Ms R Lord & Mr J Weston

92 Fitzjohn's Avenue
Hampstead
London Borough of Camden
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Sustainability and Energy Statement

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Executive Summary

This Sustainability Statement has been undertaken by SRE for the Proposed Development at 92 Fitzjohn's Avenue, London Borough of Camden (Proposed Development) in order to meet the requirements of the London Borough of Camden Core Strategy and associated Development Policies, as well as the London Plan and National Planning Policy.

The Proposed Development will meet all of the relevant policies in the provision of a resource efficient, sustainable residential development.

This Statement assesses the inclusion of energy efficiency measures to minimise on-site energy use compared to a Building Regulation compliant design, including high efficiency gas heating systems, improved insulation levels, high specification glazing and energy efficient lighting and appliances.

The availability, feasibility and suitability of connecting to a decentralised heating network, or providing on-site Combined Heat and Power is investigated in response to the planning policy requirements.

Furthermore, renewable energy solutions for the Proposed Development are assessed, taking into consideration both the technical and the economic viability of the proposals in order to meet both the **20% CO_2 offset requirement and a 35% improvement over Building Regulations 2013 for the new build house,** as outlined by Planning Policy.

The assessment of viable on-site renewable energy generation in relation to the design, site location and orientation concludes that **the installation of a Photovoltaic Array and Solar Water Heating will offset 20.6% of the predicted CO_2 emissions of the dwelling**, based on the energy baseline as well as a 45% improvement over Building Regulations 2013.

This report assesses in outline the Proposed Development in relation to wider Sustainability requirements for the area, relating to both local and regional planning policy.

The Proposed Development goes as far as is practical in meeting all of the relevant requirements set out within the London Borough of Camden policies and guidance.

1.0 Introduction

1.0.1 This Energy & Sustainability Statement has been prepared by SRE to accompany the planning application for the Proposed Development at 92 Fitzjohn's Avenue, London Borough of Camden (the Proposed Development) for Projekt Plus on behalf of Ms R Lord and Mr J Weston.

1.0.2 The Statement provides a prediction of the Proposed Development's energy baseline requirement (Building Regulation compliant), which is achieved through the use of energy efficiency measures, and assesses suitable renewable energy technologies in relation to the site layout, building design, energy demand and in response to the relevant planning requirements.

1.0.3 The statement includes the relevant London Borough of Camden (LBC) planning policy and details how the Proposed Development responds to, and meets the relevant requirements as part of an overall sustainability assessment.

1.1 The Proposed Development

1.1.1 The Proposed Development at 92 Fitzjohn's Avenue consists of 1 No. new build 4-bedroom house which is to be built on the site of an existing single family dwelling.

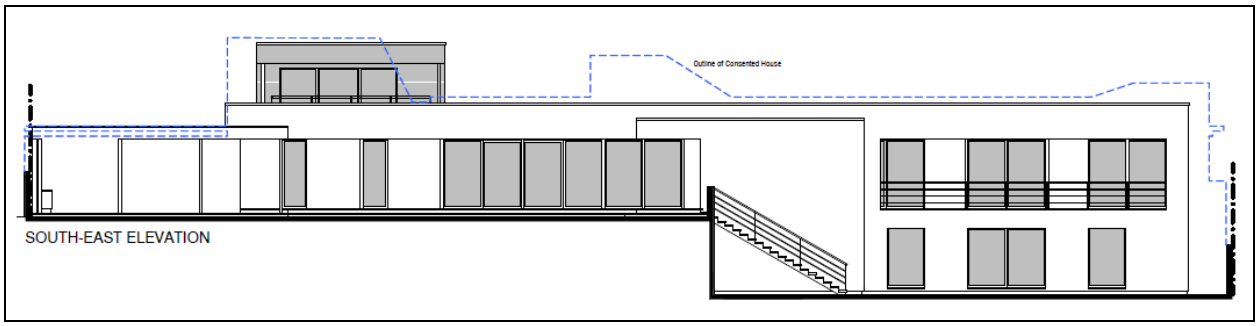


Figure 1: Proposed Development

1.1.2 Full details of the Proposed Development can be found in the supporting drawings (See Appendix A for proposed site layout plan).

2.0 Sustainability Approach

2.0.1 The World Commission on Environment and Development (WCED) report: Our Common Future, describes Sustainable Development as development which:

"meets the needs of the present without compromising the ability of future generations to meet their own needs."

2.0.2 This broad concept of Sustainable Development is taken into account within the Sustainability and Energy Statement. However, the focus is on successfully meeting the requirements of planning policy and guidance, with key documents listed below.

2.1 Sustainability Guidelines and Policy

2.1.1 The following planning policy and guidance has been used to inform the strategy and to ensure that the Proposed Development meets all requirements imposed on it through Planning Policy.

Key Policies

2.1.2 The following planning policy and guidance has been used to inform the strategy and to ensure that the Proposed Development meets all requirements imposed on it through Planning Policy.

- London Borough of Camden Core Strategy 2010 – 2025 (Adoption version 2010)
    - Policy CS13: Tackling climate change through promoting higher environmental standards
- London Borough of Camden Supplementary Planning Documents (SPDs)
    - CPG 3 Sustainability – Adopted 6th April 2009
- London Borough of Camden Local Development Framework (LDF): Camden Development Policies (Adopted version 2010)
    - Policy DP22 (Promoting sustainable design and construction)

2.2 Policy CS13: Reducing the effects of and adapting to climate change

2.2.1 The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) promoting the efficient use of land and buildings;

c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

- ensuring developments use less energy,

- making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;

- generating renewable energy on-site; and

d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

2.2.2 The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

Local energy generation

2.2.3 The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

- housing estates with community heating or the potential for community heating and other uses with large heating loads;

- the growth areas of King's Cross, Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;

- schools to be redeveloped as part of Building Schools for the Future programme;

- existing or approved combined heat and power/local energy networks and other locations where land ownership would facilitate their implementation.

f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

2.3 London Borough of Camden SPD: CPG 3 Sustainability

Section 5: Decentralised energy networks and combined heat and power

"Decentralised energy could provide 20% of Camden's heating demand by 2020."

"Combined heat and power plants can reduce carbon dioxide emissions by 30-40% compared to a conventional gas boiler."

"Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP. "

Section 6: Renewable energy

"All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies."

2.3.1 In addition to this 20% reduction, the London Plan requires new build residential developments to achieve a 35% improvement over Building Regulations 2013.

"When assessing the feasibility and viability of renewable energy technology, the Council will consider the overall cost of all the measures proposed and resulting carbon savings to ensure that the most cost-effective carbon reduction technologies are implemented in line with the energy hierarchy."

2.3.2 Additionally, "Developments should achieve 50% of the un-weighted credits in the Energy category", with the same now applicable to the Water category as well.

2.4 London Borough of Camden local Development Framework: Camden Development Policies

Policy DP22: Promoting sustainable design and construction

2.4.1 The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation.

b) incorporate green or brown roofs and green walls wherever suitable

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and **Code Level 4 by 2013** and encouraging Code Level 6 (zero carbon) by 2016.

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013.

e) expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

2.4.2 The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting

g) limiting run-off

h) reducing water consumption

i) reducing air pollution

j) not locating vulnerable uses in basements in flood-prone areas

Supporting Policies

- Mayor of London, The London Plan – Spatial Development Strategy for Greater London (July 2011)
- National Planning Policy Framework (Mar 2012)

3.0 Minimum Policy Compliance

3.0.1 The following section outlines how the minimum policy requirements relating to sustainability, outlined in Section 2.0 above will be achieved. A detailed analysis of the energy strategy for the proposed development will be covered in Section 4.0

Environmental Rating – Code for Sustainable Homes

3.0.2 The supporting Code for Sustainable Homes Pre-Assessment Estimate shows that the new build detached house is predicted to meet the requirements for certification to Code Level 4.

3.0.3 The Code for Sustainable Homes is a nationally recognised standard used to assess the environmental performance of homes and aims to acknowledge improved environmental performance in house design.

3.0.4 The scheme considers both broad environmental concerns (e.g. climate change, resource use) as well as site specific issues (e.g. energy use, ecology etc), and these issues are balanced against the desire for high quality of life and a safe and healthy internal environment. The issues assessed are arranged into nine key categories:

• Energy	• Surface Water Run-Off	• Health & Wellbeing
• Water	• Waste	• Management
• Materials	• Pollution	• Ecology & Land-Use

Table 1: CSH Categories

3.0.5 SRE are a Code for Sustainable Homes accredited assessor organisation.

3.0.6 A summary of the key measures that are to be implemented and the final credit score for the house is provided in the full Pre-Assessment (Appendix B). Code for Sustainable homes principles are relevant to the proposed house in trying to maximise the sustainability for the development as a whole.

Energy Assessment

3.0.7 The Proposed Development's predicted energy use, suitable energy efficiency measures, renewable and low carbon energy technology and associated CO_2 emissions reductions are assessed in detail in Section 4.

3.1 Energy Use and Pollution

Need for Cooling

3.1.1 The Proposed Development will not incorporate any active cooling (such as Air Conditioning).

3.1.2 The house has been designed around passive ventilation with windows on opposite elevations which enables and enhances the level of natural ventilation within the building.

3.1.3 In addition the house will incorporate a whole house mechanical ventilation system with heat recovery and summer bypass, and as such an adequate level of background ventilation will be maintained in accordance with Part F, either passively, or actively.

3.1.4 High levels of insulation will help reduce heat exiting and entering the building. A licensed woodshaving insulation will support the building to cool itself in summer. The woodshavings are produced with almost no primary energy and its apparent good phase shifting properties for heat entering the building.

3.1.5 The building specification is a highly efficient pre-fabricated Baufritz system. Therefore the external wall and roof construction is expected to feature low thermal mass with very good bridging and low U-Values.

3.1.6 Thermal mass in the external building envelope can reduce any potential risk of overheating in south facing rooms in the summer months by absorbing solar radiation and allowing it to dissipate without being transmitted into the building itself. However, the majority of solar gain is via glazing, and this can be partially controlled with blinds. Concrete flooring on the lower ground and ground floor will also assist in reducing the over-heating risk.

Heat Generation

3.1.7 Heating and cooling systems - and the heating system hierarchy - are assessed in detail in Section 4.

Pollution: Air, Noise and Light

3.1.8 Construction site impacts will be monitored as standard practice in line with CSH requirements. This includes:

- Adopt best practice in terms of air (dust) pollution from site activities

This will include items such as:

- Air quality procedures to minimise dust generation and control plant and vehicle exhaust emissions will be established.
- Ensure that all materials transported to and from site are in enclosed containers or fully sheeted.
- During dry periods the works are to be damped down to control the generation of dust.
- Ensuring materials have a minimum of packaging.
- Ensuring all polystyrene and similar lightweight materials are weighted down.
- Making sure all dust generating materials are adequately packaged.
- Provide regular road cleaning using road sweepers or brushes to control dust and must.
- Keeping the loading drop heights of spoil into lorries as low as possible.
- Implementing an effective procedure to deal with complaints from third parties to ensure issues are dealt with efficiently and quickly, via an advised and dedicated telephone number.

3.1.9 There will be no increase in noise levels to the surrounding area once the scheme is completed as a result of the proposed residential development.

3.1.10 Light pollution will be minimised through the careful specification and positioning of any external lighting required by the Proposed Development, ensuring that no lighting negatively impacts the surrounding residential units.

3.1.11 Under CSH guidelines of assessment, external lighting is controlled through daylight and/or PIR sensors and will consist of energy efficient fittings.

3.1.12 The proposed pre-fabrication build will mean that the shell of the build will be up and watertight within two weeks. Noise is therefore restricted to a limited timescale and dust emissions will be considerably less than normal construction methods. As the building is

pre-fabricated, workers on site will only use cordless drills, seldom using heavy equipment to adjust readymade panels.

3.2 Biodiversity

Minimising the threat to biodiversity

3.2.1 The proposed development is to be on the site of an existing development. Although this cannot be deemed of low ecological value in accordance with BRE Methodology due to the presence of mature trees on the site, all features will be maintained and protected during construction in accordance with EU and UK Law – this is also required as part of the CSH Assessment.

3.2.2 An ecology report was approved as part of the extant planning permission on this site. It is resubmitted as part of the application.

3.2.3 As explained in the ecological report, the introduction of bird and bat boxes and a sedum roof will allow for an increase of on-site biodiversity.

