20-28 HATTON WALL, LONDON EC1N March 2008

REPORT ON ENERGY STRATEGY

1 Introduction

The report sets out the energy strategy for the proposed new development at 20-28 Hatton Wall, London EC1N, and in particular demonstrates the steps that are being considered to address the recommendations of the London Plan (2004), Further Alterations to the London Plan (2008) and more specifically the Energy Hierarchy in the Mayor's Energy Strategy. The hierarchy is:

i) Use less energy
ii) Use renewable energy
iii) Supply energy efficiently

In preparing this report, wherever possible the recommendations and procedures have been followed as set out in the GLA document 'Integrating renewable energy into new developments: Toolkit for planners, developers and consultants', issued September 2004. In addition consideration has been given to the recommendation set out in the London Borough of Camden UDP Policy SD9.

2 Description of Proposed Development

The site at 20-28 Hatton Wall comprises an existing building at 20-24 currently used as offices and workshops and an existing building at 26-28 currently used as retail and offices.

The building at No. 20-24 is in a poor state of repair with outdated accommodation and poor energy efficiency. This building is coming to the end of its useful life and it is proposed that this building be demolished and a new building be constructed, with jewellery workshops in the basement and office space from ground to 5th floors.

The building at No. 26-28 is in better condition and it is proposed that this building will be refurbished to provide a ground floor retail unit and a change of use to 3 residential units above.

Finally, as the new office entrance will be directly into No 20-24, it is proposed that the existing office entrance through No. 18 Hatton Wall will be converted to retail use.

The overall breakdown of units and total floor areas is as follows:

Unit	Type	NIA	GIA
No. 20-24 Office Space	New Build	2,680 m^2	3,168 m^2
No. 20-24 Workshops	New Build	402 m^2	601 m^2
No. 26-28 Residential	Change of Use	219 m^2	280 m^2
No. 26-28 Retail	Refurbishment	126 m^2	132 m^2
No. 18 Retail	Change of Use	58 m^2	58 m^2

3 Sustainability and Energy Conservation

Energy conservation is just one aspect of the overall proposals for sustainable design and construction for this development. Although this report specifically deals with the energy strategy, it should be noted that other sustainability issues have been addressed elsewhere, and further that the feasibility of various energy conservation options have be considered within the framework of the overall sustainability policy for the site.

For the main new office building it is the intention that the offices and workshop units will be designed to achieve a 'Very Good' score under a BREEAM assessment, with a minimum 60% credits achieved within the Energy section.

Within the new residential units in the refurbished building all services are to be new and will be designed and specified to the same energy efficiency standards as would be expected for a new build project, for instance the installation of condensing gas boilers. However, because this is an existing building, although the thermal performance of the building fabric is to be improved wherever possible, it will not achieve the performance that would be expected for a new building.

Similarly, the thermal performance of the retail unit in the refurbished building will be improved, while the 'change of use' retail unit is in a building recently completed and therefore already well insulated. However, it should be noted that the retail spaces will be left as shells for the future fitting out by the tenants of these units. Therefore, the developer will have little control over the types of mechanical and electrical installations that will eventually be installed in these units.

4 Energy Efficiency Measures

The energy efficiency measures that have been considered for this development are intended, where feasible, to address item i of the energy hierarchy, ie to use less energy.

The following energy efficiency measures have been considered:

Orientation

The positioning and orientation of the new building on the site has primarily been determined by the site layout, surrounding streets, site access etc. For these reasons orientation for solar gain has not been a major consideration. However consideration will be given to limiting solar gain by shading, particularly through the west facing windows.

Insulation

For the new building consideration has been given to improving the insulation in walls, roofs and floors to a standard above the current Building Regulations standards, in order to decrease the total heating load. The detailed design of the fabric is to be developed, but it is proposed to aim to achieve the following insulation standards:

Walls	0.25 W/m^2K
Flat roofs	0.13 W/m^2K
Floors	0.20 W/m^2K

Within the refurbished building, the aim will be to achieve the above insulation standards for any new construction, but where existing construction is to be retained it is unlikely that the above will be achieved and therefore the aim will be to provide improvements in line with Part L1B of the Building Regulations.

