Energy Statement

Land Rear of 80-92 Whitton Road, Twickenham

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Executive Summary

This Energy Statement consists of an energy demand assessment showing how selected energy efficiency and renewable energy measures have been incorporated into the development design. The scheme is subject to the planning policies of London Borough of Richmond and the development must comply with London Plan policy 4A.7 - Renewable Energy; the development should reduce CO_2 emissions by at least 20% from the use renewable energy technologies.

The homes have been assessed under the Code for Sustainable Homes and will all achieve a level 3 rating. A Pre Assessment Estimator is included as Appendix 3.

Detailed working drawings have not been produced for the site but SAP calculations have been produced based upon the planning drawings and an assumed construction specification. These have been used to give an indication of the likely energy consumption for the site.

This approach has predicted that using the energy efficient design measures detailed in the report the annual energy demand will be 133,788 kWh p.a. with associated CO_2 emissions of 38,238 kg CO_2 /annum.

It is proposed to install a total of 24 Schuco photovoltaic panels and to install Stroma air source heat pumps to each of the nine residential units and the two commercial units.

The policy requirement is met as follows;

	Kg CO_2	**CO_2 (%) Saving**
Baseline Emissions inc. cooking & appliances (residential) and equipment (commercial) after energy efficiency measures	**38,238**	
Total savings from Renewable Technologies	**7,803**	**20.41%**

Technologies which will not be considered are; wind turbines, CHP or solar hot water panels.

1.0 Introduction

1.1 This report provides an Energy Strategy for the proposed development at the rear of 80-92 Whitton Road, Twickenham (TW1 1BS).

1.2 The report describes the methodology used in assessing the proposed development and the initiatives proposed. A prediction of the total energy demand for the scheme is calculated and the report includes an analysis of available types of on-site renewable and low carbon technologies and makes recommendations as to an appropriate solution to meet the local authority renewable energy policy.

1.3 The strategy is to reduce the energy demand to an economic minimum with investment proposed in the parts of the building that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Following this the strategy considers which renewable technologies are appropriate and makes recommendations as to their use.

1.4 The report has been prepared by Ivan Ball of Bluesky Unlimited who are licensed Code for Sustainable Homes and Ecohomes Assessors.

2.0 Planning Policies

2.1 National Policies

2.1.1 The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

2.1.2 Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in the South East, low demand in other parts of the country, and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, Thriving, Well served and Fair for everyone.

2.1.3 There are currently three planning policy documents which incorporate sustainability and are relevant to the proposed development:

- Planning Policy Statement 1: "Creating Sustainable Communities", published in 2005, and its supplement, PPS 1 : Planning and Climate Change : Supplement to PPS 1, published in December 2007
- Planning Policy Statement 3: "Housing", published in 2007
- Planning Policy Guidance 13: Transport, published in 2001.

2.1.4 Introduced in 2006, the aim of the Code for Sustainable Homes is to provide a single national standard to guide industry in sustainable design and construction. It sets out principles to be considered within the design of properties, and minimum levels of compliance that must be achieved to qualify for each of the six code levels. Energy is just one of the factors addressed in the Code.

2.1.5 It became mandatory for all new dwellings to have a Code evaluation from May 2008 but to achieve Housing Corporation funding for affordable housing it is necessary to achieve a Code 3 rating.

2.2 Local Policies

The London Plan states;

2.2.1 4A.7 Renewable energy

The Mayor will and boroughs should in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from onsite renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This will support the Mayor's Climate Change Mitigation and Energy Strategy and its objectives of increasing the proportion of energy used generated from renewable sources by:

- *requiring the inclusion of renewable energy technology and design, including: biomass fuelled heating, cooling and electricity generating plant, biomass heating, combined heat, power and cooling, communal heating, cooling and power, renewable energy from waste (Policy 4A.21) photovoltaics, solar water heating, wind, hydrogen fuel cells, and ground-coupled heating and cooling in new developments wherever feasible*
- *facilitating and encouraging the use of all forms of renewable energy where appropriate, and giving consideration to the impact of new development on existing renewable energy schemes.*

Boroughs in their DPDs should identify broad areas where the development of specific renewable energy technologies are appropriate. These should encourage the fullest realisation of the potential for renewable energy having regard to the environmental and transport policies of the London Plan.

These should include:

- *identifying sites for zero carbon development*
- *identifying suitable locations for wind turbines in developments*
- *encouraging at least one large wind power scheme in London*

encouraging applications for new street appliances (such as bus shelters, bus stops, parking ticket machines and road signs) to incorporate off-grid solar power and other renewable energy sources where feasible.

2.2.2 **London Borough of Richmond**

On 18th August 2006 the London Borough of Richmond adopted Supplementary Planning Document entitled 'Sustainable Construction Checklist'. The Checklist sets out all criteria to be considered for applications and sets certain minimum standards.

This Statement has been prepared to set out how the applicant intends to achieve the required standards at the site and utilises the guidance given in the SPD. It has been confirmed by Officers at London Borough of Richmond that for new dwellings the Ecohomes standard referred to in the SPD has been replaced by a requirement to meet the Code for Sustainable Homes level 3* rating.

The Core Strategy and policies CP1-CP6 has now been adopted.

3.0 Assessment Methodology

3.1 In assessing this proposal we have been informed by the following guidance:

- London Sustainability Checklist
- Code for Sustainable Homes.

4.0 Proposal

4.1 The development proposes nine residential units and two commercial units.

The residential units are arranged as three pairs of semi detached houses and a single terrace of three two storey houses.

The proposal can be summarised as follows;

Type	**Description**	**Area** Sq m	**Total** Sq m
1	1 Bed Terrace 2 House	67.2	**201.6**
2	4 Bed Semi Det 2 1/2 storey	129.3	**258.6**
3	4 Bed Semi Det 2 1/2 storey	158.3	**633.2**
Office 1	Office over three stories	76.0	**76.0**
Office 2	Single storey office, gnd floor	20.4	**20.4**
			1189.8

5.0 Methodology

Design

5.1 The energy performance of a building is affected by the building design, its construction and its use. Whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption. Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical.

Passive solar gain

5.2 The architectural and structural features of a building will affect energy consumption and the use of natural daylight, orientation, thermal mass, shading and mitigation of wind exposure will reduce heating, cooling and lighting requirements.

5.3 Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

5.4 The design of the site is in context with the surrounding housing and the boundary constraints of the site.

Building Performance

5.5 Buildings account for most of the UK's CO_2 emissions with dwellings alone accounting for 30% of the UK energy consumption and 28% of the resulting CO_2. Wasted energy from power stations and the national grid in the UK is approximately double the energy consumed by transport.

5.6 The overriding objective from a national perspective is to improve the efficiency of the use of energy both in the construction of and in the use of buildings, in order to reduce CO_2 emissions.

5.7 Substantial advances have been achieved in terms of reducing the heat demand in new homes in the last few years. The annual heat demand for an existing detached house, for example, is higher than 200 kW/m^2 p.a. By comparison, a new house built to high energy efficiency standards only requires approximately 70 kW/m^2 p.a.

Building Envelope

5.8 U-values of the dwelling envelope must meet Building Regulations Part L1A standards; further improvements to U-values will reduce the heating requirements of the home and hence reduced energy demand.

5.9 The selection of materials with high thermal density can help stabilise temperature fluctuations in a building and reducing maximum demands on building services.

5.10 It is therefore proposed to construct the homes using traditional brick and block albeit with high levels of insulation and thermal detailing.

- The walls are proposed as 300mm thick with 100mm facing brickwork, 100mm fully filled cavity and 100mm insulated blockwork. Internally the walls will be finished with 38 x 50mm battens and 55mm gyproc Thermaline Plus insulated plasterboard. Du Pont Climate Systems (two low emissivity cavities).

- The ground floor will be insulated with 150mm 'celotex'.

- The sloping ceilings will be insulated with Kingspan Thermapitch TP10 between the rafter (and ceiling joists) 90mm thick and between the rafters 52.5mm Kingspan K18 insulated plasterboard (comprising 12.5mm board bonded to 40mm rigid phenolic insulation).

- Roof insulation to horizontal areas will be 600mm of mineral wool.

It is proposed to set maximum limits for the elemental U-values as follows;

Element	**Building Regs L1A – Jan 2006** W/m²K	**'Best Practice'** W/m²K	**Proposed** W/m²K
External Walls	0.25	0.25	**0.17**
Roof	0.25	0.13	**0.13**
Floor	0.25	0.20	**0.13**
Windows	1.80	1.80	**1.50**

Air Leakage

5.11 Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

5.12 ADL (2006) sets a minimum standard for air permeability of 10 m^3 of air per hour per m^2 of envelope area, at 50Pa. Air tightness standards will be constructed at the development to the 'Accredited Construction Details' as compiled by Department of Communities and Local Government (DCLG). These will average a 50% improvement over Building Regulations and will achieve a permeability of less than 5m^3/hr/m^2.

5.13 In addition thermal detailing will be improved to reduce the 'psi' value.

Ventilation

5.14 As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F18 was also revised in 2006 to address the possibility of overheating and poor air quality.

Mechanical ventilation with heat recovery will be used to control internal air quality although maximum use will be made of natural ventilation for summer night time cooling.

Overheating

5.15 The possibility of summertime overheating is addressed by providing openable windows to provide natural ventilation and night cooling.

Lighting

5.16 Throughout the dwelling natural lighting will be optimised.

Approved Document L1A (2006) requires one in four light fittings (or 1 per 25m^2) to be dedicated low energy fittings. The development will exceed this and in excess of 75% of the light fittings will be of a dedicated energy efficient type.