3.3 Flooding and Drainage

Reducing and mitigating the risks of flooding and other impacts of climate change

3.3.1 The application site is in an area of low flood risk based on Environment Agency Flood Risk mapping (Figure 2).

3.3.2 The Proposed Development incorporated sustainable drainage features to help to mitigate localised flash flooding (such as permeable paving, soft landscaping and sedum roofs).

3.3.3 Compliance is assessed as part of the mandatory Sur 1 section of the CSH Assessment – please see the supporting CSH Pre-Assessment for details of compliance here.

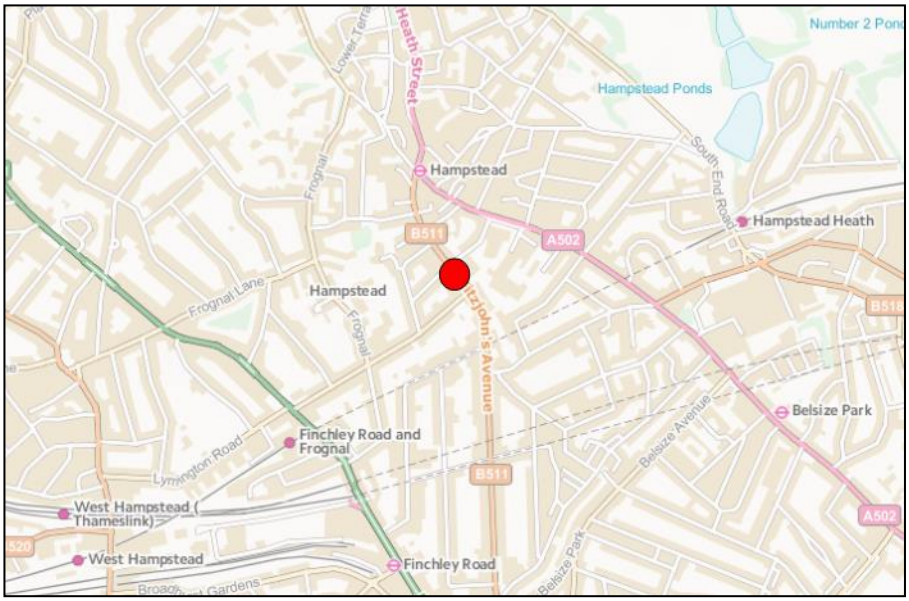


Figure 2: EA Flood Risk Map

3.4 Improving Resource Efficiency

Reduce waste generated and amount disposed of by landfill

3.4.1 A Site Waste Management Plan (SWMP) will be established before construction work commences on site to monitor, report and set targets for the level of waste being re-used

and recycled. This process will also be applicable for assessment as part of the CSH standards.

3.4.2 Appropriate monthly monitoring and waste targets will be set by the main contractor to minimise waste during the construction process – this is assessed under the Management section of the CSH.

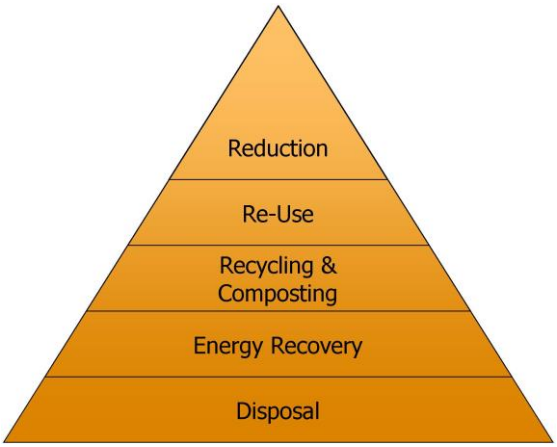


Figure 3: Waste Hierarchy

3.4.3 Environment Agency data indicates that the site is not expected to be considered as contaminated – there are no reported 'major' pollution incidences on the site or in the surrounding area (Figure 4).

3.4.4 There are no landfill sites in the surrounding area (Figure 5).

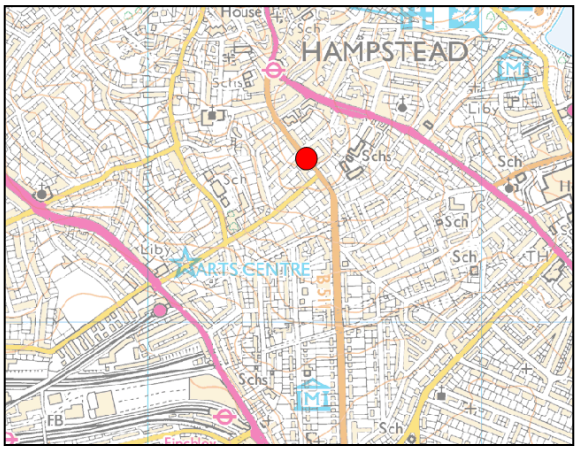


Figure 4: EA Pollution Map

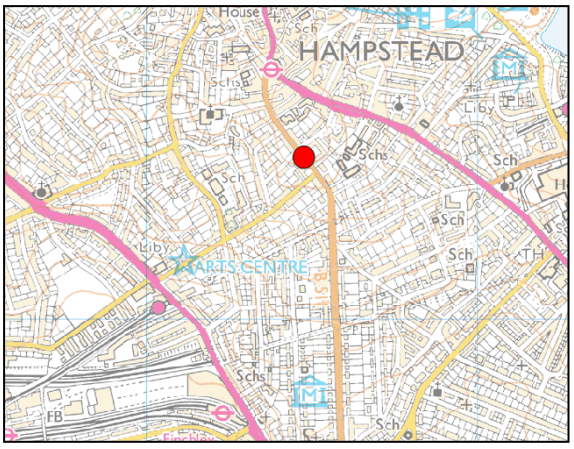


Figure 5: EA Landfill Map

Reducing levels of water waste

3.4.5 The aim of incorporating internal water conservation measures is to reduce overall water usage to a maximum of 105L/person/day, in-line with the mandatory requirements of a Code for Sustainable Homes Level 4 development.

3.4.6 The planning requirements state that at least 50% of the un-weighted credits in the water category should be achieved. Minimising water use and providing rainwater butts in the central garden area will achieve 4 out of 6 credits. Please see the CSH pre-assessment for further details.

