Great Russell Street Hotel

Energy Strategy and BREEAM Pre-Assessment
Rev. B
May, 2015

6th Floor, Town Centre House
Merrion Centre
Leeds
LS2 8LY

Tel: +44 (0) 113 245 7550

Audit Sheet

Revision	Description	Date	Prepared and Checked by	Reviewed by
A	For Information / Comment	19/02/2015	JN	
B	Updated to Suit Number of Bedrooms and address comments from pre-application meeting	21/05/2015	JN	JG

CONTENTS

1 EXECUTIVE SUMMARY

This report provides an overview of the energy and carbon appraisal in support of the planning application for the proposed Great Russell Street Hotel, including preliminary Part L modelling.

The scheme is targeting a BREEAM Very Good rating. A BREEAM pre-assessment has been carried out, and can be found in Appendix A of this report.

Approach and proposed carbon reduction strategy

The proposed hotel building was modelled against Part L2A 2013 of the Building Regulations. The Part L results presented in this report were calculated using approved compliance software IESve 2014 (v2014.1.0.0).

An initial baseline model was created which was built to meet the minimum standards prescribed in Approved Document Part L2A 2013. The baseline results were interrogated and improvements made to the key areas in line with the energy hierarchy; Be lean, Be clean, Be green.

The 'Be Lean' model demonstrates that the annual carbon emissions were reduced sufficiently so that the **scheme would be expected to achieve a ~3% improvement on Part L2A 2013 through passive design and energy efficiency measures alone, before the incorporation of low and zero carbon technologies**.

Low and zero carbon technologies (air source heat pump - ASHP) were then applied, leading to an estimated **overall carbon emission reduction of 25% on Part L2A 2013 compliance levels**.

The following design measures are currently expected to be implemented in order to reduce carbon emissions. These are for indication only at this stage and will be confirmed as the design progresses.

- Improved thermal insulation (target Wall U Value = 0.2W/m²K, Floor U Value = 0.22W/m²K)
- Improved air tightness (target 3m³/hr/m² @ 50Pa)
- Improved lighting system – e.g. LED lighting
- Use of EC/DC motors, inverter drives on pumps and fans, Improved air handling specification, lower Specific Fan Power (SFP)
- Improved domestic hot water generator and Air Source Heat Pump specification.

Review of Combined Heat and Power potential

Calculations were performed to compare the scheme's regulated carbon emissions using gas fired boilers and Combined Heat and Power (CHP) in lieu of Air Source Heat Pumps to provide heating and hot water. The results show that with gas-fired boiler and Combined Heat and Power (CHP), the scheme's regulated emissions would be ~10% higher than with ASHP (building's emissions rate of 33.6kg $kgCO_2/m^2/yr$ with CHP instead of 30.6$kgCO_2/m^2/yr$ with ASHP). Note that due to different target emissions levels, the scheme would achieve a ~30% reduction in annual carbon emissions over its Part L 2013 target, as its target emissions rate (47.9 $kgCO_2/m^2/yr$) would be higher than the target emissions rate of the scheme with ASHP (40.9 $kgCO_2/m^2/yr$).

It must also be noted that the use of gas fired boilers and/or Combined Heat and Power is not feasible for this development: since the proposed hotel is located beneath ground level, the boiler and Combined Heat and Power flues would have to run through or up the side of the existing building which sits on top of the proposed hotel. This would be expected to lead to issues with local planning and the current building owner/occupier.

Review of District Heating potential

A further study was carried out which demonstrates the annual carbon emissions if the hotel was connected to a London heat network. The Bloomsbury network, which includes combined heat and power, is located in the vicinity. As no information is currently available on its carbon content of heat, the potential carbon savings were assessed using the following CO_2 conversion and Primary Energy factors:

- District Heat Network 01 = 0.079$kgCO_2$/kWh | 0.36kWh/kWh: 'best case' theoretical scenario, i.e. a very low carbon network, served for example by highly efficient CHP and biomass boiler (or another very low carbon heat source), and with very low distribution losses.
- District Heat Network 02 = 0.104$kgCO_2$/kWh | 0.36kWh/kWh best practice' theoretical scenario: to represent a best practice network including efficient CHP and low distribution losses.

The results from these assessments indicate that, with connection to the networks, the building's regulated emissions (as assessed by Part L 2013) would be higher than in the proposed scheme, served by local ASHP – see Figure 1.1 and Table 1.1. Given the limited potential for carbon savings and the relatively small scale of the development, for which capital costs of connection could be prohibitive, a connection is therefore not proposed. The scheme's design however would allow a future connection, should this be viable in the future and subject to a detailed review of potential carbon savings, capital costs, and running cost implications.

