Energy Strategy

For

23a, 23b and Land Adjoining 23 Ravenshaw Street, London, NW6 1NP

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SECTION 1: INTRODUCTION

a) Proposed Development

1.1 Mr Chris Taylor is seeking planning permission for the demolition of the existing dwellings at 23a and 23b Ravenshaw Street, and the redevelopment of the site to comprise 12 flats with associated parking spaces and amenity space.

1.2 The development will consist of 3 studio apartments, 1 one bedroom flat, 5 two bedroom flats and 3 three bedroom flats.

b) Requirements for an energy strategy

1.3 Camden Council expects major developments of 1000m^2 or 10 housing units or more to incorporate renewable energy sufficient to provide at least 10% of predicted energy requirements, and developers must provide details of how this has been addressed.

1.4 Mr Taylor has commissioned RPS to prepare an Energy Statement in respect of the proposed scheme suitable for submission with the outline planning consent. This report assesses the expected energy demand at the property, evaluates renewable energy sources and outlines the options to comply with planning requirements.

1.5 The calculations provided in this document only provide an early indication of system size, carbon reduction and cost based on information for typical installations. They are as reliable as required at this stage. However they are not design calculations but serve to establish the viability of various sized renewable and low carbon technologies for this development. Any costings provided are budget costs based on typical unit costs achieved at similar projects and reflect premium costs only.

SECTION 2: METHOLODOLOGY

2.1 The methodology used in this report is based on the GLA London Renewable Toolkit, CIBSE TM11, the DCLG Low or Zero Carbon Strategic Guide, and the BMI retail-benchmarking guide for energy consumption.

2.2 The baseline energy demand is established and then adjusted to take account of specific design measures that will reduce the energy consumption at the development. This projected energy demand forms the basis for the requirement to generate a percentage of the total energy demand from renewable sources.

a) Baseline Energy Demand

2.3 The baseline energy demand uses different benchmarks for each area of the development and these are further explained in section 3. The consumption benchmarks used are recognised standards in England and Wales. The benchmarks used were published in 1999 (before the 2002 and 2006 changes to the Building Regulations) and so are high for a new build. However this situation is corrected in the adjustment for design and management measures.

b) Adjustment for Design & Management Measures

2.4 Our assumption at this stage is that there will be at least a 20% reduction in CO_2 emissions in the dwellings to comply with ADLA requirements. In reality the reduction will be greater as there were further energy efficiency measures in previous Building Regulations.

2.5 We have assumed that approximately 21% of the reduction comes from reduced electricity demand (lighting, small power, motors and air conditioning) and 79% from reduced heating demand. As electricity has a higher CO_2 emission factor then electricity, the reduction in annual energy consumption is 22%.

c) Renewable Technology Assessment

2.6 The technologies that are recognised as renewable by the UK government and appropriate for this development are evaluated and the relative merits of each technology in terms of cost, space requirements, CO_2 emission reductions and possible revenue streams are examined and presented for client consideration.

d) Emission factors

2.7 The report uses the emission factors listed in the current Building Regulations ADL2A Table 2.

CO_2 emission factors	
Fuel	**Emission Factor ($kgCO_2/kWh$)**
Natural Gas	0.194
Biomass	0.025
Grid supplied electricity	0.422
PV supplied electricity	0.568
Wind powered generator electricity	0.568

Table 2.1

SECTION 3: ANALYSIS OF BASELINE ENERGY DEMAND

3.1 Different areas of use throughout the development have different levels of energy use. The projected baseline load of the Ravenshaw Street property has been developed from the detail in table 3.1. The normalised consumption figures are provided by Ofgem and Centrica (electricity) and the Institution of Gas Engineers.

		Loading	
		Elec	Gas
Area Use	No.	kWh/flat/annum	
Studio	3	3300	11723
1 bed flat	1	3300	11723
2 bed flat	5	3300	11723
3 bed flat	3	3995	17584

Table 3.1 Criteria for development of predicted load.