4.0 Energy Approach

4.0.1 The outline approach for the Proposed Development in addressing energy issues, and responding to guidance listed in Section 2.0, is through minimising the building's overall environmental impact and reducing its resource use to exceed the performance standards required by Building Regulations.

4.0.2 The approach adopts the following standard energy strategy (in-line with general national energy policy) by seeking to:

- Use Less Energy (Be Lean) – minimise the overall environmental impact and energy use through energy efficiency measures - e.g. improved insulation and glazing.
- Use Clean Energy (Be Clean) – ensure that energy systems on-site (heat and power) are efficient and produce minimal CO_2 emissions - e.g. high efficiency boilers/heat pumps
- Use Renewable Energy (Be Green) – implement the use of suitable technologies to provide renewable and emission free energy sources.

4.0.3 The design has sought to greatly enhance the building envelope specification to minimise the overall energy demand and implementing good passive solar design where practicable.

4.0.4 The primary energy for the proposed development will be very low, the current calculations cannot take account of this, but it is an important consideration for the proposed development when looking at overall CO_2 emissions of the building.

4.0.5 The CO_2 Conversion Factors have been taken from Building Regulations 2013:

Fuel Source	CO_2 Conversion Factor ($kgCO_2/kWh$)
Electricity (mains)	0.519
Electricity (offset)	-0.519
Gas (mains)	0.216
Heating Oil	0.298
Wood Pellets	0.039
Wood Chip	0.016

Table 2: CO_2 Conversion Factors

4.0.6 Carbon Dioxide (CO_2) is the main greenhouse gas[1] that is deemed responsible for anthropogenic climate change[2]. Although by mass it does not have as high radiative forcing effect as other gases (namely CH4 – Methane), the sheer quantity released through combustion means that, overall, it has the most effect. It is also one of the more controllable – it can be directly controlled through reductions in fossil energy use.

4.0.7 It is also equally important in an era of ever increasing total energy consumption to increase energy efficiency in order to minimise dependency on, and conserve existing supplies of fossil oil and gas, which are estimated to be at, or close to, their peak of supply[3]. After this

[1] Joint Science Academies' statement, 2005: Global response to climate change

[2] IPCC, 2007: Summary for Policymakers & Technical Summary. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*

[3] More information, references and peer-reviewed articles at http://www.peakoil.net & http://www.odac-info.org

peak, production, and therefore availability, is expected to steadily decline resulting in a constant increase in fuel cost.

4.1 Energy Conservation Measures (be lean)

4.1.1 The overall energy strategy for the Proposed Development, as highlighted later in the report, will be to use less energy, use clean energy and use renewable energy and to, where possible, design an energy conscious building to positively influence the overall predicted energy demand.

4.1.2 A number of energy conservation measures will be incorporated by the applicant to reduce the overall energy load for the Proposed Development. This is in-line with both the guidance listed above as well as general national 'Best Practice' guidance for delivering energy efficient buildings.

Passive Solar Design

4.1.3 The Proposed Development is orientated with the majority of glazing facing south east. There will be a decrease in the space heating load due to the passive solar warming provided by these windows.

Insulation and Air Tightness

4.1.4 All elements will incorporate high performance insulation in the building envelope (walls, roofs and windows) to ensure that the space heating load will be reduced over that of a Building Regulations (Part L1A) compliant design.

Element	Proposed U-Value
Roof	0.12
External Walls	0.16
Sheltered Walls	0.3
Basement Walls	0.3
Windows	0.8
Ground Floor	0.2
Basement Floor	0.2
Upper Floor (exposed)	0.2

Table 3: Proposed U-Values

4.1.5 Air tightness has been estimated as achieving a rate of ≤3m^3/hr/m^2, and will be tested as part of Building Regulation compliance and to inform final As-Built SAP in line with best practice within the UK. It should be noted that Baufritz systems very rarely achieve air tightness results >1.5m^3/hr/m^2 and therefore the post-construction energy numbers may improve even further than currently modelled.

Energy Efficient Lighting and Appliances

4.1.6 The Proposed Development will make use of low energy lighting in-line with BRE methodology and in excess of Building Regulation requirements. All lighting is assumed as being energy efficient and is included as such within SAP modelling.

4.1.7 Where white goods are fitted, 'A' or 'A+' rated white goods will be used in line with CSH requirements. Based on the BRE calculation methodology these measures will reduce electrical demand by ~10% - although it is not possible to calculate any reductions at this stage or through the Standard Assessment Procedure.

4.1.8 The building as a whole will ensure that any external lighting is positioned, controlled and focused to provide efficient safe and secure access without using excessive energy. This will comprise dedicated energy efficient luminaires or in the case of any specified security lighting, a maximum lamp capacity of 150W per fitting, supported by infrared, daylight sensor and time controls as standard.

Whole House Mechanical Ventilation with Heat Recovery

4.1.9 The Proposed Development will utilise a whole house mechanical ventilation system with heat recovery. This system will ensure that the building ventilation is adequate and managed within an air tight design. A summer bypass feature will also be used to ensure that no additional heat is added within the building envelope during hot periods in summer months.

High Efficiency Gas Condensing Boiler

4.1.10 In the Predicted Energy Baseline the units will be specified with a high efficiency gas boiler system to provide all the space heating and hot water supply. Therefore the heat source is able to deliver greater CO_2 savings, as well as reduced NOx emissions.

Influence Energy Behaviour

4.1.11 The Proposed Development will be provided with a Home User Guide which will detail how to effectively use all the appliances and fittings installed and thereby minimise associated energy use and CO_2 emissions. This information will inform the residents on how to gain maximum benefit from the appliances and energy systems provided and will help to positively influence their long term energy behaviour.

4.1.12 Energy meters will also be provided so the residents can monitor the amount of energy used within the dwelling – energy meters can log the electricity and gas usage of a building, provide cost breakdowns and indicate if excessive energy is being used at any point. These systems allow the end user to take control of their energy use, allowing them to cut their costs and CO_2 emissions. At present a monitoring device for electricity is proposed as part of the CSH requirements.

4.1.13 All major utilities now offer a 'green energy tariff' to business and domestic customers from either their own renewable sources (such as offshore wind farms) or are purchasing power from such sources for their green energy tariff. Although this does not qualify as a renewable energy technology, it is recommended that the Proposed Development be connected to a green electricity tariff as standard in order to promote the growth of this sector of power generation.

4.2 Baseline Energy Prediction

4.2.1 The following energy baseline has been calculated taking into consideration the positive impact of the energy efficiency measures listed above.

4.2.2 SAP 2012 and Building Regulations 2013 have been used to generate the energy baseline. The unregulated 'Appliances and Cooking' load is drawn from BRE Methodology.

Unit	*Electrical Demand (kWh/yr)*	*Fossil Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2$/yr)
House	2,993	24,960	7,306	35,258	10,942

Table 4: Baseline Energy Prediction

4.3 Energy Supply (be clean)

Decentralised Heat and Power

4.3.1 An initial scoping assessment of local decentralised heat and power options has been undertaken using the London Heat Map[4].

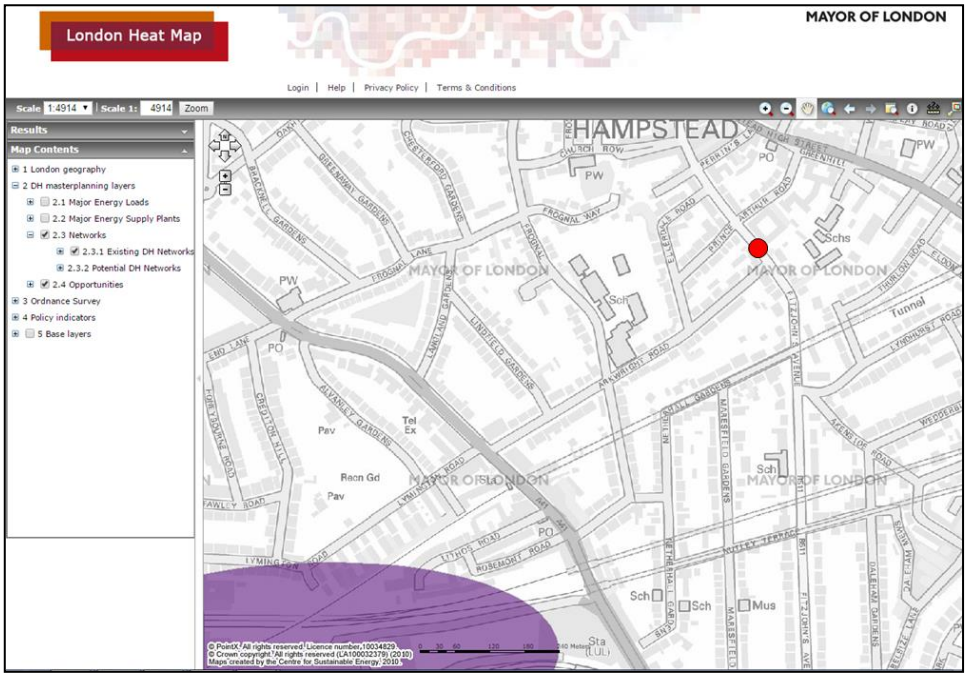


Figure 6: London Heat Map

4.3.2 The Heat Map indicates that there are currently no existing or proposed district heat networks near to the application site.

4.3.3 As such, there is not expected to be any practical scope for connecting the site to a decentralised heating network.

Combined Heat and Power

4.3.4 The use of Micro-CHP has been considered for the site as a heating system, with the added benefit of on-site electrical generation. The installation of a CHP unit (such as the Baxi

[4] www.londonheatmap.org.uk/

Ecogen[5]). The installation of a micro-CHP boiler would reduce the amount of PV that is required to meet the CO_2 offset policies slightly but not to the extent that it would be considered economically feasible.

Unit	*Electrical Demand (kWh/yr)*	*Fossil Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	CO_2 emissions ($kgCO_2/yr$)
House	2,993	25,779	7,306	36,077	10,261

Table 5: Micro-CHP Energy Prediction

The use of Heat Pump Technology

4.3.5 The use of heat pumps (HP) in place of a gas heating system can be feasible in terms of CO_2 emissions, but only if the system is well sized and ground conditions (for GSHPs) are such that a high Co-efficient of Performance can be achieved on average.

4.3.6 Heat pumps will only deliver low grade heat (~50°C) efficiently, and therefore HP systems are generally inefficient in providing Domestic Hot Water (DHW), as this requires additional electrical use (immersion or increased compressor use within the heat pump), unless a treated hot water system is used, or hot water provided via a separate system.

4.3.7 There is also the issue of 'future-proofing' a building – gas is a finite resource which is decreasing in availability and therefore increasing in cost. To maintain energy security it may be wise to ensure that, even if a building is specified with a gas system, there is the capability to move it to a heat pump based system at a later date.

4.4 Renewable Energy Assessment (be green)

4.4.1 In order to meet the required 20% CO_2 off set from renewables and 35% DER improvement target, the following technologies have been assessed for their feasibility at the Proposed Development.

4.4.2 Table 6 below summarises the various renewable energy solutions that have been assessed for the Proposed Development.

Technology	Technically Feasible	CO_2 Offset ($kgCO_2/yr$)	Benefits	Weakness
Photovoltaics	✓	2,228	High CO_2 offset and proven technology	Higher capital cost than other solar technologies
Solar Water Heating	✓	316	Efficient and integrates with a domestic heat pump	Lower CO_2 offset as replacing gas supply
Ground Source Heat Pumps	×	×	Provides space heating and a proportion of domestic hot water dependant of gas	Low CO_2 offset, ground conditions dependant, borehole drilling costs.

[5] Examples only and do not constitute product endorsements

Air Source Heat Pumps	✓	-	Provides space heating and a proportion of domestic hot water dependant of gas	Low overall CO_2 offset. Potential system noise. Large external collector required.
Biomass	~	×	Provides secondary heating with low CO_2 emissions	Fuel storage space & fuel cost, regular supply of fuel
Wind Turbines	×	×	Strong visual positive impact	Poor local wind resource and potentially intrusive

Table 6: Summary of Renewable Energy Assessment

4.5 Viable Energy Technologies

4.5.1 A number of renewable energy technologies are technically viable, although any potential design and structural issues would need to be clarified in relation to the finalised design.

• Photovoltaics	• Air Source Heat	• Biomass
• Solar Water Heating	• Ground Source Heat	• Wind Turbine

Table 7: Assessed Renewable Technologies

Photovoltaics

4.5.2 The installation of Photovoltaics (PV) will be used to offset electrical demand within the Proposed Development. The Photovoltaic arrays will be connected into the electrical system via an inverter.

4.5.3 The orientation and inclination of the PV arrays will affect the performance of the system. Part of the flat roof has been allocated for the use of PV, and therefore there is sufficient room for installation.

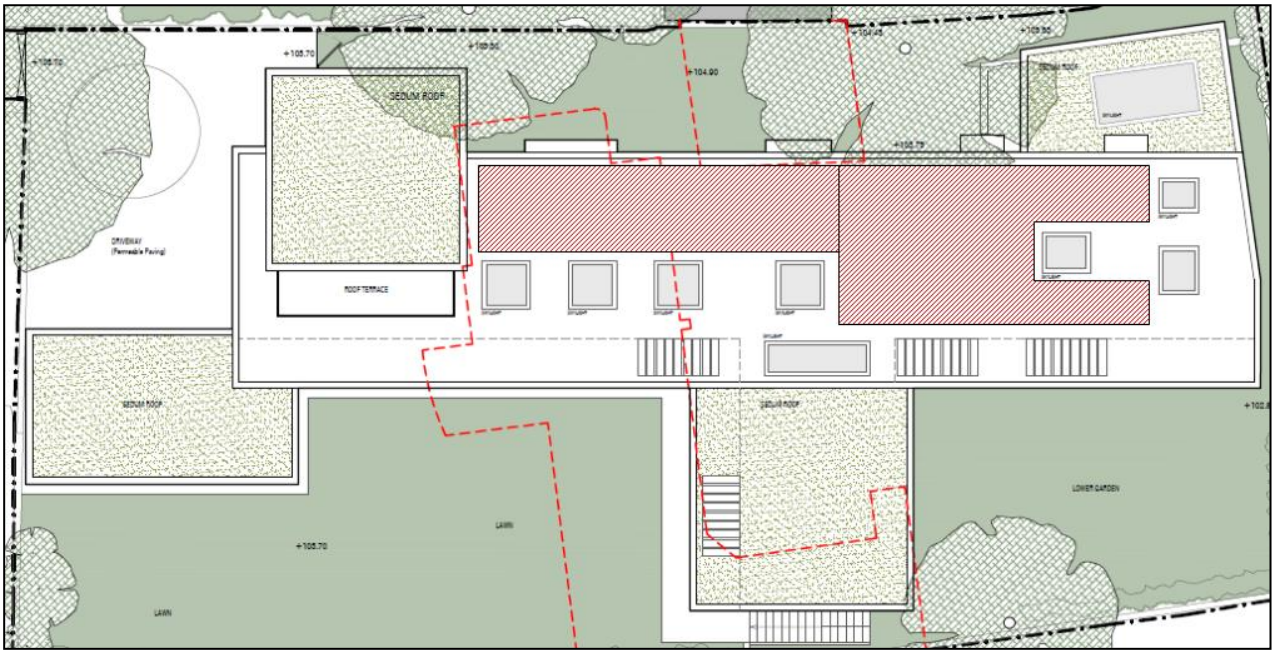


Figure 7: Usable Roof Areas (shown in red hatching)

4.5.4 Noise will not be an issue – A PV system does not feature moving parts and is silent during operation.

4.5.5 For the purposes of this study a 250W module will be used to inform the PV system size and output. Each panel covers an area of ~1.6m (1.65 x 0.95m) and has a peak output of 250W.

4.5.6 With a high-efficiency gas system boiler solution, the following array would need to be installed to achieve the necessary CO_2 offset and improvement over Building Regulations to achieve compliance with Camden policies:

Unit type	No. of Panels	Array Size (kWp)	Energy Generated (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)
Detached	20	5.00	4,292	2,228

Table 8: PV - Predicted Performance – Module

4.5.7 The size of PV array proposed (south facing, 30 degree pitch) is the best way of seeking to achieve the Camden targets, with the flat roof space being utilised.

Solar Water Heating

4.5.8 The installation of Solar Water Heating (SWH) could be used to offset a proportion of the domestic hot water demand (DHW), subject to the installation of an appropriate water cylinder and space allowed within the design for the required insulated flow and return pipework to the collectors.

4.5.9 Noise will not be an issue with SWH – the only moving part is the circulation pump, which is inside the property and would not be noticeable.

4.5.10 Unlike PV, where the overall performance is generally limited by available roof space and finances, the CO_2 offset achievable with SWH is limited by the occupancy and estimated hot water load of the unit – too large a system can overheat the tank at peak solar insolation.

4.5.11 SWH could provide a good solution as part of a renewable energy mix alongside a PV array to achieve the Camden renewable energy targets. SWH alone will not be able to achieve the required CO_2 offset, but a $9m^2$ SWH system (Vaillant VFK 145) shows that it provides a useful offset contribution (Table 9).

Energy Generated (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)	% Energy Offset over Baseline	% CO2 Offset over Baseline
1,762	365	5.0%	3.3%

Table 9: SWH - Predicted Performance

Air Source Heat Pump

4.5.12 The use of an Air Source Heat Pump (ASHP) has the potential to supply the Proposed Development with the heating and hot water requirements - with under floor heating to maximise the system performance.

4.5.13 As with all Heat Pump systems, ASHPs consume electricity in order to operate - the Coefficient of Performance of the system is the ratio of electrical energy consumed, to heat energy emitted. This is affected by a number of factors, including system design, outside air temperatures (solar irradiation) and patterns of use.

4.5.14 Based on initial analysis an ASHP would not be able to show the required 35% improvement over Building Regulations and it must be combined with other renewable solutions, such as SWH or PV. However, due to it being an electric system a larger PV array would be required to achieve the 20% CO_2 offset required when taking into account higher CO_2 factor associated with an electric system.

4.6 Unviable Renewable Technologies

4.6.1 The following technologies are deemed unviable for the Proposed Development at this stage of development:

Ground Source Heat Pump

4.6.2 The use of a Ground Source Heat Pump would have the potential to supply the Proposed Development with its space heating and hot water requirements, subject to the building thermal performance matching the initial specification, and the provision of under floor heating (wet system) to maximise the GSHP system performance.

