



ENERGY & SUSTAINABILITY STATEMENT

(To Accompany Planning Application)

Site

**HIGHGROVE HOUSE, EASTCOTE ROAD,
RUISLIP HA4 8BP**

Proposal

ERECTION OF THREE BEDROOM DWELLING

Client

WESTCOMBE ESTATES LTD

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1.0 INTRODUCTION

- a) Doherty Energy Limited have been instructed by Westcombe Estates Ltd to prepare an Energy and Sustainability Statement to support the submission of the planning application for the development at Highgrove House, Eastcote Road, Ruislip, HA4 8BP. 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 construction of a three bedroom dwelling in the grounds of Highgrove House.
- 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 London Borough of Hillingdon's Local Plan dated January 2020, the Council follows the principles set out by the Greater London Authority in the London Plan and seeks for new residential developments to be zero carbon.
- b) These 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 DMEI 2: Reducing Carbon Emissions requires proposed developments to make the fullest contribution to minimising carbon dioxide emissions in accordance with the London Plan. To meet the 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 £95 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 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) The appropriate management of water through understanding the water cycle is vital to ensuring that water quantity and quality is maintained and improved throughout the Borough. The Colne Catchment Abstraction Management Strategy produced by the Environment Agency indicates that some of Hillingdon's rivers are over abstracted, putting stress on the natural environment of these rivers. This situation is likely to be exacerbated in the future due to the effects of climate change. The London Catchment Abstraction Management Strategy indicates that the River Crane has 'water available'. It is therefore important that development uses water efficiently to limit environmental stress.
- i) 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.
- j) The Hillingdon Local Plan Policy DME1 10: Water Management, Efficiency and Quality requires all new dwellings should limit domestic water consumption to 105 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

- k) 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.

- l) 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.
- m) 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.
- n) 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) 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 dwelling 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	109.0	1,028.5	551.5	38.9	232.8	1,851.7	16.98
Dwelling		TER (kg/m²/yr)		Area (m²)		Emissions (kg/yr)	
1		16.98		109.0		1,851.7	
Baseline Carbon Dioxide Emissions (kg/yr)						1,852	

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 0.18 W/m²K.
- 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 0.19 W/m²K.
- 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 W/m²K 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/m²K 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/m²K.
- h) The air leakage rate for the dwelling can be improved. The maximum allowed under the current Building Regulations Approved Document

L1A:2013 is $10 \text{ m}^3/\text{hr}/\text{m}^2$ at 50 Pascal's. With careful detailing, this can be easily improved to $3 \text{ m}^3/\text{hr}/\text{m}^2$ 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 heating 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 (m²)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling Target CO₂ Emission Rate
1	190.0	981.8	540.2	38.9	232.8	1,793.6	16.45
Dwelling	DER (kg/m²/yr)		Area (m²)			Emissions (kg/yr)	
1	16.45		109.0			1,793.6	
Total Carbon Dioxide Emissions (kg/yr)						1,794	
Percentage Improvement over current Building Regulations						3.12 %	

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 3.12% 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 Ruislip 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 use 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 fuelled 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 CO₂ 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 needs 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 utilised 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 8-20m², 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 flat roof area of the dwellings that can be used for the installation of photovoltaic systems.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions (kgCO ₂ /yr)	Percentage Reduction (%)
No Renewables	1,793.6	-
Reduction by including 4.05 kWp PV systems	1,815.3	101.2%

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 4.05 kWp, on the roof of the dwelling, the development could reduce the carbon dioxide emissions by a further 101.2% and when combined with the fabric energy efficiency measures from in Table 2 above, a potential total reduction of 101.2% could be achieved. This demonstrates that the dwellings could achieve the policy requirements of providing zero carbon homes.
- 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 10-No. panels are required on the proposed dwellings roofs.
- m) These panels could be connected to the individual electric supply for each dwelling to be used in the dwelling, or connected to the landlords supply. Any surplus electricity can be exported to the National Grid.
- n) It is estimated that this size of system, the development could generate 3,498 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 2-4m² 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 siting 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 south facing roof of the dwelling that can be used for the installation of 3m² 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	1,793.6	-
Reduction by including 2.5 m ² DSHW systems	260.8	14.5%
Final Carbon Dioxide emissions	1,532.8 kgCO ₂ /yr	
Total Reduction over baseline emissions	17.2%	

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 14.5% and when combined with the fabric energy efficiency measures from in Table 2 above, a total reduction of 17.2% 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.

