TF Architecture

18 Hanway Street
Camden
London
W1D 1AT

Energy Statement
(Incl. BREEAM EcoHomes Pre-Assessment)

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Glossary:

ASHP	Air Source Heat Pump
CHP	Combined Heat & Power
CO_2	Carbon Dioxide – usually measured in $kgCO_2$/yr
CS	Core Strategy
CSH	Code for Sustainable Homes
DC	District Council
DPD	Development Plan Document
FGHR	Flue Gas Heat Recovery
GSHP	Ground Source Heat Pump
HP	Heat Pump
kg	Kilograms
kWh	kilo-Watt-hour – kW is peak load, kWh/yr is annual figure
LBC	London Borough of Camden
No.	Number of items
Offset	Use of this fuel/technology offsets an amount of energy/CO_2 generated off-site – e.g. the use of PV does not *reduce* electrical use, but *offsets* it through on-site generation
PV	Photovoltaic
PV-T	Photovoltaic-Thermal (Brand Name)
SWH	Solar Water Heating
TFA	Total Floor Area (Internal)
The Agent	The party who requested the scope of works
The Client	The party who is developing the property (generally the invoicee)
The Proposed Development	The new build/refurbishment on which the planning application is based

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Executive Summary

0.1 This Energy Statement has been undertaken by SRE for the Proposed Development at 18 Hanway Street, London (Proposed Development) in order to meet the requirements of the London Borough of Camden's Planning Guidance 3, as well as wider London Plan Policies.

0.2 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.

0.3 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.

0.4 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 the 20% CO_2 emissions reduction target.

0.5 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 will offset 9.4% of the predicted CO_2 emissions of site**, based on the energy baseline.

0.6 In addition, this report assesses the Proposed Development in relation to wider sustainability requirements for the area, relating to both local and regional planning policy.

0.7 The Proposed Development goes as far as is practical in meeting all of the relevant requirements set out within the London Borough of Camden Planning Guidance, and consequently meets all planning requirements (for sustainability) related to the site.

1.0 Introduction

1.1 The Energy Statement has been prepared by SRE to accompany the planning application submitted by TF Architecture for the Proposed Development at 18 Hanway Street, Camden (the Proposed Development).

1.2 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.

1.3 The statement also includes the relevant London Borough of Camden (LBC) planning policy (Camden Planning Guidance – CPG) and details how the Proposed Development responds to, and meets, the relevant requirements.

The Proposed Development

1.4 The Proposed Development at 18 Hanway Street consists of a 6-storey existing building that is undergoing refurbishment to provide 4 No. 1-bed flat, 1 No. 1-bed maisonette and 1 No. 3-bed maisonette along with a large office unit on the lower ground and ground floors.

Figure 1: Proposed Development

1.5 Full details of the Proposed Development can be found in the supporting drawings (See Appendix A for proposed Site Layout Plans).

Sustainability Approach

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

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

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

Sustainability Guidelines and Policy

1.8 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:

Key Policies

- 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

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

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.

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

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 (see Map 4) 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);

CPG 3 – 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. "

CPG 3 – 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. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

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."

Supporting Policies

- Planning Policy Statement 22 (PPS 22): Renewable Energy
- Mayor of London, The London Plan - Spatial Development Strategy for Greater London - Consultation draft replacement plan (October 2009)

2.0 Sustainability

Environmental Rating – BREEAM EcoHomes

2.1 The Proposed Development will achieve BREEAM EcoHomes 'Very Good' certification.

2.2 BREEAM is a nationally recognised standard used to assess the environmental performance of commercial and residential buildings and aims to acknowledge improved environmental performance in housing design.

2.3 The scheme considers both broad environmental concerns (e.g. climate change, resource use) as well as site specific issues (e.g. transport, energy use etc), and these issues are balanced against the desire for high quality of life and a safe and healthy internal environment. Since the inception of CSH, EcoHomes has become the assessment tool for refurbished properties.

2.4 The issues assessed are arranged into eight key categories, with a rating system consisting of Pass, Good, Very Good and Excellent:

• Energy	• Water
• Transport	• Land Use & Ecology
• Pollution	• Health & Wellbeing
• Materials	• Management

Table 1: BREEAM EcoHomes Categories

2.5 Specific measures would be delivered on the Proposed Development, including:

- High thermal efficiency of building envelope through improved U-Values (taken from SAP calculations).
- Incorporation of renewable energy technologies to reduce the associated CO_2 emissions
- Provision of internal recycling facilities in-line with Local Authority recycling collection.
- Incorporation of resource efficient fixtures and fittings for energy and water consumption to reduce ongoing CO_2 emissions and encourage resource efficiency by the residents
- Specification of materials with low embodied energy and 80% A Rated or above as per the Green Guide. Building and Finishing materials will be responsibly sourced where possible.
- Provision to all owners of information on efficient use of resources and associated appliances within the units.

2.6 The predicted score summary for the BREEAM EcoHomes Pre-Assessment Estimate is 64.52%, meeting the requirements for certification to 'Very Good'. A summary of this score is provided in Appendix C and the full Pre-Assessment is provided in a supporting document.

3.0 Energy Assessment

Energy Approach

3.1 The outline approach by the Proposed Development in addressing energy issues, and responding to the planning policies and guidance listed in paragraph 1.8 above, is through minimising the building's overall environmental impact and reducing its resource use to exceed the performance standards required by Building Regulations.

3.2 The approach adopts the following standard energy strategy (in-line with The London Plan and LBC 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.

3.3 The design has sought to enhance the building envelope to minimise energy demand.

3.4 The energy assessment has not taken into account the energy demand associated with the existing building energy usage. Renewable energy is required to achieve BREEAM EcoHomes 'Excellent', and in-line with LBC policy, a 20% CO_2 target has been used.

3.5 The CO_2 Conversion Factors have been taken from Building Regulations 2010:

Fuel Source	CO_2 Conversion Factor ($kgCO_2/kWh$)	Approx. Unit Cost (£/kWh)
Electricity (mains)	0.517	£0.133
Electricity (offset)	-0.529	~£0.30-40 (feed-in)
Gas (mains)	0.198	£0.041
Heating Oil	0.274	£0.044
Wood Pellets	0.028	£0.039

Table 2: CO_2 Conversion Factors

3.6 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 CH_4 – 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.

3.7 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 peak, production, and therefore availability, is expected to steadily decline resulting in fuel cost increases.

[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

Energy Conservation Measures (be lean)

3.8 The overall energy strategy for the Proposed Development, as highlighted in paragraph 3.1, 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.

3.9 A number of energy conservation measures will be incorporated by the Client to reduce the overall energy load for the Proposed Development. This is in-line with both the Policies listed above in Paragraph 1.8 as well as general national 'Best Practice' guidance for delivering energy efficient buildings.

Passive Solar Design

3.10 The Proposed Development is orientated with the front elevations facing south and the rear elevation facing north, both with adequate amounts of glazing. As the existing building fabric is to be retained there is little scope for enhancing the level of passive solar gain experienced within the units. Due to the inherent nature of flats, only the units with south facing external walls are expected to benefit from any appreciable level of passive solar warming provided by the south facing windows, reducing the space heating load.

3.11 The buildings are to be of brick and blockwork cavity construction and therefore of medium-high thermal mass as part of the external wall and roof construction. High thermal mass will reduce any potential risk of overheating in south facing rooms in the summer months, which can be exacerbated by low levels of ventilation in flats. Large south facing window openings can create an overheating risk - this can be further controlled by the use of blinds/solar louvres or other forms of brise soleil.

Natural Daylight & Ventilation

3.12 The provision of natural daylight and ventilation are important factors to consider in the design in order to minimise the use of artificial light and mechanical ventilation within the units.

3.13 Adequate window openings will also increase natural day lighting, and therefore help reduce the lighting load.

3.14 Natural pressure differential between two opposite elevations of a building will lead to a 'draw-through' of air. With the exception of the upper 3-bed maisonette, the flats do not feature opposite elevations so the capability for a draw of air across the unit does not exist – therefore natural ventilation is low. As a refurbishment it is expected that secondary glazing will be implemented to reduce heat loss through the windows. This will make the windows effectively sealed units.

3.15 As a result of this, mechanical ventilation is likely to be required and heat recovery ventilation (MVHR) systems are recommended for installation. These ventilation systems extract the latent energy from the warm expelled air and use it to preheat the incoming, cooler air from outside and thus help reduce the 'pluming effect' often associated with standard mechanical ventilation systems expelling moist, warm air into the local atmosphere.

3.16 Windows will be specified with low E, high transmission glazing, thereby maximising the light levels into the internal spaces whilst minimising heat loss from the window openings.

Insulation and Air Tightness

3.17 It is not known when the original building was built, but it is assumed to be before the advent of Building Regulations insulation standards.

3.18 Insulation levels, and therefore U-Values, have been modelled based on minimum *Improved* U-Values as per Table 3, column (b) of Approved Document L1B, although the external walls have been improved further as it is thought that this is more likely to represent the built structure, and what could be achieved through minimal enhancement.

3.19 Where possible, the Proposed Development will incorporate high performance insulation in the building envelope (walls, roofs and windows) to achieve an average U-Value as detailed below.

