ddp

Doherty Design & Planning Limited

ENERGY STATEMENT

(To Accompany Detailed Planning Application)

Site

6-8 & 10 HIGH STREET, HAMPTON WICK
KINGSTON UPON THAMES KT1 4DB

Proposal

CONVERSION OF LISTED BUILDING INTO 3-NO. DWELLINGS AND ADDITION OF 3-NO. DWELLINGS

Client

COUNTRYWIDE DESIGN

28th JANUARY 2014
Ref. E378-ES-00

22 Station Road, Manea, March Cambridgeshire PE15 0JL
Tel: 01354 688413
Company Registration No. 6146290

CONTENTS

List of Tables

1.0 SUMMARY OF RECOMMENDATIONS

a) This development is for the conversion of a listed building to form three dwelling and the addition of three dwellings to the rear on the site at 6-8 & 10 High Street, Hampton Wick, Kingston upon Thames, KT1 4DB.

b) It is proposed that in order to meet the requirements of policy this development will adopt a high standard of design with regard to energy efficiency principles. This report highlights a reduction of 40% in carbon dioxide emissions by the incorporation of a combination of energy efficiency measures and the provision of on-site renewable energy production equipment.

c) This development is at the planning stage and the detailed construction drawings have not been prepared, therefore initial stage SAP calculations and procedures provided in the London Renewables Toolkit, have been used to estimate that the baseline carbon dioxide emissions of this development.

d) This report has demonstrated using initial SAP calculations that it is possible to achieve a 17.9% reduction in carbon dioxide emissions by making fabric and energy efficiency measures, with a further 23.0% reduction in carbon dioxide emissions by incorporating photovoltaic systems. It is envisaged during detailed construction design, these figures can be improved.

e) It is suggested here that in order to ensure the best possible reduction in carbon dioxide emissions after consent is granted, that a planning condition is added requiring accurate carbon dioxide emission calculations and detailed proposals to be prepared and submitted prior to commencement on site.

2.0 INTRODUCTION

a) Doherty Design and Planning Limited have been instructed by Countrywide Design to prepare an Energy Statement to support the submission of the planning application for the development at 6-8 & 10 High Street, Hampton Wick, Kingston upon Thames, KT1 4DB. This report must be read in conjunction with the application forms, certificates, detailed plans and other supporting documents submitted to the Local Authority as part of the application.

b) The Application is for the conversion of a listed building into dwelling and the addition of three dwellings.

c) In the London Borough of Richmond Upon Thames's Core Strategy Policy CP1 – Sustainable Development, the Council have a requirement for new homes to meet Code for Sustainable Homes Level 3. Further details regarding the Code for Sustainable Homes for this project can be found in the Code for Sustainable Homes Pre-Assessment Report.

d) The London Borough of Richmond Upon Thames's Core Strategy Policy CP2 – Reducing Carbon Emissions, the Council seek to increase the use of renewable energy by requiring all new development to achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation.

e) Under the requirements of the London Plan 2011, development proposals should make the fullest contribution to minimising carbon dioxide emissions with the following energy hierarchy:

- Be Lean –use less energy
- Be Clean – supply energy efficiently
- Be Green – use renewable energy

f) The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national

Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

g) For residential buildings, Policy 5.2 – Minimising Carbon Dioxide Emissions requires new developments, between 2013-2016, to achieve a 40% reduction over the 2010 Building Regulations.

h) Section 3 of this report shall identify sustainable measures that can be incorporated into the design of the listed building to the front of the site to provide a reduction in energy use and carbon emissions.

i) The objectives of Section 4 of this Energy Statement are to make an appraisal of the carbon dioxide emissions of the proposed three new dwellings, the various methods of generating and using renewable energy at source, and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to renewable energy provision. The Assessment shall follow the principles set out in the London Renewable Energy Toolkit.

j) The London Renewable Energy Toolkit is the system developed by the Greater London Authority in 2004 to assist Planners, Developers and Consultants with the assessment of the appropriateness of renewable energy resources and technologies.

k) At this stage in the design of the dwellings, the detailed working drawings have not been prepared and therefore accurate calculations cannot be undertaken to produce the energy requirements and carbon dioxide emissions.

l) The Assessment shall be carried out following the principles set out in the Mayor's "Energy Hierarchy" which is implemented through the London Plan. These principles can be summarised as follows:

- Be Lean –use less energy
- Be Clean – supply energy efficiently
- Be Green – use renewable energy

m) In order to demonstrate this, it is proposed to use the Standard Assessment Procedure 2009 (SAP) for the calculations to obtain initial baseline carbon dioxide emissions figures for the development. Further SAP calculations will be used to demonstrate the potential carbon dioxide emission savings from the initial calculations by enhancements to the building fabric, plant and controls – BE LEAN. The suitability of supplying energy, both heat and power, through the use of a combined heat and power system shall be assessed – BE CLEAN. Finally, the carbon dioxide emission saving by the use of renewable energy shall be assessed through the outputs from the SAP calculation – BE GREEN.

n) As these calculations are based on the initial design at planning stage, it is suggested here that in order to ensure the best possible reduction in carbon dioxide emissions after consent is granted, that a planning condition is added requiring carbon dioxide emission calculations and detailed proposals to be prepared and submitted after detailed design and prior to commencement on site.

