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Hamilton Lofts Ltd

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37 Hamilton Road

Twickenham

Energy Statement

Submission

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Energy Statement

Energy Statement in support of the Planning Application for the Residential development at Hamilton Road by Hamilton Lofts Ltd.

This report has been undertaken by Samantha Walkden of Richard Hodkinson Consultancy.

Schedule of Issue

Version	Date	Reason for Issue	Issued By	Approved By
v.1	10.08.2010	Draft	Sam Walkden	Donald Sinclair
v.2	10.08.2010	Submission	Sam Walkden	Bill Bailey

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Executive Summary

i. The Energy Strategy for the proposed development at 37 Hamilton Road has been formulated following the London Plan Energy Hierarchy: ***Be Lean***, ***Be Clean*** and ***Be Green***. The overriding objective in the formulation of the Energy Strategy for the proposed development is to maximise the reductions in total CO_2 emissions through the application of this Hierarchy with a cost-effective approach, whilst being considerate to the specific requirements of the proposed development and local area.

ii. The proposed development will provide 27 dwellings – 3 houses and 24 flats – at 37 Hamilton Road, Twickenham.

iii. ***Be Lean*** energy efficiency measures will be applied to the development. These will reduce the total CO_2 emissions of the development by 7.2**%** over a Building Regulations 2006 compliant baseline.

iv. In line with the London Plan, the feasibility of **Combined Heat and Power (CHP)** has been evaluated as a ***Be Clean*** technology. However, it has been concluded that CHP is not the favoured technology for the proposed development due to its small size and low density.

v. Photovoltaic panels will be installed as a ***Be Green*** measure. In line with the London Plan, this will reduce the total CO_2 emissions of the development by a further **14%.** It has been concluded that this is the highest reduction that can be technically achieved on this site.

vi. The combination of all the proposed measures will reduce the **total CO_2** emissions of the proposed development by **20.6%**.

vii. The reduction in **regulated CO_2** emissions of all new build units is sufficient to meet the mandatory energy requirements of Level 3 of the Code for Sustainable Homes. Ecohomes assessments will be completed on the refurbishment portion of the development to meet Excellent standard.

1. Introduction

1.1. This Energy Statement has been prepared by Richard Hodkinson Consultancy (RHC), a specialist innovation, sustainability and energy consultancy, in support of the planning application for the proposed residential development at 37 Hamilton Road, Twickenham by Hamilton Lofts Ltd.

1.2. The formulation of the energy strategy for the proposed development takes into account several important concerns and priorities. These include:

a) To achieve the maximum viable reduction in total CO_2 emissions.

b) To affordably meet the maximum viable reduction in total CO_2 emissions through the use of renewable energy required by the London Plan.

c) To meet Level 3 of the Code for Sustainable Homes for all new units.

d) To be considerate to the existing building and devise an energy strategy that is sympathetic to its unique character.

1.3. This statement first establishes a baseline assessment of the energy demands for the development based on current Building Regulations (2006). The report will then follow The London Plan Energy Hierarchy approach of ***Be Lean, Be Clean*** and ***Be Green*** to enable the maximum viable reductions in regulated and total CO_2 emissions over the baseline.

2. Development Overview

2.1. The residential development at 37 Hamilton Road, Twickenham will provide 27 dwellings from extensively refurbished industrial buildings and new build– 3 houses and 24 flats. Additionally, the local environment will be enhanced with the provision of a turning circle and landscaping.

2.2. The existing buildings are designed as being of 'townscape merit'. The refurbishment of the existing buildings is therefore constrained by this classification.

2.3. The code for sustainable homes pre assessment attached as appendix E, illustrates the wider sustainability measures that could be incorporated to ensure that all new build units achieve code level 3. The Eco homes pre assessment (appendix F) does likewise for the refurbishment units.

3. Planning Policies and Project Requirements

3.1. National planning policy requirements relevant to this energy statement are given in the Government's Planning Policy Statement 22; Renewable Energy:

"Local planning authorities and developers should consider the opportunity for incorporating renewable energy projects in all new developments."

3.2. The London Plan provides regional guidance. Policy 4A.1 of the London Plan requires developments to:

"make the fullest contribution to the mitigation of and adaptation to climate change and to minimise emissions of carbon dioxide.

The following hierarchy will be used to assess applications:

- *Using less energy... (Policy 4A.3)*
- *Supplying energy efficiently...(Policy 4A.6)*
- *Using renewable energy (Policy 4A.7)"*

This is the ***Be Lean, Be Clean, Be Green*** approach required by the London Plan.

3.3. Policy 4A.6 expands on this, stating that:

"The heating and cooling infrastructure should be designed to allow the use of decentralised energy...Developments should evaluate combined cooling, heat, and power (CCHP) and combined heat and power (CHP) systems"

3.4. Policy 4A.7 states that:

"developments will achieve a reduction in carbon dioxide emissions of 20% from on site renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible."

3.5. The London Plan refers to Total CO_2 – that is the CO_2 associated with the regulated energy uses of hot water, space heating and fixed electrical items and also the energy associated with unregulated electrical demands (appliances and cooking).

3.6. It is also intended that the affordable units achieve Level 3 of the Code for Sustainable Homes. This requires a 25% reduction in Part L regulated CO_2 emissions from energy efficient measures and low carbon or renewable energy technologies.

4. Building Regulations Baseline

4.1. In order that an energy assessment can be conducted, a Building Regulations (2006) baseline for energy demand and associated CO_2 emissions first has to be calculated. This baseline will then be used as a basis to demonstrate the reductions in CO_2 emissions that will result from energy efficient measures and on-site energy generation. Appendix B shows the accommodation schedule for the development along with the calculated Building Regulation (2006) baseline energy demands.

Method and Limitations

4.2. The estimated annual energy demand for the proposed development has been calculated using Standard Assessment Procedure (SAP) methodology. SAP calculates the regulated energy demands associated with space heating, hot water and fixed electrical items. The unregulated energy demands for appliances that are required for the total energy demands were calculated using the SAP zero carbon calculation.

Building Regulation Compliant Baseline

4.3. The Building Regulations compliant baseline case provides that the buildings just meet the Target Emissions Rate (TER). Table 1 shows the Building Regulations (2006) compliant regulated CO_2 emissions (for Code for Sustainable Homes compliance) and total CO_2 emissions (for London Plan compliance).

Table 1: Building Regulations (2006) Baseline

	Regulated CO_2 Emissions (kg/yr)	Total CO_2 Emissions (kg/yr)
Hot Water	14,100	14,100
Space Heating	10,100	10,100
Fixed Electrical	6,700	6,700
Un-Fixed Electrical	-	23,200
Total	**30,900**	**54,100**

5. *Be Lean*: Energy Conservation Measures

5.1. In line with the London Plan Energy Hierarchy, the following energy efficient, ***Be Lean*** measures are proposed to be applied to the development to significantly lower the emissions of the development below the Building Regulations (2006) compliant baseline.

Insulation Standards

5.2. The new buildings will incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-values better than those required by Part L (2006) Building Regulations. These include:

- Low E glazing with a U-value of 1.5.
- Wall U-values will be improved to 0.25.
- Ground Floor U-values will be improved to 0.15.
- Roof U-values will be improved to 0.11.

5.3. Due to the constraints placed on the existing buildings by their designation as being of 'township merit', it is not possible to achieve these levels of insulation. It is proposed to follow the guidance in 'Building Regulations and Historic Buildings' by English heritage. It is expected that the following u values can be achieved:-

- Low E glazing with a U-value of 2.0.
- Wall U-values will be improved to 0.35.
- Ground Floor U-values will be improved to 0.25.
- Roof U-values will be improved to 0.15.

5.4. The advantage of keeping and refurbishing the existing building is that a substantial amount of embodied energy is saved.

Ventilation and Air Tightness

5.5. Air tightness standards will conform to Approved Document Part L accredited details. These details incorporate an improvement over Building Regulation requirements by reducing air leakage loss and convective bypass of insulation. An improvement of design air permeability rate from $10m^3/hm^2$ to less than $5m^3/hm^2$ will further reduce space heating requirements. Whilst all effort will be made to achieve this for the refurbishment, it may not be possible to achieve this level of air tightness.

5.6. The feasibility of installing Mechanical Ventilation and Heat Recovery (MVHR) will also be studied to further reduce space heating requirements.

Thermal Bridging

5.7. In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g. metals) in the wall construction enable a low resistance escape route for heat. It is proposed that the new build elements of the development will meet Accredited Construction Details for thermal bridging[1]. All reasonable thermal bridges will be eliminated/avoided in the refurbishment of the existing building.

Space Heating

5.8. The insulation standards and measures detailed above will significantly reduce the space heating demands of the dwellings.

5.9. Furthermore, the space heating demands of the development will be lowered by taking advantage of winter solar gains. Many of the dwellings will have elevations facing between southeast and southwest to take advantage of solar gain. Where possible, the internal layout of dwellings will be such that living areas are on the southern side of the dwellings and areas which do not need the same level of heating will be on the northern side.

5.10. High efficiency (90%+) gas boilers will be installed for all dwellings. Control systems will be selected which maximise energy efficiency in operation.

Limiting Summer Overheating

5.11. It is not intended to provide any mechanical cooling in the proposed development. In line with the Mayor's cooling hierarchy[2] it is intended to reduce the need for active cooling as far as possible. This will be done through the specification of non-mechanical measures such as good thermal insulation and air tightness. There are trees and green spaces provided as part of the development. These allow localised cooling through evapotranspiration and also provide shading in the summer and enable solar gain in the winter. Open-able windows will be installed to allow natural ventilation of the development.