Element	Proposed U-Value
Flat Roof	0.18
External Walls	0.35
Ground Floor	0.25
Windows	1.5

Table 3: Proposed U-Values

3.20 Air tightness has been estimated as achieving a rate of ~5$m^3/hr/m^2$ in each unit. This will be tested as part of Building Regulation compliance and to inform final As-Built SAP.

Thermal Bridging

3.21 Thermal bridging is the process by which materials that directly connect the internal and external walls of a building (e.g. lintels and wall ties) transfer warmth out of the building through conduction.

3.22 Although minimal building fabric alterations are likely to be made, where existing structures are altered, careful selection of materials and construction techniques will make it possible to reduce the level of thermal bridging apparent within the walls. This decreases heat loss and increases the Fabric Energy Efficiency (FEE) of the building - assessed under Building Regs 2010.

3.23 Accredited Construction Details are currently useable under the Building Regulations 2010. However, as much of the existing structure is to be retained, there is limited scope for improving thermal bridging levels. In order to achieve enhanced levels, psi values will need to be calculated for the specific materials junctions by a suitably accredited person.

3.24 Where new building elements and materials are required, through attention to detail around materials junctions (e.g. floor edges) and the use of building materials such as cobalt wall ties, the level of thermal bridging can be reduced.

3.25 The party walls must be sealed or insulated if possible, unless it is a solid party wall which is assumed for this building). This is assumed as a default – Building Regulations 2010 assume this as part of the notional TER scenario so the actual DER scenario must match this.

Voltage Optimisation

3.26 The use of a Voltage Optimiser/Regulator in the main supply the building would allow for all electrical appliances to operate more efficiently. Voltage in the UK can fluctuate between ~220-253V – UK appliances are designed to work at their most efficient at around 220V, above this they will still function perfectly but energy is lost in heat and noise.

3.27 The regulator operates by maintaining a steady 220V regardless of input, allowing for all equipment to operate at maximum efficiency. It is difficult to quantify the energy reductions as it will differ greatly from appliance to appliance, but it is stated that a regular house will experience reductions in electrical use of up to ~10%. This technology is recommended for installation within the Proposed Development.

Energy Efficient Lighting and Appliances

3.28 The Proposed Development will make use of low energy lighting in-line with BRE methodology and in excess of Building Regulation requirements. Incandescent bulbs are now being phased out through minimum energy efficiency ratings and larger wattage bulbs are now not available, with all traditional-style filament light bulbs likely to be non-compliant by Sept 2012. By the time that the Proposed Development is finalised and under construction, most bulbs are likely to be inherently energy efficient. As such this has been included within SAP modelling.

3.29 Although appropriate appliances are expected to be fitted - ‘A’ or ‘A+’ White Goods (where possible), advice will also be provided as part of the Home User Guide detailing the benefits of energy efficient appliances. 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.

3.30 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, sensor and time controls as standard.

High Efficiency Gas Condensing Boiler

3.31 In the Predicted Energy Baseline scenario the units will be supplied heating and hot water via a centralised gas boiler in the ground floor plant room, with high efficiency gas boiler system (SEDBUK A rated) 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 NO_x emissions (target ≤40mg/kWh to support CSH Assessment).

Influence Energy Behaviour

3.32 Each unit within the Proposed Development would be provided with a Home/Building 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.

3.33 Energy meters will also be provided in the permanent let flats 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.

3.34 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.

Baseline Energy Prediction

3.35 The following baseline has been calculated taking into consideration the positive impact of the improved design and the energy efficiency measures listed above, and using the same analysis technique as for the predicted energy baseline:

3.36 SAP 2009 and Building Regulations 2010 L1B have been used to generate the energy baselines for all residential units.

3.37 As the office units will utilise the same building fabric and heating system as the residential units, as similar heating load has been applied. The electrical load is drawn from CIBSE Guide F and relates to the expected electrical demands of a Type 1, cellular, naturally ventilated office.

Unit	Total Floor Area (m^2)	*Electrical Demand (kWh/yr)*	*Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2$/yr)
Residential	351.1	*2,692*	*23,604*	*9,158*	35,454	10,800
Commercial	174.3	*13,067*	*14,278*	*0*	27,345	9,583
Totals	**525.4**	***15,759***	***37,883***	***9,158***	**62,799**	**20,383**

Table 4: Baseline Energy Prediction

3.38 The baselines for all units are based on the use of centralised gas fired heating and hot water.

Incentive Schemes

3.39 The annual savings detailed in the following assessment of low carbon and renewable energy feasibility are calculated using the Feed-In-Tariff (FIT) and Renewable Heat Incentive (RHI) schemes.

3.40 FIT is available now, where RHI is not set to be adopted until July 2011 for non-domestic and July 2012 for domestic (with interim grant system), although schemes implemented now will be able to join the scheme when it becomes active.

3.41 The schemes aim to provide financial support to individuals, communities and businesses to encourage them to implement renewable/low carbon technologies. An elevated rate is paid for all energy generated on-site by renewable or low carbon means.

3.42 Further details on the schemes and the associated tariffs are provided in Appendix D.

Energy Supply (be clean)

Decentralised Heat and Power

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

3.44 The Heat Map indicates that there are currently no existing district heat networks near to the site.

3.45 There is existing CHP/Boiler Plant at Wells Street, ~500m west of the site and at Endell Street ~600m to the southeast.

3.46 There are no proposed or potential heat networks that run any closer to the site.

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

Combined Heat and Power

3.48 The use of Micro-CHP has been considered in outline for the site as a possible heating system, with the added benefit of on-site electrical generation. As part of this approach it will be necessary to install a thermal buffer vessel (~500l) within the plant room.

3.49 A CHP system is an efficient way of generating electricity on-site with the benefit of reduced fuel costs (gas being cheaper than electricity) and reduced carbon emissions. Heat generated from the gas engine is used to produce hot water or steam for heating and domestic hot water.

3.50 The use of modular Combined Heat and Power (CHP) plant is feasible for use as part of a centralised heating system of this building – this will provide the Proposed Development's heating and hot water load as well as generate electricity for use on-site, offsetting mains electricity. If cooling is found to be required (not expected), then CHP can be used to power this through the use of absorption chillers as part of a 'tri-generation' system. The inclusion of a CHP engine will enable future bio fuelled CHP engines to be incorporated in 10-15 years time - should the CHP be fired from Renewable Energy Sources (biofuels) then the site will be able to deliver even greater CO_2 savings.

3.51 As standard, CHP systems are sized to meet the Summer Heat Demand of a property – this is the period during the summer when only hot water generation is required and the load is at its lowest. This is because CHP systems are only efficient when run at close to maximum load, and hence are sized to run at high load even when there is low heat demand. Any discrepancy in heat load would usually be filled by an alternative heating system (in this case a gas boiler).

3.52 The commercial units are not expected to have significant stable hot water demand due to their intended use. As such, only the residential units have been included within this analysis:

[4] www.londonheatmap.org.uk/

	Predicted Energy Requirement (kWh/yr)	% of Total Heat Demand
Space Heating	1,750	8.8%
Hot Water Demand	18,032	91.2%

Table 5: Heat Demand Proportions - Residential

3.53 Table 5 details the proportion of the heating demand which can be allocated to space heating and hot water demand. As the units are flats and the majority are mid floor, approximately 90% of the heating load is found to be hot water demand – therefore the size of CHP that can be used is limited by this.

3.54 The high levels of electrical generation that is expected from the CHP engines mean that at times of low electrical demand within the Proposed Development, electricity will be exported to the National Grid – therefore it is recommended that the developer sign an agreement with the energy provider to export 'brown' energy.

3.55 Based on the information given in Table 5, the building is expected to have a hot water demand of 18,032 kWh/yr – based on 8 hrs/day operation, this is equivalent to a heating requirement of ~6 kW.

3.56 An example of a CHP system that would be suitable for this type of installation is the Baxi/Senertec Dachs MicroCHP[5], with outputs of 12.5kW heat and 5.5KW electricity and an overall efficiency of ~79%. This plant is typical of small CHP units on the market.

3.57 The hot water load is estimated to approximately half of the Dachs rated heat output – the CHP engine would therefore either have to operate at part power and low efficiency ('cycling' as load increases and decreases) or would need to be run at high efficiency for a couple of hours a day to heat a large thermal store, and then switch off (with the inherent heat losses from the store). Either method is not an efficient way to operate a CHP system.

3.58 Therefore, the use of CHP has not been deemed to be suitable for this site and has not been proposed at this stage. There is unlikely to be sufficient, stable demand to unsure that the CHP plant operates efficiently and cost effectively – poor efficiency will increase both running costs and reduce the CO_2 reductions benefit of the system.

3.59 A full CHP Feasibility Study with detailed assessment of heating loads and cycles would be required to inform the final specification – however this cannot be completed at this stage as full final specification will be required, and as initial investigations have shown that CHP is unlikely to be suitable, would not be considered practical.

[5] This does not constitute a produce endorsement (example only)

Renewable Energy Assessment (be green)

3.60 Based on the Energy Assessment and the subsequent Predicted Improved Energy Baseline in Table 4, a total of 4,077 $kgCO_2$/yr would be required to be offset through on-site renewable energy sources to meet the requirements of The London Borough of Camden CPG 3 requirement for a 20% reduction/offset in the predicted CO_2 emissions of the new-build units through the use of on-site renewables.

3.61 Table 6 below summarises the various renewable energy solutions that have been assessed for the Proposed Development. Further, technical details are shown in Appendix D for all the renewable energy technologies assessed, including warranty and payback information.