3.0 SUSTAINABLE DESIGN AND CONSTRUCTION ASSESSMENT

a) The section of the Energy Statement shall identify sustainable measures that can be incorporated into the design of the listed building to the front of the site to provide a reduction in energy use and carbon emissions

b) The building fabric, the building services and the management of the building broadly determines its energy usage. The detailed design of a building is an iterative process, often requiring the involvement of different professional disciplines to establish the fundamental objectives of the design. An overall design philosophy in this respect should be established at an early stage.

c) As a result of central Government objectives, followed through at local level the general design philosophy for this site has a strong emphasis on sustainable design. This is not only in terms of the location and suitability of the site but also in relation to the way in which the building is constructed and will be used by its future occupants.

d) The first step in developing an integrated design is to establish the function of the buildings envelope and how it interacts with the usage patterns of the building and the technology used to condition the individual spaces.

e) Good fabric design can minimize the need for services. Where appropriate, designs should avoid simply excluding the environment, but should respond to factors like weather and occupancy and make good use of natural light, ventilation, solar gains and shading, where they are beneficial. In this case, the external envelope shall be retained, but enhanced.

f) This section of the report will look at the ways in which energy is used within the proposed conversion of the listed building and how the design can encourage efficient levels of energy consumption.

3.1 Management

a) Although improvements can be made to the fabric and services of a building, often the biggest impact on the day-to-day energy consumption is influenced by the way in which the building is managed. It is common to find well-designed buildings operating badly due to poor management. Conversely, poorly designed buildings can be optimized to their maximum efficiency through good management practices.

b) It is recommended that due consideration is given to the management strategy of the buildings. It is understood that all of the dwellings will be within private ownership. However, there is still an opportunity to provide for the most efficient management system and to encourage the future occupants to manage their homes efficiently.

c) This may include the use of movement sensor switched lighting systems, the installation of energy efficient electrical appliances, efficient lighting and fittings that do not permit the use of non-efficient lamps, tightly controlled heating and ventilation specific to the location within the dwelling, installation of efficient hot water systems and the provision of recycling facilities.

d) The EU energy efficiency labelling scheme rates products from A (the most efficient) to G (the least efficient). For refrigeration, the scale now extends to A++. The white goods supplied to the dwellings shall meet the requirements set out under Ene 5 of the Code for Sustainable Homes, that is the fridge/freezers shall be A+ rated, any washing machines or dishwashers shall be A rated. The occupants of the dwellings shall be provided with information on the EU Energy Efficiency Labelling Scheme so that they are informed of the benefits of the scheme.

3.2 Ventilation

a) Natural ventilation is the most energy efficient form of ventilating any space. The proposed use and traditional architectural design of these buildings enable them to make best use of natural ventilation via openable windows.

b) Horizontal pivoted windows produce the most effective ventilation because of their inherent characteristic to develop large openings, where air will tend to enter at the lower level and exit via the top. They are easily adjustable to provide control and reduce the amount of energy required to run and maintain artificial ventilation systems.

c) Given the historical records for the British Isles, the weather permits a possible energy saving with the use of windows to provide cooling and ventilation. When the outside temperature ranges between 14 °C through to 24 °C, people are able to moderate the heat build up in the space with the use of an openable window systems.

d) In addition to allowing direct and flexible control of heat through the use of openable windows they, also provide for the natural provision of fresh air to the occupants eliminating the need for artificially produced fresh air supply.

e) As this development reuses an existing building, it may not be possible to provide natural ventilation to all of the dwellings. In these dwellings, mechanical ventilation with heat recovery shall be provided.

f) Mechanical ventilation with heat recovery conserves energy in buildings by recovering heat from extracted air and transferring it to the incoming air. This works both ways so if the outside temperature is higher than inside the exchanger helps to maintain a comfortable internal environment. The mechanical ventilation with heat recovery system ensures high air quality whilst maintaining a balance between extraction and supply.

g) Any new external grilles or louvers shall be carefully specified and installed to avoid impacting on the listed elements of the building.

3.3 **Heating System**

a) The proposed method of heating to be provided to these dwellings is yet to be confirmed. However, the final choice should be proven as efficient and appropriately designed to provide suitable conditions for the occupants and to offset the heat losses through the fabric of the buildings.

b) Due to the high level of insulation standards required under the current building regulations and the associated heat gains of the building, the level of artificially produced heat required to the internal spaces is envisaged to be low.

c) The use of thermostatic controls together with time switches and override facilities shall ensure that heating is optimally controlled to use the least amount of energy.

d) Weather compensation can be incorporated into the controls of the heating system. This will automatically adjust the flow temperature of the heating as the outside temperature rises, thus reducing the energy used by the heating system and the carbon emissions of the dwellings.

e) Efficient heating shall be installed and controlled in zones to ensure that the heat is delivered where and when it is required. Any radiators that are installed shall be fitted with thermostatic radiators valves.