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) Air source heat pumps could provide the heating and hot water for the dwellings. 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 CO2 Emission Rate
1	109.0	1,031.4	543.4	38.9	232.8	1,846.5	16.94
Dwelling		TER (kg/m²/yr)		Area (m²)		Emissions (kg/yr)	
1		24.9		109.0		2,712.4	
Baseline Carbon Dioxide Emissions (kg/yr)						2,712	

Table 6 - Electric Heating Baseline Carbon Dioxide Emissions

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 Target CO₂ Emission Rate
1	109.0	590.4	258.8		232.8	1,182.0	10.84
Dwelling	DER (kg/m²/yr)			Area (m²)		Emissions (kg/yr)	
1	10.84			109.0		1,182.0	
Actual Carbon Dioxide Emissions (kg/yr)						1,182	
Percentage Improvement over current Building Regulations							56.4 %

Table 7 - Air Source Heat Pump Carbon Dioxide Emissions

- m) As can be seen in Table 7 above, the use of air source heat pumps 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 56.4%.

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 1,851.2 kgCO₂/year for gas heating or 2,712.4 kgCO₂/year for electric heating.
- b) In accordance with the Planning Policies set out by London Borough of Hillingdon, this report has demonstrated a 3.12% 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	1,851.2 (gas) 2,712.4 (elec)	-
Development incorporating Energy Efficiency Measures	1,793.6	3.12% (against gas baseline)
Further Reduction in Carbon Dioxide Emissions by incorporating a Renewable Technology		
PV (4.05 kWp)	1,815.3	101.2%
DSHW (2.5 m ² system)	260.8	17.2%
ASHP	1,530.4	56.4% (against electric baseline)
Percentage Improvement incorporating the PV system		101.2 %

Table 8 – Summary of Reduction in Carbon Dioxide Emissions

- d) It has been demonstrated that it is possible to achieve a total of 101.2% reduction in carbon dioxide emissions over and above the 2013 Building Regulations by improving the energy efficiency of the development, its building services efficiencies and including the solar photovoltaic system with an output of 4.05kWp. 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 17.2%.
- i) An air source heat pump could be installed to achieve a total reduction of 56.4% over Building Regulations.
- j) At this stage of the development, the use of the photovoltaic systems, by themselves, is considered favorable as it is likely to provide an excellent reduction in carbon dioxide emissions.
- k) Air source heat pumps provide an excellent way to reduce the carbon emissions and may be considered further during the detailed design stage of the development.
- 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 the solar photovoltaic systems, a reduction of 101.2% over the 2013 Building Regulations for the

developments carbon dioxide emissions could be achieved. This complies with the requirements of the planning policies set out by the London Borough of Hillingdon.

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	1.9
After energy demand reduction	b	1.8
After heat network / CHP	c	1.8
After renewable energy	d	0.0

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	0.1	(a-b)/a*100	3.1
Savings from heat network / CHP	b-c	0.0	(b-c)/a*100	0.0
Savings from renewable energy	c-d	1.80	(c-d)/a*100	98.1
Cumulative on site savings	a-d=e	1.9	(a-d)/a*100	101.2
Annual Savings from off-set payment	a-e=f	-0.0		
Cumulative savings for off-set payment	f*30=g	-0.65		

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

- f) Table 10 above provides the cumulative savings for the off-set payment. This demonstrates that there is zero excess Tonnes Carbon to offset over the next 30 years.
- g) 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 slight 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

- a) The London Borough of Hillingdon 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.
- b) The Hillingdon Local Plan Policy DME1 10: Water Management, Efficiency and Quality requires all new dwellings should limit domestic water consumption to 105 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.
- c) 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.
- d) 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.
- e) Dual flush toilets can be installed to reduce the water consumption of the dwelling. A full flush capacity of 5 litres and a part flush capacity of 3 litres has been selected.
- f) 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 7 litres / minute. The showers shall be restricted to 8 litres / minute.
- g) The capacity of the baths to the over flow shall be 170 litres.