[1] http://www.planningportal.gov.uk/england/professionals/buildingregs/technicalguidance/bcconsfppartl/bcassociateddocuments9/bcptlaccdet/
[2] The London Climate Change Adaptation Strategy Draft Report, August 2008.

Lighting and Appliances

5.12. Energy efficient lighting will be installed in at least three quarters of internal fittings. External lighting will also be low energy lighting and controlled through PIR sensors, or daylight cut-off devices. Kitchen and other pre-installed appliances will be A or A+ rated for energy efficiency.

CO_2 Emissions Following *Be Lean* Measures

5.13. The impact of the above energy saving measures on the regulated and total CO_2 emissions of proposed development is to reduce the total CO2 emissions of the overall development by 7.2% from the Building Regulations baseline, as shown in Table 2, below.

Table 2: Improved Baseline - Energy Efficient Measures

	Regulated CO_2 Emissions (kg/yr)	Total CO_2 Emissions (kg/yr)
Hot Water	12,700	12,700
Space Heating	9,800	9,800
Fixed Electrical	5,700	5,700
Un-Fixed Electrical	-	22,000
Total	**28,200**	**50,200**
Reduction Achieved	**8.7%**	**7.2%**
20% CO_2 Target	-	**10,040**

6. *Be Clean*: Combined Heat and Power

6.1. Details on CHP can be found in Appendix A. Appendix C provides a feasibility table of the technologies that have been considered.

6.2. In line with Policy 4A.6 of the London Plan, the feasibility of installing a Combined Heat and Power engine as a ***Be Clean*** measure has been evaluated. The inclusion of CHP has been studied in terms of appropriateness to the proposed development.

6.3. CHP engine would require an energy centre and a heat distribution network. These are suitable for large and dense developments and therefore not for this development which is small and of low density. Therefore, a CHP engine and heat distribution network are not economically viable for the proposed development.

7. *Be Green*: Renewable Energy Technologies

7.1. The final part of the London Plan Energy Hierarchy is ***Be Green***. This section (Policy 4A.7) sets a target of a further 20% reduction in total CO_2 emissions from renewable energy technologies unless it can be demonstrated that this is not feasible. Table 2, above, shows the 20% target. For Policy compliance, the total CO_2 emissions of the development must be reduced by 10,040 kg per annum through the use of renewable energy technologies.

7.2. Further details on the renewable energy technologies discussed in this section can be found in Appendix A. Appendix C provides a feasibility study table of the available technologies.

Solar Thermal Panels

7.3. Due to the seasonal variation in solar radiation solar thermal panels cannot provide any more than 60% of the hot water load and are therefore unable to reduce the total CO_2 emissions of the development by the 20% required by the London Plan. Other technologies can provide greater reductions therefore, solar thermal panels have not been selected for this development and will not be installed.

Air and Ground Source Heat Pumps (ASHPs and GSHPs)

7.4. Heat Pumps are able to provide substantial reductions in energy. However, GSHPs require costly ground excavation works to bury the coils – boreholes may be required for the proposed development due to the high space requirements of ground coils. Air Source Heat Pumps are a more economic alternative to GSHPs as they do not require ground works. However, the performance of ASHPs is substantially lower than for GSHPs are therefore the reductions in CO_2 are correspondingly low. Whilst reducing energy significantly, heat pumps replace gas as the heating fuel with electricity, which is more carbon intensive. The result of this is that heat pumps do not enable sufficient reductions of CO_2 emissions for London Plan compliance. Electricity is also substantially more expensive than gas, so fuel bills are not reduced by GSHPs as much as by other technologies. Whilst ASHPs are cheaper to install they have a lower performance and provide only limited reductions in total CO_2 emissions. As such, heat pumps would not enable Planning Policy compliance.

7.5. It has therefore been concluded that heat pumps are not a viable technology for the proposed development.

Wind Turbines

7.6. Wind turbines are not a viable technology for the proposed development due to the insufficient speed and turbulent nature of urban wind conditions. As such they will not be installed.

Biomass Boiler

7.7. Biomass boilers would also require a site-wide heat distribution network. This is not a viable option due to the low density nature of the development and the consequent heat losses from the distribution pipes and high capital cost. The energy centre, heat distribution network and biomass fuel would be subject to high capital and running costs and consequently fuel bills would be higher for the residents than the selected strategy.

7.8. Furthermore, biomass boilers, although being clean burning devices, do emit particulate matter and nitrogen oxides which have a negative influence on air quality.

7.9. It has therefore been concluded that a biomass boiler is not a viable option for this development and will therefore not be installed.

Selected Technology: Photovoltaic (PV) Panels

7.10. Unlike solar thermal panels, PV panels are not constrained by the hot water demand of the dwellings. PV panels are good at enabling substantial reductions in CO_2 emissions as a result.

7.11. It has been concluded that PV panels represent the most viable renewable energy technology for the 37 Hamilton Road development. They will therefore be installed for each unit. It may prove most effective for the PV panels for the flats to be installed in a communal set-up with the electricity generated going to the landlords supply.

7.12. For optimal performance, PV panels will be oriented as close to south as possible. The calculations in Appendix D are based on an average orientation of between southeast and southwest. The PV requirements will be optimised for the orientation of each unit to ensure that sufficient energy is generated.

7.13. Whilst it has been possible to ensure that the 20% target is achieved for the new build dwellings, due to limited roof space on the refurbishment it has been concluded that the maximum amount of PV panels that can be installed is ~80m^2. This equates to 10.7kWp.

7.14. It has been calculated that in total 15.3kWp of PV panels are to be installed to generate renewable energy for the development. This is a CO_2 reduction of 7,200Kg/yr. Planning drawings PL116B, PL124B and PL127B show the extend of PV panels on the roofs of the development, at 80m2 on the refurbished buildings and 35m2 on the new buildings, producing a total area of PV panels of approx 115m2. Appendix D calculates this total area of PV panels will produce further CO2 savings of 14%, in addition to the 7% reduction achieved through energy saving measures.

Renewable Energy Generation

7.15. The reduction achieved through PV panels is summarised in Table 3 below.

Table 3: Renewable Energy Generation	
CO_2 Emissions after Efficiency Measures (kg/yr)	50,200
Reduction: PV Panels (kg/yr)	7,200
Reduction Achieved	**14%**

7.16. In the process of meeting the London plan the code for sustainable homes target of 25% reduction of CO_2 emissions will be greatly exceeded for the new build houses.

8. Summary

8.1. The Energy Strategy for the proposed development at 37 Hamilton Road, Twickenham has been formulated following the London Plan Energy Hierarchy: ***Be Lean***, ***Be Clean*** and ***Be Green***. The overriding objective in the formulation of the Energy Strategy for the proposed development is to maximise the reductions in total CO_2 emissions through the application of this Hierarchy with a cost-effective approach.

8.2. ***Be Lean*** energy efficiency measures will be applied to the development. These will reduce the total CO_2 emissions of the development by **7.2%** over a Building Regulations (2006) compliant baseline.

8.3. In line with the London Plan, the feasibility of including **CHP** as a ***Be Clean*** measure has been carefully examined. It has been concluded that CHP is not a viable technology for the proposed development due to its small size and low density.

8.4. Photovoltaic panels will be installed as a ***Be Green*** measure. This will further reduce total CO_2 emissions by **14%**. This is compliant with Policy 4A.7 of the London Plan based on this is the highest reduction in total CO_2 possible for the development.

8.5. The combination of ***Be Lean*** and ***Be Green*** measures will reduce the **total CO_2** emissions of the proposed development by **20.6%**.

8.6. The reduction in **regulated CO_2** emissions of the affordable units is **25%** overall. This meets the mandatory energy requirements of Code Level 3.

8.7. The Summary Table below shows the reductions in CO_2 that the proposed development has been designed to achieve.

Summary Table				
	Regulated CO_2 Emissions (kg/yr)		Total CO_2 Emissions (kg/yr)	
	Gas	Electricity	Gas	Electricity
Baseline (2006 TER)	24,251	6,694	24,251	29,874
Emissions after Energy Efficiency Measures	22,515	5,690	22,515	27,711
Emissions with PV Panels	22,515	-1,554	22,515	20,467
Reduction Achieved	67.73%		20.6%	

Appendices

A) Low Carbon and Renewable Energy Technologies

B) Accommodation Schedule, Baseline Energy Demands and Energy Efficient Measures

C) Feasibility of Low Carbon and Renewable Energy Technologies

D) Indicative PV Schedule

E) Code for Sustainable Homes Pre assessment

F) Eco Homes pre assessment

Appendix A:

Low Carbon and Renewable Energy Technologies

Introduction

- This Appendix is intended to provide the background information for the low carbon and renewable energy technologies that have been considered in the formulation of this Energy Statement.

- The information provided here forms the basis for the project specific technical selection of low carbon/renewable energy technologies contained in the main section of this Energy Statement.

Combined Heat and Power (CHP)

- CHP is a form of decentralised energy generation that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high CO_2 emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. As both the electricity and heat from the generator is used, the efficiency of the system is increased above that of a conventional power plant where the heat is not utilised. However, the overall efficiency of ~75% is still lower than the ~90% efficiency of a heat only gas boiler.
- Where there are high thermal loads, CHP can be used within district heating networks to supply the required heat.
- **Performance and Calculation Methodology:** - Most commonly sized on the heat load of a development, not the electrical load. This prevents an over-generation of heat.
  - Require a high and relatively constant heat demand to be viable.
  - CHP engines are best suited to providing the base heating load of a development (~year round hot water demand) with conventional gas boilers responding to the peak heating demand (~winter space heating). CHP engines are not able to effectively respond to peaks in demand.
  - In general, CHP engines have an electrical efficiency of ~30% and a thermal efficiency of ~45%.
  - Electricity produced by the CHP engine displaces grid electricity which is given a carbon intensity of 0.568 kg per kWh.
- **Capital Cost:** - High in comparison to biomass boilers.
  - Relative cost reduces as the size of engine increases.
- **Running Costs/Savings:** - CHP engines often struggle to provide cost-effective energy to dwellings on residential schemes.
  - Running costs and maintenance are higher than for domestic gas boilers.
  - Needs Private Wire supply for economic case to be positive.
- **Land Use Issues and Space Required:** - CHP engines require a plant room, and possibly an energy centre for large residential developments.
  - CHP engines require a flue to effectively disperse pollutants. The height of the chimney required is dependent on the size of the engine installed.
  - Heat network issues.

