

ARUNDEL BOROUGH COUNCIL A/16/17/DOO

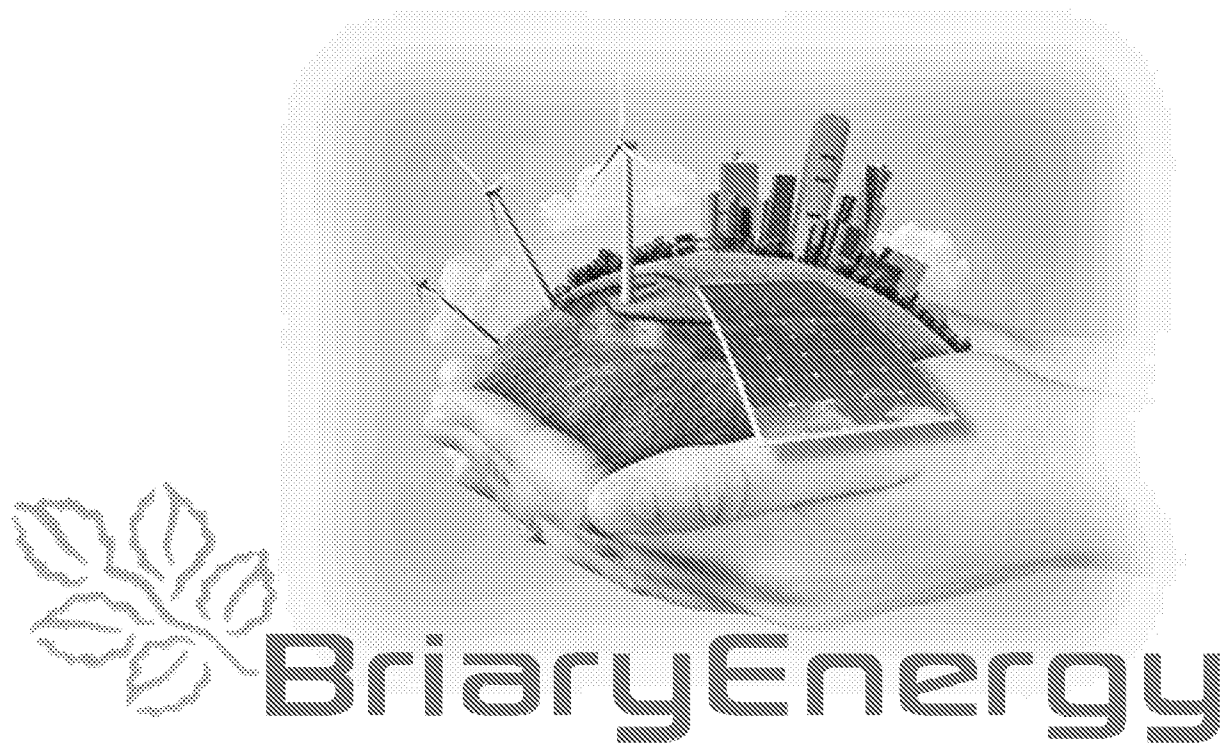
Roundstone Lane, Angmering
CALA Homes

Energy Statement

August 2017

Version 1

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Conclusions

The following statement considers the potential options available at the proposed development of Roundstone Lane, Angmering to demonstrate the proposals will amount to the same as 10% of the energy supply coming from decentralised and renewable/low carbon sources.

CALA Homes has instructed Briary Energy to create this document, which examines the feasibility of suitable low and zero carbon (LZO) technologies, high-efficiency alternative systems, or low carbon energy efficiency measures.

It also looks at energy efficiency measures that could be implemented at the development to make energy and CO₂ savings beyond current building regulations.

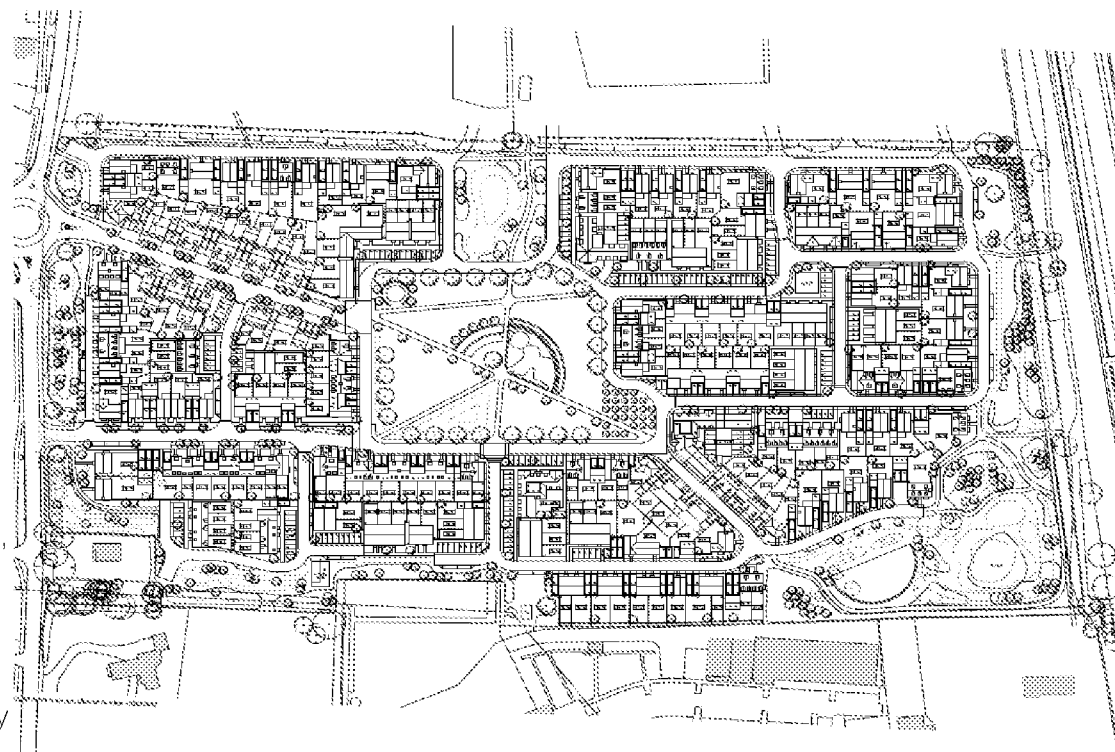
The energy consumption figures for the development are based on benchmark figures for each building type from CIBSE for non-domestic buildings or based on SAP 2012 for domestic buildings, and include regulated and non-regulated emissions.

