West Southall Masterplan Energy Strategy

including renewables

October 2008

On behalf of:
National Grid Property Limited

White Young Green

West Southall Development
Energy Strategy including Renewables

for
National Grid Property Limited

(Version 6 – October '08)

West Southall Development
Energy Strategy including Renewables

for
National Grid Property Limited

Reference: ENERGY REPORT/E00357/OCT08/SW/V6		
	Prepared by: [redacted] **Director of Building Services**	*Reviewed by:* [redacted]
Version 1	Not issued	
Version 2	Biomass identified as main strategy, single and twin energy centres considered.	
Version 3 09 Nov 07	Other potential renewable strategies included	
Version 4A 03 June 08	Blue NG system (section 4) augmented and structure reassessed	
V5 Sept 08	Prepared for Planning	
V6 Oct 08	Final	
White Young Green Environmental, Sunley House, 4 Bedford Park, Croydon CR0 2AP *Telephone: 020 8649 6600 Facsimile: 020 8649 6629*		

CONTENTS

0.0 EXECUTIVE SUMMARY

This document looks at the probable impact of phasing and the inclusion of renewable technologies. It summarises the consideration of a wide selection of options and presents a solution which is the appropriate balance of maximising efficiency, matching demand, practicality, programme, seeking to progressively better 20% energy from renewable sources, and achieving a good level of carbon savings within a framework of commercial viability at the date of the report.

It considers the latest, but current technology advice particularly how these are set within the **Mayor's Energy Hierarchy** and guidance from **London Borough of Ealing**. It presents a solution which is challenging yet currently achievable.

Furthermore it accepts that technologies are significantly advancing and as such accepts changes are likely to occur. As such, future improvements and amendments pre-construction will be fully embraced. It accepts that the targets and objectives in a national and international framework are regularly reviewed. By necessity therefore it discusses parameters or a framework rather than presenting a specific finalised detailed design.

The study focuses on two primary options.

The **first** is the inclusion on the development site of a **large scale CHP including a proportion of generation from renewable technologies**. This is subject to the planning permission of the West Southall development.

With regard to the on-site CHP scheme, the study identifies that a plant of overall capacity of 770kWe CHP unit is required. This would be expanded as each phase of development comes forward to accommodate the energy demand, including how the renewables are progressively included. A 20% renewable contribution will be achieved by a biomass installation sized at 2,200kW (2.2MW). This equates to a requirement for 4,300 tonnes of biomass woodchips per year (18,000 cubic metres of woodchips). Deliveries to a biomass store would peak in the winter at 2,000 m^3 per month, this being equivalent to 6 large delivery trucks (14m^3) every working day. Other biomass fuels such as biodiesels are also considered viable given their higher calorific value and the associated storage reduction to 1360m^3/per annum.

The **second** considers energy provision from a **gas infrastructure turbo expander scheme** (generating electricity from the reduction in pressure in going from high pressure to low pressure in the gas mains). This is a system primarily located in the same development site position but links into equipment on the adjacent retained NGG gas holder site. This is subject to a separate planning application to be submitted at approximately the same time as West Southall.

The turbo expander scheme would be linked to the gas pressure reduction facility already located on NGG site with the installation of biodiesel engines generating heat necessary to counter the cooling of gas that occurs in the pressure reduction process located on the development site. The exhaust from this generation system will be strictly controlled and discharged through a chimney located adjacent to the engines facility. This option is being led by Blue NG, a company associated with National Grid.

FOREWORD

Planning Submission

This Report is one of a series of documents that have been prepared on behalf of National Grid Property Limited (NGPL), to support an outline planning application with details of all proposed accesses submitted in full for the comprehensive redevelopment of 44.7 hectares of land known as the Southall Gas Works site ('the Application Site'). This Report should be read in conjunction with the drawings and other documents submitted as part of this application, as follows:

- Environmental Statement, including a Non-Technical Summary
- Design and Access Statement (including Landscape and Accessibility Strategy)
- Development Specification
- Planning Statement
- Transport Assessment
- Framework Travel Plan
- Retail Assessment
- Sustainability Strategy
- Regeneration Strategy
- Housing Strategy
- Health Impact Assessment
- Remediation Strategy
- PADHI Report
- General Management Strategy
- Statement of Community Involvement

Local Planning Authority

The application is submitted to both the London Borough of Ealing (LBE) and the London Borough of Hillingdon (LBH) as the Application Site straddles the borough boundaries.