Technology	Technically Feasible	CO_2 Offset ($kgCO_2$/yr)	Benefits	Weakness
Photovoltaics	✓	1,922 (9.4%)	High CO_2 offset and proven technology	Higher capital cost than other solar technologies
Solar Water Heating	✓	853 (4.2%)	Efficient and integrates with a domestic heat pump	Lower CO_2 offset as replacing gas supply
Hybrid PV/SWH	×	×	High CO_2 offset levels and minimal roof use and complimentary technologies	Limited overall size due to thermal aspect and immature technology
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.
Air Source Heat Pumps	✓	41 (0.2%)	Provides space heating and a proportion of domestic hot water dependant of gas	Low overall CO_2 offset. Potential system noise
Biomass Boiler	×	×	Low CO_2 emissions	Fuel storage space & fuel cost, regular supply of fuel
Biomass Stoves	×	×	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

Roof Layout

3.62 The buildings feature a flat roof which would allow solar technologies to be installed and orientated due south.

3.63 Due to the lack of inclination, any solar installation on the flat roof sections would be assessed at 90% (SWH) or need to be on a console/frame to increase the inclination to a minimum of 10 ° (PV) – this increases performance to 95%.

3.64 Based on the initial drawings provided by the Agent (no roof plan was available), allowing for the skylight shown on the 4th floor plan, and assuming roof space is not used for further skylights or other features, it is estimated that the flat roof will provide a total area of ~28m² (3.5m x 8m).

3.65 Aerial photos of the site indicate that there is no shading risk across the roofs of the Proposed Development.

Viable Energy Technologies

3.66 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. Payback and lifecycle carbon offset is included in Appendix D.

3.67 Total Energy & CO_2 offset in the tables below is assessed against the energy baseline from Table 4.

• Photovoltaics	• Air Source Heat	• Biomass
• Solar Water Heating	• Ground Source Heat	• Wind Turbine
• Hybrid SWH/PV		

Table 7: Assessed Renewable Technologies

Photovoltaics

3.68 The installation of Photovoltaics (PV) could be used to offset electrical demand within the Proposed Development. The Photovoltaic array would be connected into the landlord supply of the electrical system via an inverter or series of inverters, depending on system size.

3.69 The orientation of the roof as discussed in Para. 3.63 is expected to slightly affect the performance of the system.

3.70 As the roof is flat roof, either a frame or console system to increase the inclination to ~10-15° to retain warranty and performance parameters. Based on this inclination, a solar performance of 95% of peak predicted output is expected.

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

3.72 For the purposes of this study the Sanyo HIT 250W will be used as an example of a module PV system for the flat roof. Each panel covers an area of ~1.5m^2 (1.6m x 0.8m) and has a peak output of 250W.

3.73 Based on the roof areas discussed in 3.62, the following PV arrays and performance is predicted:

No. Panels	Array Size (kWp)	Energy Generated (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)	% Energy Offset	% CO_2 Offset	System Cost[6] (£)	Annual Savings (FIT)
18	4.5	3,634	1,922	5.8%	9.4%	~£22,500	~£1,600

Table 8: PV – Maximum Predicted Performance

3.74 The analysis in Table 8 indicates that the LBC CPG 3 target for 20% offset of total predicted CO2 emissions cannot be achieved solely through the use of PV.

Solar Water Heating

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

3.76 As the building has been designed with a communal heating system, there is scope for the inclusion of the required SWH infrastructure, although this will need to be verified due to the added complexity of routing the required pipework and the space requirement for a thermal store.

3.77 As discussed in Para. 3.63, the orientation of the roof is expected to slightly affect the performance of the system – although unlike PV the use of a Direct Flow Evacuated Tube system would also allow for the system to be mounted horizontally on the flat roof section. This would be assessed at 90% of peak performance.

3.78 A SWH system can be expected to generate up to 60% of the domestic hot water load of the unit, generating up to 450kWh/yr/m^2 (Flat Plate) and 550kWh/yr/m^2 (Evacuated Tube).

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

3.80 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.

3.81 As such, the installation will be limited to provide ~60% of the predicted DHW usage - for example this equates to an installation of ~1 No. Evacuated Tube collectors[7] for each residential unit (~total 8.7m² active area).

[6] Estimate based on generic system costs
[7] Such as Riomay SWH DF100 – example only, this does not constitute a product endorsement.

Energy Generated (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)	% Energy Offset	% CO_2 Offset	System Cost[8] (£)	Annual Savings (RHI) (£)
4,307	853	6.9%	4.2%	~£20,000	~£500

Table 9: SWH - Predicted Performance

3.82 The analysis in Table 9 indicates that the LBC CPG 3 target for 20% offset of total predicted CO_2 emissions cannot be achieved solely through the use of SWH. The collectors would need to be supplemented through an additional technology.

Air Source Heat Pump

3.83 The use of an Air Source Heat Pump (ASHP) has the potential to supply the units with their heating and hot water requirements, subject to the provision of underfloor heating or oversized/low temperature radiators (air-to-water systems) to maximise the system performance.

3.84 As with all Heat Pump systems ASHP systems 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. The ASHP would be assessed as providing space heat at a CoP of 3.2 and DHW at 1.8 (in-line with SAP Appendix Q efficiency figures[9].

3.85 The ASHP system features an external condenser to a small commercial air conditioning external unit and an internal thermal store and control unit. The condensers could be mounted on the roof of the building – communal systems can utilise a large single condenser or multiple single ones linked together.

3.86 As with SWH, the building has been designed with a communal heating system, there is scope for the inclusion of the required ASHP infrastructure, although this will need to be verified due to the added complexity of routing the required pipework and the space requirement for a thermal store.

3.87 As it features moving parts (an electrically driven fan) the external unit will make some noise – expected to be minimal and should not be noticeable to the surrounding area.

3.88 The use of ASHP as detailed above would provide the following offsets:

Energy Offset (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)	% Energy Offset	% CO_2 Offset	System Cost[10]	Annual Savings[11]
23,453	41	37.3%	0.2%	~£25,000	N/A

Table 10: ASHP - Predicted Performance

3.89 The analysis in Table 10 indicates that, whilst the sole use of ASHP cannot achieve the 20% CO_2 offset target, and as such would need to be used in conjunction with another

[8] Estimate based on generic system costs
[9] Mitsubishi EcoDan - example only and does not constitute a product endorsement
[10] Estimate based on generic system costs and drilling at ~£25/m
[11] First year estimate

system, such as PV and/or SWH. However ASHP could be used as a substitute for a gas fuelled heating system without an increase in CO_2 emissions.

Unviable Renewable Technologies

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

Hybrid Photovoltaics and Thermal (PV-T)

3.91 PV-T is an integrated panel which provides both water heating and electricity. These combined units operate more efficiently than separate units because excess heat which builds within the PV array is then used by a Solar Water Heating element to provide hot water – the PV can then operate at a greater efficiency than a standard PV panel due to being cooled by the SWH.

3.92 As with SWH, it requires a hot water cylinder to be included within the design – as such PV-T is not deemed feasible for the Proposed Development.

Ground Source Heat Pump

3.93 The use of a Ground Source Heat Pump has the potential to supply the house 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.

3.94 Due to a lack of plant room and lack of external area for ground loop installation, the use of GSHP is not considered feasible or practical.

Biomass Stove

3.95 Biomass stoves have not been incorporated into the buildings as chimneys/flues have not been included within the current design. Log or Pellet Stoves would also be impractical in flats.

Biomass Boiler

3.96 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 fuel storage and the access and fuel delivery infrastructure.

Wind Power

3.97 Due to the location and nature of the site, it is not likely to lend itself to the use of wind turbines.

3.98 The system performance will be reduced by the low, erratic wind speeds and air turbulence caused by the surrounding buildings and trees.

Renewable Energy Summary

3.99 SRE proposes the following renewable energy technology solution as technically viable for the Proposed Development in order for it to go as far as reasonably practical in order to achieve the LBC CPG 3 requirement for a 20% CO_2 offset/reduction through the use of on-site renewable technologies.

3.100 Further offset is not deemed to be feasible on this site:

- Centralised heating and energy efficiency measures have been included where possible in a refurbished building.
- CHP has been assessed and not deemed to be viable.
- There is insufficient roof space for further PV to be installed on the roof.

3.101 Final specification will be undertaken at detailed design stage.

Renewable Energy Technology Solution

Technology	Details	Energy Offset (kWh/yr)	CO_2 Offset ($kgCO_2$/yr)	Predicted Cost[12]
Photovoltaics **(Module)**	4.5 kWp PV array on flat roof of the building serving all units. Installed onto a frame system at 10°.	3,634 5.8%	1,922 9.4%	~£22,500 ~£1,600/yr Savings ~14yr Payback

Table 11: Proposed Renewable Energy Solution

3.102 The use of ASHP has not been proposed at this stage. The system is not expected to show significant savings in CO_2 emissions over a communal gas system, and will require insulated flow and return pipes to be run through the upper floor units into the plant room, with associated space requirements and heat losses. In addition the condensers would need to be sited on the flat roof, reducing space for PV, and may cause aesthetic issues. The complexities of installing is, at this stage, deemed to outweigh the benefits as a CO_2 offset tool.

[12] Approximate cost using generic technology prices.