The proposed Roundstone Lane, Angmering development will comprise of 246 dwellings. The developer will meet the Building Regulations reduction in emissions across all dwellings relative to a 2013 Part L1A Building Regulations baseline, and will be achieved solely through the use of improved energy efficiency measures such as improved thermal fabric efficiency, air tightness and effective heating controls.

By constructing the development as per the specification detailed on page 16, CO₂ emissions are reduced by 12.1% over Part L 2013 TER, and Energy Demand is reduced by 12.8%.

By installing Waste Water Heat Recovery Systems (WWHRS) to 206 of the dwellings, Energy Demand is reduced by 7.1%, and CO₂ emissions reduced by 6.4%. By installing a total of 58kWp of Solar Photovoltaics across the development (say 1kWp to 58 dwellings), energy demand is reduced by a further 2.9%, and CO₂ emissions reduced by a further 6.5%.

Combining results from WWHRS & Solar PV, site wide energy demand is reduced by 10.0%, and CO₂ emissions are reduced by 12.9%; therefore exceeding the 10% energy target set by the local authority.



Current Government Policy—Deregulation Bill 2015—in relation to new Homes

The government statement relating to the Deregulation Bill states "from the date the Deregulation Bill is given Royal Assent, local planning authorities and qualifying bodies preparing neighbourhood plans should not set in their emerging local plans, neighbourhood plans, or supplementary planning documents, any additional local technical standards or requirements relating to the construction, internal layout or performance of new dwellings."

"This includes any policy requiring any level of the Code for Sustainable Homes to be achieved by new development; the government has now withdrawn the code, aside from the management of legacy cases".

The statement also said that local planning authorities and qualifying bodies preparing neighbourhood plans "should consider their existing plan policies on technical housing standards or requirements and update them as appropriate, for example through a partial local plan review, or a full neighbourhood plan replacement in due course."

"Local planning authorities may also need to review their local information requirements to ensure that technical detail that is no longer necessary is not requested to support planning applications".

On energy performance, the statement said that councils "will continue to be able to set and apply policies in their local plans which require compliance with energy performance standards that exceed the energy requirements of Building Regulations until commencement of amendments to the Planning and Energy Act 2008 in the Deregulation Bill 2015" which is expected to happen alongside the introduction of zero carbon homes policy in late 2016. However, the policy should not exceed the requirement to meet Code level 4 in Energy.

We will perform our Energy analysis with the above points in mind, should the Roundstone Lane, Angmering development have any Code requirements placed upon it.

Low or Zero Carbon Review

The following Low or Zero Carbon technologies are commercially available for use in the UK housing sector; the following overview will give a brief description of each technology which will provide a better understanding of how each technology works and its appropriation for use within the Roundstone Lane, Angmering development.

Zero carbon technologies

- Solar Hot Water
- Solar Photovoltaic
- Small Scale Hydro Power
- Wind Turbines

Low carbon technologies

- Biomass
- Combined Heat and Power (CHP) and Micro CHP
- Heat pumps, Ground Source Heat Pumps (GSHP) Geothermic Heating Systems, Air Source Heat Pump.
- Other technologies, Fuel cells using hydrogen from any of the above renewable sources
- Flue Gas Heat Recovery Systems (FGHRS)
- Showersave / Waste Water Heat Recovery System (WWHRS)

Solar Hot Water

Solar water heating systems use heat from the sun to work alongside conventional primary water heaters. The technology is well developed with a large choice of equipment to suit many applications.

For domestic hot water there are three main components

Solar panels or collectors- are fitted to your roof. They collect heat from the sun's radiation.

There are 2 main types of collector:

- Flat plate systems- which are comprised of an absorber plate with a transparent cover to collect the sun's heat, or
- Evacuated tube systems- which are comprised of a row of glass tubes that each contains an absorber plate feeding into a manifold which transports the heated fluid.

A heat transfer system- uses the collected heat to heat water;

Hot water cylinder- stores the hot water that is heated during the day and supplies it for use later.

All savings are approximate and are based on the hot water heating requirements of a 3 bed semi detached home.

Solar water heating can be used in the home or for larger applications, such as swimming pools.

For a domestic system you will need 3-4 square metres of southeast to southwest facing roof receiving direct sunlight for the main part of the day, a space to locate an additional water cylinder if required.

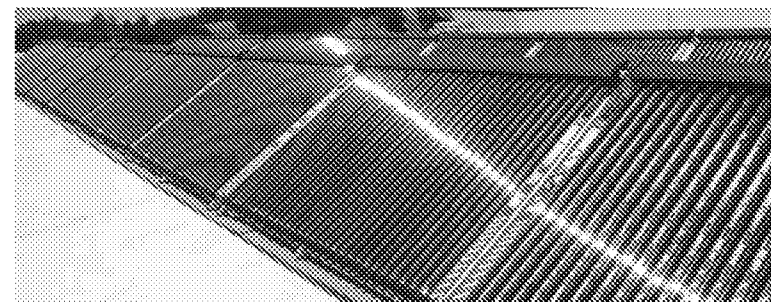
In England, changes to permitted development rights for micro generation technologies introduced on 6th April 2008 have lifted the requirements for planning permission for most solar water heating installations.