Application Proposals

The proposals are for a high quality residential-led mixed use development comprising the following:

An outline application for the demolition of the following properties: 16-32 (even) The Crescent; 1-11 (odd) Randolph Road; 137-143 (odd), 249 and 283 Beaconsfield Road; 30 The Grange; the remediation of the land and the redevelopment of the site to deliver a mixed use development for up to: 320,000sqm of residential, up to 14,200sqm for non-food retail, up to 5,850sqm of food retail, up to 1,750sqm of Class A3-A5 uses, up to 9,650sqm of hotel, up to 3,000 sqm of conference and banqueting, up to 4,700sqm of leisure forming a cinema, up to 2,550sqm of health care facilities, up to 3,450sqm of education facilities, up to 3,500sqm of office/studio units, up to 390sqm of sports pavilion, up to 600sqm of energy centre, up to 24,450sqm of multi-storey car park and associated car and cycle parking, landscaping, public realm, open space and children's playspace; and

Details are submitted for full approval (layout, scale, appearance and landscaping) of the following accesses:

- **Pump Lane Link Road – New access road from the Hayes bypass to the Application Site for vehicle, cycle and pedestrian access, including drainage and a flood relief pond.**

-
- **Eastern Access – New access road from Southall centre to the site, including land currently occupied by properties on The Crescent.**

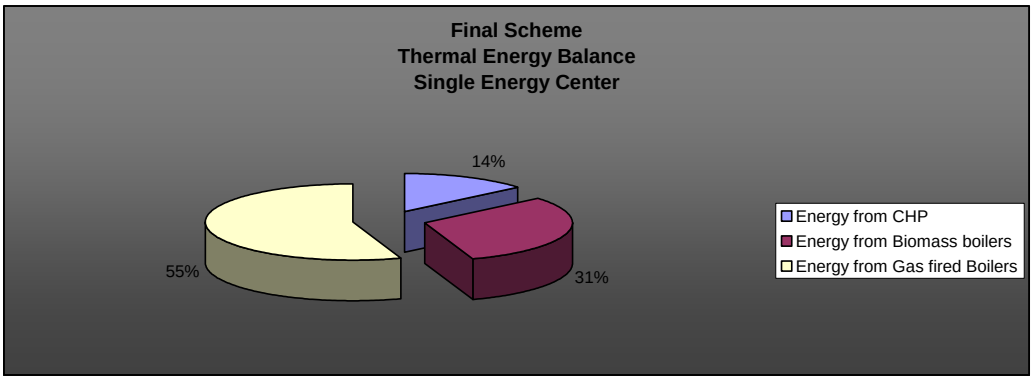
- **Minet Country Park Footbridge – Central pedestrian and cycle access to the Minet Country Park, bridging over the Canal and Yeading Brook.**
- **Springfield Road Footbridge – Northern pedestrian and cycle access to Minet County Park and Springfield Road.**
- **Widening of South Road across the railway line - Widening of south road over the railway line for the creation of a bus lane.**
- **Accesses (3no.) onto Beaconsfield Road.**

The development shall be carried out in accordance with the Development Specification and the Parameter Plans appended to that document. An illustrative Masterplan (Drawing Ref. 0317_P1017Rev 00) has been devised to demonstrate how the application proposals could be delivered. Further details of the Application Site and proposed development are set out in the Design and Access Statement and Planning Statement accompanying the outline planning application.

Application Site

The Application Site lies to the north of the Wales and Great Western Mainline Railway (with commercial uses beyond), to the south east of the Grand Union Canal (with Minet Country Park beyond) and to the south of residential developments in Southall, extending off Beaconsfield Road. A Grade II listed water tower is now in residential use, located adjacent to the south eastern corner of the Application Site. A retained operational gas works compound is located approximately mid-way along the southern boundary of the site. This comprises one working gasholders that creates the principal landmark within the Application Site. Please refer to the Design and Access Statement for further details

On Site CHP Scheme



The single (stand alone) energy centre solution would achieve the following:-

SPG Sustainable Design and Construction Appendix D Part 1 Executive Summary		
Energy	**KWh**	**CO_2 %**
Baseline Emissions	63,832,675	-
Savings from energy efficiency	10,092,000	17
Savings from renewable energy	12,100,000	14

Blue NG Combined Cycle system (Turbo Expander)

This alternative strategy introduces the possibility of using power supplied by the combined cycle energy system (also referred to as a turbo expander) proposed by Blue NG located in the same position but linked into the adjacent National Grid holder site. The energy centre is biodiesel fuelled and is capable of providing three times the power required by the whole of the West Southall development. The excess generation could be supplied to other communities in the area, or exported to the grid.

Blue NG power availability	19	MW	yearly energy	158,118,000	kWh
Site total energy demand	7.02	MW	yearly energy	58,420,440	kWh
	11.381	MW	exported to grid	99,697,560	kWh

This leads to the possibility of eventually an all electric solution for the development, where the new dwellings on the Southall site are designed to be as energy efficient as practical, and all the hot water, heating, lighting, cooking and appliance power is provided from the Blue NG system. However, early phases of the development would retain the option of partial supply direct from the existing gas network for cooking only.

A development supplied by the Blue NG system would achieve the following:-

SPG Sustainable Design and Construction Appendix D Part 1 Executive Summary		
Energy	**KWh**	**CO_2 %**
Baseline Emissions	61,502,693	-
Savings from energy efficiency	158,118,000	0
Savings from renewable energy	158,118,000	257

1.0 GENERAL SITE WIDE ENERGY STATEMENT

This is a strategy statement to detail the site wide energy demand for the site, whilst recognising and embracing sustainability objectives. This approach recognises the influential redevelopment characteristics of phased site remediation and progressively elemental build out likely to span circa 15 years, possibly with differing parties developing separate zones.

It also recognises that overall scheme viability is part of sustainability, including the need to carefully assess major capital cost outlays at the start of the energy delivery solution.

2.0 ENERGY SCENARIOS

The following strategies have been considered in the calculations that follow. In each case the capacity of the renewable technologies in the final solution has been designed to achieve a 20% contribution (based on carbon reduction).

The study identifies the capacity of plant required for each phase including generation from renewable sources. A single energy centre is presented within the current scheme.

2.1 Primary Strategy 1

A phased strategy developed to a final solution comprising a single energy centre located at H16 as shown in Section 3:

CHP unit
Biomass boiler installation
Gas fired boiler installation

2.2 Primary Strategy 2

The development will draw energy from the turbo expander scheme (combined cycle scheme) which will draw on gas pressure differentials in equipment on the retained NGG east gasholder compound and serviced by biodiesel heat engine plant located at H16 as shown in Section 3.

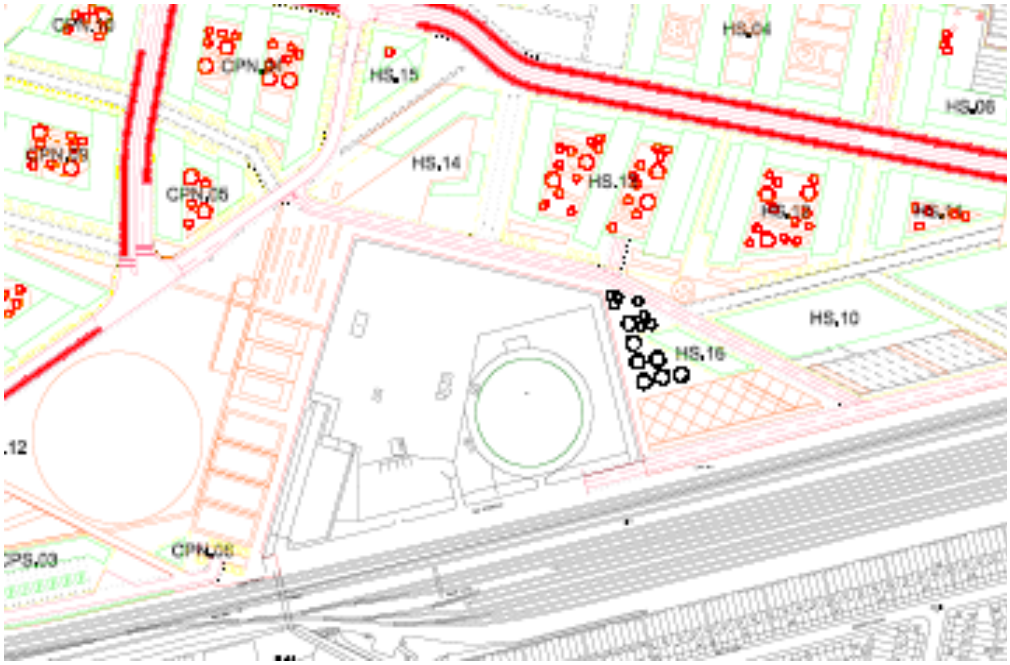
2.3 Alternative Strategy 3

The potential contribution from wind power is also discussed.