- **Operational Impacts/Issues:** - Required to be run by Energy Services Company (ESCo) who are unenthusiastic about getting involved in small – medium scale schemes.
  - Issues with rights to dig up roads for district heating networks.
  - Emissions of nitrous oxides – ~1000mg/kWh – 20 times higher than for a gas boiler.
- **Embodied Energy:** - Comparable to that of a conventional gas boiler.
- **Funding Opportunities:** - Tax relief for businesses under the Enhanced Capital Allowances scheme.
- **Reductions in Energy Achievable:** - Can provide some reductions in effective primary energy, but when distribution losses and other local losses are included more fuel is required.
- **Reductions in CO_2 Achievable:** - Can provide greater reductions in CO_2 than energy, aided by the emissions factor of grid displaced electricity of 0.568 kg CO_2/kWh.
- **Advantages:** - Good reductions in overall primary energy and CO_2 emissions.
- **Disadvantages:** - More expensive and greater NO_x emissions than a biomass boiler.
  - Often do not supply energy cost-effectively in comparison to the market.
  - Requires Private Wire network to maximise cost effectiveness.

Combined Cooling Heat and Power (CCHP)

- CCHP is a CHP system which additionally has the facility to transform heat into energy for cooling. This is done with an absorption chiller which utilises a heat source to provide the energy needed to drive a cooling system. As absorption chillers are far less efficient than conventional coolers (CoP of 0.7 compared to >4) they are generally only used where there is a current excess generation of heat. New CHP systems are generally sized to provide the year round base heating load only.
- For this reason it is generally not suitable for new CHP systems to include cooling.
- Where there are high thermal loads, CCHP can be used within district heating and cooling networks to supply the required heat and coolth.
- **Performance and Calculation Methodology:** - Most commonly sized on the heat load of a development, not the electrical load. This prevents an over-generation of heat.
  - Require a high and relatively constant heat and cooling demand to be viable.
  - CCHP systems are best suited to providing the base loads of a development with conventional gas boilers and chillers responding to the peak demands. CCHP systems are not able to effectively respond to peaks in demand.
  - In general, CHP engines have an electrical efficiency of ~30% and a thermal efficiency of ~45%.
  - Absorption chillers have a CoP of ~0.7.

  - Electricity produced by the CHP engine displaces grid electricity which is given a carbon intensity of 0.568 kg per kWh.
- **Capital Cost:** - High in comparison to biomass boilers and increased further by inclusion of absorption chiller.
  - Relative cost reduces as the size of engine increases.
- **Running Costs/Savings:** - CHP engines often struggle to provide cost-effective energy to dwellings on residential schemes.
  - Running costs and maintenance are higher than for domestic gas boilers.
  - Needs Private Wire supply for economic case to be positive.
- **Land Use Issues and Space Required:** - CHP engines require a plant room, and possibly an energy centre for large residential developments.
  - CHP engines require a flue to effectively disperse pollutants. The height of the chimney required is dependent on the size of the engine installed. Additionally the absorption chiller requires either a cooling tower or dry cooler bed for heat rejection purposes.
  - Heat network issues.
- **Operational Impacts/Issues:** - Required to be run by an ESCo who are unenthusiastic about getting involved in small – medium scale schemes.
  - Issues with rights to dig up roads for heat networks.
  - Emissions of nitrous oxides – ~1000mg/kWh – 20 times higher than for gas boilers.
- **Embodied Energy:** - Comparable to conventional gas boilers.
- **Funding Opportunities:** - Tax relief for businesses under Enhanced Capital Allowance scheme.
- **Reductions in Energy Achievable:** - Can provide some reductions in effective primary energy, but when distribution and other local losses are included, more fuel is required.
- **Reductions in CO_2 Achievable:** - Can provide greater reductions in CO_2 than energy, aided by the emissions factor of grid displaced electricity of 0.568 kg CO_2/kWh.
- **Advantages:** - Good reductions in overall primary energy and CO_2 emissions.
- **Disadvantages:** - More expensive and greater emissions of NO_x than biomass.
  - Often do not supply energy cost-effectively in comparison to the market.
  - Requires Private Wire network to maximise cost effectiveness.

Biomass Boilers

- Biomass boilers generate heat on a renewable basis as they are run on biomass fuel which is carbon neutral. Fuel is generally wood chip or wood pellets. Wood pellets are slightly more expensive than wood chips but have a significantly higher calorific value and enable greater automation of the system.

- Can be used with district heating networks or as individual boilers on a house-by-house basis.
- **Performance and Calculation Methodology: -**
  - Biomass boilers are best suited to providing the base heating load of a development (~year round hot water demand) with conventional gas boilers responding to the peak heating demand (~winter space heating).
  - Operate with an efficiency of 87-91%.
  - Small models available.
  - Conflicts with CHP they are both best suited to providing the base heating load of a development. As such they should not be installed in tandem unless surplus hot water capacity is available. Special control measures would be required in this case.
- **Capital Cost: -** Low in comparison to CHP.
  - More suitable to smaller developments than CHP as installed cost is lower.
- **Running Costs/Savings: -** Biomass fuel is more expensive than gas and as such heat being provided to dwellings is generally more expensive than the market.
- **Land Use Issues and Space Required: -** Biomass boilers require a plant room and possibly separate energy centre for large residential developments.
  - Require a flue to effectively disperse pollutants. The height of the chimney required is dependent on the size of the boiler installed.
  - Fuel store will be required. This should be maximised to reduce fuel delivery frequency.
  - Space must be available for delivery vehicle to park close to plant room.
  - Heat network issues.
- **Operational Impacts/Issues: -** Normally run on biomass, but can also work with biogas.
  - Require some operational support and maintenance.
  - Fuel deliveries required.
  - Boiler and fuel store must be sited in proximity to space for delivery vehicle to park.
  - Issues with rights to dig up roads, etc (for heat networks).
  - Emissions of nitrous oxides – ~80-100mg/kWh.
- **Embodied Energy: -** Comparable to conventional gas boiler.
- **Funding Opportunities:** - The Bio-energy Capital Grants Scheme offers grants of up to 40% of the difference between the installed cost of biomass boiler and the cost of the fossil fuel alternative to the industrial, commercial and community sectors.

- **Reductions in Energy Achievable: -** No reduction in energy demand, but energy generated from a renewable fuel. Significant long term running costs (fuel).
- **Reductions in CO_2 Achievable: -** Can provide significant reductions in CO_2, but generally limited by the hot water load (base heating load).
- **Advantages: -** Reductions in CO_2 at low installed cost.
- **Disadvantages: -** High long-term running costs.
  - Often do not supply energy cost-effectively in comparison to gas boilers.

Solar Thermal Panels

- Solar Thermal Heating Systems contribute to the hot water demand of a dwelling or building. Water or glycol (heat transfer fluid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store in the plant room where heat is exchanged with water from the conventional system. Due to the seasonal availability of heat, solar thermal panels should be scaled to provide no more than 1/2 of the hot water load.
- Can also be used to provide energy for space heating in highly insulated dwellings.
- There are two types of solar thermal panel: evacuated tube collectors and flat plate collectors.
- **Performance and Calculation Methodology: -**
  - Evacuated Tube Collectors: ~60% efficiency.
  - Flat Plate Collectors: ~50% efficiency.
  - SAP Table H2 used for solar irradiation at different angles.
  - Operate best on south facing roofs angled at 30-45^0 and free of shading, or on flat roofs on frames. East/West facing panels suffer a loss in performance of 15-20% depending on the angle of installation.
  - Flat plate collectors cannot be installed horizontally as this would prevent operation of the water pump. Must therefore be angled and separated to avoid overshadowing each other.
  - SAP limits benefit to a ~10-12% reduction in regulated CO_2 over baseline.
- **Capital Cost: -** Typically £2,500 per 4m^2 plus installation. Costs higher for evacuated tubes than flat plate collectors.
- **Running Costs/Savings: -** Reduce reliance on gas and therefore reduce costs.
  - Payback period of ~20 years per dwelling.
- **Land Use Issues and Space Required: -** Installed on roof so no impact on land use.
  - Due to amount of roof space required and distance from tank to panels, less suitable for dense developments of relatively high rise flats.

- Within permitted development rights unless in a conservation area where they must not be visible from the public highways.
- Dormer and Velux windows may conflict if energy/CO_2 reduction required is large.

- **Operational Impacts/Issues:** - Biggest reductions achieved by people who operate their hot water system with consideration of the panels.
- **Embodied Energy:** - Carbon payback is ~2 years.
- **Funding Opportunities:** - none
- **Reductions in Energy Achievable:** - Reduce primary energy demand by more per standard panel area than solar PV panels.
- **Reductions in CO_2 Achievable:** - Comparable to solar PV per m^2.
- **Advantages:** - Virtually free fuel, low maintenance and reductions in energy/CO_2.
- **Disadvantages:** - Benefits limited to maximum ~50% of hot water load.