Roof mounted and stand-alone systems can now be installed in most dwellings, as long as they respect certain size criteria. Exceptions apply for Listed Buildings, and buildings in Conservation Areas and World Heritage Sites.

In Wales, Scotland and Northern Ireland, the devolved governments are currently all considering changes to their legislation on permitted developments, to facilitate installations of micro generation technologies, including solar water heating. Legislation is expected in all three countries later this year. Until then, householders in Wales, Scotland and Northern Ireland must consult with their local authority regarding planning permission.

Solar water heating systems tend to require little maintenance Installation and maintenance costs.

The typical installation cost for a domestic system is £3,000- £5,000. Evacuated tube systems are more advanced in design than flat plate, and so tend to be more expensive. Solar water heating systems generally come with a 5-10 year warranty and require little maintenance. A yearly check by the householder and a more detailed check by a professional installer every 3-5 years should be sufficient.



Roundstone Lane, Angmering Solar Thermal Calculation

Number of plots with panels	45
Size of Panel	4.5
Number of Panels per plot	1
Total m ²	202.5
Average kWh/m ²	294
Energy produced by panels	59,452
Energy% Saved From Panels	3%
CO ₂ % Saved From Panels	3%

Photovoltaic Collectors (PV)

Solar PV (photovoltaic) uses energy from the sun to create electricity to run appliances and lighting. PV requires only daylight- not direct sunlight- to generate electricity.

How it works

Photovoltaic systems use cells to convert solar radiation into electricity. The PV cell consists of one or two layers of a semi conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity. PV systems generate no greenhouse gases, saving approximately 325kg of carbon dioxide emissions per year- adding up to about 8 tonnes over a system's lifetime- for each kilowatt peak (kWp - PV cells are referred to in terms of the amount of energy they generate in full sun light).



PV arrays now come in a variety of shapes and colours, ranging from grey 'solar tiles' that look like roof tiles, to panels and transparent cells that you can use on conservatories and glass to provide shading as well as generating electricity. As well as enabling you to generate free electricity they can provide an interesting alternative to conventional roof tiles!

PV systems for a building with a roof or wall that faces within 90 degrees of south, as long as no other buildings or large trees overshadow it.

If the roof surface is in shadow for parts of the day, the output of the system decreases. Solar panels are not light and the roof must be strong enough to take their weight, especially if the panel is placed on top of existing tiles. Solar PV installations should always be carried out by a trained and experienced installer. The area of PV required to generate 1kw hour peak varies but generally 6-8m² for M6n crystalline or 102 for polycrystalline modules of PV will produce 1Kw peak of electricity.

Cost and maintenance

Prices for PV systems vary, depending on the size of the system to be installed, type of PV cell used and the nature of the actual building on which the PV is mounted. The size of the system is dictated by the amount of electricity required. For the average domestic system, costs can be around £4,000- £9,000 per kWp installed, with most domestic systems usually between 1.5 and 2 kWp. Solar tiles cost more than conventional panels, and panels that are integrated into a roof are more expensive than those that sit on top. Grid connected systems require very little maintenance, generally limited to ensuring that the panels are kept relatively clean and that shade from trees has not become a problem.

The wiring and components of the system should however be checked regularly by a qualified technician. Stand-alone systems, i.e. those not connected to the grid, need maintenance on other system components, such as batteries.

Photovoltaic Collectors (PV) Calculations

We will use a global formula $E = A \times r \times H \times PR$ to calculate the energy generated by the proposed PV to be placed on the Roundstone Lane, Angmering development.

Losses details (depend of site, technology, and sizing of the system)

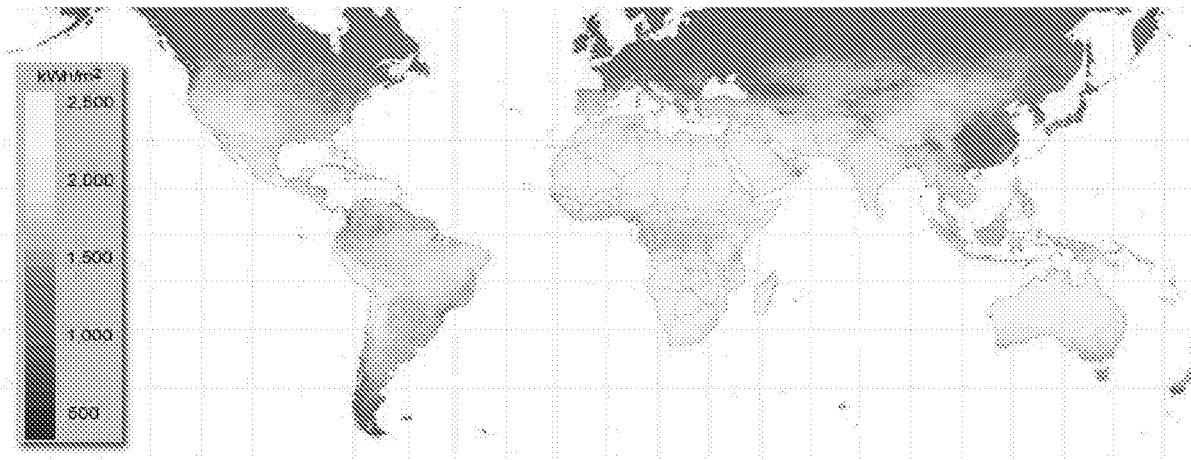
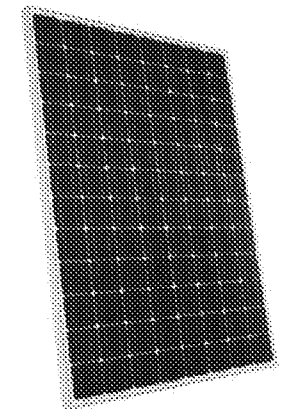
			kWp System	PR = Perf Ratio	H = Annual irradiation	r=panel yield(%)	A=Panel Area(m ²)	E=Energy (kWh)
Inverter losses	4%							
Temperature losses	3%							
DC cables losses	1%	South	58.0	0.89	1054	20%	290.0	54,407
AC cables losses	1%	SE/SW	0.0	0.89	997	20%	0.0	0
Shadings	0%	E/W	0.0	0.89	854	20%	0.0	0
Losses weak irradiation	1%	NE/NW	0.0	0.89	686	20%	0.0	0
Losses due to dust, snow	1%	North	0.0	0.89	640	20%	0.0	0
Other Losses	0%		58.0					
Total Energy kWh								54,407

