ENERGY & SUSTAINABILITY STATEMENT

(To Accompany Planning Application)

Site
TREETOPS, UPLAND ROAD,
SUTTON, SM2 5EL

Proposal
ERECTION OF ONE DWELLING
TO REPLACE EXISTING DWELLING

Client
OEMO LTD

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Ref. E1102-ESS-00

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1.0 INTRODUCTION

a) Doherty Energy Limited have been instructed by OeMO limited to prepare an Energy and Sustainability Statement to support the submission of the planning application for the development at Treetops, Sutton, SM2 5EL. 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 redevelopment of the site to a new three bedroom detached dwelling.

c) The objectives of this Energy and Sustainability Statement are to outline the possible measures that can be incorporated into the development during detailed design, to make an appraisal of the carbon dioxide emissions of the proposed development, assess the potential fabric and building services efficiencies to reduce the carbon dioxide emission and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to reducing carbon dioxide emissions and energy consumption. It also investigates the water usage of the development with a view to reducing the water consumption of the dwelling.

d) The Assessment shall be carried out following the principles set out in the "Energy Hierarchy". These principles can be summarised as follows:

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

e) At this stage in the design of the development, the detailed Building Regulations construction information has not been prepared and therefore following detailed construction design, the energy calculations will be revisited to ensure the energy requirements and carbon dioxide emissions are up to date.

f) In order to demonstrate the carbon dioxide emissions, it is proposed to use the Standard Assessment Procedure (SAP) for the calculations to obtain initial baseline carbon dioxide emissions figures for the dwelling.

g) Further 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.

2.0 POLICY CONTEXT

a) Within the Sutton Local Plan 2016-2031, the Council identifies the need for action on climate change. Sutton is committed to becoming a One Planet Borough by 2025 and has set some of the most challenging sustainability targets in the UK.

b) This would follow the principles set out in the London Plan which requires all new buildings to minimise emissions in line with the Mayor's energy hierarchy - Be lean - Be clean - Be green and sets a target for all major housing schemes to be 'zero carbon' from 1 October 2016.

c) The Local Plan Policy 31: Carbon and Energy requires proposed developments to meet the following targets for reducing carbon dioxide emissions expressed as a percentage improvement over Approved Document L of the 2013 Building Regulations:

- all residential buildings forming part of major developments should achieve 'zero carbon' standards, by:

  (i) achieving at least a 35% reduction in regulated carbon dioxide emissions on site.

  (ii) offsetting the remaining regulated emissions (to 100%) through the delivery of carbon dioxide reduction measures elsewhere through a Section 106 contribution to the council's carbon offset fund priced at £60 per tonne over 30 years.

- all major non-residential developments should achieve at least a 35% reduction in regulated carbon dioxide emissions on site.

- all minor residential developments should achieve at least a 35% reduction in regulated carbon dioxide emissions on site.

d) In seeking to minimise carbon dioxide emissions in line with the above targets, all proposed developments will apply the Mayor's energy hierarchy by:

- achieving the highest standards of energy efficient design and layout.

- supplying energy efficiently in line with the following order of priority:

  (i) being designed to connect to existing or planned district heating and/or cooling networks supplied by low or zero-carbon energy, unless it can be demonstrated through whole life cycle evidence that connection is not reasonably possible. All major developments located within identified Decentralised Energy Opportunity Areas (Maps 10.1 and 10.2) should apply the council's 'Decentralised Energy Protocol' (Schedule 10.A).

  (ii) site wide heating and/or cooling network supplied by low or zero-carbon energy.

  (iii) communal heating and cooling.

- using renewable energy generated on-site. Major developments will be expected to achieve at least a 20% reduction in total carbon dioxide emissions (regulated and unregulated) through renewables with minor developments achieving a reduction of at least 10%.

e) The Local Authority requires all planning applications for new dwellings or major non-residential developments should be supported by an Energy Statement incorporating 'as-designed' Building Regulations Approved Document L outputs to demonstrate how the relevant targets for reducing carbon dioxide emissions will be met. The Energy Statement should include calculations of energy demand and emissions at each stage of the Mayor's energy hierarchy for both regulated and non-regulated elements in line with GLA 'Guidance on Preparing Energy Assessments' as amended.

f) London and the South East is classified as 'seriously' water stressed, meaning that more water is taken from the environment than the environment can sustain in the long term. London is relatively resilient to drought and it takes two consecutive drier than normal winters to create water supply issues.

g) In 2006 and 2012, London experienced significant droughts, and in 2012 only avoided serious water restrictions by the wettest summer in a century.

h) It is estimated that 85% of Sutton's water supply comes from groundwater abstraction via boreholes, with the remaining 15% coming from Bough Beech reservoir.

a) Proposed developments should minimise vulnerability of people and property and be fully adapted and resilient to the future impacts of climate change. Conserving water resources by maximising the flood storage role of rivers, aquifers, ponds, natural floodplains and other surface water features; promoting the benefits of SuDS for groundwater recharge; and achieving high standards of water efficiency.

b) The Sutton Local Plan Policy 33: Climate Change Adaptation requires all new dwellings should limit domestic water consumption to 110 litres per person per day (l/p/d) in line with the Government's higher 'optional requirements' for water efficiency set out in Part G of the Building Regulations as amended.

3.0 SUSTAINABLE DESIGN AND CONSTRUCTION ASSESSMENT

a) 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 has been established at an early stage.

b) 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.

c) 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.

d) 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.

e) This section of the report will look at the ways in which energy is used within the proposed 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 optimised to their maximum efficiency through good management practices.

b) It is recommended that due consideration is given to the management strategy of the building. It is understood that the dwelling 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 occupants of the dwelling 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 this building enables it 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. Normal casement windows can provide a degree of natural ventilation and with the layout of the dwelling; it is possible to obtain good cross ventilation.

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) At other times of the year, mechanical ventilation with heat recovery can conserve energy in dwelling by recovering heat from the warm moist extracted air and transferring it to the incoming fresh 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.

3.3 Heating System

a) The method of heating for the dwelling is not yet decided, however, it proposed method of heating for the dwelling will use of a highly efficient heat source, with weather compensation. It shall be appropriately designed to provide suitable conditions for the occupants and to offset the heat losses through the fabric of the dwelling.

b) The heating systems will be provided with time and temperature zone control to control the heating in the spaces.

c) Weather compensation will be used to help control the heating system. It uses an outdoor temperature sensor to adjust the system controls to compensate for changes in outdoor temperature automatically. As the weather gets colder the system works harder and produces more heat to the space. However, the weather warms up the system reduces the temperature of the heating system thereby reducing the energy consumption and carbon dioxide emissions.

d) If a central heating system was used, the heat would be have to be available for any occupant all the time, which would require a large buffer storage vessel and distribution around the building all the time. With the local heating systems, there are no storage or distribution losses.

e) 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.

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. It is envisaged that all the habitable rooms within the dwelling are to 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) The dwellings are orientated so that the large windows do not face south or are shaded, thus avoiding excessive solar gains during the summer.

c) 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.

