Be Lean' refers to all the energy efficiency measures employed to improve the energy performance of the development.

Dynamic Thermal Modelling assessments have been undertaken from inception to intelligently inform the design. This included assessing thermal comfort during the Concept Design stage in order to assess the impact of glazing areas, U-Value and g-Value specifications etc. and suggest amendments in order to improve the internal conditions. The carbon emissions output from the Dynamic Thermal modelling for non-domestic areas is known as the Building Emission Rate (BER).

7.2. Energy Efficiency Measures

The exhaustive list of input data used for the "Be Lean" stage for the Southampton Row development is presented below:

Data	Unit	Value
Construction		
External Walls	$W/m^2.K$	3.20 (Existing Basement) 1.38 (Existing External Wall) 0.16 (New Wall)
Roof U-Value	$W/m^2.K$	0.45 (Existing Roof) 0.12 (New Roof)
Exposed Ground Floor U-Value	$W/m^2.K$	3.37 (Existing Basement and Ground Floor) 0.15 (New Basement)
Vertical Glazing U-Value (including frame)	$W/m^2.K$	1.8 (Existing, Secondary) 1.3 (New)
Vertical Glazing G-Value	$W/m^2.K$	0.72
Ventilation		
Air Permeability	$m^3/h.m^2$ at 50Pa	15
Type of ventilation		
Bedrooms, Restaurant, Reception, Circulation, BOH		Mechanical with heat recovery
En Suites, Linen Store		Mechanical extract
Stairs, Residential		Natural Ventilation
Water Heating		
Source of Domestic Hot Water		Dedicated (Gas)
Boiler seasonal efficiency (%)		Hotel: 95.74 Residential: 96.03
Storage Volume (Hotel)		1500L
Standing Losses		3.75 kWh / day

Primary Heating			
VRF Seasonal Coefficient of Performance (SCOP)	kW/kW	2.93-4.4	
Gas Boiler	%	96.03	
Heating supply			
Bedroom, En Suites, Restaurant, Reception,		FCU	
En Suite Bathrooms, Stairs, Linen Store		Electric Radiator	
Residential		Underfloor Heating	
Primary Cooling			
Bedrooms, Restaurant, Reception, Circulation		4.60 - 4.85	
Residential		2.6	
Lighting			
Internal Lighting Gain			
BOH, Store, Basement	W/m²/100 lux	3.5	
Bedroom, En Suite		3.1	
Restaurant, Bar		1.24	
Reception		3.5	
New Circulation		1.17	
Existing Circulation		1.3	
Kitchen		3.5	
Lighting Control			
Parasitic power of lighting sensors	W/m²	0.10	
Space	**Control Type**	**Occupancy Sensing?**	**Daylight Sensing?**
Bedrooms	Switching	Auto	×
Restaurant	Switching	None	×
Reception	Switching	Auto	×
Circulation	Switching	Auto	×
BOH	Switching	Auto	×
Plant	Switching	Auto	×
En Suite Bathroom	Switching	Auto	×
Linen Store	Switching	Manual	×
Stairs	Switching	Auto	×
Management Factors			
Metering		Yes	
Out of range		Yes	
Power Factor Correction		Yes (0.9-0.95)	

Table 3 - 'Be Lean' Specification

7.3. Results

The results from the “Be Lean” stage calculation are presented in the graph below:

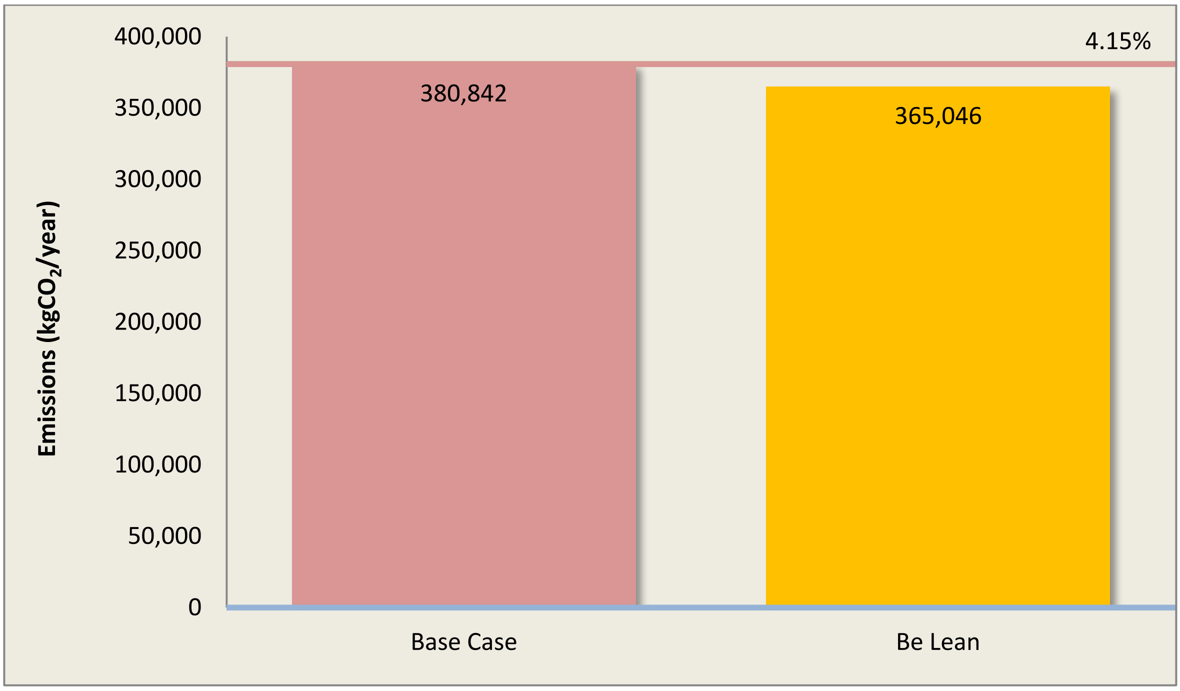


Figure 4 - Be Lean Emissions

Be Lean” Overall Emissions = 365,046 $kgCO_2$/year

The development at the ‘Be Lean’ stage increases on the whole development Target Emission Rate set by Building Regulations. There is an overall reduction of 4.15% against the TER for the total development.

8. Be Clean

8.1. District Heat Networks

The London Heat Map[2] is consulted to determine the feasibility of heat network connection in London. The figure below demonstrates that the connection of the Southampton Row development to a district heat network is not feasible for a number of reasons. The development is 0.7 miles (by road) from the nearest proposed heat network, and 0.8 miles from the nearest existing heat network. The works required to connect to either of these options would cause major disruption along major roads.

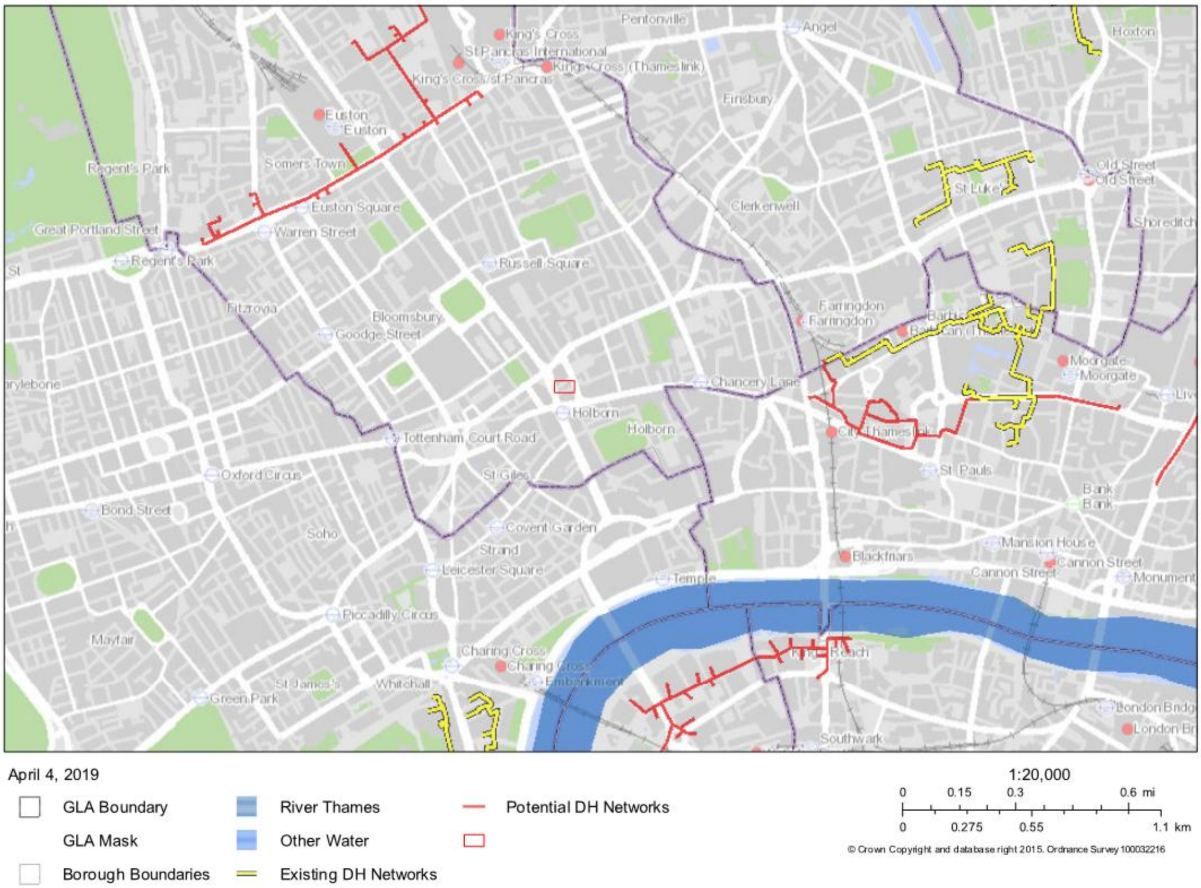


Figure 5 - Map of the proposed (red) and existing (yellow) district heating networks for the area surrounding the development. The Southampton Row development's location is indicated by the red box in the centre.

[2] https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map

8.2. Centralised Energy Solution

The operation of a site wide decentralised energy generation plant should be based on the presence of a base heating or cooling load on site.

Centralised energy solutions generally operate with either Combined Heating or Power (CHP); or as Combined Cooling Heating and Power (CCHP).

8.2.1. Combined Heat and Power (CHP)

Combined Heat and Power (CHP) is an efficient form of power generation since the transmission losses are lower providing greater efficiency.