Amount of PV Panels to meet 58kWp Requirement

240w Panels
242 Panels Required

250w Panels
232 Panels Required

260w Panels
223 Panels Required



Yearly sum of global irradiance

Small Scale Hydro Power

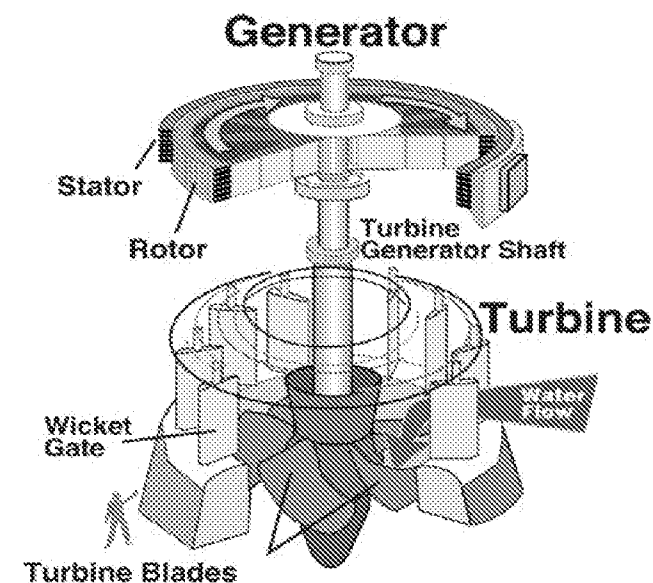
Hydro power systems use running water turning a turbine to produce electricity. A micro hydro plant is one that generates less than 100kW. Improvements in small turbine and generator technology mean that micro hydro schemes are an attractive means of producing electricity. Useful power may be produced from even a small stream.

Benefits

For houses with no mains connection but with access to a micro hydro site, a good hydro system can generate a steady, more reliable electricity supply than other renewable technologies at a lower cost. Total system costs can be high but often less than the cost of a grid connection and with no electricity bills to follow.

It should be noted that in off grid applications the power is used for lighting and electrical appliances.

However, space and water heating can be supplied when available power exceeds demand. Hydro power systems convert potential energy stored in water held at height to kinetic energy.



How it works

Hydro power systems convert potential energy stored in water held at height to kinetic energy (or the energy used in movement) to turn a turbine to produce electricity.

Energy available in a body of water depends on the water's flow rate and the height (or head) that the water falls. These are divided into low head, medium head and high head, where the height drop is greater. The scheme's actual output will depend on how efficiently it converts the power of the water into electrical power (maximum efficiencies of over 90% are possible but for small systems 60- 80% is more realistic).

Hydro power requires the source to be relatively close to where the power will be used or to a suitable grid connection. Hydro systems can be connected to the main electricity grid or as a part of a standalone (off grid) power system. In a grid connected system, any electricity generated but not used can be sold to electricity companies.

Costs and savings

Hydro costs are very site specific and are related to energy output. For low head systems (assuming there is an existing pond or weir), costs may be in the region of £4,000 per kW installed up to about 10kW and would drop per kW for larger schemes.

For medium heads, there is a fixed cost of about £10,000 and then about £2,500 per kW up to around 10kW- so a typical 5kW domestic scheme might cost £20-£25,000. Unit costs drop for larger schemes. Maintenance costs vary but small scale hydro systems are very reliable.

Micro wind

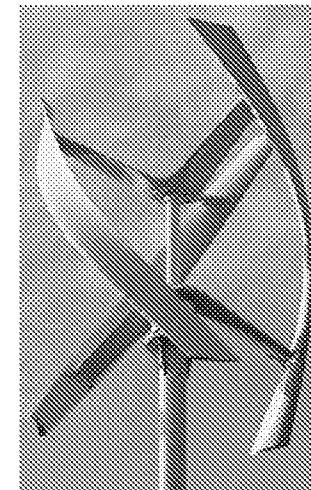
Wind turbines use the wind's lift forces to rotate aerodynamic blades that turn a rotor which creates electricity. In the UK we have 40% of Europe's total wind energy. But it's still largely untapped and only 0.5% of our electricity requirements are currently generated by wind power.

How does it work? Most small wind turbines generate direct current (DC) electricity. Systems that are not connected to the national grid require battery storage and an inverter to convert DC electricity to AC (alternating current- mains electricity). Wind systems can also be connected to the national electricity grid. A special inverter and controller convert DC electricity to AC at a quality and standard acceptable to the grid. No battery storage is required. Any unused or excess electricity may be able to be exported to the grid and sold to the local electricity supply company.

There are two types of wind turbines:

Mast mounted- which are free standing and located near the building(s) that will be using the electricity.

Roof mounted- which can be installed on house roofs and other buildings.



Benefits

Wind power is a clean, renewable source of energy which produces no carbon dioxide emissions or waste products.