3.2 Applying the required CO_2 reductions produces a predicted annual energy requirement of 155,765kWh with associated CO_2 emissions of 39 tonnes per annum.

		CO_2 reduction	Loading			
			Elec	Gas	Total	Annual Emissions
Area Use	No.	%	kWh/flat/annum			Tonnes CO_2
Studio	3	20%	2922	8804	11726	8.8
1 bed flat	1	20%	2922	8804	11726	2.9
2 bed flat	5	20%	2922	8804	11726	14.7
3 bed flat	3	20%	3538	13206	16743	12.2
				Savings	**81,092 kWh**	**38.6 Tonnes CO_2**

Table 3.2 Breakdown of predicted energy consumption and emissions.

3.3 Throughout this report, our predicted emission saving figures are based on a building built in 2000, but our renewable percentages are based on the projected consumption as this is a more realistic assessment of the energy requirements of the Ravenshaw Street property.

SECTION 4: MANAGEMENT OF ENERGY DEMAND

4.1 Factors that affect a buildings lifecycle use of energy include considered design, construction, fit out, occupant behavior, levels of management and maintenance, and refurbishment.

4.2 The developer of the building and the design team can have an impact on these factors in the design and construction phases and also by the application of technology to assist occupant behaviour and provision of real time information.

a) <u>Design</u>

4.3 In order to reduce the development's carbon footprint and produce a building that is more sustainable, the following features should be considered:

1) To maximise natural light and minimise summer solar gain, the buildings will be orientated to benefit as far as the site allows.

2) U Values – All building fabric 'U' values will exceed the limiting standards in ADL2A.

3) Air permeability – The building be tested to an air permeability standard of $7m^3$ (h.m) @50 Pa. The limiting standard for the building regulations is $10m^3$ (h.m) @50 Pa.

4) Glazing – All glazing will meet or exceed the requirements of the building regulations. A lower U Value glass may be used on the north side to prevent overheating of the building in the summer as permitted in the building regulations providing the carbon target is met.

5) Lighting - All lighting will be designed to exceed the current Building Regulation "reasonable provision" level of 45 luminaire-lumens/circuit/Watt.

6) Lighting controls – Passive lighting controls will be fitted in all areas of intermittent occupancy.

7) Energy Efficient Building Services – Equipment on the ECA approved technology list is recognised for its energy efficiency and is encouraged through Enhanced Capital Allowances. Wherever appropriate, the development will use equipment that has been selected by the Carbon Trust for inclusion in the ECA scheme.

8) Where installed, mechanical ventilation systems will comply with Building Regulations part F. Heat recovery and variable speed inverters will be fitted where appropriate.

4.4 As stated in 3.2, a mix of the above measures will produce emission reductions over a 2002 model building by at least 20%. The projected annual energy consumption figures taking into account the above measures are detailed in table 3.2. It is likely that the actual occupation figures will be lower, subject to normal occupancy characteristics.

SECTION 5: RENEWABLE TECHNOLOGIES

5.1 The Government's Renewable Obligation (2002) defines renewable energy in the UK. The accepted renewable technologies are:

- Landfill and sewage gas;
- Small hydro-electric (under 20 MW) or larger hydro-electric if commissioned after 1982;
- Onshore and offshore wind;
- Biomass;
- Geothermal power;
- Tidal and wave power;
- Solar