Solar Photovoltaic (PV) Panels

- Solar PV panels generate electricity by harnessing the power of the sun. They convert solar radiation into electricity which can be used on site or exported to the grid in times of excess generation.
- **Performance and Calculation Methodology:** -
  - The best PV panels operate with an efficiency approaching 20%. ~7m^2 of these high performance panels will produce 1kWp of electricity.
  - Operate best on south facing roofs angled at 30-45^0 or on flat roofs on frames. Panels orientated east/west suffer from a loss in performance of 15-20% depending on the angle of installation.
  - Must be free of any potential shading.
  - Cannot be installed horizontally as would prevent self-cleaning. Must therefore be angled and separated to avoid overshadowing each other.
  - Electricity produced displaces grid electricity which has a carbon intensity of 0.568 kg CO_2 per kWh.
- **Capital Cost:** - ~£5,500 – £6,500 per kWp depending on performance of panels.
- **Running Costs/Savings:** - Reduce reliance on grid electricity and therefore reduce running costs.
  - At current electricity prices, payback period of ~60-70 years per dwelling.
  - Feed-in tariff and Renewables Obligation Certificates (ROCs) payments required for maximum financial benefit.
- **Land Use Issues and Space Required:** - Installed on roof so no impact on land use.

- Due to amount of roof space required are less suitable for dense developments of relatively high rise flats.
- Within permitted development rights unless in a conservation area where they must not be visible from the public highways.
- Dormer and Velux windows may conflict if energy/CO_2 reduction required is large.

- **Operational Impacts/Issues:** - Proportionately large arrays may need electrical infrastructure upgrade.
  - Virtually maintenance free and panels are self cleaning at angles in excess of 10 degrees.
- **Embodied Energy:** - Carbon payback of 2-5 years.
- **Funding Opportunities:** - Financier utilising Feed-in-Tariffs.
- **Reductions in Energy Achievable:** - Reduce energy demand by less per m^2 than solar thermal panels.
- **Reductions in CO_2 Achievable:** - Provide greater percentage reductions in CO_2 than energy. Comparable to solar thermal per square metre.
- **Advantages:** - Virtually free fuel, very low maintenance and good reductions in CO_2.
- **Disadvantages:** - More expensive than solar thermal.
  - Slightly greater loss in performance than solar thermal panels when orientated away from south.

Ground Source Heat Pumps (GSHPs)

- Ground Source Heat Pumps work in much the same way as a refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input in a smaller space. Electricity drives the pump which circulates a fluid (water/antifreeze mix or refrigerant) through a closed loop of underground pipe. This fluid absorbs the solar energy that is stored in the earth (which in the UK remains at a near constant temperature of 12°C throughout the year) and carries it to a pump. A compressor in the heat pump upgrades the temperature of the fluid which can then be used for space heating and hot water.
- **Performance and Calculation Methodology:** - System requires electricity to drive the pump. Therefore displaces gas heating with electric, which has a higher carbon intensity (gas: 0.194; electricity: 0.422).
  - As they are upgrading heat energy from the earth, GSHPs operate at 'efficiencies' in excess of 350%. This is limited in SAP.
  - Due to the lower temperature of the output of GSHPs compared to traditional gas boilers, GSHPs work best in well insulated buildings and with underfloor heating. They can,

however, also be installed with oversized radiators, albeit with a consequent reduction in performance

- **Capital Cost:** - ~£7,500 per house. Additional costs if underfloor heating is to be installed.
- **Running Costs/Savings:** - Electricity more expensive than gas, thus fuel costs not reduced as much as energy is reduced.
  - Payback period of ~20 years per dwelling.
- **Land Use Issues and Space Required:** - Require extensive ground works to bury the coils that extract the low grade heat from the earth. They therefore require a large area for horizontal burial (40-100m long trench) or a vertical bore (50-100m) which is considerably more expensive but can be used where space is limited.
  - Must be sized correctly to prevent freezing of the ground during winter and consequent shutdown of the system.
  - May require planning permission for engineering works. Once buried, there is no external evidence of the GSHPs.
- **Operational Impacts/Issues:** - Work best in well insulated houses.
  - Need immersion for hot water.
  - Highly reliable and require virtually no maintenance.
  - Problems if ground bore fails.
- **Embodied Energy:** - Low, but as gas is being replaced with the more carbon intensive electricity, carbon payback is slowed. Carbon payback depends on CoP.
- **Funding Opportunities:** - none.
- **Reductions in Energy Achievable:** - Reduce energy demand by less per m^2 than solar thermal panels.
- **Reductions in CO_2 Achievable:** - Provide greater %age reductions in CO_2 than energy. Comparable to solar thermal (esp. in SAP).
- **Advantages:** - Large reductions in Energy. Currently receives benefit from SAP of an electrical baseline rather than gas.
- **Disadvantages:** - Small reduction in CO_2. CoP limited in SAP. Only small cost savings.

Air Source Heat Pumps (ASHPs)

- Air Source Heat Pumps work in much the same way as a refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input into a smaller space. Electricity drives the pump which extracts heat from the air as it flows over the coils in the heat pump unit. A compressor in the heat pump upgrades the temperature of the extracted energy which can then be used for space heating and hot water.

- Generally ASHPs are air-to-water devices but can also be air-to-air.
- **Performance and Calculation Methodology:** - System requires electricity to drive the pump. Therefore displaces gas heating with electric, which has a higher carbon intensity (gas: 0.194; electricity: 0.422).
  - Performance defined by the Coefficient of Performance (CoP) which is a measure of electricity input to heat output. However, the concept of a CoP must be treated with caution as it is an instantaneous measurement and does not take account of varying external conditions throughout the year.
  - As they are upgrading heat energy from the air, ASHPs operate at 'efficiencies' in excess of 250%. This is limited in SAP.
  - British winter conditions (low temperatures and high humidity) lead to freezing of external unit. Reverse cycling defrosts the ASHP, but can substantially reduce performance when it is most needed. Performance under these conditions varies considerably between models. Vital that ASHP that has been proven in British winter conditions is installed.
  - Due to the lower temperature of the output of ASHPs compared to traditional gas boilers, ASHPs work best in well insulated buildings and with underfloor heating. They can, however, also be installed with oversized radiators, albeit with a consequent reduction in performance.
- **Capital Cost:** - ~£2,000 per house.
- **Running Costs/Savings:** - Electricity more expensive than gas, thus fuel costs not reduced as much as energy is reduced.
  - Payback period of ~10 years per dwelling.
- **Land Use Issues and Space Required:** - No need for external ground works, only a heat pump unit for the air to pass through.
  - Minimal external visual evidence.
- **Operational Impacts/Issues:** - Work best in well insulated houses.
  - Unit must be sized correctly for each dwelling.
  - Vital that ASHP model selected has been proven to maintain performance at the low temperature and high humidity conditions of the British winter.
  - May need immersion for hot water.
  - Highly reliable and require virtually no maintenance.
- **Embodied Energy:** - Low. Carbon payback longer than for GSHPs as the CoP is lower.

- **Funding Opportunities:** - none
- **Reductions in Energy Achievable:** - Large reductions in energy demand. Less so than GSHPs.
- **Reductions in CO_2 Achievable:** - Provide smaller percentage reductions in CO_2 than energy. Less than GSHPs.
- **Advantages:** - Large reductions in Energy. Currently receives benefit from SAP of an electrical fuel factor rather than a gas baseline.
- **Disadvantages:** - Small reduction in CO_2. CoP limited in SAP. Only small cost savings.

Wind Power

- Wind energy installations can range from small domestic turbines (1kW) to large commercial turbines (140m tall, 2MW). There are also different designs and styles (horizontal or vertical axis; 1 blade to multiple blades) to suit the location. They generate clean electricity that can be provided for use on-site, or sold directly to the local electricity network
- **Performance and Calculation Methodology:** - Power generated is proportional to the cube of the wind speed. Therefore, wind speed is critical.
  - Horizontal axis turbines require >~6m/s to operate effectively and vertical axis turbines require >~4.5m/s. The rated power of a turbine is often for wind speeds double these figures.
  - Wind speeds for area from BERR's Wind Speed Database.
  - Electricity produced displaces grid electricity which has a carbon intensity of 0.568 kg/kWh.
- **Capital Cost:** - ~£1,000 per kW. Smaller models are more expensive per kW.
  - Vertical axis turbines more expensive than horizontal.
- **Running Costs/Savings:** - Reduce reliance on grid electricity and therefore reduce costs.
  - Payback period of ~15-20 years per dwelling.
  - Feed-in tariff and ROC payments required for maximum financial benefit.
- **Land Use Issues and Space Required:** - Smaller models (<6kW) can be roof mounted.
  - Must be higher than surrounding structures/trees.
  - Planning permission required.
- **Operational Impacts/Issues:** - Urban environments generally have low wind speeds and high turbulence which reduce the effectiveness of turbines.
  - Vertical axis turbines have a lower performance than horizontal axis turbines but work better in urban environments.

- Annual services required.
- Turbines rated in excess of 5kW may require the network to be strengthened and arrangements to be made with the local Distribution Network Operator and electricity supplier.
- Noise.

- **Embodied Energy: -** Carbon payback is ~1 year for most turbines.
- **Funding Opportunities: -** Financier utilising Feed-in-Tariffs.
- **Reductions in Energy Achievable: -** Significant reduction in reliance on grid electricity.
- **Reductions in CO_2 Achievable: -** Good. Greater reduction in CO_2 than PV for same investment.
- **Advantages: -** Virtually free fuel; reductions in CO_2.
- **Disadvantages: -** Expensive, although cheaper than PV for same return.
  - Lack of suitable sites.
  - Maintenance costs.
  - Often not building integrated.