4.6.3 However, due to the trees in the garden of the property it is likely there will be an issue with tree roots (during installation) and shading of the ground which makes the system unfeasible for the project.

Biomass Boiler

4.6.4 The use of a biomass boiler system to supply hot water and space heating has been deemed unfeasible and unpractical due to the complications in providing the space required for the boiler, associated fuel storage and BoS, along with regular fuel supply of pellets/chips.

Wind Power

4.6.5 Due to the location and nature of the site, it does not lend itself to the use of wind turbines.

4.6.6 Any turbine performance will be reduced by the low, erratic wind speeds and air turbulence caused by the surrounding buildings and trees.

4.7 Heating & Hot Water Strategies

Option 1 - PV

4.7.1 The first option would be for the Proposed Development to benefit from the use of a highly efficient gas system boiler, combined with on-site renewable energy provision from a total of 5kWp PV array in order to address the London Borough of Camden planning requirement of a 20% CO_2 offset and 35% improvement in Dwelling Emission rate over Building Regulations 2013 target.

Unit Type	*Electrical Demand (kWh/yr)*	*Fossil Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2$/yr)	CO_2 offset from PV ($kgCO_2$/yr)
House	2,993	24,960	7,306	35,258	10,942	2,228 (20.4%)

4.7.2 This would mean low capital costs for the heating & hot water systems, but relatively high cost for the renewable energy provision. Although in this case the dwelling would benefit from being able to apply for a Feed In Tariff, where the government would pay a set amount for each kWh generated by the array (currently c. 9-14 pence/kWh dependent on system size).

Option 2 – Micro-CHP and PV

4.7.3 The second option would be the use of micro-CHP with PV in order to address the London Borough of Camden planning conditions of 35% improvement in Dwelling Emission rate over Building Regulations 2013 and 20% CO_2 offset.

Unit Type	*Electrical Demand (kWh/yr)*	*Fossil Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2$/yr)	CO_2 offset from PV ($kgCO_2$/yr)
House	2,993	25,779	7,306	36,077	10,261	2,116 (20.6%)

4.7.4 This would mean that the development would have higher capital costs for the heating & hot water systems, but slightly lower capital costs from the renewable energy provision. For this solution, a total of 4.75 kWp PV would be required in order to achieve the 20% CO_2 offset requirement and 35% improvement in Dwelling Emission rate over Building Regulations 2013.

Option 3 – PV and SWH

4.7.5 The third option would be the use of both SWH and PV in order to address the London Borough of Camden planning aspiration of 35% improvement in Dwelling Emission rate over Building Regulations 2013 and 20% CO_2 offset requirement.

Unit Type	*Electrical Demand (kWh/yr)*	*Fossil Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2$/yr)	CO_2 offset from PV ($kgCO_2$/yr)	CO_2 offset from SWH ($kgCO_2$/yr)
House	2,993	24,960	7,306	35,258	10,942	1,893 (17.3%)	365 (3.3%)

4.7.6 This would mean that the development would have slightly higher capital costs for the heating & hot water systems, but lower capital costs from the renewable energy provision. For this solution, a total of 4.25 kWp PV alongside a $9m^2$ SWH system would be required in order to achieve the 35% improvement in Dwelling Emission rate over Building Regulations 2013 and 20% CO_2 offset.

4.8 Renewable Energy Summary

4.8.1 SRE proposes the following renewable energy technology solution as technically viable for the Proposed Development in order to achieve the LBC requirement of a 20% CO_2 offset/reduction through the use of on-site renewable technologies, as well as achieving a 35% CO_2 improvement over a 2013 Building Regulations compliant design in line with the London Plan for the new build house.

Technology	Details	Energy Offset (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)
Photovoltaics (Module)	Total of 4.25 kWp	3,648 10.3%	1,893 17.3%
Solar Water Heating	$9m^2$ gross area	1,762 5.0%	365 3.3%

Table 10: Proposed Renewable Energy Solution

4.8.2 The proposed PV array and SWH system also means the development meets the required 50% of Code for Sustainable Homes energy credits in the 'Energy' section.

4.8.3 Further offset is not deemed practical at this stage:

- The building envelope performance has been improved as far as is practical (including triple glazing).
- Energy efficient heating, ventilation and lighting systems are used throughout.
- Mechanical ventilation with Heat Recovery will be utilised.

4.8.4 SWH is proposed alongside PV as the best way to achieve the 20% of CO_2 emissions required as well as achieving a 35% improvement over 2013 Building Regulations.

5.0 Summary

5.0.1 The Proposed Development at 92 Fitzjohn's Avenue, London Borough of Camden will comprise 1 No. new build 4-bedroom house.

5.0.2 The development will deliver energy efficiency measures throughout and, will comply not only with the sustainability requirements outlined in the London Borough of Camden Core Strategy, SPDs and LDF, but also with the London Plan requirements.

5.0.3 The following TER/DER figure is taken from the supporting SAP Building Regulations Compliance Checklist, which show the % improvement in Dwelling Emission rate over Building Regulations 2013.

Proposed Site	$Kg/CO_2/m^2$
Proposed TER	15.65
Proposed DER with Gas system boiler, SWH & PV	8.48
Improvement	45.81%