In the UK we have 40% of Europe's total wind energy. Individual turbines vary in size and power output from a few hundred watts to two or three megawatts (as a guide, a typical domestic system would be 1- 6 kilowatts). Uses range from very small turbines supplying energy for battery charging systems (e.g. on boats or in homes), to turbines on wind farms supplying electricity to the grid.

You should consider the following issues if you're thinking about small scale wind. An accredited installer will be able to provide more detailed advice. Wind speed increases with height so it's best to have the turbine high on a mast or tower. Generally speaking the ideal site is a smooth top hill with a flat, clear exposure, free from excessive turbulence and obstructions such as large trees, houses or other buildings.

Small scale wind power is particularly suitable for remote off grid locations where conventional methods of supply are expensive or impractical. Please note that the electricity generated at any one time by a wind turbine is highly dependent on the speed and direction of the wind. The wind speed itself is dependent on a number of factors, such as location within the UK, height of the turbine above ground level and nearby obstructions. Ideally, you should undertake a professional assessment of the local wind speed for a full year at the exact location where you plan to install a turbine before proceeding. In practice, this may be difficult, expensive and time consuming to undertake. Therefore I recommend that, if you are considering a domestic building mounted installation and electricity generation is your main motivation, then you only consider a wind turbine under the following circumstances:

The local annual average wind speed is 6 m/s or more. There are no significant nearby obstacles such as buildings, trees or hills that are likely to reduce the wind speed or increase turbulence

Planning issues such as visual impact, noise and conservation issues also have to be considered. System installation normally requires permission from the local authority.

Bio Mass

Biomass is produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. It is often called 'bio energy' or 'bio fuels'. It doesn't include fossil fuels, which have taken millions of years to be created.

Biomass fall into two main categories:

Woody biomass includes forest products, untreated wood products, energy crops and short rotation coppice (SRC), which are quick-growing trees like willow.

Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops. Examples are rape, sugar cane, maize.



The Benefits

Producing energy from biomass has both environmental and economic advantages. Although biomass produces CO₂ it only releases the same amount that it absorbed whilst growing, which is why it is considered to be carbon neutral. Furthermore, biomass can contribute to waste management by harnessing energy from products that are often disposed of at landfill sites. It is most cost effective and sustainable when a local fuel source is used, which results in local investment and employment and also minimises transport miles to your home.

Fuel

It's important to have storage space for the fuel, appropriate access to the boiler for loading and a local fuel supplier.

Flue

The vent material must be specifically designed for wood fuel appliances and there must be sufficient air movement for proper operation of the stove. Chimneys can be fitted with a lined flue.

Smokeless zones

Wood can only be burnt in exempted appliances, under the Clean Air Act.

Planning

If the building is listed or in an area of outstanding natural beauty (AONB), then you will need to check with your Local Authority Planning Department before a flue is fitted.

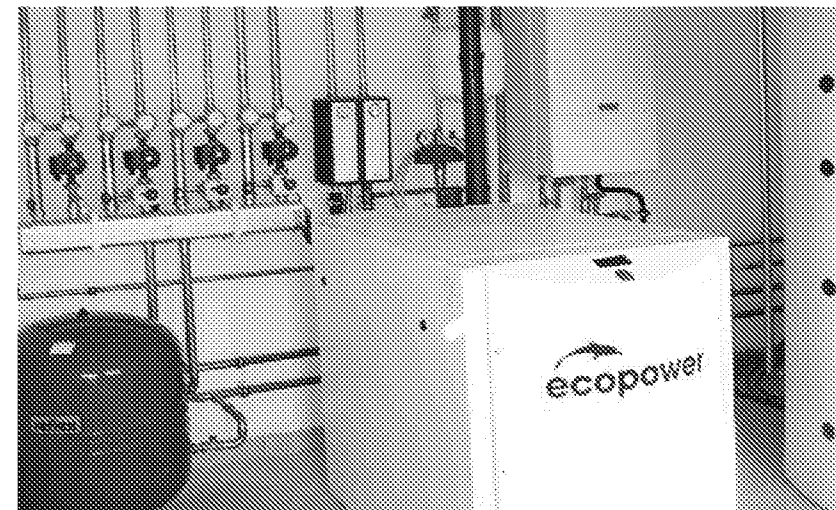
Costs and savings

Stand alone room heaters generally cost £2,000 to £4,000 installed. Savings will depend on how much they are used and which fuel you are replacing. A biomass stove which provides a detached home with 10% of annual space heating requirements could save around 840kg of carbon dioxide when installed in an electrically heated home. Due to the higher cost of biomass pellets compared with other traditional heating fuels, and the relatively low efficiency of the stove compared to a central heating system it will cost more to run. The cost for boilers varies depending on the system choice; a typical 15kW (average size required for a three-bedroom semi detached house) pellet boiler would cost around £5,000- £14,000 installed, including the cost of the flue and commissioning. A manual log feed system of the same size would be slightly cheaper. A wood pellet boiler could save you around £750 a year in energy bills and around 6 tonnes of CO₂ per year when installed in an electrically heated home.

Combined Heat & Power (CHP)

Combined heat and power (CHP) and Micro combined heat and power (Micro CHP) CHP (combined heat and power) the earlier ones where basically diesel engines converted to run on oil or gas, electricity been the primary output and heat been the secondary.

They have been around for many years, but mainly used in larger buildings like hotels and large blocks of flats etc. For CHP systems to be economically viable they need to run for at least 4,000 hours per year. They are more suitable for leisure centres with swimming pools and hospitals that have a high, year round heat demand or in mixed use developments with suitable heat demands However, new housing or office developments may be able to make use of existing CHP schemes nearby.



