APPLIED ENERGY

UNITE GROUP AND TRAVIS PERKINS

11-13 ST PANCRAS WAY, CAMDEN

ENERGY AND SUSTAINABILITY STATEMENT

"A Winning Team"
Building Services Consultancy

March 2011
Ref 0106
Revision G

The heart of student living

CONTENTS

1.0 EXECUTIVE SUMMARY

This energy and sustainability assessment has been prepared on behalf of the Unite Group Plc for the proposed development on 11 – 13 St. Pancras Way, London, NW1 0PT. The proposed mixed use development consists of ten storeys with commercial space located at ground floor level with 564 student bedrooms located above in four blocks. The accommodation buildings vary in height from five to nine storeys.

This assessment will demonstrate that the proposed scheme will improve the sustainability and environmental performance of London's built environment by increasing energy efficiency, reducing CO_2 emissions, generating energy services efficiently and implementing building integrated renewable energy technology.

The table below illustrates the CO_2 emissions reduction for each step taken through the energy design process.

Model	Carbon Dioxide Savings (Tonnes CO_2/Annum)		
	Regulated	Unregulated	Total
Building Regulations 2010 Part L Compliant Development	582.78	179.36	762.14
'Be Lean' – Energy Efficiency	567.02	179.36	746.38
'Be Clean' – CHP	343.14	179.36	522.50
'Be Green' - Renewables	343.14	179.36	522.50

Table 1: CO_2 Emissions Savings after each stage of the Energy Hierarchy

The proposed design will aim to exceed Part L 2010 Building Regulations requirements for energy performance by following the London Plan's Energy Hierarchy. These measures are estimated to result in a 2.71% reduction in CO_2 emissions when compared to the Target Emissions Rate (TER).

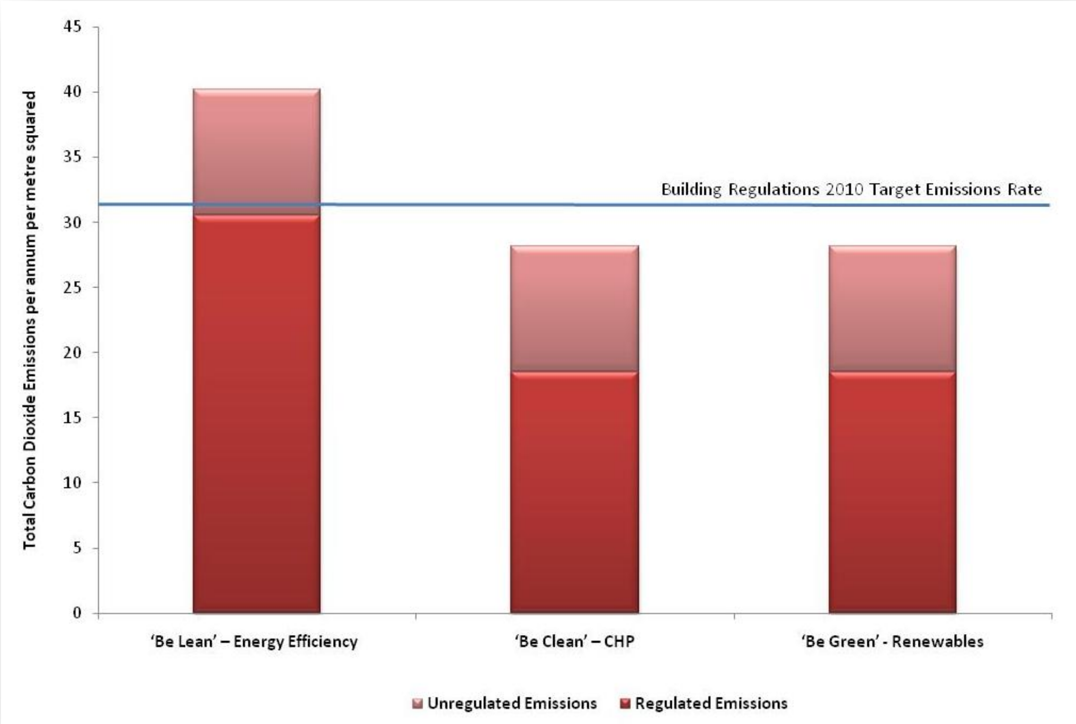
In keeping with the 'Be Clean' step of the London Plan guidance it is proposed that the development utilises a Combined Heat and Power unit to generate heating and hot water. By providing this low carbon heat source, it has been calculated that CO_2 emissions can be reduced by a further 39.48%. Investigations were made into connecting to a local district heating network which turned up two schemes near the development; Kings Cross and the Camden Council Euston Road scheme. Although neither scheme was deemed suitable at this time, provisions will be made to allow potential connection in the future.

In order to incorporate renewable energy and 'Be Green', investigations for all the potential technologies were undertaken but none were deemed suitable for the project without having an adverse effect on the previous stages of the energy hierarchy.

In total, the proposed scheme would achieve a 41.12% reduction in regulated CO_2 emissions against the 2010 Buildings Regulations Target Emissions Rate.

Model	Carbon Dioxide Savings (Tonnes CO_2/Annum)		Carbon Dioxide Savings	
	Regulated	Total	Regulated	Total
'Be Lean' – Energy	15.77	15.77	2.71%	2.07%
'Be Clean' – CHP	223.88	223.88	39.48%	30.00%
'Be Green' - Renewables	0	0	0%	0%
TOTAL CUMULATIVE SAVINGS	239.64	239.64	41.12%	31.44%

Table 2: CO_2 Emissions Savings from each stage of the Energy Hierarchy



Graph 1: The Energy Hierarchy

Initial analysis has shown that both the proposed student accommodation and Travis Perkins commercial unit could achieve a BREEAM Excellent rating.

2.0 INTRODUCTION

2.1 Background

Applied Energy has been commissioned by the Unite Group PLC to prepare an energy and sustainability strategy to accompany the planning submission for the proposed mixed use development on 11 – 13 St. Pancras Way, London. This statement identifies how the proposed development addresses the energy related policies of the London Borough of Camden and the Greater London Authority (GLA) as set out in the draft London Plan, published in October 2009.

Options have been reviewed for reducing CO_2 emissions through energy efficiency measures, heating and cooling hierarchy technologies and renewable energy systems. The local environment and proposed site have been considered throughout.

2.2 Description of the Site

The proposed mixed use development at the Travis Perkins builder's merchants, 11-13 St. Pancras Way is approximately 300m to the northwest of St. Pancras International Train Station. The site is situated within the London Borough of Camden. The building has been designed with a large ground floor area which is to be largely used for commercial space with the student accommodation situated above. The student accommodation consists of four blocks which vary in height up to nine storeys. There are 564 student apartments which consist of a mixture of self contained studio flats which have their own living, sleeping, kitchen and bathroom facilities and cluster flats which have individual sleeping and bathroom facilities and communal kitchen and living areas.

The proposed site is indicated in Figure 1 below.

Figure 1: Proposed Site

2.3 Design Philosophy

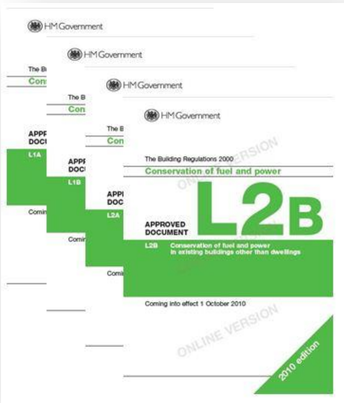
This statement has been produced to show what measures are economically feasible and practically viable to increase sustainability for the proposed development. The proposed development will base its design on The Draft London Plan 2009 with guidance taken from The Supplementary Planning Guidance (SPG), Renewable Energy Toolkit, Low Carbon Designer Toolkit, Camden Councils Planning Guidance Documents (specifically no3 – Sustainability) and Replacement Unitary Development Plan (UPD) and the GLA's guidance document on Energy Assessments (Oct 2010) in order to reduce carbon dioxide emissions.

The mechanical and electrical design of the proposed development will be carefully considered to provide the most efficient balance between requirement, effectiveness, cost and maintainability.

In achieving a sustainable design, it is important that the building is as efficient as possible such that the total base load is minimal. This also helps in reducing the requirement for renewable energy. This report highlights the measures that will be taken to improve energy efficiency and assesses the viability of the renewable technologies available. All assessments within this report have been made using preliminary information and can be subject to development as the project progresses into the detailed design stage.