Hydro Power

- Hydro power harnesses the energy of falling water, converting the potential or kinetic energy of water into electricity through use of a hydro turbine. Micro hydro schemes (<100kW) tend to be 'run-of-river' developments, taking the flow of the river that is available at any given time and not relying on a reservoir of stored water. They generate clean electricity that can be provided for use on-site, or sold directly to the local electricity network.
- **Performance and Calculation Methodology: -**
  - Flow rates at particular sites from National River Flow Archive held by Centre for Ecology and Hydrology.
  - Electricity produced displaces grid electricity which has a carbon intensity of 0.568 kg/kWh.
- **Capital Cost: -** £3,000 - £5,000 per kW.
  - Particularly cost effective on sites of old water mills where much of the infrastructure is in place.
- **Running Costs/Savings: -** Reduce reliance on grid electricity and therefore reduce costs.
  - Payback period of ~10-15 years per dwelling
  - Feed-in tariff and ROC payments required for maximum financial benefit.
- **Land Use Issues and Space Required: -** Require suitable water resource.

  - Visual intrusion of scheme.
  - Special requirements where river populated by migrating species of fish.
  - Planning permission will require various consents and licences including an Environmental Statement and Abstraction Licence.
- **Operational Impacts/Issues:** - Routine inspections and annual service required.
  - Automatic cleaners should be installed to prevent intake of rubbish.
- **Embodied Energy:** - Carbon payback for small schemes of ~1 year.
- **Funding Opportunities:** - Financier utilising Feed-in-Tariffs.
- **Reductions in Energy Achievable:** - significant reduction in reliance on grid electricity.
- **Reductions in CO_2 Achievable:** - High.
- **Advantages:** - Virtually free fuel, reductions in CO_2.
- **Disadvantages:** - Expensive, but good payback period.
  - Lack of suitable sites.
  - Planning obstructions.

Appendix B: Accommodation Schedule, Baseline Energy Demands and Energy Efficient Measures

BASELINE

Type	No. Units	Area (m^2)	Hot Water Demand (kWh/m^2)	Hot Water Demand per Type (kWh)	Space Heating Demand (kWh/m^2)	Space Heating Demand per Type (kWh)	Fixed Electrical Demand (kWh/m^2)	Fixed Electrical Load per Type (kWh)	Non-Fixed Elecrtrical Demand (kWh/m^2)	Non-Fixed Electrical Demand per Type (kWh)	Total Energy Demand (kWh/m^2)	Regulated CO2 (kg/yr)	Total CO2 (kg/yr)
From Accommodation Schedule			From SAP Table 1 Hot Water Calculator		From RHC Energy Benchmarks		From SAP Table - Electricity: Lighting, Pumps & Fans		SAP 2005 (updated 2008): ZC2 Calculation		TOTAL		
Flats Existing with refurb													
6	1	42.0	59.0	2,478	40	1,680	11.62	488	38.3	1,609	148.9	1,013	1,691
21	1	47.0	54.5	2,562	40	1,880	11.18	525	37.7	1,772	143.4	1,083	1,831
8	1	48.0	53.7	2,578	40	1,920	11.10	533	37.7	1,810	142.5	1,097	1,861
15	1	48.0	53.7	2,578	40	1,920	11.10	533	37.7	1,810	142.5	1,097	1,861
18	1	48.0	53.7	2,578	40	1,920	11.10	533	37.7	1,810	142.5	1,097	1,861
4	1	49.0	53.0	2,597	40	1,960	11.03	540	37.7	1,847	141.7	1,112	1,892
12	1	49.0	53.0	2,597	40	1,960	11.03	540	37.7	1,847	141.7	1,112	1,892
19	1	51.0	51.6	2,632	35	1,785	10.89	555	37.6	1,918	135.1	1,091	1,900
20	1	51.0	51.6	2,632	35	1,785	10.89	555	37.6	1,918	135.1	1,091	1,900
3	1	55.0	49.0	2,695	35	1,925	10.64	585	37.3	2,052	131.9	1,143	2,009
11	1	55.0	49.0	2,695	35	1,925	10.64	585	37.3	2,052	131.9	1,143	2,009
14	1	55.0	49.0	2,695	35	1,925	10.64	585	37.3	2,052	131.9	1,143	2,009
17	1	55.0	49.0	2,695	35	1,925	10.64	585	37.3	2,052	131.9	1,143	2,009
13	1	56.0	48.4	2,710	35	1,960	10.58	592	37.2	2,083	131.2	1,156	2,035
2	1	58.0	47.3	2,743	35	2,030	10.47	607	37.1	2,152	129.9	1,182	2,090
10	1	58.0	47.3	2,743	35	2,030	10.47	607	37.1	2,152	129.9	1,182	2,090
16	1	58.0	47.3	2,743	35	2,030	10.47	607	37.1	2,152	129.9	1,182	2,090
5	1	63.0	44.9	2,829	25	1,575	10.23	644	36.5	2,300	116.6	1,126	2,097
7	1	63.0	44.9	2,829	25	1,575	10.23	644	36.5	2,300	116.6	1,126	2,097
1	1	78.0	39.3	3,065	25	1,950	9.70	757	34.0	2,652	108.0	1,292	2,411
9	1	78.0	39.3	3,065	25	1,950	9.70	757	34.0	2,652	108.0	1,292	2,411
Houses New Build													
22	1	34.0	68.8	2,339	40	1,360	12.60	428	44.5	1,513	165.9	898	1,537
23	1	37.0	64.7	2,394	40	1,480	12.18	451	41.9	1,550	158.8	942	1,596
24	1	37.0	64.7	2,394	40	1,480	12.18	451	41.9	1,550	158.8	942	1,596
25	1	58.0	47.3	2,743	35	2,030	10.47	607	37.1	2,152	129.9	1,182	2,090
26	1	58.0	47.3	2,743	35	2,030	10.47	607	37.1	2,152	129.9	1,182	2,090
27	1	105.0	33.0	3,465	40	4,200	9.12	958	28.8	3,024	110.9	1,891	3,167
Flats	21	855		56,738		39,610		12,361		42,987		23,908	42,048
Houses	3	221		16,079		12,580		3,502		11,941		7,038	12,077
Total	24	1,076		72,817		52,190		15,863		54,928		30,945	54,125

Appendix B: Accommodation Schedule, Baseline Energy Demands and Energy Efficient Measures

ENERGY EFFICIENCY

Plot	No. Units	Area (m^2)	Hot Water Demand (kWh/m^2)	Hot Water Demand per Type (kWh)	Space Heating Demand (kWh/m^2)	Space Heating Demand per Type (kWh)	Fixed Electrical Demand (kWh/m^2)	Fixed Electrical Load per Type (kWh)	Non-Fixed Elecrtrical Demand (kWh/m^2)	Non-Fixed Electrical Demand per Type (kWh)	Total Energy Demand (kWh/m^2)	Regulated CO2 (kg/yr)	Total CO2 (kg/yr)
From Accommodation Schedule	27	1076	From SAP Table 1 Hot Water Calculator		From RHC Energy Benchmarks		From SAP Table - Electricity: Lighting, Pumps & Fans		SAP 2005 (updated 2008): ZC2 Calculation		TOTAL		
Flats existing with refurb													
			10% Improvement		0% Improvement		15% Improvement		5% Improvement				
6	1	42.0	53.1	2,230	40	1,680	9.88	415	36.4	1,528	139.4	934	1,579
21	1	47.0	49.1	2,305	40	1,880	9.50	447	35.8	1,683	134.4	1,000	1,711
8	1	48.0	48.3	2,320	40	1,920	9.44	453	35.8	1,719	133.6	1,014	1,739
15	1	48.0	48.3	2,320	40	1,920	9.44	453	35.8	1,719	133.6	1,014	1,739
18	1	48.0	48.3	2,320	40	1,920	9.44	453	35.8	1,719	133.6	1,014	1,739
4	1	49.0	47.7	2,337	40	1,960	9.38	459	35.8	1,755	132.9	1,028	1,768
12	1	49.0	47.7	2,337	40	1,960	9.38	459	35.8	1,755	132.9	1,028	1,768
19	1	51.0	46.4	2,368	35	1,785	9.26	472	35.7	1,822	126.4	1,005	1,774
20	1	51.0	46.4	2,368	35	1,785	9.26	472	35.7	1,822	126.4	1,005	1,774
3	1	55.0	44.1	2,426	35	1,925	9.04	497	35.4	1,949	123.6	1,054	1,876
11	1	55.0	44.1	2,426	35	1,925	9.04	497	35.4	1,949	123.6	1,054	1,876
14	1	55.0	44.1	2,426	35	1,925	9.04	497	35.4	1,949	123.6	1,054	1,876
17	1	55.0	44.1	2,426	35	1,925	9.04	497	35.4	1,949	123.6	1,054	1,876
13	1	56.0	43.6	2,439	35	1,960	8.99	504	35.3	1,979	122.9	1,066	1,901
2	1	58.0	42.6	2,469	35	2,030	8.90	516	35.2	2,044	121.7	1,091	1,953
10	1	58.0	42.6	2,469	35	2,030	8.90	516	35.2	2,044	121.7	1,091	1,953
16	1	58.0	42.6	2,469	35	2,030	8.90	516	35.2	2,044	121.7	1,091	1,953
5	1	63.0	40.4	2,546	25	1,575	8.70	548	34.7	2,185	108.8	1,031	1,952
7	1	63.0	40.4	2,546	25	1,575	8.70	548	34.7	2,185	108.8	1,031	1,952
1	1	78.0	35.4	2,759	25	1,950	8.25	643	32.3	2,519	100.9	1,185	2,248
9	1	78.0	35.4	2,759	25	1,950	8.25	643	32.3	2,519	100.9	1,185	2,248
Houses new build													
			10% Improvement		15% Improvement		15% Improvement		5% Improvement				
22	1	34.0	61.9	2,105	36	1,224	10.71	364	42.3	1,437	150.9	800	1,406
23	1	37.0	58.2	2,155	36	1,332	10.35	383	39.8	1,473	144.4	838	1,460
24	1	37.0	58.2	2,155	36	1,332	10.35	383	39.8	1,473	144.4	838	1,460
25	1	58.0	42.6	2,469	30	1,726	8.90	516	35.2	2,044	116.5	1,032	1,894
26	1	58.0	42.6	2,469	30	1,726	8.90	516	35.2	2,044	116.5	1,032	1,894
27	1	105.0	29.7	3,119	34	3,570	7.75	814	27.4	2,873	98.8	1,641	2,853
Flats	12	855		51,064		39,610		10,507		40,837		22,025	39,258
Houses	3	221		14,471		10,909		2,977		11,344		6,180	10,967
Total	27	0		65,535		50,519		13,483		52,182		28,205	50,225
Market Reduction Achieved												7.9%	6.6%
Affordable Reduction Achieved												12.2%	9.2%
Total Reduction Achieved												8.9%	7.2%
Total Reduction Achieved												8.9%	7.2%
							Code Level 3 Reduction Still Required (HA Units Only)					902	
							20% CO2 Target						10,045