3.4 Lighting (Natural / Artificial)

a) The proposed design makes best use of natural daylight to reduce the amount of electrical energy used to provide the minimum luminance for the required conditions. All rooms within the dwellings apart from bathrooms and water closets should be provided with natural light via windows. The number of windows proposed and the use of dimming controls on the lighting scheme where appropriate may assist in achieving the maximum reduction of electrical consumption.

b) When selecting luminaries, consideration should be given to their inherent local power consumption and luminance levels. This together with the use of energy saving lamps will reduce the consumption of energy through lighting to a minimum. It is suggested that a development of this kind could reduce the energy usage further by installing luminaries that only allow the use of energy saving lamps.

c) Any lighting in the communal areas shall be fitted with automatic control systems, like passive infrared sensors, timeswitches or “dawn to dusk” day light sensors. These luminaires shall fitted with low energy lamps.

3.5 Hot Water Systems

a) The hot water system should be designed to appropriate standards required by the current building regulations. This will ensure the minimum amount of heat loss from hot water pipe work by applying a high standard of thermal insulation and ensuring the correct circulation throughout the system.

b) Any hot water storage vessels shall be insulated to a high standard to minimise any heat loss.

c) Waste Water Heat Recovery Systems can be attached to the showers and are a proven and cost effective way to achieve energy savings and carbon emission reductions. They are either fitted around the wast pipe from a shower or bath, or in the shower tray itself, and recover heat from the drain water as it leaves the shower or bath. This recovered heat is used to preheat the cold water feed to the boiler or hot water storage tank and therefore reduces the amount of energy used by the boiler.

d) It is possible, with the ever-increasing demand on the limited supply of the natural resource of water, to suitably restrict the flow of water outlets. Flow restrictors can be installed on outlets where a reduced flow is acceptable, for example on showers and basins. This system allows for a uniform maximum flow to be provided regardless of natural water pressures throughout the building.

e) The Code for Sustainable Homes Water Calculator shall be used to calculate the indoor water use with the aim of specifying the fittings and appliances that could achieve the water consumptions requirements of Code Level 3.

3.6 Cold Water Systems

a) Cold water consumption can be kept to a minimum by the installation of a numbers of facilities.

b) Modern water efficient dual flush WC cisterns should be fitted as standard and as with the hot water system flow restrictors can be fitted to provide a uniform maximum flow rate throughout the building.

c) The Code for Sustainable Homes Water Calculator shall be used to calculate the indoor water use with the aim of specifying the fittings and appliances that could achieve the water consumptions requirements of Code Level 3.

d) Simple water butts can be provided in appropriate locations, allowing for the collection of rain water for the direct use on external landscaped areas. Water butts are the cheapest and easiest way of reducing the use of drinking water for this purpose. There are many products on the market ranging in price and size and some local authorities offer their own option at a subsidised price to the consumer.

e) It is not possible to estimate the total water saving from the installation and use of such a device as this is very much dependant on the landscaping design of each dwelling, the annual rain fall and the required usage of this water within the domestic setting. However, an average storage device can produce up to 5000 litres of usable rainwater per year.

3.7 Sustainable methods of construction

a) Sustainable methods of construction can range from the simplest of solutions, such as construction in locations with access to sustainable modes of transport to the more complex solutions including passive solar design and rainwater harvesting.

b) The following paragraphs will briefly discuss some of the additional options available for incorporation into the scheme at this early stage or later during the detailed design process.

3.8 Building Envelope

c) As the facades of the building are being retained, these will be enhanced as much as possible to try to meet the requirements of the current Building Regulations. This can be done by incorporating insulation in the internal faces of the walls if possible.

d) An insulation that is used in this development shall have global warming potential of less than 5. This shall include not only the thermal insulation, but any acoustic insulation.

3.9 Rainwater Harvesting

a) The harvesting and recycling of rainwater can considerably reduce mains water consumption for toilets and other uses that do not need a sanitized water supply. However, the plant space requirement for treatment and storage is often difficult to incorporate into such a scheme. It also requires additional public health and water system risers to be installed to serve the facilities able to utilise such a water supply.

b) If this system were to be considered then early design allowances would be required. However, it is considered unlikely that this system could be easily incorporated into this refurbishment project.

c) An alternative option would be to install a water butt system as discussed above, that allows the collection of rainwater from the roof to be used in the amenity space provided.

3.10 Sustainable Material Choices

a) A high percentage of Carbon Dioxide emissions are generated by unsustainable modes of transport. This is not only made up of the use of the private car but is substantially increased by the use of road as the popular way of transporting materials and goods needed for construction purposes.

b) Many opportunities are now available to Architects wishing to make more sustainable choices when specifying building materials. The consideration can include where the materials come from, its' travel distance, mode of transport, and the nature in which the material resource is manufactured and managed.