Glazing

Windows for the development are to comprise double glazed units. Windows generally contribute a significant proportion of the heat loss of a building and it is therefore proposed to specify high performance windows for this development with a U-value of 1.8 W/m^2K.

These standards will be applied to the new build and the refurbished building.

Air Tight Construction

The improved insulation levels being proposed will mean that uncontrolled leakage would represent a high proportion of the total energy usage. The aim for the new building will therefore be to eliminate as many air-leakage routes as possible by careful detailing at the design stage and by rigorous sealing around openings and penetrations during construction.

CIBSE TM23 sets out a best practice air permeability of $2.0m^3/hr.m^2$ for offices with balanced ventilation. With extremely careful detailing and close quality control it is anticipated that this figure can be achieved. However, for the purpose of this energy strategy a good practice figure of $3.5m^3/hr.m^2$ is believed to be a reasonable standard for the form of construction proposed and this will be aimed for as a minimum standard.

In the case of the refurbished building controlling leakage through the existing construction will be more difficult, but again the aim will be to eliminate as many air-leakage routes as possible.

Ventilation

Due to the deep plan nature of the offices, and the fact that the workshops are located at basement level, a naturally ventilated solution for the main building is not considered a feasible option. A mechanical ventilation system will therefore be provided to supply minimum fresh air requirements to all areas to maintain healthy conditions. The installations will be designed following recommendations to reduce energy use as given in Energy Efficiency Good Practice Guide 257, with heat recovery ventilation units being provided so that as much as possible of the energy can be recovered from the outgoing air and put back into the fresh air supplies.

For the residential units it is intended to develop the ventilation strategy based around an assisted ventilation system, using a low-energy fan unit in each dwelling and humidity-sensitive extracts. This system runs continuously at low speed to provide background ventilation with minimum trickle vent areas for fresh air make up, thus minimising uncontrolled leakage.

Reducing Cooling Demand

The developer will have little control over the final use of the spaces by the tenants and the equipment they use. However, where possible options for reducing cooling loads will be appraised, including controlling solar gains through glazing, installing energy efficient lighting systems and making use of thermal mass.

Lighting and Appliances

Energy efficient light luminaires will be used throughout the office building and within the workshops, with high luminous efficacy lamps, and lighting control systems will be installed where appropriate to prevent lights being left on unnecessarily. This will include daylight controls where possible, although the deep plan nature of the building will limit areas where daylight alone is adequate.

Within the residential units low energy lighting will be used wherever possible and the aim will be to achieve significantly better than the 25% required by the Building Regulations.

Within the communal areas energy efficient light fittings will be used throughout. The lighting in these areas will be controlled using presence-detecting controls, with daylight cut-offs controls where appropriate. However, consideration will also need to be given to security to ensure that this is not compromised.

Within the retail space the lighting will be installed by other as part of the fit-out.

All appliances supplied by the developer within the residential units will be A-rated.

Water Saving

Although not a direct energy saving, reducing cold water consumption will provide an indirect energy saving as treatment of water to drinking water standards is an expensive and energy intensive process. In addition it will reduce demand on already stretched water resources.

In addition reducing hot water consumption does provide a direct energy saving as less water has to be heated.

Water saving measures to be incorporated will be as follows:

- Use of low flush or dual flush toilets.
- Use of water saving white goods where these are being supplied by the developer.
- Use of showers in all en-suites and use of shower mixers over baths.
- Use of aerated spray taps where appropriate.
- Provision of water meters to all dwellings to encourage sensible water use.

5 Renewable Energy Technologies

In order to address item ii of the energy hierarchy, ie to use renewable energy, consideration has been given to each of the main renewable energy technologies.

The following gives a brief description of each technology considered and summarises how they may be appropriate for this development in order to achieve a reduction in carbon dioxide emissions of 20%, where feasible, using on site renewable energy generation, as required by the Further Alterations to the London Plan (2008).

Wind Energy

There are various problems associated with the use of wind turbines on major developments within urban areas. Firstly the output and efficiency is affected by lower and disruptive wind speeds. Secondly there are major planning issues regarding the proximity of the wind turbines to buildings with the associated visual, noise and vibration implications.