Appendix C: Low Carbon and Renewable Energy Technology Feasibility Table

Feasibility Study Table

Technology	Sufficient Energy Generated?	Payback	Land Use Issues	Local Planning Requirements	Noise	Carbon Payback	Available Grants	Feasible?	Reason not Feasible or Selected
Combined Heat & Power (CHP)	Yes	Medium	Air quality in residential area	None	In Plant Room	Yes	Tax Relief - ECA	No	Density of development too low for heat distribution network
Biomass	Yes	None	Air quality in residential area	Encouraged for large scale developments	In Plant Room	Yes	Bio-energy Capital Grants Scheme	No	Density of development too low for heat distribution network
Solar Thermal	No	High	Sufficient roof space required	Encouraged	None	~2 years	none	Yes	PV a more viable alternative
Solar Photovoltaic (PV)	**Yes**	**Very High**	**Sufficient roof space required**	**Encouraged**	**None**	**2-5 years**	**none**	**Yes**	**Selected**
Ground Source Heat Pumps (GSHPs)	No	High	Requires large area for coils or borehole	Encouraged	None	Low	none	No	Do not meet policy requirements
Air Source Heat Pumps (ASHPs)	No	Very High	Visual intrusion of external units	None	Low	Low	none	No	Do not meet policy requirements
Wind Power	No	Low	Urban Area - low and turbulent wind; Visual impact	Encouraged for large scale developments	Yes	~1 year	none	No	Wind speed in area likely to be insufficient
Hydro Power	No	Medium	Requires suitable water resource; Visual impact	None	Low	~1 year	none	No	No River

Appendix D: PV Calculation

Renewable Energy Generation	
Reduction Required (kg/yr) - New Build	2,193
Aspect	South
Angle	30
PV Required (kWp)	4.6
Cost @ £3800 per kWp (£)	**17,600**
Area Required (sq.m.)	**34.7**

1kWp (m2)	7.5

SAP Table H2					
	Horizontal	**30**	**45**	**60**	**Vertical**
North	933	709	621	485	360
Northwest	933	762	666	580	427
West	933	886	829	753	565
Southwest	933	997	968	900	684
South	933	1042	1023	960	727
Southeast	933	997	968	900	684
East	933	886	829	753	565
Northeast	933	762	666	580	427

PV Output (kWh/yr) for 1kWp				
Horizontal	**30**	**45**	**60**	**Vertical**
746	567	497	388	288
746	610	533	464	342
746	709	663	602	452
746	798	774	720	547
746	834	818	768	582
746	798	774	720	547
746	709	663	602	452
746	610	533	464	342

Overshading Factor		None/V. Little	1.0
	% Sky Blocked	**Overshading Factor**	
Heavy	>80%	0.5	
Significant	>60%-80%	0.65	
Modest	20%-60%	0.8	
None/V. Little	<20%	1	

	CO2 for 1kWp				
	Horizontal	**30**	**45**	**60**	**Vertical**
North	424	322	282	220	164
Northwest	424	346	303	264	194
West	424	403	377	342	257
Southwest	424	453	440	409	311
South	424	473	465	436	330
Southeast	424	453	440	409	311
East	424	403	377	342	257
Northeast	424	346	303	264	194

Appendix D: PV Calculation

Renewable Energy Generation	
Area Available (sq.m.) - Refurb	80
Aspect	South
Angle	30
PV Required (kWp)	10.7
Cost @ £3800 per kWp (£)	**40,500**
CO2 Reduction (kg/yr)	**5,051**

New Build Reduction (kg/yr)	2,193
Refurb Reduction (kg/yr)	5,051
Total Site Reduction	**14%**

Code for Sustainable Homes Planning Pre-Assessment - 37 Hamilton Road

THE CODE FOR SUSTAINABLE HOMES™

Total Predicted Score 62.19

36 Points	Level 1 *
48 Points	Level 2 **
57 Points	Level 3 ***
68 Points	Level 4 ****
84 Points	Level 5 *****
90 Points	Level 6 ******

richard HODKINSON consultancy

Category	Issue	Issues Criteria	Credits Available	Credits Predicted	Design Assumptions Made
Energy & Carbon Dioxide Emissions	ENE 1 Dwelling Emission Rate	Credits are awarded based on the percentage improvement of the Dwelling Emission Rate (DER) over the Target Emission Rate (TER) as calculated using SAP 2005. Minimum Standards for each Code Level applies.	15	5	Design measures will be included to ensure the 25% percentage improvement over Building Regulations (2006) are achieved. This will include insulation improvements through increased u-values in the main building elements and the inclusion of renewable energy technologies, as outlined in the Energy Strategy for the development (submitted with this application). Connection to the Southwark MUSCO will also assist in this target being met.
	ENE 2 Building Fabric	Credits are awarded based on the Heat Loss Parameter (HLP), obtained from the SAP 2005 calculations. This is based on the level of insulation provided in the dwelling(s).	2	1	Insulation improvements and a best practice levels of air tightness will assist in the HLP being between 1.3 and 1.1.
	ENE 3 Internal Lighting	Credits are awarded based on the percentage of fixed internal fittings that are dedicated energy efficient provided in habitable spaces in the dwelling.	2	2	75% of the light fittings in the dwelling (habitable areas) should be dedicated to accommodating only Low Energy bulbs.
	ENE 4 Drying Space	Credits are awarded for the provision of either internal or external secure drying space	1	1	Secure space with post and footings or fixings capable of holding 4m+ of drying line for 1-2 bed units and 6m+ of drying line for 3+ units is provided for drying clothes.
	ENE 5 Energy Labelled White Goods	Credits are awarded where each dwelling is provided with either information regarding the EU Energy Labelling Scheme, White Goods with ratings ranging from A+ to B, or a combination of the previous according to the technical guidance.	2	1	The EU Labelling Leaflet to be provided to all units.
	ENE 6 External Lighting	Credits are awarded based on the provisions of space lighting with dedicated energy efficient fittings and security lighting fittings with appropriate control gear OR provision of dual lamp luminaires with both space and security lamps compliant with the above energy efficiency requirements.	2	2	All lighting in communal areas should be dedicated low energy, and controlled with means to ensure the space is not illuminated.
	ENE 7 Low or Zero Carbon Technologies	Credits are awarded where either there is 10% or 15% reduction in total carbon emissions that result from using low or zero carbon technologies.	2	2	The use of renewable energy technologies (refer to the Energy Statement submitted with this Planning Application)
	ENE 8 Cycle Storage	Credits are awarded where adequate, safe, secure and weather proof cycle storage is provided according to the Code requirements.	2	2	Secure cycle storage providing adequate space for the residents
	ENE9 Home Office	A credit is awarded for the provision of space for a home office. The location, space and services provided must meet the Code requirements	1	1	Adequate provisions to be provided to ensure this credit is achieved in an suitable room, with compliant daylighting levels (HEA1)
	Total Energy & CO2 Category Predicted Score		29	17	Cedit Weighting = 1.25
Water	WAT 1 Indoor Water Use	Credits are awarded based on the predicted average household water consumption, calculated using the Code Water Calculator Tool. Minimum Standards Apply.	5	3	Low flow water appliances (taps, showers, WC's) to be included throughout to ensure the 105 litres per person per day are met.
	WAT 2 External Water Use	A credit is awarded where a compliant system is specified for collecting rainwater for external irrigation purposes. Where no outdoor space is provided the credit can be achieved by default.	1	0	This Credit is not Sought
	Total Water Category Predicted Score		6	3	Credit Weighting = 1.49
Materials	MAT 1 Environmental Impact of Materials	At least 3 of the 5 key building elements must achieve a Green Guide (2008) Rating of A+ to D. Points are awarded on a scale based on the Green Guide Rating Specifications.	15	7	Materials should be chosen in accordance with the Green Guide, with a number of the main building elements having a low environmental impact
	MAT 2 Responsible Sourcing of Materials - Basic Building Elements	Credits are awarded where 80% of the materials used in the basic building elements are responsibly sourced. The Code Materials Calculator can be used to predict a potential score.	6	0	This Credit is not Sought
	MAT3 Responsible Sourcing of Materials - Finishing Elements	Credits are awarded where 80% of the materials used in the finishing elements are responsibly sourced. The Code Materials Calculator can be used to predict a potential score.	3	0	This Credit is not Sought
	Total Materials Category Predicted Score		24	7	Credit Weighting = 0.3
Surface Water Run-off	SUR 1 Management of surface water run-off from developments	Drainage and surface water run-off for the site to be in accordance with Code requirements	2	0	The Mandatory level will be achieved - addressing the peak rate of run-off (post development no more than pre development), and volume of run-off (entirely reduced through a number of means). It is assumed that the tradable credits will not be awarded as SUDS will not be used.
	SUR 2 Flood Risk	Credits are awarded where developments are located in areas of low flood risk or where, in areas of medium or high flood risk, appropriate measures are taken to prevent damage to the property & its contents in accordance with the Code Criteria in the Technical Guide.	2	2	Site lies within the Thames Flood Zone and therefore the credits may not be achieved, unless there is an FRA stating otherwise.
	Total Surface Water Run-off Category Predicted Score		4	2	Credit Weighting = 0.55