5.17 External lighting will be fitted with time controls and light sensors to ensure illumination is restricted to required times. External lighting will be limited to a maximum fitting output of 150w. This improves energy consumption and reduces the effects of light pollution.

Heating

5.18 Controls will be fitted to heating systems with individual timer controls, optimum start and temperature set back. Individual rooms will have the ability to be set at different temperatures according to use.

Summary

5.19 A summary of the building fabric improvements is outlined below;

- Insulation values will significantly exceed Part L of the 2006 Building Regulations and those values normally quoted as 'best practice'.
- The dwelling will be built in traditional brick and block construction with high levels of insulation.
- Construction of the scheme will be in accordance with the 'accredited construction details by DCLG. These will average a 50% improvement over Building Regulations and air tightness will achieve a target of lower than 5 $m^3/ (h.m^2)$.
- All windows will be double-glazed with argon filled units and have thermally insulated frames with window locks to provide secure natural ventilation.
- Mechanical ventilation with heat recovery will be provided to all homes.
- The thermal mass of materials will be enhanced where practical.
- External lighting will be positioned, controlled and focused such that its energy provides efficient safe and secure access. This will comprise energy efficient luminaries supported by infrared, sensor and time controls.
- The scheme as a whole will be designed to reduce light pollution.
- Kitchen appliances will be energy efficient.

6.0 Energy Demand

6.1 Residential Units

A SAP calculation has been prepared for Plots 1 and 4 being representative of the two of the types of houses. It is assumed the energy demand for the types 2 and 3 will be similar per square metre. The calculations are attached as Appendix 1.

6.2 Commercial Accommodation

The Simplified Building Energy Model (SBEM) has been used to determine the baseline energy demand for commercial areas.

6.3 Detailed design has not been carried out but assumptions have been made regarding the construction type and specification and these have been highlighted above.

6.4 The energy demand and CO_2 emissions for the homes have been assessed as follows: (see Appendix 1 for detail)

Energy Demand for the residential element

1 Bedroom End Terrace 2 storey	**Design Energy** kWh/m²/annum	**Design CO_2** Kg CO_2/annum
Space Heating	31.25	6.06
Secondary heating (elec)	0	0
Water heating	52.53	10.19
Electricity for lights, pumps & fans	26.71	11.27
Total kWh/m2/annum SAP	110.49	27.52

4 Bedroom Semi Det House 2 1/2 storey	Design Energy kWh/m²/annum	Design CO_2 Kg CO_2/annum
Space Heating	28.00	5.43
Secondary heating (elec)	0	0
Water heating	36.94	7.17
Electricity for lights, pumps & fans	22.02	9.29
Total SAP	86.96	21.89

6.5 Commercial Accommodation

The proposal includes two commercial units. The end user of these is currently unknown and for the purposes of this Statement the energy demand for the commercial units has been modelled as an office user. Energy demand is predicted using SBEM.

Energy demand for the Commercial element

Commercial	Design Energy kWh/m²/annum	Design CO_2 Kg CO_2/annum
Space Heating	49.00	9.51
Hot Water	4.00	0.78
Auxiliary	15.00	6.33
Lighting	53.00	22.37
Total SBEM	121.00	38.99

6.6 The total energy demand and CO_2 emissions for the site therefore is;

(The policy requires energy for cooking and appliances (residential) and equipment (commercial) to be added in and an allowance of 20% of the total energy has been included for this element)

	Area	Totals	
		Energy kWh/annum	CO_2 Kg /annum
1 Bed terrace 2 storey house	201.6	22,275	5,548
Cooking and Appliances		4,455	1,880
4 Bed semi det 2 ½ storey house	891.8	77,551	19,522
Cooking and Appliances		15,510	6,545
Offices	96.4	11,664	3,759
Equipment		2,333	984
Total		**133,788**	**38,238**

6.7 The total energy demand of the site is;

- **133,788 kWh / annum**

With associated CO_2 emissions of;

- **38,238 kg CO_2 / annum**

7.0 Renewable Technologies

7.1 The energy demand established above has been used to test the viability of various renewable and low carbon technologies as follows.

7.2 This section determines the appropriateness of each renewable technology and considers the ability of each technology to comply with the planning requirements as set out above in Section 2.0.

7.3 The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

7.4 The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

7.5 Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall mounted units for individual dwellings.

7.6 The Government wind speed database predicts local wind speeds at Whitton Road to be 4.8 m/s at 10m above ground level and 5.6 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines and in addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

7.7 Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment is purely tokenism.

Combined Heat and Power and Community Heating

7.8 Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for us in buildings. The plant is essentially a small scale electrical power station.

7.9 The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation. Consequently CHP can demonstrate significant CO_2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

7.10 Biomass does have an associated CO_2 emission which is generated in the transport and combustion stage but the majority of the CO_2 released is offset by that absorbed during the growth stage.

7.11 The use of biomass as a fuel source has been considered and the effect of a biomass heating system on air quality in the local area. Biomass systems do suffer from higher levels of emissions particularly NOx and particulates and consequently it has been decided not to pursue this type of installation at Whitton Road.

7.12 In order to optimise a combined heat and power plant, whether fuelled by biomass or a fossil fuel the development needs to possess a minimum critical mass of homes or commercial space to provide for a balanced, economic output from the plant. Buildings need to be built at a relatively high density, close together and preferable multi storey in order to minimise infrastructure pipework.

7.13 The plant should be run at maximum output for as much of the time as possible and to facilitate this installations usually serve mixed use schemes where there is a fairly constant demand during the day and night. An example may be a mixed commercial and residential scheme. Schemes with just a single use tend not be operate efficiently since the plant is constantly switching on and off.

7.14 Therefore CHP is not proposed.

Ground Source Heat Pumps

7.15 Sub soil temperatures are reasonable constant and predictable in the UK, providing a store of the sun's energy throughout the year. Ground source

heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

7.16 GSHPs operate on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators. The pumps require electricity for their operation and the resultant reduction in CO_2 is not as significant as with other renewables.

7.17 There are generally two types of installation being a bore hole (open loop) and a closed loop system. Open loop bore holes extract energy from ground water located deep below the surface and discharge the water back to the ground reservoir whilst closed loop systems circulate a fluid around a series of boreholes or horizontal 'slinky' and extract heat from the ground.

7.18 Ground source heat pumps could be used subject to satisfactory ground investigation to establish whether the sub strata is appropriate.

7.19 There is sufficient land area available in the rear garden of each property to accommodate the network of collection pipework

Solar

(i) Solar Water Heating

7.20 Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes. The technology is simple and easily understood by purchasers.

7.21 Solar hot water heating panels are based generally around two types which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum*.

* Figures taken for Schuco Compact K

7.22 Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. The rear roof pitches for Plots 1-5 are correctly orientated and with the front (west facing) or rear (east facing) roof slopes of Plots 6-9 being able to accommodate panels albeit at a reduced efficiency. However, the CO_2 saving would be insufficient to meet the LPA policy solely using this technology although they could be used in conjunction with other technologies.

(ii) Photovoltaics

7.23 Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

7.24 PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

7.25 The expectation is that there will be a reduction in the capital costs in the near future but currently the capital cost per unit of energy output is significantly higher than solar water heating panels and the efficiency of energy conversion lower.

7.26 PVs could be used either in isolation or in conjunction with other technologies. With a CO_2 saving of 80 kg CO_2 per panel a total of 96 panels would be required to achieve the policy target. At a cost of circa £4,700 per kWp this will lead to a total cost of £77,000.

Photovoltaic panels could be used.

Air Source Heat Pumps (ASHP)

7.27 Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

7.28 ASHPs tend to have a lower coefficient of performance (CoP) than GSHPs with CoPs of circa 3.0-3.5 quoted by the majority of manufacturers. There is sufficient space to suitably locate the outside unit away from visible elevations.

8.0 Proposal for On –Site Renewal Energy

8.1 The total site energy demand is **133,788 kWh p.a.** with CO_2 emissions of **38,238 kg CO_2 /annum.**

8.2 To achieve the LPA policy the total required on-site renewable energy output needs to reduce CO_2 emissions by at least **7,648 kg CO_2 /annum.**

Proposal

Photovoltaic Panels (PVs)

8.3 It is proposed to install a total of 24 photovoltaic panels to the south facing roof slope to each of Plots 1-5.

8.4 Six panels will be installed to Plots 4 & 5 and four panels will be installed to each of Plots 1-3. The panels are proposed as Schuco 170wp panels with an output of 142 kWh per annum.

8.5 The roof area required for Plots 1-3 is measured as 1.66m x 3.34m and to Plots 4 & 5 will be 3.32m x 2.50m

Air Source Heat Pump (ASHP)

8.6 It is proposed to install a Stroma AirRES air source heat pump into each house and each of the two office units.

8.7 The heat pump absorbs free energy (heat) from a low-temperature source (air) and upgrades it to a higher temperature, via the refrigerant cycle. From manufacturers data (attached) we have based the following on an efficiency of 350%.