3.11 Sustainable Location

a) The proposed development is within the former village of Hampton Wick, which is a Thames-side area of the London Borough of Richmond upon Thames, with good access to major road and rail networks.

b) Hampton Wick train station is 0,2 miles to the north of the site and is serviced by South West trains, with Waterloo Station only 30 minutes away. The site is on the A310, which provides good access to the M3 and M4 motorways.

c) There are numerous local amenities within 500m of the development, via safe pedestrian routes. These include food shops, postal facilities, banks, pharmacy, leisure centre, places of worship, public houses and outdoor open access public areas.

d) The development shall incorporate save, secure and weatherproof cycle storage facilities. This shall have direct access to the public highway.

3.12 **Recycling Facilities**

a) In order to encourage the homeowners to recycle household waste, the dwellings can be provided with recycling bins.

b) The recycling bins could be in the form of three internal in a dedicated non obstructive location in the kitchen. The bins shall be in a variety of sizes and a total capacity of 30 litres and no individual bins shall have a capacity of less than 7 litres.

c) External bins shall be provided for the Local Authority collection scheme. This area is suitably sized and located to comply with the Local Authority's refuse guidelines for collection.

4.0 RENEWABLE ENERGY AND LOW CARBON ENERGY SYSTEMS

4.1 Introduction

a) This section of the Energy Statement shall make an appraisal of the carbon dioxide emissions of the proposed three new dwellings, the various methods of generating and using renewable energy at source, and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to renewable energy provision

b) The London Renewables Toolkit (LRT) is the system developed by the Greater London Authority in 2004 to assist Planners, Developers and Consultants with the assessment of the appropriateness of renewable energy resources and technologies. It offers advice on which renewable technologies are suitable including aesthetic issues, risks, reliability and gives an insight into the cost benefit analysis of installing renewable.

c) It also provides guidance on how to comply with the requirements of the London Plan and relevant borough development documents. Typical detailed calculations are provided to help determine the most appropriate renewable technology for each scheme.

d) Within Section 4 of the LRT – 'Including Renewables in the Development Proposals', a route map is provided to help consider the feasibility of renewable technologies and how to include them in the development proposals.

e) The dwellings emissions have been estimated using the Standard Assessment Procedure 2009. A second set of SAP calculations have been undertaken to demonstrate an improvement in the carbon dioxide emissions by incorporating better fabric constructions, better windows and doors, improved ventilation systems and enhanced air tightness.

4.2 Baseline Carbon Dioxide Emissions

a) In order to assess the carbon dioxide emissions of the development, the delivered energy demand needs to be estimated. At this stage in the design of the dwellings, the detailed construction drawings have not been prepared and therefore detailed carbon emission calculations cannot be undertaken to produce the carbon dioxide emissions.

b) However, the dwellings carbon dioxide emission estimates can be based on initial stage SAP calculations. In this case, a SAP calculation has been prepared for one of the proposed dwellings and the results prorated to reflect the entire development.

c) As there is no mains gas to the development site, the SAP Assessments will use electric heating.

d) Table 1 below shows that the results for the standard dwellings of the same size and bulk, constructed to comply with the current Building Regulations.

Typical Dwelling Floor Area	145	m^2
Target Emissions Rate	21.55	$kgCO_2/m^2/yr$
SAP CO_2 Emissions		
Space Heating	2,173	$kgCO_2/yr$
Hot Water	535	$kgCO_2/yr$
Pumps, fans	322	$kgCO_2/yr$
Lighting	2,134	$kgCO_2/yr$
Total Floor Area of Dwellings	416	m^2
Total Estimated Development CO_2 emissions	**14,815**	**$kgCO_2/yr$**

Table 1 – Baseline Carbon Dioxide Emissions

4.3 Improved Baseline Carbon Dioxide Emissions – BE LEAN

a) Following the principles set out in the Mayor's "Energy Hierarchy" which is implemented in the London Plan and the Local Policy, the design has been improved to use less energy - BE LEAN.

b) This has been achieved by improving the thermal performance of the various constructions, like the walls, roof, floors, windows, doors etc and incorporating mechanical ventilation heat recovery and improving the air tightness of the dwelling.

c) The wall U Values can be improved by improving the thermal performance of the insulation, either by increased thickness or lower thermal conductivity.

d) The thermal performance of the windows can be improved by adding coatings to the panes or adding an inert gas to the cavities.

e) A composite front door can be used instead of a timber door. Modern composite doors have good thermal, fire, acoustic and security properties.

f) The air leakage rate for the dwellings can be improved. The maximum allowed under the current Building Regulations Approved Document L1A:2010 is 10 $m^3/hr/m^2$ at 50 Pascal's. With carful detailing, this can be easily improved to 5 $m^3/hr/m^2$ at 50 Pascal's.

g) The use of Accredited Construction details in the development means that the thermal bridging coefficient can be greatly improved, thus lowering the γ can be lowered.

h) More efficient controls can be installed to control the heating, which can include weather compensation on the boiler control and the use of programmers, thermostats and thermostatic radiator valves all improve the efficiency of the heating system.

i) Instead of simply installing 75% of the light fittings as low energy efficient light fittings, as required by the current Building Regulations, 100% of the light fitting could be low energy fittings.

j) By incorporating items like those stated above, the SAP calculations have been updated to demonstrate the effect of these improvements and the results are listed in Table 2.