Be green

Due to the nature of the site, 'Be Green' options cannot be utilised. Since the proposed hotel is located underground with the upper floors under different ownership, there is no available roof space for Photovoltaics, Solar Hot Water panels or building mounted Wind Turbines.

Conclusions

Figure 1.1 and Table 1.1 provide an overview of all of the results generated, showing the estimated Part L 2013 annual regulated carbon emissions per m^2 for each of the assessed scenarios. The results suggest that the 'Be Lean' using Air Source Heat Pumps (ASHP) provides the best results in terms of annual carbon emissions, and this is the option proposed for this scheme. This scenario is expected to provide a 25% reduction in annual carbon emissions and an EPC rating of A (21).

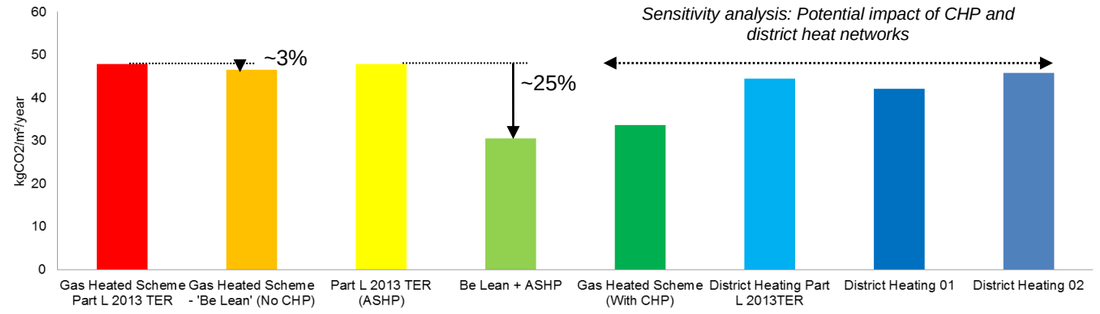


Figure 1.1 Part L 2013 results and sensitivity analysis (Target and Building Emissions Rates)

Model	Building Emission Rate ($kgCO_2/m^2$/year)	Target Emission Rate ($kgCO_2/m^2$/year)	EPC Rating	% Carbon Reduction
Be Lean – with gas boiler	46.5	47.9	B 32	3%
Be Lean - with ASHP	30.6	40.9	A 21	25%
For comparison:				
Be Lean – With CHP	33.6	47.9	A 23	30%
District Heating Network 01	42.1	44.5	B 29	5%
District Heating Network 02	45.8	44.5	B 31	N/A

Table 1.0 Part L 2013 Modelling Results Summary

2 INTRODUCTION

The proposed Great Russell Street hotel consists of 166 bedrooms, receptions areas and maids rooms. The proposed hotel is located beneath the ground, below an existing building. Dynamic software IESve 2014 was used to create a 3D thermal model of the hotel based on the proposed architectural layouts.