4.0 Summary

4.1 The Proposed Development at 18 Hanway Street will comprise the refurbishment of the existing building to provide 5 No. 1-bed and 1 No. 3-bed units and 1 No. office unit (over two floors).

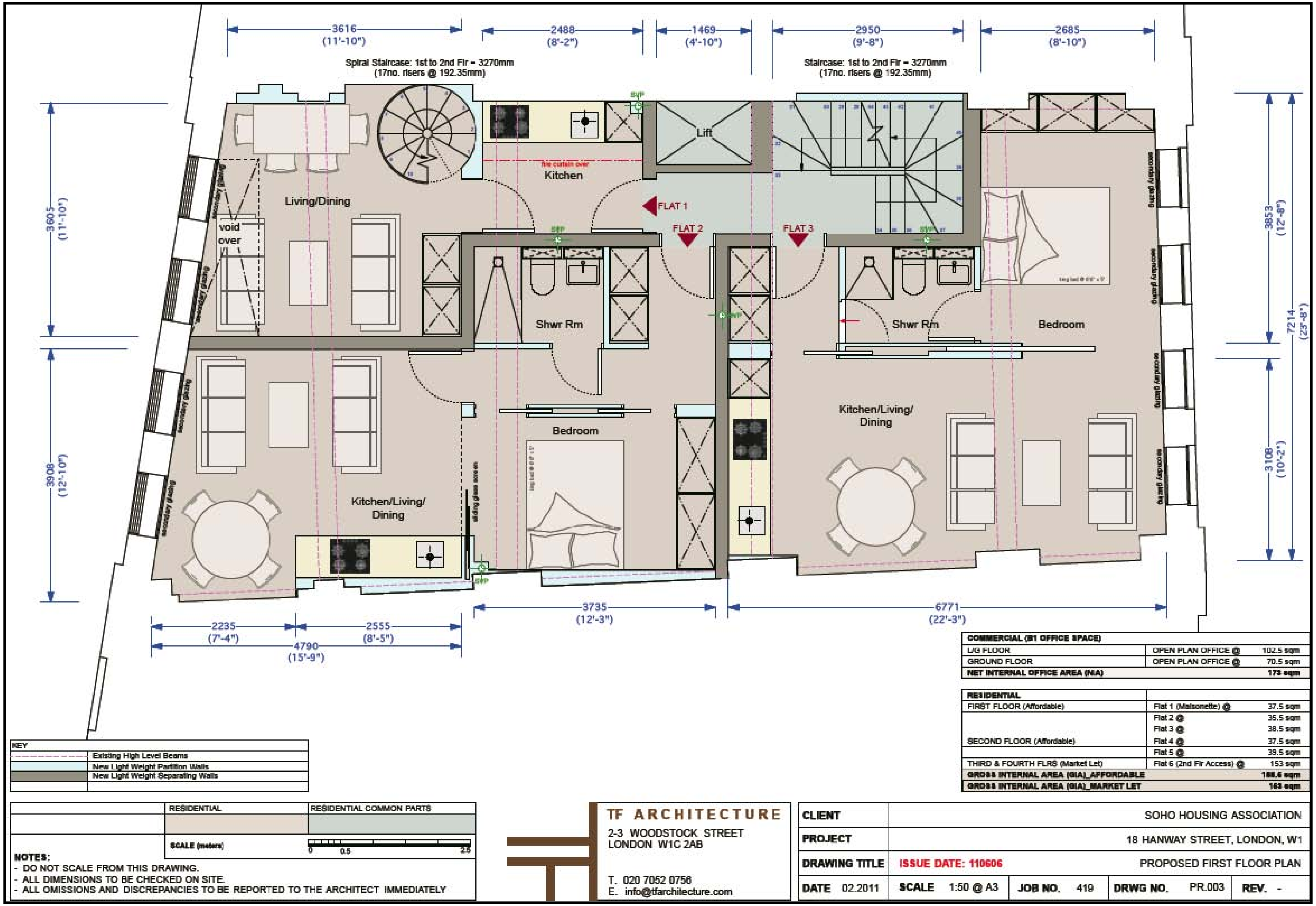
4.2 Much of the existing building fabric will be retained, and will be supplemented where possible through good building practice and energy efficiency measures. Furthermore, a high efficiency, centralised heating system will be implemented along with mechanical ventilation with heat recovery to deliver an energy and resource efficient building that will meet the requirements of Building Regulations 2010, BREEAM EcoHomes 'Excellent' the local and regional planning policy.

4.3 The installation of PV is predicted to be capable of offsetting 9.4% of the predicted site-wide CO_2 emissions. Further offset has not been deemed practical – due to the inherent layout of the building, the energy density is high in comparison to the available roof area. PV has been selected as it is felt to offer the most practical renewables solution.

4.4 In taking this positive approach the Proposed Development will provide a modern, resource efficient, sustainable unit, which comply with all the relevant items of the LBC Planning Guidance (where possible), and include the following measures:

- BREEAM EcoHomes – 'Excellent'
- Improved building envelope performance
    - Improved U-Values
    - Decreased Air Permeability
    - High performance glazing
- Resource efficient heating
- Energy Efficient Lighting
- Water Conserving Fittings
- On-site renewable energy generation, offsetting/reducing CO_2 emissions by 9.4%.
    - Photovoltaic Array – 4.5 kWp Module system - mounted on flat roof on frame at 10° pitch.

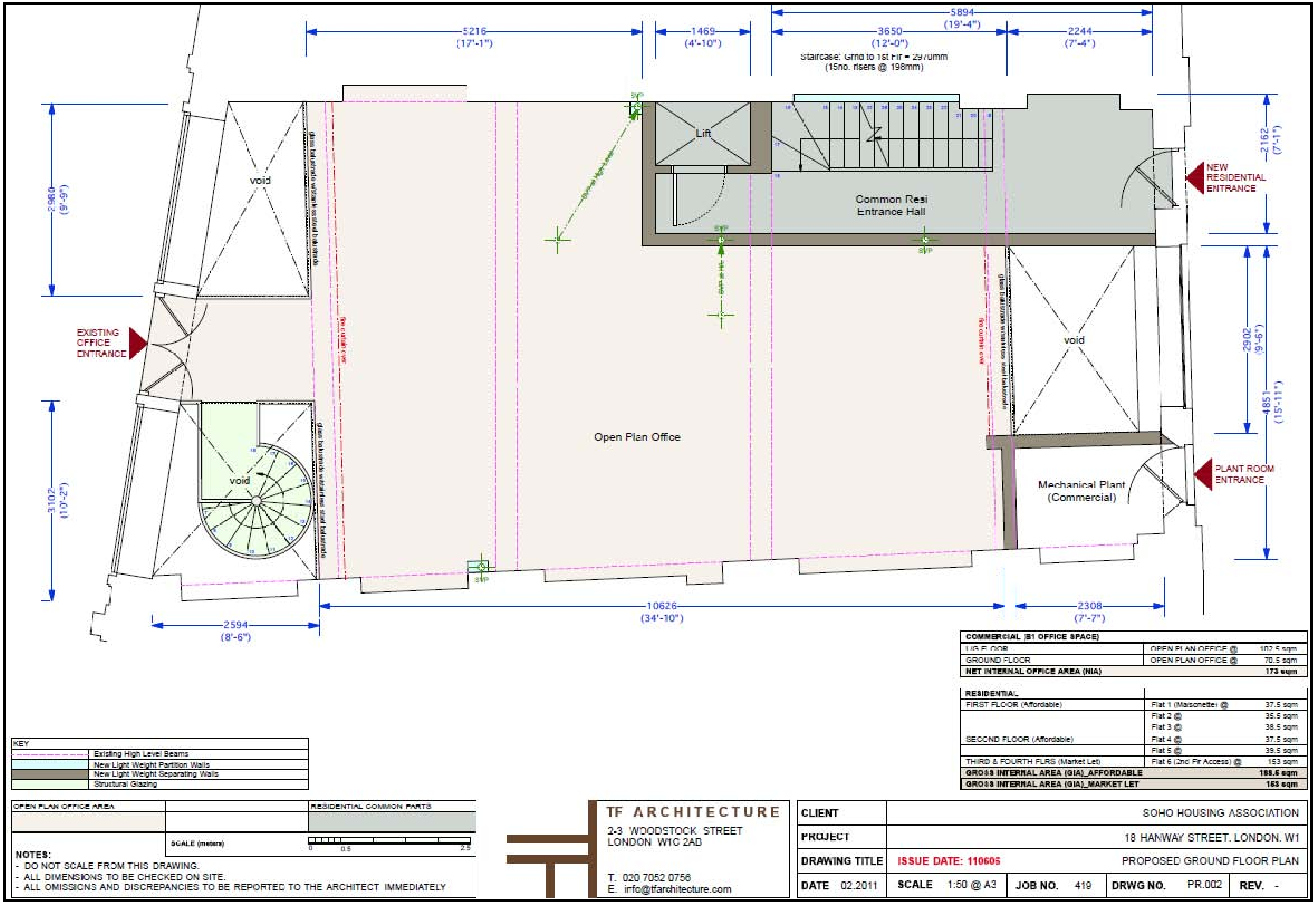
Appendix A – Typical Residential Floor Layout



COMMERCIAL (B1 OFFICE SPACE)		
L/G FLOOR	OPEN PLAN OFFICE @	102.5 sqm
GROUND FLOOR	OPEN PLAN OFFICE @	70.5 sqm
NET INTERNAL OFFICE AREA (NIA)		173 sqm