8.8 The CO_2 saving from using air source heat pumps is represented by the following table;

Type	Area	No	Space Heating kWh/unit	Water Heating kWh/unit	Total Space & Water Heating kWh/total	Energy Demand using ASHP CoP = 3.5	Energy Saving	Total CO_2 Saving Kg /annum
Type 1	67.2	3	2,100	3,530	5,630	1,609	4,021	**1,240**
Type 2	129.3	2	3,620	4,776	8,396	2,399	5,997	**1,233**
Type 3	158.3	4	4,431	5,847	10,278	2,937	7,341	**3,019**
Offices	96.4	2	4,724	386	5,110	1,460	3,650	**375**
		11						**5,867**

Renewables Summary;

8.9 It is therefore proposed to install the following;

Renewable Technologies	No.	Energy reduction or saving kWh p.a.	Total energy reduction or saving from renewables KWh p.a.	Total CO2 savings Kg CO_2 p.a
Stroma AirRES air source heat pumps	11	57,071	57,071	5,867
Schuco Photovoltaic panels	24 panels	142	3,408	1,936
Total			**60,479**	**7,803**

8.10 This equates to a total reduction in CO_2 emissions from renewables of;

- **7,803 / 38,238 x 100**
- **<u>20.41%</u>**

Appendix 1 ; Energy Demand Calculation for Plots 1 and 4

SAP Energy Demand Worksheet - Draft

Site;	Land Rear of 80-92 Whitton Road, Twicker	**Client;**	Davies and Roche (Cymru) Ltd
Type/Plot;	Plot 1 - 1 Bed End Terrace, 2 storey	**Date;**	January 2010

1. Home Dimensions

	Area		Storey Height	Volume	
Ground Floor	33.60	(1a)	2.4	80.64	(1)
First Floor	33.60	(2a)	2.4	80.64	(2)
Second Floor		(3a)		0.00	
Total Floor Area	67.20	(5)			
Total Volume				161.28	(6)

2. Ventilation rate

Air Permeability (air permeability / 20)	5		0.25	(19)
Number of Sides on which sheltered	2		2.00	(20)
Shelter Factor		1 - {0.075 x (20)}	0.85	(21)
Adjusted Infiltration Rate		(19) x (21)	0.21	(22)
a) If balanced whole house ventilation with HR		(22) + 0.17	0.38	(23)
b) If balanced whole house ventilation without HR		(22) + 0.5		(23a)
c) If whole house extract vent or PIV from outside				(23b)
		if (22) < 0.25 then (23b) = 0.5; otherwise (23b) = 0.25 + (22)		
d) If natural vent or whole house PIV from loft				(24)
		if (22) > 1.0 then (24) = (22); otherwise (24) = 0.5 + I(22)^2 x 0.5I		
Effective air change rate - enter (23) or (23a) or (23b) or (24) in box (25)			0.38	(25)

3. Heat Losses and HLP

	Area		U-Value	AXU (W/K)	
Windows	10.02		1.50	15.03	(27)
Doors	1.95		1.50	2.93	(26)
Ground Floor	33.60		0.13	4.37	(28)
Walls	67.52		0.17	11.48	(29)
Roof (horizontal)	33.60		0.13	4.37	(30)
Roof (sloping)				0.00	
Total Area of Elements	146.69	(32)			
Fabric Heat Loss, W/K				38.17	(33)
		(26)+(27)+(27a)+(28)+(29)+(29a)+(30)+(30a)+(31)			
Thermal Bridges - calculated using Appendix K				11.74	(34)
		Accredited construction details used, therefore y = 0.08			
Total Fabric Heat Loss		(33)+(34)		49.90	(35)

Ventilation Heat Loss			(25) x 0.33 x (6)	20.22 (36)
Heat Loss Coefficient, W/K			(35) + (36)	70.13 (37)
Heat Loss Parameter (HLP), W/m^{2}K			(37) / (5)	1.04 (38)

4. Water Heating Requirement

Energy Content of hot water from Table 1 column (b)	2.18	225.00		1675.38 (39)
Distribution losses from Table 1 columnn (c)				295.66 (40)
Water Storage Loss;				
a) If manufacturers declared loss factor is known (kWh/day);				(41)
Temperature factor from Table 2b				(41a)
Energy loss from water storage, kWh/year			(41)x(41a)x365	0.00 (42)
b) If manufacturers declared loss factor is not known;				
Cylinder volume including any solar storage within same cylinder				170.00 (43)
			if combi boiler enter '0' in box (43)	
Hot water storage loss factor from Table 2 (kWh/litre/day)				0.02 (44)
Volume factor from Table 2a				0.89 (44a)
			170l = 0.891, 210l = 0.830	
Temperature factor from Table 2b				0.54 (44b)
			Assumed to be separate time control of DHW	
Energy loss from water storage, kWh/year			(43)x(44)x(44a)x(44b)x365	453.28 (45)
Enter (42) or (45) in box (46)				453.28 (46)
Primary circuit loss from Table 3				360.00 (48)
			Assumed to be insulated pipework and with cylinder thermostat	
Combi loss from Table 3a (enter '0' if no combi)				0.00 (49)
Output from water heater, kWh/year			(39)+(40)+(46)+(48)+(49)	2784.32 (51)
Heat Gains from water heating			0.25x{(39)+(49)}+0.8x{(40)+(46)+(48)}	1306.00 (52)

5. Internal Gains

Lights, appliances, cooking and metabolic (Table 5)	2.18			417.37 (53)
Reduction of internal gains due to low energy lighting (Appendix L)				27.77 (53a)
		% of low energy lighting	75 %	
Additional gains from Table 5a			Assumed central heating pump	10.00 (53b)
Water heating			(52) / 8.76	149.09 (54)
Total internal gains			(53)+(53b)+(54)-(53a)	548.69 (55)

6. Solar Gains

	Access factor table		Area		Flux table		g Table 6b		FF Table 6c		Gains W
North	0.77	x	2.82	x	29	x 0.9 x	0.63	x	0.70	=	24.99
North-East	0.77	x		x	34	x 0.9 x	0.63	x	0.70	=	0.00

East	0.77	x		x	48	x 0.9 x	0.63	x	0.70	=	0.00	
South-east	0.77	x		x	64	x 0.9 x	0.63	x	0.70	=	0.00	
South	0.77	x	7.20	x	72	x 0.9 x	0.63	x	0.70	=	158.43	
South-west	0.77	x		x	64	x 0.9 x	0.63	x	0.70	=	0.00	
West	0.77	x		x	48	x 0.9 x	0.63	x	0.70	=	0.00	
North-west	0.77	x		x	34	x 0.9 x	0.63	x	0.70	=	0.00	

Total solar gains		183.42	(65)
Total gains, W	(55) + (65)	732.11	(66)
Gain/Loss ratio (GLR)	(66) / (37)	10.44	(67)
Utilisation factor, (Table 7, using GLR in box (67)		0.82	(68)
Useful gains, W	(66) x (68)	601.21	(69)

7. Mean internal temperature

Mean internal temperature of the living room (Table 8)		18.88	(70)
Temperature adjustment from Table 4e, where appropriate		0.00	(71)
Adjustment for gains	{[(69) / (37)] - 4.0} x 0.2 x R	0.91	(72)
R is obtained from responsiveness column of Table 4a or Table 4d	R= 1.00		
Adjusted living room temperature	(70)+(71)+(72)	19.79	(73)
Temperature difference between zones (Table 9)		1.42	(74)
Living area fraction Area= 18	living room area / (5)	0.27	(75)
Rest of house fraction	1 - (75)	0.73	(76)
Mean internal temperature	(73) - [(74)x(76)]	18.76	(77)

8. Degree Days

Temperature rise from gains	(69) / (37)	8.57	(78)
Base temperature	(77) - (78)	10.18	(79)
Degree days, use box (79) and Table 10		984.20	(80)

9. Space Heating Requirement

Space heating requirement (useful), kWh/year	0.024 x (80) x (37)	1656.51	(81)

Space heating

Fraction of heat from secondary/supplementary system (use value from Table 11,App F or N)		0.00	(82)
Efficiency of main heating system, %		90.70	(83)
Efficiency of secondary/supplementary heating system, % (use value from Table 4a or App E)	Seebuk or from Table 4a or 4b,	0.00	(84)
Space heating fuel (main) requirement, kWh/year	[1 - (82)] x (81) x 100 / (83)	1826.36	(85)
Space heating fuel (secondary), kWh/year	(82) x (81) x 100 / (84)	N/A	(85a)

Water Heating

Efficiency of water heating, %		90.70 (86)
Energy required for water heating, kWh/year	Seebuk or from Table 4a or 4b (51) x 100 / (86)	3069.81 (86a)

Electricity for pumps and fans

	kWh/year
each central heating pump, Table 4f	130
each boiler with a fan-assisted flue, Table 4f	45
warm air heating system fans, Table 4f	0
mechanical ventilation - balanced extract or PI from outside	157.41
maintaining keep-hot facility for gas combi boiler, Table 4f	0
pump for solar water heating, Table 4f	0
Total electricity for the above requirement	332.41 (87)

13a Primary Energy

	Energy kWh/year		Primary energy factor		Primary Energy kWh/year
Space heating main from box (85)	1826.35692	x	1.15	=	2100.31
Space heating secondary from box (85a)	N/A	x		=	0.00
Energy for water heating from box (86a)	3069.81	x	1.15	=	3530.28
Space and water heating					5630.60
Electricity for pumps and fans from box (87)	332.40928	x	2.8	=	930.75
Energy for lighting from Appendix L	308.57	x	2.8	=	864.01
Energy produced or saved in dwelling, Appendix Q		x	2.8	=	0.00
Primary Energy kWh/year					7425.35
Primary Energy kWh/m2/year					110.50

SAP Energy Demand Worksheet - Draft

Site;	Land Rear of 80-92 Whitton Road, Twicker	**Client;**	Davies and Roche (Cymru) Ltd
Type/Plot;	Plot 4 - 4 Bed Semi Det, 2 $^{1/2}$ storey	**Date;**	January 2010