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

3.5 Hot Water Systems

a) The hot water demand for the dwelling shall be generated using the efficient heating source and very well insulated hot water storage cylinders are to be provided.

b) The hot water system shall 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.

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 waste 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 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 dwelling.

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 dwelling.

c) 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.

d) 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 for the 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 Passive Solar Design

a) Passive solar gain can be experienced in both a positive and negative manner. South facing facades can often benefit from solar passive gain during the winter months but this is counteracted by the increased requirement for cooling during the summer.

b) In a scheme like that proposed, it is important to recognise where solar passive gains will be experienced and to design the scheme to enhance the effect during the winter and protect from it during the summer.

3.9 Building Envelope

a) All facades of the dwellings shall be designed to ensure that the minimum standards required by the Approved Document L of the Building Regulations are exceeded and that care shall be exercised to ensure flexibility and good shading systems are installed where necessary.

b) Any 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.

3.10 Enhanced Construction Details

a) The dwellings envelope shall be designed using the Enhanced Construction Details to limit recurring thermal bridging. This exceeds the requirement of the Building Regulations and helps lower the carbon emissions of the dwelling by reducing the heat losses by cold bridging.

3.11 Surface Water Drainage

a) Surface water drainage at the site will follow the Sustainable Drainage Systems (SuDS) management train.

b) The surface water will drain into the existing watercourse on site, with the permeable surfacing acting as an attenuation device for slowing and holding the surface water run-off.

3.12 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.

b) However, the plant space requirement for treatment and storage is often difficult to incorporate into 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. If this system were to be considered then early design allowances would be required.

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.

3.13 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 during the 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.

c) Throughout the design process consideration will be given to not only the quality of materials to be specified, but also to the quantities. Additional consideration will be given to building material selection that maximises the life expectancy of the building by selecting materials build-ups from the Green Guide to Specification published by the Building Research Establishment (BRE).

d) The proposed development will be constructed of materials with a low environmental impact, achieving a Green Guide rating of between A+ and D for all five elements of construction, as follows:

- Roof.
- External walls.
- Internal walls.
- Upper and ground floors.
- Windows.

e) Consideration will also be given to the use of materials and products manufactured in the UK and Europe. Once a contractor is appointed, the opportunities for the use of local suppliers for their supply chain will also be explored.

f) All timber, including that used in the construction processes, will be required to be legally sourced. The definition of legally sourced timber follows the UK Government's definition of legally sourced timber, according to the CPET 2nd Edition report on UK Government timber procurement policy.

3.14 Recycling Facilities

a) In order to encourage the homeowners to recycle household waste, the dwelling can be provided with recycling bins, both within the dwelling and in the external waste storage area.

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. These shall be located in a dedicated location.

4.0 ENERGY ASSESSMENT

4.1 Introduction

a) This section of the Energy and Sustainability Statement shall make an appraisal of the carbon dioxide emissions of the proposed development, assess the implications of fabric and building services enhancements, 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) In order to assess the impact of the improved building envelope and the fixed building services, the initial Standard Assessment Procedure 2012 (SAP) Assessments have been carried out on the proposed dwellings as if they were constructed simply to comply with the requirements of the current Building Regulations. Further SAP calculations have been undertaken to demonstrate an improvement in the carbon emissions by incorporating better fabric constructions, better windows and doors, improved ventilation systems and efficient building services.

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.

c) Based on the current design and using construction information, the proposed dwelling complies with the current Building Regulations.

d) The building services information is based on standard building services to meet the requirements of the building regulations.

e) Table 1 below summarises the results from the SAP Worksheets that can be found in Appendix A.

Dwelling	Floor Area (m2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling CO2 Emission Rate
1	**179.5**	**1,824.4**	**568.1**	**38.9**	**286.9**	**2,718.4**	**15.14**

Dwelling	TER ($kg/m^2/yr$)	Area (m^2)	Emissions (kg/yr)
1	**15.14**	**179.5**	**2,718.4**
Baseline Carbon Dioxide Emissions (kg/yr)			**2,718**

Table 1 – Baseline Carbon Dioxide Emissions

4.3 Improved Baseline Carbon Dioxide Emissions

a) Following the principles set out above, the design has been improved to use less energy and to lower the carbon dioxide emissions.

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 floor U Values can be improved by incorporating insulation under the screed, or by using insulation blocks instead of concrete blocks between the beams. For the purposes of these calculations, the U Values of the current floor constructions have been calculated as 0.10 W/m^{2}K.

d) The wall U Values can be improved by improving the thermal performance of the insulation, either by increased thickness or lower thermal conductivity. For the purposes of these calculations, the U Values of the current wall constructions have been calculated as 0.17 W/m^{2}K.

e) The roof areas offer excellent opportunity to enhance the insulation levels and for the purposes of these calculations, the U Value of 0.08-0.13 W/m^{2}K has been used.

f) The thermal performance of the windows can be improved by adding coatings to the panes or adding an inert gas to the cavities. For the purposes of these calculations, a U Value for the windows of 1.2 W/m^{2}K has been used, which uses double glazed planitherm glass, argon gas and warm edge spacer bars.

g) A composite front door can be used instead of a timber door. Modern composite doors have good thermal, fire, acoustic and security properties. These types of door can have U Values as low as 0.55 W/m^{2}K.

h) The air leakage rate for the dwelling can be improved. The maximum allowed under the current Building Regulations Approved Document

L1A:2013 is 10 $m^3/hr/m^2$ at 50 Pascal's. With carful detailing, this can be easily improved to 3 $m^3/hr/m^2$ at 50 Pascal's.

i) The use of Accredited Construction Details in the development means that the thermal bridging coefficient can be greatly improved thus a lower γ Value can be used.

j) With regard to the heating, a highly efficient gas fired condensing boiler shall be provided in the dwelling to provide the heating and hot water. This provides excellent control for the dwelling occupants.

k) More efficient controls can be installed to control the heating, which can include weather compensation on the heat pump control and the use of time and temperature zone control will improve the efficiency of the heating system.

l) 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.

m) The use of natural lighting has been considered and although its use is not measured in the SAP calculations, it can help lower the energy use and therefore carbon dioxide emissions. This is carefully assessed against any unwanted solar overheating. Whilst a degree of solar gain can be beneficial for the occupants and helps lower the carbon dioxide emissions, it must be controlled to minimise the risk of solar overheating. The calculations show that there is only a slight to medium risk of overheating.

n) The development shall be designed to ensure that the Dwelling Emission Rates are better than the Target Emission Rates and the Fabric Energy Efficiency is better than the Target Fabric Energy Efficiency. These are the requirements from Criterion 1 of the current Building Regulations Approved Document L (2013).

o) 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 below.

p) Full details of the SAP calculations can be found in the Full SAP Calculations Printout in Appendix A.

Dwelling	Floor Area (m^2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling Target CO_2 Emission Rate
1	179.5	1,381.5	572.3	38.9	286.9	2,313.8	12.89

Dwelling	DER ($kg/m^2/yr$)	Area (m^2)	Emissions (kg/yr)
1	12.89	179.5	2,313.8
Total Carbon Dioxide Emissions (kg/yr)			**2,314**
Percentage Improvement over current Building Regulations			**14.9 %**

Table 2 – Actual Carbon Dioxide Emissions

q) As demonstrated in Table 2 above, it can be seen that the improvements in the thermal performance and fixed building services, a reduction of 14.9% can be achieved in the carbon dioxide emissions of the development.