Waste	WAS 1 Storage of non-recyclable waste & recyclable household waste	The space provided for waste storage should be sized to hold the larger of either all external containers provided by the Local Authority or the minimum capacity calculated from BS 5906 AND all waste and recycling storage is wheelchair accessible in accordance with the CSH WAS 1 Accessibility Checklist. Internal provisions should also be included	4	4	Adequate space must be provided to accommodate refuse bins sized in accordance with BS5906, located on hardstanding and covered.
	WAS 2 Construction Site Waste Management	A SWMP including the monitoring of waste generated on site and the setting of targets to promote resource efficiency must be produced and implemented. The SWMP should also include procedures and commitments for minimising waste and/or commitments to sort, reuse and recycle construction waste.	2	2	A full SWMP should be provided, and include the identification of waste groups to divert from landfill and to highlight potential for waste minimisation
	WAS 3 Composting	A credit is awarded where individual home composting facilities are provided, or where a community/communal composting service, either run by the Local Authority or overseen by a management plan is in operation.	1	0	This Credit is not Sought
		Total Waste Category Predicted Score	7	6	Credit Weighting = 0.91
Pollution	POL 1 Global Warming Potential (GWP) of Insulants	A credit is awarded where all insulating Materials only use substances (in manufacture & installation) that have a GWP of less than 5.	1	1	All insulation to be chosen on the premise of it having a low (less than 5) Global Warming Potential - GWP
	POL 2 NOx Emissions	Credits are awarded on the basis of NOx emissions arising from the operation of the space and water heating system within the dwelling.	3	3	This must be assessed in greater detail at the detailed design stage, but it is estimated that NOx emissions will be no greater than 40mg/kwh
		Total Pollution Category Predicted Score	4	4	Credit Weighting = 0.7
Health & Wellbeing	HEA 1 Daylighting	Credits are awarded for ensuring key rooms in the dwelling have high daylighting factors (DF) and have a view of the sky	3	2	Kitchens should achieve the 2% A.D.F, and all living, dining and home offices should achieved the 1.5% A.D.F.
	HEA 2 Sound Insulation	Credits are awarded where performance standards exceed those required in Building Regulations Part E. This can be demonstrated by carrying out pre completion testing or through the use of Robust Details Limited (RSL).	4	1	A 3dB improvement over Part E of the Building Regulations (2006) should be sought.
	HEA 3 Private Space	A credit is awarded for the provision of an outdoor space that is at least partially private. The space must allow easy access to all designated occupants, inc. wheelchair access (BS8300) and sized accordingly (private - 1.5m2/bedroom; semi-private/communal - 1m2/bedroom).	1	1	All units are served by a balcony with adequate space. This space must also be wheelchair accessible with the correct door widths and level/low access thresholds
	HEA 4 Lifetime Homes	All 16 criteria of Lifetime Homes to be awarded.	4	4	All units will be designed to meet all 16 design criteria of lifetime homes.
		Total Health & Wellbeing Category Predicted Score	12	8	Credit Weighting = 1.66
Management	MAN 1 Home User Guide (HUG)	Credits are awarded where a simple guide is provided to each dwelling covering information relevant to the 'non-technical' home occupier, in accordance with the Code requirements.	3	3	A full Home User Guide to be provided to the homeowners at handover, covering locational and operational issues.
	MAN 2 Considerate Constructors Scheme	Credits are awarded where there is a commitments to comply with best practice site management principles using either the Considerate Constructors Scheme or an alternative locally/nationally recognised scheme. * In the first instance, contact a Code Service Provider if you are considering to use an alternative scheme	2	2	Best practice principles to be complied with a score of between 24 and 31.5 being achieved, with no area scoring less than 3.
	MAN 3 Construction Site Impacts	Credits are awarded where there is a commitment and a strategy to operate site management procedures on site.	2	1	The development should monitor and reduce construction site impacts to reduce the affect of construction on the local area. This can involve the limiting of air and water pollution in accordance with best practice principles.
	MAN 4 Security	Credits are awarded for complying with Section 2 - Physical Security from Secure by Design - New Homes. An Architectural Liaison Officer (ALO), or alternative needs to be appointed early in the design process and their recommendations incorporated.	2	2	Secure By Design to be achieved on the site, with the recommendations of the ALO/CPDA being incorporated in the design.
		Total Management Category Predicted Score	9	8	Credit Weighting = 1.11
Ecology	ECO 1 Ecological Value of Site	1 Credit is awarded for developing land of inherently low value.	1	1	The site is assumed as having low ecological value
	ECO 2 Ecological Enhancement	A credit is awarded where there is a commitment to enhance the ecological value of the development.	1	1	Measures to enhance the ecology will be included through the use of green roofs and balcony gardens. Other measures will be included to comply with PPS9 and local planning polices
	ECO 3 Protection of Ecological Features	A credit is awarded where there is a commitment to maintain and adequately protect features of ecological value.	1	1	Site is of low ecological value and so awarded by default
	ECO 4 Change of Ecological Value of Site	Credits are awarded where the change in ecological value has been calculated in accordance with the Code requirements.	4	2	A negligible change in ecological value is predicted
	ECO 5 Building Footprint	Credits are awarded where the ratio of combined floor area of all dwellings on the site to their to their footprint is:	2	0	This credit is not sought
		Total Ecology Category Predicted Score	9	5	Credit Weighting = 1.33

EcoHomes 2006 Pre-assessment Estimate on proposed development at 37 Hamilton Road, Twickenham.

This estimate is based on a meeting at Frendcastle on 16th October 2006 and a desktop study.

Items shown in *italics* are to be confirmed as the design progresses.

Issues	**Score**	
Energy Total	*17.43*	Pass 36
Transport Total	*8.00*	Good 48
Pollution Total	*8.19*	Very Good 58
Materials Total	*7.21*	**Excellent 70**
Water Total	*8.34*	
Land use and Ecology	*9.32*	
Health and Wellbeing	*10.50*	
Management Total	*7.00*	
Total all sections	***75.99***	

	Topic	**% credits**	**Details**	**Score**
Ene 1	**Carbon Dioxide emissions:**			
	< or = to 40 kg/m^2/yr	0.92		
	< or = to 35 kg/m^2/yr	1.83		
	< or = to 32 kg/m^2/yr	2.75		
	< or = to 30 kg/m^2/yr	3.67		
	< or = to 28 kg/m^2/yr	4.58		
	< or = to 26 kg/m^2/yr	5.50	*Space heating and hot water are provided by centralised gas boilers. There will be a contribution from heat recovery and solar thermal panels. The predicted Carbon Dioxide emissions are < 18 kg/m^2/yr.*	
	< or = to 24 kg/m^2/yr	6.42		
	< or = to 22 kg/m^2/yr	7.33		
	< or = to 20 kg/m^2/yr	8.25		
	< or = to 18 kg/m^2/yr	9.17		*9.17*
	< or = to 15 kg/m^2/yr	10.08		
	< or = to 10 kg/m^2/yr	11.00		
	< or = to 5 kg/m^2/yr	11.92		
	< or = to 0 kg/m^2/yr	12.83		
	< or = to -10 kg/m^2/yr	13.75		
Ene 2	**Building envelope**		*The thermal insulation will exceed the requirements of Part L. The predicted Heat Loss Parameter < 1.1 W/m^2/K.*	
	HLP < or = to 1.3 W/m^2/K	0.92		
	HLP < or = to 1.1 W/m^2/K	1.83		*1.83*
Ene 3	**Drying space**		*Provide retractable line over bath (extract fan will need humidistat)*	*0.92*
	Provision of drying space	0.92		
Ene 4	**Ecolabelled white goods:**			
	A$^+$ rated fridges/freezers	0.92	*Private units will have A* rated fridge-freezers*	*0.92*
	A rated washing machines, dishwashers & B dryers	0.92	*Private units will have A rated dishwashers & B rated washer/dryers*	*0.92*
	OR Guidance on labelling	0.92	Affordable units will have guidance	incl.
Ene 5	**Internal Lighting**			
	40% dedicated low energy lights specified	0.92		
	75% dedicated low energy lights specified	1.83	*75% of light fittings will be dedicated low energy.*	*1.83*