RESIDENTIAL		
FIRST FLOOR (Affordable)	Flat 1 (Maisonette) @	37.5 sqm
	Flat 2 @	35.5 sqm
	Flat 3 @	38.5 sqm
SECOND FLOOR (Affordable)	Flat 4 @	37.5 sqm
	Flat 5 @	39.5 sqm
THIRD & FOURTH FLRS (Market Let)	Flat 6 (2nd Flr Access) @	153 sqm
GROSS INTERNAL AREA (GIA)_AFFORDABLE		188.6 sqm
GROSS INTERNAL AREA (GIA)_MARKET LET		163 sqm

Appendix B – Typical Commercial Floor Layout



Appendix B – Planning Policy and Guidance

National Policy Requirements

The national policy requirements are outlined in PPS 22: Renewable Energy, from which the following observations are drawn:

- The energy to be displaced through renewable sources is electrical energy as this represents the highest proportion of CO_2 emissions.
- The policy is primarily framed around the need for discrete renewable energy sites although local policies "may" require local renewable energy generation provided this is viable and not burdensome

PPS1 - Delivering Sustainable Development (February 2005)

PPS1 seeks to ensure that sustainable development is pursued in an integrated manner by Development Plans, in line with the principles for sustainable development set out in the UK strategy. The policy states that Regional Planning bodies and Local Planning Authorities should ensure that development plans promote outcomes in which environmental, economic and social objectives are all delivered over time.

There are 4 main themes to PPS1:

- Climate Change is a very important issue for sustainable development and the causes and the impacts must be considered through development policies.
- Planning policies must promote high quality inclusive design in the layout of new developments and individual buildings in terms of function and impact, not just for the short term but over the lifetime of the development.
- Development plans are to contain clear, comprehensive and inclusive access policies (such policies should consider people's diverse needs and aim to break down unnecessary barriers and exclusions in a manner that benefits the entire community).
- Community involvement is an essential element in delivering sustainable development and creating sustainable and safe communities. As such in developing the vision for their areas, planning authorities are to ensure that communities are able to contribute to ideas about how that vision can be achieved, have the opportunity to participate in the process of drawing up the vision, strategy and specific plan policies, and to be involved in development proposals.

There is often a tendency with new developments for the focus to be entirely on environmental issues which neglects the integrated consideration of the wider range of issues associated with economic and social objectives that need to be properly considered for sustainable development.

PPS1 is a practical and realistic policy statement which, whilst aiming to achieve a significant amount of the environmental agenda, is also aware that development mostly takes place in the context of commercial reality and economic and social factors are important issues. The following extracts from PPS1 highlight this approach;

In proposing development;

- plans should not impose disproportionate costs, in terms of environmental and social impacts, or by unnecessarily constraining otherwise beneficial economic or social development. (Para 26 (iii))
- plans should have regard to the resources likely to be available for implementation and the costs likely to be incurred, and be realistic about what can be implemented over the period of the plan.

Regional Policy

The London Plan - Spatial Development Strategy for Greater London - Consultation draft replacement plan (October 2009):

Major Developments are defined as these:

- For dwellings: where 10 or more are to be constructed (or if number not given, area is more than 0.5 hectares).
- For all other uses: where the floor space will be 1000 sq metres or more (or the site area is 1 hectare or more). The site area is that directly involved in some aspect of the development. Floor space is defined as the sum of floor area within the building measured externally to the external wall faces at each level. Basement car parks, rooftop plant rooms, caretakers' flats etc. should be included in the floor space figure.

Policy 5.2: Minimising carbon dioxide emissions

Planning decisions

A. Development proposals should make the fullest contribution to minimising carbon dioxide missions in accordance with the following energy hierarchy:

1 Be lean: use less energy
2 Be clean: supply energy efficiently
3 Be green: use renewable energy

B. As a minimum, all major development proposals should meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential Buildings:	
Year	**Improvement on 2010 Building Regulations***
2010 - 2013	25% (CSH Level 4)
2013 – 2016	40%
2016 - 2031	Zero Carbon
* To be calculated using a 'Flat 25 per cent' approach for new homes in accordance with 2010 Part L Building Regulations.	

Non-Domestic Buildings:	
Year	**Improvement on 2010 Building Regulations***
2010 - 2013	25%
2013 – 2016	40%
2016 – 2019	As per building regulations requirements
2019 - 2031	Zero Carbon
* To be calculated using an 'Aggregate 25 per cent' approach new non-domestic buildings in accordance with the final 2010 Part L Building Regulations.	

C. Major development proposals should include a detailed energy assessment to demonstrate how the minimum targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D. As a minimum, energy assessments should include the following details:

a. Calculation of baseline energy demand and carbon dioxide emissions on a 'whole energy' basis, showing the contribution of emissions both from uses covered by building regulations and those that are not (see paragraph 5.22);

b. Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services;

c. Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP); and

d. Proposals to further reduce carbon dioxide emissions through the use of onsite renewable energy technologies.

E. The carbon dioxide reduction targets should be met onsite. Where it is clearly demonstrated that the specific targets cannot be fully achieved onsite, any shortfall may be provided offsite or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.3: Sustainable design and construction

Strategic

A. The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new development.

Planning decisions

B. Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.

C. Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance on Sustainable Design and Construction and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve the following sustainable design principles:

a. minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)

b. avoiding internal overheating and contributing to the urban heat island effect

c. efficient use of natural resources, including making the most of natural systems both within and around buildings

d. avoiding pollution (including noise, air and urban runoff)

e. minimising the generation of waste and maximising reuse or recycling

f. avoiding impacts from natural hazards (such as flooding)

g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions

h. securing sustainable procurement of materials, using local supplies where feasible, and

i. promoting and protecting biodiversity and green infrastructure.

Policy 5.4: Retrofitting

A. The environmental impact of existing urban areas should be reduced through policies and programmes that bring existing buildings up to the Mayor's standards on sustainable design and construction. In particular programmes should reduce carbon dioxide emissions, improve the efficiency of resource use (such as water) and minimise the generation of pollution and waste from existing building stock.

Policy 5.5: Decentralised Energy Networks

Strategic

A. The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide level, as well as larger scale heat transmission networks. The Mayor has developed a London Heat Map tool to help boroughs and developers identify decentralised energy opportunities in London.

Policy 5.6: Decentralised Energy in Development Proposals

Planning decisions

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks;
2. Site wide CHP network;
3. Communal heating and cooling;

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7: Renewable Energy

Strategic

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the minimum targets for installed renewable energy capacity outlined in Table 5.1 *(of The London Plan)* will be achieved in London.

Planning Decisions

B. Within the framework of the energy hierarchy, major development proposals should provide a reduction in carbon dioxide emissions through the use of onsite renewable energy generation, where feasible.

Policy 5.8: Innovative Energy Technologies

Strategic

A. The Mayor supports and encourages the more widespread use of innovative energy technologies to reduce use of fossil fuels and carbon dioxide emissions. In particular the Mayor will seek to work with boroughs and other partners to:

   a. maximise the uptake of electric and hydrogen fuel cell vehicles

   b. plan hydrogen supply and distribution infrastructure

   c. maximise the uptake of advanced conversion technologies such as anaerobic digestion, gasification and pyrolysis for the treatment of waste.

Policy 5.9: Overheating and Cooling

Strategic

A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to mitigate overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Planning Decisions

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

   1. minimise internal heat generation through energy efficient design

   2. reduce the amount of heat entering a building in summer through shading, albedo, fenestration, insulation and green roofs and walls

3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

Policy 5.10: Urban Greening

Strategic

A. The Mayor will promote and support urban greening, such as new planting in the public realm (including streets, squares and plazas) and green infrastructure, to contribute to the adaptation to, and mitigation of, the effects of climate change.

B. The Mayor seeks to increase the amount of surface area greened in the Central Activities Zone by at least five per cent by 2030, and a further five per cent by 2050

Planning decisions

C. Development proposals should integrate green infrastructure from the beginning of the design process to contribute to urban greening, including the public realm. Elements that can contribute to this include tree planting, green roofs and walls, and soft landscaping. Major development proposals within the Central Activities Zone should also demonstrate how they are contributing to the target outlined above.

Policy 5.11: Green roofs and development site environs

Planning decisions

A. Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

a. adaptation to climate change (i.e. aiding cooling)
b. sustainable urban drainage
c. mitigation of climate change (i.e. aiding energy efficiency)
d. enhancement of biodiversity
e. accessible roof space
f. improvements to appearance and resilience of the building
g. growing food.

Policy 5.12: Flood risk management

Planning decisions

A. Development proposals must comply with the flood risk assessment and management requirements set out in PPS25 over the lifetime of the development and have regard to measures proposed in TE2100 and Catchment Flood Management Plans.

B. Developments which are required to pass the PPS25 Exceptions Test will need to address flood resilient design and emergency planning by demonstrating that:

1. the development will remain safe and operational under flood conditions
2. a strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions
3. key utilities including electricity, water, lifts etc will continue to be operational under flood conditions
4. buildings are designed for quick recovery following a flood.

C. Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible be set back from those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

Policy 5.13: Sustainable drainage

Planning decisions

D. A Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so and should aim to achieve greenfield run-off rates and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy:

1. store rainwater for later use
2. use infiltration techniques, such as porous surfaces in non-clay areas
3. attenuate rainwater in ponds or open water features for gradual release
4. attenuate rainwater by storing in tanks or sealed water features for gradual release
5. discharge rainwater direct to a watercourse
6. discharge rainwater to a surface water sewer/drain
7. discharge rainwater to the combined sewer.

Policy 5.15: Water use and supplies

Planning decisions

B. Development should minimise the use of treated water by:

1. a incorporating water saving measures and equipment
2. meeting water consumption targets of 105l/p/d in residential development.
3. New development for sustainable water supply infrastructure will be supported.

Local Planning Policy

- **London Borough of Camden Core Strategy 2010 – 2025 (Adoption version 2010)**

Policy CS13: Tackling climate change through promoting higher environmental standards

Reducing the effects of and adapting to climate change

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.

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

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 (see Map 4) 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);

- **London Borough of Camden Supplementary Planning Documents (SPDs)**

CPG 3 – 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. "

CPG 3 – 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. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

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."

Appendix C – BREEAM EcoHomes Pre-Assessment

EcoHomes 2006
Summary Score sheet **Site:** 18 Hanway Street, Camden

			Score	Credits available	Sub-total	Credits available	% achieved	Weighting factor	Credits Score
Energy	**Ene 1**	Dwelling Emission Rate	6	15	15	24	62.5	0.22	13.75
	Ene 2	Building fabric	2	2					
	Ene 3	Drying space	1	1					
	Ene 4	EcoLabelled goods	2	2					
	Ene 5	Internal Lighting	2	2					
	Ene 6	External lighting	2	2					
Transport	**Tra 1**	Public transport	2	2	6	8	75.0	0.08	6.00
	Tra 2	Cycle storage	0	2					
	Tra 3	Local amenities	3	3					
	Tra 4	Home office	1	1					
Polution	**Pol 1**	Insulant GWP	1	1	8	11	72.7	0.1	7.27
	Pol 2	NO_x Emissions	3	3					
	Pol 3	Reduction of Surface Runoff	0	2					
	Pol 4	Renewable and Low Emission E	2	3					
	Pol 5	Flood Risk	2	2					
Materials	**Mat 1**	Environmental Impact of Materia	16	16	28	31	90.3	0.14	12.65
		Roof	3	3					
		External Walls	3	3					
		Internal Walls	3	3					
		Floors - upper and ground	3	3					
		Windows	2	2					
		External surfacing	1	1					
		Boundary Protection	1	1					
	Mat 2	Responsible Sourcing of Materia	4	6					
	Mat 3	Responsible Sourcing of Materia	2	3					
	Mat 4	Recycling Facilities	6	6					
Water	**Wat 1**	Internal Potable Water	4	5	5	6	83.3	0.1	8.33
	Wat 2	External Potable Water	1	1					
	Eco 1	Ecological Value of Site	1	1	4	9	44.4	0.12	5.33
Land Use and Ecology	**Eco 2**	Ecological Enhancement	0	1					
	Eco 3	Protection of Ecolgoical Feature	1	1					
	Eco 4	Change of Ecological Value of S	2	4					
	Eco 5	Building footprint	0	2					
	Hea 1	Daylighting	2	3	5	8	62.5	0.14	8.75
Health and Wellbeing	**Hea 2**	Sound Insulation	3	4					
	Hea 3	Private space	0	1					
Management	**Man 1**	Home User Guide	3	3	8	10	80.0	0.1	8.00
	Man 2	Considerate Constructors	1	2					
	Man 3	Construction Site Impacts	3	3					
	Man 4	Security	1	2					
					Total Available	**107**		**Score:**	**70.08**
								Rating:	**Excellent**

Based on: EcoHomes 2006
Sheet Version: 1.2
Version Date: 16/10/2006

Rating	Score
Pass	36
Good	48
Very Good	58
Excellent	70

Appendix D - Renewable Energy Technology – Supporting Data

Photovoltaics (PV)

Bolt on Array (Module PV)

Building Integrated PV Array (Tile)

Summary:

Photovoltaic (PV) arrays convert solar energy into electricity that is either used directly within the development or exported to the national grid, offsetting mains electricity used on-site.

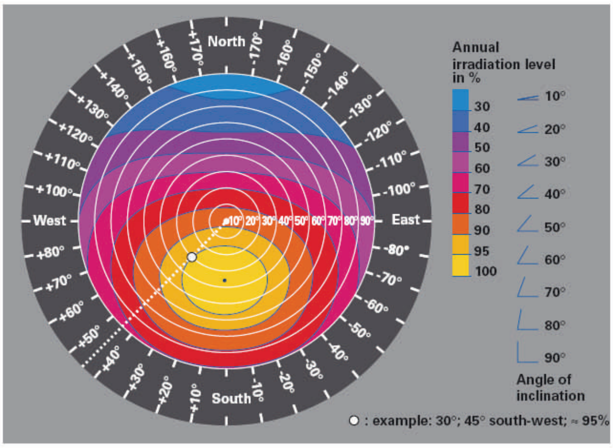
How it works:

Each solar module is made up of a series of silicon cells. Photons (packets of solar energy) striking the surface of the cell are absorbed by the semi-conducting silicon. The absorbed energy 'excites' an electron of a particular atom into a higher energy band (valence -> conduction) creating a 'hole'. An electron from a neighbouring atom can then move into this 'hole' (due to a missing covalent bond). Thus continuous exposure to photons (solar energy) creates a 'flow' of electrons through the silicon cell and a voltage difference between the upper and lower side of the panel - electrical generation.

Silicon is manufactured in ingots - wafers are then sliced from this to form the cells, which are then grouped together to form the panel. The more cells in a module (and the more efficient each cell is), the higher the rated peak wattage (Wp). Module capacity is measured in kWp and performance is measured as kWh.

Ensuring Efficiency:

Three factors effecting the efficiency of a PV installation are the orientation, inclination and potential shading of the system. Greatest efficiencies are achieved with an orientation of due south with an inclination of 30 degrees. Shading should be considered in each instance as it can reduce system efficiency significantly and should be avoided where practicable.



Relationship Between Efficiency and Orientation

Derivatives:

There are 4 main types of PV cell available:

- **Monocrystalline -** Expensive, but highest efficiency (10-15%) and longevity (80% of rated output after 20/25 years)
- **Polycrystalline** - Cheaper than Monocrystalline, but lower efficiency (9-13%) with similar longevity
- **Amorphous Multi Junction** - Most expensive, average efficiency (8-10%) but works well in areas of diffuse radiation. Longevity - 80% of rated output for 10/20 years.
- **Amorphous Thin Film** - Least expensive. However, low efficiency (3-6%) and generally only suited for small applications. Can be fragile and degrades 10% in first 3 months.

Commercial and Residential applications in the UK tend to use Mono or Polycrystalline panels (although thin film is used in some integrated systems such as in standing seam roofs).

Applications:

- **Traditional Modules** - most commonly used PV application for 'bolt-on' or retrofit and for commercial uses. Modules generally tend to use mono or polycrystalline cells and have an output of 180-220W

- **Building Integrated** (Slate, Tile or Façade) - generally used for new-build. Allows for low aesthetic intrusion but lower kWp/m^2 than modules and greater cost. Systems are also available that are mounted into roofing felt (Alwitra).

- **Glass-Glass Laminates** - PV Cells set into glass (e.g. for conservatories). These are generally bespoke and expensive, but adaptable — for instance the cell spacing can be set to control light transmission.

- **Cylindrical** - Pioneered by the 'Solyndra' system. Effectively a module system, but similar in appearance to Evacuated Tube SWH and able to be mounted horizontally flat roof. Offers good performance at a similar cost to an integrated system

- **Hybrid** - PV film under laid by solar water heat collectors; cooling effect increases efficiency of PV and provides additional benefit achieved through solar water heat.

Noise:

A PV system does not feature moving parts and is silent during operation.

Technology Summary Table:

Bolt On (Module PV)	Building Integrated (Slate, Tile or Facade)
~6m^2/kWp	~8-9m^2/kWp
Performance - 800-900 kWh/yr/kWp	
~£5,500/kWp	~£6,500/kWp

Solar Water Heating (SWH)

Evacuated Tubes Collectors

Flat Plate Collectors

Summary:

Solar Water Heating (SWH) arrays convert solar radiation into hot water which is then passed through a coil within the hot water tank, thus reducing demand from fossil fuelled hot water systems.

How it works:

There are two types of collector for heating although working on similar principles. An average family house would feature a SWH system made up of 2-3 individual collectors:

Evacuated Tube (ET) - consist of a copper pipe running down the centre of an evacuated glass tube along an absorber plate, the under side of the glass is painted black to increase temperature. The vacuum reduces the convective heat loss from the tube, increasing efficiency. It is also possible to turn the tubes the frame to reduce the effects of poor orientation.

Additionally, there are two derivatives of the ET system:

- Direct Flow (DF) - the glycol mix is pumped throughout the system, through each pipe in turn and through the manifold. This allows the system to be mounted at any inclination.

- Heat Pipe (HP) - each tube is a sealed, separate circuit which are connected 'dry' into the manifold. Allows for easier installation but relies on a minimum inclination level for the system to operate correctly.