Typical Flat Floor Area	145	m^2
Target Emissions Rate	21.55	$kgCO_2/m^2/yr$
SAP CO_2 Emissions		
Space Heating	1,330	$kgCO_2/yr$
Hot Water	521	$kgCO_2/yr$
Pumps, fans	322	$kgCO_2/yr$
Lighting	2,078	$kgCO_2/yr$
Total Floor Area of Dwellings	416	m^2
Total Estimated Residential CO_2 emissions	**12,196**	**$kgCO_2/yr$**
Percentage Improvement over current Building Regulations	**17.7 %**	

Table 2 – Improved Baseline Carbon Dioxide Emissions

k) As demonstrated above, it can be seen that the improvements in the thermal performance and fixed building services, a reduction of 17.7% can be achieved.

4.4 Supplying Energy Efficiently – BE CLEAN

a) Following the principles set out in the Mayor's "Energy Hierarchy" which is implemented in the London Plan and the Local Policy, the second step is to reduction the carbon dioxide emissions by supplying energy efficiently - BE CLEAN.

b) Combined Heat and Power typically generates electricity on site as a by-product of generating heat. It uses fuel efficient energy technology that, unlike traditional forms of power generation, uses the by-product of the heat generation required for the development. Normally during power generation, the heat is discharged or wasted to atmosphere. A typical CHP plant can increase the overall efficiency of the fuel use to more than 75%, compared to the traditional power supplies of 40%, which uses inefficient power stations and takes into account transmission and distribution losses.

c) The use of this development is residential and it will be built to the current building regulations. The aim of these regulations is minimise the base heating load and electrical loads. The site base heating and electrical loads is key to the sizing and operation of any CHP system.

d) Due to the high levels of insulation and energy efficiency measures that will be incorporated into this development, there is no year round heat load for the CHP plant and therefore, a CHP system would not be viable on this development. If a CHP system were to be incorporated, it would not operate efficiently and therefore NOT BE CLEAN.

4.5 Renewable Technologies Considered – BE GREEN

a) Taking into account the requirements of planning policy set out by the London Borough of Richmond upon Thames, the annual carbon dioxide emission reduction target of 20% for the development from renewable energy production on site has been calculated as 8,259 kgCO_2/year.

b) The final step in the Mayor's "Energy Hierarchy" is to reduction the carbon dioxide emissions by the use of renewable technologies - BE GREEN.

c) In accordance with the toolkit the following renewable energy resources have been assessed for availability and appropriateness in relation to the site location, building occupancy and design.

- Combined Heat and Power
- Biomass Heating
- Biomass CHP
- Heat Pumps
- Solar Photovoltaics
- Domestic Solar Hot Water Systems
- Wind Power

d) A preliminary assessment has been carried out for each renewable energy technology and for those appearing viable a further detailed appraisal has been undertaken.

e) The preliminary study considered the site location and the type of building in the development and surroundings and produced a shortlist of renewable energy technologies that will be the subject of a further feasibility study.

f) Table 3 below provides a summary of the assessment.

4.6 Renewables Toolkit Assessment

Energy System	Description	Comment
Combined Heat and Power (CHP)	Combined Heat and Power systems use the waste heat from an engine to provide heating and hot water, while the engine drives an electricity generator. These systems uses gas or oil as the main fuel and therefore can not truly be considered as renewable technology however, it is recognised that they have a significant reduced impact on the environment compared to conventional fossil fueled systems.	As CHP systems produce roughly twice as much heat as they generate electricity, they are usually sized according to the base load heat demand of a building, to minimise heat that is wasted during part-load operations. Therefore, to be viable economically they require a large and constant demand for heat, which make their use in new energy efficient housing, with high insulation, not really suitable. The efficiency of small scale CHP is relatively low and is unlikely to result in CO_2 emission savings. Economic viability relies on 4000 hours running time, which is unlikely to be achieved in this scheme. As policy requires a reduction in carbon dioxide emissions via true renewable sources this would not assist in achieving the policy objectives.
Combined Heat and Power		**Feasible – NO**
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating. Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and is used commercially in the form of wood chips or pellets, although traditional logs are also used. Other forms of Biomass can be used, e.g. bio-diesel.	Wood pellet or wood chip fired or dual bio-diesel/gas-fired boilers could be considered. As this development consists of a new building, it offers the opportunity to accommodate such a system. The flues would have to be discharged to atmosphere above roof level and concerns raised by Environmental Health regarding the pollutants and particles, which would have to be addressed. Care need to be taken with the design of the flue to ensure particle discharge is not a concern to residents. The fuel storage silo/tank would have to be located external to the building, taking up private space for the dwellings. A suitable local fuel supplier is required to supply the site.
Biomass Heating		**Feasible – NO**