- h) 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.
- i) No water softeners are being installed.
- j) Using the Building Regulations Approved Document G Calculator, the water consumption has been calculated as 104.13 litres / person / day.
- k) The calculated water consumption for the dwelling complies with the requirements of the Local Plan and the Building Regulations Approved Document G.
- l) Details of the calculations can be found in Appendix B.

7.0 **CONCLUSION**

- a) The London Borough of Hillingdon requires all minor residential developments to aim for zero carbon homes, but it achieve at least a 35% reduction in regulated carbon dioxide emissions on site over the 2013 Building Regulations.
- b) The Application is for the redevelopment of the site to create a three bedroom dwelling at Highgrove House, Eastcote Road, Ruislip, HA4 8BP.
- 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 3.12% in the carbon dioxide emissions through fabric and services efficiencies, with a further reduction of 101.2% by the use of solar photovoltaic systems resulting in a total reduction over 2013 Building Regulations of 101.2%.
- 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 Hillingdon.

Appendix A – Full SAP Calculations Printout

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	E1071-01			Issued on Date	16/03/2021
Assessment Reference	E1071-Blr	Prop Type Ref			
Property	Highgrove House, Eastcote Road, Ruislip, HA4 8BP				
SAP Rating	84 B	DER	16.45	TER	16.98
Environmental	85 B	% DER<TER	3.15		
CO ₂ Emissions (t/year)	1.55	DFEE	47.16	TFEE	54.04
General Requirements Compliance	Pass	% DFEE<TFEE	12.74		
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)



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 109 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:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.98 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 16.45 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)47.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.19 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.07 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified ψ -value of 0.060

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Ideal LOGIC+ HEAT H12

Efficiency: 89.4% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.32 kWh/day