5.2 This section considers the merit of each technology for use at the Ravenshaw Street property.

a) <u>Landfill and Sewage Gas</u>

5.3 As there are no onsite landfill or sewage works this is not an appropriate technology choice for the development.

b) <u>Small Scale Hydro-electric, Tidal and Wave Power</u>

5.4 There are no opportunities on the site for these technologies.

c) Electricity generation from wind turbines

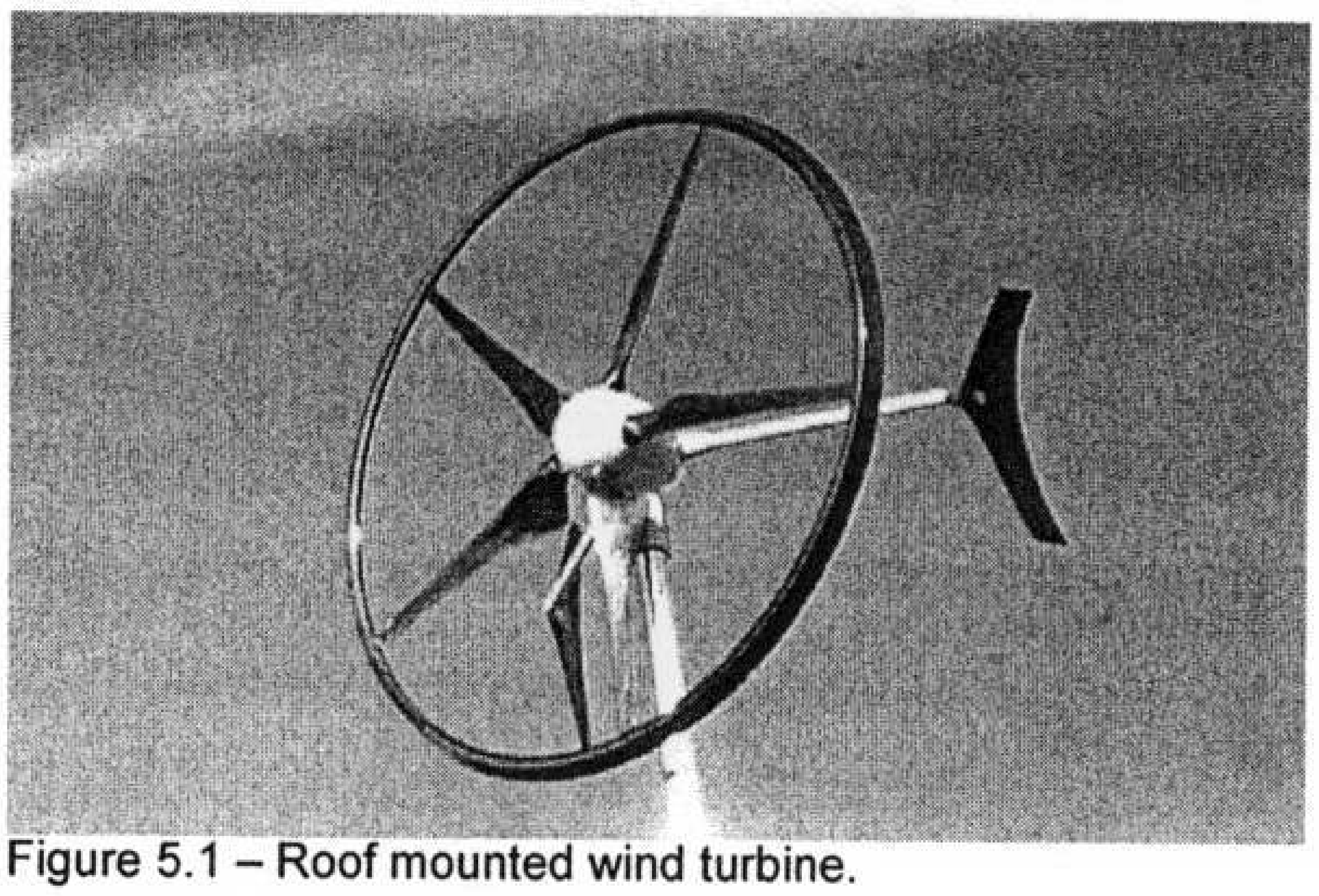
Figure 5.1 – Roof mounted wind turbine.

5.5 Small 1.5kW wind turbines are available that can be mounted on the roof of a development. The UK wind speed database indicates average wind speeds at the site of 5.7 m/s at 25 metres above ground level.

5.6 As the roof height of the proposed development is in line with that of other properties in the street, any roof mounted wind turbines would be visible from a large area and may force local objections.

5.7 In order to supply the full requirement of 10% of the property's energy demand, it would be necessary to install seven of the roof mounted turbines.

5.8 In view of the number of wind turbines required, and likely local opposition, we have discounted the use of small wind turbines.

d) Biomass

5.9 Biomass fuel is obtained from organic matter, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products.

5.10 The use of biomass is generally classed as a 'carbon-neutral' process because the carbon dioxide released during the generation of energy is balanced by that absorbed by plants during their growth.

5.11 Biomass falls into three main groups:

- dependent resources: these are the co-products and waste generated from agricultural, industrial and commercial processes e.g. poultry litter or residue from sawmills,
- dedicated energy crops: these are short-rotation crops which are gown specifically to generate biomass fuel e.g. coppice, miscanthus, willow and poplar,
- multifunctional crops: these are crops that can be used to create different types of energy e.g. the ears of wheat can be used to create fuel while the straw can be burned to generate electricity.

5.12 Biomass boilers could be considered for heating. Fully automated biomass boilers are now available, in a range of sizes that only require occasional attendance. Adjacent storage hoppers are filled with wood pellets at regular intervals and ash is removed periodically. This could provide heating for all areas of the property.

5.13 Wood pellet biomass is now available for delivery in London. At present it is more expensive than gas, though cheaper than heating oil, and so there is currently no payback on biomass. It is anticipated that this will change as gas prices continue to increase and biomass prices drop as scale of production increases.

5.14 The disadvantage of biomass is that carbon emissions are produced at source and so there will be a small impact on immediate air quality. Camden is designated as an Air Quality Management Area for the pollutants of Nitrous Oxide NO_2 and Particulate Matter PM_{10}. Preliminary enquiries with the Air Quality officer at Camden council suggests that they would encourage the use of alternative sources of renewable energy in preference to biomass, but may be open to its use after further discussion.

e) <u>Geothermal</u>

5.15 The sub soil and water temperatures in the UK are reasonably constant and predictable. Heat pumps use this geothermal energy by extracting heat at a low temperature and converting the low-grade energy to usable heat. Geothermal systems typically provide four units of energy output for every unit in.

5.16 There are two types of geothermal that could be considered for this development, either borehole or subsoil.

5.17 The borehole system extracts energy from depths of between 100 and 150 metres depending on the geological conditions of the site. Borehole systems can be either open loop, requiring a supply and return borehole, or closed loop systems comprised of a series of "U" tubes.

5.18 The sub-soil system utilises the constant temperature of 10-12°C found at relatively shallow depths. It requires a sub soil grid of pipes to act as a "heat sink". Water is circulated through these pipes picking up low-grade heat before being pumped above ground for circulation through heat pumps located in the buildings.

5.19 As sub-soil systems are effectively recharged by energy from the sun, it is preferable to have the subsoil grid located in an area exposed to sunlight, such as a car park. The polyethylene pipework would normally be at a depth of 1.2 metres. The area required for a sub soil system to provide 10% of the total energy requirements is dependant on site characteristics that are not known at this stage, although typically we estimate the area to be approximately $230m^2$. The required area is not available at this site due to the existence of the basement level car park arrangement under some of the garden area.

5.20 Geothermal heat pump systems can efficiently provide a supply water temperature of 30-40°C. This makes it particularly suited to providing space heating through under floor heating, or through a warm air system. Alternatively the temperature of the water could be increased further in order to allow the energy to be used to heat the building through radiators, although this would have a detrimental effect on the performance of the heat pumps.

5.21 Once installed, the ground loop has minimum maintenance requirements and the heat pumps have an expected lifetime of 15 to 20 years.

5.22 Multiple heat pumps can be connected to one ground exchanger, providing greater control for individual residences. Initial installation costs will be greater with this scenario, however the need to monitor and charge apartments for the supply of heat are removed.

f) Solar

5.23 Solar energy involves capturing and harnessing directly the free and clean energy of the sun. There are three main ways of achieving this:

- *Passive Solar design* ensures that a building's form and fabric captures the sun's energy and reduces the need for artificial light and heating.
- *Active solar water heating* - converts solar radiation into hot water.
- *Solar photovoltaic* (PV) panels or solar cells - convert sunlight directly into electricity.

g) Passive solar design

5.24 Passive solar design involves the application of design principles to ensure that free and readily available energy from the sun is put to best use within a building. Material choice and positioning of amongst other elements, all work together to find the best energy solutions regardless of the season. Passive solar design ensures that excess heat loss is avoided in winter and direct solar gains are increased; natural daylight is captured to minimise the need for lighting; summer solar radiation is minimised to prevent overheating and natural ventilation is built into the building wherever possible. This reduces the need for mechanical heating and cooling within the building.

h) Active solar water heating

5.25 Active solar water heating captures and stores the sun's heat via water storage systems, without the need to transform the energy into another fuel.

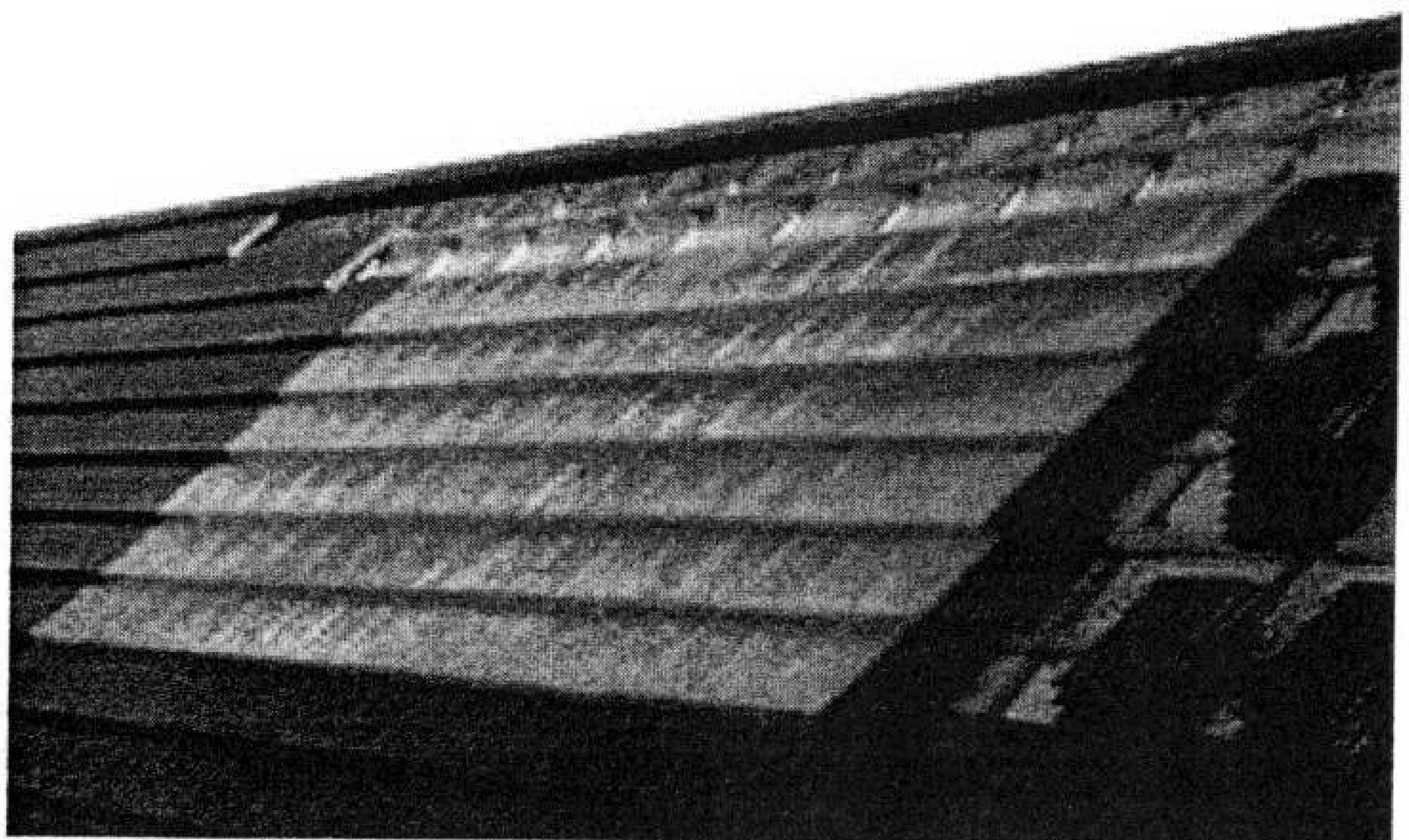

Figure 5.2 – Solar hot water tiles installed on a roof

5.26 Solar collectors heat water for domestic use by the building occupants by passing a liquid through tubes that are designed to allow the water to absorb as much solar energy as possible. It satisfies up to 70% of a household's hot water demand for the year and would be a very easy, quick and low risk way to provide the required renewable energy for the property.

i) Solar Photovoltaic

5.27 Solar photovoltaic (PV) panels convert energy from sunlight into electricity by means of a chemical process generating an electric current. Solar PV delivers clean silent electricity at point of use and is only dependant on a source of natural light. PV panels do not require direct sunlight to operate, and will continue to generate electricity even when it is overcast. Although this reduces the efficiency of the panel, a significant quantity of electricity can still be generated in these conditions.

5.28 PV cells can be arranged in panels on a building's roof, on walls or as elements of solar shading. Recent developments mean that they can be integrated into the roof tiles, solar louvres or the cladding.

Figure 5.3 - Solar Tiles combining PV and Solar Hot Water.

5.29 The PV panels typically have an electrical warranty of 20-25 years and an expected system lifetime of 30-50 years.

5.30 The lower efficiency of PV cells compared to solar hot water collectors means that a larger area of tiles are required for a similar energy output.

5.31 At present, solar PV is not economical in densely populated areas. Our provisional calculations are that a low output PV tile installation would pay back in around 64 years i.e. payback period exceeds the lifetime of the panels.

SECTION 6: ANALYSIS OF COSTS AND BENEFITS

6.1 A variety of technologies have been considered to allow the Ravenshaw Street property to achieve the planning requirement of 10% of energy use supplied by renewable energy. The most suitable options for the development are PV tiles to provide electricity, solar water tiles to provide hot water, or a geothermal installation to provide space heating.

6.2 Because of Camden Council's initial reservations about the use of biomass, the space within the development that would be required for the boiler and fuel storage, the need for a flue, service risers and corridors, and the need for additional management of service charge which the scheme would introduce, the technology is not suitable for this development.

6.3 As sufficient space for a sub soil geothermal installation is not believed to be available, a borehole system would be necessary. The cost of the installation will vary depending on the geological conditions at the site, but is expected to be in the region of £18,000, or approximately £1,500 for each flat for a 2.5kW heat pump. The heat pump would provide approximately 9kW of heating. With a geothermal installation, space will need to be set aside within the building for the installation of the heat pumps and to allow for heat distribution. Meters will need to be installed in each of the flats that are served by the geothermal installation.

6.4 PV tiles that could be included in the roof would blend in well with the intended building design although a large area of tiles would be required in order to satisfy the requirement for 10% renewable. A roof area of approximately 160m^2 would need to be covered with the PV tiles. The cost of PV tiles is high, at an estimated cost of £115,000, which equates to nearly £9,700 for each flat.

6.5 Solar hot water tiles can also be integrated into the roof to provide hot water for a proportion of the flats. The area necessary for hot water tiles is considerably less than that required for PV, approximately 40m^2 of roof area would be sufficient to provide 10% of the property's energy demand. The premium cost for each flat supplied by the solar hot water tiles is expected to be around £2,000 for the installation of the tiles and associated equipment. Space will be required within each of the flats supplied by the solar tiles for a water tank. The occupants of these flats will benefit from reduced energy costs.

6.6 The renewable technology options for the site that have been considered are presented in table 6.1 below.