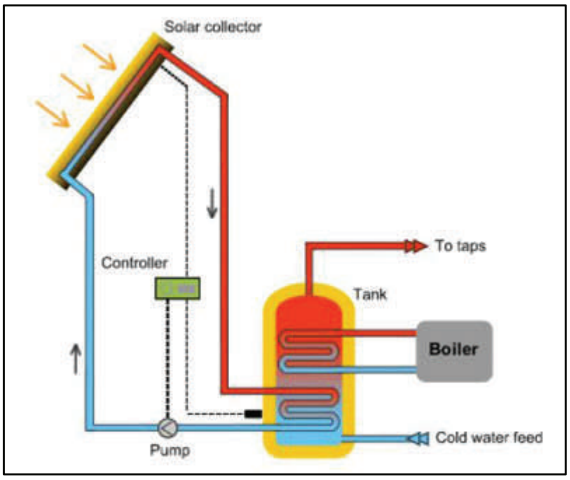
Flat Plate (FP) - have a layer of insulation covered by a black absorber plate with water/glycol pipes running through the collector. Heat is then absorbed by the fluid within the pipes, again, normally glycol. Protective glass covers the system although a vacuum is generally not created, therefore convective heat losses are greater than that from evacuated tubes.

There are also Integrated SWH systems available—these work on the same principle as a Flat Panel but are made up of separate 'Tiles', containing the required pipework, which are linked together to form a larger collector. These offer a much lower level of aesthetic intrusion but are more complex and as they are integrated into the roof, more difficult to maintain,

With either system type, the fluid heated by the collector is circulated through a dual coil hot water cylinder.

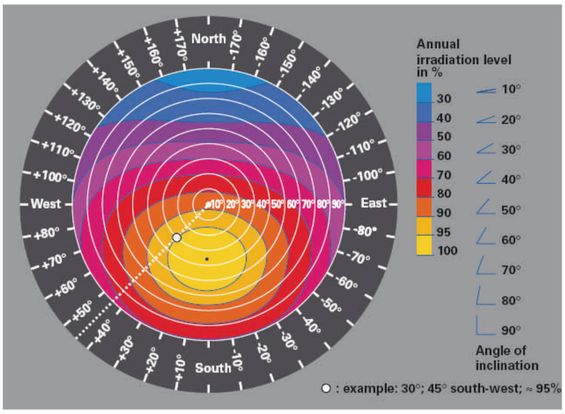
The systems are generally sized to meet a maximum of 60% of the unit's DHW load—this is to reduce the risk of the SWH collectors overheating the hot water system during periods of high solar insolation and/or low hot water demand. Heat dump radiators (such as a towel rail) are sometimes used to 'vent' excess hot water. The outstanding hot water load is provided by the larger heating system.

Example Schematic:



Ensuring Efficiency:

Three factors effecting the efficiency of a SWH installation are the orientation, inclination and potential shading of the system. Greatest efficiencies are achieved with an orientation of due south with an inclination of 30 degrees. Shading from vegetation and neighbouring buildings should be considered for all installations as it can reduce system efficiency significantly and should be avoided where practicable.



Relationship Between Efficiency and Orientation.

In order to ensure system efficiency the aim must be to minimise the use of additional immersion heater. Reducing domestic hot water use through water efficient fittings/appliances, and minimising heat loss through pipe lagging are two methods.

Evacuated tubes are more efficient although the initial cost of the system is higher and the visual impact is perceived as being greater than that of the flat panel collectors. These are additional considerations to be taken into account when deciding which installation is most appropriate.

Noise

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

Technology Summary Table:

Evacuated Tube Collector	**Flat Panel Collector**
Typically 2.2m x 0.8m each	Typically 2.1m x 1.1m each
550 kWh/m^2/yr	450 kWh/m^2/yr
~£6,000/system	~£4,000/system

Ground Source Heat Pumps (GSHP)

Internal Unit (Cover Removed)

External Collection Trench

Summary:

Ground Source Heat Pump (GSHP) systems extract latent heat from the ground through the use of a ground loop and heat condenser. This heat is then able to be used within the house for space or water heating.

How it works:

Heat Pump systems operate by extracting thermal energy from a renewable energy 'reservoir' (such as the ground, air or water) and upgrade it to a higher, more useful temperature. The system (collector -> heat pump -> thermal store) is a sealed, pressurised loop containing a water/glycol mix.

In an GSHP, the 'collector' comprises of ground loop - plastic pipework either buried in 'trenches' or boreholes

The collector allows transfer of available energy (heat) from the source (in the case of GSHP, the ground) into the glycol mix. The pre-heated glycol transfers this energy into the Heat Pump itself, where it is 'upgraded' to a more useful temperature through increasing the pressure of the liquid and utilising the energy released when a liquid changes state to become a gas. This heat is transferred into the thermal store through a separate coil.

Performance is measured as a value of energy input against the energy output to provide a ratio know as the coefficient of performance (CoP). This is affected by a number of factors, including system design, solar irradiation, local geology and patterns of use.

GSHP is capable of providing space heat at CoP's of 3.2 - 5, but due to the increased electrical consumption associated with producing high grade domestic hot water (DHW), the CoP is reduced to 2.24 for the DHW fraction. The system can work with external temperatures (–10°C), although at these temperatures the CoP will be reduced and there is the risk of freezing the soil as the GSHP will pull all the remaining energy (heat) from the ground.

Compared to a traditional gas boiler, GSHP systems can reduce energy consumption for space heating by ~30-40%, however, CO_2 offset is dramatically lower due to the high CO_2 factor of the electricity used to run the ASHP.

Ensuring Efficiency:

In order to ensure system efficiency the use of additional immersion heating should be avoided if possible. Reducing heat loss by maximising insulation levels and reducing air permeability and reducing the target temperature of the hot water tank (from 60^{o}C to 45^{o}C for example) by using underfloor heating or low temperature radiators, rather than traditional radiators can help to achieve this.

As a consequence heat pump systems are generally considered to be more applicable to new developments rather than retrofits.

Additionally, due to the low emitter temperatures, heat pump systems suffer from not having the 'huddle-around-the-radiator' effect of conventional, high temperature systems. Although the temperature of the building will be sufficient, there isn't the instant heat of a radiator and as such, the occupant may feel cold. The inclusion of a small biomass stove as a direct heat feature can be used to negate this.

Noise

The compressor makes a similar level of noise to a refrigerator when operating.

Technology Summary Table:

Ground Source Heat Pump
Typically £5,000—10,000, although drilling/ groundwork costs can double plant costs
CoP - 3.5 to 5 (limited at 3.2 by current SAP)
Offsets ~30-40% of energy usage
Reduces CO_2 emissions by ~8-10%

Air Source Heat Pump (ASHP)

External Collector **Internal Control Unit and Thermal Store**

Summary:

Air Source Heat Pump (ASHP) systems extract latent atmospheric heat through the use of a heat condenser. This heat is then able to be used within the house for space or water heating.

How It Works:

Heat Pump systems operate by extracting thermal energy from a renewable energy 'reservoir' (such as the ground, air or water) and upgrade it to a higher, more useful temperature. The system (collector -> heat pump -> thermal store) is a sealed, pressurised loop containing a water/glycol mix.

In an ASHP, the 'collector' comprises a heat exchanger and an electrically driven fan - the fan increases airflow across the heat exchanger to increase energy transfer.

The collector allows transfer of available energy (heat) from the source (in the case of ASHP, the ambient air) into the glycol mix. The pre-heated glycol transfers this energy into the Heat Pump itself, where it is 'upgraded' to a more useful temperature through increasing the pressure of the liquid and utilising the energy released when a liquid changes state to become a gas. This heat is transferred into the thermal store through a separate coil.

Performance is measured as a value of energy input against the energy output to provide a ratio know as the coefficient of performance (CoP). This is affected by a number of factors, including system design, solar irradiation and patterns of use.

ASHP is capable of providing space heat at CoP's of 2.5 - 3.5 but due to the increased electrical consumption associated with producing high grade domestic hot water (DHW), the CoP is reduced to 2.24 for the DHW fraction. The system can work with external temperatures as low as $-15^{o}C$.

Compared to a traditional gas boiler, ASHP systems can reduce energy consumption for space heating by ~30%, however, CO_2 offset is dramatically lower due to the high CO_2 factor of the electricity used to run the ASHP.

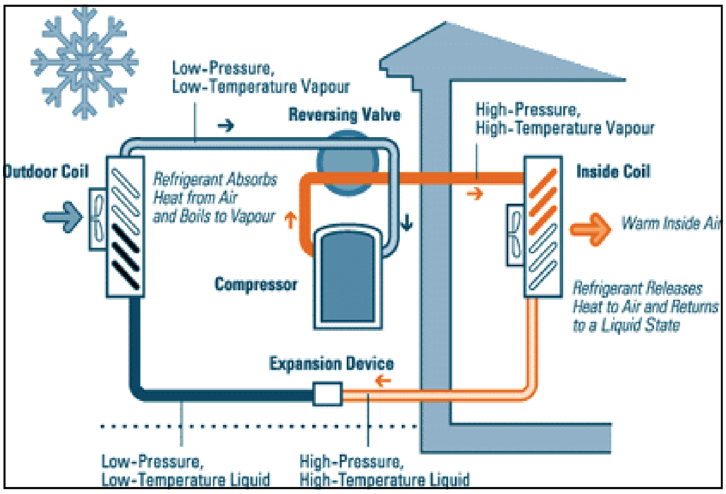
Ensuring Efficiency:

In order to ensure system efficiency the use of additional immersion heating should be avoided if possible. Reducing heat loss by maximising insulation levels and reducing air permeability and reducing the target temperature of the hot water tank (from 60°C to 45°C for example) by using underfloor heating or low temperature radiators, rather than traditional radiators can help to achieve this.