However, there has been significant development in the design of wind turbines recently to address these problems and vertical axis wind turbines are specifically designed to work well in the urban environment. Furthermore, the inclusion of wind turbines installed on the tallest part of the building can make a clear architectural statement to show that sustainable issues are being taken seriously.

A typical vertical axis wind turbine rated at 6kW would have an expected output of approximately 10,000kWh/yr. At least twelve of these would probably be required to provide the 20% renewable energy requirement and this is not considered to be a sensible proposal. A single turbine might be possible and if used to serve the landlord's electrical installation could make a small contribution when combined with other technologies. However, it is considered that a wind turbine is unlikely to be visually acceptable within a conservation area.

Solar Energy – Photovoltaics

Photovoltaic cells covert solar energy to electricity and as such are best suited to buildings that use electricity during the day, such as offices and retail.

Photovoltaic cells should ideally face between south-east and south-west and at an elevation of about 30-40^{O}. Efficiency and costs for photovoltaic panels vary considerably according to type, but in order to provide the 20% target it is likely that a collection area of 1000m^2 to 1500m^2 would be required.

It is therefore clear that there will not be sufficient roof area to accommodate PV panels to provide the 20% energy requirements. Furthermore, of the flat roof area available a significant proportion is to be used as green roof to satisfy other sustainability requirements.

Again, as with wind energy, a smaller PV array could be considered just to provide a small contribution. However, due to its limited potential impact in comparison with other renewables PV is not considered viable for this development.

Solar Energy – Water Heating

Solar heating systems use solar energy to heat water and are therefore generally used for supplying domestic hot water requirements. However, for a mainly commercial site such as Hatton Wall, the domestic hot water is a relatively small part of the overall energy load, and therefore it would not be possible to achieve the 20% target for the whole site using solar hot water alone.

Solar hot water could be considered for the 3 residential units and would require a collection area of 4m^2 per dwelling to provide between 50% and 70% of the hot water requirements. This would contribute around 1% of the total energy requirements of the site.

Solar water heating can also be used to preheat main boiler plant. This would require a total panel area of around 300m^2 to 340m^2 to provide 20% reduction in CO_2 emissions using on site renewable energy. It is unlikely that sufficient roof space is available.

Biomass Heating

Biomass or wood burning systems do emit carbon dioxide, but are normally considered as carbon neutral as the amount released is equal to that absorbed when the tree was growing. However to be a truly renewable energy source the fuel must come from a sustainable source, which ideally should be in reasonably close proximity.

Biomass heating is generally the cheapest (capital cost) solution to meet the requirements for 20% reduction in CO_2 emissions. Biomass heating would be provided through a communal heating system with the biomass boiler acting as the lead boiler to meet the base load, supported by conventional gas boilers that would modulate to meet the heating peaks.

However, there are two significant implications of biomass heating. Firstly a relatively large space is required for fuel storage and this may mean losing potential rentable space in the building, which obviously needs to be taken into account in assessing the financial viability of biomass heating. Secondly the method and frequency of fuel delivery needs to be considered and the location of this site is not the easiest with regard fuel deliveries.

Furthermore, although mentioned as a possible source of renewable energy in the London Plan, it is noted that biomass heating is not included in the Camden UDP Policy SDP as one of the listed renewable technologies suitable for use in Camden.

Ground Source Heating and Cooling

Ground source heating uses the heat in the ground as a constant reliable heat source to provide space and water heating via heat pumps as a replacement for a boiler. Ground source cooling can provide cooling, either by circulating ground water directly through chilled beams or ceilings, or via a heat pump to operate with a more conventional cooling system as a replacement for a chiller. For buildings requiring both heating and cooling it is usually possible to use the same ground source equipment for both.

Strictly speaking neither ground source heating or cooling are completely renewable technologies as electrical energy is used to drive the heat pump. However, the energy supplied by the system significantly exceeds the electrical energy used and the difference between output and input energy is the renewable component.