4.4 Supplying Energy Efficiently – BE CLEAN

a) Following the principles set out in the Energy Hierarchy, the next step is to reduce the carbon dioxide emissions by supplying energy efficiently - BE CLEAN.

4.5 District Heat Network

a) Although Sutton have identified possible areas for district heat networks, unfortunately, the development site is outside these future areas so there are no district heating systems in this location at this time.

4.6 Combined Heat and Power

a) 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.

b) 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 exceed the current Building Regulations. The aim of these regulations is to 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 be considered not viable on this development. As such, if a CHP system were to be incorporated, it would not operate efficiently and therefore NOT BE CLEAN.

4.7 Renewable Technologies Considered – BE GREEN

a) The current planning policy does not require any low or zero carbon technology to be incorporated into the development as long as the national carbon dioxide targets are met.

b) However, the final step in the Energy Hierarchy is to reduce the carbon dioxide emissions by the use of renewable technologies - BE GREEN.

c) A review of the potential renewable technologies has been undertaken to identify any potential low or zero carbon technologies which could be incorporated at a later date. 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.

4.8 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.
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, which is not available on this site. 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.	Whilst the Biomass CHP system may overcome 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 appear to have external areas of sufficient size for the installation of ground loops for the collection of heat. It is considered that the use of ASHP to offset the heat losses of the dwelling could also be feasible.
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 areas of roof that could 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 towards the 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. There are areas of roof that could be used for the installation of solar thermal collectors and careful consideration must be given to the chosen roof finish to ensure compatibility.
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 buildings and the visual impact it is not considered to be the most sensitive system of providing energy via renewable resources in this location.
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 solar photovoltaics, domestic solar hot water, heat pumps or a combination of these.

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 buildings and trees in the surrounding area which are likely to cause disruption to air flows.

4.9 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.

f) 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.

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

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

j) Space has been identified on the southerly facing roof of the dwelling that can be used for the installation of photovoltaic systems. It is estimated there is enough space for 3-No. 405Wp panels.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions ($kgCO_2/yr$)	Percentage Reduction (%)
No Renewables	2313	-
Reduction by including 1.22 kWp PV systems	551	23.8%

Table 4 – Photovoltaic Carbon Dioxide Emissions

k) As can be seen from Table 4 above, the incorporation of a photovoltaic system, with a total output of 1.22 kWp, on the roof of the dwelling, the development could reduce the carbon dioxide emissions by a further 23.8% and when combined with the fabric energy efficiency measures from in Table 2 above, a potential total reduction of 35.2% could be achieved.

l) From the above calculations, based on 405 watt panels, orientated towards the south and mounted on the roof finishes at a 30 degree pitch, it is calculated that 3-No. panels are required on the proposed dwellings roof.

m) These panels would be connected to the individual electric supply for the dwelling to be used in the dwelling. Any surplus electricity can be exported to the Nation Grid.

n) It is estimated that this size of system, each dwelling could generate 1,062.3 kWh of electricity in a year.

o) Further detailed calculations for the carbon dioxide emissions and the final system size and layout shall be carried out during detailed design.

4.10 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 dwelling, allowing the water to be heated by the sun when possible whilst retaining the backup 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 development, 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) Space has been identified on the southerly facing roof of the dwelling that can be used for the installation of $3m^2$ evacuated tube systems, mounted on the roofs at a 30 degree pitch and orientated in a southerly direction, with a twin coil cylinder in the dwelling. The Table 5 below shows the reduction achieved if this system is installed on the dwelling.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions ($kgCO_2/yr$)	Percentage Reduction (%)
No Renewables	2,314	-
Reduction by including $3m^2$ DSHW system	350	15.2%
Final Carbon Dioxide emissions	1,963.4 $kgCO_2/yr$	
Total Reduction over baseline emissions	27.8%	

Table 5 – Solar Hot Water Carbon Dioxide Emissions

j) As can be seen from Table 5 above, the incorporation of domestic solar hot water systems on the dwellings, the development could reduce the carbon dioxide emissions by a further 15.2% and when combined with the fabric energy efficiency measures from in Table 2 above, a total reduction of 27.8% can be achieved.

k) The use of domestic solar hot water may be considered further at a later date, however, at this stage, it will not be considered as the carbon dioxide emissions from this system are relatively small when compared to the other proposed systems. The use of domestic solar hot water may be considered at a later date.

4.11 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.

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, fan coil units 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 building. 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 within a garage or 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 surrounding the building. However, the use of horizontal heat exchangers which are buried around 1 metre below ground, may affect the future use of the land.

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) This site has limited space for the installation of horizontal ground loops. However, there are areas which boreholes could be sunk for the installation of vertical heat collectors. Further investigation would be required.

j) An air source heat pump could provide the heating and hot water for the dwelling. The external condensing unit could be installed external to the building and away from external seating areas.

k) As the heat pumps use electricity as the fuel source, the baseline carbon dioxide emission from the SAP Assessments has to be changed to use electricity as the fuel source as well. Full details of the SAP calculations can be found in the Full SAP Worksheets in Appendix A.

l) Table 6 below provides the new Baseline Carbon Dioxide Emission figures for the same dwelling with electric heating and hot water. Table 7 and below provides the carbon dioxide emissions for the dwelling with the air source heat pump heating systems.

Dwelling	Floor Area (m2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling CO_2 Emission Rate
1	179.5	1,824.4	568.1	38.9	286.9	2,718.4	15.14

Dwelling	TER (kg/m^2/yr)	Area (m^2)	Emissions (kg/yr)
1	22.48	179.5	4,035.2
Actual Carbon Dioxide Emissions (kg/yr)			**4,035**

Table 6 - Electric Heating Baseline Carbon Dioxide Emissions

Dwelling	Floor Area (m^2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling Target CO_2 Emission Rate
1	179.5	1,093.8	438.8		286.9	1,819.6	10.14

Dwelling	DER (kg/m^2/yr)	Area (m^2)	Emissions (kg/yr)
1	10.14	179.5	1,819.6
Baseline Carbon Dioxide Emissions (kg/yr)			**1,820**
Percentage Improvement over current Building Regulations			**54.9 %**

Table 7 - Air Source Heat Pump Carbon Dioxide Emissions

m) As can be seen in Table 7 above, the use of an air source heat pump to provide the heating and hot water for the dwelling, together with the improvements in the thermal performance from Table 2, could reduce the carbon dioxide emissions by 54.9%.

4.12 Annual Carbon Dioxide Emission Reduction

a) Based on the initial SAP calculations for the dwelling, it has been calculated that the baseline carbon dioxide emissions figure for the development is 2,718 kgCO_2/year for gas heating or 4,035 kgCO_2/year for electric heating.

b) In accordance with the Planning Policies set out by London Borough of Sutton, this report has demonstrated a 14.9% improvement in carbon dioxide emissions by fabric and energy efficiencies.

c) 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 8 below.

	Total Carbon Dioxide Emissions (kgCO_2/yr)	Reduction in Carbon Dioxide Emissions (%)
Building Regulations Compliant Development	2,718 (gas) 4,035 (elec)	-
Development incorporating Energy Efficiency Measures	2,313	14.9%
Further Reduction in Carbon Dioxide Emissions by incorporating a Renewable Technology		
PV (1.22 kWp)	551	23.9%
DSHW (3m^2 system)	350	15.2%
ASHP	2,215	54.9% (against electric baseline)
Percentage Improvement incorporating the ASHP system and PV Panels		**68.6 %**

Table 8 – Summary of Reduction in Carbon Dioxide Emissions

d) It has been demonstrated that it is possible to achieve a 68.6% reduction in carbon dioxide emissions over and above the 2013 Building Regulations by improving the energy efficiency of the development and its building services efficiencies and the incorporation of low or zero carbon technologies. This could be further improved during detailed design.

e) 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 development.

f) 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.

g) Wind power is considered not feasible for this development due to the visual impact in the area and the turbulence caused by the surrounding buildings and trees etc.

h) Solar hot water could be considered further at this time. The current design shows a reduction in the region of 15.1%.

i) An air source heat pump could be installed to achieve a total reduction of 54.9% over Building Regulations.

j) In addition, if a photovoltaic system, with an output of 1.22kWp, were to be installed to further reduce the carbon dioxide emissions, it is possible to provide a total reduction in carbon dioxide emissions of 68.6%.

k) At this stage of the development, the use of the air source heat pump systems, together with the photovoltaic system, is considered favorable as it is likely to provide a good reduction in carbon dioxide emissions.

l) Detailed calculations of the total carbon dioxide emissions compared to the estimated carbon dioxide reduction for the development can be undertaken once the detailed design has progressed to construction drawing stage.

m) 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 air source heat pump system, together with a photovoltaic system, a reduction in excess of 68.6% of the developments carbon dioxide emissions could be achieved. This complies with the requirements of the planning policies set out by the London borough of Sutton.

4.13 Energy Hierarchy Carbon Dioxide Emissions Summary

a) The concept of applying the energy hierarchy in relation to Approved Document L of the Building Regulations 2013, the Energy Planning, Greater London Authority Guidance on Preparing Energy Assessments (March 2016) document provides further guidance on how the carbon dioxide emission figures can be presented.

b) The regulated carbon dioxide emissions reduction target for the development would be to achieve zero carbon as assessed under the Approved Document L 2013 of the Building Regulations.

c) These figures are based on the current design information and are subject to change when the detailed construction information is produced.

d) Table 9 provides Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings.

		Tonnes CO_2/yr
Baseline: Part L 2013 of the Building Regulations Compliant Development	a	4.0
After energy demand reduction	b	1.8
After heat network / CHP	c	1.8
After renewable energy	d	1.3

Table 9 – Carbon Dioxide Emissions after each stage of the Energy Hierarchy

e) Table 10 provides Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

		Tonnes CO_2/yr		%
Savings from energy demand reduction	a-b	2.2	(a-b)/a*100	8.6%
Savings from heat network / CHP	b-c	0.0	(b-c)/a*100	0.0%
Savings from renewable energy	c-d	0.6	(c-d)/a*100	19.6%
Cumulative on site savings	**a-d=e**	**2.8**	**(a-d)/a*100**	**28.2%**
Annual Savings from off-set payment	a-e=f	1.3		
Cumulative savings for off-set payment	f*30=g	38.05		

Table 10 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy

f) The calculations contained within this Energy Statement are based on the current design information and are subject to change when the detailed design is undertaken and the construction information is produced.

5.0 OVERHEATING

a) It is important to consider the internal comfort conditions for the occupants of the dwelling. At design stage, this can be met through the use of the "cooling hierarchy".

b) The cooling hierarchy seeks to reduce any potential overheating and also the need to cool a building through active cooling measures. Air conditioning systems are a very resource intensive form of active cooling, increasing carbon dioxide emissions, and also emitting large amounts of heat into the surrounding area. By incorporating the cooling hierarchy into the design process buildings will be better equipped to manage their cooling needs and to adapt to the changing climate they will experience over their lifetime.

c) The development shall reduce the potential for overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

   a) minimise internal heat generation through energy efficient design
   b) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
   c) manage the heat within the building through exposed internal thermal mass and high ceilings
   d) passive ventilation
   e) mechanical ventilation
   f) active cooling systems (ensuring they are the lowest carbon options).

d) During the initial design, the initial SAP Assessment was carried out for the dwelling to help assess the energy demand and carbon emissions of the development. The SAP Assessment includes an overheating assessment in line with the requirements of the Building Regulations.

e) Based on this SAP Assessment, the dwelling has a medium risk of solar overheating. This is acceptable under the requirements of the Building Regulations.

f) The internal heat generation has been minimised through energy efficient design. All of the luminaires shall be low energy which will also remove an internal heat generating load.

g) The heat entering the building in summer is reduced through the optimisation of glazing area, the use of shading via building form and other protruding edges, together with the inclusion of very high performance façade materials and improved air tightness. The use of a solar control glazing, which has a coating applied to lower the G Value of the glass, can be applied. This acts in the same way that the low e coating lowers the U Value which helps reduce heat losses through the windows.

h) The dwelling could have a mechanical ventilation system installed, which provides filtered fresh air to the dwelling. This is tempered by the crossover heat exchanger, which recovers waste heat from the extract air from the dwelling. The ventilation systems shall be controlled locally by the occupants.

i) Low energy lamps shall be used in the luminaires to reduce heat gain. These lamps do not emit heat like traditional GLS lamps.

6.0 WATER CALCULATIONS

i) The London Borough of Sutton recognises that London and the South East is classified as 'seriously' water stressed, meaning that more water is taken from the environment than the environment can sustain in the long term. London is relatively resilient to drought and it takes two consecutive drier than normal winters to create water supply issues.

c) The Sutton Local Plan Policy 33: Climate Change Adaptation requires all new dwellings should limit domestic water consumption to 110 litres per person per day (l/p/d) in line with the Government's higher 'optional requirements' for water efficiency set out in Part G of the Building Regulations as amended.

a) Low water usage fitting, or flow restrictors can be fitted in the dwelling. Efficient white goods that are not only energy efficient but also water efficient can also be installed.

b) At this stage in the design, the final selection of the water fittings and appliance has not been made, but this calculations shows the design intent for these fittings and appliances.

c) Dual flush toilets can be installed to reduce the water consumption of the dwelling. A full flush capacity of 4.5 litres and a part flush capacity of 3 litres has been selected.

d) Flow restrictors shall be installed to limit the flow rates of the taps to 4 litres / minute. Flow restrictors shall also be installed in the kitchen taps and the showers to restrict their flow to 10 litres / minute. The showers shall be restricted to 8 litres / minute.

e) The capacity of the baths to the over flow shall be 175 litres.

f) No Appliances have been selected at this time, so the default Best Practise values have been used. The washing machine shall have a water consumption of 8.17 litres / kg of dry load. The dishwasher shall have a water consumption of 1.25 litres / place setting.

g) No water softeners are being installed.

h) Using the Building Regulations Approved Document G Calculator, the water consumption has been calculated as 108.74 litres / person / day

i) The calculated water consumption for the dwelling complies with the requirements of the Local Plan and the Building Regulations Approved Document G.

j) Details of the calculations can be found in Appendix B.