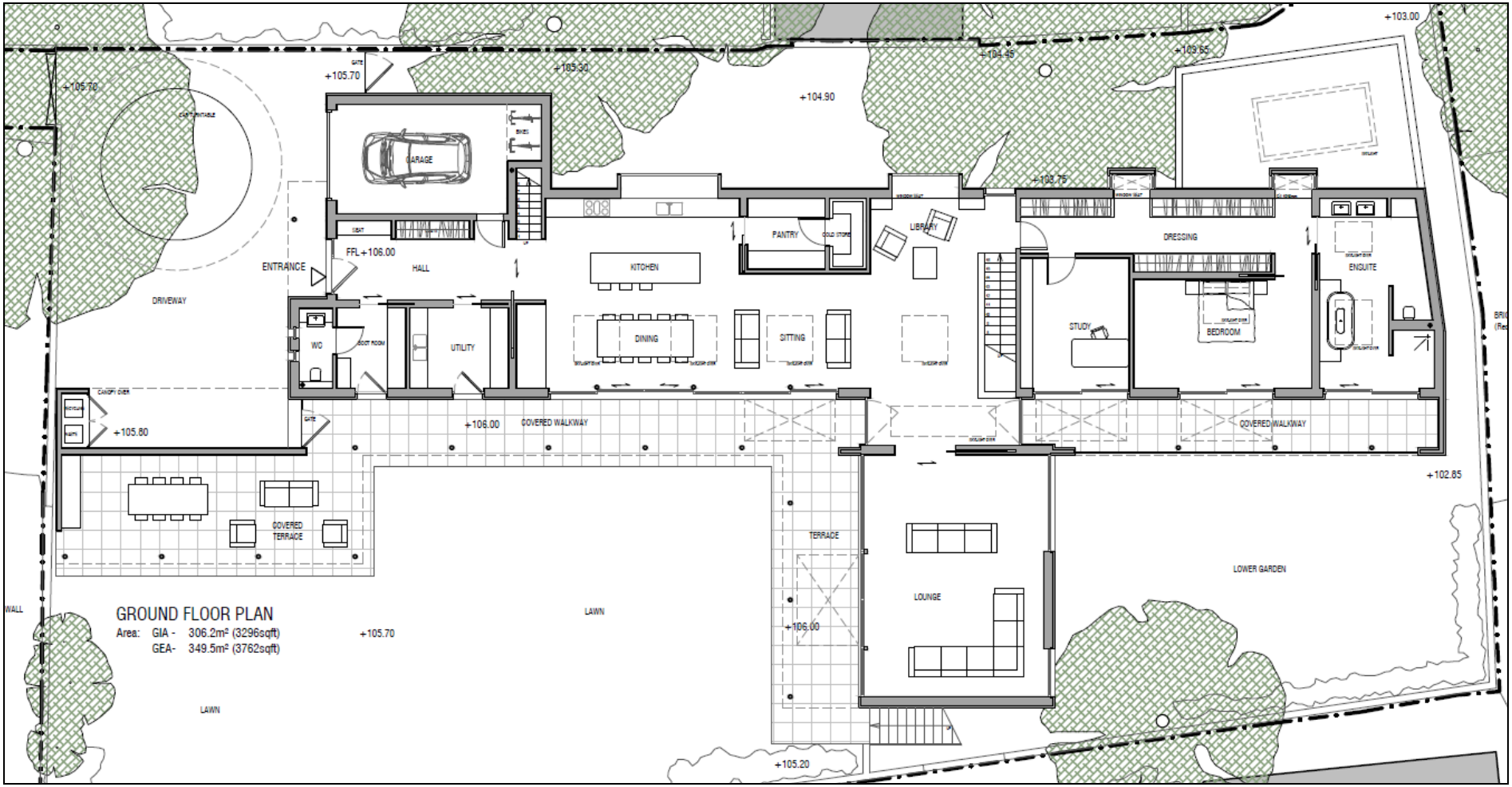
Table 11: DER Improvement (Building Regulations 2013)

5.0.4 Overall, the Proposed Development will provides a modern, resource efficient, sustainable residential dwellings which comply with all the relevant planning policy, and include the following measures:

- Resource Efficient Heating
- Passive Solar Design
- Energy Efficient Lighting and Appliances
- Water Conserving Fittings
- 4.25 kWp of Solar Photovoltaic Panels with a $9m^2$ (gross area) SWH array

5.0.5 Through this approach the Proposed Development has gone as far as is practical in attaining compliance with all relevant environmental sustainability Planning Policy.

6.0 Appendix A – Site Layout Plan



7.0 Appendix B – CSH Summary Sheet

Section	Description	Credits Available	Target Score	92 Fitzjohns Avenue
Energy				
Ene 1	DER improvement over TER	10	**5**	5.1
Ene 2	Fabric Energy Efficiency (FEE)	9	**4**	4.2
Ene 3	Energy Display Device	2	**1**	1
Ene 4	Drying Space	1	**1**	1
Ene 5	White Goods	2	**2**	2
Ene 6	External Lighting	2	**2**	2
Ene 7	Low Zero Carbon Technologies	2	**2**	2
Ene 8	Cycle Storage	2	**1**	1
Ene 9	Home Office	1	**1**	1
		31	**19**	**19.3**
Water				
Wat 1	Internal Water Use	5	**3**	3
Wat 2	External water use/water butts	1	**1**	1
		6	**4**	**4**
Materials				
Mat 1	Materials Specification/Green Guide	15	**10**	10
Mat 2	Responsible sourcing (basic construction)	6	**4**	4
Mat 3	Responsible sourcing (finishing)	3	**1**	1
		24	**15**	**15**
Surface Water				
Sur 1	Surface water runoff	2	**2**	2
Sur 2	Flood Risk	2	**2**	2
		4	**4**	**4**
Waste				
Was 1	Internal and external waste storage and access	4	**4**	4
Was 2	Site Waste Management Plan	3	**3**	3
Was 3	Composting	1	**1**	1
		8	**8**	**8**
Pollution				
Pol 1	Global Warming Potential (GWP) of insulation	1	**1**	1
Pol 2	NOx emissions from boilers	3	**3**	3
		4	**4**	**4**
Health & Wellbeing				
Hea 1	Daylighting	3	**2**	2
Hea 2	Sound insulation	4	**4**	4
Hea 3	Private/communal secure + accessible open space	1	**1**	1
Hea 4	Lifetime Homes	4	**4**	4
		12	**11**	**11**
Management				
Man 1	Home User Guide	3	**3**	3
Man 2	Considerate Constructors Scheme	2	**2**	2
Man 3	Monitoring of Site Impacts	2	**2**	2
Man 4	Secured By Design (Section 2) compliance	2	**2**	2
		9	**9**	**9**
Ecology and Land-Use				
Eco 1	Ecological Value of Pre-Existing Site	1	**0**	0
Eco 2	Addoption of Ecological Recommendations	1	**0**	0
Eco 3	Protection of Ecological Features	1	**1**	1
Eco 4	Change in Ecological Value	4	**2**	2
Eco 5	Footprint to Floor Area Ratio	2	**0**	0
		9	**3**	**3**
Weighted Total (%)		**100.0**	**71.0**	**71.4**
CSH Level			**4**	**4**