As a consequence heat pump systems are generally considered to be more applicable to new developments rather than retrofits.

Additionally, due to the low emitter temperatures, heat pump systems suffer from not having the 'huddle-around-the-radiator' effect of conventional, high temperature systems. Although the temperature of the building will be sufficient, there isn't the instant heat of a radiator and as such, the occupant may feel cold. The inclusion of a small biomass stove as a direct heat feature can be used to negate this.

System Schematic:



Noise

As it features moving parts (an electrically driven fan) the external unit will make some noise – expected to be minimal and should not be noticeable to the surrounding area (~50dB Max). The compressor makes a similar level of noise to a small refrigerator.

Technology Summary Table:

Air Source Heat Pump
Typically £2 - 5,000
CoP - 2.5 to 3.5 (limited at 2.5 by current SAP)
Offsets ~30% of energy usage
Reduces CO_2 emissions by ~5%

Feed In Tariff (FIT)

Summary:

The Feed In Tariff (FIT) scheme aims to provide financial support to individuals, communities and businesses to encourage them to implement renewable/low carbon electrical generating technologies.

The scheme will effectively pay an elevated rate for all electricity produced on-site (whether exported or not) in addition to any savings from electricity they would have purchased.

How it works:

The scheme will come into operation on the 1st April 2010, although MCS compliant schemes completed after 15th July 2009 are eligible for the scheme as well. Payments through the FIT tariff are tax free for the duration of the scheme.

The scheme consists of two elements:

Generation Tariff:

The generation tariff is the amount paid for every metered kWh of electricity generated on-site. This is paid regardless of whether the electricity is used on-site or is exported

Export Tariff:

The export tariff is the amount paid per kWh of electrical energy that is exported from the site (e.g. to the national grid). For larger installations this is metered, where as for smaller installations it is assumed as a set proportion of the generated electricity over the year. The standard tariff is £0.03/ kWh, although the site may opt out and sell their electricity on the open market (for larger sites).

- To be eligible for the FIT, the technology must be MCS accredited and installed by an MCS accredited installer (unless accreditation has been achieved under the Renewable Obligation process).
- The FIT payment rates start high, although these will decrease over the lifetime of the scheme as the cost of renewable installations is expected to reduce accordingly. However, in order to stimulate early adoption of the scheme, the current rate at time of sign-up will be maintained over the life of the tariff. All rates are inflation linked.
- The scheme currently support Photovoltaics, Wind and Hydro up to 5MW in size, with Anaerobic Digestion and MicroCHP* also included (although the latter is a pilot for the first 30,000 units only). New technologies and tariffs will be considered under scheme reviews.
- Ofgem will administer the feed-in tariff scheme and suppliers will be responsible to paying the reward to their customers.
- Current Grant schemes such as the Low Carbon Buildings Programme, CERT and CSEP will currently still be available and can be claimed as well as the RHI.

Tariff levels for Feed In Tariff

Energy Source	Scale	Tariff (p/kWh)	Duration (years)
Anaerobic digestion	≤250kW	14.0	20
Anaerobic digestion	>250kW - 500kW	13.0	20
Anaerobic digestion	>500kW	9.4	20
Hydro	≤15 kW	20.9	20
Hydro	>15 - 100kW	18.7	20
Hydro	>100kW - 2MW	11.5	20
Hydro	>2MW - 5MW	4.7	20
Micro-CHP	<2 kW	10.5	10
Solar PV	≤4 kW new	37.8	25
Solar PV	≤4 kW retrofit	43.3	25
Solar PV	>4-10kW	37.8	25
Solar PV	>10 - 50kW	32.9	25
Solar PV	>50 - 150kW	19.0	25
Solar PV	>150 - 250kW	15.0	25
Solar PV	>250kW - 5MW	8.5	25
Solar PV	Standalone	8.5	25
Wind	≤1.5kW	36.2	20
Wind	>1.5 - 15kW	28.0	20
Wind	>15 - 100kW	25.3	20
Wind	>100 - 500kW	19.7	20
Wind	>500kW - 1.5MW	9.9	20
Wind	>1.5MW - 5MW	4.7	20
Existing generators transferred from RO		9.4	to 2027

Further Information

- http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/feedin_tariff/feedin_tariff.aspx
- http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Feed-in-Tariff-scheme

Renewable Heat Incentive (RHI)

Summary:

The Renewable Heat Incentive (RHI) scheme aims to provide financial support to individuals, communities and businesses to encourage them to implement renewable/low carbon technologies in-place/instead of conventional heating systems (fossil fuelled). It effectively acts as a 'Feed-In-Tariff' for heating technologies.

How it works:

On 10th March 2011 DECC released final details of how the long-awaited Renewable Heat Incentive (RHI) will be implemented:

Phased scheme with two key phases:

- 1st phase scheduled to come into operation July 2011 – will comprise tariff payments for non-domestic installations and Renewable Heat Premium Payments for the domestic sector
- 2nd phase will include tariff payments for domestic sector and provide further response to feedback from 1st phase - tariff implementation for domestic schemes has been delayed to coincide with the Green Deal for Homes

- People in receipt of the Renewable Heat Premium Payments will be able to receive long term RHI tariff support once these tariffs are introduced as will anybody who has installed an eligible installation since 15th July 2009.
- The RHI will be funded from general Government spending, not through the previously proposed RHI levy
- RHI payments to be claimed by, and paid to, the owner of the equipment. The RHI will be available to householders, local authorities and social landlords as well as the public, industrial and commercial sectors.
- For small and medium-sized installations (up to and including 45kWth), both installers and equipment to be certified under the Microgeneration Certification Scheme (MCS) or equivalent standard, helping to ensure quality assurance and consumer protection. For installations larger than 45kWth, OFGEM will verify eligibility based on the required documentation provided by RHI applicants as part of the accreditation process.
- Heat output to be metered and the support calculated from the amount of useful heat used for eligible purposes, multiplied by the tariff level. 'Useful Heat' is to be determined by OFGEM.
- Domestic installations will be required to be for well insulated homes, based on Energy Performance Certificate – specific details not yet available.
- RHI payments to be claimed by, and paid to, the owner of the heat installation or producers of biomethane for injection (non-domestic but domestic expected to be similar)
- The renewable heat installation will be the sole fixed heating installation in the property (not counting any immersion heater that may form part of such installation).
- For domestic schemes, there will be a focus on people living off the gas grid, where fossil fuels like heating oil are both more expensive and have a higher carbon content – specific details not yet available.

Technologies Supported at outset:

- Biomass Boilers
- Energy From Waste (organic waste)
- Ground and Water Source Heat Pumps (minimum CoP of 2.9)
- Deep Geothermal
- Solar Thermal (Solar Water Heating) – up to 200kWth
- Biogas – up to 200kWth
- Biomethane Injection into the grid
- Renewable Combined Heat and Power

Technologies NOT supported at outset – to be reviewed in 2012:

- Air Source Heat Pumps
- Direct Air Heating (Renewable Fuelled)
- Bioliquid (Biofuels)

Excluded Technologies:

- Co-firing biomass with fossil fuel (within single piece of equipment)
- Exhaust Air Heat Pumps
- Transpired Solar Thermal Panels
- Fossil Fuel CHP
- Waste Heat from Fossil Fuel

Tariff levels for Renewable Heat Incentives

<table>
<tr><th>Tariff name</th><th>Eligible technology</th><th>Eligible sizes</th><th>Tariff rate (pence/ kWh)</th><th>Tariff duration (Years)</th><th>Support calculation</th></tr>
<tr><td rowspan="2">Small biomass</td><td rowspan="5">Solid biomass; Municipal Solid Waste (incl. CHP)</td><td rowspan="2">Less than 200 kWth</td><td>Tier 1: 7.6</td><td rowspan="5">20</td><td rowspan="4">Metering
Tier 1 applies annually up to the Tier Break, Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.:
kWth x 1,314</td></tr>
<tr><td>Tier 2: 1.9</td></tr>
<tr><td rowspan="2">Medium biomass</td><td rowspan="2">200 kWth and above; less than 1,000 kWth</td><td>Tier 1: 4.7</td></tr>
<tr><td>Tier 2: 1.9</td></tr>
<tr><td>Large biomass</td><td>1,000 kWth and above</td><td>2.6</td><td>Metering</td></tr>
<tr><td>Small ground source</td><td rowspan="2">Ground-source heat pumps; Water-source heat pumps; deep geothermal</td><td>Less than 100 kWth</td><td>4.3</td><td rowspan="2">20</td><td rowspan="2">Metering</td></tr>
<tr><td>Large ground source</td><td>100 kWth and above</td><td>3</td></tr>
<tr><td>Solar thermal</td><td>Solar thermal</td><td>Less than 200 kWth</td><td>8.5</td><td>20</td><td>Metering</td></tr>
<tr><td>Biomethane</td><td>Biomethane injection and biogas combustion, except from landfill gas</td><td>Biomethane all scales, biogas combustion less than 200 kWth</td><td>6.5</td><td>20</td><td>Metering</td></tr>
</table>

Further Information

- http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx