MRB Consulting Engineers LLP
For
Parklake Limited and Travelodge Hotels Ltd

Energy Efficiency and Renewable Energy Plan

Travelodge Hotel Extension
St Giles House
1 Drury Lane
London
WC2B 5RS

Issue Four: 16 November 2009

Contents

1.0 Executive Summary

1.1 General

This energy efficiency and renewable energy plan has been prepared in accordance with Section 2.14 and 4.6 of the agreement pursuant to Section 106 of the Town and Country Planning Act 1990 (as amended).

In particular this plan sets out the package of measures to be adopted by the Owner in the management of the Development with a view to reducing carbon emissions.

1.2 Project Commitments

The following energy and carbon targets and commitments were identified in the renewable energy statement (issue 5 dated 3 September 2009) in support of the Planning application.

Energy Efficiency:	Significant energy efficiency measures will be adopted to improve the energy efficiency of the existing building. In particular the thermal performance of the external envelope and windows will be considerably improved.
BREEAM:	The development will obtain a very good score under the BREEAM bespoke assessment method and will target a minimum of 52.22% score under the energy credits section.
Renewable Energy:	This development seeks to achieve the maximum reduction in CO_2 emissions subject to site constraints. An installation of CHP and air source heat pumps will save over 11% of the annual CO_2 emissions.

1.3 Further Reductions of the Carbon Emission Baseline

A carbon emission baseline of 513,677kg/annum has been established.

In order to improve the developments percentage contribution from on-site renewable energy the following further measures have been identified following the planning application submission:

- Further improve U-value of existing glazing
- Further improve U-value of the external envelope
- Use of aerated shower heads and basin mixer taps
- Use of intelligent panel heater controls (subject to an ongoing evaluation exercise)

It is predicted that these measures will further reduce energy consumption by over 110,443kW/annum equivalent to a reduction in CO_2 emissions by over 24,122kg/annum.

1.4 Incorporation of a Combined Heat and Power System

A full analysis and pricing exercise has been undertaken demonstrating that a carbon efficient combined heat and power system can be incorporated.

1.5 Feasibility and Viability of Exporting Energy

Due to the need to ensure the CHP units remain operational for the maximum period possible in order to maximise the units' efficiency and minimise energy consumption a modular CHP installation is proposed based on the building hot water base load.

Therefore there would be insufficient spare capacity, particularly heat, for exporting without oversizing the CHP units and rendering them inefficient for Travelodge's requirements.

It is unfeasible to link the CHP system with the existing hotel due to the relative positions of the existing and new plant area which creates pressure differential issues and difficulties of physically interlinking and controlling the systems.

1.6 Carbon Benefits of Air Source Heat Pumps

On 17 December 2008, the European Parliament adopted the EU Directive on promoting the use of energy from renewable energy sources. In addition to geothermal energy, aerothermal and hydrothermal energy were also recognised as renewable energy sources. The Directive text implied that member states should promote air source heat pumps in the same way as solar and wind energy.

Air source heat pumps are additionally recognised by both the BRE under BREEAM as a LZC (low or zero carbon) technology for the purpose of gaining credits for the use of local renewable energy sources under credit reference Ene 5 and the emerging revised London Plan.

It is predicted that the use of air source heat pumps will save 4,383kgCO_2/annum which is equivalent to 0.85% of the total carbon dioxide emissions.

1.7 Building Management System

The integrated modem within each CHP unit provides the facility for remote monitoring and control of the CHP system, enabling the transfer of operational data and faults.

A phone line will be installed to the CHP units which will enable the manufacturer to commission, monitor and control the operation of the CHP units. Utilising this facility it will be possible for Travelodge to monitor the performance of the CHP system, including assessing the operational periods and outputs. This will provide the information necessary, when combined with meter readings, to ensure the CHP system operation is achieving the predicted CO_2 emissions.

1.8 Separate Metering of Low and Zero Carbon Technologies

The low and zero carbon technologies will be provided with the following separate metering provision in addition to sub metering of substantial energy uses.

- Gas sub meter on gas service to CHP units
- Electricity sub meter on electricity supply to each CHP unit (4No. total)
- Electricity sub meter on electricity supply to each bar cafe heat pump unit (3No. total)
- Electricity sub meter on electricity supply to level 2 bedrooms heat pump

1.9 Means of Ensuring the Provision of Information

Continual monitoring of the performance of the CHP units will enable data to be collected to ensure the CHP system operation is achieving the predicted CO_2 emission savings.

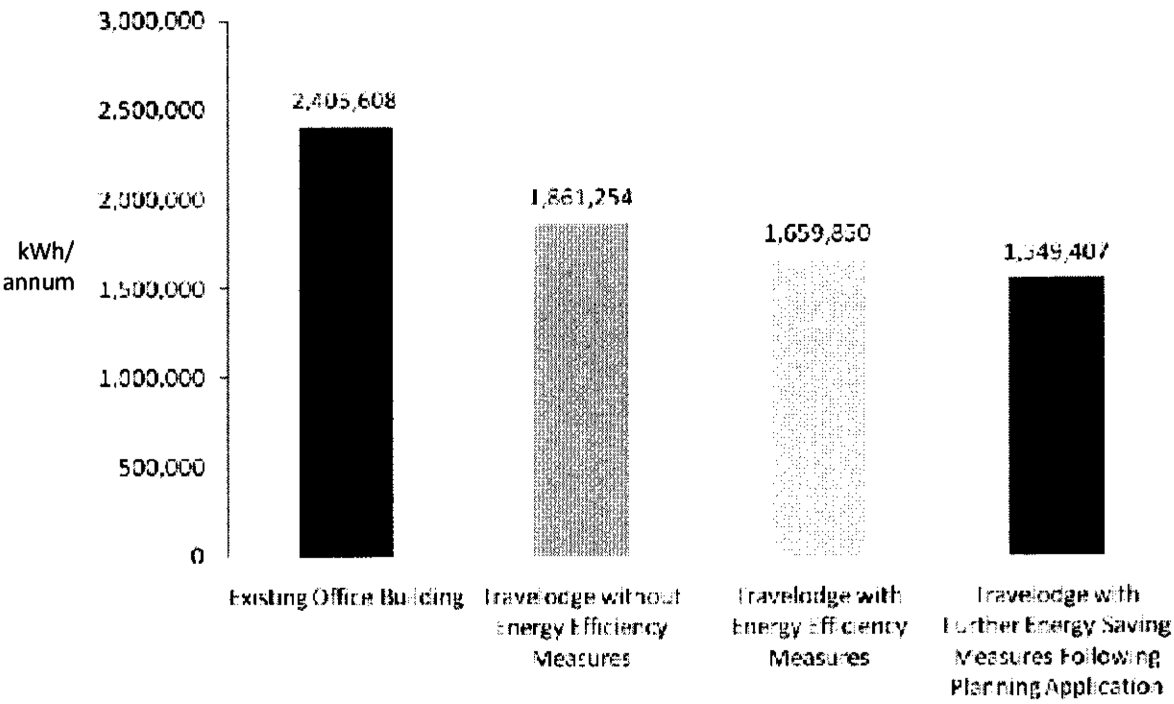
This information will be reviewed regularly by Travelodge and their external consultants since significant energy saving benefits as a result of the use of CHP will inform future developments.

In addition Travelodge utilise an external energy consultant who monitor the energy consumption across the entire Travelodge estate. These consultants are able to provide all necessary energy consumption data to the council to enable the performance of individual sites to be investigated.

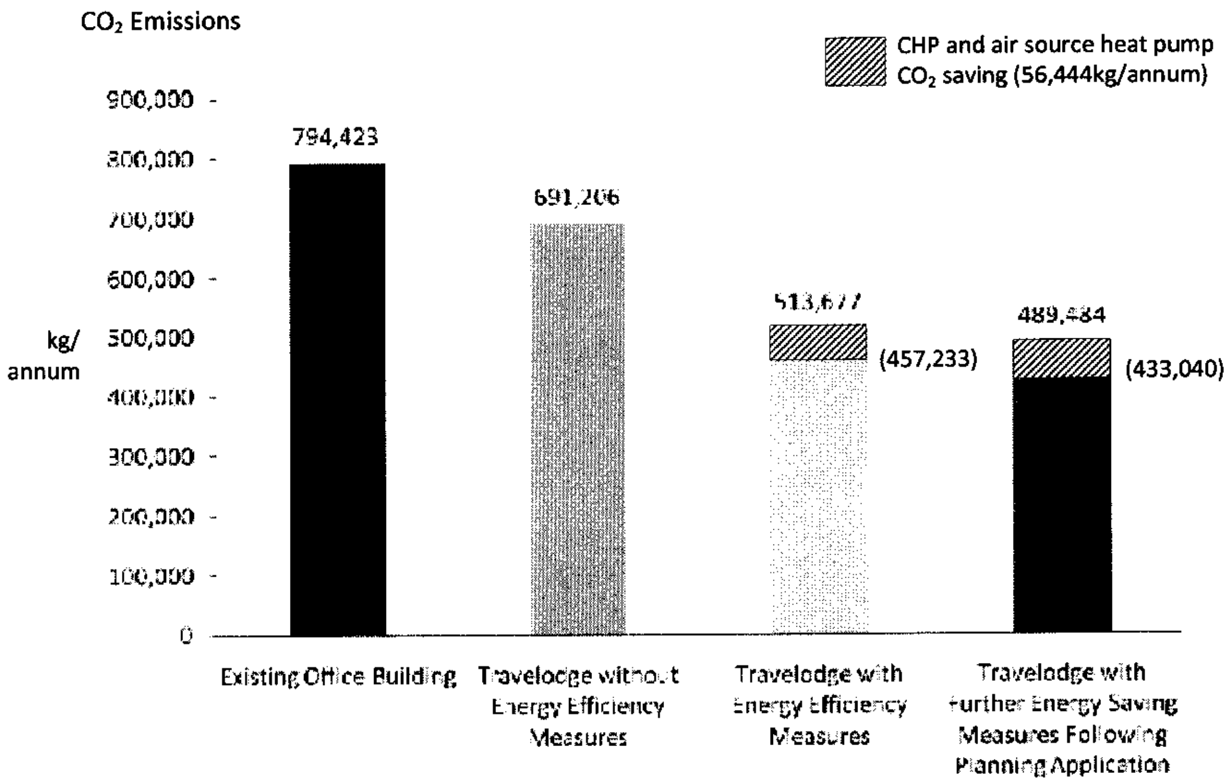
1.10 Overall Energy Consumption and CO_2 Emission Savings

The energy consumption and CO_2 emission savings predicted for this development as a result of converting a fully air conditioned office building into an energy efficient Travelodge are detailed graphically below.

Energy Consumption



The conversion of the existing office building will therefore save 856,201kWh/annum i.e. 35.6% of the original energy consumption before the introduction of renewable energy sources.



The conversion of the existing office building will therefore save 304,939kgCO_2/annum i.e. 38.4% of the original CO_2 emissions before the introduction of renewable energy sources.

Following the incorporation of renewable energy sources there will be a further saving of 56,444kg/annum as represented by the banded boxes above.

2.0 Introduction

2.1 General

This energy efficiency and renewable energy plan has been prepared in accordance with Section 2.14 and 4.6 of the agreement pursuant to Section 106 of the Town and Country Planning Act 1990 (as amended).

In particular this plan sets out the package of measures to be adopted by the Owner in the management of the Development with a view to reducing carbon emissions.

St Giles House comprises of eleven storeys of office accommodation together with a basement car park level and two levels of high level plant. The proposals change the existing office accommodation into 249 bedrooms for Travelodge and incorporate a small extension of 341m^2 to provide improved reception and restaurant facilities for the existing hotel and extension plus a number of other minor external alterations.

A renewable energy statement (issue five dated 3 September 2009) was prepared in support of the Planning application for this Travelodge. The statement provided an assessment of the energy consumption and associated carbon dioxide emissions reductions for the proposed Travelodge utilising predicted consumption data and identified the target amount of energy generation and carbon savings to be provided from on-site renewable energy generation technology. A range of renewable energy technologies was evaluated to determine how the London Plan's renewable target of 20% CO_2 emissions could be met and which technologies are most appropriate for the site.

The key issues from the renewable energy statement are detailed below:

2.2 Carbon Emission Reduction Measures

The proposed development has been designed to minimise operational carbon emissions. Savings are delivered through following the Mayor's energy hierarchy which identifies three stages of an energy strategy.

1. Use less energy via energy efficiency and demand reduction measures

   The predicted energy consumption of the existing fully air conditioned office building is 2,405,608kWh/annum, which is equivalent to CO2 emissions of 794,423kg/annum.

   The conversion of this office building into a Travelodge reduces energy consumption by 544,354kWh/annum (23%), corresponding to a reduction in CO_2 emissions by 103,217kg/annum (13%), prior to the adoption of any energy efficiency measures or renewable energy technologies.

   The following energy efficiency and demand reduction measures will also be adopted:

   - Improve U-values of the external envelope
   - Improve U-value of glazing

- Improve air tightness
- Use of energy efficient lighting
- Use of intelligent lighting controls
- Use of variable speed pumps, fans and drives to match supply and demand
- Use of heat recovery to mechanical ventilation systems

Following the adoption of these energy efficiency measures a further reduction in the overall energy consumption of 204,404kWh/annum will be achieved, which is equivalent to a reduction in CO_2 emissions of 177,529kg/annum.

Hence, the conversion of the existing building into a Travelodge and the incorporation of energy efficiency and demand reduction measures saves 280,746kg/annum, equivalent to a 35.3% saving.

2. Supply energy efficiently via decentralised energy

Decentralised energy is an efficient means of generating and distributing heat and power. A combined heat and power (CHP) system has been considered for this development.

Whilst CHP has not historically been considered as a renewable energy technology it is recognised by the BRE under BREEAM as a LCZ (low or zero carbon) technology for the purpose of gaining credits for the use of local renewable energy sources under credit reference Ene5. It is also recognised under Policy 4A.7 of the London Plan as a compliant renewable energy technology.

A detailed analysis has been undertaken to demonstrate that an appropriately designed CHP installation saves up to 10.1% of the predicted annual CO_2 emissions after the energy efficiency and demand reduction measures have been adopted.

3. Renewable energy technologies

The feasibility of a number of potentially appropriate renewable energy technologies was investigated.

Estimates show that the initial proposed installation could save up to 21.7% of the annual CO_2 emissions utilising biomass water heating however the London Borough of Camden advised that biomass is not their preferred renewable choice.

Air source heat pumps will save 0.85% of the annual CO_2 emissions.

All other technologies were rejected since the analysis indicated that they would be unsuitable.

2.3 Renewable Energy Plan

An installation of CHP and air source heat pumps was proposed which will save 56,444kg CO_2/annum, equivalent to 11% of the annual CO_2 emissions.

3.0 Further Reductions of the Carbon Emission Baseline

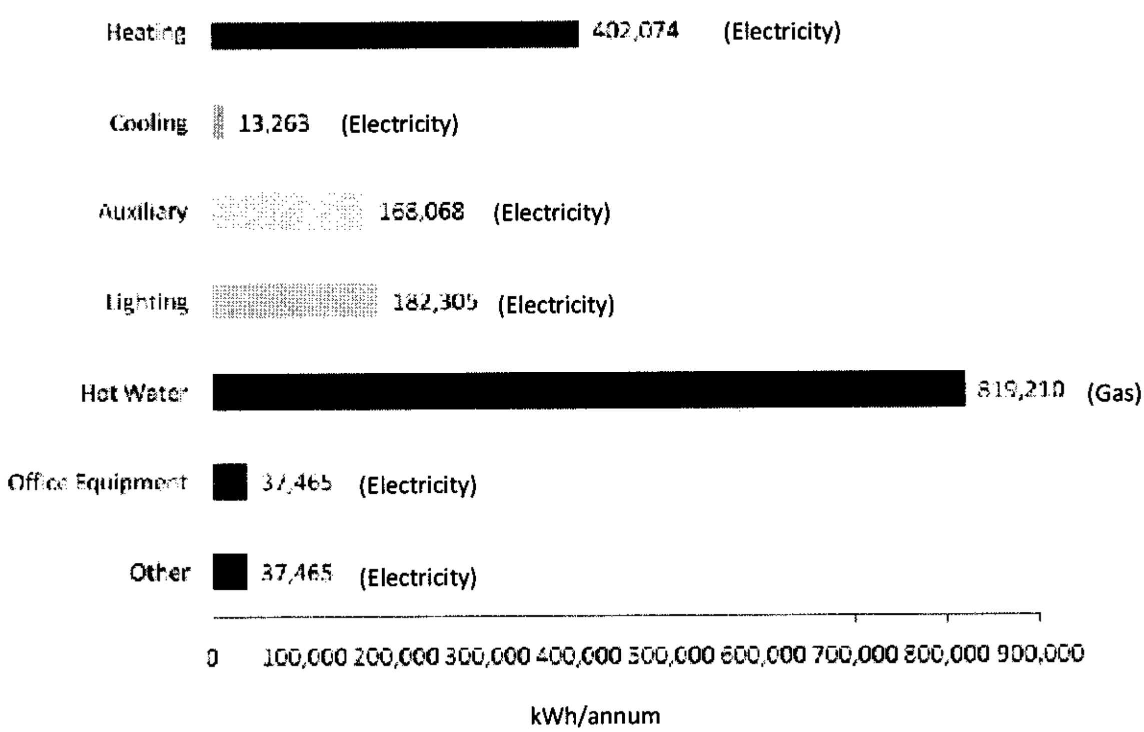
3.1 General

Prioritising a reduction in the carbon emission baseline will improve the development's percentage contribution from on-site renewable energy.

3.2 Carbon Emission Baseline

The results of the energy assessment undertaken in the renewable energy statement can be graphically represented as follows:

Building Energy Consumption



It is clear that hot water is by far the largest energy consumer within the development consistent with many hotel projects.

The actual carbon emission baseline is 513,677kg/annum. In order to reduce the carbon emission baseline particular measures need to be concentrated upon reducing the heating and hot water energy consumptions.

In particular the following measures have been identified which could be incorporated into the project.

3.3 Further Improve U-value of Existing Glazing

The largest source of heat loss from the building after infiltration and ventilation is the windows. These typically represent about 20% of the total heat loss.

The existing window U-values are poor compared to current Building Regulations requirements with a U-value of 3.0W/m^{2}K anticipated.

The addition of secondary glazing to achieve a window U-value of 2.2W/m^{2}K was identified in the renewable energy strategy as part of a package of energy demand reduction measures which reduced the predicted energy consumption of the proposed Travelodge by over 18% and reduced CO_2 emissions by 23.5%.

Further detailed analysis by Allglass has improved this U-value to 2.1W/m^{2}K by the use of Sapa Dualframe 75mm internal windows thermally broken with laminated softcoat Argon filled glass. This provision will further reduce energy consumption by 8,318kWh/annum (0.50%) and CO_2 emissions by 3510kg/annum (0.68%).

3.4 Further Improve U-values of the External Envelope

The existing individual element U-values are poor compared to current Building Regulations with the following existing U-values anticipated:

- Walls 1.0W/m^{2}K
- Roof 0.6W/m^{2}K
- Floor 1.0W/m^{2}K

Measures were identified in the renewable energy strategy to improve these U-values to achieve the following:

- Walls 0.35W/m^{2}K
- Roof 0.25W/m^{2}K
- Floor 0.25W/m^{2}K

A detailed analysis of the fabric element build ups has been undertaken and the following U-values will be achieved as detailed in the elemental U-value calculations contained in Appendix 1.

- Bedroom block external walls 0.34W/m^{2}K
- Bar cafe external walls 0.32W/m^{2}K

- Bedroom block roof soffit 0.22W/m^{2}K
- Bedroom block floor slab 0.23W/m^{2}K
- Bar cafe floor slab 0.19W/m^{2}K

This provision will further reduce energy consumption by 3,820kWh/annum (0.23%)and CO_2 emissions by 1612kg/annum (0.31%).

3.5 Water Use

Water heating accounts for 50% of the Travelodge's energy use.

Aerated shower heads introduce air bubbles into the water stream and reduce the amount of water used to shower whilst maintaining apparent water flow and pressure. Basin mixer tap inserts operate on the same principle.

Travelodge have recently been undertaking trials of aerated shower heads and basin mixer tap inserts which have indicated a potential reduction in gas consumption/room of 12%, equivalent to an energy consumption saving of 98,305kWh and a CO_2 saving of 19,071kg/annum, and a potential reduction in water consumption of almost 45%.

It is proposed to introduce aerated shower heads and spray taps on this project to further reduce CO_2 emissions and water use.

3.6 Use of Electrical Panel Heaters

3.6.1 General

The efficiency of electrical panel heaters is considerably superior to gas fired heating systems. Additionally there are no transmission losses arising from pipework heat loss etc.

The use of electric panel heaters provides the hotel operator with greater flexibility with the control of the heating system since individual heaters within bedrooms are switched off via staff when rooms are vacated thereby reducing energy consumption in use.

Panel heaters provide a faster response and warm up time compared to a gas fired heating solution offering a significant benefit over a central plant solution for heating a building since there is no requirement to pre heat the building.

3.6.2 Intelligent Panel Heater Controls

The uncontrolled use of panel heaters is believed to be the largest potential waste of energy in the Travelodge estate.

Intelligent heater controllers restrict panel heater output to a pre determined setback temperature and provide guests with a boost facility to allow the heater to work at full output for a pre determined period of time.

Travelodge are undertaking an evaluation exercise during winter 2009/2010 to determine the benefits of incorporating intelligent heater controllers. If following this exercise a decision is made to introduce intelligent controls they would be installed on this project prior to the hotel becoming operational.

4.0 Incorporation of a Combined Heat and Power System

4.1 General

A combined heat and power system is an efficient way of generating electricity onsite with the benefit of reduced fuel costs (gas being cheaper than electricity) and reduced carbon emissions. Heat generated from the gas engine can be used to produce hot water for heating and domestic hot water.

4.2 Engineering Feasibility

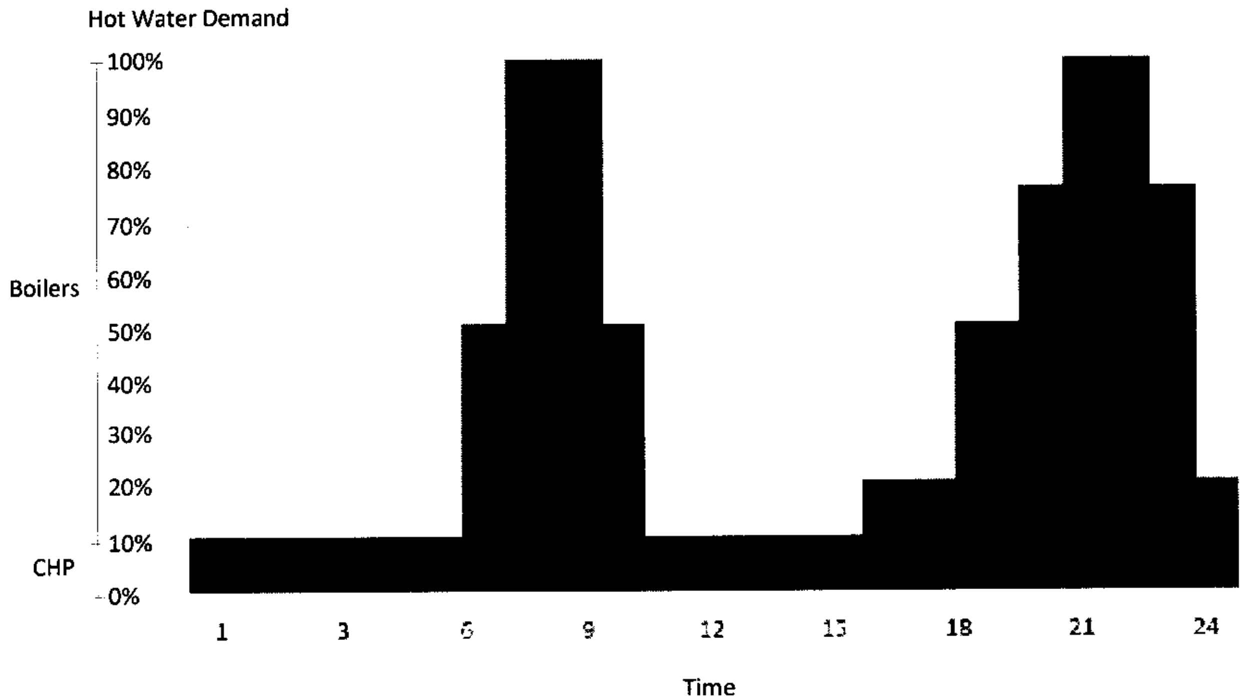
Integrating CHP into an electrically heated hotel facility, without the type of constant base load which would normally be provided by leisure facilities such as swimming pools, requires careful consideration since the CHP units need to be sized to match the available base load without excessive cycling which would reduce the effectiveness and life expectancy of the units.

The base load for this building would be provided by the bedroom hot water requirements.

Establishing the base load is difficult for a hotel of this nature, particularly since the usage of a Travelodge in Central London is more varied than in other areas and therefore the actual hot water demand is uncertain.

However, it is reasonable to assume a base load of approximately 10% which is not impacted by summer/winter periods.

The following hot water demand profile is currently anticipated which indicates periods of anticipated peak usage. However in order to satisfy these peak periods it is necessary to utilise the CHP system to maintain a dedicated buffer volume of hot water equivalent to 1500 litres.



It is anticipated that a single large CHP unit would be unable to modulate down to the loads experienced in quiet periods. Therefore, in order to ensure the CHP units remain operational for the maximum period possible in order to maximise the unit's efficiency and minimise energy consumption, a mini-CHP solution has been developed in conjunction with Baxi-SenerTec UK who act as agents for Dachs SE mini-CHP units.

A CHP appraisal was included within the renewable energy statement. It is anticipated that the CHP provision would offset 52,061kg CO_2/annum, equivalent to a 10.1% saving in predicted CO_2 emissions.

This appraisal is based upon the provision of 4 mini-CHP units mounted in parallel linked into buffer vessels. The units would incorporate exhaust flue gas condensers to provide additional heat output.

Baxi-SenerTec UK suggested that technically up to 6 mini-CHP units could be installed in parallel which could theoretically demonstrate even further savings in CO_2 emissions. However, due to the fluctuating hot water demands experience has demonstrated that on a project of this size, only 4 units could be expected to operate continuously to satisfy the hot water requirements.

4.3 System Design

A detailed design appraisal has been undertaken. Included within Appendix 2 are the following drawings indicating the plant location and its integration into the domestic water services installation.

- Drawing W137/M301 rev 3. Level 1 Domestic Hot and Cold Water Services
- Drawing W137/M320 rev 2. Central Plant Layout Schematic Domestic Hot and Cold Water Services

The CHP installation will generally comprise:

- 4No. Dachs SE 5.5 CHP units with condensers
- Primary circuit from buffer vessels to low loss header including pump set valves fittings etc.
- 2No. buffer vessels (750 litres)
- Condenser exhaust flue
- Controls to ensure CHP operates as lead boiler. Dach's software will let BMS 'see' CHP units as one with CHP operating under its own control
- A phone line located adjacent to one CHP unit for commissioning and energy monitoring.
- The CHP units are compliant with the ENA G83/1 Engineering Recommendations which permits direct connection of the CHP to the building circuits and hence parallel connection with the public grid network. The grid will make up any power

shortfall from the CHP and any excess power generated by the CHP will be automatically exported to the grid.

- Earthing to CHP units (on daisy chain arrangement)
- 4 spare ways in local distribution board DB1 or level 1 MCC panel
- Electricity meter to distribution board to measure produced energy

4.4 Management Plan

The operation of the CHP system will be encompassed within Travelodge's standard maintenance contract.

This contract includes call-outs to unplanned outages or breakdowns within a guaranteed response time and comprehensive maintenance cover associated with both planned and unplanned maintenance requirements.

5.0 Feasibility and Viability of Exporting Energy

5.1 Exporting External to Site

As detailed within section 4.2 establishing a constant base load against which to match the CHP installation is a difficult exercise. It is anticipated that this will be in the order of 10% of the peak hot water load.

A single large CHP unit will be unable to modulate down to the loads experienced in quiet periods. Therefore, in order to ensure the CHP units remain operational for the maximum period possible in order to maximise the units efficiency and minimise energy consumption, a mini-CHP solution has been developed tailored to the specific operational needs of this hotel.

The hot water produced and electricity generated will service the hotel's requirements therefore there is insufficient capacity available to feed into a district wide combined heat and power system.

In order to produce a system which could produce sufficient spare capacity particularly heat, for exporting from the site to serve the Oasis Sports Centre, it would be necessary to significantly oversize the CHP capacity possibly by as much as several thousand percent. By so doing the operational periods and therefore efficiencies would be significantly reduced until the external sources came on line.

Additionally logistical issues associated with metering of energy exported, energy supply contracts (the exporter would need to form an energy supply company and effectively become a utility) and the legal consents required to run district heating mains in the public highway or over third party property would all suggest that exporting energy from the site would be both unfeasible and unviable.

5.2 Integration of CHP with Existing Hotel

The existing hotel is provided with hot water via 2No. Hoval hot water and heating combination boilers located on the roof of the existing hotel. The location of the new CHP system at level 1 relative to the existing hotel system means that it would be hydraulically unfeasible to link the systems together due to the static pressures each system are operating under plus the logistics of physically interlinking the systems and controlling them effectively.

6.0 Carbon Benefits of Air Source Heat Pumps

On 17 December 2008, the European Parliament adopted the EU Directive on promoting the use of energy from renewable energy sources. In addition to geothermal energy, aerothermal and hydrothermal energy were also recognised as renewable energy sources. The Directive text implied that member states should promote air source heat pumps in the same way as solar and wind energy.

Air source heat pumps are additionally recognised by both the BRE under BREEAM as a LZC (low or zero carbon) technology for the purpose of gaining credits for the use of local renewable energy sources under credit reference Ene 5 and the emerging revised London Plan.

Air source heat pumps are used to extract heat from surrounding air to provide space heating. Heat pumps take in heat at a certain temperature and release it at higher temperature, using the same process as a refrigerator.

Recent developments in air source heat pump technology has improved the performance of systems over the vast air temperature range that can be expected.

Most heat pumps are electrically driven. The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of the heat output, divided by quantity of energy put in. CoP's up to 4-5 should be achievable. Electrically driven heat pumps are very reliable but require regular maintenance.

It is a Travelodge requirement to provide cooling to the bar cafe area. In addition 5 bedrooms at level 2 require cooling because it is not possible to open windows to provide rapid ventilation and natural cooling.

Cooling/heating will be provided to the level 2 bedrooms by a heat recovery simultaneous heating and cooling system. The remote air cooled condensing unit will be located in the external compound. Each bedroom will be provided with a wall mounted indoor unit to distribute cooling or heating as required.

A separate system will be provided to the bar cafe consisting of heat pump units. Systems will be split type comprising remote air cooled condensing units serving indoor units housing evaporator coils for heating exchange. Each unit will recirculate air from the conditioned space and will regulate the temperature through a thermostat. The remote air cooled condensing units will be located in the car park below.

An air source heat pump appraisal was included within the renewable energy statement. It is estimated that 10,386 kWh per annum of energy could be saved which is equivalent to 0.6% of the total energy consumption. The carbon dioxide saving of 4,383 kg/annum is equivalent to 0.85% of the total carbon dioxide emissions.

7.0 Building Management System

Travelodge does not have a specific requirement for a dedicated building management system to control the operation of the mechanical services due to the relative simplicity of the services solution. Instead a control panel will be provided with a reception common alarm which will be activated by any mechanical services fault condition.

However each CHP unit is controlled by an intelligent controller which controls all components associated with the system including peak load boiler and the domestic hot water heat exchanger module.

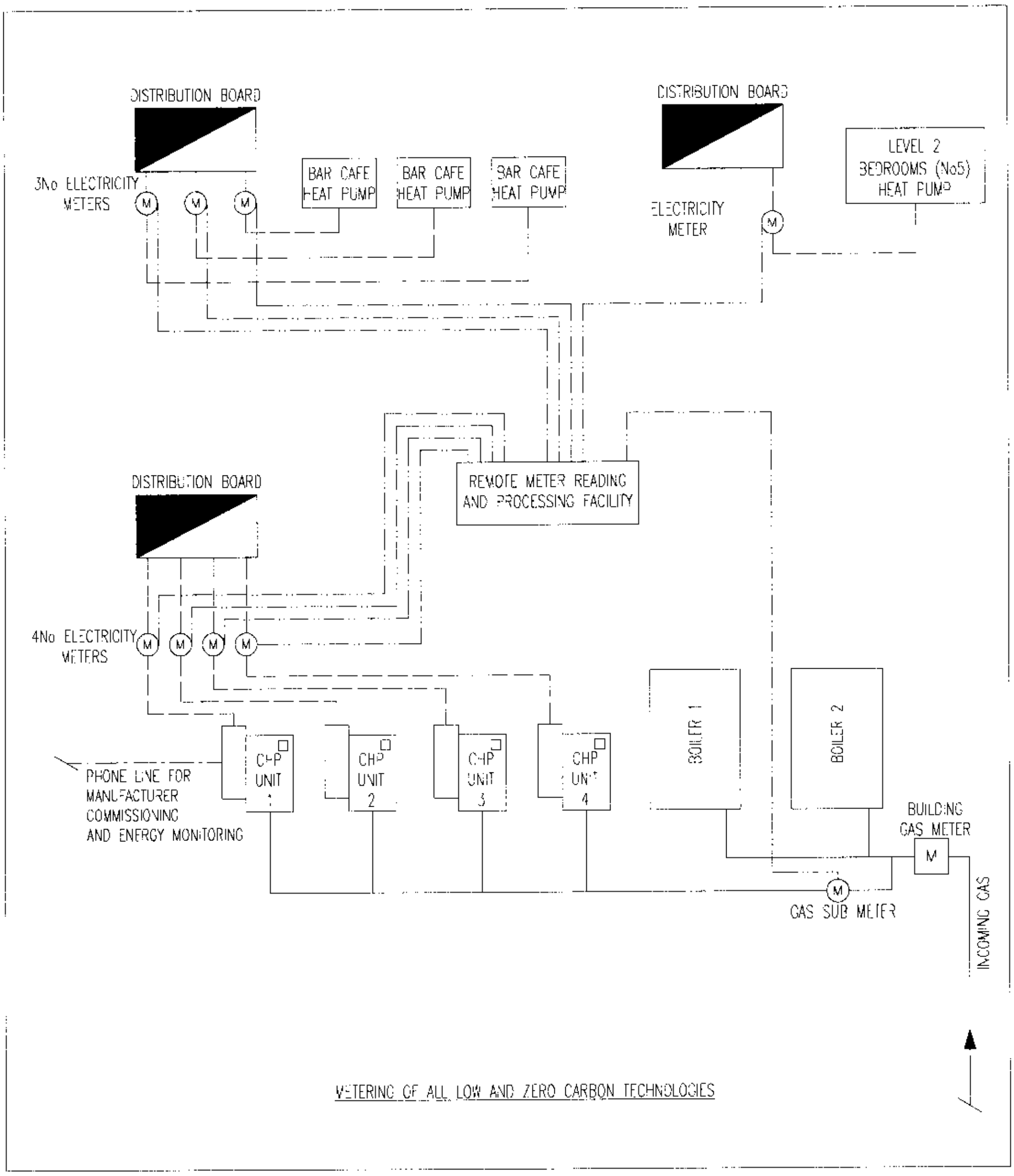
The integrated modem within each CHP unit provides the facility for remote monitoring and control of the CHP system, enabling the transfer of operational data and faults.

A phone line will be installed to the CHP units which will enable the manufacturer to commission, monitor and control the operation of the CHP units. Utilising this facility it will be possible for Travelodge to monitor the performance of the CHP system, including assessing the operational periods and outputs. This will provide the information necessary, when combined with meter readings, to ensure the CHP system operation is achieving the predicted CO_2 emissions.

It is considered that the CHP intelligent controllers adequately provide all of the functionality of a BMS system with regard to the control of the CHP system.

8.0 Separate Metering of Low and Zero Carbon Technologies

In accordance with the BREEAM assessment sub-metering of substantial energy uses will be provided. This provision will additionally cover the low and zero carbon technologies as demonstrated in the diagram below.



The provision of these meters will enable the monitoring of energy and carbon emissions and savings to be undertaken.

9.0 Means of Ensuring the Provision of Information

As noted in section 7.0 continual monitoring of the performance of the CHP units will enable data to be collected to ensure the CHP system operation is achieving the predicted CO_2 emission savings.

This information will be reviewed regularly by Travelodge and their external consultants since significant energy saving benefits as a result of the use of CHP will inform future developments.

In addition Travelodge utilise an external energy consultant who monitor the energy consumption across the entire Travelodge estate. These consultants are able to provide all necessary energy consumption data to enable the performance of individual sites to be investigated.

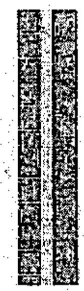
Appendix 1: Elemental U-value Calculations

Bedroom Block
External Walls
Insulation.

BuildDesk U 3.3

Documentation of the component
Thermal transmittance (U-value) according to [
Source: own catalogue - External walls
Component: JWA Architects

OUTSIDE INSIDE



This illustration of inhomogeneous layers is provided only to assist in visualising the arrangement.

Assignment: External wall

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.04
☑	1	Generic Building Materials	Concrete block (dense) outer leaf (1800 kg/m³) & Mortar outer leaf (f = 0.000 / automatic disregarding acc. BRE 4.4.3)	0.100	1.210	D	0.08
☑	2	Unventilated Airspace BR 443	Normal cavity - 50 mm, unventilated	0.050	0.278	D	0.18
☑	3	Rockwool Ltd	High Performance Partial Fill (50-80mm)	0.050	0.034	B	1.47
		Fixings	Helifix TimTie No./m²:	2.5/m²	17.000	D	-
		Air gaps	Level 0: dU" = 0.00 W/(m²K)				
☑	4	BS EN 12524	Breather membrane	0.000	0.170	D	0.00
☑	5	Light steel-frame	consisting of:	0.050	ø 0.188		0.27
	5a	Rockwool Ltd	Flexi (50-120mm) 600mm wide	99.70 %	0.038	A	-
		Air gaps	Level 0: dU" = 0.00 W/(m²K)				
	5b	BS EN 12524	Steel	00.30 %	50.000	D	-
☑	6	BS EN 12524	Polyethylene 0.15 mm	0.000	0.170	D	0.00
☑	7	Generic Building Materials	Standard wallboard plasterboard	0.013	0.210	D	0.06
		Rsi					0.13
				0.263			

$R_T = p*R_T' + (1-p)*R_T'' = 2.90$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Mechanical fasteners	Digest 465	~~0.002~~
Air gaps	BS EN ISO 6946 Annex D	~~0.038~~
Air gaps and fixings corrections need not be applied, as their total effect is less than 3% (Annex D BS 6946:1996).		
		0.000

$U = 1/R_T + \Sigma\Delta U = 0.34$ W/(m²K)

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
A .. A: Data is entered and validated by the manufacturer or supplier. Data is continuously tested by 3rd party.
B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
C .. C: Data is entered and validated by the manufacturer or supplier.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

U_{max} = 0.35 W/(m²K) U = 0.34 W/(m²K) R_T = 2.90 m²K/W

Source of Umax value: England, Wales: Approved Document L1A (2006), Table 2 - New Build Dwellings

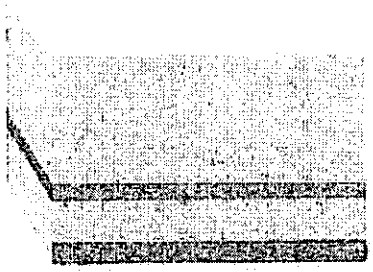
Calculated with BuildDesk 3.3.1

BuildDesk U 3.3

Bedroom Block
Roof Soffit
Insulation.

Documentation of the component
Thermal transmittance (U-value) according to BS
Source: rwip0801 - rwip1000 - Pitched Ro
Component: rwip0913 - JWA Architects - Ceili

OUTSIDE



INSIDE

Assignment: Pitched roof < 70°, with insulation between joists

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.10
☐	1	Matt Calcs	Glazed Unit	0.015	1.400	E	~~0.01~~
☐	2	BS EN ISO 6946	Well ventilated air layer	0.900	0.000	D	-
☑	3	BS EN 12524	Concrete, Reinforced (with 1% of steel)	0.110	2.300	D	0.05
☑	4	BS EN ISO 6946	Unventilated air layer: 300 mm, upwards heat flow	0.300	1.875	D	0.16
☑	5	Rockwool Ltd	Flexi 140mm 400mm wide	0.140	0.035	A	4.00
		Air gaps	Level 0: $dU'' = 0.00$ W/(m²K)				
☑	6	BS EN 12524	Aluminium foil 0.05 mm	0.000	200.000	D	0.00
☑	7	Generic Building Materials	Standard wallboard plasterboard	0.013	0.210	D	0.06
		Rsi					0.10
				1.478			

☐ was not taken into consideration in the calculation

$R_T = R_{si} + \Sigma R_i + R_{se} = 4.47$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Air gaps	BS EN ISO 6946 Annex D	~~0.000~~
		0.000

$U = 1/R_T + \Sigma\Delta U = 0.22$ W/(m²K)

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
A .. A: Data is entered and validated by the manufacturer or supplier. Data is continuously tested by 3rd party.
B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
C .. C: Data is entered and validated by the manufacturer or supplier.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

U_{max} = 0.25 W/(m²K)   U = 0.22 W/(m²K) R_T = 4.47 m²K/W

Source of Umax value: England, Wales: Approved Document L1A (2006), Table 2 - New Build Dwellings

Calculated with BuildDesk 3.3.1

Kingspan.
Kingspan Insulation Ltd

File reference : SC7K54A0.FCF
Client : JWA Architects Ltd
Contract : Travelodge
Structure element : Floor, other than ground floor
Description : Soffit lining insulation fixed with fasteners of lambda value or part of it less than 1 W/mK
Calculated 'U' value = 0.23W/m²K (Calculated in accordance with BS EN ISO 6946)

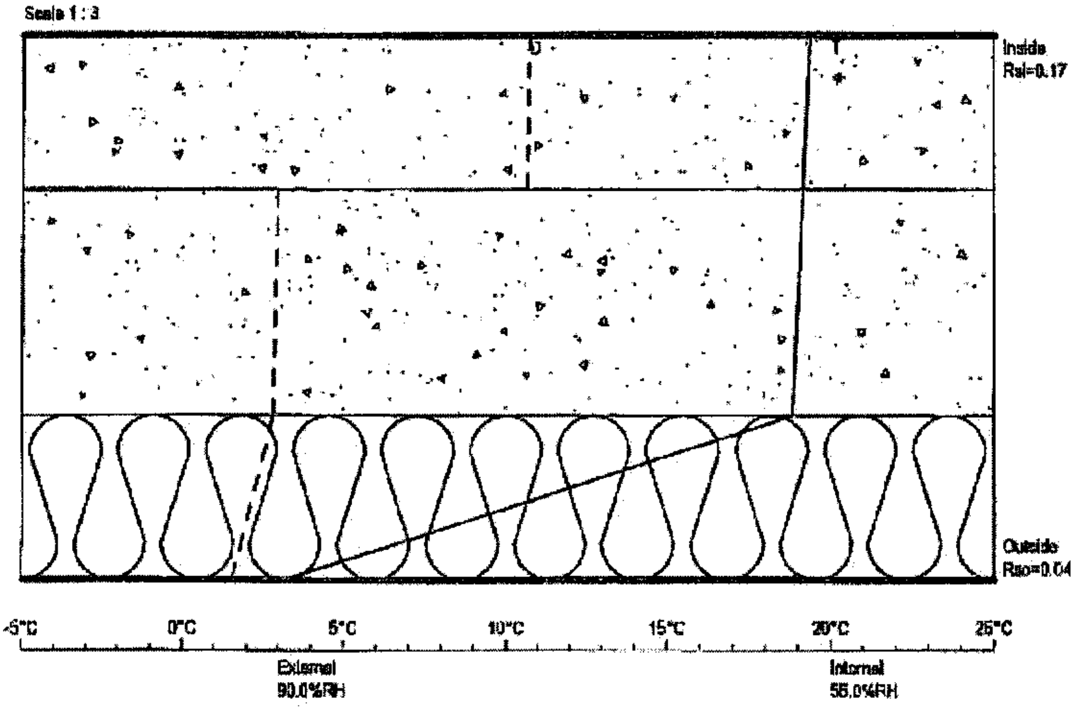
(Correction for mechanical fasteners, Delta Uf = 0.0000W/m²K | Correction for air gaps, Delta Ug = 0.0000W/m²K)
(Alpha 0.0 m⁻¹ | Fasteners per square metre 0.00)
(Fasteners cross-sectional area 0.000 mm² | Thermal conductivity of fastener 0.00 W/mK)

Condensation calculations performed in accordance with BS5250

Element Description	Element Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m²K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Inside surface resistance	-	-	0.170	-	-
SAND CEMENT SCREED	75.0	1.400	0.054	100.00	7.50
DAMP PROOF MEMBRANE	0.9	-	0.001	-	800.00
CONCRETE 1:2:4 2000 Kg/m3	110.0	1.400	0.079	100.00	11.00
KOOLTHERM K10 - all joints taped with foil tape	80.0	0.020	4.000	-	100.00
Outside surface resistance	-	-	0.040	-	-

Values at Interfaces			
Vapour Pressure (kPa)	Structure Temperature (°C)	Dewpoint Temperature (°C)	Condensation Risk (kg/60 days)
1.285	20.0	10.7	
1.285	19.3	10.7	
1.280	19.1	10.6	
0.755	19.1	2.9	
0.747	18.8	2.8	

Scale 1 : 3



Bedroom Block
Floor Slab
Insulation.

FabCalc 2.02m

Kingspan.

Kingspan Insulation Ltd

File reference : JCAR42FC.FCF
Client : JWA Architects Ltd
Contract : Travelodge
Structure element : Floor, other than ground floor
Description : Suspended floor
Calculated 'U' value = 0.19W/m²K (Calculated in accordance with BS EN ISO 6946: 2007)

(Correction for mechanical fasteners, Delta Uf = 0.0000W/m²K | Correction for air gaps, Delta Ug = 0.0000W/m²K)
(Alpha 0.0 m^{-1} | Fasteners per square metre 0.00)
(Fasteners cross-sectional area 0.000 mm² | Thermal conductivity of fastener 0.00 W/mK)

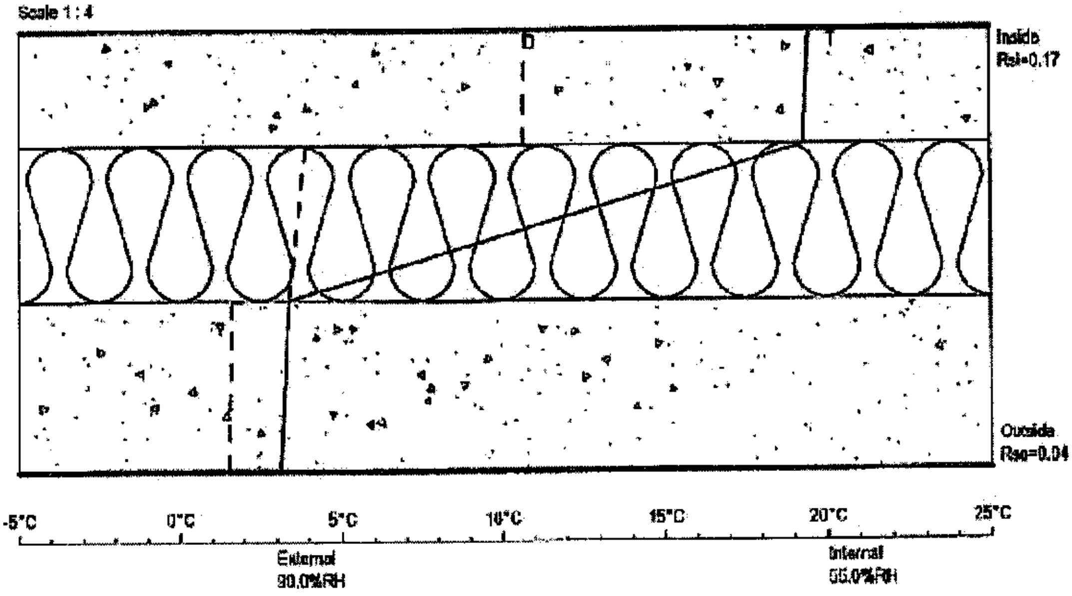
Condensation calculations performed in accordance with BS5250

Calculated 'Q' value under notional winter conditions over 60 days = 0.004kg/m²

Element Description	Element Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m²K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Inside surface resistance	-	-	0.170	-	-
SAND CEMENT SCREED	75.0	1.400	0.054	100.00	7.50
POLYTHENE SEPARATION LAYER	0.5	-	0.001	-	600.00
KOOLTHERM K3	100.0	0.020	5.000	300.00	30.00
DAMP PROOF MEMBRANE	0.9	-	0.001	-	800.00
CONCRETE 1:2:4 2000 Kg/m3	110.0	1.400	0.079	100.00	11.00
Outside surface resistance	-	-	0.040	-	-

Values at Interfaces			
Vapour Pressure (kPa)	Structure Temperature (°C)	Dewpoint Temperature (°C)	Condensation Risk (kg/60 days)
1.285	20.0	10.7	
1.285	19.6	10.7	
1.278	19.3	10.6	
0.806	19.3	3.9	
0.778	3.4	3.4	0.004
0.687	3.4	1.6	

Scale 1 : 4



Bar Café
Floor Slab
Insulation.

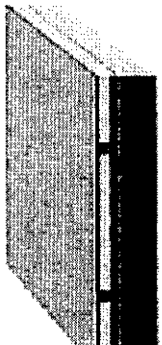
FabCalc 2.02r

BuildDesk U 3.3

Documentation of the component | 18. June 2009
Thermal transmittance (U-value) according to Digest 465 | Page 1/4
Source: **own catalogue - External walls**
Component: **SSRB1107SteveBlake**

Bar Cafe
external wall insulation

OUTSIDE INSIDE



This illustration of inhomogeneous layers is provided only to assist in visualising the arrangement.

On the basis of the given information about the inhomogeneous layers, it is not possible to estimate how and where bearing elements intersect each other. It was assumed that the layers intersect crosswise. The size of the areas was calculated corresponding to their percentage of the whole area.

Assignment: External wall

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.13
☐	1	BS EN 12524	Steel	0.007	50.000	■	~~0.00~~
☐	2	DuPont Tyvek	Tyvek Supro	0.000	0.100	■	~~0.00~~
☐	3	BS EN 12524	Plywood [500 kg/m³]	0.024	0.130	■	~~0.18~~
☐	4	Inhomogeneous material layer	consisting of:	0.040	ø 0.011		~~3.69~~
	4a	BS EN ISO 6946	Well ventilated air layer	91.67 %	0.000	■	-
	4b	BS EN 12524	Softwood Timber [500 kg/m³]	08.33 %	0.130	■	-
☑	5	Inhomogeneous material layer	consisting of:	0.030	ø 0.043		0.70
	5a	Rockwool Ltd	RWA45 Slabs	91.67 %	0.035	■	-
		Air gaps	Level 0: dU" = 0.00 W/(m²K)				
	5b	BS EN 12524	Softwood Timber [500 kg/m³]	08.33 %	0.130	■	-
☑	6	DuPont Tyvek	Tyvek Housewrap	0.000	0.100	■	0.00
☑	7	BS EN 12524	Oriented strand board (OSB)	0.015	0.130	■	0.12
☑	8	Light steel-frame	consisting of:	0.140	ø 0.185		0.76
	8a	Rockwool Ltd	Flexi 140mm 600mm wide	99.70 %	0.035	■	-
		Air gaps	Level 0: dU" = 0.00 W/(m²K)				
	8b	BS EN 12524	Steel	00.30 %	50.000	■	-
☑	9	BS EN 12524	Polyethylene 0.15 mm	0.000	0.170	■	0.00
☑	10	Lafarge Plasterboard Ltd	Lafarge Vapourcheck Wallboard	0.013	0.180	■	0.07
		Rsi					0.13
				0.269			

☐ was not taken into consideration in the calculation

Documentation of the component
Thermal transmittance (U-value) according to Digest 465
Source: **own catalogue - External walls**
Component: **SSRB1107SteveBlake**

$R_T = p*R_T' + (1-p)*R_T'' = 3.08\ m^2K/W$

Correction to U-value for	according to	delta U [W/(m²K)]
Air gaps	BS EN ISO 6946 Annex D	0.000
		0.000

$U = 1/R_T + \Sigma\Delta U = 0.32\ W/(m^2K)$

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
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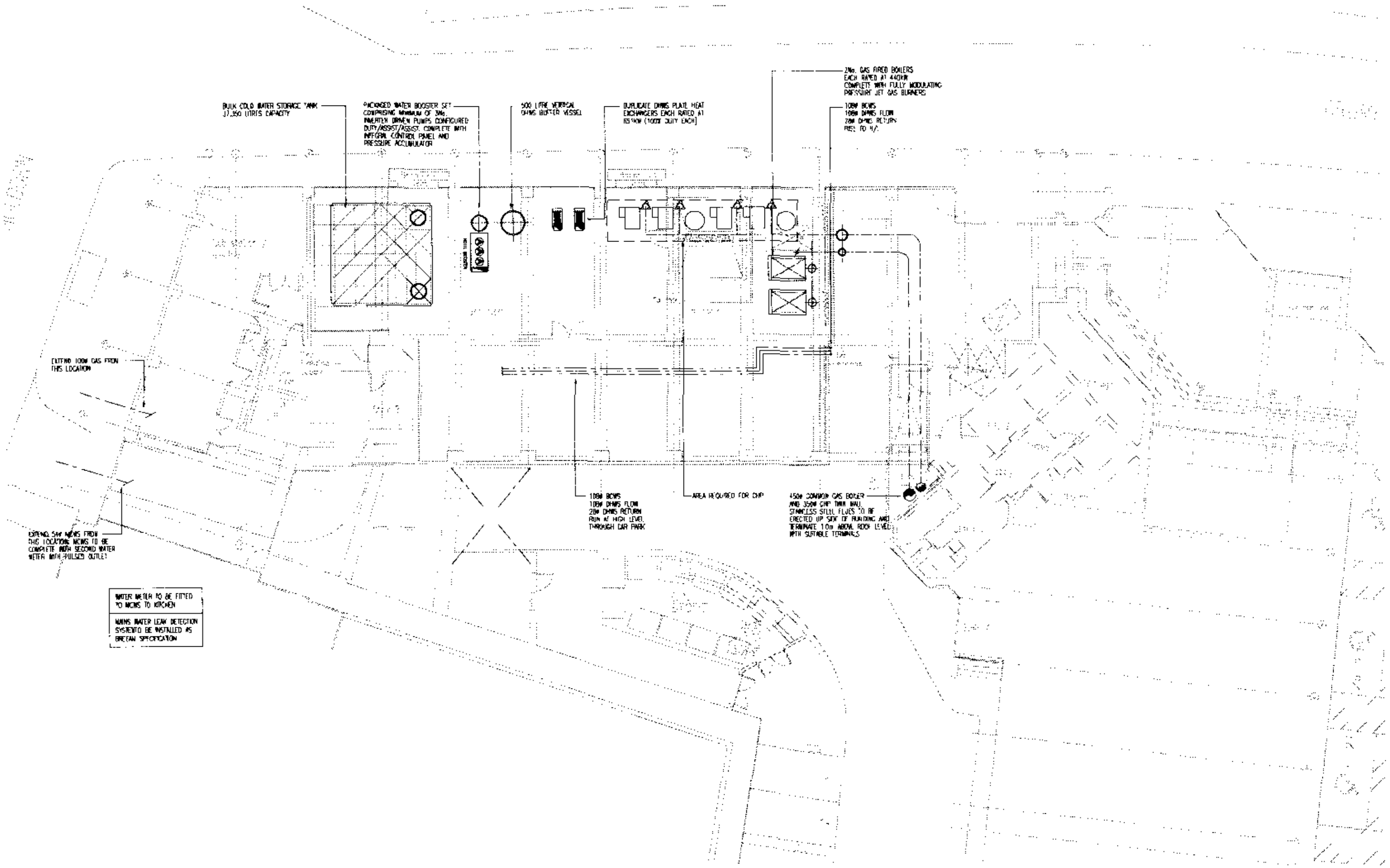
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

U_{max} = 0.35 W/(m²K) U = 0.32 W/(m²K) R_T = 3.08 m²K/W

Source of Umax value: England, Wales: Approved Document L1A (2006), Table 2 - New Build Dwellings

Appendix 2: CHP System Design Drawings

Do Not Scale



WATER METER TO BE FITTED TO MCWS TO KITCHEN

MAINS WATER LEAK DETECTION SYSTEM TO BE INSTALLED AS BREEAM SPECIFICATION

NOTES

1 READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER ARCHITECTS, STRUCTURAL ENGINEERS AND BUILDING SERVICES ENGINEERS DRAWINGS, SPECIFICATIONS AND SCHEDULES

2 THE SERVICES CONTRACTOR SHALL BE RESPONSIBLE FOR THE COORDINATION OF HIS WORK WITH ALL OTHER TRADES

Rev	Description	Date
3	CONSTRUCTION ISSUE	27/10/09
2	BIOMASS BOILER OMITTED CHP ADDED	30/06/09
1	2ND STAGE TENDER ISSUE	08/06/09
A	BOILERS / FLUES RELOCATED	23/03/09
0	1ST STAGE TENDER ISSUE	06/03/09

Issue Status

CONSTRUCTION

Client

BARNES CONSTRUCTION

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11 The Shambles
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Project

TRAVELODGE
DRURY LANE

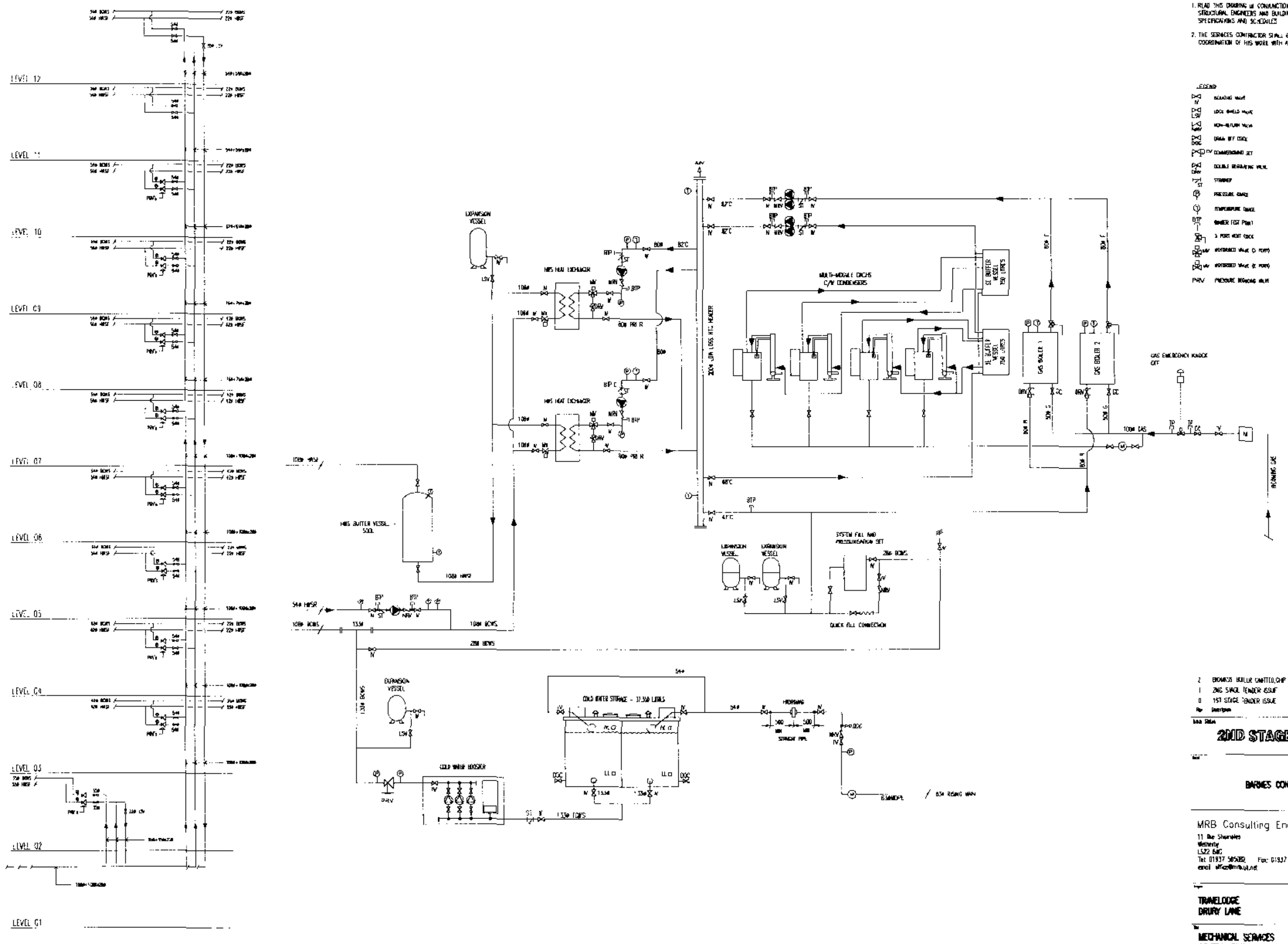
Title

MECHANICAL SERVICES
LEVEL 1
DOMESTIC HOT & COLD WATER SERVICES

Drawn	Checked	Date	Scale
MC		FEB 09	1:100 @ A1

Job No	Dwg No	Rev
W137	M301	3

Do Not Scale



DOMESTIC HOT & COLD WATER RISER SCHEMATIC

NOTES

1. READ THIS DRAWING in CONJUNCTION WITH ALL OTHER ARCHITECTS, STRUCTURAL ENGINEERS AND BUILDING SERVICES ENGINEERS DRAWINGS, SPECIFICATIONS AND SCHEDULES

2. THE SERVICES CONTRACTOR SHALL BE RESPONSIBLE FOR THE COORDINATION OF HIS WORK WITH ALL OTHER TRADES

LEGEND

- IV ISOLATING VALVE
- LSV LOCK SHIELD VALVE
- NRV NON-RETURN VALVE
- DOC DRAIN OFF COCK
- CV COMMISSIONING SET
- DRV DOUBLE REGULATING VALVE
- ST STRAINER
- PRESSURE GAUGE
- TEMPERATURE GAUGE
- BTP BINDER TEST POINT
- 3 PORT VENT COCK
- MV MOTORISED VALVE (3 PORT)
- MV MOTORISED VALVE (2 PORT)
- PRV PRESSURE REDUCING VALVE

Rev	Description	Date
2	BIOMASS BOILER OMITTED,CHP ADDED	30/05/09
1	2ND STAGE TENDER ISSUE	08/05/09
0	1ST STAGE TENDER ISSUE	06/03/09

Issue Status

2ND STAGE TENDER

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TRAVELODGE
DRURY LANE

MECHANICAL SERVICES
CENTRAL PLANT LAYOUT - SCHEMATIC
DOMESTIC HOT & COLD WATER SERVICES

Drawn	Checked	Date	Scale
MC		FEB.09	NTS@ A1

Job No	Dwg No	Rev
M137	M320	2

Appendix 3: Renewable Energy Statement (Issue 5 dated 3 September 2009)

MRB Consulting Engineers LLP
For
Parklake Limited and Travelodge
Hotels Ltd

Renewable Energy Statement

UPDATE

Proposed Travelodge Hotel Extension
St Giles House
1 Drury Lane
London
WC2B 5RS

Issue Five: 3 September 2009

Contents

1.0 Executive Summary

1.1 General

This updated energy statement has been undertaken for the proposed Travelodge Hotel extension at St Giles House, 1 Drury Lane, London, WC2B 5RS in order to address the requirements of The London Plan: Spatial Development Strategy for Greater London (February 2008) and the London Borough of Camden Replacement Unitary Development Plan (UDP) as adopted June 2006. The UDP is accompanied by the 'Camden Planning Guidance' (CPG) which was adopted on 14 December 2006.

This updated report has been prepared in light of the London Borough of Camden's advice that biomass is not their preferred renewable choice.

The energy model has also been developed in this version of the report to more accurately reflect the energy associated with cooling to the level 2 bedrooms and the bar cafe which had been determined previously utilising benchmark data.

The proposed development has been designed to minimise operational carbon emissions. Savings are delivered through following the Mayor's energy hierarchy which identifies three stages of an energy strategy.

1. Use less energy via energy efficiency and demand reduction measures

   The predicted energy consumption of the existing fully air conditioned office building is 2,405,608kWh/annum, which is equivalent to CO2 emissions of 794,423kg/annum.

   The conversion of this office building into a Travelodge will reduce energy consumption by 544,354kWh/annum (23%), corresponding to a reduction in CO_2 emissions by 103,217kg/annum (13%), prior to the adoption of any energy efficiency measures or renewable energy technologies.

   The following energy efficiency and demand reduction measures will also be adopted:

   - Improve U-values of the external envelope
   - Improve U-value of glazing
   - Improve air tightness
   - Use of energy efficient lighting
   - Use of intelligent lighting controls
   - Use of variable speed pumps, fans and drives to match supply and demand
   - Use of heat recovery to mechanical ventilation systems

   Following the adoption of these energy efficiency measures a further reduction in the overall energy consumption of 351,121kWh/annum will be achieved, which is equivalent to a reduction in CO_2 emissions of 148,104kg/annum.

Hence, the conversion of the existing building into a Travelodge and the incorporation of energy efficiency and demand reduction measures will save 251,321kg/annum, equivalent to a 31.6% saving.

2. Supply energy efficiently via decentralised energy

Decentralised energy is an efficient means of generating and distributing heat and power. A combined heat and power (CHP) system has been considered for this development.

Whilst CHP has not historically been considered as a renewable energy technology it is recognised by the BRE under BREEAM as a LCZ (low or zero carbon) technology for the purpose of gaining credits for the use of local renewable energy sources under credit reference Ene5. It is also recognised under Policy 4A.7 of the London Plan as a compliant renewable energy technology.

A detailed analysis has been undertaken to demonstrate that an appropriately designed CHP installation would save up to 10.1% of the predicted annual CO_2 emissions after the energy efficiency and demand reduction measures have been adopted.

3. Renewable energy technologies

Estimates show that the initial proposed installation could save up to 21.7% of the annual CO_2 emissions utilising biomass water heating however the London Borough of Camden have advised that biomass is not their preferred renewable choice. Travelodge has considerable experience in the use of biomass within their portfolio of hotels including some within London and have in place contracts for the national supply of biomass fuel.

Air source heat pumps will additionally save 0.85% of the annual CO_2 emissions.

1.2 Proposal

An installation of CHP and air source heat pumps is proposed which will save 56,444kg CO_2/annum which is equivalent to 11% of the annual CO_2 emissions. It has not been possible to achieve the London Plan 20% target with other renewable energy technologies however the Camden 10% target is achieved.

It can be demonstrated that the proposed conversion of an existing fully air conditioned office building into a Travelodge will save in total 307,765 kg CO_2/annum by change of use, energy efficiency and demand reduction measure plus incorporation of renewables which is equivalent to 38.7% of the existing building's annual CO_2 emissions.

A Bespoke BREEAM pre assessment has additionally been undertaken to demonstrate the environmental impact of the development and a separate provisional BREEAM report comments on this issue.

2.0 Introduction

2.1 General

This renewable energy statement has been prepared in support of the planning application for the proposed Travelodge hotel at St Giles House, 1 Drury Lane, London, WC2B 5RS. The application effectively comprises an extension to the existing Travelodge hotel at 10 Drury Lane located within the same building.

St Giles House comprises of eleven storeys of office accommodation together with a basement car park level and two levels of high level plant.

The proposals would change the existing office accommodation into 249 bedrooms for Travelodge and incorporate a small extension of $341m^2$ to provide improved reception and restaurant facilities for the existing hotel and extension plus a number of other minor external alterations.

This statement provides an assessment of the energy consumption and associated carbon dioxide emissions reductions for the proposed Travelodge utilising both benchmark data and predicted consumption data and identifies the target amount of energy generation and carbon savings to be provided from on-site renewable energy generation technology.

A range of renewable energy technologies have been evaluated to determine how the London Plan's renewable target of 20% CO_2 emissions can be met and which technologies are most appropriate for the site.

Travelodge has a requirement for heating to be via electric panel heaters with no bedroom cooling, this therefore limits the range of potential renewable energy solutions since a large proportion of energy consumption will be electrical, with only water heating being via fossil fuel.

2.2 Project Commitments

The following energy and carbon targets and commitments will be made:

Energy Efficiency:	Significant energy efficiency measures will be adopted to improve the energy efficiency of the existing building. In particular the thermal performance of the external envelope and windows will be considerably improved.
BREEAM:	The development will obtain a very good score under the BREEAM bespoke assessment method and will target a minimum of 52.22% score under the energy credits section.
Renewable Energy:	Camden seek developments to try and achieve a 20% reduction in CO_2 emissions through renewable energy generation in accordance with the London Plan. This development seeks to achieve the maximum reduction in CO_2 emissions subject to site constraints.

3.0 Policy Review

3.1 Summary Review of Planning Policy Context

This section summarises the policy context for the St Giles House, 1 Drury Lane energy statement.

The various policies from international to local level, that aim to reduce greenhouse gas emissions, particularly carbon dioxide, and hence contribute to sustainable development are identified below.

3.2 International Energy Policy – The Kyoto Protocol

The Kyoto Protocol obligates countries to commit to reduce national carbon dioxide (CO_2) emissions. Total reductions from the combined nations must equal at least 5% from 1990 levels in the commitment period 2008-2012.

For its part under Kyoto, the UK has a legally binding commitment to reduce greenhouse gases by 12.5% below base year levels over the period of 2008-2012.

3.3 EU Policy

In 2006, the Energy Performance of Buildings Directive (EPBD) was introduced to contribute to achieving the Kyoto Protocol obligations. The directive works by facilitating requirements to measure energy use in buildings by:

- Introducing agreed measurements of relative energy performance.
- Regular inspections and re-evaluations.
- Requiring higher standards for upgrading larger buildings.
- Improving standards for new buildings.

3.4 National Planning Policy – Planning Policy Statements

Following public consultation, the government prepared Planning Policy Statements (PPSs) in order to provide guidance on planning policy. The following PPSs are particularly pertinent for the energy strategy:

- PPS1: Delivering Sustainable Development (2005): this document sets out a holistic sustainable approach to development, covering the sustainable use and management of water, as well as resource and energy efficiency. The supplement to PPS1 'Planning and Climate Change' (Dec 2007) sets out how planning should contribute to reducing emissions and stabilising climate change.

- PPS22: Renewable energy (2004): this document presents local planning authorities with the option to require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy installations.

3.5 National Legislation

3.5.1 The Building Regulations

The key Building Regulations for sustainable and energy efficient development are as follows:

- Part F (Ventilation) – regulates the control and effectiveness of ventilation schemes.
- Part L (Conservation of Fuel and Power) – regulates the energy performance and carbon emissions of new and existing buildings.

These documents were updated in 2006 in order to comply with the Energy Performance of Buildings Directive.

Part L for new buildings other than dwellings requires that CO_2 emissions be reduced by more than 20% (the percentage target depends on the building type) compared with a standard notional building, designed to Part L 2002 standards.

3.5.2 Our Energy Future: Creating a Low Carbon Economy (2003)

The 2003 Energy White Paper states the four goals of the government's energy policy as follows:

- To ensure the UK is on a path to cut its CO_2 emissions by some 60% by 2050, with real progress by 2020.
- To maintain the reliability of energy supplies.
- To promote markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity.
- To ensure that every home is adequately and affordably heated.

Energy efficiency is considered to be the lowest cost and most deliverable way of achieving these goals, while renewable energy is to play an important part in reducing CO_2 emissions.

3.5.3 Meeting the Energy Challenge (2007)

The 2007 White Paper sets out the government's international and domestic energy strategy in response to changing circumstances, particularly in light of two long term goals identified in the 2006 Energy Review Report:

- Tackling climate change by reducing CO_2 emissions, both within the UK and abroad.
- Ensure secure, clean and affordable energy as we become increasingly dependent on imported fuel.

The key elements of the 2007 strategy are:

- Establish an international framework to tackle climate change.
- Provide legally binding carbon targets for the whole UK economy, progressively reducing emissions.
- Make further progress in achieving fully competitive and transparent international markets.
- Encourage more energy saving through better information, incentives and regulation.

- Provide more support for low carbon technologies.
- Ensure the right conditions for investment.

3.6 Regional Energy Policy

3.6.1 The London Plan: Spatial Development Strategy for Greater London.

The London Plan aims to ensure London becomes an 'exemplary, sustainable world city', whilst allowing London to grow in a responsible and considered socio-economic manner.

The London Plan was originally introduced in 2004 however the plan has been consolidated with alterations since 2004 and was reissued in February 2008.

Relevant policy sections are:

- *Policy 4A.1 Tackling Climate Change*

  The Mayor will, and boroughs should, in their DPDs require developments to make the fullest contribution to the mitigation of and adaptation to climate change and to minimise emissions of carbon dioxide.

  The following hierarchy will be used to assess applications:

  - *Using less energy, in particular by adopting sustainable design and construction measures (Policy 4A.3).*
  - *Supplying energy efficiently, in particular by prioritising decentralised energy generation (Policy 4A.6), and*
  - *Using renewable energy (Policy 4A.7)*

- *Policy 4A.2 Mitigating climate change*

  The Mayor will work towards the long term reduction of carbon dioxide emissions by 60 per cent by 2050. The Mayor will and boroughs and other agencies should seek to achieve the following minimum reduction targets for London against a 1990 base; these will be monitored and kept under review:

  - *15% by 2010*
  - *20% by 2015*
  - *25% by 2020*
  - *30% by 2025*

- *Policy 4A.3 Sustainable design and construction*

  The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in DPD policies. These will include measures to:
  - *Reduce carbon dioxide and other emissions that contribute to climate change.*
  - *Design new buildings for flexible uses throughout their lifetime.*
  - *Avoid internal overheating and excessive heat generation.*
  - *Make most effective and sustainable use of water, aggregates and other resources.*

- *Minimise energy use, including by passive solar design, natural ventilation and vegetation on buildings.*
- *Supply energy efficiently and incorporate decentralised energy systems (Policy 4A.6) and use renewable energy where feasible (Policy 4A.7).*

Note: DPD relates to Development Plan Document policies.

- *Policy 4A.4 Energy assessment*

  The Mayor will, and boroughs should, support the Mayor's Energy Strategy and its objectives of improving energy efficiency and increasing the proportion of energy used generated from renewable sources.

  The Mayor will, and boroughs should, require an assessment of the energy demand and carbon dioxide emissions from proposed major developments, which should demonstrate the expected energy and carbon dioxide emission savings from the energy efficiency and renewable energy measures incorporated in the development, including the feasibility of CHP/CCHP and community heating systems. The assessment should include:

  - *Calculation of baseline energy demand and carbon dioxide emissions.*
  - *Proposals for the reduction of energy demand and carbon dioxide emissions from heating, cooling and electrical power (Policy 4A.6).*
  - *Proposals for meeting residual energy demands through sustainable energy measures (Policies 4A.7 and 4A.8).*
  - *Calculation of the remaining energy demand and carbon dioxide emissions.*

  This assessment should form part of the sustainable design and construction statement (Policy 4A.3).

- *Policy 4A.5 Provision of heating and cooling networks*

  Boroughs should ensure that all DPDs identify and safeguard existing heating and cooling networks and maximise the opportunities for providing new networks that are supplied by decentralised energy. Boroughs should ensure that all new development is designed to connect to the heating and cooling network. The Mayor will and boroughs should work in partnership to identify and to establish network opportunities, to ensure the delivery of these networks and to maximise the potential for existing developments to connect to them.

- *Policy 4A.6 Decentralised Energy: Heating, Cooling and Power*

  The Mayor will and boroughs should in their DPDs require all developments to demonstrate that their heating, cooling and power systems have been selected to minimise carbon dioxide emissions. The need for active cooling systems should be reduced as far as possible through passive design including ventilation, appropriate use of thermal mass, external summer shading and vegetation on and adjacent to developments. The heating and cooling infrastructure should be designed to allow the use of decentralised energy (including renewable generation) and for it to be maximised in the future.

Developments should evaluate combined cooling, heat and power (CCHP) and combined heat and power (CHP) systems and where a new CCHP/CHP system is installed as part of a new development; examine opportunities to extend the scheme beyond the site boundary to adjacent areas.

The Mayor will expect all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:

- *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.*
- *Communal heating and cooling fuelled by renewable sources of energy.*
- *Gas fired communal heating and cooling.*

- *Policy 4A.7 Renewable Energy*

The Mayor will, and boroughs should, in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from on site renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This will support the Mayor's Climate Change Mitigation and Energy Strategy and its objectives of increasing the proportion of energy used generated from renewable sources by:

- *Requiring the inclusion of renewable energy technology and design, including: biomass fuelled heating, cooling and electricity generating plant, biomass heating, renewable energy from waste (Policy 4A.21) photovoltaics, solar water heating, wind, hydrogen fuel cells, and ground coupled heating and cooling in new developments wherever feasible.*

- *Facilitating and encouraging the use of all forms of renewable energy where appropriate, and giving consideration to the impact of new development on existing renewable energy schemes.*

- *Policy 4A.9 Adaptation to climate change*

The Mayor will and other agencies should, promote and support the most effective adaptation to climate change, including:

- *Minimising overheating and contribution to heat island effects (Policy 4A.10).*
- *Minimising solar gain in summer (Policy 4A.10).*
- *Contributing to reducing flood risk including applying principles of sustainable urban drainage (Policies 4A.13 and 4A.14).*
- *Minimising water use (Policy 4A.16) and*
- *Protecting and enhancing green infrastructure.*

- *Policy 4A.10 Overheating*

The Mayor will, and boroughs should, strongly encourage development that avoids internal overheating and excessive heat generation and contributes to the prevention of further overheating, especially where the urban heat island is most intense. Developers should demonstrate how development could be made heat resilient in design, construction and operation. The Mayor will work with partners to reduce the heat island effect through energy efficiency and appropriate design.

3.7 Local Energy Policy

The local planning authority, the London Borough of Camden, has prepared a Unitary Development Plan (UDP) adopted June 2006, which together with the London Plan will comprise the development plan for the borough. The UDP is accompanied by the 'Camden Planning Guidance' (CPG) which was adopted on 14 December 2006.

The relevant UDP policy is Policy SD9 – Resources and Energy (Part C – Use of Energy and resources) with further advice relating to energy contained with supporting paras. 1.62 – 1.64.

Camden Planning Guidance also provides guidance relating to sustainability and energy in sections: 17 – Energy and on site renewable facilities; and 44 – Sustainable design and construction.

In summary the UDP and CPG policy requires developments over 1,000m^2 to include the provision of renewable energy on the site. However the provision of 10% of energy requirements of any new development to be provided through renewable energy sources, as specified in the UDP and CPG has been superseded by further amendments to the London Plan in February 2008. This has specified that new developments should aspire to meet a 20% target.

With any renewable energy technology proposed the applicant should make sure they have followed the Mayor's energy hierarchy (1. use less energy, 2. supply energy efficiently and 3. use renewable energy) to show that renewable energy is not just an 'add on'.

The case officer has subsequently advised that biomass is not the preferred renewable choice of the London Borough of Camden, due to air quality issues resulting from the boiler emissions and fuel supply issues.

4.0 The Building Regulations Approved Document L

The revision of the Part L Approved Documents is a direct outcome of the Government's Energy White Paper commitment to raise the energy performance of buildings. It requires implementation of the European Energy Performance of Buildings Directive to Member States setting performance standards requiring certification of buildings, including periodic inspections and certification of air-conditioning and boiler systems.

Generally, the 'Building Regulations are made for specific purposes: health and safety, energy conservation and the welfare and convenience of disabled people'.

The Regulations that came into force in April 2006 require that reasonable provision should be made for the conservation of fuel and power in buildings which use energy to condition the indoor climate by:

- Limiting heat gains and losses through the fabric of the building;
- Limiting heat losses from pipes, ducts and vessels used for space heating, space cooling and hot water storage;
- Providing energy-efficient fixed building services which have effective controls and which have been properly commissioned;
- Providing the owner with sufficient information about the building and building services and their maintenance so that it can be operated to minimise use of fuel and power as much as is reasonable in the circumstances.

Regulation L (2006) requires all buildings to be energy efficient and to have their building services fitted with effective controls and be properly commissioned. In addition, the building owner needs to be given sufficient information on the building, the fixed building services and their maintenance requirements so that the building can be operated efficiently, using no more fuel and power 'than is reasonable in the circumstances'.

The 2000 version of Regulation L focused on limiting heat loss by defining levels of insulation; it neither referred to heat gains nor required that the building services were energy efficient and properly commissioned. There was no requirement to provide information to users, so that the building could be operated efficiently.

In April 2002, Regulation L was revised and Regulation L2 was introduced for buildings other than dwellings. These revisions introduced the need for building services to be energy efficient and, in the case of L2, required heat gains to both the building and cooling plant installation to be limited. L2 also required the provision of information on the relevant services installation to enable its operation and maintenance so as to use no more energy than is reasonable.

In April 2006 requirement under Part L is now the same for all building types. The Approved Document though is in four sections to differentiate between dwellings and other buildings, and to further differentiate between new building work and work to existing buildings of each group.

This building will be required to comply with Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings.

The existing building is classified as B1 office hence the conversion into a hotel will result in a material change of use as defined in Regulation 5 (Approved Document L2B paragraphs 34 and 35 apply). Therefore, since the material change of use is greater than $100m^2$ and greater than 25% of the volume of the existing building, then the work should meet the requirements of L2A and consequential improvements may be required.

There are 2 options available to demonstrate compliance:

Option 1: U-value of existing windows less than $3.3W/m^2$ to be replaced to Table 5(b) (paragraphs 36e and 75-78) i.e. $2.2W/m^2$ for the whole unit.

AND

Fixed building services (such as heating, hot water, pipes, mechanical ventilation, cooling, fixed internal and external lighting – controlled services) comply (paragraphs 36a and 40-76)

AND

New thermal elements to Table 6(a) (paragraphs 36b and 79-84)

AND

As few as possible thermal bridges (paragraphs 83 and 84)

AND

Reduction of unwanted air leakage (paragraphs 83 and 84)

AND

Renovated thermal elements to Table 6(b) (paragraphs 36c, 85 and 86)
Thermal elements worse than Table 7(a) to be upgraded to Table 7(b) subject to simple payback calculation (paragraphs 36d, 87 and 88)
i.e. fabric elements to be improved as follows:

- Walls $0.35W/m^2K$
- Roof $0.25W/m^2K$
- Floor $0.25W/m^2K$

Option 2 Calculate whole building CO_2 emission using an accredited whole building calculation model to demonstrate that it will become no worse than following Option 1 (paragraph 37)
U-value of any individual element is no worse than Table 3(b) (paragraph 37)

Demonstrating Building Regulations compliance will form part of a separate submission however due to the intention to minimise energy consumption as far as possible it is proposed to follow option 1 since the adopted U-values are more onerous than following option 2.

The existing individual element U-values are poor compared to current Building Regulations requirements with the following existing U-values anticipated:

- Walls 1.0W/m^{2}K
- Roof 0.6W/m^{2}k
- Floor 1.0W/m^{2}K
- Windows, roof windows, roof lights and doors 3.0W/m^{2}k

In order to demonstrate compliance U-values of individual elements will be improved to achieve the following limiting U-values:

- Walls 0.35W/m^{2}K
- Roof 0.25W/m^{2}k
- Floor 0.25W/m^{2}K
- Windows, roof windows, roof lights and doors 2.20W/m^{2}k

A detailed analysis has been undertaken to determine how these U-values can be achieved. Whilst the details below require finalising it is proposed to adopt the following upgrades to existing thermal elements.

External walls (solid wall) – 0.35W/m^{2}K
Existing glazed unit/existing concrete structure.
Breather membrane
25mm Gyplyner system
65mm Gyproc Thermaline super plus

External walls (below window/secondary glazing) – 0.35W/m^{2}K
Existing glazed unit/existing concrete structure
Breather membrane
50mm Isowool 1200 acoustic roll suspended
200mm void/cavity
50mm Isover wool 1200 acoustic roll between 70mm studs
2 layers 12.5mm Soundbloc

Roof (Level 12) – 0.25W/m^{2}K
100mm concrete roof (waterproof plant area) assumed
75mm Celotex
Monoflex Reflex Vapour Control Layer
12.5mm plasterboard ceiling on MF system

Floor (Level 2) – 0.25W/m^{2}K
18mm T&G chipboard on 18mm plank
25mm Acoustic Rockfloor resilient layer
18mm chipboard
130mm floor joist 600mm c/c with 130mm Rockwool flexi (60 + 70mm layers)
100mm existing concrete suspended floor

Windows – 2.20W/m^{2}K
Secondary double glazing added

5.0 Energy Efficiency and Demand Reduction Measures

5.1 General

Prioritising a reduction in overall energy demand is the most effective way in which to minimise environmental impacts associated with energy use. The use of efficient technologies and renewables to supply the remaining load results in lower greenhouse gas emissions as compared with the use of conventional alternatives.

Cost effective measures can be adopted to reduce energy demand without making a significant impact on the design, appearance or character of the building. In accordance with the energy saving design principles set out in the sustainable design and construction section of Camden Planning Guidance it is intended to implement energy efficiency measures to improve on the minimum standards required in Part L of the Building Regulations.

The following specific measures are proposed to achieve an energy demand reduction at the development:

- Improve U-values of the external envelope
- Improve U-value of glazing
- Improve air tightness
- Use of energy efficient lighting
- Use of intelligent lighting controls
- Use of variable speed pumps, fans and drives to match supply and demand
- Use of heat recovery to mechanical ventilation systems

5.2 Improve U-values of the External Envelope

As detailed in section 4.0 the following U-values are proposed for the development.

Walls – $0.35W/m^2K$
Roof – $0.25W/m^2K$
Floor – $0.25W/m^2K$

5.3 Improve U-values of Glazing

The largest source of heat loss from the building after infiltration and ventilation is the windows. These typically represent about 20% of the total heat loss.

As detailed in section 4.0 the following U-values are proposed for the development.

Windows – $2.20W/m^2k$

5.4 Improve Air Tightness

The existing building air permeability is unknown however the CIBSE Guide suggest that a figure of $20m^3/h(m^2)$ at 50Pa could be expected (CIBSE Guide Table A4.15 refers).

The proposed fabric improvements, including the addition of secondary glazing will significantly reduce the air permeability and therefore reduce energy losses. Based upon the advice within CIBSE Guide Table A4.15 it is anticipated that air permeability will reduce to approximately $7m^3/h(m^2)$ at 50Pa, a reduction of over 50%.

5.5 Energy Efficient Lighting

Lighting accounts for approximately 11% of the predicted electrical consumption of the building.

Hotels traditionally use very large numbers of halogen downlighters. The use of these should be restricted to architecturally important features, such as reception areas. Even in these areas consideration will be given to alternatives such as LED and HID lamps.

Where halogen downlights are retained correct selection of the lamps can provide an energy saving of around 40% per luminaire.

All corridor lighting and general guest room lighting will use low energy compact fluorescent downlights, fitted with high frequency electronic ballasts.

5.6 Use of Intelligent Lighting Controls

Even with efficient lamps and luminaires, the energy used for lighting can be wasted in various ways. There are a number of ways of lighting control, local manual switching, timed control, reset control (manual on, timed off), occupancy control (presence detectors) and photoelectric switching and dimming. Lighting controls should ensure that light is provided in the right amount, in the right place for the required time.

Occupancy sensing will be utilised in all back of house areas and corridors.

5.7 Use of Variable Speed Pumps, Fans and Drives to Match Supply and Demand

There are a number of ways to control the pump or fan speed with the most efficient being an inverter. An inverter rectifies the alternating current to a direct current supply and then uses this to produce a smooth variable frequency alternating current output to the pump/fan motor. Controlling the frequency of the output device provides the desired speed modulation for the motor driving the fan or pump. As power consumption falls by the cube of the speed, cutting the motor speed to match the demand dramatically reduces electricity consumption. (ie cutting speed from 100% to 80% halves the energy use, reducing the speed further to 50% reduces the energy use to 15%).

Variable speed equipment, particularly fans, will be considered on this project.

5.8 Use of Heat Recovery to Mechanical Ventilation Systems

Where it is necessary to provide ventilation it is good practice to recover the heat from the extract air to pre heat the fresh air being introduced to the building. A typical heat recovery system will recover between 40-70% of the heat that would have been lost to atmosphere. Whilst there is an offset of additional resistance to the ventilation system fan due to the heat recovery device this is normally offset by the energy recovery from the extract air which can give, in some cases, a payback of 2-5 years for the additional capital outlay.

It is a requirement of this project to provide a bedroom fresh air ventilation system and bathroom extract system. Heat recovery will be incorporated between these systems to recover as much heat as possible.

5.9 Prediction of Resulting Energy Demand Reduction

The energy model utilised to calculate the actual energy of consumption of the building has been utilised to determine the energy consumption of the proposed Travelodge without the incorporation of the energy efficiency and demand reduction measures outlined above. The calculated energy consumption, excluding non controlled energy uses, is 258.38kWh/m^2, which is equivalent to 1,936,041kWh/annum. The calculated CO_2 emissions are 630,161kg/annum.

As detailed in Section 7.5 of this report, the energy consumption of the proposed actual building, excluding non controlled energy uses, was 211.51kWh/m^2, which is equivalent to 1,584,920kWh/annum.

Therefore, the energy demand reduction measures will save 351,121kWh/annum, equivalent to a reduction in energy consumption of over 18%. This will reduce CO_2 emissions by 148,104kg/annum, equivalent to a reduction in CO_2 emissions of 23.5%.

6.0 BREEAM

Sustainability is a key aim of the Replacement UDP in order to maximise the sustainability of developments and secure best practice in terms of sustainability.

In order to demonstrate that the development incorporates sustainable design a Bespoke BREEAM pre assessment has been undertaken which measures the overall performance of the building against sustainability criteria.

The BREEAM pre assessment forms a separate planning document however, in accordance with Replacement UDP policies B1 – General Design Principles and SD9C – Resources and Energy, the energy section of the BREEAM assessment is included within Appendix D of this report to help demonstrate the energy efficiency of the scheme.

7.0 Energy Assessment

7.1 General

In accordance with Policy 4A.4 of The London Plan in order to identify and highlight appropriate energy saving and renewable energy measures an outline energy assessment has been undertaken to establish the predicted energy consumption and associated carbon dioxide emissions for the proposed development.

7.2 Existing Building

The existing building is currently a fully air conditioned office which was vacated in December 2008 by BT.

In order to demonstrate the inherent efficiency of the proposed conversion in comparison with the current building the energy consumption of the existing building has been determined utilising the benchmark data published within CIBSE Guide F: 2004 'Energy Efficiency in Buildings' for standard air conditioned office buildings. This data is drawn from Energy Consumption Guide (ECG) 19 published by Action Energy in 2000.

The following table indicates annual energy loads that are based on the following 'typical practice' figures from CIBSE Guide F: 2004 'Energy Efficiency in Buildings'. Typical practice figures have been used to reflect the age of the existing building and installed services.

System	Energy Consumption ($kWh/m^2/annum$)	Fuel Type
Heating and hot water	178	Gas
Cooling	31	Electricity
Fans, pumps and controls	60	Electricity
Lighting	54	Electricity
Office equipment	31	Electricity
Other electricity	8	Electricity
Computer room	18	Electricity

The internal floor area of the office is approximately 6548m^2 of which 5609m^2 was lettable office accommodation. The following table shows the predicted annual energy consumption in kWh and in $kgCO_2$ based upon the split lettable and landlord areas.

Fuel	System	Energy Consumption (kWh/annum)	CO_2 Emissions (kg/annum)
Gas	Heating and hot water	1,165,544	226,116
Electricity	Cooling	173,879	73,377
	Fans, pumps and controls	392,880	165,795
	Lighting	353,592	149,216
	Office equipment	173,879	73,377
	Other electricity	44,872	18,936
	Computer room	100,962	42,606
TOTAL		**2,405,608**	**794,423**

Note: A CO_2 emission factor of 0.194kgCO_2/kWh has been used for fossil fuel and 0.422kg/CO_2/kWh has been used for electricity demand as detailed in Part L of the Building Regulations.

Hence, utilising benchmark data it is predicted that the gas consumption of the existing building would have been 1,165,544kWh/annum and electricity consumption would have been 1,240,064kWh/annum. This equates to carbon dioxide emissions of 794,423kg/ annum.

7.3 Proposed Travelodge

7.3.1 Proposed Services Installation

Travelodge has the following standard services strategy.

- Heating via electric panel heaters.
- Hot water via gas fired direct water heaters.
- Mechanically ventilated bedrooms (minimum fresh air only).
- Bathroom mechanical extract via a central system.
- No cooling to bedrooms.
- No catering requirements (serviced via adjacent building).
- Mechanical cooling to bar cafe.

The requirement for natural ventilation to bedrooms (i.e. no air conditioning or mechanical ventilation) is in accordance with Policy 4A.6 of The London Plan requiring active cooling systems to be reduced as far as possible. However the 5 bedrooms at level 2 on the Drury Lane elevation will require mechanical cooling due to the fact that openable windows cannot be incorporated into the scheme.

The energy assessment has been undertaken on this proposed services installation.

7.3.2 Benchmark Energy Consumption

In order to enable a simple comparison of energy consumption between the existing building and the proposed Travelodge the calculation of energy consumption for the Travelodge has also been determined utilising the benchmark data published within CIBSE Guide F: 2004 'Energy Efficiency in Buildings' for business hotels. This data is drawn from Energy Consumption Guide (ECG) 36 published by BRECSU. This document was first created in 1993 and has not been updated since this date.

The following table indicates annual energy loads that are based on the following 'good practice' figures from CIBSE Guide F: 2004 'Energy Efficiency in Buildings'. Good practice figures have been used in lieu of 'typical practice' to reflect the design intentions by the developer.

System	Energy Consumption ($kWh/m^2/annum$)	Fuel Type

Heating	160	Electricity
Hot water	60	Gas
Lighting	35	Electricity
Ventilation fans, pumps & controls	5	Electricity
Office equipment	5	Electricity
Cooling	2 (Bar cafe and 5 bedrooms only – $612m^2$)	Electricity
Other	5	Electricity

The gross internal floor area of the hotel is approximately $6889m^2$ which reflects the increased area of the Travelodge due to the new build element. The following table shows the predicted annual energy consumption in kWh and in $kgCO_2$ assuming that bedroom cooling is not provided.

Fuel	**System**	**Energy Consumption (kWh/annum)**	**CO_2 Emissions (kg/annum)**
Gas	Hot water	413,340	80,188
Electricity	Heating	1,102,240	465,145
	Lighting	241,115	101,751
	Ventilation fans, pumps & controls	34,445	14,536
	Office equipment	34,445	14,536
	Cooling	1,224	517
	Other	34,445	14,536
TOTAL		**1,861,254**	**691,206**

Note: A CO_2 emission factor of $0.194kgCO_2/kWh$ has been used for fossil fuel and $0.422kgCO_2/kWh$ has been used for electricity demand as detailed in Part L of the Building Regulations.

Hence, utilising benchmark data it is predicted that gas consumption would be 413,340kWh/annum and electricity consumption would be 1,447,914kWh/annum. This would equate to carbon dioxide emission of 691,206kg/annum.

7.4 Comparison Between Existing Building and Proposed Travelodge

Utilising the above benchmark data it can be seen that the proposed Travelodge will utilise considerably less energy than the existing building if it continued as office accommodation.

The Travelodge will save 544,354kWh/annum, equivalent to a reduction in energy consumption of nearly 23%. This will reduce CO_2 emissions by 103,217kg/annum, equivalent to a reduction in CO_2 emissions of 13%. Additionally, as a result of the energy efficiency measures outlined earlier in this report, the energy consumption and CO_2 emissions will be further reduced as detailed in section 5.9 of this report

7.5 Building Regulations Methodology – Travelodge

Building upon the above, an energy model has been produced to predict the actual energy consumption of the building. The software used was Hevacomp v8i which is approved to perform Building Regulations calculations using the National Calculation Methodology (NCM). This methodology has been adopted as an acceptable and understandable method of informing energy strategies.

When a simulation is performed, a 'notional' building is created. This building has the same shape and patterns of use as the actual, designed building, but makes standard assumptions regarding the heating, cooling and ventilation plant, lighting and building fabric. The energy consumption of this building is predicted using the software.

Energy consumption and carbon emissions were calculated incorporating the energy efficiency and demand reduction measures outlined in section 5.0 of this report and are determined based on an internal floor area of 7493m^2 The discrepancy in floor area is a result of the difficulties of creating the building model since areas such a lift shafts etc are incorporated into the plan area and whilst there is no energy consumption associated with these areas, the total consumption is averaged by the model across the entire area.

The actual building energy consumptions are as follows:

System	Fuel	Energy Consumption (kWh/m^2/annum)	kWh/annum)	CO_2 Emissions (kg/annum)
Heating	Electricity	53.66	402,074	169,675
Cooling	Electricity	1.77	13,263	5,597
Auxiliary	Electricity	22.43	168,068	70,925
Lighting	Electricity	24.33	182,305	76,933
Hot water	Gas	109.33	819,210	158,927
TOTAL		**211.52**	**1,584,920**	**482,057**

Note: A CO_2 emission factor of 0.194kgCO_2/kWh has been used for fossil fuel and 0.422kgCO_2/kWh has been used for electricity demand as detailed in Part L of the Building Regulations.

In order to utilise this data within the energy analysis this baseline must also include energy uses not controlled by the Building Regulations. These are obtained from benchmark data identified in section 6.3.2 of this report.

Benchmarks for non-controlled energy uses for a business hotel from CIBSE Guide F

System	Energy Consumption (kWh/m^2)	
	Electricity	**Gas**
Office equipment	5	0
Other	5	0

Hence, the non-controlled energy usage based on an internal floor area of 7493m^2 is:

System	Energy Consumption (kWh/annum)	
	Electricity	**Gas**
Office equipment	37,465	0
Other	37,465	0
TOTAL	**74,930**	**0**

Therefore the calculated energy consumption and CO_2 emission figures are:

Fuel	**Energy Consumption (kWh/annum)**	**CO_2 Emissions (kg/annum)**
Gas	819,210	158,927
Electricity	840,640	354,750
TOTAL	**1,659,850**	**513,677**

This baseline represents the target emission rating plus carbon emissions from non-controlled building energy uses. This value has therefore been used for reporting all progress against carbon mitigation measures.

It will be noted that the energy consumption and figures calculated under the Building Regulations methodology are slightly lower to those determined utilising benchmark data however the carbon dioxide figures are significantly lower. This seems to be because the NCM model assumes a significantly higher energy consumption for hot water and lower consumption for heating than is made by benchmarking data.

The Building Regulation methodology is generally required for compliance with energy related planning requirements. However, it should be noted that the methodology is a compliance tool rather than a prediction tool. The methodology forces certain assumptions to be made regarding energy consumption which has been observed to generally underestimate the heating requirements in both the notional and the actual case.

In order to comply with The London Plan: Spatial Development Strategy for Greater London (February 2008) and to respond to the London Borough of Camden Unitary Development Plan it will be necessary to save 102,735kg (20% of 513,677) of the annual CO_2 emissions using renewable energy technologies.

In order to comply with the UDP it will be necessary to save 51,368kg (10% of 513,677) of the annual CO_2 emissions using renewable energy technologies.

8.0 Decentralised Energy

8.1 General

Policy 4A.6 of The London Plan requires that combined cooling, heat and power (CCHP) and combined heat and power (CHP) systems are evaluated.

The high year round domestic hot water demand makes the use of a combined heat and power plant potentially feasible for this building. However, the pattern of demand for both heat and electricity across the day needs to be considered which has implications for the economic feasibility of combined heat and power plant.

There are no known existing CCHP/CHP distribution networks available locally and wood fired CHP units are not currently common in the UK therefore this analysis considers gas fired CHP.

A combined heat and power system is an efficient way of generating electricity onsite with the benefit of reduced fuel costs (gas being cheaper than electricity) and reduced carbon emissions. Heat generated from the gas engine can be used to produce hot water for heating and domestic hot water. However Travelodge's requirement for electric heating reduces the potential benefits from a CHP scheme.

8.2 Operator Constraints

CCHP requires cooling to form a significant element of the developments energy consumption. Travelodge's requirement for limited cooling means that CCHP will not be feasible.

8.3 Site Constraints

There is available plant space at both roof level and within the existing car park at level 1.

8.4 Engineering Feasibility

Integrated CHP into a hotel facility without the type of constant base load which would normally be provided by leisure facilities requires careful consideration since the CHP units need to be sized to match the available base load without excessive cycling which would reduce the effectiveness and life expectancy of the units.

The base load for this building would be provided by the bedroom hot water requirements. It is anticipated that a single large CHP unit would be unable to modulate down to the loads experienced in quiet periods. Therefore, in order to ensure the CHP units remain operational for the maximum period possible in order to maximise the unit's efficiency and minimise energy consumption, a mini-CHP solution has been developed in conjunction with Baxi-SenerTec UK who act as agents for Dachs SE mini-CHP units.

The CHP appraisal is included within Appendix C of this report. It is anticipated that the CHP provision could offset 52,061kg CO_2/annum, equivalent to a 10.1% saving in predicted CO_2 emissions.

This appraisal is based upon the provision of 4 mini-CHP units mounted in parallel linked into buffer vessels. The units would incorporate exhaust flue gas condensers to provide additional heat output.

Baxi-SenerTec UK suggested that technically up to 6 mini-CHP units could be installed in parallel which could theoretically demonstrate even further savings in CO_2 emissions. However, due to the fluctuating hot water demands experience has demonstrated that on a project of this size, only 4 units could be expected to operate continuously to satisfy the hot water requirements.

9.0 Renewable Energy Technologies

9.1 General

The feasibility of a number of potentially appropriate renewable energy technologies has been investigated for the proposed development. The outcome of this analysis is summarised in the following table, and a full description of the considerations is included in Appendix A of this report.

Technology	Suitable?	Observations
Air source heat pumps	√	Limited suitability for dedicated areas of the building
Ground source heat pumps	X	Existing building precludes formation of boreholes
Biomass hot water	√	Dedicated plant space and fuel storage required.
Solar water heating	X	Limited energy saving. Not compatible with CHP
Photovoltaics (rooftop)	X	Limited energy saving and long payback period
Wind turbines	X	Limited energy saving

The summary table indicates that the most appropriate technology for use at the development is biomass hot water since the other technologies are either unsuitable or will deliver only limited energy savings. Additionally air source heat pumps will be provided to satisfy the bar cafe and level 2 bedroom heating and cooling requirements.

Preliminary system sizes and arrangements have been investigated and details are given in Appendix A however the following table summarises these investigations.

Technology	Predicted Energy Saving (kWh/annum)	Energy Saving as % of total development	Predicted CO_2 saving (kg/annum)	CO_2 saving as a % of total development
Air source heat pumps	10,386	0.6	4,383	0.85
Biomass hot water	574,428	34.6	111,439	21.7

9.2 Integrating Biomass Hot Water into the Development

9.2.1 General

The case officer has advised that biomass is not the preferred renewable choice of the London Borough of Camden, due to air quality issues resulting from the boiler emissions and fuel supply issues. However in order to ensure that biomass hot water could be integrated into the development a detailed analysis has been undertaken based upon previous Travelodge experience of biomass hot water and with reference to the London Energy Partnership Publication 'Biomass for London: Wood Fuel Guide' dated August 2008.

The following constraints are identified within the Biomass for London guide and these have been addressed to demonstrate that biomass hot water is justified as an acceptable renewable energy technology.

9.2.2 Space

Wood fuel boilers are larger than gas boilers and require additional space for the storage of the fuel. The existing building has a car park at level 1, the majority of which has been dedicated as a plantroom.

A design layout has been produced indicating that a biomass boiler with $35m^3$ of biomass fuel storage can be accommodated in this area in conjunction with all other necessary equipment to form an operational hot water system.

9.2.3 Access

Good access is achievable into the designated plant area via the service road from High Holborn.

It is anticipated that monthly deliveries of biomass fuel would be acceptable on the same basis as refuse collections down the service road from High Holborn.

9.2.4 Capital Cost

Biomass hot water has been accepted by the developer as the renewable energy solution and costed accordingly.

9.2.5 Air Quality

The system will be designed to be fully compliant with the Clean Air Act 1993. A flue route has been determined up the side of the building which will terminate above roof level.

9.2.6 Confidence in Fuel Supply

Travelodge have a national agreement in place with Forever Fuels for the supply and delivery of biomass fuel.

9.2.7 Proposal

A scheme has been developed utilising a biomass boiler rated at 150kW which would operate as a lead boiler in conjunction with 2No. gas fired boilers to provide primary hot water for heating secondary domestic hot water via 2No. packaged heat exchangers.

A $35m^3$ biomass fuel storage would be provided to store 8mm pellets.

10.0 Summary

It has been demonstrated that the proposed conversion of an existing fully air conditioned office building into a Travelodge will save 251,321kgCO_2/annum, which is equivalent to 31.6% of the existing building's annual CO_2 emissions, as a result of the change of use and energy efficiency measures.

The predicted energy consumption using the Building Regulations methodology for the proposed development is 1,659,850kWh/annum.

The predicted CO_2 emissions from the proposed development are 513,677kg/annum.

In the initial stages of design development a range of environmental design issues and opportunities for renewable energy use have been evaluated to achieve a sustainable approach to the proposed development.

In order to provide a commercially viable scheme, and in accordance with the London Borough of Camden's guidance, it is proposed to develop the use of CHP and air source heat pumps since these technologies will save 56,444 kg CO_2/annum which is equivalent to 11% of the predicted annual CO_2 emissions. It has not been possible to achieve the London Plan 20% target with other renewable energy technologies however the Camden 10% target is achieved.

APPENDIX A: APPROPRIATE RENEWABLE ENERGY TECHNOLOGIES

Appropriate Renewable Energy Technologies

In accordance with Policy 4A.7 of the London Plan an initial feasibility study has been carried out to determine which technologies are potentially suitable for use in the development.

Carbon dioxide savings are specific to each technology. The generation of energy from renewable technologies offsets that which has to be taken from the national gas network at an emission rate of 0.194kg CO_2/kWh. The generation of electricity from renewable energy technologies offsets that which has to be taken from the National Grid at an emission rate of 0.422kg CO_2/kWh.

Air Source Heat Pumps

Application:	Space heating and cooling
Predicted energy savings:	10,386 (0.6%)
Predicted CO_2 savings:	4,383 (0.85%)
Installation requirements:	Suitable clear space required
Suitability:	This technology is considered suitable for the bar cafe and bedroom heating and cooling at level 2

Air source heat pumps are used to extract heat from surrounding air to provide space heating. Heat pumps take in heat at a certain temperature and release it at higher temperature, using the same process as a refrigerator.

Recent developments in air source heat pump technology has improved the performance of systems over the vast air temperature range that can be expected.

Most heat pumps are electrically driven. The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of the heat output, divided by quantity of energy put in. CoP's up to 4-5 should be achievable. Electrically driven heat pumps are very reliable but require regular maintenance.

An air source heat pump is not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat extracted from the surrounding air less the primary electrical energy input to the extraction pumps.

The following performance calculation has been adapted from the DCLG Strategy Guide for Low and Zero Carbon Energy Sources.

Symbol	Units	Description	Value	Calculation
Q_{htot}	kWh	Annual demand for heating and cooling in bar cafe and level 2 bedrooms		13,263
G	%	Percentage of demand met by air source heat pumps		100
Q_{hp}	kWh	Annual demand supplied by air source heat pumps.	$Q_{htot} \times G$	13,263
CoP_{hp}	None	CoP of the air source heat pump		4.61
Q_h	kWh	Resulting electrical energy consumption of the heat pump	Q_{hp}/CoP_{hp}	2877

Cf_h	$kgCO_2/kWh$	Carbon dioxide burden of the power supply to the heat pump	Grid-supplied electricity = 0.422	0.422
C_{hp}	kg	Resulting carbon dioxide emissions due to the operation of the heat pump	$Q_H \times Cf_h$	1,214
E_{com}	%	Seasonal efficiency of comparison heating plant	Electric = 100%	100%
Q_{com}	kWh	Fuel input to the conventional heating plant to provide equivalent output to the air source heat plant	Q_{hp}/E_{com}	13,263
Cf_{com}	$kgCO_2/kWh$	Carbon dioxide factor for fuel supply to the conventional heating plant	Grid-supplied electricity – 0.422	0.422
C_{com}	kg	Resulting carbon dioxide emissions due to the operation of the conventional heating plant	$Q_{com} \times Cf_{com}$	5,597
C_s	kg	Carbon dioxide saving resulting from air source heat pumps	$C_{com} - C_{hp}$	4,383
	kWh	Equivalent energy saving	Cs/0.422	10,386

Based on this preliminary analysis it is estimated that 10,386 kWh per annum of energy could be saved which is equivalent to 0.6% of the total energy consumption. The carbon dioxide saving of 4,383 kg/annum is equivalent to 0.85% of the total carbon dioxide emissions.

Ground Source Heat Pumps

Application:	Domestic hot water
Predicted energy savings:	N/A
Predicted CO_2 savings:	N/A
Installation requirements:	Suitable ground conditions
Suitability:	Existing building precludes formation of boreholes

Ground source heat pumps are used to extract heat from the ground and can provide both space and water heating. Heat pumps take in heat at a certain temperature and release it at higher temperature, using the same process as a refrigerator.
As the ground stays at a fairly constant temperature throughout the year heat pumps can use the ground as the source of heat. The ground temperature is not necessarily higher than ambient air temperature in winter but it is more stable whereas air has a vast temperature range. This makes system design more robust.

Water (or another fluid) is circulated through pipes buried in the ground and passes through a heat exchanger in the heat pump that extracts heat from the fluid. The heat pump then raises the temperature of the fluid via the compression cycle to supply hot water to the building as from a normal boiler.

Most heat pumps are electrically driven. The measure of efficiency of a heat pump is given by the Coefficient of Performance (CoP), which is defined as the ratio of the heat output, divided by

quantity of energy put in. CoP's up to 6 should be achievable subject to ground conditions. Electrically driven heat pumps are very reliable but require regular maintenance.
The ground pipe system can be horizontal or vertical. For horizontal systems, a coiled pipe network is buried at around 2 metres depth below ground level, thus requiring a large area of open space. For vertical systems, the pipes are placed in holes bored straight into the ground at a depth of 15 to 150 metres depending on ground conditions and size of systems.

A ground source heat pump is not a wholly renewable energy source as it uses electricity, the renewable component is considered as the heat extracted from the ground less the primary electrical energy input to the extraction pumps.

Because this is an existing building forming boreholes would not be practical therefore ground source heat pumps would not be suitable for this project.

Biomass Hot Water

Application:	Domestic hot water
Predicted energy savings:	574,428kWh/annum (34.6%)
Predicted CO_2 savings:	111,439kg/annum (21.7%)
Installation requirements:	Dedicated plant space and fuel storage required
Suitability:	This technology is considered suitable subject to accommodating plant space.

Biomass fuel such as wood chip or wood pellets is used as a heating source for boilers to produce heat for hot water and heating.

Biomass is normally considered a carbon neutral fuel due to the short time span of the carbon cycle if the wood is harvested and replanted. The same quantity of atmospheric carbon dioxide is absorbed when the tree is growing as released when the wood is burned. However some carbon is expended during the harvesting, processing and delivery of the wood fuel therefore a carbon emission factor of 0.025kgCO_2/kWh is assumed in the Building Regulations.

Fuel availability, delivery and storage, and the need to commission the boilers and service them at regular intervals often precludes the use of biomass however the preferred hotel operator has experience of biomass water heating in similar hotel applications in central London.

Biomass boilers require more frequent cleaning than gas or oil boilers and they must be capable of being taken out of service for cooling and cleaning while maintaining the building heating supply.

It is unlikely that any cost savings will arise from the use of biomass boilers as the fuel is likely to be more expensive particularly when compared to gas.

The following performance calculation has been undertaken in accordance with the DCLG Strategic Guide for Low or Zero Carbon Energy Sources.

Symbo	Units	Description	Value	Calculation

I				
Proposed Biomass Plant				
Q_{hest}	kWh	Annual demand hot water provision		819,210
B	%	Percentage of hot water demand met by biomass plant, which may be 100% for dwellings or less for non-domestic or community heating applications		70
Q_{bio}	kWh	Annual heating supplied by biomass plant	Q_{hest} x B	573,447
E_{bio}	%	Seasonal efficiency of boiler plant calculated in accordance with CIBSE Applications Manual 3: Condensing boilers		80%
Q_{bfuel}	kWh	Calorific content of fuel input to the biomass heating plant	Q_{bio}/E_{bio}	716,809
Cf_{bfuel}	$kgCO_2/kWh$	Carbon dioxide burden of the biomass fuel supply		0.025
C_{bio}	kg	Resulting carbon dioxide emissions due to the operation of the biomass plant	Q_{bfuel} x Cf_{bfuel}	17,920
Comparison Case				
E_{com}	%	Seasonal efficiency of comparison heating plant as calculated in accordance with the Non-domestic Heating, Cooling and Ventilation Compliance Guide		86%
Q_{com}	kWh	Fuel input to the comparison heating plant to provide equivalent output to the biomass heating plant	Q_{bio}/E_{com}	666,799
Cf_{com}	$kgCO_2/kWh$	Carbon dioxide factor for fuel supply to the comparison heating plant		0.194
C_{com}	kg	Resulting carbon dioxide emissions due to the operation of the comparison heating plant	Q_{com} x Cf_{com}	129,359
C_s	kg	CO_2 saving from the proposed biomass heating plant	C_{com} - C_{bio}	111,439
	kWh	Equivalent energy saving	Cs/0.194	574,428

Based on this preliminary analysis it is estimated that 574,428kWh per annum of energy could be saved which is equivalent to 34.6% of the total energy consumption. The carbon dioxide saving of 111,439kg/annum is equivalent to 21.7% of the total carbon dioxide emissions.