2.4 Building Regulation

The Government has used Building Regulations Part L, to bring about the efficient use of energy within new and existing buildings. The regulations are split into 4 sections L1(A/B), L2(A/B) with section L1 covering new and existing dwellings and L2 applicable to all new and existing non-domestic buildings, such as offices, hotels and warehouses. Part L aims to limit the maximum energy usage from mechanical and electrical plant and strives for better quality of construction to reduce building air leakage.



The Government set out in its 'Building a Greener Future' Policy Statement (July 2007) that non-dwellings are to be net zero carbon by 2019. It is likely that following a 25% step change in 2010 similar changes will follow in 2013 and 2016.

The design of the proposed development will be based on the 2010 version of Building Regulations to increase sustainability and energy efficiency.

3.0 POLICY AND PLANNING CONTEXT

This energy statement is based on The Draft London Plan 2009 with guidance taken from The Supplementary Planning Guidance (SPG), Renewable Energy Toolkit, Low Carbon Designer Toolkit and Camden Council's Planning Guidance 3 (CPG 3) – Sustainability and includes:

1. An energy demand assessment for heating, cooling, electricity and baseline CO_2 emissions
2. A review of the design of the building and the potential for energy efficiency design measures
3. An assessment of the feasibility of low carbon heating and cooling technologies
4. An assessment of renewable energy technologies including details on possible technology/plant sizes and resulting carbon savings
5. A summary indentifying the preferred energy strategy and the overall CO_2 emissions reductions achieved over the Building Regulations 2010 compliance baseline

A summary of the relevant policy and guidance documents on which this report are based are listed below:

- Planning for a Sustainable Future – White Paper
- The London Plan 2008 and Draft London Plan 2009: Spatial Development Strategy for Greater London, Consolidated with Alterations
- London Plan Supplementary Planning Guidance on Sustainable Design and Construction
- The Mayor's Energy Strategy: Green Light to Clean Power, Mayor of London
- Camden Council Planning Guidance 3 – Sustainability

3.1 London Plan 2008

The London Plan replaced the previous strategic planning guidance for London. It is a requirement of the Greater London Authority (GLA) Act 1999 that the document deals with matters of strategic importance to Greater London.

Since its original release the document has received further alterations with new policies associated with climate change in Chapter 4A representing the most significant alterations. The latest 2008 version of this document has been used to produce this report.

The former Mayor of London published a document in February 2004 entitled 'Green Light to Clean Power – The Mayor's Energy Strategy'. Its purpose was to reduce London's contribution to climate change, tackle fuel poverty whilst promoting London's economic development through renewable and energy efficient technologies.

The document lays out a coherent Energy Policy for London with emphasis on an Energy Hierarchy based on three key principles: **Be Lean, Be Clean, Be Green**.

3.2 Draft London Plan 2009

The current Mayor has issued a draft revised London Plan (2009) which is out for consultation. This revised document has removed the requirement for a 20% reduction in carbon emissions from renewable energy and instead focuses on the energy hierarchy and use of decentralised plant. This is seen as guidance for the future policy direction and has been addressed within this report.

The energy assessment has been based on the requirements set out in the London Plan with specific focus on Policies 4A.1 to 4A.7 which focus on climate change impact and mitigation measures which can be adopted, whilst setting out targets for developments to achieve.

In addition to the above, guidance has been taken from the *GLA Energy Team Guidance on Planning Energy Assessments* document which this report is intended to sets out to fulfil.

3.3 Supplementary Planning Guidance – Sustainable Design and Construction

The Supplementary Planning Guidance (SPG) published in May 2006 provides additional information to support the implementation of the London Plan. This document cannot set new policies, but has weight as a formal supplement to the London Plan and is applicable to all building types and associated spaces.

The SPG provides guidance on the way that the seven measures identified in the policy can be implemented to meet the London Plan objectives and therefore the SPG is structured around these seven factors.

3.4 London Renewables Toolkit

In 2004, The London Renewables Toolkit was developed to help support planners, developers, consultants and other interested parties implement Mayoral and related borough planning policies in London which require renewable energy. It was designed to encourage the use of renewable energy technologies in London through new developments and aims to contribute to meeting London's CO_2 reduction and renewable energy targets.

4.0 BREEAM ASSESSMENT

In line with the current Camden Council Supplementary Planning Documents (SPD) the proposed development will aim to achieve a minimum BREEAM rating of 'Very Good' with aspirations for 'Excellent'. A separate assessment will be carried out for the student accommodation and commercial space.

The development will also aim to achieve the following as required by Camden Council:-

- Achieve 60% of the credits available under the Water section of the BREEAM assessment.
- Achieve 60% of the credits available under the Energy section of the BREEAM assessment.
- Achieve 40% of the credits available under the Materials section of the BREEAM assessment.

A pre planning analysis has been undertaken, the results indicate that the development will achieve an Excellent rating for both the multi-residential (student accommodation) and commercial (Travis Perkins) assessments. These assessments are detailed in a separate report.

5.0 BUILDING ENERGY MODELLING

5.1 Building Simulation

The proposed building has been thermally modelled using EDSL TAS dynamic simulation modelling software. This model has been produced to determine the annual energy demand and resultant CO_2 emissions for the different stages of the energy hierarchy.

This software contains the construction database which defines all the construction U-values for each of the building elements. Outputs from the simulation program include hourly kW demands arising from heating and cooling, small power, lighting and fan power. The model was simulated using the CIBSE test reference year (TRY) weather data for London, as required by Part L2A of the building regulations 2010. The outputs from the software allow gas and electrical consumption and related CO_2 emissions to be calculated. The building's performance can therefore be measured against the targeted reduction in CO_2 emissions.

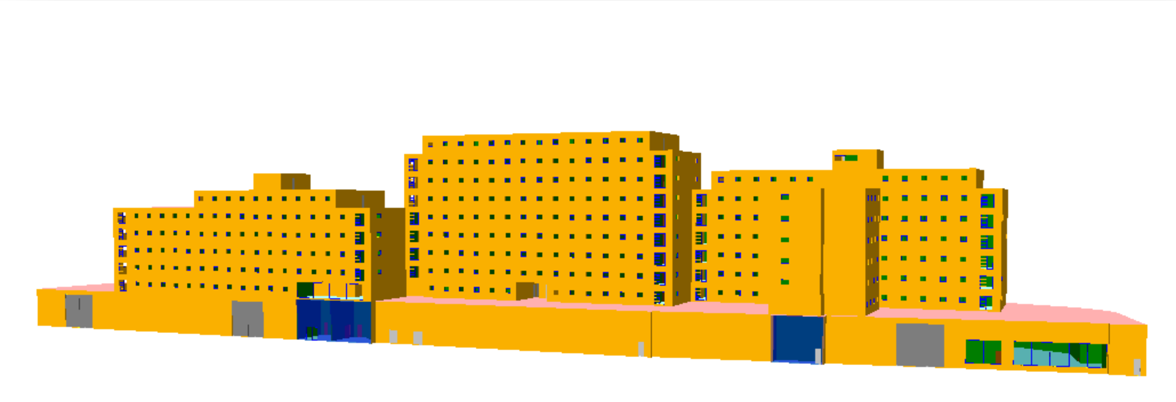


Figure 2: 3-D Model

6.0 DEMAND REDUCTION – 'BE LEAN'

The aim of the 'Be Lean' strategy is to reduce energy usage through the inclusion of energy efficiency measures and good practice sustainable building services, thereby improving the building's performance over and above the minimum levels stipulated within Part L of the Building Regulations documents.

6.1 Building Fabric Performance

The proposed development will aim to improve on the current Building Regulations Part L2A (2010) area weighted U-values for the opaque building fabrics and glazing elements.

It is a requirement for all new buildings to be pressure tested as detailed within Building Regulations Part L2A (2010). The maximum permissible air leakage rate is set at 10m3/(h.m^2) @ 50 Pa. All endeavours will be taken to improve the air leakage performance of the development over and above the Building Regulations minimum standard.

Based on previous experience of other similar developments the building has been modelled using 7m3/(h.m^2) @ 50 Pa.

6.2 Heating

It is proposed that a wet heating system is provided for the space heating in the student accommodation which will utilise high efficiency gas fired boilers to minimise energy usage.

The heating system efficiency will be improved further by including the following features into the design:

- Plant equipment will be selected with efficiencies exceeding the requirements in the Building Regulations Part L2A (2010).
- Major circulating pumps will be fitted with variable speed drives.
- Heating circuits will be split into zones allowing independent control or set back when zones are not occupied.
- Thermostatic Radiator Valves (TRV) will be provided to all radiators to allow zonal and occupant control
- The main Travis Perkins storage area will not be heated and the showroom will be provided with air source heat pumps to meet the space heating requirements. The details of this system are detailed below.

6.3 Cooling

There is no cooling requirement within the student accommodation bedrooms and public areas.

Efficient air source heat pumps are proposed to be used within the Travis Perkins showroom to meet the calculated cooling loads. The system will be selected with a minimum Energy Efficiency Rating (EER) of 3.5.

6.4 Water Services

With the majority of the development consisting of student accommodation, water usage will play a major role in the sites energy use. To minimise the impact of the proposed development on the existing services infrastructure, the following measures are proposed.

6.4.1 Dual Flush Toilets

The 'Climate Change and The Demand for Water Report 1996' states that the use of water for flushing toilets uses on average 30% of the domestic water demand.

Dual flush cisterns allow users to decide whether to flush only a portion of, or all the water from the cistern.

It is proposed that dual flush cisterns (4 litres/6 litres) are installed to help contribute towards improved water savings.

6.4.2 Low Flow Basin Taps

A standard wash basin mixer tap has a flow rate of around 12 litres per minute which can be reduced through the use of low flow taps. It is proposed that all basin taps will be specified with a flow rate of less than 6 litres per minute.

Percussion taps, or self closing taps as they are otherwise known, have a slow release valve mechanism which, once pressed, allows the flow of water for a predetermined time before the valves closes. By having this level of control, it eliminates human error and the possibility of taps being left on for long periods of time.

It is proposed that percussion and/or sensing taps are provided to all the public and staff toilets to help minimise water wastage.

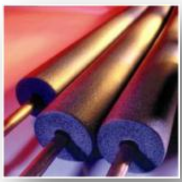
6.4.3 Shower Flow Restrictors

It is proposed that low flow shower heads are fitted to limit the flow rate to no more than 9 litres per minute.

6.4.4 Urinal Flush Controls

In order to save water usage in public toilets, the installation of urinal flush controllers are proposed. The use of Passive Infrared (PIR) detectors and/or waterless urinals will be investigated to reduce water consumption in these areas.

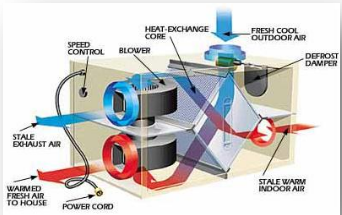
6.5 Services Distribution



All services pipework, valves, fittings and ductwork will be insulated to minimise unwanted heat loss or heat gain.

6.6 Ventilation

Ventilation rates will be in accordance with Building Regulations Part L2A and CIBSE Guide B2.



Variable speed motors will be provided to modulate the operation of the various ventilation systems from local switches in the kitchen for the extract hoods and via a humidistat's located in the extract ductwork.

Low energy units will be specified that meet with The Code level 5 standards.

Heat recovery will be installed wherever possible with achievable efficiencies of at least 70%.

6.7 Lighting

It is proposed that energy efficient lamps with high frequency ballast and automatic and/or manual switching facilities are provided to assist in keeping the electrical consumption low. The use of photo-electric sensors to control external lighting will be investigated. Consideration will be given to the use of PIR detectors to control lighting in low occupancy back of house and corridor areas.

Lighting shall be designed to achieve illuminance levels for each space in accordance with the 'Unite' Bowen specification (latest revision) and CIBSE 'Codes of Practice'.

6.8 Building Energy Management System

It is proposed that a Building Energy Management System (BEMS) is installed to monitor, control and sequence key mechanical and electrical plant to help drive out energy savings through effective control strategies.

6.9 Summary

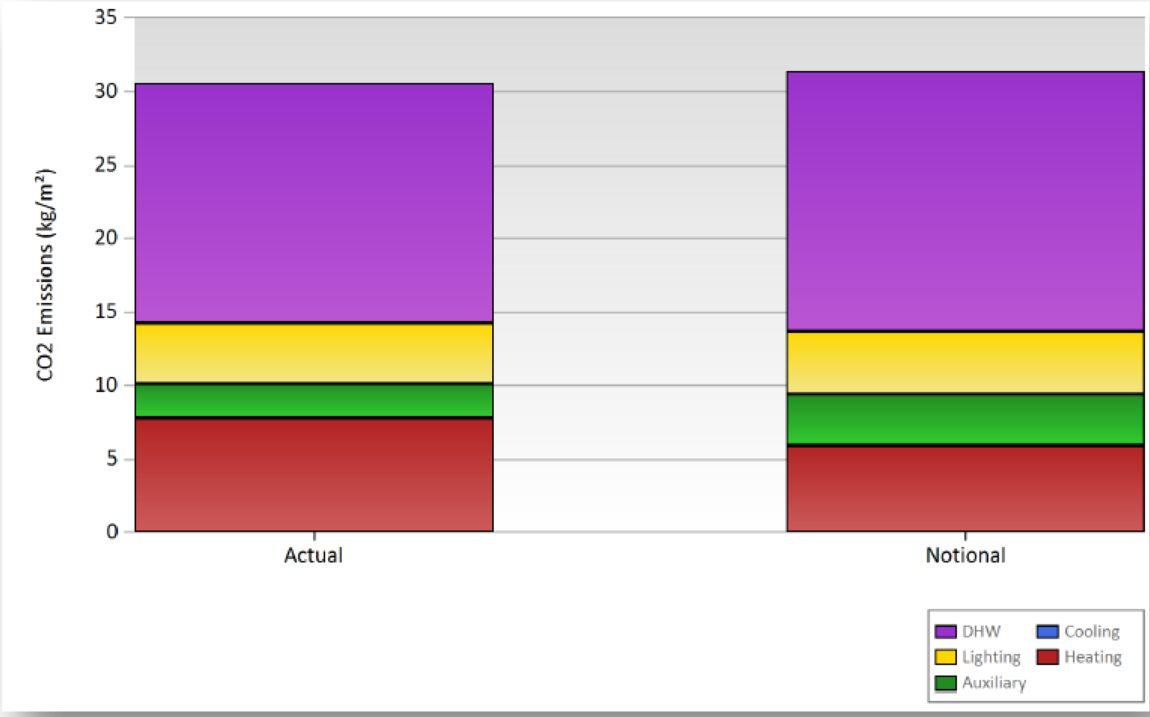
A summary of the above proposed measures and energy efficient figures to be used in the modelling of the development are detailed in Table 3.

Building Services	*2010 L2A Values*	*'Be Lean' Values*
Boiler Efficiency	*86%*	*90%*
Heat Recovery Efficiency	*50%*	*70%*
Electric Heating Efficiency	*100%*	*100%*
Cooling System Seasonal Energy Efficiency Ratio (EER)	*2.5*	*2.5*
Domestic Hot Water Efficiency	*80%*	*85%*
AHU with Heat Recovery Specific Fan Power (W/l/s)	*2.2*	*2.2*
Local Fan Specific Fan Power (W/l/s)	*0.4*	*0.4*
U-Values (W/m^2K)		
Wall	*0.35*	*0.35*
Floor	*0.25*	*0.25*
Roof	*0.25*	*0.25*
Windows	*2.2*	*2.2*
High Usage Entrance Doors	*3.5*	*3.5*

Table 3: 'Be Lean' Design Criteria

6.10 Be Lean Calculations

TAS simulates the operation of the building for an entire year, calculating the total energy demands for heating, cooling, hot water, lighting and fan power based on specific input data for the development, such as plant efficiencies, room uses and building fabric. From these figures, the resulting CO_2 emissions are obtained and compared against the notional model. The results are detailed below.



Graph 2: CO_2 emission from 'Be Lean' measures

The Building Emissions Rate (BER) achieved a 2.71% reduction in CO_2 against the TER from the inclusion of energy savings measures. The calculated total annual carbon emissions of the development from the 'Be Lean' stage are 567.02 Tonnes CO_2 per year which is a saving of 15.77 Tonnes CO_2 over the TER.

11-13 St. Pancras Way	TER ($kgC0_2/m^2$/ annum)	BER ($kgC0_2/m^2$/ annum)	Percentage Reduction over TER
Heating	5.95	7.76	-30.42%
Cooling	0.00	0.00	0.00%
Auxiliary	3.48	2.35	32.47%
Lighting	4.21	4.18	0.71%
Domestic Hot Water	17.78	16.27	8.49%
			1
TOTAL	31.42	30.57	2.71%

Table 4: 'Be Lean' SBEM results Breakdown

7.0 ENERGY HIERARCHY – 'BE CLEAN'

For major commercial and residential developments such as the proposed development, Policy 4A.6 of the London Plan sets out a preferred technology hierarchy in respect to supplying the energy demands for heating, and where necessary, cooling. This is as follows:

- Connection to existing CCHP/CHP distribution networks
- Site-wide CCHP/CHP powered by renewable energy
- Gas-fired CCHP/CHP or hydrogen fuel cells, both accompanied by renewables
- Gas fired communal heating and cooling
- Communal heating and cooling fuelled by renewable sources of energy

7.1 Connection to Existing CCHP/CHP Distribution Networks

The London Heat Map tool has been used to determine if there are any existing or proposed district heating schemes available within the area for the development to utilise. Figure 3 indicates that the development is in close proximity of a proposed district heating network (Euston Road scheme) and in one of the focus areas identified through the heat mapping work undertaken by the London Borough of Camden.

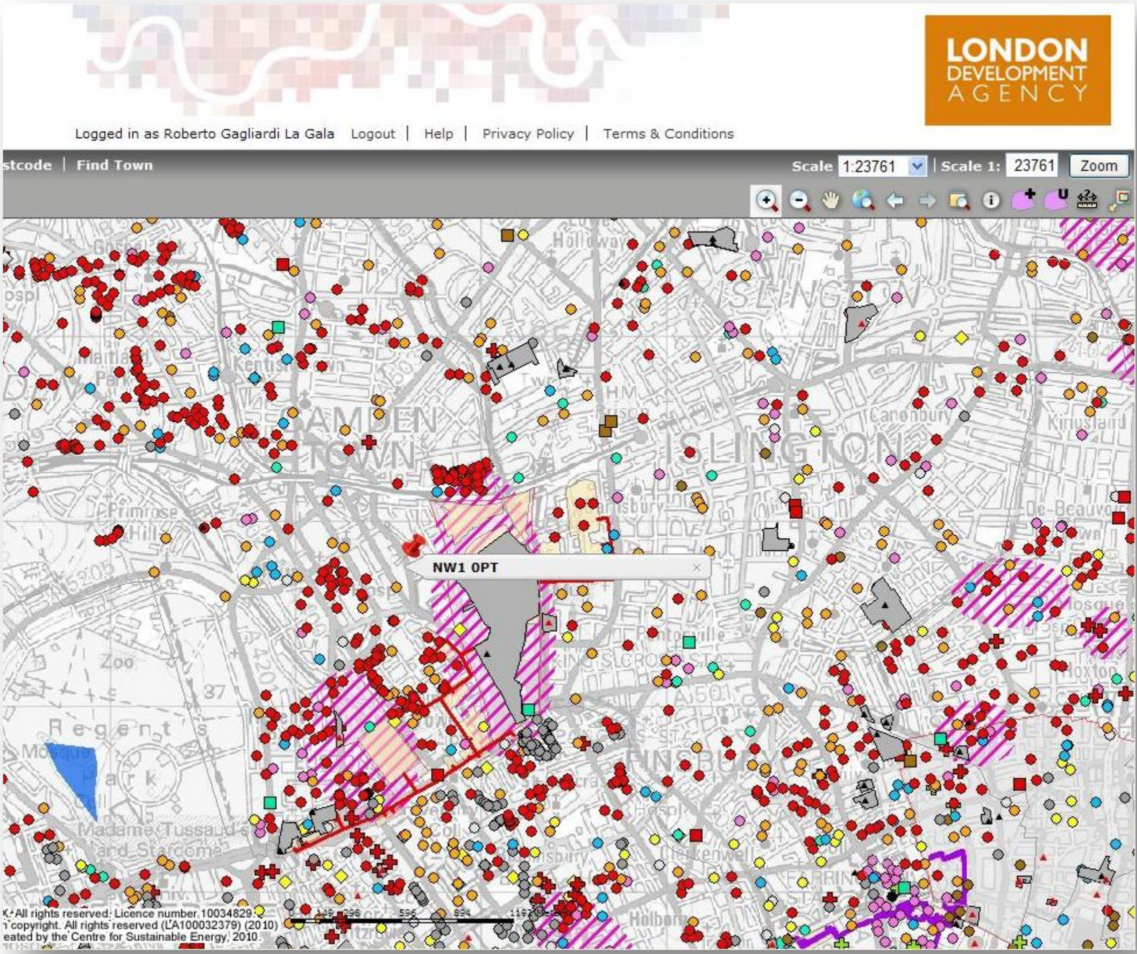


Figure 3: London Heat Map – 11-13 St. Pancras Way

Discussions were undertaken with the Energy Supply Department of the LDA (London Development Agency) whom confirmed that in addition to the Camden Council Euston Road scheme there was also a district CHP heating network at Kings Cross by Argent.

Initial discussions with Peter North of the LDA on Euston Road confirmed that the proposed scheme can potentially accommodate the loads of the development and could therefore connect to the network. However the scheme is not currently available and is at least another 2-3 years from completion.

The Kings Cross heating scheme is already providing heat to nearby buildings and although closer to the development than the Euston Road scheme, the current distribution network lies to the east of the Kings Cross rail network whereas the proposed development lies to the west. This creates a potential issue with regards to connecting the development to the scheme as the distribution pipework would have to cross the railway network. This would be potentially very costly and would require coordinated and detailed discussions with a number of parties in order to finalise a scheme. So although it may be technically viable to connect the development to the Kings Cross network, it may not be financial or practically feasible to do so.

Taking the above into account, it has been deemed unsuitable to connect to either scheme at this time. Given the projected dates for completion of the Euston Road scheme and potential issues with connecting to the Kings Cross network, it is proposed to provide an alternative energy source as part of the *'Be Clean'* process. However provisions will be made to allow connection to a suitable district heating network in the future. These provisions, based on previous experience with district heating networks, will include capped valved connections in the main heating pipework header and allocated space to accommodate future district heating connection plant (e.g. plate heat exchangers).

7.2 Site-wide CCHP/CHP Powered by Renewable Energy

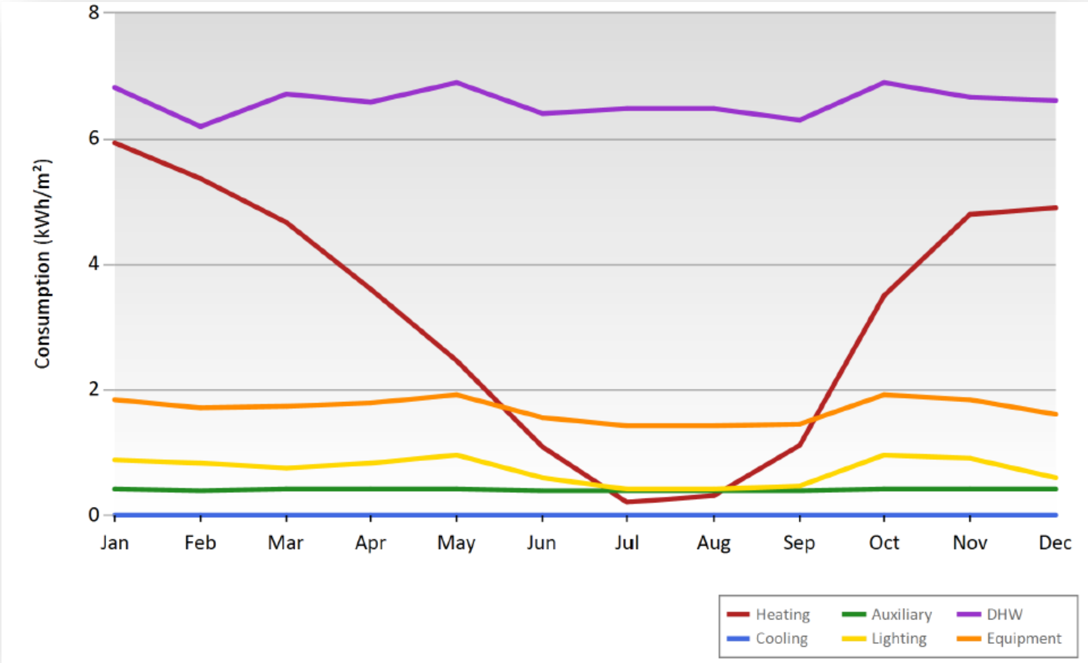
Given the lack of renewable biofuel infrastructure within the locality and the site's location within heart of London, the use of biofuels to power CHP is deemed to not be feasible at this site. Biomass CCHP/CHP is still in the demonstration phase and is therefore not suitable for commercial operation. Bio-diesels have unresolved issues as a fuel for CHP. At present the energy cost of producing bio-fuels are not accurately known therefore the true effect on the sites CO_2 emissions are uncertain. Digester gas involves using the methane produced from anaerobic decomposition of bio-degradable waste as a fuel for the CHP. The bio-digesting plant requires a large amount of space which is not available on this project. It is therefore concluded that CCHP/CHP powered by renewables would not be suitable for this project given the building location.

7.3 Gas-fired CCHP/CHP Accompanied by Renewables

Gas fired CHP (Combined Heat and Power) is a well proven technology when sized correctly and utilised to its full potential. Gas fired CHP will be considered for this development.

The use of CCHP (Combined Cooling Heat and Power) does not suit this development as there is no requirement for cooling in the student accommodation and very minimal cooling demand in Travis Perkins showroom. Therefore the inclusion of CCHP is not a viable option.

As seen in graph 3 below, there are significant heat loads in the winter periods which would benefit from the inclusion of CHP. However the drop in demand in the summer would result in high modulation of the unit which heavily impacts on efficiency. Therefore to maximise performance, the CHP should be sized just above the base summer heat load. Although potential savings in the colder months would be reduced from this method, the overall annual performance of the CHP would be optimised.



Graph 3: Monthly Energy Demands

In addition to the seasonal heat load patterns, there is a constant hot water load present throughout the year which would benefit from the installation of a CHP.

Experience shows that in this type of environment, hot water consumption will have two peak periods a day; one in the early morning and one in the early evening with a small base hot water load provided throughout the remainder of the day. CHP units operate most efficiently with a constant base load and minimal modulation. Providing a standard instantaneous hot water generation system would therefore not suit the provision of a CHP. This can be overcome by using effective water storage techniques to ensure that the CHP runs for the majority of the day. In this instance, the development could benefit further from the installation of a CHP.

The most suitable CHP size that would provide the level of service required whilst maximising efficiency has been determined and discussions have been made with CHP manufacturers and suppliers in order to obtain a proposal.

It is recommended that a 140kWe CHP is installed to provide the development with 203kWth of thermal energy used to meet the base heating and hot water load.

It is proposed that a CHP is installed to provide the developments base heating and hot water load and generate electricity to offset that imported from the grid.

Given the calculated electricity to be generated from the CHP and anticipated site consumption, a percentage of electricity will need to be exported to the National grid and so measures will need to be in place to facilitate this. The proposed system will comply with G 59 - *Recommendations for the Connection of Embedded Generating Plant to the Regional Electricity Companies' Distribution Systems* and metering facilities will be provided. Once planning approval is given, discussions will take place with the proposed CHP supplier, electricity supplier and electricity distribution network operator to review and agree the exporting arrangement and rates for the site.

7.4 Hydrogen Fuel Cells Accompanied by Renewables

Hydrogen fuel cells are a relatively new technology and would be fed from a natural gas supply given the lack of a hydrogen distribution network at present. The capital cost of such a system is much greater than that of a gas-fired CHP of similar size. With the technology still very embryonic, the use of Hydrogen fuel cells are not recommended for this site.

7.5 Gas fired communal heating and cooling

Analysis has been undertaken with regards to the viability of providing a communal heating and/or cooling system for the development.

As mentioned previously, the student accommodation will be heated via a wet radiator system fed from CHP and gas fired boilers. The only element of the Travis Perkins commercial area that requires heating is the showroom which is normally provided from Air Source Heat Pumps in line with brand standards.

There is a possibility of providing a communal system to serve both uses of the development by however there are problems associated with providing this. Given the distance between the plantroom and showroom, there are potentially high heat losses from the distribution pipework resulting in energy wastage. There are also likely control issues from providing a separate a heating and cooling system which would lead to inefficiencies in the overall system performance. Taking into account the above and comparing against the brand standard Air Source Heat Pumps with high COP's, it is deemed that a communal heating system is not a viable option for this development.

A communal hot water system was also investigated but again due to the pipework heat losses and the minimal hot water load for Travis Perkins in comparison to the rest of the development, it was not deemed viable to provide a communal hot water system.

Cooling is only required for the Travis Perkins showroom and offices and therefore a communal cooling system is not viable.

The requirement for cooling can have a big impact on a sites energy needs. Although the cooling requirements are small in comparison to the rest of the energy needs of the development, measures will be incorporated to minimise the load. These measures will include, but are not limited to, effective solar control, occupant controlled blinds and effective controls.

7.6 Communal heating and cooling fuelled by renewable sources of energy

Given the previous item, these options have been discounted.

7.7 Be Clean Calculations

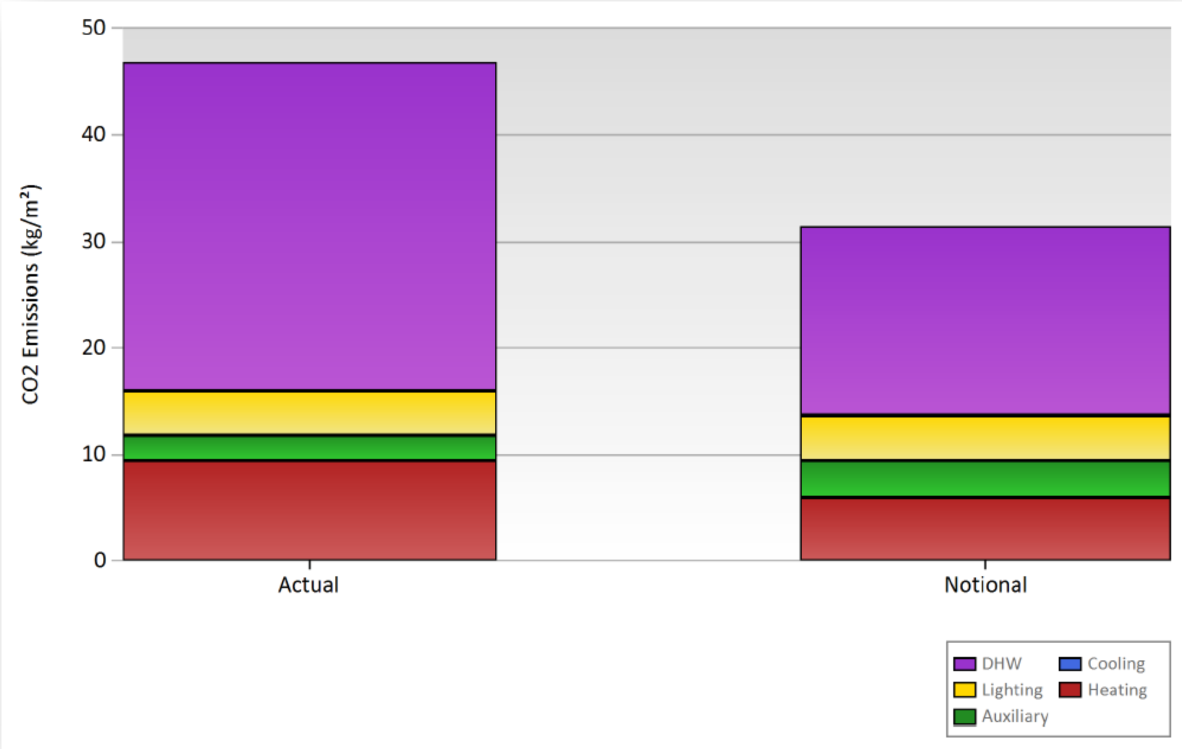
The building has been re-modelled with the inclusion of a gas fired CHP.

The following assumptions have been used in the modelling of the CHP which are based on manufactures data and Building Regulations Part L2A minimum requirements:

- Size Fraction – 0.25
- CHP Efficiency – 78.7%
- Heat to Power Ratio – 1.45

The manufactures technical data for the proposed unit can be found in appendix A of this report.

The resulting annual fuel consumption comparison and CO_2 emissions from the inclusion of the CHP are detailed as follows:



Graph 4: Annual CO_2 emissions from 'Be Clean' Measures *(please note that displaced electricity contribution is not shown on this graph)*

The BER for the development now achieves a further 39.48% reduction in CO_2 against the 'Be Lean' strategy BER which included energy savings measures only. This combines to give an overall reduction of 41.12% against the 2010 TER. The calculated total carbon emissions of the development from the 'Be Clean' stage are 343.14 Tonnes CO_2 per year which is a saving of 233.88 Tonnes CO_2 over the 'Be Lean' stage.

11-13 St. Pancras Way	TER ($kgC0_2/m^2/$ annum)	BER ($kgC0_2/m^2/$ annum)	Percentage Reduction over TER
Heating	5.95	9.52	-60.00%
Cooling	0.00	0.00	
Auxiliary	3.48	2.35	32.47%
Lighting	4.21	4.18	0.71%
Domestic Hot Water	17.78	30.77	-73.06%
Displaced Electricity	0.00	-28.32	
TOTAL	31.4	18.5	41.12%

able 5: 'Be Clean' SBEM Results Breakdown

8.0 RENEWABLE MEASURES – 'BE GREEN'

In accordance with the London Plan Policy A4.7, the Mayor requires major developments to achieve a 20% reduction in CO_2 emissions from on-site renewable energy, except where it can be demonstrated that this is not feasible. This section reviews the potential on-site renewable energy technologies available and assesses their viability in conjunction with the CHP.

- Biomass Boilers
- Ground Source Heat Pumps (GSHP)
- Solar Thermal
- Solar Photovoltaic (PV)
- Wind Turbines
- Air Source Heat Pumps

8.1 Renewable Energy Assessment

From the predicted 'Be Clean' annual CO_2 emissions shown in table 6, it is possible to establish the target renewable CO_2 reduction as shown below.

	CO_2 Emissions (Tonnes.CO_2/annum)
'Be Clean' Strategy	343.14
Target 20% Reduction from Renewable Energy	68.63

Table 6: Renewable Energy CO_2 Emissions Target

8.2 Biomass Boilers

The spatial requirement for biomass plant, equipment and associated fuel storage would be significant and would impact on the current layout of the building.

The site has limited off-street loading facilities for the larger vehicles needed to deliver the biomass fuel. Biomass requires frequent and regular deliveries of fuel which would impact on local transportation and would potentially affect the regular delivery and access requirements of Travis Perkins. Therefore biomass has been deemed not suitable for this development.

There are many discussions at this time with regards to the suitability of biomass within the GLA region due to the Clean Air Act requirements and the viability of clean biomass systems has not yet been proven. An air quality assessment for the development has been undertaken and shows that the annual mean objective for NO_2 is exceeded in some areas of the site and so the inclusion of a biomass system would only worsen the current situation.

Investigations were made into combining the use of CHP and biomass boilers with the former reducing CO_2 emissions and the latter providing a renewable contribution. The modelling showed direct conflicts between the two technologies resulting in loss of efficiency of both systems.

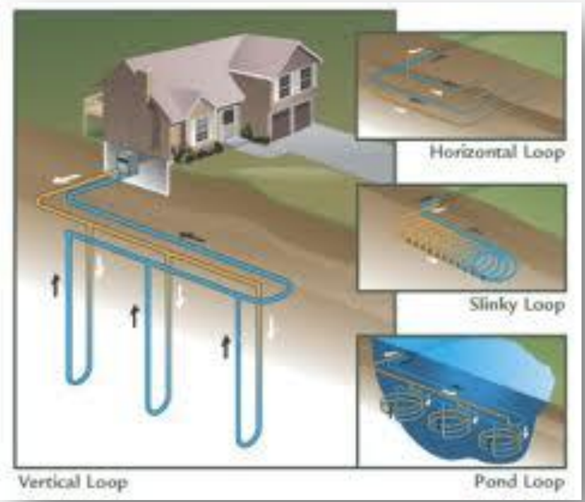
It is therefore believed that the technology is not suitable for this commercial operation in combination with a CHP set.

8.3 Ground Source Heat Pumps

Ground Source Heat Pumps (GSHP) can be used to provide heating and or cooling to the building. Whilst ground source does rely on fossil fuels (indirectly) to provide the energy source, they are considered renewable given their high coefficient of performance and hence reduced fossil fuel reliance.

This can be one of four methods:

- Closed horizontal loops in the strata, generally comprising a number of flow and return horizontal coiled loops often referred to as "slinkies".
- Closed vertical loops in the strata, generally comprising a number of flow and return vertical loops to approximately 100m.
- Open loop, generally comprising of an abstraction and rejection well
- Abstraction only open loop, comprising of an abstraction well with water rejected to either the local sewer systems or river/water course.



Whilst it is practically viable to incorporate any of the above measures given the sites large footprint, the impact on reducing the energy demand would be limited based on the performance of the system. Ground Source Heat pumps can only provide a relatively low hot water temperature which although ideal for low temperature heating systems, for example underfloor heating, is not best suited for a radiator system. Additional heat sources would be needed to achieve the desired temperatures for heating and domestic hot water.

Installing a GSHP system would compromise the efficiency and effectiveness of the CHP. Taking into account the potential energy and cost savings and reduced capital expenditure from the CHP in comparison to the GSHP, it is deemed that GSHP are not best suited for this site and have therefore not been considered further.

8.4 Solar Thermal

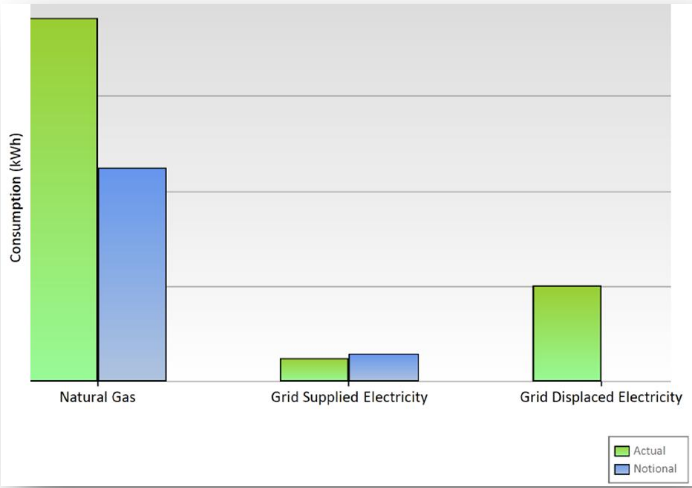
It is proposed that the development will use a CHP set to provide the contribution to the generation of heating as well as hot water. CHP units operate most efficiently with a constant base heating load, minimising modulation which can reduce the unit's effectiveness. By introducing solar thermal technology to pre-heat the domestic hot water, the base heating load is reduced thereby affecting the performance of the CHP.

It is deemed that incorporating CHP with solar thermal will not provide an efficient and effective system and therefore has not been considered for this application.

8.5 Solar Photo-Voltaic

The amount of electricity needed to be generated by a solar PV system in order to meet the 20% renewables target is more than 140,000 kWh. This would equate to a solar collector area of just under 1,000m2. The proposed useable roof area of the development for PV would is less than half that needed to meet the requirement. The proposed facade treatment to the south and eastern elevations and shadowing from the nearby building would make a PV cladding system unviable, and so the maximum potential amount of PV available at the site would not meet the 20% renewable target.

From the modelling detailed in the previous section of this report, the electricity generated from the CHP offsets electricity taken from the grid which has helped reduced the potential CO_2 emissions of the development.



Graph 4: Annual Fuel Consumptions

The results show that the development would consume around 250,000 kWh of electricity per annum. The CHP would generate approximately 805,000 kWh of electricity per annum, meaning that nearly 555,000 kWh of surplus electricity would be exported to the grid. Even if the consumption from unregulated sources is taken into account, 181,000 kWh of electricity would still be exported to the grid.

	Electricity Consumption (kWH/annum)
Regulated Electricity	249,472
Unregulated Electricity	374,486
Displaced Electricity	-805,120
Electricity Exported to Grid	181,162

Table 7: Anticipated Electricity Consumption

The above is based on an ideal scenario, and does not take into account human error and other variables that would alter this figure in reality.

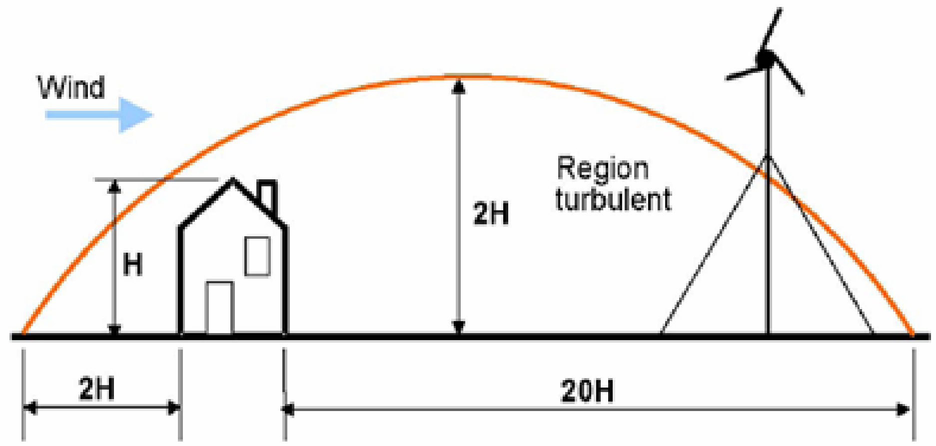
The calculations already show a large percentage of the electricity generated from the CHP being exported to the grid given the sites low electrical consumption, and so any electricity generated from solar PV would be exported directly with no beneficial use for the site. Taking this and the above points into account, the inclusion of solar PV has not deemed suitable for this project.

8.6 Wind Turbine

This section covers both large scale and micro wind solutions.

Large scale wind generation systems have capacities over 100kW and are usually used to power larger developments such as, larger scale housing and industrial estates. These systems cannot be roof mounted due to their size and weight. Due to the restricted site, large scale wind turbine systems are not considered appropriate for this project.

It is difficult to obtain predictable or large amounts of wind energy in city centre locations, as they require non-turbulent, horizontal air streams to be most effective. Surrounding buildings, trees etc can cause significant issues with regards to micro and large scale installations unless the rotors are positioned at a considerable height. An indicative layout is shown below.



Micro wind turbine technology has been found to be extremely difficult to achieve a 20% contribution economically.

Given the massing of the proposed development, changes in height of the tower blocks which are likely to create turbulence and proximity to the surrounding buildings, achieving an acceptable contribution, whilst possible in theory, is unlikely to be achievable in reality. Furthermore, tall buildings give their own specific problems in that the building acts as a spoiler, pushing wind upwards and over the turbine, reducing effectiveness considerably.

Additional considerations with large and micro wind solutions are the potential issues from stroboscopic light, topple distance, noise and impact on wildlife, that are all detrimental given this location.

Based on the above points and those made in the solar PV section, the use of wind power has not been deemed as feasible for this development.

8.7 Air Source Heat Pumps

Due to the Travis Perkins brand requirement, heating and cooling to the showrooms and offices is to be provided by air source heat pumps.

Air source heat pumps (ASHP) extract thermal energy from the surrounding air and can be used to provide heating and/or cooling.

The air source heat pumps require electricity to operate but have a very high coefficient of performance which is why they are now classed as a low/zero carbon technology.

Although a manufacturer hasn't been selected at this stage, the units will be selected to have a SEER and SCOP of no lower than 3.5 to ensure an efficient system is selected.

The outdoor units will be located external adjacent to the offices in a position that minimises there visual impact to the surrounding areas.

Contribution

As the Travis Perkins offices and showroom are the only areas of the development that require cooling and form a small part of the development, the savings from the introduction of energy efficient ground source heat pumps are minuscule in relation to the 20% renewables target. Calculations have shown that this would only account in a CO_2 saving of 650 kg.CO_2 which equates to 0.97% of the renewable target and as a result, the re-modelling of the building has not been undertaken.

The results of the 'Be Clean' stage of the report remain unchanged given the negligible change in CO_2 emissions from the inclusion of ASHP's.

9.0 UNREGULATED EMISSIONS

Unregulated emissions are those which are not covered by the Building Regulations, namely CO_2 emissions from appliances and cooking. To give a true representation of the developments carbon emissions, the estimated contribution from unregulated sources needs to be added to the figures calculated from within the accredited modelling software.

Guidance on how these unregulated consumptions are estimated have been drawn from CIBSE guidelines, ECON and evidence gained from similar previous projects. From these the following assumptions have been made:-

Based on guidelines within CIBSE guide F, office equipment benchmarks for air conditioned offices should use on average 23 kWh/m2/annum as good practice. Using the CO_2 conversion factor of 0.48 kg.CO_2/kWh and applying a 60% treated floor areas factor for the installed IT equipment, this equates to 6.62 kgCO_2/annum/m^2.

The large storage space for Travis Perkins is purely for storing goods where only lighting is provided. No unregulated emissions are deemed applicable to this area.

For the student accommodation, it is likely that the majority of rooms, if not all, will have a least a TV and a laptop or computer which wouldn't have been accounted for in the part L calculations. Therefore some assumptions have been made on the potential energy consumption of this equipment to give a true representation of the developments total energy demands.

There is no particular reference within CIBSE guide F to benchmarks for unregulated energy consumption for dwellings or apartments as a basis for the student accommodation. However there are benchmarks for business hotels which are not dissimilar to student accommodation with TV's and laptops likely to be used. Therefore a good practice benchmark taken from CIBSE guide F (based on a business hotel) for the student accommodation of 5 kWh/m2/annum will be used. Using the CO_2 conversion factor of 0.48 kg.CO_2/kWh, this equates to 2.4 kgCO_2/annum/m^2.

Taking account of the two figures above, the sites total carbon emissions rate from unregulated sources would be 9.02 kgCO_2/annum/m^2

The latest version of TAS is based upon the 2010 version of Buildings Regulations and now includes emissions from equipment (e.g. non regulated emissions). However these results are not included within the final BER. The figure given from the software for the development is 10.33 kgCO_2/m^2 as seen in the table below.

	Actual	Notional
Heating (kgCO2/m²)	7.76	5.95
Cooling (kgCO2/m²)	0.00	0.00
Auxiliary (kgCO2/m²)	2.35	3.48
Lighting (kgCO2/m²)	4.18	4.21
DHW (kgCO2/m²)	16.27	17.78
*Equipment (kgCO2/m²) **	*10.33*	*10.18*
Total (kgCO2/m²)	30.57	31.42
Total Floor Area (m²)	3576.20	3576.20

** Energy used by equipment does not contribute to total value - it is presented here for comparison only*

Table 9: SBEM breakdown of results

As the modelling software results do not differ greatly from the figure calculated from CIBSE guide F benchmarks, it can be assumed that these give a realistically representation of the potential emission from unregulated sources. Therefore an average of these two will be used as the basis of this report. The figure used is 9.675 $kgCO_2/m^2$.

10.0 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

Many conclusions and recommendations have been made in the previous sections of this report. In this section the main conclusions and recommendations are summarised.

Table 9 summarises the CO_2 emissions for the development for each stage of the assessment:

- 'Be Lean' (Energy Efficiency)
- 'Be Clean' (Community Heating Network)
- 'Be Green' (Renewable Technology)

Model	Carbon Dioxide Savings (Tonnes CO_2/Annum)		Carbon Dioxide Savings	
	Regulated	Total	Regulated	Total
'Be Lean' – Energy	15.77	15.77	2.71%	2.07%
'Be Clean' – CHP	223.88	223.88	39.48%	30.00%
'Be Green' - Renewables	0	0	0%	0%
TOTAL CUMULATIVE SAVINGS	239.64	239.64	41.12%	31.44%

Table 9: CO_2 Emissions Savings from each stage of the Energy Hierarchy

The investigation of CO_2 emissions savings involved the analysis and simulation of:

- Energy Efficiency Measures
- Hierarchy of Heating and Cooling Technologies
- Renewable Energy Technologies

It is proposed that the following energy efficiency measures are provided to reduce energy demand for the building before renewable technologies have been considered:

- Improved Heating and Cooling Plant Efficiencies
- Energy Efficient Lighting
- Inclusion of Heat Recovery to Ventilation Systems
- Improved Services Distribution
- Inclusion of Variable Speed Drives to Pumps and Fans
- Installation of a Building Energy Management System to provide active control of the Key Building Services Systems
- Water Saving Technologies

The above energy efficiency measures will provide a 2.71% reduction in CO_2 emissions over the TER.