1. Home Dimensions

	Area		Storey Height	Volume	
Ground Floor	59.20	(1a)	2.4	142.08	(1)
First Floor	46.80	(2a)	2.4	112.32	(2)
Second Floor	23.30	(3a)		0.00	
Total Floor Area	129.30	(5)			
Total Volume				254.40	(6)

2. Ventilation rate

Air Permeability (air permeability / 20)	5		0.25	(19)
Number of Sides on which sheltered	2		2.00	(20)
Shelter Factor		1 - {0.075 x (20)}	0.85	(21)
Adjusted Infiltration Rate		(19) x (21)	0.21	(22)
a) If balanced whole house ventilation with HR		(22) + 0.17	0.38	(23)
b) If balanced whole house ventilation without HR		(22) + 0.5		(23a)
c) If whole house extract vent or PIV from outside				(23b)
		if (22) < 0.25 then (23b) = 0.5; otherwise (23b) = 0.25 + (22)		
d) If natural vent or whole house PIV from loft				(24)
		if (22) > 1.0 then (24) = (22); otherwise (24) = 0.5 + I(22)^2 x 0.5I		
Effective air change rate - enter (23) or (23a) or (23b) or (24) in box (25)			0.38	(25)

3. Heat Losses and HLP

	Area		U-Value	AXU (W/K)	
Windows	17.97		1.50	26.96	(27)
Doors	1.95		1.50	2.93	(26)
Ground Floor	59.20		0.13	7.70	(28)
Walls	115.76		0.17	19.68	(29)
Roof (horizontal)	22.88		0.13	2.97	(30)
Roof (sloping)	26.68		0.20	5.34	
Total Area of Elements	244.44	(32)			
Fabric Heat Loss, W/K				65.57	(33)
		(26)+(27)+(27a)+(28)+(29)+(29a)+(30)+(30a)+(31)			
Thermal Bridges - calculated using Appendix K				19.56	(34)
		Accredited construction details used, therefore y = 0.08			
Total Fabric Heat Loss		(33)+(34)		85.12	(35)

Ventilation Heat Loss			(25) x 0.33 x (6)	31.90 (36)
Heat Loss Coefficient, W/K			(35) + (36)	117.02 (37)
Heat Loss Parameter (HLP), W/m^{2}K			(37) / (5)	0.91 (38)

4. Water Heating Requirement

Energy Content of hot water from Table 1 column (b)	3.89	329.30		2451.98 (39)
Distribution losses from Table 1 columnn (c)				432.70 (40)
Water Storage Loss;				
a) If manufacturers declared loss factor is known (kWh/day);				(41)
Temperature factor from Table 2b				(41a)
Energy loss from water storage, kWh/year			(41)x(41a)x365	0.00 (42)
b) If manufacturers declared loss factor is not known;				
Cylinder volume including any solar storage within same cylinder				210.00 (43)
			if combi boiler enter '0' in box (43)	
Hot water storage loss factor from Table 2 (kWh/litre/day)				0.02 (44)
Volume factor from Table 2a				0.83 (44a)
			170l = 0.891, 210l = 0.830	
Temperature factor from Table 2b				0.54 (44b)
			Assumed to be separate time control of DHW	
Energy loss from water storage, kWh/year			(43)x(44)x(44a)x(44b)x365	522.19 (45)
Enter (42) or (45) in box (46)				522.19 (46)
Primary circuit loss from Table 3				360.00 (48)
			Assumed to be insulated pipework and with cylinder thermostat	
Combi loss from Table 3a (enter '0' if no combi)				0.00 (49)
Output from water heater, kWh/year			(39)+(40)+(46)+(48)+(49)	3766.87 (51)
Heat Gains from water heating			0.25x{(39)+(49)}+0.8x{(40)+(46)+(48)}	1664.91 (52)

5. Internal Gains

Lights, appliances, cooking and metabolic (Table 5)	3.89			711.65 (53)
Reduction of internal gains due to low energy lighting (Appendix L)				53.44 (53a)
		% of low energy lighting	75 %	
Additional gains from Table 5a			Assumed central heating pump	10.00 (53b)
Water heating			(52) / 8.76	190.06 (54)
Total internal gains			(53)+(53b)+(54)-(53a)	858.27 (55)

6. Solar Gains

	Access factor table		Area		Flux table		g Table 6b		FF Table 6c		Gains W
North	0.77	x	9.09	x	29	x 0.9 x	0.63	x	0.70	=	80.56
North-East	0.77	x		x	34	x 0.9 x	0.63	x	0.70	=	0.00

East	0.77	x		x	48	x 0.9 x	0.63	x	0.70	=	0.00	
South-east	0.77	x		x	64	x 0.9 x	0.63	x	0.70	=	0.00	
South	0.77	x	8.88	x	72	x 0.9 x	0.63	x	0.70	=	195.40	
South-west	0.77	x		x	64	x 0.9 x	0.63	x	0.70	=	0.00	
West	0.77	x		x	48	x 0.9 x	0.63	x	0.70	=	0.00	
North-west	0.77	x		x	34	x 0.9 x	0.63	x	0.70	=	0.00	

Total solar gains		275.96	(65)
Total gains, W	(55) + (65)	1134.23	(66)
Gain/Loss ratio (GLR)	(66) / (37)	9.69	(67)
Utilisation factor, (Table 7, using GLR in box (67)		0.84	(68)
Useful gains, W	(66) x (68)	951.96	(69)

7. Mean internal temperature

Mean internal temperature of the living room (Table 8)		18.88	(70)
Temperature adjustment from Table 4e, where appropriate		0.00	(71)
Adjustment for gains	{[(69) / (37)] - 4.0} x 0.2 x R	0.83	(72)
R is obtained from responsiveness column of Table 4a or Table 4d	R= 1.00		
Adjusted living room temperature	(70)+(71)+(72)	19.71	(73)
Temperature difference between zones (Table 9)		1.39	(74)
Living area fraction Area= 16	living room area / (5)	0.12	(75)
Rest of house fraction	1 - (75)	0.88	(76)
Mean internal temperature	(73) - [(74)x(76)]	18.48	(77)

8. Degree Days

Temperature rise from gains	(69) / (37)	8.13	(78)
Base temperature	(77) - (78)	10.35	(79)
Degree days, use box (79) and Table 10		1016.50	(80)

9. Space Heating Requirement

Space heating requirement (useful), kWh/year	0.024 x (80) x (37)	2854.88	(81)

Space heating

Fraction of heat from secondary/supplementary system (use value from Table 11,App F or N)		0.00	(82)
Efficiency of main heating system, %		90.70	(83)
Efficiency of secondary/supplementary heating system, % (use value from Table 4a or App E)	Seebuk or from Table 4a or 4b,	0.00	(84)
Space heating fuel (main) requirement, kWh/year	[1 - (82)] x (81) x 100 / (83)	3147.61	(85)
Space heating fuel (secondary), kWh/year	(82) x (81) x 100 / (84)	N/A	(85a)

Water Heating

Efficiency of water heating, %		90.70 (86)
Energy required for water heating, kWh/year	Seebuk or from Table 4a or 4b (51) x 100 / (86)	4153.11 (86a)

Electricity for pumps and fans

	kWh/year
each central heating pump, Table 4f	130
each boiler with a fan-assisted flue, Table 4f	45
warm air heating system fans, Table 4f	0
mechanical ventilation - balanced extract or PI from outside	248.29
maintaining keep-hot facility for gas combi boiler, Table 4f	0
pump for solar water heating, Table 4f	0
Total electricity for the above requirement	423.29 (87)

13a Primary Energy

	Energy kWh/year		Primary energy factor		Primary Energy kWh/year
Space heating main from box (85)	3147.61011	x	1.15	=	3619.75
Space heating secondary from box (85a)	N/A	x		=	0.00
Energy for water heating from box (86a)	4153.11	x	1.15	=	4776.08
Space and water heating					8395.83
Electricity for pumps and fans from box (87)	423.2944	x	2.8	=	1185.22
Energy for lighting from Appendix L	593.73	x	2.8	=	1662.44
Energy produced or saved in dwelling, Appendix Q		x	2.8	=	0.00
Primary Energy kWh/year					11243.50
Primary Energy kWh/m2/year					86.96

Appendix 2 ; Product Detail Schuco photovoltaic panels and Stroma air source heat pumps

Schüco S 170-SP-3 photovoltaic module

Technical information

PV module of the highest quality
The SP-3 series of Schüco PV modules are distinguished by multicrystalline solar cells with a cell efficiency of up to 15 % for high yields per square metre of module area. The output tolerance of an SP-3 module is +5/-0 %, only modules of the highest quality provide this level of reliability. The rated output is always achieved or exceeded.

Comprehensive warranty
Schüco SP-3 modules have a 5-year product warranty. In fact, the guarantee on performance values is considerably longer – after 25 years, the Schüco module will still provide at least 80 % of its rated output.