7.0 CONCLUSION

a) The London Borough of Sutton requires all minor residential developments to achieve at least a 35% reduction in regulated carbon dioxide emissions on site.

b) The Application is for the redevelopment of the site to create a new detached residential unit at Treetops, Sutton, SM2 5EL.

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. It has been estimated that the proposed development will achieve a reduction of at least 14.9% in the carbon dioxide emissions through fabric and services efficiencies and a total of 68.6% through the use of an air source heat pump and solar photovoltaics.

d) At planning stage it is not possible to produce the final reports on the energy demand, carbon dioxide emissions, based on the initial construction information. It is envisaged that during detailed design, the reduction in carbon dioxide emissions can be improved.

e) This report has assessed the risk of overheating and the development has been identified as having a slight risk, which can be reduced by incorporating low G value glazing, internal shading by light coloured curtains or cross ventilation by opening the windows fifty percent of the time.

f) The water usage has been assessed and although the actual water fittings have not been selected yet, the calculations show that it is possible for this development to achieve the requirements of the planning policy, thus minimising the impact of the development on the local water resources.

g) This Energy and Sustainability Statement demonstrates that the proposed development complies with the requirements of planning policy with regard to carbon dioxide reduction, incorporation of low and zero carbon technologies and water consumption. It is for these reasons it is considered that this application should be viewed favorably by the London Borough of Sutton.

Appendix A – Full SAP Calculations Printout

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Property Reference	E1102-01	**Issued on Date**	07/05/2021
Assessment Reference	E1102-01-ASHP	**Prop Type Ref**	
Property	Treetops , Upland Road, Sutton, SM2 5EL		

SAP Rating	89 B	**DER**	10.14	**TER**	22.48
Environmental	90 B	**% DER<TER**	54.88		
CO_2 Emissions (t/year)	1.58	**DFEE**	44.19	**TFEE**	56.62
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.95		

Assessor Details	Mr. Jason Doherty, Doherty Energy Limited, Tel: 01480451569, jason@doherty-energy.co.uk	**Assessor ID**	L143-0001
Client			

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

DohertyEnergy

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 180 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.48 kgCO_2/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.14 kgCO_2/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.2 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.19 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.16 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.030

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3 Air permeability

Air permeability at 50 pascals:	3.00 (design value)	
Maximum	10.0	OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi Electric Ecodan 14.0 kW PUZ-HWM140VHA

Secondary heating system: Room heaters - Wood Logs

Open fire in grate
Efficiency: 37%
Minimum: 37% OK

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5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.70 kWh/day	
Permitted by DBSCG 2.24	OK	
Primary pipework insulated:	Yes	OK

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6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North:	19.39 m², No overhang	
Windows facing North East:	0.72 m², No overhang	
Windows facing East:	6.31 m², No overhang	
Windows facing South East:	0.72 m², No overhang	
Windows facing South:	8.64 m², No overhang	
Windows facing West:	8.73 m², No overhang	
Air change rate:	4.00 ach	
Blinds/curtains:	None	

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10 Key features

Party wall U-value	0.00 W/m²K
Roof U-value	0.08 W/m²K
Roof U-value	0.08 W/m²K
Floor U-value	0.10 W/m²K
Door U-value	0.55 W/m²K
Thermal bridging y-value	0.030 W/m²K
Air permeability	3.0 m³/m²h
Secondary heating (wood logs)	
Secondary heating fuel:	wood logs

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

DohertyEnergy

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE   09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE   09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	87.5000	(1b)	x	2.5000	(2b)	=	218.7500	(1b) - (3b)
First floor	70.8000	(1c)	x	2.8000	(2c)	=	198.2400	(1c) - (3c)
Second floor	21.2000	(1d)	x	2.2000	(2d)	=	46.6400	(1d) - (3d)

Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)   179.5000   (4)
Dwelling volume   (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =   463.6300 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0863	(8)
Pressure test		Yes	
Measured/design AP50		3.0000	
Infiltration rate		0.2363	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2008	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2561	0.2510	0.2460	0.2209	0.2159	0.1908	0.1908	0.1858	0.2008	0.2159	0.2259	0.2360	(22b)
Effective ac	0.5328	0.5315	0.5303	0.5244	0.5233	0.5182	0.5182	0.5173	0.5202	0.5233	0.5255	0.5278	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Door			3.2500	0.5500	1.7875			(26)
Window (Uw = 1.20)			44.5100	1.1450	50.9656			(27)
Roof Light (Uw = 1.40)			0.8000	1.3258	1.0606			(27a)
Heat Loss Floor 1			87.5000	0.1000	8.7500			(28a)
External Wall 1	226.7600	45.2400	181.5200	0.1700	30.8584			(29a)
Dormer	3.5800	1.2000	2.3800	0.1500	0.3570			(29a)
Loft Wall	32.6000	1.3200	31.2800	0.1900	5.9432			(29a)
Sceiling	27.8000	0.8000	27.0000	0.1300	3.5100			(30)
1st Main	49.6000		49.6000	0.0800	3.9680			(30)
Grd	15.4800		15.4800	0.0800	1.2384			(30)
Total net area of external elements Aum(A, m2)			443.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		108.4388			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K   100.0000 (35)
Thermal bridges (User defined value 0.030 * total exposed area)   13.2996 (36)
Total fabric heat loss   (33) + (36) =   121.7384 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	81.5149	81.3201	81.1292	80.2325	80.0647	79.2837	79.2837	79.1390	79.5845	80.0647	80.4041	80.7589	(38)
Heat transfer coeff	203.2532	203.0585	202.8675	201.9708	201.8030	201.0220	201.0220	200.8774	201.3228	201.8030	202.1424	202.4973	(39)

Average = Sum(39)m / 12 =   201.9700 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1323	1.1312	1.1302	1.1252	1.1243	1.1199	1.1199	1.1191	1.1216	1.1243	1.1261	1.1281	(40)
HLP (average)												1.1252	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy   2.9752 (42)
Average daily hot water use (litres/day)   104.8600 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3460	111.1516	106.9572	102.7628	98.5684	94.3740	94.3740	98.5684	102.7628	106.9572	111.1516	115.3460	(44)
Energy conte	171.0548	149.6056	154.3796	134.5918	129.1441	111.4415	103.2670	118.5003	119.9156	139.7501	152.5481	165.6574	(45)