Fuel types for CHP/Micro CHP

Natural Gas

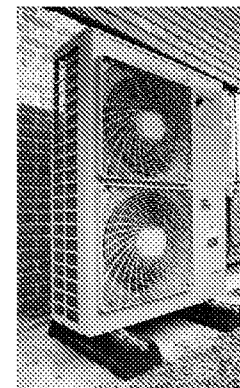
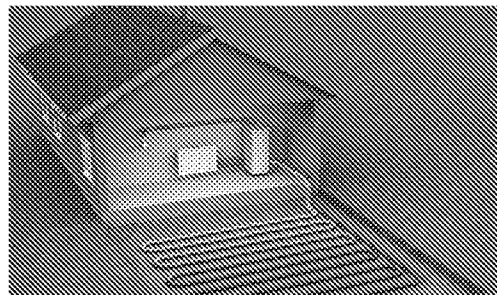
Micro CHP units are currently being developed for the domestic market by Potterton Baxi, and Powergen (Whispergen) and it shouldn't be long before they become commercially available. Micro CHP boilers work using similar principle to their older commercial counterparts, an engine produces heat and electricity, the heat is used in the home much like heat from a conventional boiler and the electricity is either used in the home or exported into the national grid.

Biogas

Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas originates from biogenic material and is a type of bio fuel. One type of biogas is produced by anaerobic digestion or fermentation of biodegradable materials such as biomass, manure or sewage, municipal waste, and energy crops. This type of biogas comprises primarily methane and carbon dioxide. The other principal type of biogas is wood gas which is created by gasification of wood or other biomass. This type of biogas is comprised primarily of nitrogen, hydrogen, and carbon monoxide, with trace amounts of methane. The gases methane, hydrogen and carbon monoxide can be combusted or oxidized with oxygen. Air contains 21% oxygen. This energy release allows biogas to be used as a fuel. Biogas can be used as a low-cost fuel in any country for any heating purpose, such as cooking. It can also be utilized in modern waste management facilities where it can be used to run any type of heat engine, to generate either mechanical or electrical power. Biogas is a renewable fuel and electricity produced from it can be used to attract renewable energy subsidies in some parts of the world.

Heat Pumps

There are two types of heat pumps, ground source and air source. Heat pumps work in a very similar way to fridges and air conditioners and absorb heat from the ground or from the air. Ground or air source heat pumps are mainly designed to work with under floor heating systems because of the lower design temperatures of under floor systems. Efficiencies of ground source heat pumps are between 350%-400% and air source between 200%-250%.



Ground source heat pumps

Ground source heat pumps use a buried ground loop which transfers heat from the ground into a building to provide space heating and, in some cases, to pre-heat domestic hot water. As well as ground source heat pumps, air source and water source heat pumps are also available.

The benefits

The efficiency of a ground source heat pump system is measured by the coefficient of performance (CoP). This is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP over the year, known as seasonal efficiency, is around 3-4 although some systems may produce a greater rate of efficiency. This means that for every unit of electricity used to pump the heat, 3-4 units of heat are produced, making it an efficient way of heating a building. If grid electricity is used for the compressor and pump, then you should consult a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

Air and water source heat pumps

Air and water source heat pumps use air or water respectively. They do not rely on a collection system and simply extract the heat from the source at the point of use.

Air source heat pumps can be fitted outside a house or in the roof space and generally perform better at slightly warmer air temperatures. Water source heat pumps can be used to provide heating in homes near to rivers, streams, lakes and lochs for example.

Costs and savings

A typical 8- 12kW system costs £6,000- £12,000 (not including the price of distribution system). This can vary with property and location. When installed in an electrically heated home a ground source heat pump could save as much as £880 a year on heating bills and almost 7 tonnes of carbon dioxide a year. Savings will vary depending on what fuel is being replaced.

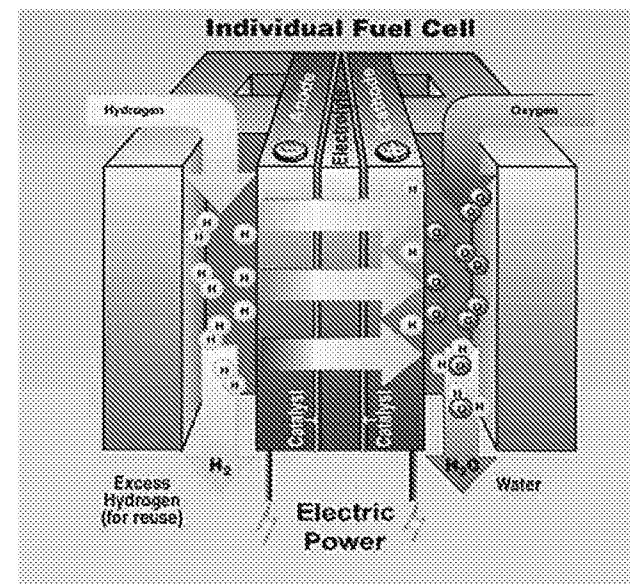
Fuel Cells

In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat. A fuel cell produces electricity.

The fuel cell is similar to a battery. It produces electricity using chemicals. The chemicals are usually very simple, often just hydrogen and oxygen. In this case the hydrogen is the "fuel" that the fuel cell uses to make electricity.

Another very important difference is that fuel cells do not run down like batteries. As long as the fuel and oxygen is supplied to the cell it will keep producing electricity for ever. The oxygen needed by a fuel cell is usually simply obtained from air. Although the majority of fuel cells use hydrogen as the fuel, some fuel cells work off methane, and a few use liquid fuels such as methanol. Fuel cells that use hydrogen can be thought of as devices that do the reverse of the well known experiment where passing an electric current through water splits it up into hydrogen and oxygen. In the fuel cell hydrogen and oxygen are joined together to produce water and electricity. Fuel cells can be made in a huge range of sizes. They can be used to produce quite small amounts of electric power, for devices such as portable computers or radio transmitters, right up to very high powers for electric power stations.

Hydrogen fuel is fed into the "anode" of the fuel cell. Oxygen (or air) enters the fuel cell through the cathode. Encouraged by a catalyst, the hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and oxygen in a molecule of water.



A fuel cell system which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel -from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes.

Fuel Cells Using Hydrogen From Renewable Sources

Fuel cells can be used as CHP systems in buildings. There are currently several different systems under development using different chemical processes, which operate at different temperatures. They currently use natural gas as the fuel, which is 'reformed' to produce hydrogen, the required fuel for the fuel cell. When and if hydrogen becomes available from renewable sources, e.g. as the storage medium of wind generated energy, fuel cell CHP from renewable sources may be possible in buildings.

Flue Gas Heat Recovery Systems (FGHRS)

In reality the FGHRS provides a good reduction in CO₂ emissions compared to some technologies that are classified and listed as LZC technologies yet do not provide a reduction in CO₂ emissions when compared to a Natural Gas energy model.

Background

Condensing combination boilers only condense when the flow and return water temperature differential is large enough, generally 11oc, during hot water mode the primary heating water is just circulated around the boiler through a secondary heat exchanger and the temperature differential between flow and return water will be very low and therefore the boiler will not condense.

How it works

The FGHRS is fitted above the boiler and is connected to the boiler flue outlet; the flue is the terminated from the FGHRS as normal.

Cold mains water enters the FGHRS and is pre heated by the waste flue gasses via an air to water heat exchanger, the preheated water is then feed to the inlet cold connection on the boiler therefore reducing the amount of gas required to heat the hot water to a sufficient usable temperature.

Costs and maintenance

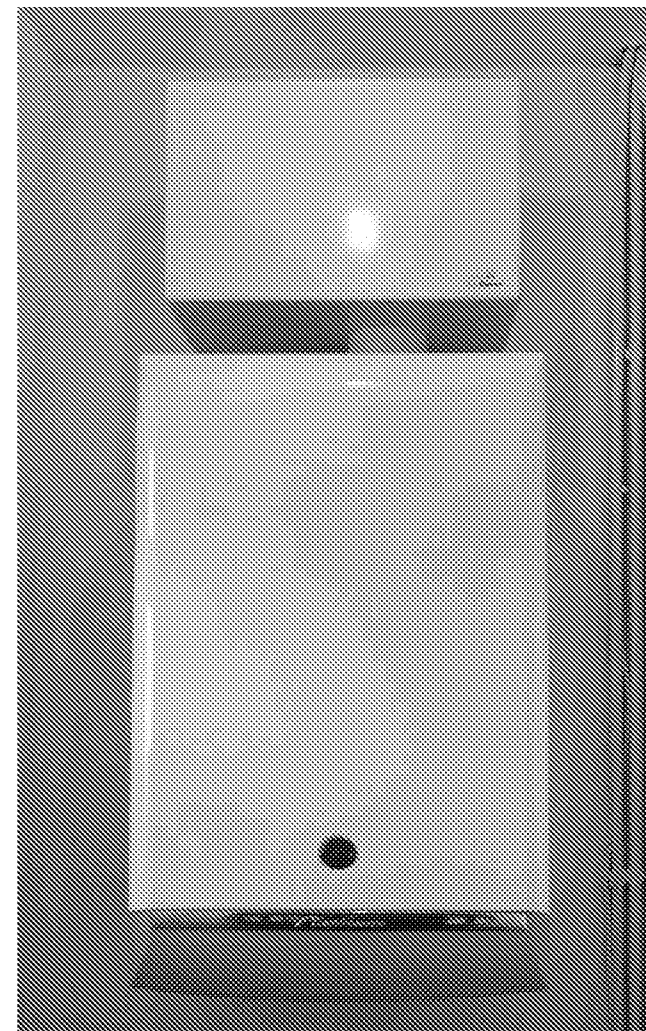
FGHRS cost between £500-£650 and according to the manufacture will require none or very little maintenance.

Land use

FGHRS requires no specific land use requirements.

Planning

FGHRS require no additional planning requirements.



Waste Water Heat Recovery Systems (WWHRS)

Shower Save (Figures 1 & 2)

Waste Water Heat Recovery Systems (WWHRS) is a Dutch technology, where in The Netherlands, they are fitted to 20% of new dwellings. Although generically classified as a WWHRS, the Shower-Save device is primarily applicable to heat recovery from warm shower waste water.

The most common configuration known as Recoh-vert (Figure 1), is applicable to upstairs showers, whilst the Recoh-tray (Figure 2) can be used in apartments, bungalows or other single storey properties. The principle of heat recovery is the same in both cases:

Warm shower water passes through the 'grey' water side of a copper counter-flow heat exchanger

Mains pressure water simultaneously passes through the fresh water side of the heat exchanger, where it is pre-heated before passing into both the 'cold' inlet of the mixer shower and the 'cold' inlet to the hot water cylinder, combi boiler or other water heater.

The use of pre-heated water (orange line in Figures 1 and 2) reduces the total volume of hot water required per shower, whilst also pre-heating the cold feed to the hot water heater which increases potential flow rates for combi or shortens the re-heat time of cylinders. The energy saving applies to whichever fuel is used for water heating, which is therefore not limited solely to gas boilers. Whilst technically applicable to instantaneous electric showers, these ARE NOT currently modelled by SAP, so it is not possible to apply in Appendix Q either. WWHRS does not save energy from baths, in which hot water use is in advance of grey water disposal, but it is applicable to the shower over a bath.