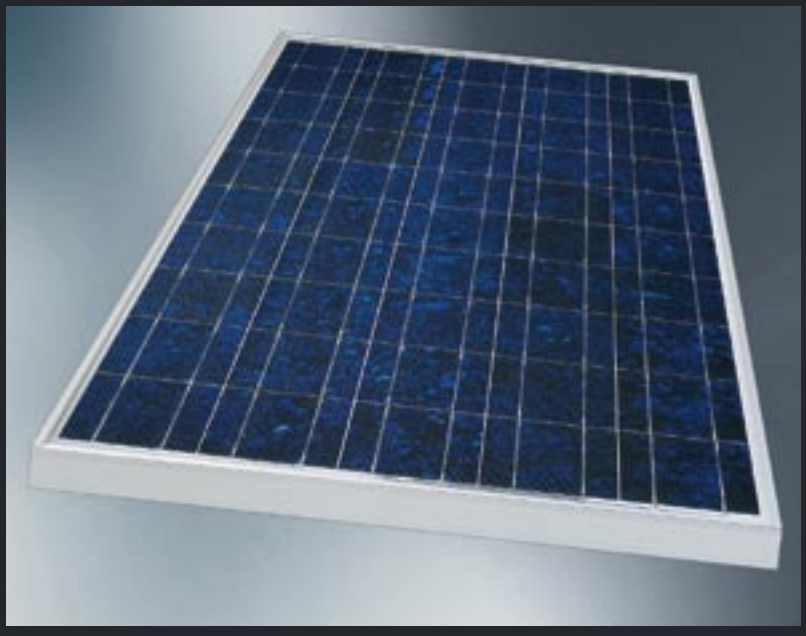
Each SP-3 module complies with international quality standards such as protection class II and IEC 61215, including damp heat test and climate change test.

Optimised labelling
Prior to delivery, each SP-3 module is subject to a visual and electrical quality test. The performance data measured is indicated on the back of the module and on the packaging. Homogeneous module fields can be grouped together quickly and effectively during installation.

High level of operational reliability
Schüco SP-3 modules have two connection boxes on the back of each module. A bypass diode bridge for each connection box prevents the individual solar cells from overheating (hot spot effect). This ensures the reliable operation of the overall system from module field and inverter.

Environmental protection
The use of a lead-free solder in the manufacture of SP-3 modules results in a saving of 50 grams of lead per module, which makes a considerable contribution to environmental protection.

Attractive and robust
The module frame made from torsion-proof, anodised aluminium meets the highest requirements in terms of stability and corrosion resistance. SP-3 modules can be installed with assembly components from the Schüco PV Light installation system.



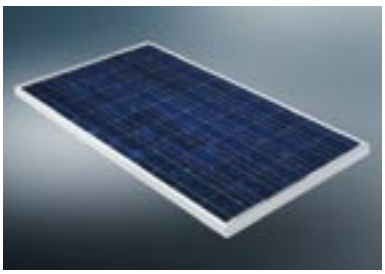
Schüco S 170-SP-3
Dimensions: 1658 x 834 x 46 mm
Rated output (P_{mpp}): 170 W
Suitability to type: IEC 61215 / EN 61215

SCHÜCO

Schüco S 170-SP-3 photovoltaic module

Electrical key data	
Performance data (except NOCT) under Standard Test Conditions (STC)*:	
Rated output (P_{mpp})	170 W
Output tolerance (ΔP_{mpp})	+5/-0 %
Guaranteed minimum output ($P_{mpp\ min}$)	170 W
Nominal voltage (U_{mpp})	23.7 V
Nominal current (I_{mpp})	7.19 A
Open circuit voltage (U_{oc})	29.9 V
Short circuit current (I_{sc})	7.83 A
Module efficiency	12.3 %
Temperature coefficient α (P_{mpp})	-0.365 %/°C
Temperature coefficient β (I_{sc})	+0.043 %/°C
Temperature coefficient χ (U_{oc})	-0.346 %/°C
Temperature coefficient δ (I_{mpp})	+0.004 %/°C
Temperature coefficient ε (U_{mpp})	-0.448 %/°C
Normal Operating Cell Temperature (NOCT)**	46.2 °C
Max. permissible system voltage (as per protection class II)	780 V
Max. permissible system voltage (as per IEC 61215)	1000 V
Number of cells / size of cells	50 (5 x 10) / 156 x 156 mm (6"+)

* Intensity of solar radiation 1000 W/m², air mass AM 1.5, cell temperature 25 °C
** Intensity of solar radiation 800 W/m², ambient temperature 20 °C, wind speed 1 m/s



Schüco S 170-SP-3

TÜV-certified

Mechanical key data	
Outer dimensions (L x W x H)	1658 x 834 x 46 mm
Design of aluminum frame	Anodised, silver (similar to RAL 7035)
Front glass	Toughened safety glass (TSG)
Weight	19.5 kg
Height of connection box	11.5 mm
Connection system / cross section of solar cable	Multi Contact type 4 / 4 mm²
Lengths: positive cable / negative cable	125 cm ± 5 cm / 80 cm ± 5 cm

Qualifications, guarantees and certificates	
Suitability to type / type approval	IEC 61215 / EN 61215
Electrical classification	Protection class II
Product guarantee	5 years
Performance guarantee to 90 % $P_{mpp\ min}$	12 years
Performance guarantee to 80 % $P_{mpp\ min}$	25 years

Miscellaneous	
Weight of packing unit	44 kg
Schüco installation system	PV-Light
Schüco end clip Art. No.	221673
Schüco intermediate clip Art. No.	221674
Schüco S 170-SP-3 Art. No.	249262
Packing unit	2 modules

Subject to change without notice.

Performance

170 Watt, +5/-0% ▶ Optimised power density ▶ Highest yields

Design and production

Optimised labelling ▶ Individual performance data on module and packaging
Use of lead-free solder ▶ Active environmental protection thanks to saving of 50 g of lead per module
Anodised aluminium frame ▶ Meets highest requirements in terms of stability and corrosion resistance
Bypass diodes ▶ Reliable prevention of "hot spot effect"

Highest Schüco quality

Meets all international quality standards ▶ Tests to determine performance data; data listed for each module

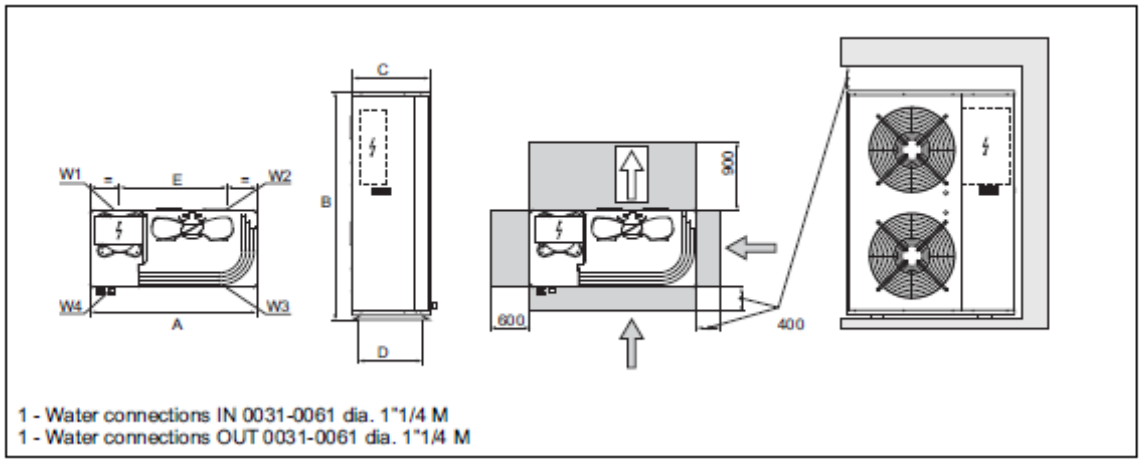
Stoma AirRES Air Source Heat Pump

General Technical Data

HiRES HT			9kW	14kW	14kW	19kW
Heating Capacity	(1)	kW	10.4	14.9	14.1	19.7
	(2)	kW	10.4	15.1	14.3	19.7
C.O.P.	(1)		4.16	4.26	4.27	4.19
	(2)		3.47	3.6	3.58	3.52
Power Input	(1)	kW	2.5	3.5	3.3	4.7
	(2)	kW	3.0	4.2	4.0	5.6
Rated water flow	(1)	m^3/h	1.79	2.56	2.43	3.39
Useful pressure head	(1)	kPa	54	60	60	49
No. of fans		no.	2	2	2	2
Air flow-rate		m^3/s	1.9	2	2	1.8
Type of compressor			SCROLL			
Number of compressors		n°	1	1	1	1
Number of compressors circuits		n°	1	1	1	1
Refrigerant		Kg		3.3	3.3	4.0
Oil Mobil EAL ARCTIC 22cc		Kg	1.45	1.89	1.89	1.89
Type of pump			circulating			
Number of pumps		n°	1	1	1	1
Operating weight		kg	140	160	170	180
Water connections		inch	1 1/4	1 1/4	1 1/4	1 1/4
Sound pressure level	(3)	dB(A)	61	61	61	61
Power supply		V/ph/Hz	230~50		400-3N~50	

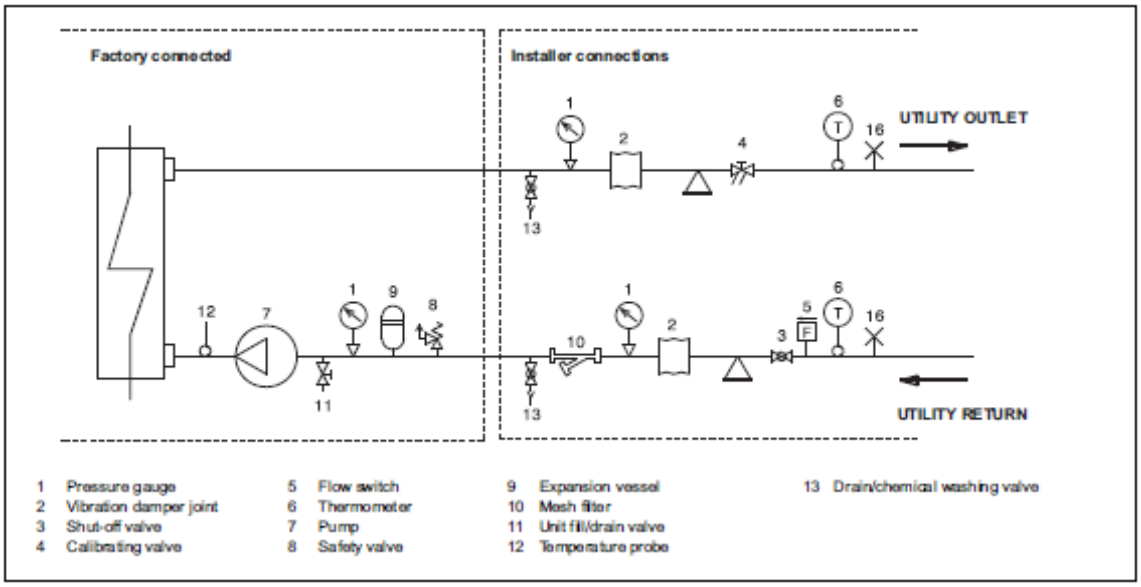
Data measured in the following conditions:
(1) Heat pump operation: Outside air temperature 7°C DB- 6°C WB, water inlet 30°C and outlet 35°C
(2) Heat pump operation: Outside air temperature 7°C DB- 6°C WB, water inlet 40°C and outlet 45°C
(3) Noise measured at 1 metre in open field on fan side
The power input does not include the water circulating pump.

Dimensions and Weight



HiRES HT	9kW	14kW	19kW
Width (mm)	970	970	970
Depth (mm)	525	525	525
Hight (mm)	1450	1450	1600
Gross Weight (kg)	165	175	190

Utility water circuit connection diagram



1	Pressure gauge	5	Flow switch	9	Expansion vessel	13	Drain/chemical washing valve
2	Vibration damper joint	6	Thermometer	10	Mesh filter		
3	Shut-off valve	7	Pump	11	Unit fill/drain valve		
4	Calibrating valve	8	Safety valve	12	Temperature probe		

Appendix 3 ; Code for Sustainable Homes Pre Assessment

Code for Sustainable Homes
PRE ASSESSMENT ESTIMATOR TOOL

RESULTS

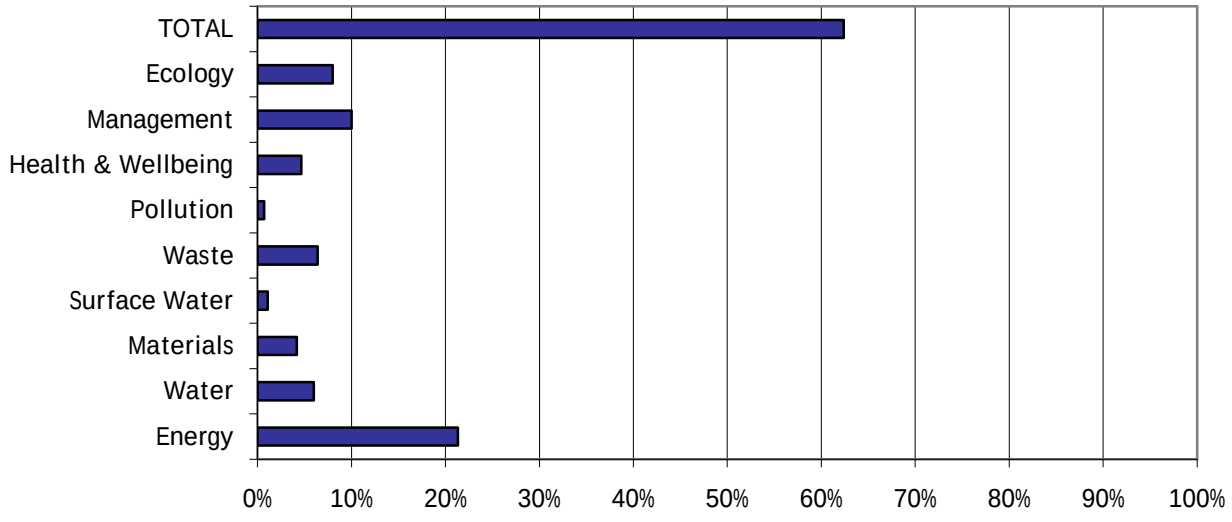
Development Name:	Twickenham, Whitton Road
Dwelling Description:	9 Houses
Name of Company:	
Code Assessor's Name:	Ivan Ball
Company Address:	
Notes/Comments:	

PREDICTED RATING - CODE LEVEL: 3

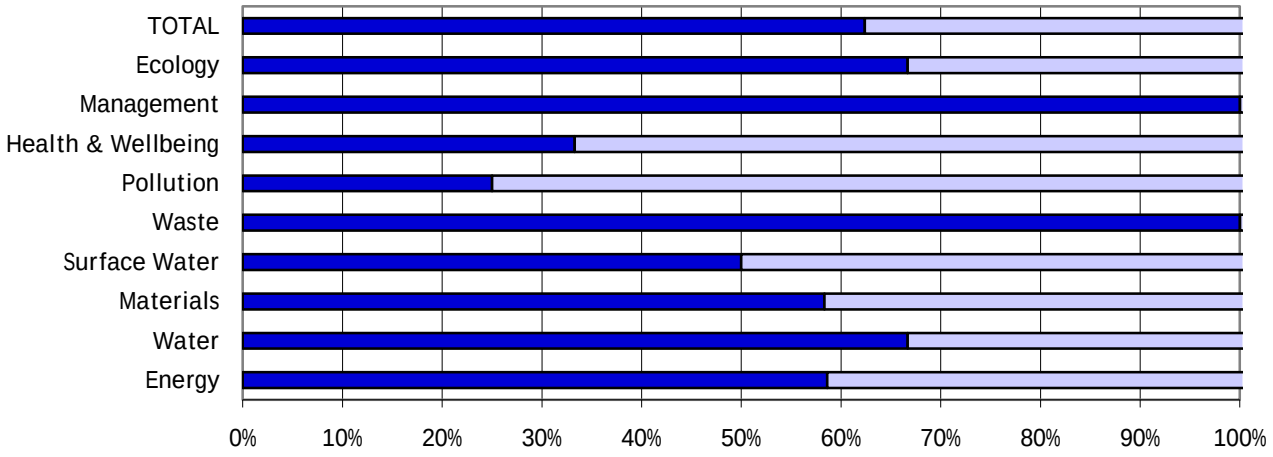
Mandatory Requirements: **All Levels**

% Points:	**62.39%**	**- Code Level: 3**
Breakdown:	**Energy**	**- Code Level: 3**
	Water	**- Code Level: 4**

Graph 1: Predicted contribution of individual sections to the total score and percentage of total achievable score



Graph 2: Predicted percentage of credits achievable: Total and by Category



NOTE: The rating obtained by using this Pre Assessment Estimator is for guidance only. Predicted ratings may differ from those obtained through a formal assessment, which must be carried out by a licensed Code assessor.

CATEGORY 1 ENERGY	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 58.00%		Credits	Level		
Contribution to Overall Score: 21.33 points		17 of 29 Credits	Level 3		
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 apply. Select the % improvement / Mandatory Requirement 0% improvement ○ OR 10% Improvement ○ OR 14% Improvement ○ OR 18 % Improvement ○ OR 22% Improvement ○ OR 25% Improvement ◉ OR 31% Improvement ○ OR 37% Improvement ○ OR 44% Improvement ○ OR 52% Improvement ○ OR 60% Improvement ○ OR 69% Improvement ○ OR 79% Improvement ○ OR 89% Improvement ○ OR 100% Improvement ○ OR Zero Carbon Home* ○ * as defined in the Code Technical Guide	5 of 15 Credits	Level 3	The 25% improvement is a mandatory requirement for Code level 3. Renewables will be required to achieve the standard.	SAP 2005 Worksheet, dated with the energy assessors name, registration number and address of the development prepared at plans approval stage. Copy of plans, elevations and sections as designed and construction details sufficient to check building details
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 dwellings. Select a HLP range Greater than 1.30 ○ OR Less than or equal to 1.30 ◉ OR Less than or equal to 1.10 ○	1 of 2 Credits	-	The SAP calculation will give this information and the homes wil achieve a standard of less than 1.30	SAP 2005 Worksheet, dated with the energy assessors name, registration number and address of the development prepared at plans approval stage. Copy of plans, elevations and sections as designed and constrcution details sufficient to check building details. A copy of the 'Design Stage' Part L1A Building Regulation Compliance Checklist showing full compliance for each 'Energy Type'.
Ene 3 Internal Lighting	Credits are awarded based on the percentage of fixed internal fittings that are dedicated energy efficient provided in habitable spaces within the dwelling. Select the % of dedicated energy efficient fittings Less than 40% ○ OR Greater than or equal to 40% ○ OR Greater than or equal to 75% ◉	2 of 2 Credits	-	Over 75% of the light fittings will be dedictated low energy.	Text in specification or relevant design stage showing the location of all light fittings in all rooms or a letter of instruction to a contractor/ supplier or a formal letter to the Code assessor giving the specific undertaking and calculation of dedicated energy efficient light fittings in all habitable rooms. Manufacturers information confirming types of light fitting & efficacy, in lumens/ circuit watt.

Issue		Credits	Level	Assumptions Made	Evidence Required
Ene 4 Drying Space	One credit is awarded for the provision of either internal or external secure drying space with posts and footings or fixings capable of holding 4m+ of drying line for 1-2 bed dwellings and			A rotray drier will be provided. The dryer needs to have at least 6m of line.	Drawings need to show the location of fixings/ footings or posts and confirmation of the minimum length of drying line.