Energy System	Description	Comment
Biomass CHP	CHP as above, but with biomass as the fuel.	Biomass CHP overcomes the issue of the reduction in carbon dioxide emissions via true renewable sources, however, the lack of a year round base load is still a problem and therefore Biomass CHP is not feasible for this development.
Biomass CHP		**Feasible - NO**
Ground/Air Source Heat Pumps (GSHP / ASHP) - heating	The ground collector can be installed, either as a loop of pipe, in the piles or using a borehole and a compressor offer efficient heating of a space in winter, as the temperature of the ground (below approx 2m) remains almost constant all year. For air source, the external condensing unit can be located adjacent to the dwelling in a discreet location	Ground and air source heat pumps are most efficient when supplying heat continuously and in areas where a mains gas supply is not available. In dwellings, GSHP and ASHP are capable of supplying the majority of the total space heating and pre heat for the hot water demand. This site does not have external areas of sufficient size for the installation of ground loops for the collection of heat. It is preferred in this case to use an ASHP due to the size of the ground loops that would be required to offset the heat losses of these dwellings.
Ground/Air Source Heat Pumps		**Feasible – YES**
Solar Photovoltaics (PV)	Building Integrated Photovoltaics (BIPV) or Roof mounted collectors provide noiseless, low maintenance, carbon free electricity.	There appears to be a reasonable amount of flat roof area that can be utilitised to install PV panels onto the scheme. These could be integrated into the roof finishes or mounted on frames on the roof and orientated south for optimal performance. Careful consideration must be given to the chosen roof finish to ensure compatibility.
Solar PhotoVoltaics		**Feasible – YES**
Solar Thermal Hot Water	Solar collectors for low temperature hot water systems require direct isolation, so the chosen location, orientation and tilt are critical.	This solution could be utilised to generate hot water using the energy from the sun. The area of flat roof could be used for the installation of solar thermal collectors. These could be mounted on frames and orientated south for optimal performance. These would have to be installed at a pitch of 30-40 degrees and ideally as close to the dwelling served as possible.
Solar Thermal Hot Water		**Feasible –YES**

Energy System	Description	Comment
Wind Power	Most small (1-25kW) wind turbines can be mounted on buildings, but larger machines require foundations at ground level and suitable site location	It could be viable to install some form of wind turbines on this site, however due to surrounding trees and the visual impact it is not considered to be the most sensitive system of providing energy via renewable resources in this built up location. There are also concerns that the wind across the site would be turbulent because of the surrounding trees.
Wind Power		**Feasible – NO**

Table 3 – Renewable Technology Feasibility Assessment

a) From the above it has been established that there are three potential ways of providing energy via renewable sources appropriate for inclusion in this scheme, these being the use of heat pump systems, solar photovoltaics and domestic solar hot water or a combination thereof.

b) CHP and Micro CHP are considered not feasible as the economic viability relies on at least 4,000 hours runtime which is unlikely to be achieved in this development.

c) Biomass systems have been considered unfeasible for this site due to particle discharge in a built up area, fuel handling and storage on a site with limited open space, required plant areas and the on going maintenance of the system.

d) Wind has been considered not viable for this site as there are a lot of the trees in the surrounding area which are likely to cause disruption to air flows.

4.7 Heat Pumps

a) Heat pumps are used to extract the heat from the ground, air or water and transfer it to a heating distribution system, such as under floor heating or radiators using an electric pump. They are usually efficient enough to provide for all space heating requirements and a pre-heat for the domestic hot water systems in dwellings.

b) The system would comprise of a heat exchanger either buried in the ground, or mounted on the exterior of the building, or located within a water course, and a heat pump. These would be connected to a traditional heating distribution system, like radiators, underfloor heating etc.

c) The system uses the latent solar energy stored in the ground or water, or the latent temperature of the air around or within the building. The heat pump upgrades the heat energy to provide the heating for the dwellings. The heat pump operates on the same principles as a refrigeration cycle, like a domestic fridge, except the heat is retained and the cold rejected.

d) Ground source heat pumps are generally the most efficient however can be expensive to install as the heat exchanger needs to be buried under the ground. Their efficiency and practicality can also be affected by the ground conditions of the site. Water source heat pumps are only suitable where there is a water source available and when appropriate consents have been obtained to utilize this source. Air source heat pumps are generally more flexible as the heat pump and exchanger unit is usually mounted external to the building or in a storage space.

e) With regard to emissions, noise and vibration, heat pump installations are pollution free and noise levels are generally low. There are no local emissions and, although there will be carbon dioxide emissions associated with their electricity use, these are much less than other forms of electric heating and can be lower than those associated with conventional gas or oil fired boilers.

f) Heat pump installations are unobtrusive. The technology used in ground-source heating systems has very low visual impact and most of the infrastructure can be hidden beneath the ground and therefore has additional land use. In this case, there is not enough garden areas surrounding the dwellings, therefore horizontal loops cannot be installed. It may be possible to install vertical loops, but further investigation would be required.

g) Many of the safety considerations appropriate to any refrigeration or air conditioning systems apply to the use of heat pumps since the working fluid is often a controlled substance that needs to be handled by trained personnel. However, once the system is commissioned, accidental release of refrigerant is unlikely.

h) In general terms heat pumps of all kinds are expected to operate an average output efficiency of 3:1, this means that for every 1 unit of energy used to run the system it will produce 3 units of energy as a result.

i) The proposed development does not have sufficient area around the site to incorporate horizontal ground loops, nor would it appear that the required number of piles are available to collect the heat for the dwellings. Therefore, it is suggested that systems incorporating the use of an air source heat pump system will be used in this assessment.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions ($kgCO_2/yr$)	Percentage Reduction (%)
No Renewables	12,196	-
Reduction by including ASHP	Increase 2,137	+17.5%

Table 4 – ASHP Carbon Dioxide Emissions

j) As demonstrated in Table 4 above, although the use of heat pumps could reduce the energy consumption by nearly 38%, the potential carbon dioxide emissions are increased by over 17% and therefore, the use of ASHPs do not meet the requirements of planning policy.

4.8 Solar Photovoltaics

a) Photovoltaics (PV) is a technology that allows the production of electricity directly from sunlight. The term originates from “Photo” referring to light and “voltaic” referring to voltage. This type of technology has been developed for incorporation within building design to produce electricity for either direct consumption or re-sale to the National Grid.

b) PV panels come in modular panels which can be fitted on the top of roofs or incorporated in the finishes like slates or shingles to form integral part of the roof covering. PV cells can be incorporated into glass for atria walls and roofs or used in the cladding or rain screen on a building wall.

c) When planning to install PV panels, it is important to consider the inherent cost of installation in comparison to possible alternatives. The aesthetic impact of the PV panels also requires careful consideration.

d) Roof mounted PV panels should ideally face south-east to south-west at an elevation of about 30-40°. However, in the UK even if installed flat on a roof, they receive 90% of the energy of an optimum system.

e) PV installations are expressed in terms of the electrical output of the system, i.e. kilowatt peak (kWp). The Department of Trade and Industry estimate that an installation of 1kWp, could produce approximately 700-850 kWh/yr, which would require an area of between 8-20m^2, depending on the efficiencies and type of PV panel used. It is also estimated that a gas heated, well insulated typical dwelling would use approximately 1,500kWh/year electricity for the lights and appliances, therefore the 1kWp system could save approximately 45% of a single dwellings electrical energy requirements.

f) Although often not unattractive, and possible to integrate into the building or roof cladding system PV systems are still considered likely to have visual implications, therefore careful sighting of the panels is required.

g) As this installation will be contained on the roof of the proposed dwellings, it involves no additional land use.

h) With regard to noise and vibration, a PV system is completely silent in operation.

i) Care must be taken with the design and installation of PV systems as they need to meet standards for electrical safety.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions ($kgCO_2$/yr)	Percentage Reduction (%)
No Renewables	12,196	-
Reduction by including 3-No. 2.5kWp PV systems	3,576	29.3%

Table 5 – Photovoltaic Carbon Dioxide Emissions

j) As can be seen from Table 5 above, the incorporation of 3-N o. 2.5 kWp photovoltaic systems on the roofs of the dwellings could reduce the carbon dioxide emissions by over 29% which would exceed policy requirements. When combined with the fabric energy efficiency measures from in Table 2 above, a total reduction of 41.8% is achieved

k) From the above calculations, based on 250 watt panels, orientated towards the south and mounted on the roof finishes at a 10 degree pitch, it is calculated that 10-No. panels are required on each of the proposed new dwellings roofs. An area of approximately 16m^2 has been identified to accommodate the pv panels on each of the flat roofs. Further detailed calculations for the carbon dioxide emissions and system size shall be carried out during detailed design.

4.9 Domestic Solar Hot Water System

a) This system uses the energy from the sun to heat water, most commonly to provide the hot water demands of the development. The system uses heat collectors, generally mounted on the roof, in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate cylinder or a twin coil hot water cylinder inside the dwelling. The system works very successfully in the UK, as it can operate in diffused light conditions.

b) As with PV panels, the collectors should be mounted facing in a southerly direction, from south-east through to south-west and at an elevation of 10 to 60°. The panels can be installed on the roof, either on the slope of the roof, on a frame, or they can be integrated into the roof finishes.

c) This system would be best suited on sites where the solar thermal collectors can be located close to the hot water storage vessel within the dwelling and therefore any losses can be minimised.

d) Approximately 2-4m^2 of solar thermal collectors could provide the hot water requirements of a typical dwelling. These could be used to feed twin coil hot water cylinders positioned within the dwellings, allowing the water to be heated by the sun when possible whilst retaining the back up of the main heating system when required.

e) This system would be relatively easy to install. However, the visual impact needs to be given consideration.

f) Although often not unattractive, and possible to integrate into the building or roof cladding system domestic solar thermal collectors are still considered likely to have visual implications, therefore careful sighting of the panels is required.

g) As this installation will be contained on the roof of the proposed dwellings, it involves no additional land use.

h) With regard to noise and vibration, a domestic solar hot water system is completely silent in operation.