Permitted by DBSCG 2.10 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK

Independent timer for DHW OK

Boiler interlock

Yes OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average

Windows facing North: 10.84 m², No overhang

Windows facing South: 2.63 m², No overhang

Windows facing West: 2.55 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

Roof U-value 0.08 W/m²K

Door U-value 0.55 W/m²K

Air permeability 3.0 m³/m²h

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	52.6900 (1b)	x 2.4000 (2b)	= 126.4560 (1b) - (3b)
First floor	56.3300 (1c)	x 2.7000 (2c)	= 152.0910 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 278.5470 (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							3 * 10 =	30.0000 (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) =						30.0000 / (5) =	0.1077 (8)				
Pressure test							Yes					
Measured/design AP50							3.0000					
Infiltration rate							0.2577	(18)				
Number of sides sheltered							1	(19)				
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.9250 (20)				
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.2384 (21)				
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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	0.3039	0.2980	0.2920	0.2622	0.2563	0.2265	0.2265	0.2205	0.2384	0.2563	0.2682	0.2801 (22b)
Effective ac	0.5462	0.5444	0.5426	0.5344	0.5328	0.5256	0.5256	0.5243	0.5284	0.5328	0.5360	0.5392 (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			4.0800	0.5500	2.2440		(26)					
Window (Uw = 1.20)			16.0200	1.1450	18.3435		(27)					
Rooflight (Uw = 1.30)			0.4300	1.2357	0.5314		(27a)					
Grd			49.0500	0.1500	7.3575		(28a)					
1st			3.6400	0.2200	0.8008		(28b)					
External Wall 1	163.2000	20.1000	143.1000	0.1900	27.1890		(29a)					
External Roof 1	56.5300	0.4300	56.1000	0.0800	4.4880		(30)					
Total net area of external elements Aum(A, m2)			272.4200				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9542		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.060 * total exposed area)							16.3452 (36)					
Total fabric heat loss						(33) + (36) =	77.2994 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 50.2057	Feb 50.0408	Mar 49.8792	Apr 49.1202	May 48.9782	Jun 48.3172	Jul 48.3172	Aug 48.1948	Sep 48.5718	Oct 48.9782	Nov 49.2655	Dec 49.5658 (38)
Heat transfer coeff	127.5051	127.3402	127.1786	126.4196	126.2776	125.6166	125.6166	125.4942	125.8712	126.2776	126.5649	126.8652 (39)
Average = Sum(39)m / 12 =												126.4189 (39)
HLP	Jan 1.1696	Feb 1.1680	Mar 1.1666	Apr 1.1596	May 1.1583	Jun 1.1522	Jul 1.1522	Aug 1.1511	Sep 1.1546	Oct 1.1583	Nov 1.1609	Dec 1.1637 (40)
HLP (average)												1.1596 (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												2.8088 (42)
Average daily hot water use (litres/day)												100.9093 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.0003	106.9639	102.9275	98.8911	94.8548	90.8184	90.8184	94.8548	98.8911	102.9275	106.9639	111.0003 (44)
Energy conte	164.6102	143.9691	148.5632	129.5210	124.2785	107.2429	99.3763	114.0358	115.3977	134.4849	146.8008	159.4162 (45)
Energy content (annual)												1587.6967 (45)
Distribution loss	Total = Sum(45)m = 1587.6967 (45)											
	(46)m = 0.15 x (45)m											
	24.6915	21.5954	22.2845	19.4282	18.6418	16.0864	14.9064	17.1054	17.3097	20.1727	22.0201	23.9124 (46)
Water storage loss:												
Store volume	180.0000 (47)											

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.3200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7128 (55)
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (56)
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (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	209.9694	184.9387	193.9224	173.4170	169.6377	151.1389	144.7355	159.3950	159.2937	179.8441	190.6968	204.7754 (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	209.9694	184.9387	193.9224	173.4170	169.6377	151.1389	144.7355	159.3950	159.2937	179.8441	190.6968	204.7754 (64)
Heat gains from water heating, kWh/month	91.0202	80.6454	85.6846	78.1825	77.6100	70.7751	69.3300	74.2043	73.4865	81.0036	83.9281	89.2932 (65)
Total per year (kWh/year) = Sum(64)m =												2121.7647 (64)

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	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.3986	22.5588	18.3460	13.8891	10.3823	8.7652	9.4711	12.3109	16.5236	20.9805	24.4873	26.1045	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.1404	272.9437	265.8796	250.8412	231.8579	214.0163	202.0969	199.2937	206.3577	221.3962	240.3795	258.2211	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	(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)	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	(71)
Water heating gains (Table 5)	122.3390	120.0081	115.1675	108.5869	104.3145	98.2987	93.1855	99.7369	102.0646	108.8758	116.5668	120.0178	(72)
Total internal gains	486.0103	483.6427	467.5254	441.4494	414.6869	389.2123	372.8857	379.4737	393.0782	419.3847	449.5658	472.4756	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
North	10.8400	10.6334	0.7200	0.7000	0.7700	40.2592 (74)
South	2.6300	46.7521	0.7200	0.7000	0.7700	42.9458 (78)
West	2.5500	19.6403	0.7200	0.7000	0.7700	17.4925 (80)
South	0.4300	43.9921	0.7200	0.7000	1.0000	8.5806 (82)