Collectors can either be horizontal or vertical. Horizontal collectors are generally cheaper, but require a large area of land which generally makes them unsuitable for city developments. Vertical collectors are more expensive, but clearly require less plan area and can in some circumstances make use of piles if these are already being provided for structural reasons. However, meeting the full cooling demand of an inner city office is often not possible due to restricted ground space, even using vertical collectors.

In order to provide ground source heating and cooling to the offices at Hatton Wall it is estimated that approximately 60 no. vertical boreholes drilled to a depth of 100m would be required, subject to thermal conductivity tests.

Shortlist of Renewables for Further Consideration

There is insufficient collection area available to achieve the 20% target from solar photovoltaic cells. For this reason PVs are not considered a viable option.

Biomass boilers could provide 20% reduction in CO_2 emissions, but the space and delivery requirements are significant and this is a technology not listed by Camden. For these reasons biomass heating is not recommended.

Wind energy is not an option to provide the full 20% target, but could contribute a proportion of this. However, the visual impact of a turbine at roof level would need to be considered and would probably not be appropriate for this development.

Solar hot water heating is also not an option to provide the full 20% reduction in CO_2 emissions. However, it could be considered for the residential units and would help these dwellings to achieve a high rating under the Code for Sustainable Homes.

Ground source heating and cooling is therefore considered the most appropriate principle renewable technology for this development.

6 Heating and Cooling Systems

Generally the options for heating and cooling systems address item iii of the energy hierarchy, ie to supply energy efficiently. The appropriate system within each building will also be dependant on the renewable energy technology chosen in order to seek to achieve the 20% reduction in CO_2 emissions.

Offices and Workshops

As discussed earlier in this report, a mechanical ventilation installation will be required to the offices and workshops in order to provide minimum fresh air requirements. Heating and cooling will then be provided using a number of local fan coil units which will re-circulate room air, either heating it or cooling it as required.

Traditionally a system as described above would use 4-pipe fan coil units with heating and cooling from central boiler and chiller plant, or a variable refrigerant system with external air cooled heat pump units.

However, with the preferred renewable energy solution of ground source heating and cooling, water source heat pumps would be used. There are various options for doing this, but the likely method will be for the local fan coil units to be small individual water source heat pumps, connected by water distribution pipework to the geothermal water loop system.

Dwellings

Options for the heating within the dwellings includes direct electric heating, individual gas boilers or a single communal heating system.

Of the above options, direct electric heating has the lowest capital cost and in the past has been the system preferred by many developers, especially within flats. However, it also has by far the highest carbon emission per unit of energy. Electric heating is therefore not considered to be a viable option for this development.

Communal heating can offer energy efficiency advantages for large schemes, but this would be insignificant for only 3 units. It is therefore intended to provide individual gas boilers within the dwellings, but in order to provide maximum energy efficiency condensing boilers with a SEDBUK A-rating are proposed, and heating controls are to be provided in accordance with standards as the Housing Energy Efficiency Best Practice Programme.

Retail

Heating within the retail space will be by the tenants.

Combined Heat and Power (CHP)

CHP units generate electricity locally, usually using a gas generator, so that the waste heat produced in the process can be used beneficially. Potentially therefore, CHP systems can produce electricity far more efficiently than conventional power stations.

However, CHP systems generally produce almost twice as much waste heat as they generate electricity and it is only worth running the CHP plant if this heat can be usefully used. Also to be economically viable the CHP plant needs to run on average 14 hours per day throughout the year. CHP plant therefore needs to be sized on the ‘base’ or continuous heating load and the feasibility of CHP for a development will be dependant on having a significant and constant base demand.

Due to the high insulation standards proposed to reduce heating loads, the space heating requirements will be low and only present for part of the year. The constant heat demand is therefore limited to the base domestic hot water load. Such a small CHP system will result in limited carbon savings and is unlikely to be viable for this development.

7 Energy Demand Assessments

An Energy Demand Assessment has been carried out using Typical Benchmark Values taken from the guidelines within the London Renewable Toolkit and Energy Consumption Guides.