i) Incorporating a 3m^2 evacuated tube systems for each dwelling, mounted on the roof at a 10 degree pitch and orientated south, with a twin coil cylinder in the dwelling, into the SAP calculations, the reduction in carbon dioxide emissions can be estimated.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions (kgCO_2/yr)	Percentage Reduction (%)
No Renewables	12,196	-
Reduction by including 7-No. 2m^2 of DSHW	792	9.7%

Table 6 – Domestic Solar Hot Water Carbon Dioxide Emissions

j) As can be seen from Table 6 above, the installation of domestic solar hot water systems incorporating 3m^2 of evacuated tube solar collectors for each of the dwellings would reduce the carbon dioxide emissions by 9.7% and when combined with the fabric energy efficiency measures from in Table 2 above, a total reduction of 23.0% is achieved, which does not meet the requirements of planning policy.

4.10 Annual Carbon Dioxide Emission Reduction

a) From the above, it can be seen that a Photovoltaic system could be used to achieve the 40% reduction in carbon dioxide emissions as required by Planning Policy.

b) Based on the initial SAP calculations for the dwellings, it has been calculated that the baseline carbon dioxide emissions figure for the development is 14,815kgCO_2/year.

c) In accordance with the London Borough of Richmond upon Thames Core Strategy and the London Plan, this report has demonstrated a 17.7% improvement in carbon dioxide emissions by fabric and energy efficiencies. In addition, a further reduction of 29.32% in carbon dioxide emissions is possible by the use of renewable technologies, resulting in a total reduction of 41.8%.

d) A number of options have been considered and the potential carbon dioxide reductions calculated using the SAP calculations and a summary of the results is provided in Table 7 below.

	Total Carbon Dioxide Emissions (kgCO_2/yr)	Reduction in Carbon Dioxide Emissions (%)
Building Regulations Compliant Development	14,815	-
Development incorporating Energy Efficiency Measures	12,196	17.7%
Further Reduction in Carbon Dioxide Emissions by incorporating a Renewable Technology		
Air Source Heat Pump	2,137 increase	+17.5%
PV (3-No. 2.5 kWp)	3,576	29.3%
DSHW (3-No. 3m^2)	792	6.5%
Percentage Improvement incorporating the ASHP system		**41.8 %**

Table 7 – Summary of Reduction in Carbon Dioxide Emissions

e) It has been demonstrated that it is possible to achieve a 41.8% reduction in carbon dioxide emissions over and above the 2010 Building Regulations by improving the energy efficiency of the dwellings and their building services efficiencies and by the incorporation of renewable technologies.

f) CHP and Biomass CHP have been analysed but are considered not feasible for this development as the heating and electrical load profiles would not provide a good clean efficient system for the dwellings.

g) Biomass heating has been analysed but is considered not feasible for this development due to particle discharge in the built up area, space requirements and the cost and the reliability of a biomass fuel source.

h) Wind power is considered not feasible for this development due to the turbulence caused by the surrounding buildings and trees etc.

i) With regard to the installation of domestic solar hot water (DSHW), the calculations show that if $3m^2$ of southerly facing solar collectors were installed for each of the dwellings; they would provide the required reduction.

j) The initial SAP assessments calculations show that in order to achieve in excess of the 20% reduction via PV panels, a 3-no. 2.5 kWp systems with a southerly aspect would be required. Detailed calculations of the total carbon dioxide emissions compared to the estimated carbon dioxide reduction for the proposed development can be undertaken once the detailed design has progressed to construction drawing stage.

k) For the purpose of planning and based on the figures provided by initial SAP calculations, this report has demonstrated that it is feasible, with the improvement of the building fabric, the introduction of energy efficient controls and systems and the incorporation of photovoltaic systems, a reduction in excess of 40% of the developments carbon dioxide emissions could be achieved. This complies with the requirements of the London Borough of Richmond upon Thames Core Strategy and the London Plan.

5.0 CONCLUSION

a) In the London Borough of Richmond upon Thames Core Strategy and the London Plan, there is a requirement for all new residential developments to achieve a reduction in carbon dioxide emissions of 40% over the 2010 Building Regulations. Furthermore, the development shall be designed and constructed to achieve Code Level 3 as set out in the Code for Sustainable Homes.

b) This development is for the conversion of a listed building to form three dwelling and the addition of three dwellings to the rear on the site at 6-8 & 10 High Street, Hampton Wick, Kingston upon Thames, KT1 4DB.

c) It is proposed that in order to meet the requirements of policy this development will adopt a high standard of design with regard to energy efficiency principles and will achieve a reduction of at least 40% in the carbon dioxide emissions.

d) At planning stage it is not possible to produce detailed reports on the energy demand, carbon dioxide emissions or financial appraisals of the appropriate systems. However, this report has demonstrated using figures from the initial SAP calculations, that it is possible reduce carbon dioxide emissions by more than 40% for this development.

e) It is suggested that in order to ensure the best possible reduction in carbon dioxide emissions after consent is granted, that a planning condition is added requiring detailed carbon dioxide emission calculations and proposals to be prepared and submitted prior to commencement on site.