	6m+ for dwellings with 3 bedrooms or greater. Will drying space meeting the criteria be provided? Yes ◉ OR No ○	**1 of 1 Credits**	-		
Ene 5 Energy Labelled White Goods	Credits are awarded where each dwelling is provided with either information about the EU Energy Labelling Scheme, White Goods with ratings ranging from A+ to B or a combination of the previous acording to the technical guide. Select the appropriate option below EU Energy labelling information ☑ A+ Rated Fridges and Freezers ☑ Combination of rated white goods with EU Energy Labelling Scheme ☐	**2 of 2 Credits**	-	Energy efficient white goods will be supplied to all homes.	A copy of the EU Energy Efficiency labelling scheme energy rating for all white goods to be provided.
Ene 6 External Lighting	Credits are awarded based* on the provision 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 effiicciency requirements. Space Lighting None provided ○ OR Non Code compliant lighting ○ OR Code compliant lighting ◉ Security Lighting None provided ○ OR Non Code compliant lighting ○ OR Code compliant lighting and controls ◉ Dual lamp luminaires Compliant with both above criteria ☑ * Statutory safety lighting is not covered by this requirement	**2 of 2 Credits**	-	External lighting will be dedicated low energy fittings and security lighting will be a maximum wattage of 150w.	Relevant drawings clearly showing the location and type of all external light fittings.

Issue		Credits	Level	Assumptions Made	Evidence Required
Ene 7 Low or Zero Carbon Technologies	Credits are awarded where either there is a 10% or 15% reduction in total carbon emissions that result from using low or zero carbon technologies. Note that where funding has not been granted through the Low Carbon Buildings Programme, a feasibility study is required that meets the Code requirements. Select % contribution made by low or zero carbon technologies Less than 10% of demand ○ OR 10% of demand or greater ○ OR 15% of demand or greater ◉	**2 of 2 Credits**	-	Air source heat pumps are proposed and PV to Plots 1-5	

Ene 8 Cycle Storage	Credits are awarded where adequate, safe, secure and weather proof cycle storage is provided according to the Code requirements. Fill in the development details below Number of bedrooms: 4 Number of cycles stored per dwelling* 2.0 * if you have storage for 1 cycle per two dwellings insert 0.5 in number of cycles stored per dwelling	**1 of 2 Credits**	-	Storage is provided.	Drawings need to show location, type, size of storage including access and security measures.
Ene 9 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. Will there be provision for a Home Office? Yes ◉ OR No ○	**1 of 1 Credits**	-	Space is available in all units.	Drawings or specification text needs to detail the location of and sufficient space for the home office including the location of sockets, telephone points, adequate ventilation and confirmation that cable connection or that broadband is available at the address.

CATEGORY 2 WATER	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 66.00%		Credits	Level		
Contribution to Overall Score: 6.00 points		4 of 6 Credits	Level 4		
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 for each code level apply. Select the predicted water use / Mandatory Requirement greater than 120 litres/ person/ day ○ OR less than 120 litres/ person/ day ○ OR less than 110 litres/ person/ day ○ OR less than 105 litres/ person/ day ◉ OR less than 90 litres/ person/ day ○ OR less than 80 litres/ person/ day ○	3 of 5 Credits	Level 3 AND Level 4	Generally dual flush wcs, spray taps etc will be installed. The baths and showers will need to be limited to a maximum capacity and the shower to a maximum flow rate.	Drawings and specification detailing the location, details and type of appliances/ fittings that use water in the dwelling including any specific water reduction equipment with the capacity / flow rate of equipment. This should include confirmation that the hot and cold water system will be designed to reduce the risk of microbial contamination in line with best practice. Drawings should also show the location, size and details of any greywater and rainwater collection systems.
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. Select the scenario that applies No internal or communal outdoor space ○ OR Outdoor space with collection system ◉ OR Outdoor space without collection system ○	1 of 1 Credits	-	At least a single butt of in excess of 200 litres will be provided to each downpipe for apartments.	Drawings and specification detailing the location, details and type of any rainwater collection system.For the homes a minimum collection of 200 litres need to be provided.

CATEGORY 3 MATERIALS	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 58.00%		Credits	Level		
Contribution to Overall Score: 4.20 points		14 of 24 Credits	All Levels		
Mat 1 Environm-ental Impact of Materials	Mandatory Requirement: At least three of the five key building elements must achieve a Green Guide 2008 Rating of A+ to D. Tradable Credits: Points are awarded on a scale based on the Green Guide Rating of the specifications. The Code Materials Calculator can be used to predict a potential score. Mandatory Requirement Will the mandatory requirement be met? ☑ Enter the predicted score What is the predicted number of credits? 11	11 of 15 Credits	All Levels	It has been assumed that the materials preliminarily specified will include a membrane roof covering, traditionally built structure with facing bricks externally, UPVC windows, concrete ground floor.	Drawings and specfication need to detail location and area of elements and details of the materials used within the elements.
Mat 2 Responsible Sourcing of Materials - Basic Building Elements	Credits are awarded where materials used in the basic building elements are responsibly sourced. The Code Materials Calculator can be used to predict a potential score. Enter the predicted Score What is the predicted number of credits? 2	2 of 6 Credits	-	The contractor will be required to demonstrate this standard has been achieved.	Drawings or specification needs to detail the location of elements and materials used.
Mat 3 Responsible Sourcing of Materials - Finishing Elements	Credits are awarded where materials used in the finishing elements are responsibly sourced. The Code Materials Calculator can be used to predict a potential score. Enter the predicted Score What is the predicted number of credits? 1	1 of 3 Credits	-	The contractor will be required to demonstrate this standard has been achieved.	Drawings or specification needs to detail the location of elements and materials used.

CATEGORY 4 SURFACE WATER RUN-OFF	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 50.00%		Credits	Level		
Contribution to Overall Score: 1.10 points		2 of 4 Credits	All Levels		
Sur 1 Management of Surface Water Run-off from developments	Mandatory Requirement: Peak rate of run-off into watercourses is no greater for the developed site than it was for the pre-development site. Tradable Credits: Where SUDS are used to improve water quality of the rainwater discharged or for protecting the quality of the receiving waters. Mandatory Requirement Will the mandatory requirement be met? ☑ Select the appropriate option No SUDS or default case compliance ○ Code compliant SUDS systems ◉ Non Code compliant SUDS systems ○ Site discharges rainwater directly to a tidal estuary or the sea ○	2 of 2 Credits	All Levels		Drawings need to show the location and capacity of soakaways.
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 and its contents in accordance with the Code criteria in the technical guide. Select the annual probability of flooding (from PPS25*) Zone 1 - Low ○ OR Zone 2 - Medium ◉ OR Zone 3 - High ○ Select the apropriate option(s) Low risk of flooding from FRA** ☐ All measures of protection are demonstrated in FRA ☐ Ground floor level and access routes are 600 mm above design flood level ☐ * Planning Policy Statement 25 - Planning and Flood Risk ** FRA - Flood Risk Assessment	0 of 2 Credits	-		

CATEGORY 5 WASTE	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 100.00%		Credits	Level		
Contribution to Overall Score: 6.40 points		7 of 7 Credits	All Levels		
Wa 1 Storage of non-recyclable waste and recyclable household waste	Mandatory Requirement: 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 min capacity calculated from BS 5906. Tradable Credits are awarded for adequate internal and/ or external recycling facilities. **Mandatory Requirement** Will the minimum space be provided and be accessible to disabled people? ☑ **Internal Recyclable household waste storage** Where there is no external recyclable waste storage and no Local Authority collection scheme Internal storage (capacity 60 litres) ☐ **Local Authority collection Scheme** Post Collection sorting Internal storage (capacity 30 litres) ☐ Pre-collection sorting Internal storage (capacity 30 litres) ☑ **External Storage, no Local Authority collection scheme** 3 separate internal storage bins (capacity 30 litres) ☐ Houses External Storage(capacity 180 litres) ☐ Flats Private recycling operator ☐ 3 or greater types of waste collected ☐	0 of 2 Credits 4 of 4 Credits 0 of 4 Credits	All Levels	Recycling bins will be provided in the kitchen of at least 30 litres. An area will be identified externally for the storage of refuse and recycling bins.	Drawings and specifications describing the location and size of storage, access to storage and that an information booklet will be supplied.

Issue		Credits	Level	Assumptions Made	Evidence Required
Wa 2 Construction Site Waste Management	Mandatory Requirements: A SWMP plan including the monitoring of waste generated on site and the setting of targets to promote resource efficiency must be produced and implemented. Tradable Credits: The SWMP should also include procedures and commitments for minimising waste and/ or commitments to sort, reuse and recycle construction waste. **Mandatory Requirement** Is the development cost less than £300K? ☐			The developer will have a Site Waste Management Plan. This is a mandatory requirement for all levels of the Code.	

	Contents of the SWMP Does the SWMP include: + monitoring of waste generated on site? ☑ + targets to promote resource efficiency? ☑ + the waste groups? ☑ + compliance with best practice? ☑ + procedures for reducing waste? ☑ + commitments for reducing waste? ☑ + procedures to sort, reuse and recycle waste? ☑ + commitments to sort, reuse and recycle waste? ☑	**2 of 2 Credits**	**All Levels**		
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. Select the facilities available No composting facilities ○ Individual composting facilities ◉ OR Communal/ community composting*? ○ Local Authority ☐ OR Private with management plan ☐ * including if a automated waste collection system is in place	**1 of 1 Credit**	**-**	Composting facilities will be provided	Drawings and specifications detailing number fo bedrooms, location of internal and external storage, the types and sizes of internal and external storage, how of storage is accessed.