Table 1. Site Energy Demand Assessment

Use	Area (m^2)	Annual Energy Demand - Gas		Annual Energy Demand - Electricity		Total
		kWh/m^2	kWh	kWh/m^2	kWh	kWh
Office	3168	97	307,296	128	405,504	712,800
Workshop	601	79	47,479	54	32,454	79,933
Residential	280	90	25,200	35	9,800	35,000
Retail	190	80	15,200	300	57,000	72,200
			395,175		504,758	899,933

8. Breakdown of site baseline carbon dioxide emissions

For the purposes of this report Carbon emission factors have been taken as set out in Building Regulations Approved Document L2A 2006 as follows:

Gas 0.194 kg CO^2/kWh
Electricity 0.422 kg CO^2/kWh

Table 2. Breakdown of Site Carbon Dioxide Emissions

Use	CO2 Emissions - Gas		CO^2 Emissions - Electricity		Total
	kWh	kg/yr	kWh	kg/yr	kg/yr
Office	307,296	59,615	405,504	171,123	230,738
Workshop	47,479	9,211	32,454	13,696	22,907
Residential	25,200	4,889	9,800	4,136	9,025
Retail	15,200	2,949	57,000	24,054	27,003
	395,175	76,664	504,758	213,009	289,673

9. Assessment of Contribution from Renewable Technology

Technology 1: Ground Source Heating and Cooling

The typical benchmark energy assessment above assumes that space heating from a central gas boiler plant, with an assumed efficiency of around 90%, and cooling provided from an air-cooled chiller with an assumed average EER of approximately 3.0.

With the proposed ground source heating/cooling solutions heat pumps will be used for both heating and cooling. It is anticipated that the heat pumps will give a COP of approximately 3.4 for heating and an EER of approximately 4.2 for cooling.

In addition, as gas is no longer required for space heating, it will no longer be necessary to bring gas into the building and water heating would therefore need to be by local electric water heaters. This is a more energy efficient solution, but has a higher carbon emission.

The following tables give comparisons of the estimated energy use for heating, cooling and hot water for the benchmark building and the proposed building, along with the associated carbon emissions:

Table 3. Heating, cooling and hot water emissions for benchmark office building.

Use		Energy kWh/yr	Fuel	CO^2 Emission kg/yr
Office	Heating	285,120	Gas	55,313
	Cooling	95,040	Electricity	40,107
	Hot Water	22,176	Gas	4,302
Workshops	Heating	43,272	Gas	8,395
	Cooling	14,424	Electricity	6,087
	Hot Water	4,207	Gas	816
	Totals	464,239		115,020

Table 4. Heating, cooling and hot water emissions for proposed office building.

Use		Energy kWh/yr	Fuel	CO^2 Emission kg/yr
Office	Heating	75,473	Electricity	31,850
	Cooling	67,886	Electricity	28,648
	Hot Water	12,672	Electricity	5,348
Workshops	Heating	11,454	Electricity	4,834
	Cooling	10,303	Electricity	4,348
	Hot Water	2,404	Electricity	1,014
	Totals	180,192		76,042

Estimated energy saving: 284,047 kWh/yr
Estimated reduction in carbon emissions 38,978 kg CO^2/yr

The above savings represent a 31.6% energy reduction from the overall site annual energy usage and a 13.5% reduction in carbon emissions.

Technology 2: Solar Water Heating to Dwellings

Solar water heating installations to 3 no. residential units. Each dwelling to have $4m^2$ evacuated tube solar collectors to provide an estimated 582 kWh/yr energy saving per m^2 of panel.

Total estimated energy saving: 12 x 582 = 6,984 kWh/yr

Reduction in CO^2 emissions: 9,984 x 0.194 = 1,355 $kgCO^2$/yr

The above savings represent a 0.8% energy reduction from the overall site annual energy usage and a 0.5% reduction in carbon emissions.

10. <u>Conclusion</u>

The Further Alterations to the London Plan seeks that developments achieve a reduction in CO_2 emissions of 20% using on site renewable energy generation unless it can be demonstrated that such a provision is not feasible. The proposed ground source heating and cooling installation for the offices and solar hot water heating for the residential will together achieve substantially more than 20% energy savings, and provide a 14% reduction in CO_2 emissions, the maximum amount considered feasible for the site.

The development has also been designed to achieve a ‘very good’ score under a BREEAM assessment with a minimum 60% credits achieved within the energy section.