Energy content (annual)   Total = Sum(45)m =   1649.8559 (45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.6582	22.4408	23.1569	20.1888	19.3716	16.7162	15.4900	17.7751	17.9873	20.9625	22.8822	24.8486	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	222.7752	196.3208	206.1000	184.6438	180.8645	161.4935	154.9874	170.2207	169.9676	191.4705	202.6001	217.3778	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	222.7752	196.3208	206.1000	184.6438	180.8645	161.4935	154.9874	170.2207	169.9676	191.4705	202.6001	217.3778	(64)
Total per year (kWh/year) = Sum(64)m =												2258.8219	(64)
Heat gains from water heating, kWh/month	98.2520	87.1160	92.7075	84.7934	84.3167	77.0959	75.7126	80.7777	79.9135	87.8432	90.7639	96.4574	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.3025	27.8026	22.6106	17.1177	12.7957	10.8026	11.6726	15.1725	20.3645	25.8575	30.1795	32.1725	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.1188	354.7623	345.5807	326.0343	301.3605	278.1706	262.6783	259.0348	268.2163	287.7627	312.4366	335.6265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	(71)
Water heating gains (Table 5)	132.0592	129.6369	124.6069	117.7686	113.3289	107.0776	101.7642	108.5722	110.9910	118.0688	126.0609	129.6471	(72)
Total internal gains	582.1078	579.8292	560.4256	528.5480	495.1125	463.6782	443.7425	450.4068	467.1992	499.3164	536.3043	565.0734	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	19.3900	10.6334	0.7200	0.7000	0.7700	72.0134	(74)
Northeast	0.7200	11.2829	0.7200	0.7000	0.7700	2.8374	(75)
East	6.3100	19.6403	0.7200	0.7000	0.7700	43.2853	(76)
Southeast	0.7200	36.7938	0.7200	0.7000	0.7700	9.2528	(77)
South	8.6400	46.7521	0.7200	0.7000	0.7700	141.0842	(78)
West	8.7300	19.6403	0.7200	0.7000	0.7700	59.8860	(80)
West	0.8000	26.4634	0.7200	0.7000	1.0000	9.6030	(82)

Solar gains	337.9621	611.3854	925.7916	1287.5985	1563.8509	1604.2802	1525.2962	1312.4566	1050.6382	700.3197	411.4394	284.8560	(83)
Total gains	920.0699	1191.2146	1486.2171	1816.1464	2058.9633	2067.9584	1969.0387	1762.8635	1517.8375	1199.6360	947.7437	849.9294	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.5315	24.5551	24.5782	24.6873	24.7078	24.8038	24.8038	24.8217	24.7667	24.7078	24.6663	24.6231	
alpha	2.6354	2.6370	2.6385	2.6458	2.6472	2.6536	2.6536	2.6548	2.6511	2.6472	2.6444	2.6415	
util living area	0.9764	0.9545	0.9109	0.8229	0.6914	0.5411	0.4179	0.4746	0.6932	0.8880	0.9618	0.9806	(86)
Tweekday	16.6144	17.1400	17.9211	18.8167	19.4810	19.8341	19.9447	19.9247	19.6501	18.7227	17.4829	16.5053	
Tweekend	19.3841	19.6191	19.9713	20.3839	20.7058	20.8910	20.9600	20.9432	20.7810	20.3290	19.7685	19.3347	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	18.5062	18.8639	19.4124	20.0379	20.5459	20.8327	20.9382	20.9123	20.6581	19.9645	19.0770	18.4299	(87)
Th 2	19.9745	19.9754	19.9763	19.9803	19.9811	19.9846	19.9846	19.9853	19.9833	19.9811	19.9795	19.9779	(88)
util rest of house	0.9728	0.9476	0.8974	0.7965	0.6465	0.4740	0.3318	0.3852	0.6313	0.8649	0.9549	0.9776	(89)
Tweekday	16.6144	17.1400	17.9211	18.8167	19.4810	19.8341	19.9447	19.9247	19.6501	18.7227	17.4829	16.5053	
Tweekend	16.6144	17.1400	17.9211	18.8167	19.4810	19.8341	19.9447	19.9247	19.6501	18.7227	17.4829	16.5053	
MIT 2	16.6144	17.1400	17.9211	18.8167	19.4810	19.8341	19.9447	19.9247	19.6501	18.7227	17.4829	16.5053	(90)
Living area fraction										fLA = Living area / (4) =		0.3053	(91)
MIT	17.1919	17.6663	18.3764	19.1895	19.8061	20.1390	20.2480	20.2262	19.9578	19.1018	17.9696	17.0929	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.1919	17.6663	18.3764	19.1895	19.8061	20.1390	20.2480	20.2262	19.9578	19.1018	17.9696	17.0929	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9579	0.9261	0.8706	0.7726	0.6381	0.4848	0.3550	0.4075	0.6295	0.8399	0.9354	0.9646	(94)
Useful gains	881.3564	1103.1634	1293.8970	1403.2036	1313.8526	1002.4824	698.9241	718.3250	955.5321	1007.6164	886.5627	819.8520	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2620.3228	2592.3020	2409.3346	2078.1841	1635.8386	1113.4515	733.3286	768.5936	1179.3144	1715.6860	2197.2023	2610.7726	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1293.7910	1000.7011	829.8856	485.9860	239.5576	0.0000	0.0000	0.0000	0.0000	526.8038	943.6605	1332.4449	(98)
Space heating												6652.8306	(98)
Space heating per m2											(98) / (4) =	37.0631	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	315.6599	(206)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Space heating requirement	2107.5944	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1293.7910	1000.7011	829.8856	485.9860	239.5576	0.0000	0.0000	0.0000	0.0000	526.8038	943.6605	1332.4449	(98)
Space heating efficiency (main heating system 1)	315.6599	315.6599	315.6599	315.6599	315.6599	0.0000	0.0000	0.0000	0.0000	315.6599	315.6599	315.6599	(210)
Space heating fuel (main heating system)	409.8687	317.0188	262.9050	153.9587	75.8911	0.0000	0.0000	0.0000	0.0000	166.8897	298.9485	422.1141	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	222.7752	196.3208	206.1000	184.6438	180.8645	161.4935	154.9874	170.2207	169.9676	191.4705	202.6001	217.3778	(64)
Efficiency of water heater												267.1400	(216)
(217)m	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	267.1400	(217)
Fuel for water heating, kWh/month	83.3927	73.4899	77.1505	69.1188	67.7040	60.4528	58.0173	63.7197	63.6249	71.6742	75.8404	81.3722	(219)
Water heating fuel used												845.5573	(219)