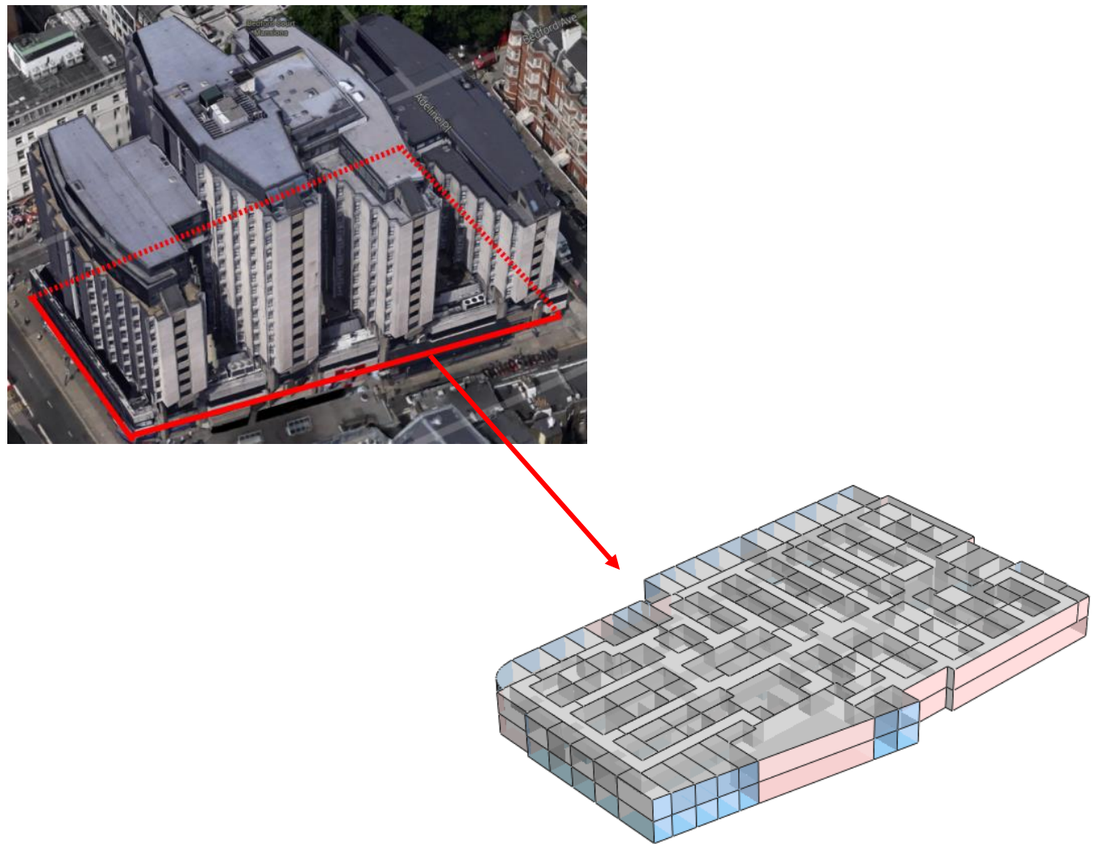


Figure 2.1 3D Thermal Model & Location

The thermal model was simulated against Part L2A 2013 of the Building Regulations to provide a benchmark for the performance of the hotel. Part L Compliance calculations assume standard periods of occupancy, usage and internal environmental parameters to ensure that the designed building or 'actual' building is compared to a 'notional' equivalent. This is known as the National Calculation Methodology (NCM).

The results from the thermal modelling analysis were compared against the notional building results to establish the potential energy and carbon savings. The energy data from the thermal models was also included in the BREEAM pre-assessment found in Appendix B of this report.

A CIBSE accredited energy assessor carried out the energy and carbon analysis and a BREEAM accredited assessor prepared the BREEAM pre-assessment.

3 THERMAL MODELLING

3.1 Baseline Model

A baseline model was first constructed to the minimum building fabric and system efficiencies prescribed in Part L2A of the Building Regulations 2013. The tables below provide an overview of the minimum building fabric efficiencies given in Part L2A 2013:

Element	Part L 2013 Minimum Requirement (W/m²K)	Notes
Roof	0.25	Not Applicable to Scheme
External Wall	0.35	0.35
Floor	0.25	0.25
Glazing	2.20	Not Applicable to Scheme

Table 3.1 Part L2A 2013 Minimum U Value Requirements

Part L 2013 Minimum Requirement (m³/hr.m² @ 50Pa)
10

Table 3.2 Part L2A 2013 Minimum Building Air Tightness

The thermal model was simulated using the preliminary mechanical and electrical services proposals. Due to the constraints of the site, Air Source Heat Pumps (ASHP) were used to provide heating and cooling (where applicable) for the proposed hotel. The thermal model also accounts for mechanical ventilations systems which are included in the preliminary services strategies.

The 'baseline' model would not be expected to pass criterion 1 of building regulations Part L 2013, and improvements were therefore applied.

Figure 3.1 below illustrates which system has the largest contribution to the annual carbon emissions:

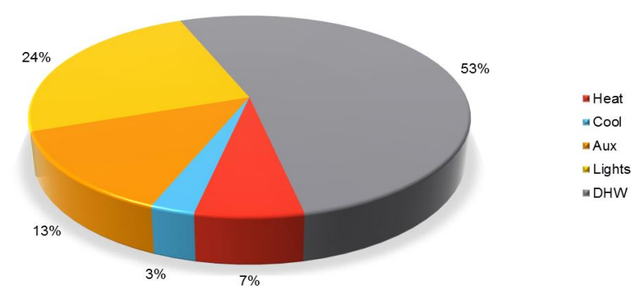


Figure 3.1 Baseline Building – Part L 2013 Breakdown of Regulated Carbon Emissions

Figure 3.1 shows that the domestic hot water system accounts for the greatest proportion of annual carbon emissions (53%) followed by lighting (24%) and auxiliary energy (13%). Since the building is located beneath the ground, heat losses are minimised and there are no solar gains hence the heating and cooling systems only account for 7% and 3% of the annual carbon emissions respectively.