	Topic	% credits	Details	Score
Ene 6	**External lighting:** Space lighting to accommodate only CFL or fluorescent strip	0.92	*The specification will require space lighting to accommodate only CFL or fluorescent strip*	*0.92*
	Intruder lighting max.150W with PIR Security lighting to accommodate CFL or fluorescent strips with sensors or timers	0.92	*The specifcation will require intruder lighting max.150W with PIR Security lighting to accommodate CFL or fluorescent strips with sensors or timers*	*0.92*
Energy Total (maximum 22.00)				***17.43***
Tra 1	**Public Transport** URBAN & SUBURBAN 80% of development within: 1000m of a 30 min peak & hourly off peak service	1.00	The development is within 500m of a bus stop served by routes 281, 110, 490, 267 & 290. Buses run between 00.42 and 00.27 Monday to Saturday.	
OR	500m of a 15 min peak & half hourly off peak service	2.00		2.00
	RURAL 80% of development within: 1000m of an hourly service OR a community bus service	1.00		
	500m of an hourly service OR community bus service	2.00		
Tra 2	**Cycle storage** Provision of cycle storage for: 50% of dwellings	1.00	Cycle requirement is 32 secure & weathertight spaces. Provision shown as 34.	
	95% of dwellings	2.00		2.00
Tra 3	**Local amenities** 500m of food shop & post-box	1.00	Phils, 160 Heath Road	1.00
	1000m of 5 from:	1.00		1.00
	Food shop if not claimed above			
	Postal facility		40-42 King Street	
	Bank/cash machine		ATM Dhillons 136 Heath Road	
	Pharmacy		Maple Leaf Pharmacy, 20 The Green	
	Primary School		Archdeacon Cambridge's, The Green	
	Medical centre		The Green Surgery, 1b the Green	
	Leisure centre			
	Community centre			
	Public house		Kings Arms, Albion Road	
	Children's play area		Holy Trinity, Vicarage Road	
	Place of worship			
	Outdoor open access public area			
	Safe pedestrian access	1.00	There is safe pedestrian access	1.00
Tra 4	**Home Office** Space & services for home office	1.00	*2 double sockets, double telephone point, openable window, space for desk & storage*	*1.00*
Transport Total (Maximum 8.00)				***8.00***

	Topic	% credits	Details	Score
Pol 1	**Insulation ODP and GWP** Insulating materials with Ozone Depleting Potential of zero & Global Warming Potential of < 5 in either manufacture or composition Roof (incl. roof hatch) Wall - internal & external (incl.doors & window lintels) Floor (incl. Foundations) Hot water cylinder (incl. Pipe insulation & other thermal store)	0.91	*The specification will require insulating materials with Ozone Depleting Potential of zero & Global Warming Potential of < 5 in either manufacture or composition*	*0.91*
Pol 2	**NOx emissions** 95% of dwellings must be served by heating & hot water systems with average NOx emission rate :			
	< or = to 100 mg/kWh	0.91		
	< or = to 70 mg/kWh	1.82		
	< or = to 40 mg/kWh	2.73	*Low NOx community boiler*	*2.73*
Pol 3	**Reduction of surface runoff** Reducing peak surface runoff rates to either natural or municipal systems by 50% in low risk areas, 75% in medium risk areas, 100% in high risk areas for:		*A water attenuation sytem will be developed to meet these criteria.*	
	Hard surfaces	0.91		*0.91*
	Roofs	0.91		*0.91*
Pol 4	**Zero emission energy source** Carry out & act on feasibility study considering low emission & renewable energy	0.91	An energy strategy report will be commissioned to meet these criteria.	0.91
AND	10% total energy demand from local renewable or low emission sources	0.91	10% total energy demand will be met from local renewables. The favoured option is solar thermal.	0.91
OR	15% total energy demand from local renewable or low emission sources	1.82		
Pol 5	**Flood Risk Mitigation** Development in zone with low annual probability of flooding	1.82		
OR	Development in zone with medium annual probability of flooding & ground level of building, car parking and access is above design flood level.	0.91	A flood risk assessment has been done and the design incorporates measures to mitigate flood risk.	0.91
Pollution Total (Maximum 10.01)				***8.19***

	Topic	% credits	Details	Score
Mat 1	**Environmental Impact of Materials** A rating from Green Guide for Housing for:			
	Roof	1.35	*A rated roof*	*1.35*
	External walls	1.35	*Re-used bricks & aerated blockwork*	*1.35*
	Internal walls - party walls & internal partitions	1.35	*Stud partition*	*1.35*
	Floors	1.35		0.00
	Windows	0.90	Aluminium (B rated)	0.00
	External surfacing	0.45		0.00
	Boundary protection	0.45	Timber fencing & living hedges	0.45
Mat 2	**Responsible sourcing of Materials: Basic building elements** Majority of materials responsibly sourced in: 1 Frame 2 Ground floor 3 Upper floors (including loft boarding) 4 Roof (structure & cladding) 5 External walls (including cladding) 6 Internal walls (including partitions) 7 Foundations/substructure 8 Staircase (including tread, rises & stringers)	0.9 to 2.71	Unlikely to score due to difficulties sourcing non-timber materials from sustainable sources.	0.00
Mat 3	**Responsible sourcing of Materials: Finishing elements** Majority of materials responsibly sourced in: 1 Stair (including handrails, balustrades, banisters but excluding staircase) 2 Window (including sub-frames, frames, boards, sills) 3 External & internal door (including sub-frames, frames, linings, door) 4 Skirting (including architrave, skirting board & rails) 5 Panelling (including any other trim) 6 Furniture (including fitted: kitchen, bedroom & bathroom) 7 Fascias (soffit boards, bargeboards, gutter boards) 8 Any other significant use	0.90 to 1.35	Unlikely to score due to difficulties sourcing non-timber materials from sustainable sources.	0.00

Topic		% credits	Details	Score
Mat 4	**Recycling Facilities** Storage of recyclable waste Internal storage only External storage (or LA collection) only Internal & external (or LA collection) storage	 0.90 0.90 2.71	*30 litre recycling bin in kitchen.* London Borough of Richmond upon Thames has a kerbside collection.	*2.71*
Materials Total (Maximum 14.00)				***7.21***
Wat 1	**Internal water use** < 52 m^3/bedspace/yr < or = to 47 m^3/bedspace/yr < or = to 42 m^3/bedspace/yr < or = to 37 m^3/bedspace/yr < or = to 32 m^3/bedspace/yr	 1.67 3.33 5.00 6.67 8.33	*Less than 35 m^3/bedspce/yr* *Rain water flushing of cisterns* *Aerated taps* *Shower head flow less than 9 litre/minute* *Best practice washing machine* *No dishwasher*	*6.67*
Wat 2	**External water use** Rain water collection system for watering gardens & landscaped areas	1.67	*Rain water harvesting for irrigation.*	*1.67*
Water Total (Maximum 10.00)				***8.34***
Eco 1	**Ecological value of site** Building on land of inherently low ecological value	1.33	Land is of inherently low ecological value.	1.33
Eco 2	**Ecological enhancement** Enhancing the ecological value of site through consultation with an accredited expert	1.33	*An accredited expert will be retained to advise on the green roof and other new areas of planting.*	*1.33*
Eco 3	**Protection of ecological features** Ensuring the protection of any existing ecological features on site	1.33	Default credit	1.33
Eco 4	**Change in ecological value of site** Between - 9 & - 3 species Between - 3 & + 3 species Between + 3 & + 9 species Greater than + 9 species	 1.33 2.67 4.00 5.33	*There will be an improvement in ecological value*	*5.33*
Eco 5	**Building footprint** Total combined Floor area to Footprint ratio for all houses is > 2.5:1 AND Total combined Floor area to Footprint ratio for all flats is > 3.5:1 Total combined Floor area to Footprint ratio for all dwellings is > 3.5:1	1.33 2.67	These criteria will not be met.	0.00
Land Use and Ecology Total (Maximum 11.99)				***9.32***

	Topic	% credits	Details	Score
Hea 1	**Daylighting** Provision of adequate daylighting, according to BS 8206 part 2			
	Kitchen	1.75	*Kitchen areas should achieve DF > 2%*	*1.75*
	Living rooms, dining rooms & studies	1.75	*All living rooms should achieve DF > 1.5%*	*1.75*
	View of sky in all above rooms	1.75	All rooms have a view of the sky	1.75
Hea 2	**Sound Insulation** Pre-completion testing for every 10 dwellings in a group			
	Testing approx. 50% of walls/floors	1.75		
	Testing approx. 66% of walls/floors	3.50		
	Testing approx. 66% of walls/floors AND exceed Part E by 3dB	5.25	*These criteria will be met.*	*5.25*
	Testing approx. 66% of walls/floors AND exceed Part E by 5dB	7.00		
Hea 3	**Private space** Provision of private or semi private space	1.75	*These criteria will not be met.*	*0.00*
Health and Wellbeing Total (Maximum 14.00)				***10.50***
Man 1	**Home User Guide** Provision of 'non-technical' guide to occupiers on:			
	Environmental performance of homes	2.00	*These criteria will be met*	*2.00*
	Information about site & surroundings	1.00	*These criteria will be met*	*1.00*
Man 2	**Considerate Constructors** Demonstrate commitment to comply with best practice site management principles	1.00	*These criteria will be met*	*1.00*
OR	Demonstrate commitment to go significantly beyond best practice site management principles	2.00		

Topic		% credits	Details	Score
Man 3	**Construction Site Impacts**			
	Strategy to monitor, sort & recycle construction waste on site	1.00	*A strategy to monitor, sort & recycle construction waste on site will be implemented.*	*1.00*
AND	Evidence that 2 or more shown below are achieved	1.00		*1.00*
OR	Evidence that 4 or more shown below are achieved	2.00		
a	Monitor & report CO_2 or energy arising from site activities			
b	Monitor & report CO_2 or energy arising from transport to & from site activities			
c	Monitor & report water consumption from site activities		*There will be a strategy to monitor & report water consumption from site activities*	
d	Adopt best practice policies in respect of air pollution arising from the site			
e	Adopt best practice policies in respect of water (ground & surface) pollution occurring on the site			
f	80% of site timber is reclaimed, reused or responsibly sourced		*80% of site timber will be reclaimed, reused or responsibly sourced*	
Man 4	**Security**			
	Commit to work with Architectural Liaison Officer & achieve Secured by Design award.	1.00	*These criteria might not be met*	*0.00*
	Security standards for external doors & windows to achieve minimum of either: LPR1175SR1 or PAS24-1	1.00	*These criteria will be met*	*1.00*
Management Total (Maximum 10.00)				***7.00***