Combined Heat & Power (CHP) converts a fuel into both electricity and heat within a single unit at the point of use and can deliver a number of positive financial, operational and environmental benefits. A CHP unit utilises an engine, often fuelled by natural gas, linked to an alternator to produce electricity. Heat is recovered from the engine by removal from the exhaust, water jacket and oil cooling circuits.

CHP is appropriate for this development for a number of reasons. Past energy strategies for hotel developments show that DHW is a significant portion of the annual carbon emissions (frequently as much as half). This can make achieving Part L criteria difficult. Coupled with the inability to connect to a district heating network, this makes CHP a good candidate for meeting the DHW load while keeping carbon emissions to a minimum.

CHP Information

Location	Plant Space
Buffer Vessel	3 x 1m^3
Manufacturer	SAV Systems
Model	Loadtracker CHP XRGI 20
No.	3
Thermal Output	38.7kWth
Electrical Output	20kWe
Fuel	Gas
Fuel Consumption	67.2kW HHV
Thermal Efficiency	57.6%
Electrical Efficiency	29.8%
Overall Efficiency	79.5%
Heat to Power Ratio	1.9
Selective Catalytic Reduction	Yes
NOx Emissions	19mg/kWh (NCV)

Total energy exported per years (%)	Output to be used on site where possible. Remainder to be exported.
Life span (years)	10-15 years with maintenance. Major overhaul at 10-15 years will extend lifespan.
Noise Impact	Designed to appropriate sound standards for plant room None for residential.
Land use	Internal. Located in 8^{th} floor plant space
Export electricity meter	Export meter required with network connection agreements

CHP Operation	
CHP estimated run hours	6,920
Annual heat generation (kWh)	803,357
Annual electricity generation (kWh)	415,172
Annual carbon saving (kg CO_2)	86,923 (based on Part L calculations)
Carbon saving contribution	22.22% over Lean Design
Annual provision of DHW to site	74.40%

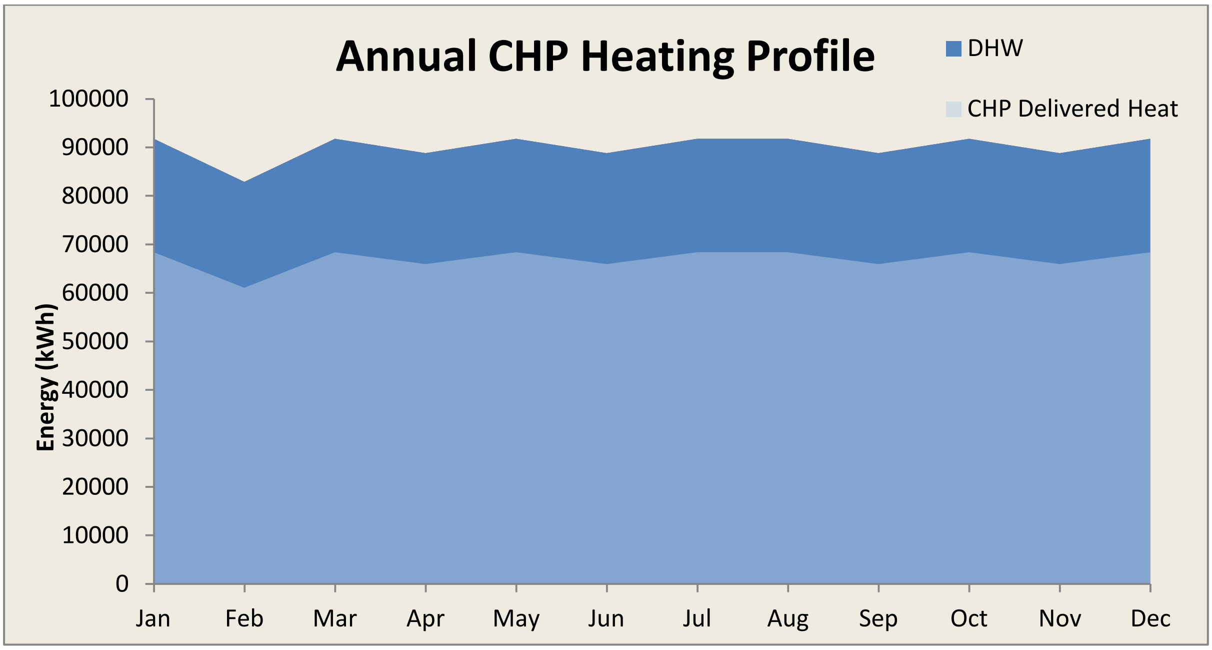


Figure 6 - Annual Heating Profile for the CHP system used for the hotel DHW demand

8.2.2. Combined Cooling, Heat and Power (CCHP)

As per Section 8.2, a site wide Combined Cooling Heat and Power plant should be based on the presence of a base heating load on site. Whilst a CHP unit will be appropriate, the cooling load size may to be low to allow an adsorption chiller to be operated effectively and efficiently meaning that the installation of the absorption chiller would not be technically or financially feasible.

8.3. Results

The results from the 'Be Clean' stage are presented below:

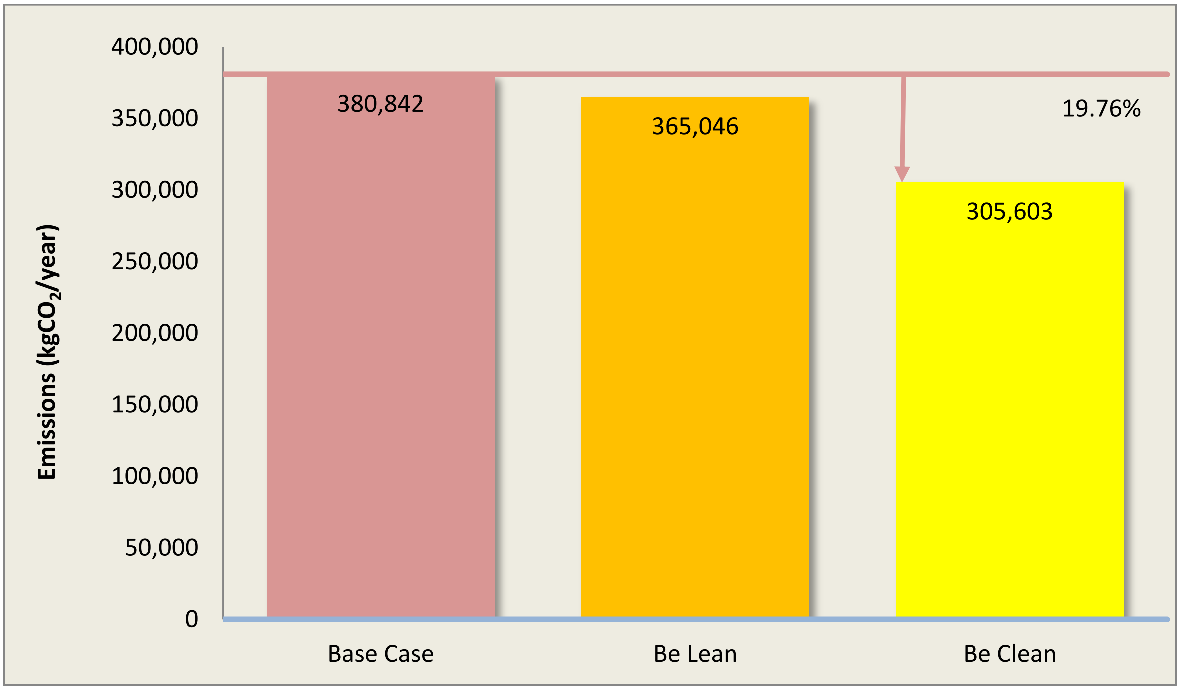


Figure 7 - Be Clean Emissions

"Be Clean" Overall Emissions = 305,603 $kgCO_2$/year

The development at the 'Be Clean' stage further reduces the carbon emissions of the development, to a total of 19.76% below the 'Base Case' model.

9. Be Green

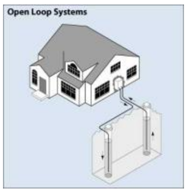
9.1. Technical Assessment

The first step of the analysis examines the suitability of all the renewable technologies which can potentially be integrated into the development.

This is examined by the design team in terms of technical feasibility.

Renewable Technology		Applicability	Conclusion
Wind turbine		Situated in an urban environment, the site is surrounded by other buildings and as such the wind yield will be turbulent and non continuous. Since the electricity production is proportionate to the cube of the wind speed, thus a lower and turbulent wind speed will diminish the electricity production and increase the payback period. The inclusion of wind turbines will also affect the height restrictions and visual impact of the development In addition a wind turbine will generate noise and, potentially, vibrations which would prove detrimental to a residential development and surrounding areas.	Not Applicable
Solar Water Heating		The technology conflicts with the proposed CHP system which is proposed to provide heat for domestic hot water demand and space heating The site has a greater electrical demand in comparison to DHW and as a result allocating the roof space to PV would provide a greater benefit to the development.	Not Applicable

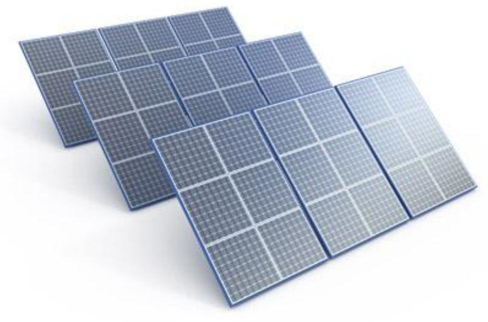
Ground Source Heat Pump (GSHP)		A ground source heat pump has been considered for provision of cooling to the residential units. The cooling load for these spaces is low, meaning that any capital cost of installing the heat pump would have a very long payback time. Thus, it is recommended that a GSHP is not used for this development.	Not Applicable
Air Source Heat Pump (ASHP)		This technology is considered to be suitable for application to the Hotel area. It provides high efficiency heating and cooling to all conditioned spaces, cutting carbon emissions in the process.	Applicable
Biodiesel		Biodiesel can potentially offer higher CO_2 savings compared to other renewable technologies. However, this option comes with considerable issues: Frequent deliveries are required. A biodiesel storage tank is required. Air quality to be assessed and filtration considered.	Not Applicable
Photovoltaics		Photovoltaics can be installed on the available roof areas of the development. The technology is straightforward to install on any development and does not require any integration or create conflict with the main building services plant.	Applicable
Biomass		Biomass can potentially offer higher CO_2 savings compared to other renewable technologies. However, this option comes with considerable issues: Frequent deliveries are required A fuel storage tank is required. Air quality to be assessed and filtration considered.	Not Applicable

Water Source Heat Pump		An open loop water source heat pump is not proposed for this development as there is no water source available.	Not Applicable

The technical feasibility assessment carried out by the design team and documented above give a clear route forward for the most efficient and technically feasible solution for the development, that being a community heating system with high efficiency gas boilers, along with rooftop PV and ASHP space heating and cooling.

The calculation in the next section assesses the PV panels and ASHP in detail as the technologies to be taken through for the 'Be Green' stage of the carbon emissions hierarchy.

9.2. Detailed Feasibility Analysis - PVs



Description

Photovoltaics (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. In the UK they currently benefit financially from the Feed-In Tariff scheme.

A roof plan for PV is shown in the Appendix.

General information

Height of the building (m)	~27m
Access to solar radiation	Yes
Angle of the roof	0°
Orientation of the collector	10 panels facing South
Over shading factor	None or Very Little <20%
Total energy exported per years (%)	Output to be used on site where possible. Export to be 0% if possible
Type of integration	Framed

Technical information

Total area of PVs (m^2)	16.3
Area of one PV panel (m^2)	1.63
Tilt of collector (^{o})	10 ^{o}
Number of PV panels	10
Type of PV panels	Monocrystalline
Output per PV panel (W)	327Wp
Total PV capacity (kW)	3.27kWp
Life span (years)	20
Noise	None
Land of use	Roof mounted PV panels

Feasibility of exporting electricity from the system

All of the electricity generated by the PV panels will be used within the site where possible with any excess being exported. Thus an export meter and agreement will be required.

General cost (Estimation)

Capital cost (£)	£ 3,900[3]
Annual saving (£) from use of PV electricity	£ 492
Annual saving (£) from FIT	£ 0
Maintenance (£)	£ 39
Payback period (years)	8

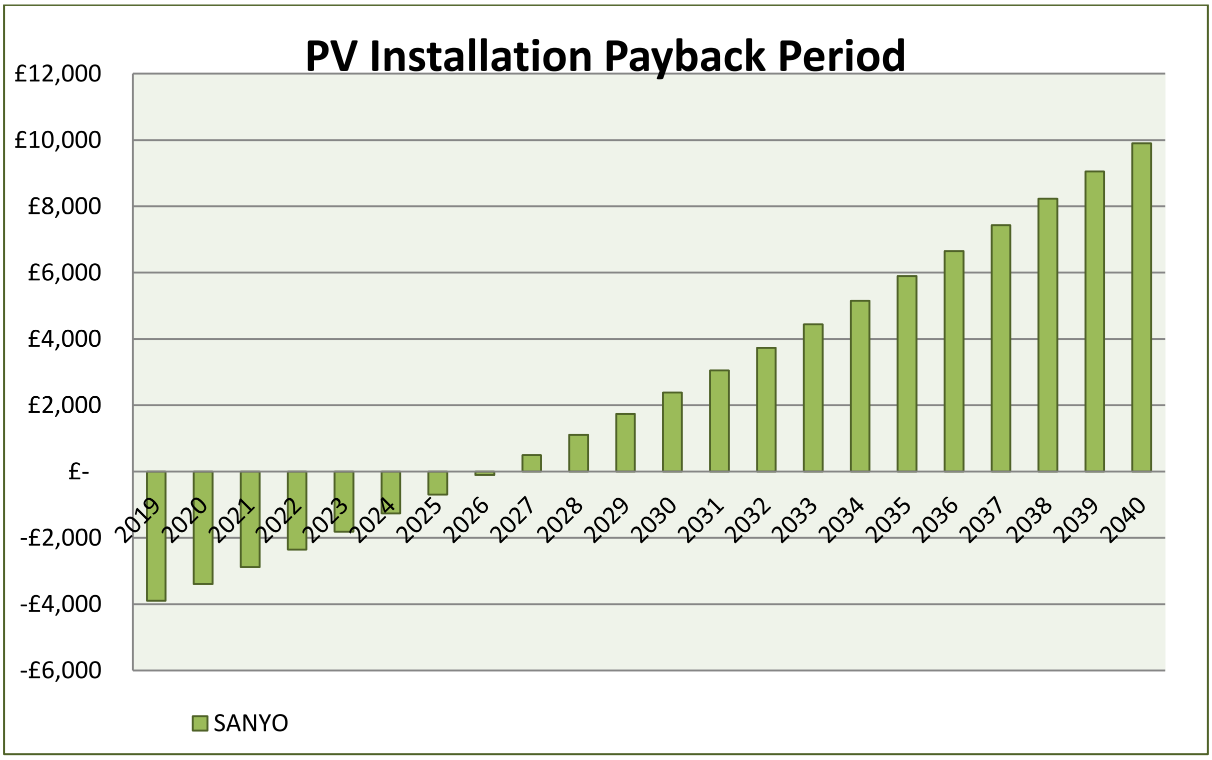


Figure 8 - PV Installation Payback

PV Carbon saving

Annual Energy Saving (kWh)	2,347
Annual carbon saving (kg CO_2)	1,218
PV contribution over Clean (%)	0.41%

Drawings showing the PV layout are contained in the appendix.

[3] Based on a price of £260/panel (inc. VAT)

9.3. Detailed Feasibility Analysis - ASHP

Description

Air source heat pumps (ASHP) is a system which transfers heat from outside to inside a building. Using vapour compression refrigeration, an ASHP uses a system involving a compressor and a condenser to absorb heat at one place and release it at another.

Advantages: - ASHP can be run in reverse cycle to provide both heating and cooling

The Air Source Heat Pump is to provide heating and cooling to the Hotel areas.

Technical Information

Heating SCOP of ASHP	Heating = 2.93 - 4.4
Life span (years)	25
Noise	Minimal to Moderate dependant on location
Visual Impact	Minimal – technology is normally low profile.
Land of use	Plant Space / Roof Space
Capital cost (£)	£0[1]
Annual Fuel Saving (£) using ASHP	£11,336 (using Part L consumptions)
Maintenance (£)	£1,200 (common for both boilers and ASHP)
Payback period (years)	-[1]

[1] Only the heating side of a VRF is classified as a Be Green measure. As the cooling side is already included within Be Lean measures, including the heating side within the design incurs no additional cost.

ASHP Heating Carbon Saving

Annual Energy Saving (kWh)	78,565
Annual carbon saving (kg CO_2)	16,970
ASHP contribution over Clean (%)	5.72%

Total ‘Be Green’ Carbon Saving

Annual Energy Saving (kWh)	80,912
Annual carbon saving (kg CO_2)	18,188
Total Renewable contribution over Clean (%)	6.13%

The results from the ‘Be Green’ stage calculation are presented in the Graph below:

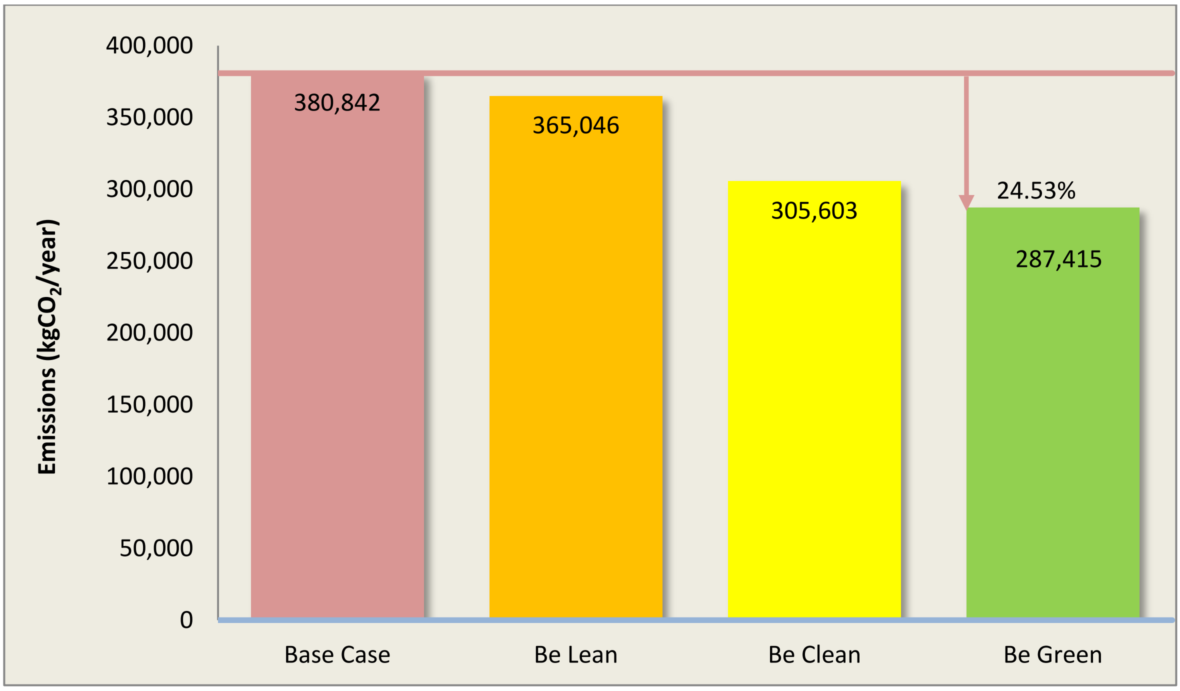


Figure 9 - Be Green Emissions

Be Green refers to the renewable technologies incorporated into the building design to improve the development’s energy performance. This report promotes the installation of roof mounted PV panels to provide renewable electricity and ASHP to provide renewable space heating.

“Be Green” Overall Emissions = 287,415 kgCO_2/year

“Be Green” Overall Emissions = 24.53% reduction on Base Case

The results above demonstrate that the annual CO_2 emissions are predicted to be 24.53% below the regulated target emission rate (TER), complying with Part L.