3.2 Be Lean – Before Air Source Heat Pump

Improvements were made to the building fabric and building services systems. These are summarised below. Please note that due to the early stage of design, these are for indication only to ensure that the proposed targets are achievable; final values will be confirmed as the design progresses.

The following improvements are proposed to the building performance:

- Improved thermal insulation: Wall U Value = 0.2W/m²K, Floor U Value = 0.22W/m²K
- Improved air tightness = 3m³/hr/m² @ 50Pa

Additionally, the following improvements are proposed to the baseline HVAC systems:

- Improved lighting system – LED lighting
- Use of EC/DC motors
- Inverter drives on pumps and fans
- Improved air handling specification, lower Specific Fan Power (SFP).

As a result, the **'be lean' building would be expected to meet Part L 2013 before low and zero carbon technologies**:

- Target Emissions Rate (with gas boiler): 47.9 $kgCO_2/m^2$/year
- Building Emissions Rate (with gas boiler): 46.5 $kgCO_2/m^2$/year i.e. 3% improvement.

3.3 Be Lean – With Air Source Heat Pump

As a second step and having applied fabric and efficiency improvements, the air source heat pump system was applied to the building, with improved ASHP efficiencies:

- Heating Seasonal Efficiency = 3.9 (Seasonal Coefficient of Performance = 3.74)
- Cooling Seasonal Energy Efficiency Ratio = 4.9 (Seasonal SEER = 3.70)
- Domestic Hot Water Seasonal Efficiency = 3.85

The results from the 'be lean' model provided the following result;

- Target Emissions Rate (with gas boiler): 40.9 $kgCO_2/m^2$/year
- Building Emission Rate = 30.6kgCO2/m²/year = 203,621$kgCO_2$/year i.e. 25% improvement.

With the application of improved fabric, efficient services, and improved air source heat pump, the scheme is expected to achieve a 25% reduction in annual carbon emissions compared to Part L 2013.

Figure 3.1 shows the comparison between the actual (be lean) model and the notional building:

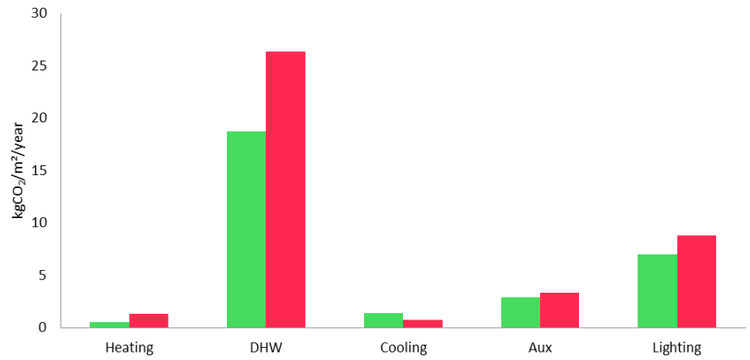


Figure 3.2 Actual Building (with ASHP) vs. Notional Building – Carbon Emission Breakdown Comparison

The building would outperform the notional building in the majority of areas – with the exception of the cooling systems.

3.4 Be Lean Model (ASHP) vs. Be Lean Model (CHP)

In order to assess the potential for Combined Heat and Power (CHP) to offer additional carbon savings, a test in the Part L model was carried out using the 'Be Lean' model with gas fired boilers and Combined Heat and Power (CHP), instead of air source heat pumps

The Target Emission Rate from the hotel model served by gas fired boilers or CHP was calculated to be 47.9$kgCO_2/m^2$/year.

Table 3.3 below provides an overview of the two sets of results:

Model	Building Emission Rate (kgCO2/m²/year)	Target Emission Rate (kgCO2/m²/year)	EPC Rating	% Carbon Reduction
Be Lean (ASHP)	30.6	40.9	A 21	25
Gas Heated Scheme – With CHP	33.6	47.9	A 23	30

Table 3.3 Part L 2013 tests: electric ASHP vs. Gas boiler and CHP

Table 3.3 shows that the gas fired boilers and CHP option would provide a ~ 30% improvement on Part L 2013 (compared to a target rate of 47.9$kgCO_2/m^2$/year), however with the use of air source heat pumps the total carbon emission would be ~ 10% less than with the gas fired boiler and CHP option. Additionally the EPC rating is lower for the hotel served by air source heat pumps (A 21 against A 23).

Using the results generated by the Part L analysis, the air source heat pump model consumes 350MWh of electricty and the building which uses gas fired boilers and CHP consumes 185MWh of electricty and 1,150MWh of gas.