Solar gains	109.2780	197.1471	300.3450	425.6614	527.2402	546.0558	517.0074	437.4805	343.0017	226.0082	132.8611	92.2615 (83)
Total gains	595.2882	680.7898	767.8704	867.1108	941.9270	935.2681	889.8931	816.9542	736.0799	645.3929	582.4269	564.7371 (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	23.7507	23.7814	23.8117	23.9546	23.9816	24.1078	24.1078	24.1313	24.0590	23.9816	23.9271	23.8705	
alpha	2.5834	2.5854	2.5874	2.5970	2.5988	2.6072	2.6072	2.6088	2.6039	2.5988	2.5951	2.5914	
util living area	0.9729	0.9606	0.9368	0.8860	0.7963	0.6662	0.5382	0.5893	0.7793	0.9130	0.9613	0.9763 (86)	
MIT	18.4768	18.7262	19.1673	19.7564	20.3067	20.7038	20.8793	20.8430	20.5175	19.8169	19.0419	18.4230 (87)	
Th 2	19.9444	19.9456	19.9468	19.9525	19.9535	19.9584	19.9584	19.9593	19.9565	19.9535	19.9514	19.9492 (88)	
util rest of house	0.9687	0.9545	0.9264	0.8660	0.7576	0.5965	0.4359	0.4889	0.7231	0.8936	0.9542	0.9726 (89)	
MIT 2	16.5637	16.9256	17.5633	18.4063	19.1670	19.6821	19.8769	19.8459	19.4654	18.5070	17.3910	16.4882 (90)	
Living area fraction									fLA = Living area / (4) =			0.1687 (91)	
MIT	16.8864	17.2293	17.8339	18.6340	19.3592	19.8544	20.0460	20.0141	19.6429	18.7279	17.6695	16.8146 (92)	
Temperature adjustment												0.0000	
adjusted MIT	16.8864	17.2293	17.8339	18.6340	19.3592	19.8544	20.0460	20.0141	19.6429	18.7279	17.6695	16.8146 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9500	0.9313	0.8977	0.8338	0.7316	0.5887	0.4452	0.4947	0.7029	0.8630	0.9313	0.9554 (94)	
Ext temp.	565.5465	633.9987	689.3301	723.0259	689.1281	550.6364	396.1843	404.1877	517.3976	556.9959	542.4100	539.5599 (95)	
Heat loss rate W	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)	
Month fracti	1604.8291	1570.0176	1441.4242	1230.5728	967.1911	660.0456	432.8696	453.5521	697.6892	1026.3740	1337.7238	1600.3513 (97)	
Space heating kWh	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	773.2263	629.0047	559.5580	365.4337	206.8789	0.0000	0.0000	0.0000	0.0000	349.2173	572.6259	789.2288 (98)	
Space heating per m2												4245.1736 (98)	
												(98) / (4) =	38.9394 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)													93.4000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													4545.1538	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	773.2263	629.0047	559.5580	365.4337	206.8789	0.0000	0.0000	0.0000	0.0000	349.2173	572.6259	789.2288	(98)	
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)	
Space heating fuel (main heating system)	827.8654	673.4526	599.0985	391.2567	221.4977	0.0000	0.0000	0.0000	0.0000	373.8943	613.0898	844.9987	(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 requirement	209.9694	184.9387	193.9224	173.4170	169.6377	151.1389	144.7355	159.3950	159.2937	179.8441	190.6968	204.7754	(64)	
Efficiency of water heater (217)m	87.8804	87.7241	87.3808	86.6559	85.2438	79.7000	79.7000	79.7000	79.7000	86.4545	87.4664	87.9670	(216)	
Fuel for water heating, kWh/month	238.9263	210.8187	221.9281	200.1214	199.0029	189.6348	181.6004	199.9937	199.8667	208.0217	218.0229	232.7865	(219)	
Water heating fuel used												2500.7240	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4545.1538	(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)													448.5466	(232)
Total delivered energy for all uses													7569.4244	(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	4545.1538	0.2160	981.7532 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2500.7240	0.2160	540.1564 (264)
Space and water heating			1521.9096 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	448.5466	0.5190	232.7957 (268)
Total CO2, kg/year			1793.6303 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.4500 (273)

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

DER		16.4500	ZC1
Total Floor Area	TFA	109.0200	
Assumed number of occupants	N	2.8088	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.6835	ZC2
CO2 emissions from cooking, equation (L16)		1.7099	ZC3
Total CO2 emissions		32.8434	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		32.8434	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	52.6900 (1b)	x 2.4000 (2b)	= 126.4560 (1b) - (3b)
First floor	56.3300 (1c)	x 2.7000 (2c)	= 152.0910 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 278.5470 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1436 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3936 (18)
Number of sides sheltered					1 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3641 (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	0.4642	0.4551	0.4460	0.4005	0.3914	0.3459	0.3459	0.3368	0.3641	0.3914	0.4096	0.4278 (22b)
Effective ac	0.6077	0.6036	0.5995	0.5802	0.5766	0.5598	0.5598	0.5567	0.5663	0.5766	0.5839	0.5915 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			4.0800	1.0000	4.0800		(26)
TER Opening Type (Uw = 1.40)			16.0200	1.3258	21.2386		(27)
TER Room Window (Uw = 1.70)			0.4300	1.5918	0.6845		(27a)
Grd			49.0500	0.1300	6.3765		(28a)
1st			3.6400	0.1300	0.4732		(28b)
External Wall 1	163.2000	20.1000	143.1000	0.1800	25.7580		(29a)
External Roof 1	56.5300	0.4300	56.1000	0.1300	7.2930		(30)
Total net area of external elements Aum(A, m ²)			272.4200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.9038		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Total fabric heat loss						(33) + (36) =	65.9038 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	55.8640	55.4795	55.1025	53.3319	53.0007	51.4586	51.4586	51.1730	52.0526	53.0007	53.6708	54.3714 (38)
Heat transfer coeff	121.7678	121.3833	121.0063	119.2357	118.9045	117.3623	117.3623	117.0768	117.9563	118.9045	119.5746	120.2752 (39)
Average = Sum(39)m / 12 =												119.2341 (39)
HLP	1.1169	1.1134	1.1099	1.0937	1.0907	1.0765	1.0765	1.0739	1.0820	1.0907	1.0968	1.1032 (40)
HLP (average)												1.0937 (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												2.8088 (42)
Average daily hot water use (litres/day)												100.9093 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.0003	106.9639	102.9275	98.8911	94.8548	90.8184	90.8184	94.8548	98.8911	102.9275	106.9639	111.0003 (44)
Energy conte	164.6102	143.9691	148.5632	129.5210	124.2785	107.2429	99.3763	114.0358	115.3977	134.4849	146.8008	159.4162 (45)
Energy content (annual)											Total = Sum(45)m =	1587.6967 (45)
Distribution loss	(46)m = 0.15 x (45)m											
	24.6915	21.5954	22.2845	19.4282	18.6418	16.0864	14.9064	17.1054	17.3097	20.1727	22.0201	23.9124 (46)
Water storage loss:												
Store volume												180.0000 (47)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):												1.5520 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8381 (55)
Total storage loss												
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage												
25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month												
213.8529	188.4464	197.8059	177.1752	173.5212	154.8971	148.6190	163.2784	163.0519	183.7276	194.4550	208.6588	(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	(63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h												
213.8529	188.4464	197.8059	177.1752	173.5212	154.8971	148.6190	163.2784	163.0519	183.7276	194.4550	208.6588	(64)
Heat gains from water heating, kWh/month												
94.1270	83.4515	88.7914	81.1891	80.7167	73.7816	72.4368	77.3110	76.4931	84.1104	86.9346	92.4000	(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)
(66)m	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	140.4407	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
25.3986	22.5588	18.3460	13.8891	10.3823	8.7652	9.4711	12.3109	16.5236	20.9805	24.4873	26.1045	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
270.1404	272.9437	265.8796	250.8412	231.8579	214.0163	202.0969	199.2937	206.3577	221.3962	240.3795	258.2211	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	37.0441	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	-112.3526	(71)
Water heating gains (Table 5)												
126.5148	124.1838	119.3433	112.7626	108.4902	102.4745	97.3612	103.9127	106.2404	113.0516	120.7425	124.1936	(72)
Total internal gains												
490.1860	487.8185	471.7012	445.6252	418.8626	393.3881	377.0615	383.6495	397.2540	423.5605	453.7416	476.6514	(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				10.8400	10.6334	0.6300	0.7000	0.7700	35.2268 (74)			
South				2.6300	46.7521	0.6300	0.7000	0.7700	37.5775 (78)			
West				2.5500	19.6403	0.6300	0.7000	0.7700	15.3059 (80)			
South				0.4300	43.9921	0.6300	0.7000	1.0000	7.5080 (82)			