CATEGORY 6 POLLUTION	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 25.00%		Credits	Level		
Contribution to Overall Score: 0.70 points		1 of 4 Credits	All Levels		
Pol 1 Global Warming Potential (GWP) of Insulants	A credit is awarded where <u>all</u> insulating materials only use substances (in manufacture AND installation) that have a GWP of less than 5. Select the most appropriate option All insulants have a GWP less than 5 (●) OR Some insulants have a GWP of less than 5 (○) OR No insulants have a GWP of less than 5 (○)	1 of 1 Credits	-	All technical details of all insulation will be provided but it has been assumed all insulation will meet the target.	Proposed insulation materials for each element and drawings and specification showing the type and location and where specified, manufacturers/ installers literature for any foamed insulation materials installed using blowing agents.
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. Select the most appropriate option Greater than 100 mg/kWh (●) OR Less than 100 mg/kWh (○) OR Less than 70 mg/kWh (○) OR Less than 40 mg/kWh (○) OR Class 4 boiler (○) OR Class 5 boiler (○) OR All space and hot water energy requirements are met by systems who do not produce NOx emissions (○)	0 of 3 Credits	-	The air source heat pump is run off mains electricity.	Drawings and/or specifications detailing primary and any secondary heating systems and where a system is specified manufacturers literature confirming the dry Nox levels and/or the boiler class of the primary and secondary system.

CATEGORY 7 HEALTH & WELLBEING	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 33.00%		Credits	Level		
Contribution to Overall Score: 4.66 points		4 of 12 Credits	-		
Hea 1 Daylighting	Credits are awarded for ensuring key rooms in the dwelling have high daylight factors (DF) and a view of the sky. Select the compliant areas Room Kitchen: Avg DF of at least 2% ☐ Living Room*: Avg DF of at least 1.5% ☑ Dining Room*: Avg DF of at least 1.5% ☑ Study*: Avg DF of at least 1.5% ☑ 80% of working plane in all above rooms receive direct light from the sky? ☑ Any room used for Ene 9 Home Office must also achieve a min DF of 1.5%. *Tick the box if there is no study/ home office as this aspect of the credit will be awarded by default.	2 of 3 Credits	-	A Daylight calculation will be required to be carried out in order to achieve Ene 9. It is assumed the living rooms will achieve greater than 2%.	Calculations required of avergae daylight factor using the formula provided in the Relevant Definition section as set out in BS 8206-2 or computer simulation or scale model measurements.
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. Select a type of property Detached Property ○ Attached Properties: - Separating walls and floors only exist between non habitable spaces ○ - Separating walls and floors exist between habitable spaces ◉ Select a performance standard Performance standard not sought ○ Airborne: 3db higher; Impact: 3dB lower ◉ OR Airborne: 5db higher; Impact: 5dB lower ○ OR Airborne: 8db higher; Impact: 8dB lower ○	1 of 4 Credits	-	It is proposed to use the robust details.	

Issue		Credits	Level	Assumptions Made	Evidence Required
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 occupants. Will a private/ semi-private space be provided? Yes, private/semi-private space will be provided ◉ OR No private/semi-private space ○	1 of 1 Credits	-	All houses have private gardens.	Drawings need to specify the number of bedrooms served by the outside space and that the outside space meets the minimum size requirements. These are 1.5 m2 per bedroom.
Hea 4	Mandatory Requirement: Lifetime Homes is mandatory when a			Lifetime Homes standards will NOT be achieved for all	

Lifetime Homes	dwelling is to achieve Code Level 6. Tradable credits: Credits are awarded where the developer has implemented all of the principles of the Lifetime Homes scheme. Mandatory Requirement Dwelling to achieve Code Level 6? ☐ Lifetime Homes Compliance All Lifetime Homes criteria will be met ○ OR Credit not sought ◉	**0 of 4 Credits**	-	dwellings.	

CATEGORY 8 MANAGEMENT	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 100.00%		Credits	Level		
Contribution to Overall Score: 10.00 points		9 of 9 Credits	All Levels		
Man 1 Home User Guide	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. Tick the topics covered by the Home User Guide Operational Issues? ☑ Site and Surroundings? ☑ Is available in alternative formats? ☑	3 of 3 Credits	-	A Home User Guide will be prepared.	Where a Home User Guide covering operational issues will be supplied confirmation in the specification that the guide will be supplied to the home and be developed to the required standards and as a minimum will cover the following; environmental strategy/ design and features, energy, water use, recycling and waste, sustainable DIY, emergency information, links/references and further information.
Man 2 Considerate Constructors Scheme	Credits are awarded where there is a commitment to comply with best practice site management principles using either the Considerate Constructors Scheme or an alternative locally/ nationally recognised scheme. Select the appropriate scheme and score No scheme used ○ Considerate Constructors OR Best Practice: Score between 24 and 31.5 ○ OR Best Practice+: Score between 32 and 40 ◉ Alternative Scheme* OR Mandatory + 50% optional requirements ○ OR Mandatory + 80% optional requirements ○ * In the first instance, contact a Code Service Provider if you are considering to use an alternative scheme.	2 of 2 Credits	-	It is assumed the site will be registered with the Considerate Constructors scheme and that scores relating to best practice+ will be achieved.	
Man 3 Construction Site Impacts	Credits are awarded where there is a commitment and strategy to operate site management procedures on site as following: Tick the impacts that will be addressed Monitor, report and set targets, where applicable, for: - CO_2/ energy use from site activities ☐ - CO_2/ energy use from site related transport ☐ - water consumption from site activities ☑ Adopt best practice policies in respect of: - air (dust) pollution from site activities ☑ - water (ground and surface) pollution on site ☑ 80% of site timber is reclaimed, re-used or responsibly sourced ☑	2 of 2 Credits	-	The developer will monitor site water and adopt best practice policies in repsect of air and water and ensure 80% of the site timber has been responsibly sourced.	

Issue		Credits	Level	Assumptions Made	Evidence Required
Man 4 Security	Credits are awarded for complying with Section 2 - Physical Security from Secured by Design - New Homes. An Architectural			Secured by Design accreditation standards will be sought.	Specification clause or other confirmation of commitment showing that an ALO/ CPDA has been or

	Liaison Officer (ALO), or alternative, needs to be appointed early in the design process and their recommendations incorporated. Secured by Design Compliance Credit not sought ○ OR Secured by Design Section 2 Compliance ◉	**2 of 2 Credits**	-		will be appointed to provide advice early in the design stage to ensure the requirements of Section 2 - Physical Security of Secured by Design - New Homes are met and that the advice of the ALO/ CPDA will be followed.

CATEGORY 9 ECOLOGY	Overall Level: 3	Overall Score	62.39	Assumptions Made	Evidence Required
% of Section Credits Predicted: 66.00%		Credits	Level		
Contribution to Overall Score: 8.00 points		6 of 9 Credits	All Levels		
Eco 1 Ecological Value of Site	One credit is awarded for developing land of inherently low value. Select the appropriate option Credit not sought ○ OR Land has ecological value ○ OR Land has low/ insignificant ecological value* ◉ * Low ecological value is determined either a) by using Checklist Eco 1 across the whole development site; or b) where an suitably qualified ecologist is appointed and can confirm or c) produces an independent ecological report of the site, that the construction zone is of low/ insignificant value; AND the rest of the development site will remain undisturbed by the works.	1 of 1 Credits	-	The site is of low ecological value.	Plans of the site and surrounding area prior to development, identifying any features, both built and ecological.
Eco 2 Ecological Enhancement	A credit is awarded where there is a commitment to enhance the ecological value of the development site. Tick the appropriate boxes Will a *Suitably Qualified Ecologist* be appointed to recommend appropriate ecological features? ☐ AND Will all key recommendations be adopted? ☐ AND 30% of other recommendations be adopted? ☐	0 of 1 Credits	-		
Eco 3 Protection of Ecological Features	A credit is awarded where there is a commitment to maintain and adequately protect features of ecological value. Type and protection of existing features Site with features of ecological value? ○ OR Site of low ecological value (as Eco 1)? ◉ AND All* existing features potentially affected by site works are maintained and adequately protected? ☐ *If a suitably qualified ecologist has confirmed that a feature can be removed due to insignificant ecological value or poor health conditions, as long all the rest have been protected, then this box can be ticked.	1 of 1 Credits	-	No trees are proposed to be removed.	

Issue		Credits	Level	Assumptions Made	Evidence Required
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 and is calculated to be: Change in Ecological Value Major negative change: fewer than -9 ○ Minor negative change: between -9 and -3 ○ OR Neutral: between -3 and +3 ◉	2 of 4 Credits	-	The new gardens generally will not have a significant ecological value and it has been assumed there will be a neutral change. Although the ecological corridor around the perimeter of the site may provided additional credits. Possible upside.	

	Change in Ecological Value Minor enhancement: between +3 and +9 ○ Major enhancement: greater than 9 ○				
Eco 5 Building Footprint	Credits are awarded where the ratio of combined floor area of all dwellings on the site to their footprint is: Ratio of Net Internal Floor Area: Net Internal Ground Floor Area Credit Not Sought ○ OR Houses: 2.5:1 OR Flats: 3:1 ○ OR Houses: 3:1 OR Flats: 4:1 ◉ OR Houses & Flats Weighted (2.5:1 & 3:1) ○ OR Houses & Flats Weighted (3:1 & 4:1) ○	**2 of 2 Credits**		The site is two and two a half storey.	