In addition, **gas fired boilers and CHP options are no viable due to the location of the proposed building. In order to use gas fired heating plant flues would be required to run up the outside of the existing buildings or go through the existing building**, which is not expected to be acceptable to the current occupier of these upper floors.

3.5 District Heating

The potential for district heating network connections was reviewed. The figure below was taken from the interactive London Heat Map. The map shows the site location (highlighted in the red box), existing District Heating networks (yellow lines), proposed District Heating networks (red lines) and a 500m radius from the centre of the proposed developments (grey highlighted area).

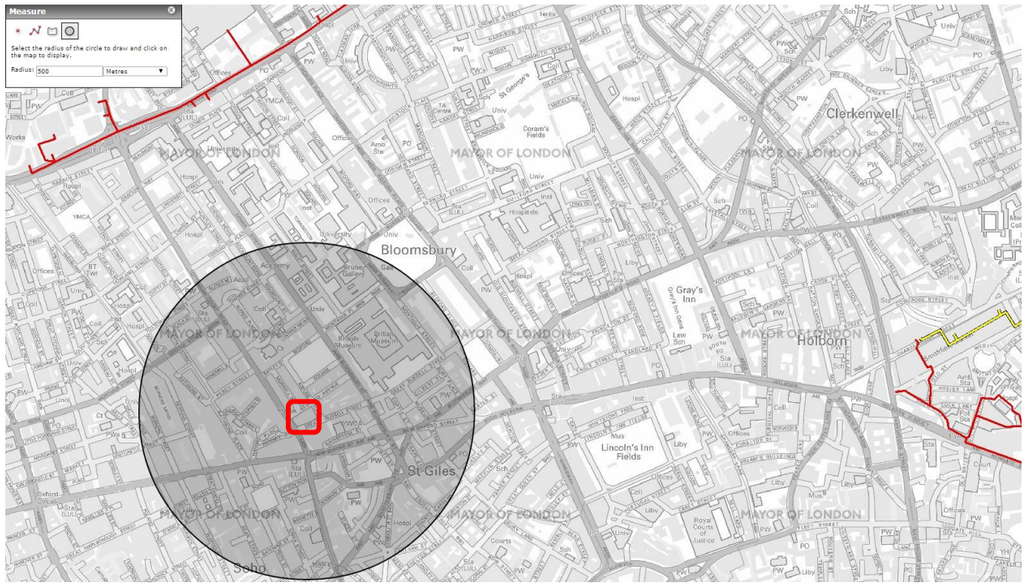


Figure 3.3 London Heat Map – Exisiting and Proposed District Heating Networks

Figure 3.3 demonstrates that there are no District Heating networks within a 500m radius of the proposed development. The closest active District Heating Netwok (yellow line on map) is approximately 1,500m away from the development site. The red lines on the map represent planned District Heating netowork expansion, howevever the proposed expansion routes are approximately 800m from the proposed site (North of site). The costs of such a connection would therefore be expected not to be viable.

Pre-application discussions (January 2015) however highlighted that closer networks were existing and further investigations were therefore carried out. The following figure 3.4 from Camden Council (produced as part of the Heat Mapping 2015 exercise) highlights existing networks and 'energy clusters' as well as proposed expansions. The Great Russell Street site is locatd between the Bloomsbury heat and power network, which is owned by a consortium of Bloomsbury universities and provides electricity and heat from two combined heat and power engines to a number of college buildings.