3.0 PRIMARY STRATEGY 1 (On Site Energy Centre)

Location

It is proposed that the energy centre be located at Plot HS16, located as shown on the following part Masterplan. Alternative fuels can be utilized. If biodiesel fuel is selected, this will be stored on the HS16 site. If biomass is selected, a number of alternatives exist including the potential reuse of former gasholder bases once fully refurbished.



A phased strategy is developed below up to a final solution comprising:

Multiple CHP units
Biomass boiler installation
Gas fired boiler installation

In this strategy the plant selection is proposed to be as follows:-

The CHP would consist of a number of modules in one plantroom that are installed as the phased development progresses. This would start from a 110 kWe unit, building up to a 770 kWe installation on completion of the final phase of development.

The proposed biomass or biodiesel boiler installation would be sized to meet at least the 20% renewable energy requirement upon completion of the development. The biomass or biodiesel plant would be modular, starting at a 200kW installation increasing in 500kW modules up to the final installed capacity of 2200kW.

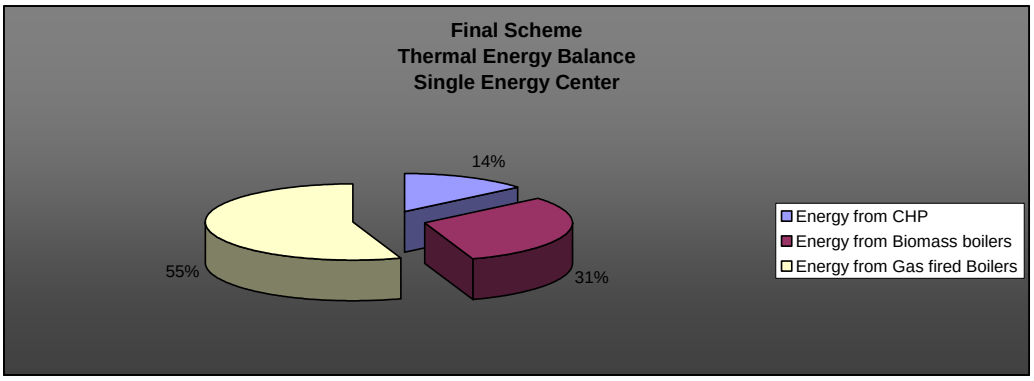
CHP	**Gas fired**
770	**kWe**
912	**kWth**
2295	**kWinput**
6000	**Running hours**
73%	**net efficiency**

Biomass	
2200	**kW**
5500	**Running Hours**
24%	**Energy- renewables**
20%	**Carbon reduction from renewables**

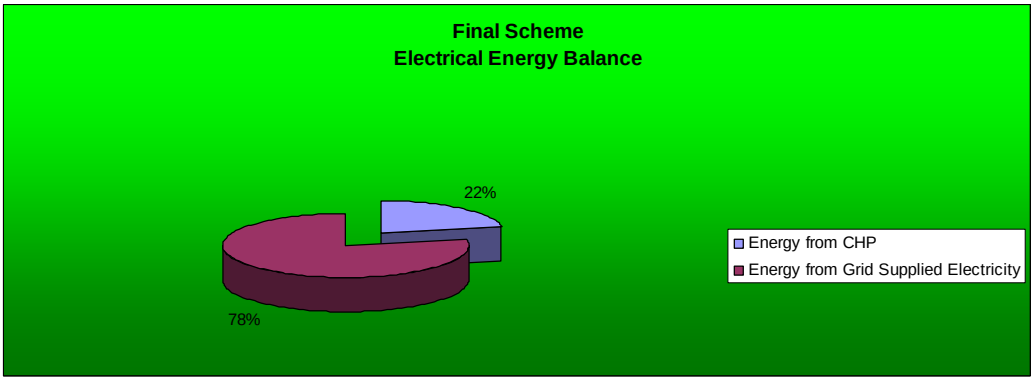
Total energy contribution would be as follows:

Month	Heating and Hot Water kWh	Electricity kWh
Cumulative TOTAL kWh/annum	39,354,271	21,442,568
CHP kWh/annum	5,472,000	4,620,000
CHP kWh/month	456,000	385,000
% electricity met by CHP		22%
% heat/hot water met by CHP	14%	
Energy Required after CHP	33,882,271	16,822,568
Energy from Renewables		
Energy from Biofueled boilers	12,100,000	
Energy from Wind Turbines		0
Energy from Fossil Fuels		
Gasfired Boilers	21,782,271	
Grid Supplied Electricity		16,822,568

Final scheme thermal energy balance; single energy centre.



Final scheme electrical energy balance; single energy centre.



Biomass storage and delivery.

The anticipated load profile of the final scheme is as follows:

Month	Heating kWh	Cooling kWh	Hotwater kWh	Electricity kWh
jan	4,495,272	0	1,441,827	2,037,053
feb	4,083,177	0	1,418,287	1,929,836
mar	2,959,528	0	1,324,127	1,822,620
apr	1,806,052	23,536	1,330,012	1,715,403
may	997,410	164,746	1,250,564	1,608,186
jun	0	400,093	1,224,082	1,500,969
jul	0	847,267	1,147,577	1,500,969
aug	0	682,521	1,106,382	1,608,186
sep	610,495	188,283	1,194,657	1,715,403
oct	1,333,119	23,536	1,253,507	1,929,836
nov	2,634,550	0	1,347,667	2,037,053
dec	4,665,788	0	1,730,193	2,037,053
TOTAL kWh/annum	**23,585,391**	**2,329,982**	**15,768,881**	**21,442,568**
average kWh/m^2/annum	*56*	*0*	*40*	*46*

Biomass storage required based on Woodchips at 22% moisture content.

Biomass Storage and Fuel Supply		
Biomass	2200	**kW**
Run Hours	6500	**hr/annum**
Output	14,300,000	**kWhr/annum**
Fuel Source	Woodchip 22%	
tonnage of fuel	3,865	**Tonnes/annum**
volume of fuel	15,889	**m3/annum**

Biomass storage required based on Woodchips at 40% moisture content.

Biomass Storage and Fuel Supply		
Biomass	2200	**kW**
Run Hours	6500	**hr/annum**
Output	14,300,000	**kWhr/annum**
Fuel Source	Woodchip 40%	
tonnage of fuel	4,469	**Tonnes/annum**
volume of fuel	17,875	**m3/annum**

The monthly fuel requirement will be:

Biomass Capacity	Output kWh	chip(22%) m3	chip(44%) m3	chip(22%) deliveries	chip(44%) deliveries
jan	1,636,800	2,142	2,409	153	172
feb	1,478,400	1,934	2,176	138	155
mar	1,636,800	2,142	2,409	153	172
apr	1,584,000	2,072	2,332	148	167
may					
jun					
jul					
aug					
sep	950,400	1,243	1,399	89	100
oct	1,636,800	2,142	2,409	153	172
nov	1,584,000	2,072	2,332	148	167
dec	1,636,800	2,142	2,409	153	172
note delivery based on a 14m3 (8 x 4) truck					

Biomass storage required based on bio-diesel.

Biomass Storage and Fuel Supply		
Biomass	2200	**kW**
Run Hours	6500	**hr/annum**
Output	14,300,000	**kWhr/annum**
Fuel Source	Bio-Diesel	
tonnage of fuel	1,226	**Tonnes/annum**
volume of fuel	1,362	**m3/annum**

Appendix 1 indicates the CO_2 saving from this option in the "GLA SPG Appendix D" format.

4.0 PRIMARY STRATEGY 2 – Turbo Expanders (Combined Cycle Scheme)

The team has liaised with Blue NG (the company linked with National Grid) to progress the potential installation of turbo expander energy generation plants). Southall is identified as one of two full sized pilot schemes being considered for potential construction in 2009 to capture a new efficient energy delivery system.

The turbo expanders are installed into the gas distribution system to reduce the pressure from the high pressure transmission mains to the lower pressure distribution network. During the expansion process the gas is made to do useful work in the form of electricity generation. However, during this process the gas cools and requires re-conditioning to allow distribution along the network. As a result of this heat is also required for the process at the turbo expander site.

The heat is provided by a high efficiency bio-plant which has fuel storage tanks and runs 2 engines fired by liquid bio-fuel. The system achieves 60% electricity in efficiency. It has been estimated to produce 15 to 20 MW of electricity and has some heat recovery.

Blue NG is progressing a separate planning application but the team has identified that this alternative may provide an excellent energy source as part of this development. However, it is appreciated that there are a number of permissions and approvals to be gained prior to its confirmed availability so at present it does not allow a guaranteed solution.

Any noise generated will be suppressed to 35 dB at the site boundary by a housing which will be approximately 30 x 30 x 8 m high. We are advised that no greater PADHI restrictions exists over and above those detailed on the site in the HSE model at present. (See Advantica Report for details).

Subject to approvals, it is hoped to be designed by the end of 2008, with power on by 2009/10.

The GLA has been informed of this system and they indicated they are supportive of its adoption in principle.

The system is able to generate 20MWe of power, which equates to 158 GWh/annum. At the end of the development the West Southall site, is estimated to require 58 GWh/annum for power, heating and hot water services.

Blue NG power availability	19	MW	yearly energy	158,118,000	kWh
Site total energy demand	7.02	MW	yearly energy	58,420,440	kWh
	11.381	MW	exported to grid	99,697,560	kWh

This leads to the prospect of an all electric site. Appendix 2 indicates the CO_2 savings from the Blue NG system in “GLA SPG Appendix D” format. However, for practical purposes, early phases will also have provision for some gas energy direct from the network.

The Blue NG system is a bio-diesel system, and can provide all of the power required for the West Southall site. The fuel source is bio-diesel and therefore renewable. It is proposed that a dedicated power supply network is installed from the energy centre to supply energy to the West Southall site. The system would also be grid connected allowing the export of excess power to the wider electricity grid.

The system has the following advantages.

- A single energy centre
- No requirement for a district heating scheme.
- All non domestic buildings have the potential to achieve the maximum number of BREEAM credits in respect of the energy criteria.
- The bio fuelled engines will have an exhaust requirement and after suitable treatment this will pass through a tall chimney located, for dispersion reasons (see air quality report) on the development site at Plot HS16.

The development would also follow the Mayor's wider energy policy hierarchy. Buildings throughout the scheme would be constructed so as to reduce energy consumption as far as practical. Typically the dwellings would be insulated to a high level similar to "passive house", and the air leakage would be set at around 2m3/m2h@50 Pa. Whole house ventilation systems would be as standard.

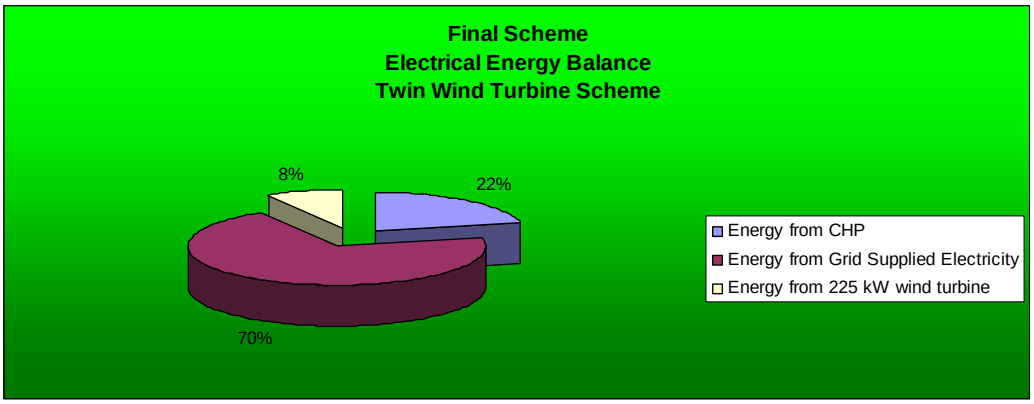
5.0 OTHER ALTERNATIVE STRATEGIES

5.1 Wind Turbines – Alternative Strategy 3

The siting of any wind turbines has significant restrictions on distances from residences (200m–300m). The CAA also has constraints and considerations limiting maximum capacity to 225kW units due to the proximity of the site to Heathrow. However, their inclusion on the scheme is considered herein.