10. Summary of Solution

This report highlighted the energy strategy proposed for the Southampton Row development, the main points of this report are summarised below:

'Be Lean'

- Improved U-Values
- Improved lighting efficiency
- Reduced infiltration where possible
- Improved systems performance

'Be Clean'

- CHP is used to meet the high hotel DHW demand

'Be Green'

- 16.3m^2 of PV panels with a total capacity of 3.3kWp
- ASHP providing space heating to hotel

The table below summarises the regulated CO_2 emissions performance for each stage for the development as a whole:

Whole Development	Emissions (kg CO_2/year)	Carbon reduction to previous stage (kg CO_2)	% carbon reduction compared to previous stage
Base Case	380,842	N/A	N/A
Be Lean	365,046	15,796	4.15%
Be Clean	305,603	59,443	16.28%
Be Green	287,415	18,188	5.95%
Renewable contribution	5.95%		
Overall reduction compared to Part L 2013 target	24.53%		

Table 4 - Regulated Emissions for the whole development

The results in the table above are visualised in the graph below:

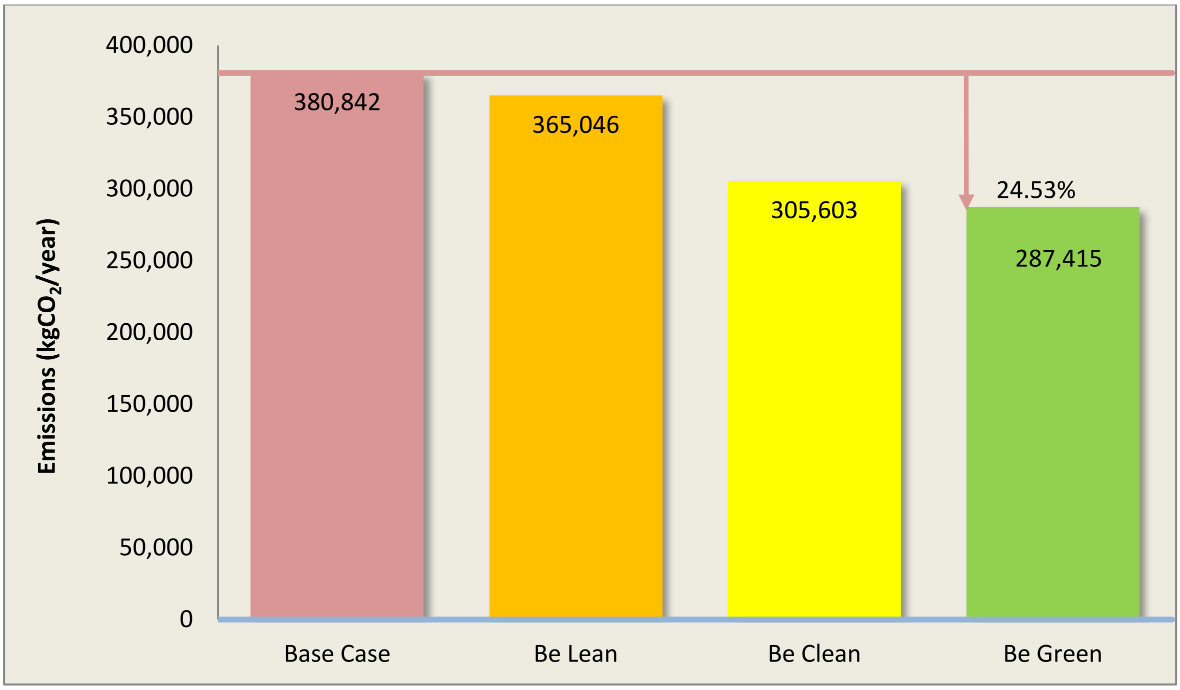


Figure 10 - Summary of Regulated Carbon Emissions

The results above demonstrate that the annual regulated and unregulated CO_2 emissions are predicted to be 24.53% below the regulated target emission rate (TER) for the development.

The results show that the development passes Part L compliance.

11. Appendix A – Results Breakdown

The results from section 10 are the sum of both the commercial and residential parts of the development. The breakdown of the results into the two types of building is presented in the tables below.

Summary of Regulated CO_2 Emissions		Hotel	Residential
Base Case	380,842	371,534	9,308
Be Lean	365,046	356,102	8,944
Be Clean	305,603	296,659	8,944
Be Green	287,415	278,471	8,944

Table 5 - Summary of the emissions of the Southampton Row development, split into the hotel and residential areas

In accordance with GLA guidance the carbon emissions of the new and existing sections for the whole development are shown below (note that the 'New' emissions include both the New build hotel areas and the residential units):

Summary of Regulated CO_2 Emissions		Existing	New
Base Case	380,842	232,729	148,113
Be Lean	365,046	205,080	159,966
Be Clean	305,603	178,343	127,260
Be Green	287,415	170,162	117,253

Table 6 - Breakdown of carbon emissions results, split into existing and new build areas, according to GLA guidance

12. Appendix B – Regulated and Unregulated CO_2 Emissions

The regulated and unregulated carbon dioxide emissions are presented in the tables below:

Summary of Regulated & Unregulated CO_2 Emissions		Hotel	Residential
Base Case	479,473	460,404	19,069
Be Lean	463,677	444,972	18,705
Be Clean	404,234	385,529	18,705
Be Green	386,046	367,341	18,705

Table 7 - Summary of the regulated and unregulated carbon emissions for both the hotel and residential areas

Whole Development	Emissions (kg CO_2/year)	Carbon reduction to previous stage (kg CO_2)	% carbon reduction compared to previous stage
Base Case	479,473	N/A	N/A
Be Lean	463,677	15,796	3.29%
Be Clean	404,234	59,443	12.82%
Be Green	386,046	18,188	4.50%
Renewable contribution	4.50%		
Overall reduction compared to Part L 2013 target	19.49%		

Table 8 - Summary of the regulated and unregulated carbon emissions for both the hotel and residential areas

13. Appendix C – PV Layout

The proposed PV layout for the Southampton Row development is demonstrated in the figure below:

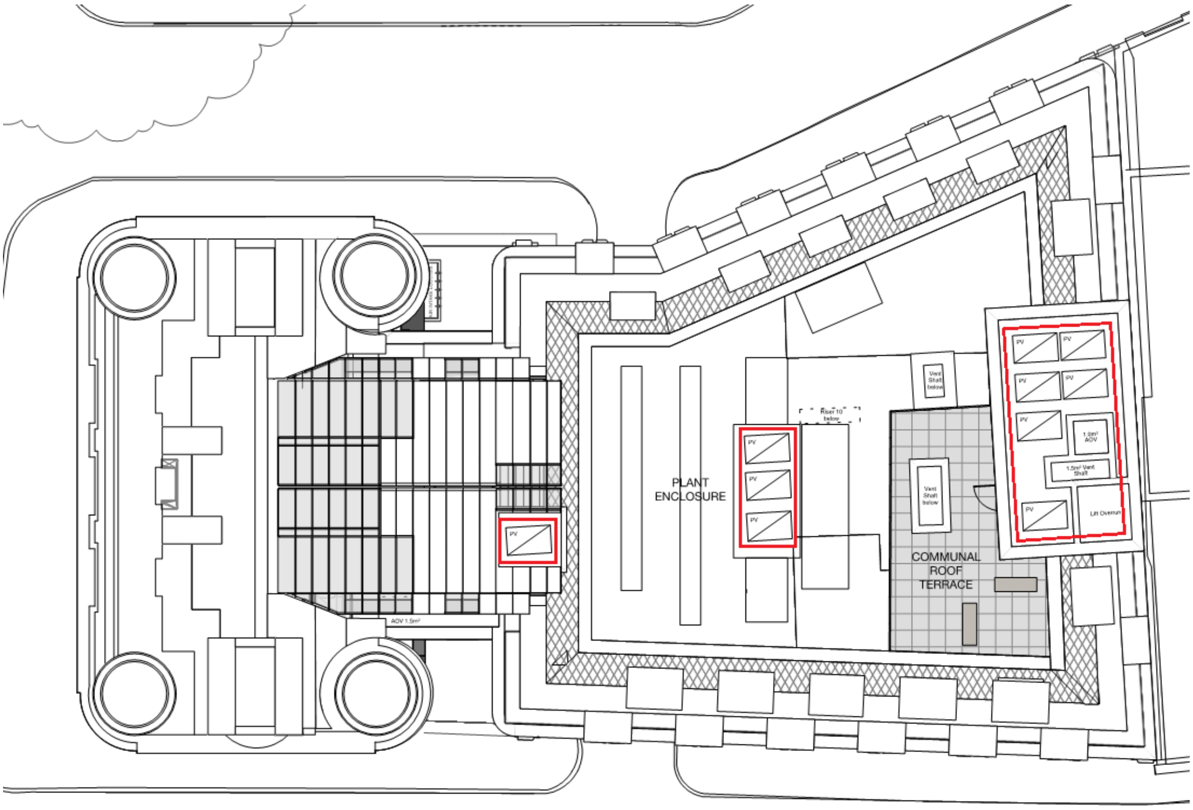


Figure 11 - PV layout on the roof of the development

A total of 10 panels, each of area 1.63m^2, are placed on all available flat roof areas.

14. Appendix D – SAP 10 Conversion

In line with GLA guidance, updated (SAP 10) carbon emissions factors have been used to assess the expected carbon performance of the new development. The results contained in this section are those obtained using SAP 10 carbon emission factors, and are for reference only.

SAP 2012 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	9	10
After energy demand reduction	9	10
After heat network / CHP	9	10
After renewable energy	9	10

SAP10 PERFORMANCE

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	8	4
After energy demand reduction	8	4
After heat network / CHP	8	4
After renewable energy	8	4

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	0	2%
Savings from heat network / CHP	0	0%
Savings from renewable energy	0	0%
Cumulative on site savings	**0**	**2%**
Annual savings from off-set payment	9	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**267**	-
Cash in-lieu contribution (£)	**16,038**	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	0	2%
Savings from heat network / CHP	0	0%
Savings from renewable energy	0	0%
Cumulative on site savings	**0**	**2%**
Annual savings from off-set payment	8	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**236**	-
Cash in-lieu contribution (£)	**14,166**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	346	89
After energy demand reduction	323	89
After heat network / CHP	148	89
After renewable energy	221	89

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	271	40
After energy demand reduction	261	40
After heat network / CHP	212	40
After renewable energy	228	40

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	24	7%
Savings from heat network / CHP	175	50%
Savings from renewable energy	-73	-21%
Total Cumulative Savings	**126**	**36%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**121**	-
Shortfall	-5	-139
Cash in-lieu contribution (£)	**-8,357**	-

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	11	4%
Savings from heat network / CHP	49	18%
Savings from renewable energy	-16	-6%
Total Cumulative Savings	**44**	**16%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	95	-
Shortfall	51	1,536
Cash in-lieu contribution (£)	**92,159**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	356		
Be lean	332	24	7%
Be clean	157	175	49%
Be green	229	-73	-20%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**128**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	279		
Be lean	268	11	4%
Be clean	220	49	17%
Be green	235	-16	-6%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,772**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	16	14	2	0	5	170	0
Non-domestic	297	727	56	121	18	176	0

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	52.66	43.25	18%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	37.89	167040
Notional	105.9	467573