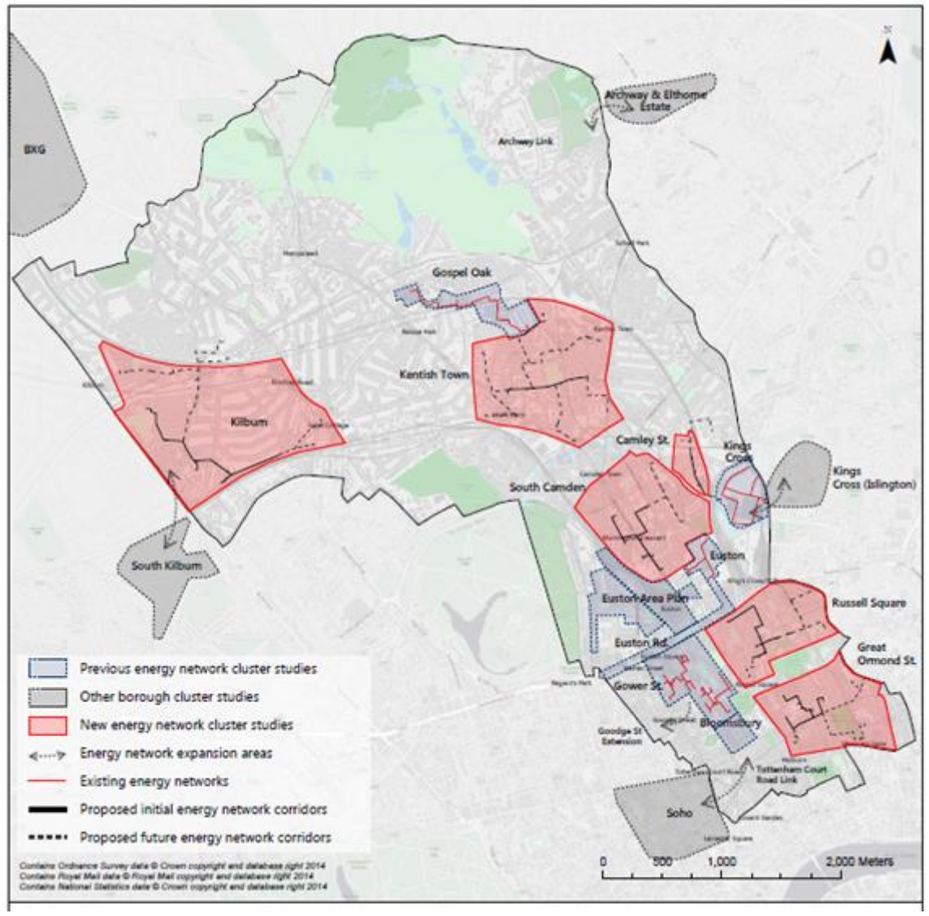


Figure 3.4 Decentralised Energy Priority Areas in Camden (available from Camden Council http://www.camden.gov.uk/ccm/navigation/environment/green-camden/supplying-low-carbon-energy/)

The potential carbon savings from connection to heat networks were assessed using two hypothetical scenarios:

- District Heat Network 01 = 0.079kgCO_2/kWh | 0.36kWh/kWh: 'best case' theoretical scenario, with efficient CHP (~30% electrical, 50% thermal) providing the majority of the heat (60%), and low distribution losses (15%)
- District Heat Network 02 = 0.104kgCO_2/kWh | 0.36kWh/kWh best practice' theoretical scenario: with highly efficient CHP (~35% electrical, 45% thermal) and biomass boiler (or other very low carbon source), and very low distribution losses (10%).

The results from these assessments are summarised in the following table and indicate that, with connection to the networks, the building's regulated emissions (as assessed by Part L 2013) would be higher than in the proposed scheme, served by local ASHP.

Model	Building Emission Rate ($kgCO_2/m^2/year$)	Target Emission Rate ($kgCO_2/m^2/year$)	EPC Rating
Be Lean - with ASHP	30.6	40.9	A 21
District Heating Network 01	42.1	44.5	B 29
District Heating Network 02	45.8	44.5	B 31

Table 3.4 Part L 2013 tests: electric ASHP vs. district heat network scenarios

A connection to existing networks is therefore not proposed, however the scheme will have the potential to connect in the future, subject to a detailed evaluation including potential carbon savings, financial viability, and running costs. This is incorporated into the mechanical services design: since the current proposal is based on the use of Air Source Heat Pumps to provide Space Heating and Domestic Hot Water, connecting into a heat network could potentially improve the efficiency of the ASHP system by raising the DHW temperature up to 60°C. Generally AHSP system efficiency drops off when trying to achieve a water temperature > 45°C.

4 APPENDIX A BREEAM PRE-ASSESSMENT

Pre-assessment : Basement Hotel - Great Russell Street (1441010)

Pre-assessment references:

Name:	Basement Hotel - Great Russell Street		
Reference number:	1441010	**Date created:**	29/1/2015
Created By:	Hannah Nistri		
Architect name:	Proun		Edit
Developer name:	Criterion		Edit
Property owner:			Edit

Site details:

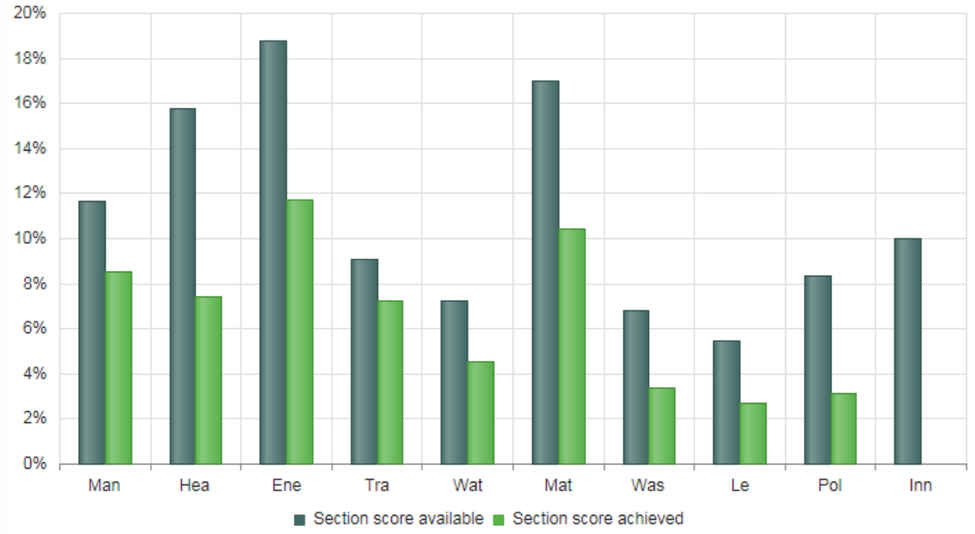
Site name:	Great Russell Street
Address:	112a
	Great Russell Street
Town:	London
County:	
Post code:	WC1B3NP
Local planning authority:	Camden

Edit

BREEAM Rating

Man	Hea	Ene	Tra	Wat	Mat	Was	Le	Pol	Inn	Total	Rating
8.53%	7.40%	11.72%	7.24%	4.52%	10.44%	3.39%	2.71%	3.13%	0.00%	59.13%	Very Good

Building performance by environmental category



Initial Details

Stage 1 filtering: Scope of the assessment

Part 1 : Fabric and structure
Yes

Part 2 : Core services
Yes

Part 3 : Local services
Yes

Part 4 : Interior design
Yes

Stage 2 filtering: Project specific filtering

Is the project a change of use? (e.g. change from office to a hotel)
Yes

Are transportation systems specified or present within the refurbishment or fit-out zone? (lifts, escalators, moving walks)
Yes, newly specified transportation systems

Are there laboratories present and if so what % of total building area do they represent
No laboratories present

Laboratory containment area
No laboratories present

Is cold storage specified or present within the refurbishment or fit-out zone?
No

Are soft landscaped areas within the scope of refurbishment or fit-out zone?
No

If the asset undergoing refurbishment or fit-out is part of a larger building, is the cooling generation plant centralised or localised?
Local

If the asset undergoing refurbishment or fit-out is part of a larger building, is the heating generation plant centralised or localised?
Local

Is Wat01 within the scope of the assessment in accordance with Table 42?
Yes

What is the building type?
Other building transport type 2

If Industrial, does the building have office areas?
N/A

Does the building have any unregulated water demands? e.g. irrigation, car washing, or other process related water use
No

Does the building have unregulated energy demands from significantly contributing systems?
No

Is the project a simple building?
Yes

Does the building have external lighting within the scope of works?
Yes

Does the building have any existing or newly specified externally mounted plant?
Yes

If undertaking a Part 4 assessment, is there any equipment specified that requires commissioning (see Man04 CN13)

Management

More information

Man 01 Project brief and design

Stakeholder consultation (project delivery)
0

Stakeholder consultation (third party)
0

Sustainability champion (design)
0

Sustainability champion (monitoring progress)
0

Man 02 Lifecycle cost and service life planning

Capital cost reporting
1

Man 03 Responsible construction practices

Environmental management
1

Has criterion 2 been met?
Yes

Considerate construction
2

Exemplary level criteria
No

Monitoring of refurbishment or fit-out site impacts
2

Man 04 Commissioning and handover

Commissioning and testing schedule and responsibilities
1

Handover
1

Has criterion 9 been met?
Yes

Man 05 Aftercare

Aftercare support
1

Exemplary level criteria
No

Seasonal commissioning
1

Post occupancy evaluation
1

Credits awarded

Credits available : 15

Credits awarded : 11

Exemplary credits

Exemplary credits available : 2

Exemplary credits awarded : 0

Minimum Standards

Minimum Standard Achieved : Outstanding

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Health & Wellbeing

More information

Hea 01 Visual comfort

Glare control
0

Daylighting
0

Exemplary level criteria

View out
0

Internal and external lighting
1

Due to this currently being a basement car park, credits for Visual comfort are not available.