Annual totals kWh/year		
Space heating fuel - main system	2107.5944	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	552.8118	(232)
Total delivered energy for all uses	3505.9635	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2107.5944	0.5190	1093.8415	(261)
Space heating - secondary	0.0000	0.0190	0.0000	(263)
Water heating (other fuel)	845.5573	0.5190	438.8443	(264)
Space and water heating			1532.6857	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	552.8118	0.5190	286.9093	(268)
Total CO2, kg/year			1819.5951	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.1400	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		10.1400	ZC1
Total Floor Area	TFA	179.5000	
Assumed number of occupants	N	2.9752	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.5914	ZC2
CO2 emissions from cooking, equation (L16)		1.0607	ZC3
Total CO2 emissions		22.7921	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		22.7921	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		87.5000	(1b)	x	2.5000	(2b)	=	218.7500	(1b) - (3b)
First floor		70.8000	(1c)	x	2.8000	(2c)	=	198.2400	(1c) - (3c)
Second floor		21.2000	(1d)	x	2.2000	(2d)	=	46.6400	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	179.5000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	463.6300	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0863	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3363	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2858	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3644	0.3573	0.3501	0.3144	0.3073	0.2715	0.2715	0.2644	0.2858	0.3073	0.3216	0.3359	(22b)
Effective ac	0.5664	0.5638	0.5613	0.5494	0.5472	0.5369	0.5369	0.5350	0.5409	0.5472	0.5517	0.5564	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			3.2500	1.0000	3.2500			(26)
TER Opening Type (Uw = 1.40)			40.8900	1.3258	54.2102			(27)
TER Room Window (Uw = 1.70)			0.7300	1.5918	1.1620			(27a)
Heat Loss Floor 1			87.5000	0.1300	11.3750			(28a)
External Wall 1	226.7600	41.7200	185.0400	0.1800	33.3072			(29a)
Dormer	3.5800	1.1000	2.4800	0.1800	0.4464			(29a)
Loft Wall	32.6000	1.3200	31.2800	0.1800	5.6304			(29a)
Sceiling	27.8000	0.7300	27.0700	0.1300	3.5191			(30)
1st Main	49.6000		49.6000	0.1300	6.4480			(30)
Grd	15.4800		15.4800	0.1300	2.0124			(30)
Total net area of external elements Aum(A, m2)			443.3200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	121.3607			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		0.0000	(36)
Total fabric heat loss	(33) + (36) =	121.3607	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	86.6592	86.2647	85.8779	84.0615	83.7217	82.1396	82.1396	81.8467	82.7490	83.7217	84.4092	85.1279	(38)
Heat transfer coeff	208.0199	207.6254	207.2387	205.4222	205.0824	203.5003	203.5003	203.2074	204.1097	205.0824	205.7699	206.4887	(39)
Average = Sum(39)m / 12 =												205.4206	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1589	1.1567	1.1545	1.1444	1.1425	1.1337	1.1337	1.1321	1.1371	1.1425	1.1464	1.1504	(40)
HLP (average)												1.1444	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9752	(42)
Average daily hot water use (litres/day)	104.8600	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.3460	111.1516	106.9572	102.7628	98.5684	94.3740	94.3740	98.5684	102.7628	106.9572	111.1516	115.3460	(44)
Energy conte	171.0548	149.6056	154.3796	134.5918	129.1441	111.4415	103.2670	118.5003	119.9156	139.7501	152.5481	165.6574	(45)
Energy content (annual)											Total = Sum(45)m =	1649.8559	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	25.6582	22.4408	23.1569	20.1888	19.3716	16.7162	15.4900	17.7751	17.9873	20.9625	22.8822	24.8486	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	221.9808	195.6033	205.3056	183.8751	180.0702	160.7248	154.1930	169.4264	169.1989	190.6762	201.8314	216.5835	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	221.9808	195.6033	205.3056	183.8751	180.0702	160.7248	154.1930	169.4264	169.1989	190.6762	201.8314	216.5835	(64)
Total per year (kWh/year) = Sum(64)m =												2249.4693	(64)
Heat gains from water heating, kWh/month	97.6166	86.5421	92.0721	84.1784	83.6813	76.4809	75.0771	80.1422	79.2986	87.2078	90.1489	95.8219	(65)

5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	148.7579	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.3025	27.8026	22.6106	17.1177	12.7957	10.8026	11.6726	15.1725	20.3645	25.8575	30.1795	32.1725	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	351.1188	354.7623	345.5807	326.0343	301.3605	278.1706	262.6783	259.0348	268.2163	287.7627	312.4366	335.6265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	37.8758	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	-119.0063	(71)
Water heating gains (Table 5)	131.2051	128.7828	123.7528	116.9145	112.4748	106.2235	100.9101	107.7180	110.1369	117.2147	125.2068	128.7929	(72)
Total internal gains	584.2537	581.9750	562.5715	530.6938	497.2583	465.8241	445.8884	452.5527	469.3451	501.4623	538.4502	567.2193	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	17.8100	10.6334	0.6300	0.7000	0.7700	57.8772	(74)
Northeast	0.6600	11.2829	0.6300	0.7000	0.7700	2.2758	(75)
East	5.7900	19.6403	0.6300	0.7000	0.7700	34.7534	(76)
Southeast	0.6600	36.7938	0.6300	0.7000	0.7700	7.4215	(77)
South	7.9400	46.7521	0.6300	0.7000	0.7700	113.4470	(78)
West	8.0300	19.6403	0.6300	0.7000	0.7700	48.1986	(80)
West	0.7300	26.4634	0.6300	0.7000	1.0000	7.6674	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	271.6410	491.3935	744.0596	1034.7975	1256.7770	1289.2544	1225.7855	1054.7614	844.3828	562.8638	330.6965	228.9583	(83)
Total gains	855.8947	1073.3685	1306.6310	1565.4913	1754.0354	1755.0785	1671.6739	1507.3141	1313.7279	1064.3261	869.1467	796.1775	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.9235	60.0373	60.1494	60.6812	60.7818	61.2543	61.2543	61.3426	61.0715	60.7818	60.5787	60.3679	
alpha	4.9949	5.0025	5.0100	5.0454	5.0521	5.0836	5.0836	5.0895	5.0714	5.0521	5.0386	5.0245	
util living area	0.9993	0.9977	0.9912	0.9617	0.8677	0.6919	0.5250	0.5983	0.8629	0.9848	0.9983	0.9995	(86)
MIT	19.6321	19.8128	20.1062	20.4867	20.7981	20.9538	20.9907	20.9827	20.8559	20.4317	19.9568	19.6014	(87)
Th 2	19.9530	19.9548	19.9565	19.9647	19.9663	19.9734	19.9734	19.9747	19.9706	19.9663	19.9632	19.9599	(88)
util rest of house	0.9991	0.9969	0.9880	0.9470	0.8202	0.6006	0.4080	0.4758	0.7946	0.9768	0.9975	0.9994	(89)
MIT 2	18.1160	18.3814	18.8097	19.3584	19.7694	19.9431	19.9700	19.9676	19.8521	19.2900	18.5983	18.0760	(90)
Living area fraction									fLA = Living area / (4) =			0.3053	(91)
MIT	18.5789	18.8184	19.2055	19.7029	20.0834	20.2517	20.2816	20.2775	20.1586	19.6386	19.0131	18.5417	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5789	18.8184	19.2055	19.7029	20.0834	20.2517	20.2816	20.2775	20.1586	19.6386	19.0131	18.5417	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9986	0.9956	0.9847	0.9424	0.8263	0.6268	0.4440	0.5134	0.8090	0.9733	0.9965	0.9990	(94)
Useful gains	854.6759	1068.5980	1286.6651	1475.2475	1449.3734	1100.0440	742.1650	773.8127	1062.8507	1035.8575	866.1209	795.3855	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2970.2942	2889.8058	2633.0699	2219.1502	1719.2963	1150.1145	749.2089	787.9350	1236.6113	1853.6507	2451.3484	2961.3991	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1574.0200	1223.8517	1001.7251	535.6100	200.8227	0.0000	0.0000	0.0000	0.0000	608.4381	1141.3638	1611.5141	(98)