Solar gains	95.6182	172.5037	262.8018	372.4537	461.3352	477.7988	452.3815	382.7955	300.1265	197.7572	116.2535	80.7288 (83)
Total gains	585.8043	660.3222	734.5030	818.0789	880.1978	871.1869	829.4429	766.4449	697.3805	621.3176	569.9950	557.3802 (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	62.1743	62.3713	62.5656	63.4947	63.6716	64.5082	64.5082	64.6655	64.1833	63.6716	63.3147	62.9459
alpha	5.1450	5.1581	5.1710	5.2330	5.2448	5.3005	5.3005	5.3110	5.2789	5.2448	5.2210	5.1964
util living area	0.9988	0.9975	0.9935	0.9771	0.9188	0.7730	0.6025	0.6667	0.8980	0.9864	0.9975	0.9991 (86)
MIT	19.7447	19.8764	20.1107	20.4400	20.7413	20.9322	20.9855	20.9759	20.8363	20.4568	20.0488	19.7282 (87)
Th 2	19.9870	19.9899	19.9927	20.0060	20.0085	20.0201	20.0201	20.0222	20.0156	20.0085	20.0034	19.9982 (88)
util rest of house	0.9984	0.9967	0.9911	0.9676	0.8842	0.6870	0.4785	0.5424	0.8410	0.9791	0.9965	0.9988 (89)
MIT 2	18.3047	18.4993	18.8428	19.3270	19.7410	19.9720	20.0143	20.0115	19.8734	19.3575	18.7613	18.2886 (90)
Living area fraction									fLA = Living area / (4) =			0.1687 (91)
MIT	18.5476	18.7316	19.0567	19.5147	19.9097	20.1339	20.1782	20.1742	20.0358	19.5429	18.9785	18.5314 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5476	18.7316	19.0567	19.5147	19.9097	20.1339	20.1782	20.1742	20.0358	19.5429	18.9785	18.5314 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9975	0.9951	0.9878	0.9614	0.8800	0.6980	0.4994	0.5630	0.8424	0.9743	0.9949	0.9981 (94)
Useful gains	584.3474	657.0588	725.5571	786.5154	774.5512	608.1315	414.2413	431.5067	587.4792	605.3377	567.0824	556.3110 (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												
	1734.9028	1678.9235	1519.4349	1265.6566	976.1752	649.4769	419.9407	441.8687	700.1683	1063.3536	1420.3667	1723.7165 (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												
	856.0133	686.6931	590.6451	344.9817	150.0082	0.0000	0.0000	0.0000	0.0000	340.7638	614.3647	868.5496 (98)
Space heating												4452.0196 (98)
Space heating per m2											(98) / (4) =	40.8367 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