Hea 02 Indoor air quality

Ventilation
1

Volatile organic compounds
1

Potential for natural ventilation
0

Hea 03 Safe containment in laboratories - NA

Hea 04 Thermal comfort

Thermal modelling
1

Adaptation - for a projected climate change scenario
0

Thermal zoning and controls
1

Hea 05 Acoustic performance

Acoustic performance
2

Hea 06 Safety and security

Security of site and building
1

Credits awarded

Credits available : 17

Credits awarded : 8

Exemplary credits

Exemplary credits available : 1

Exemplary credits awarded : 0

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Ene01 Assessment Option

Which option is being followed
Option 1a simple estimate (whole building)

Ene 01 - Option 1a

Credits
8

Ene 02 Energy monitoring

Sub-metering of major energy consuming systems
1

Sub-metering of high energy load and tenancy areas
1

Ene 03 External lighting

External lighting
1

Ene 04 Low carbon design

Passive design analysis
1

Free cooling
0

Low and zero carbon technologies
1

Ene 05 Energy efficient cold storage - NA

Ene 06 Energy efficient transportation systems

Energy consumption
1

Energy efficient measures
1

Ene 07 Energy efficient laboratory systems - NA

Ene 08 Energy efficient equipment - NA

Ene 09 Drying space - NA

Credits awarded

Credits available : 24

Credits awarded : 15

Minimum Standards

Minimum Standard Achieved : Outstanding

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Transport

More information

Tra 01 Sustainable transport solutions

Sustainable transport options
3

Tra 02 Proximity to amenities

Proximity to amenities
1

Tra 03 Cyclist facilities

Cycle storage
1

Cylist facilities
1

Tra 04 Maximum car parking capacity

Car parking capacity
2

Tra 05 Travel plan - NA

Credits awarded

Credits available : 10

Credits awarded : 8

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Water

More information

Wat 01 Water consumption

Water consumption
2

Exemplary level criteria

Wat 02 Water monitoring

Water monitoring
1

Has criterion 1 been met?
Yes

Wat 03 Leak detection

Leak detection system
1

Flow control devices
1

Wat 04 Water efficient equipment - NA

Credits awarded

Credits available : 8

Credits awarded : 5

Exemplary credits

Exemplary credits available : 1

Exemplary credits awarded : 0

Minimum Standards

Minimum Standard Achieved : Outstanding

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Materials

More information

Mat 01 Environmental impact of materials

Environmental impact of materials
3

Exemplary level criteria

Mat 03 Responsible sourcing of materials

Sustainable procurement plan
1

Has criterion 1 been met?
Yes

Responsible sourcing of materials
1

Exemplary level criteria
No

Mat 04 Insulation

Insulation
1

Mat 05 Designing for durability and resilience

Designing for durability and resilience
1

Mat 06 Material efficiency

Material efficiency
1

Credits awarded

Credits available : 13

Credits awarded : 8

Exemplary credits

Exemplary credits available : 2

Exemplary credits awarded : 0

Minimum Standards

Minimum Standard Achieved : Outstanding

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Waste

More information

Was 01 Construction waste management

Pre-refurbishment audit
1

Re-use and direct recycling of materials
1

Diversion of waste from landfill
0

Exemplary level criteria

Was 02 Recycled aggregates

Recycled aggregates
0

Exemplary level criteria

Was 03 Operational waste

Operational waste
1

Was 04 Speculative finishes - NA

Was 05 Adaptation to climate change

Adaptation to climate change - structural and fabric resilience
0

Exemplary criteria: Responding to adaptation to climate change

Was 06 Functional adaptability

Functional adaptability
1

Credits awarded

Credits available : 8

Credits awarded : 4

Exemplary credits

Exemplary credits available : 3

Exemplary credits awarded : 0

Minimum Standards

Minimum Standard Achieved : Excellent

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Land use and ecology

More information

Le 02 Protection of ecological features

Protecting ecological value
0

Le 04 Ecological enhancement

Ecological enhancement
1

Credits awarded

Credits available : 2

Credits awarded : 1

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Pollution

More information

Pol 01 Impact of refrigerants - NA

Pol 02 NOx Emissions

NOx emissions
0

Pol 03 Flood risk and reducing surface water run-off

Flood risk management
0

Exemplary level criteria

Surface water run-off
1

Minimising watercourse pollution
1

Pol 04 Reduction of night time light pollution

Reduction of night time light pollution
1

Pol 05 Noise attenuation - NA

Credits awarded

Credits available : 8

Credits awarded : 3

Exemplary credits

Exemplary credits available : 1

Exemplary credits awarded : 0

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.

Innovation

Innovation

More information

Inn 01 Approved innovations

Approved innovations
0

Credits awarded

Credits available : 0

Credits awarded : 0

Exemplary credits

Exemplary credits available : 10

Exemplary credits awarded : 0

To prevent the loss of assessment data entered above please ensure you click the save button below before navigating away from this issue.