Due to the density required for the development and the presence of residences uniformly across the proposals on site itself, wind turbines would have to be located off site in less sensitive locations. Such would only be possible subject to third party agreements not yet in place. However, these agreements may be enhanced by provision of renewable energy to a wider area.

However, if we consider the inclusion of twin 225kW wind turbines contributing into the scheme's overall energy strategy, these would provide an estimated 8% of the site's electricity needs either raising the renewable contribution or providing an alternative. The energy split would be as follows:



Using the single energy centre model of a 770kWe CHP and 2200kW biofueled plant, this combined with wind turbines would lead to a 26% renewable contribution on site. However, it can be seen that a combination of systems like this would be complex to build, operate and maintain with increased environmental impact and, as such, provides no real overall advantages.

As such it is assessed that primary strategy 1 and 2 are best overall options and are submitted for planning consideration.

Carbon Dioxide Emmissions	Heating and Hot water kgCO2/annum	Electricity kgCO2/annum
C02 Before renewables	7,634,729	9,048,764
C02 reduction due to CHP	-955,759	
% CO2 reduction due to CHP	-13%	
C02 reduction due to Wind turbines		1,022,400
C02 reduction due to Biomass	2,347,400	
Total CO2 saving	3,303,159	1,022,400
%renewables	31%	11%
%combined renewables	26%	

5.2 ESCo / MUSCo

As part of this energy strategy, provision of requirements through an ESCo investment and operation company, possibly to a wider area, has been considered as likely to be viable and a potentially desirable management structure. However, it is inappropriate to consider this further at this stage and negotiations will be progressed if permission is forthcoming as part of pre-construction considerations.

Furthermore, it is also possibly feasible with the inclusion of other utilities that an expanded MUSCo arrangement can be considered in the same way as an enhanced alternative.

Appendix 1: Mayor of London SPG Appendix D Information: Primary Energy Strategy 1 (On Site CHP Energy Centre with Biomass)

SPG Sustainable Design and Construction Appendix D Part 1 Executive Summary		
Energy	**KWh**	**CO_2 %**
Baseline Emissions	63,832,675	-
Savings from energy efficiency	10,092,000	17
Savings from renewable energy	12,100,000	14

SPG Sustainable Design and Construction Appendix D Part 2 Total energy efficiency vs baseline savings						
	1.8.1.1 Baseline Scheme		1.8.1.2 Proposed Scheme		1.8.1.3 Change	
Energy	**KWh**	**Kg/CO_2**	**KWh**	**Kg/CO_2**	**KWh**	**Kg/CO_2**
Electricity	22,148,422	9,346,634	17,528,422	7,396,994	4,620,000	1,949,640
Heating	39,354,271	7,634,729	21,782,271	4,225,761	17,572,000	3,408,968
Cooling	2,329,982	327,748	2,329,982	327,748	0	0
Total	63,832,675	17,309,110	41,640,675	11,950,502	22,192,000	5,358,608

SPG Sustainable Design and Construction Appendix D Part 2 Energy efficiency summary and Carbon dioxide emissions reductions		
Energy	**Amount**	**%**
Reduction in energy demand (KWh)	22,192,000	35
Reduction in CO_2 emissions	5,358,608	31

Appendix 2: Mayor of London SPG Appendix D Information: Primary Energy Strategy 2 (Turbo Expanders/Combined Cycle System)

SPG Sustainable Design and Construction Appendix D Part 2 Renewable Energy Savings and Carbon Dioxide reductions		
Energy	**Amount (KWh/yr)**	**%**
Required energy reduction from renewables	6,383,268	10
Proposed energy reduction from renewables	12,100,000	19
	Amount ($KgCO_2/yr$)	**%**
Required CO_2 reduction from renewables	1,730,911	10
Proposed CO_2 reduction from renewables	2,347,400	14

National Grid Property Limited

Beyond Green

Capita Lovejoy

Cyril Sweett

Hakes Associates

Hunt Dobson Stringer

Make

Marks Barfield Architects

PPS Group

RPS

Savell Bird & Axon

Savills

White Young Green