Solar Water Heating

Application:	Domestic hot water
Predicted energy savings:	30,876kWh/annum (1.9%)
Predicted CO_2 savings:	5,990kg/annum (1.2%)
Installation requirements:	South facing roof at a pitch of 10-60°. Avoid overshading.
Suitability:	Due to the limited energy saving this technology is not considered suitable. Not compatible with CHP

The very high demand for domestic hot water (DHW) associated with hotels makes a solar thermal system a sustainable and potential option.

Solar water heating systems use the energy from the sun to heat water, most commonly in the UK for hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building.

There are two types of collectors used for solar water heating applications – flat plate collectors and evacuated tube collectors. The flat plate collector is the predominant type used in domestic systems as they tend to be cheaper. Evacuated tube collectors are generally more expensive due to a more complex manufacturing process (to achieve the vacuum) but manufacturers generally claim better performance in cloudy or low-light conditions.

Evacuated tubes collectors, which provide a higher efficiency than flat plate collectors, could be mounted either onto southerly orientated tilted frames, or installed horizontally without reducing the system performance and will generate 535kWh/m^2/annum based on advice from Stokvis and Egga.

The limiting factor in the design of a solar thermal system for this building is the location of the solar panels. Ideally the panels would be installed on a southerly orientation to maximise efficiencies however the available roof area is limited and to incorporate solar panels it would be necessary to replace plantroom facade.

An area of roof of approximately 200m^2 has been identified at level 9 for the inclusion of solar panels. Subject to detailed discussions with the panel manufacturers, it is anticipated that an area of solar panels equivalent to 80m^2 could be accommodated.

An annual maintenance check will be required.

The following performance calculation has been undertaken in accordance with the DCLG Strategic Guide for Low or Zero Carbon Energy Sources.

Symbol	**Units**	**Description**	**Value**	**Calculation**
Q_{hwtot}	kWh	Annual hot water demand		819,210
U	kWh/m^2	Output per functional unit installed		535
A	m^2	Net available area of the SDHW collector		80
Q_{hw}	kWh	Annual hot water supplied by SDHW system	U x A	42,800
A	m^2	Net area of the SDHW collector to meet desired target M%	Q_{hw}/U	1531 (80m^2 available)
Q_{pump}	kWh	Energy input for circulating water in the SDHW system (circulating pump)	3kW pump operating hours	8760
$Q_{control}$	kWh	Energy loss without thermostatic control	75kWh per year from DTI side by side testing	75
Cf_e	$kgCO_2$/kWh	Carbon dioxide factor for used electricity	Grid supplied electricity = 0.422	0.422
C_{shw}	kg	Resulting carbon dioxide emissions due to	(Q_{pump} -	3665

		the operation of the SDHW system	$Q_{control}) \times Cf_e$	
Cf_{con}	$kgCO_2/kWh$	Carbon dioxide factor for fuel supply to a conventional boiler	Natural gas = 0.194	0.194
C_{be}	%	Conventional boiler efficiency during intermittent operation		86
C_{con}	kg	Resulting carbon dioxide emissions due to the operation of a conventional boiler for an equivalent output of the SDHW system	$(Q_{hw} \times Cf_{con})/C_{be}$	9,655
Cs	kg	Carbon dioxide saving resulting from solar hot water system	$C_{con} - C_{shw}$	5,990
	kWh	Equivalent energy saving	Cs/0.194	30,876

Based on this preliminary analysis it is estimated that 30,876kWh per annum of energy could be saved which is equivalent to 1.9% of the total energy consumption. The carbon dioxide saving of 5,990kg/annum is equivalent to only 1.2% of the total carbon dioxide emissions.

The incorporation of solar water heating would reduce the effectiveness of the CHP operation and, in conjunction with the limited energy saving, it is anticipated that the use of solar water heating will be less viable compared to other technologies.

Photovoltaics

Application:	Generation of electricity
Predicted energy savings:	9680kWh/annum (0.6%)
Predicted CO_2 savings:	5498kg/annum (1.1%)
Installation requirements:	South facing roof (within 25° of due south) at a pitch of 25-45°
Suitability:	Due to the limited energy saving and long payback period this technology is less viable compared to other technologies.

Photovoltaic systems convert energy from the sun into electricity through semi conductor cells. Systems consist of semi-conductor cells connected together and mounted into modules. Modules are connected to an inverter to turn their direct current (DC) output into alternating current (AC) electricity for use is buildings.

Photovoltaics supply electricity to the building they are attached to or to any other load connected to the electricity grid. Excess electricity can be sold to the National Grid when the generated power exceeds the local need.
Photovoltaic systems require only daylight, not sunlight to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions. Photovoltaics can be used successfully in all parts of the UK.

Photovoltaic panels come in modular panels which can be fitted to the top of the roof and in slates or shingles which are an integral part of the roof covering.

Photovoltaics should ideally face within 25° of due south at an elevation of about 25-45° however the available roof area is limited and to incorporate photovoltaic panels it would be necessary to replace plantroom facade.

There are little maintenance requirements with the exception of cleaning and a life expectancy of 20-25 years should be expected.

An area of roof of approximately 200m² has been identified at level 9 for the inclusion of photovoltaic panels. Subject to detailed discussions with the panel manufacturers, it is anticipated that an area of photovoltaic panels equivalent to 80m² could be accommodated however the impact of shading cannot be determined at this stage and therefore a best case scenario has been considered.

The latest generation of photovoltaic modules (such as the Sanyo Hybrid HIT modules) are realistically able to generate 121kWh/m²/annum. Based on these figures it is estimated that 9,680kWh per annum of electricity could be generated, equivalent to only 0.6% of the total energy consumption of the building. This is equivalent to a carbon dioxide saving of 5498kgCO_2/annum (1.1% of the total carbon dioxide emissions) based on a carbon factor for grid displaced electricity of 0.568 kg CO_2/kWh.

A detailed cost analysis has not been undertaken to date however previous experience indicates a payback period considerably in excess of 20 years. Therefore, due to their limited energy saving it is anticipated that their use on this development will be less viable compared to other technologies.

Wind Turbines

Application:	Generation of electricity
Predicted energy savings:	3500kWh/annum (0.21%)
Predicted CO_2 savings:	1477kg/annum (0.28%)
Installation requirements:	In prevailing wind. Avoid shelter/turbulence
Suitability:	Due to the limited energy saving this technology is not considered suitable

Wind turbines are designed to be mounted directly to building rooftops and directly generate electricity from the power of the wind.

The most common design is for three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower. The blades drive a generator either directly or via a gearbox (generally for larger machines) to produce electricity. The electricity can either link to the grid or charge batteries. An inverter is required to convert the electricity from the direct current (DC) to alternative current (AC) for feeding into the grid.

Modern wind turbines are becoming viable in low density areas, where ease of maintenance and immediate connection to the grid or directly for use of the electricity in a building, may make them cost effective, despite lower wind speeds than in open areas. Wind turbines are generally less suited to dense urban areas as their output will be affected by potentially lower and more disrupted wind speeds, and the use of larger more cost effective machines may be prohibited by their proximity to some building types.

Because of the location of this building and the likelihood of highly turbulent air, due to the presence of other buildings, the most viable micro-wind option is likely to be a vertical axis wind turbine. Due to their design vertical axis turbines are able to utilise turbulent air and generate significantly lower sound pressures than traditional turbines.

There are very few maintenance requirements and a life expectancy of 20-25 years should be expected.

The true potential output of a wind turbine can only be calculated by long term monitoring at the proposed location. A very rough estimate has been given below based on available data.

The DTI wind speed database estimates that at 25m above ground level the average wind speed at this location is about 5.6m/s. Vertical axis turbines require a minimum wind speed of 4m/s to begin generating onsite electricity. Assuming this wind speed (or above) is present 20% of the time then a total of 3,500kWh/annum can be expected equivalent to approximately 0.21% of the total energy consumption of the building. This is equivalent to a carbon dioxide saving of 1,477kgCO_2/annum (0.28% of the total carbon dioxide emissions). An estimated cost in the order of £35,000.00 is expected.

Due to their limited energy saving it is anticipated that the use of wind turbines on this development will be less viable compared to other technologies.

Due to Travelodge's requirement for bar cafe and bedroom cooling at level 2 air source heat pumps are suitable for this project, however, their use is limited to those areas requiring cooling only

APPENDIX B: ENERGY MODEL DATA

Building Rating

	Heating	Cooling	Auxiliary	Lighting	Hot water	Total	
Actual	53.66	1.77	22.43	24.33	109.33	211.51	kWh/m^2
Notional	47.9	4.54	14.55	27.31	216.67	310.98	kWh/m^2

CO2 emissions mandatory requirement

BER	64.32	$kgCO2/m^2$		
Notional	70.91	$kgCO2/m^2$	LF	LZC
TER	52.1	$kgCO2/m^2$	0.18	0.1
Pass CO2	No			

SBEM Main Calculation Output Document

Mon Sep 07 10:32:59 2009

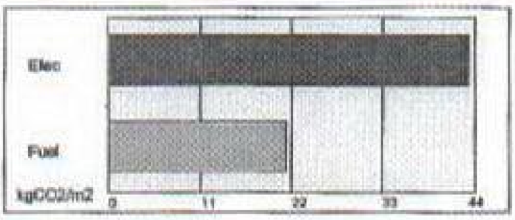
Building name

Travelodge Hotel - 1 Drury Lan

Building type: Hotel

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

Building Energy Performance and CO2 emissions

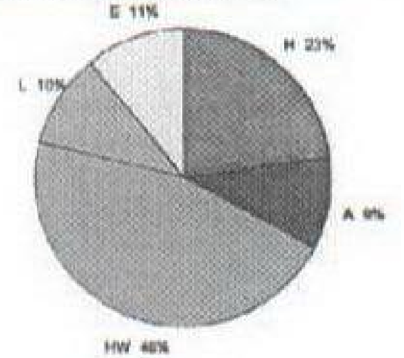


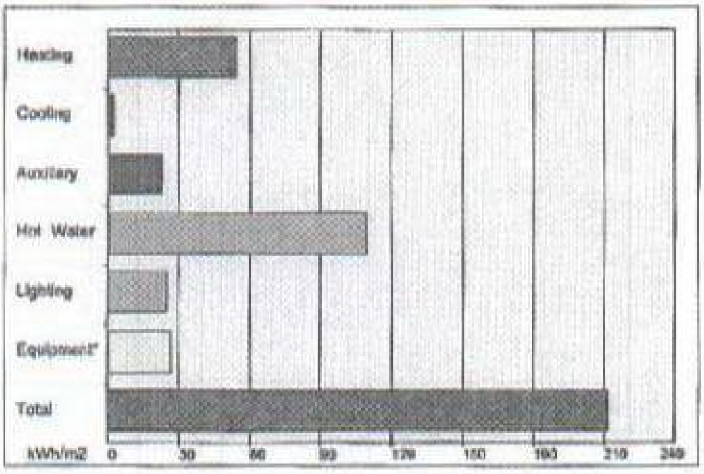
0 kgCO2/m2 displaced by the use of renewable sources.

Building area is 7493.36m2

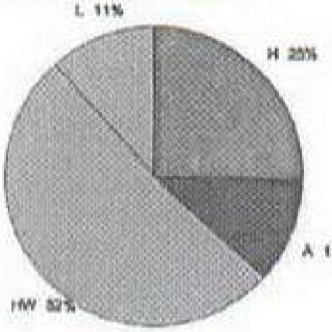
Annual Energy Consumption

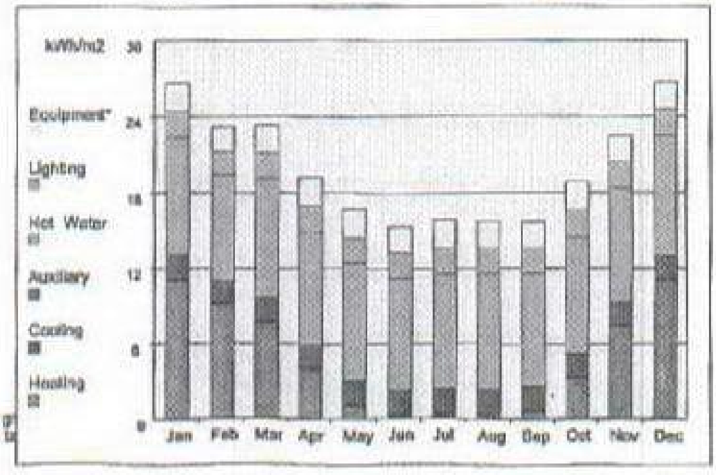
(Pie chart including Equipment end-use)





(Pie chart excluding Equipment end-use)





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

APPENDIX C: CHP ANALYSIS

What is the value of the energy saved by a Dachs chp unit ?

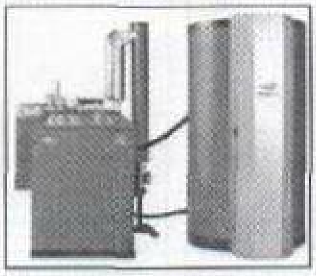
Dachs gas consumption	8.52	m^3/h
Energy content of 1 m^3 gas	10.7	kWh/m^3
Dachs gas input	91.164	kW
Cost of servicing Dachs:	£0.026	£/kWh_{el}
Dachs electricity output	22.0	kW

Project:	Travelodge Drury Lane
Quotation:	
Client:	MRB Consulting Engineers LLP
Contact:	Mark Roberts
Tel.:	01937 585082
Email:	mark.roberts@mrb.uk.net

Temp. of heating return to condenser →	20 deg.C	35 deg.C	50 deg.C	60 deg.C
Total Dachs condensing heat output →	**15.5. kW**	**14.8 kW**	**13.4 kW**	**13.3 kW**

Dachs heat output	56.0	kW	← *(select from above, or insert 12.5 kW if no condenser)*
Cost of gas:	£0.03810	£/kWh	← *(insert value, excl. CCL)*
Cost of electricity:	£0.10750	£/kWh	← *(insert value, excl. CCL)*
Boiler efficiency:	80	%	← *(insert value)*
Dachs daily operating hours:	17	h	← *(insert value)*

Dachs Energy Balance



Gas cost	£3.47	£/h
Servicing cost	£0.57	£/h
Value of electricity	£2.37	£/h
Value of heat output	£2.67	£/h
Total operating costs	£4.05	£/h
Total value of energy output	£5.03	£/h

Savings = value of energy output - operating costs	£0.99	per operating hour
Dachs annual operating hours	6,205	hours per year
Annual savings	**£6,122.17**	per year

How much CO2 is saved by a Dachs chp unit ?

Emission factor for grid electricity	0.568	kg/kWh
Emission factor for natural gas	0.194	kg/kWh
Electricity CO_2 emissions = emission factor x electrical output	12.50	kg/h
Boiler CO_2 emissions = emission factor x fuel input	13.58	kg/h
Dachs CO_2 emissions = emission factor x fuel input	17.69	kg/h
Dachs annual CO_2 savings	**52,061**	kg/year

APPENDIX D: BREEAM ENERGY SECTION ASSESSMENT

A BREEAM pre assessment has been carried out under the Bespoke BREEAM assessment method using draft criteria issued by the BRE. This has been updated in light of this revised energy statement.

The building previously achieved a score of 60.91% in the energy section however the amendments to the energy strategy has resulted in a revised score of 52.22% as follows:

Energy	**Credits Available**	**Credits Achieved**
Ene 1 Reduction of CO_2 Emissions	15	5
Ene 2 Sub Metering Substantial Energy Uses	1	1
Ene 3 Sub Metering of High Energy Loads	1	1
Ene 4 External Lighting	1	1
Ene 5 Low Carbon Technologies	3	2
Ene 8 Lifts	2	2

Therefore the building falls short of the 60% planning requirement for the energy section of the BREEAM Pre Assessment due to the move away from biomass as a renewable energy solution.

Further details are included in the accompanying BREEAM Pre Assessment Report (second update).