It is proposed that the development uses a Combined Heat and Power unit to generate a proportion to the sites heating and hot water requirements which will provide a further 39.48% reduction in CO_2 emissions.

From investigations made into local district heating networks, two schemes were found to be in close proximity to the development. Although both had the potential to accommodate the development neither were deemed viable to connect to at this time due to the proposed completion date of the Euston Road scheme and difficulties connecting to the Kings Cross scheme. However provisions will be made to allow connection to a suitable district heating network at a later date.

Due consideration has been given to incorporating renewable technologies into the development however none were deemed suitable. The inclusion of CHP as part of the 'Be Clean' strategy showed good CO_2 savings over the Building Regulations 2010 compliant scheme. Any introduction of heat generating renewable technology would be in direct conflict with the CHP resulting in reduced efficiencies of both systems and reduced CO_2 savings. The option to not include the CHP to allow the inclusion of renewable technology was reviewed however it was deemed that the provision of CHP provided a better all round solution in terms of carbon savings and site suitability.

It was therefore concluded that a scheme with CHP and no heat generating renewable technology would provide a better technical and sustainable solution to a scheme with CHP and heat generating renewables, or no CHP and some heat generating renewables.

The inclusion of electricity generating renewable technology such as wind and solar PV was also reviewed. However as the calculations already showed that the CHP was already more than enough electricity for the site and so surplus amounts would need to be exported to the grid, it was deemed that the inclusion of such systems would not directly benefit the site.

It is proposed that Air Source Heat Pumps are provided to meet the heating and cooling requirements of the Travis Perkins offices and showrooms. The heating and cooling demand of these areas are small in comparison to the rest of the development and so the savings from the ASHP's are insignificant to the total site emissions. It was calculated that this reduction would contribute less than 1% of the required renewables target. As a result, calculations showing the savings from ASHP's have not been included in the final results.

The proposed Building Services strategy for the development achieves a 41.12% reduction in regulated CO_2 emission over 2010 Building Regulations and a saving including unregulated emission of 31.44%.

Initial analysis has shown that the proposed development would achieve an Excellent BREEAM rating for both the multi-residential and commercial assessments as required by planning.

APPENDIX A - CHP Data Sheet

COGENCO DATA SHEET

CGC-0140MA-080-NG-50

Low Temperature | Natural Gas

ENERGY BALANCE AND PART LOAD DATA

			100%		75%		50%	
Fuel input (HHV)	(+/-5%)	kW	435	%	346	%	253	%
Electrical output	(+/-3%)	kW	140	*32.2%*	105	*30.3%*	70	27.7%
Total usable heat output	(+/-7%)	kW	203	*46.7%*	167	*48.3%*	128	50.7%
Total usable energy	(+/-7%)	kW	343	*78.8%*	272	*78.6%*	198	78.4%
Heat output from jacket water and oil cooler	(+/-7%)	kW	128	*29.4%*	108	*31.2%*	86	*34.0%*
Heat output from exhaust gases (120°C)	(+/-7%)	kW	75	*17.2%*	59	*17.1%*	42	*16.6%*
Mechanical shaft power	(+/-3%)	kW	150	*34.5%*	113	*32.7%*	75	*29.7%*
Radiated and unaccounted for heat	(+/-7%)	kW	18	*4.1%*	16	4.6%	14	*5.5%*

		100%	75%	50%
Fuel mass flow	kg/hr	37	29	22
Fuel volume flow	nm3/hr	44	35	26
Combustion air mass flow	kg/hr	489	389	285
Combustion air volume flow	nm3/hr	379	302	221
Ventilation air volume flow (incl. comb. air)	nm3/hr	5,000	5,000	5,000
Exhaust gas mass flow (wet)	kg/hr	526	419	306
Exhaust gas volume flow (wet)	nm3/hr	423	337	246
Exhaust gas volume flow (wet) @ 120°C	m3/hr	609	484	354
Jacket water flow	m3/hr	18	18	18
Intercooler water flow - minimum	m3/hr	N/A		
Secondary water flow - minimum	m3/hr	18	18	18
Maximum return water inlet temperature	°C	80.0	80.0	80.0
Secondary water outlet temperature	°C	90.0	88.0	86.0
Exhaust gas temperature before cooler	°C	590	580	570

ENGINE DATA

Manufacturer		MAN
Model		E2876 E312
ISO Power	kW	150
Cylinder configuration		In line 6
Exhaust manifold		Water Cooled
Piston Speed	m/s	8.30
Bore	mm	128
Stroke	mm	166
Swept volume	litres	12.82
Mean effective pressure	bar	9.36
Compression ratio		12.0:1
Engine speed	rpm	1500
Engine weight	kg	830
Sump oil content	litres	41
Engine cooling water content	litres	16
Starter motor voltage	v	24
Air fuel ratio		1.00
Oil Consumption	g/kWh	0.2 - 0.5
Gas heating value (HHV)	kJ/nm3	38620
Minimum methane index / content		MI>70
Maximum methane content fluctuation		5%
Fuel Maxium Siloxane content	mg/nm3	n/a
Fuel Maximum Sulphur Compound content	mg/nm3	n/a

GENERATOR DATA

Type (Synchronous)		ECO38-2SN/4 50
Stator configuration		Star
Rating	kVA	200
Frequency	Hz	50
Voltage	V	400
Rating at PF 0.8	kW	160
Current per phase PF 0.8 (@ CHP duty)	A	253
Current per phase PF 1.0 (@ CHP duty)	A	202
Efficiency at PF 1.0	%	95.0
Efficiency at PF 0.8	%	93.0
Power factor lagging		0.8
Generator speed	rpm	1500
Permissible overspeed	rpm	2250
Generator weight	kg	560
Generator moment of inertia	kgm2	1.8799
Radio interference level to VDE 0875		VDE0875K
Protection class		IP21
Insulation class		H
xd direct axis synchronous reactance	p.u.	2.00
X'd direct axis transient reactance	p.u.	0.11
X"d direct axis sub transient reactance	p.u.	0.059
T"d sub transient reactance time constant	seconds	0.012
T'do open circuit field time constant	seconds	0.9

EXHAUST GAS HEAT EXCHANGER

Capacity	kW	75
Fouling factor		10%
Shell and inlet material		Mild Steel
Tube and outlet material		AISI 316, 304

PLATE HEAT EXCHANGER

Capacity	kW	203
Fouling factor		10%
Materials		AISI 316
Pressure drop (secondary side)	kPa	-

MISCELLANEOUS DATA

Glycol content intercooler circuit and engine circuit		30%
Intercooler circuit max. available head loss	m	n/a
Primary circuit max. available head loss	m	5
Primary pump		FCE 65-125/30-5
Intercooler pump		n/a
Maximum exhaust back pressure at unit	mbar	25
Minimum gas pressure (dynamic)	mbar	20
Maximum gas pressure fluctuation		10%
Ventilation fan available pressure drop	Pa	25
Air fuel ratio control		Kronos 10
Preferred lubrication oil type		Pegasus 710
Spark plug type		Champion
NOx emissions (@ 5% O2)	mg/nm3	5000
CO emissions	mg/nm3	[redacted]
Catalyst type		None
Ambient test barometric pressure	kPa	100
Ambient test atmospheric temperature	°C	25
Definition of ratings		ISO 3046

*** Check production GA for confirmation*

All information provided for guidance only, specifications may change without notice.

CONNECTIONS AND DIMENSIONS**

Gas train diameter	DN/PN	40/screw
Secondary water connections	DN/PN	65/16
Exhaust pipe diameter	DN/PN	100/10
Intercooler connections	DN/PN	-
Condensate drain connection		1" BSP (ABS)
Attenuator connection size	mm	800x800
Weight dry	kg	5,390
Weight wet	kg	5,767
Length - canopy only	mm	3,007
Length - canopy and control panel	mm	3,407
Width	mm	1,347
Height - canopy only	mm	1,960
Height - canopy and 75 dBA attenuators	mm	2,660

MAXIMUM OPERATING PRESSURES

Fuel system	mbar	150
Exhaust system	mbar	25
Primary circuit	bar	3
Secondary circuit	bar	8
Intercooler circuit	bar	n/a

Datasheet issue date	11/06/2007
Data sheet revision	PRELIM
Database revision date	17/11/2008

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