4761.5183 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	856.0133	686.6931	590.6451	344.9817	150.0082	0.0000	0.0000	0.0000	0.0000	340.7638	614.3647	868.5496	(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)	915.5222	734.4311	631.7060	368.9644	160.4366	0.0000	0.0000	0.0000	0.0000	364.4533	657.0746	928.9301	(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 requirement	213.8529	188.4464	197.8059	177.1752	173.5212	154.8971	148.6190	163.2784	163.0519	183.7276	194.4550	208.6588	(64)
Efficiency of water heater (217)m	88.1377	87.9603	87.5547	86.5617	84.4283	79.8000	79.8000	79.8000	79.8000	86.4400	87.6737	88.2090	(216)
Fuel for water heating, kWh/month	242.6348	214.2402	225.9226	204.6808	205.5248	194.1066	186.2393	204.6096	204.3257	212.5494	221.7940	236.5506	(219)
Water heating fuel used												2553.1785	(219)
Annual totals kWh/year													
Space heating fuel - main system												4761.5183	(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)												448.5466	(232)
Total delivered energy for all uses												7838.2433	(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	4761.5183	0.2160	1028.4879 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2553.1785	0.2160	551.4866 (264)
Space and water heating			1579.9745 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	448.5466	0.5190	232.7957 (268)
Total CO2, kg/m2/year			1851.6952 (272)
Emissions per m2 for space and water heating			14.4925 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1353 (272b)
Emissions per m2 for pumps and fans			0.3570 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.4925 * 1.00) + 2.1353 + 0.3570, rounded to 2 d.p.			16.9800 (273)

Appendix B – Water Calculations

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

Project Details

Address/Reference	Highgrove House	Case Reference	E1071
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

Baths

Bath Type	Capacity to Overflow	Quantity (No.)	Total per Fitting type
Bath	170.00	1	170.00
			0.00
			0.00
			0.00
Total No. of Fittings (No.)		1	
Total Capacity (l)			170.00
Maximum Capacity (l)			170.00
Average Capacity (l)			170.00
Weighted Average Capacity (l)			119.00
Capacity for Calculation (l)			170.00

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

Kitchen Taps

Tap Fitting Type	Flow Rate Litres/Min	Quantity (No.)	Total per Fitting type
Kitchen Tap	8.00	1	8.00
			0.00
			0.00
Total No. of Fittings (No.)		1	
Total Flow (l/s)			8.00
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

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)	3.67	4.42	0.00	16.21
Taps Exc. Kitchen	Flow Rate	4.00	1.58	1.58	7.90
Bath (shower present)	(l/s)	170.00	0.11	0.00	18.70
Shower (bath present)	(l/s)	7.00	4.37	0.00	30.59
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)	8.00	0.44	10.36	13.88
Washing Machines	(l/kgdry)	8.17	2.10	0.00	17.16
Dishwashers	(l/place)	1.25	3.60	0.00	4.50
Waste Disposal	(l/s)	0.00	3.08	0.00	0.00
Water Softner	(l/s)	0.00	1.00	0.00	0.00
Total Calculated Water Use (l/p/day)					108.93
Grey/RainWater Reused (l)					0.00
Normalisation Factor (Factor)					0.91
Total Consumption CSH (l/p/day)					99.13
External Water Use Allowance (l)					5.00
Total Consumption Part G (l/p/day)					104.13

Showers

Shower fitting Type	Flow Rate Litres/Min	Quantity (No.)	Total per Fitting type
Thermostatic Shower	7.00	2	14.00
			0.00
			0.00
			0.00
			0.00
			0.00
Total No. of Fittings (No.)		2	
Total Flow (l/s)			14.00
Maximum Flow (l/s)			7.00
Average Flow (l/s)			7.00
Weighted Average Flow (l/s)			4.90
Flow for Calculation (l/s)			7.00

WCs

WC Type	Full Flush Volume	Part Flush Volume	Quantity (No)
Dual WC	5.00	3.00	3
Total number of fittings			3
Average effective flushing volume			3.67

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

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 Available Grey Water Supply (l)	197.16
Possible Demand (l)	133.45
Grey/Rain Installed Capacity (l)	0.00
Figure for Calculation lit/person/day	0.00

<< Note - these may be default values.
<< You can change them by entering
the actual appliances in the
appropriate sections above

Assesment Result

PASS