Space heating		7897.3455	(98)
Space heating per m2	(98) / (4) =	43.9964	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	8446.3588	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1574.0200	1223.8517	1001.7251	535.6100	200.8227	0.0000	0.0000	0.0000	0.0000	608.4381	1141.3638	1611.5141	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	1683.4438	1308.9323	1071.3638	572.8449	214.7836	0.0000	0.0000	0.0000	0.0000	650.7360	1220.7100	1723.5445	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	221.9808	195.6033	205.3056	183.8751	180.0702	160.7248	154.1930	169.4264	169.1989	190.6762	201.8314	216.5835	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.0246	88.8582	88.4820	87.5015	85.1052	79.8000	79.8000	79.8000	79.8000	87.6943	88.7126	89.0848	(217)
Fuel for water heating, kWh/month	249.3477	220.1299	232.0309	210.1393	211.5854	201.4095	193.2243	212.3138	212.0287	217.4328	227.5115	243.1205	(219)

Water heating fuel used	2630.2743	(219)
Annual totals kWh/year		
Space heating fuel - main system	8446.3588	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	552.8118	(232)
Total delivered energy for all uses	11704.4450	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8446.3588	0.2160	1824.4135	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2630.2743	0.2160	568.1393	(264)
Space and water heating			2392.5528	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	552.8118	0.5190	286.9093	(268)
Total CO2, kg/m2/year			2718.3871	(272)
Emissions per m2 for space and water heating			13.3290	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.5984	(272b)
Emissions per m2 for pumps and fans			0.2169	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.3290 * 1.55) + 1.5984 + 0.2169, rounded to 2 d.p.			22.4800	(273)

Appendix B – Water Calculations

Water Efficiency Calculator for New Dwellings (V1f - Aug 2010)

Project Details

Adress/Reference	Treetops	Case Reference	E1102
Number of Bedrooms	3	Occupancy for Calculation Purposes	4

Appliance/Useage Details

Taps (Excluding Kitchen Taps)

Tap Fitting Type	Flow Rate Litres/Min	Quantity (No.)	Total per Fitting type
Mixer Taps	4.00	3	12.00
			0.00
			0.00
			0.00
			0.00
			0.00
Total No. of Fittings (No.)		3	
Total Flow (l/s)			12.00
Maximum Flow (l/s)			4.00
Average Flow (l/s)			4.00
Weighted Average Flow (l/s)			2.80
Flow for Calculation (l/s)			**4.00**

Showers

Shower fitting Type	Flow Rate Litres/Min	Quantity (No.)	Total per Fitting type
Thermostatic Shower	8.00	2	16.00
			0.00
			0.00
			0.00
			0.00
			0.00
Total No. of Fittings (No.)		2	
Total Flow (l/s)			16.00
Maximum Flow (l/s)			8.00
Average Flow (l/s)			8.00
Weighted Average Flow (l/s)			5.60
Flow for Calculation (l/s)			**8.00**

Baths

Bath Type	Capacity to Overflow	Quantity (No.)	Total per Fitting type
Main	175.00	1	175.00
			0.00
			0.00
			0.00
Total No. of Fittings (No.)		1	
Total Capacity (l)			175.00
Maximum Capacity (l)			175.00
Average Capacity (l)			175.00
Weighted Average Capacity (l)			122.50
Capacity for Calculation (l)			**175.00**

WCs

WC Type	Full Flush Volume	Part Flush Volume	Quantity (No)
Dual WC	4.50	3.00	3
Total number of fittings			**3**
Average effective flushing volume			**3.50**

Dishwashers

Dishwasher Type	L per Place Setting	Quantity (No.)	Total per Fitting type
			0.00
			0.00
Total No. of Fittings (No.)		0	
Total Consumption (l)			1.25
Maximum Consumption (l)			1.25
Average Consumption (l/s)			1.25
Weighted Average Consumption (l)			0.88
Consumption for Calculation (l/s)			**1.25**

Washing Machines

Washing Machine Type	L per Kg Dry Load	Quantity (No.)	Total per Fitting type
			0.00
			0.00
Total No. of Fittings (No.)		0	
Total Consumption (l)			8.17
Maximum Consumption (l)			8.17
Average Consumption (l/s)			8.17
Weighted Average Consumption (l)			5.72
Consumption for Calculation (l/s)			**8.17**

Kitchen Taps

Tap Fitting Type	Flow Rate Litres/Min	Quantity (No.)	Total per Fitting type
Kitchen Tap	10.00	1	10.00
			0.00
			0.00
Total No. of Fittings (No.)		1	
Total Flow (l/s)			10.00
Maximum Flow (l/s)			10.00
Average Flow (l/s)			10.00
Weighted Average Flow (l/s)			7.00
Flow for Calculation (l/s)			**10.00**

Other Fittings

Waste Disposal Y/N	N
Water softner	
Consumption beyond 4% l/p/d	

Use of grey water and harvested rainwater

Total Grey water from WHB taps (l)	0
Total Availble Grey Water Supply (l)	216.84
Possible Demand (l)	130.51
Grey/Rain Installed Capacity (l)	0.00
Figure for Calculation lit/person/day	0.00

Water Use Assessment

Installation Type	Unit	Capacity/ Flow Rate	Use Factor	Fixed use (l/p/day)	**Total Use (l/p/day)**	
WC Single Flush	Volume (l)	0.00	4.42	0.00	0.00	
WC Dual Flush	Full Flush (l)	0.00	1.46	0.00	0.00	
	Pt Flush (l)	0.00	2.96	0.00	0.00	
WC's (Multiple)	Volume (l)	3.50	4.42	0.00	15.47	
Taps Exc. Kitchen	Flow Rate	4.00	1.58	1.58	7.90	
Bath (shower present)	(l/s)	175.00	0.11	0.00	19.25	
Shower (bath present)	(l/s)	8.00	4.37	0.00	34.96	
Bath Only	(l)	0.00	0.50	0.00	0.00	
Shower Only	(l/s)	0.00	5.60	0.00	0.00	
Kitchen Taps	(l/s)	10.00	0.44	10.36	14.76	
Washing Machines	(l/kgdry)	8.17	2.10	0.00	17.16	<< Note - these may be default values.
Dishwashers	(l/place)	1.25	3.60	0.00	4.50	<< You can change them by entering
Waste Disposal	(l/s)	0.00	3.08	0.00	0.00	___the actual applicances in the
Water Softner	(l/s)	0.00	1.00	0.00	0.00	___appropriate sections above
Total Calculated Water Use (l/p/day)					**114.00**	
Grey/RainWater Reused (l)					0.00	
Normalisation Factor	(Factor)				0.91	
Total Consumption CSH (l/p/day)					**103.74**	
External Water Use Allowance (l)					5.00	
Total Comsumption Part G (l/p/day)					**108.74**	

Assesment Result	**PASS**