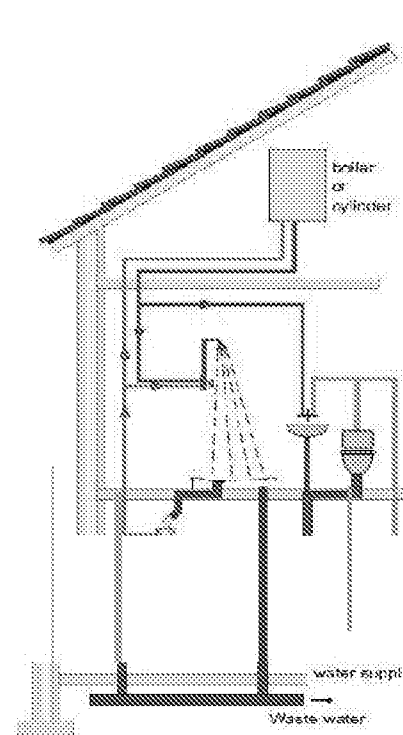


Figure 1

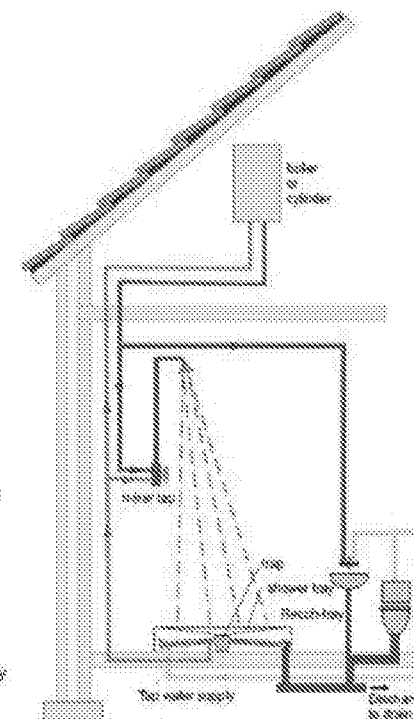


Figure 2

Energy Consumption

The Roundstone Lane, Angmering development will be developed with the aim to reduce annual energy consumption, whilst providing energy in the most environmentally friendly way to reduce the annual CO₂ footprints.

The outline strategy has been developed using established methodology (as recommended by the London Plan), i.e. achieving reductions in CO₂ emissions in accordance with the following hierarchy:

1. reducing energy needs through improved design and construction (Be Lean)
2. delivering energy through the use of decentralised and low carbon energy (Be Clean)
3. further reducing CO₂ emissions through the use of on-site renewables. (Be Green)

Further to the above methodology, we have also looked at other steps towards achieving a low carbon solution, including:

- The incorporation of passive design solutions by considering the dwellings orientation and layout issues
- The incorporation of energy efficiency measures through the design of services and improved fabric performance
- Calculation of the predicted design energy consumption rates and associated annual CO₂ emissions in comparison with a 'baseline' building (using Part L Regulations compliance standards) to include both regulated and non-regulated energy use
- Assessment of the viability of incorporating low and zero carbon energy sources.

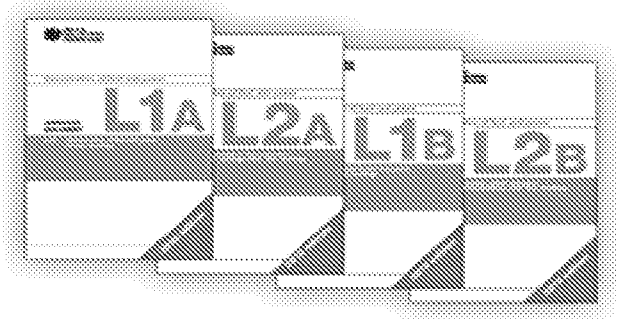
The main areas of concern that has a great impact on the Part-L compliance will be addressed as follows:

Thermal insulation, to include the lowest possible U-values, air permeability of no more than 5.0 m³/hr/m² and accredited thermal bridging detail.

Area and type of glazing, 30 to 40% of façade area with U-Value of 1.4 W/m²k, is recommended to provide day lighting and prevent overheating.

Heating system and controls. High efficiency gas boiler system with well insulated hot water storage and efficient variable speed pumps.

100% of the lighting will be low energy.



Element	Building Regulations	Proposed
Ground Floor	0.25 W/m ² k	0.21 W/m ² k
External Wall	0.30 W/m ² k	0.24 W/m ² k
Cold Roof	0.20 W/m ² k	0.16 W/m ² k
Warm Roof	0.20 W/m ² k	0.18 W/m ² k
Windows	2.00 W/m ² k	1.40 W/m ² k
Doors	2.00 W/m ² k	1.09 W/m ² k
Air Perm	10.00 m ³ /hr/m ²	5.00 m ³ /hr/m ²
Heating	Gas Boiler	Ideal 89% Efficient
Ventilation	Natural Ventilation	Natural

Regulated vs Unregulated Energy

Sometimes, an Energy Statement is required to show 'unregulated' energy savings, as well as 'regulated'. The only other instance where an 'unregulated' calculation is completed is for assessing whether a particular dwelling is truly 'Zero Carbon' by current definitions.

What Is Regulated Energy?

This is exactly what it sounds like: it is the energy used by systems governed by Building Regulations. These include space heating, water heating, ventilation and lighting – the basics of a modern house. All SAP and SBEM assessments, as well as EPC certificates, are calculated using regulated energy use only.

What Is Unregulated Energy?

This is everything that falls outside of Building Regulations. Televisions, kettles, hairdryers, ovens– all the appliances and devices the occupier adds themselves. In the interest of practicality, these appliances don't fall under Building Regulations.

Is there a future for Unregulated Calculations?

In the current definition of Zero Carbon homes, both types of energy consumption need to be offset by renewable sources; while in the Zero Carbon Hub's proposals, unregulated energy is being taken out of the requirements.

There are two main reasons for this:

Firstly, the unregulated energy calculation can only provide a ballpark figure based on the average household. There is no simple way of taking into account the human aspect of living in a house, and knowing how efficiently the occupants behave. Because of this, there have always been doubts around the accuracy of the unregulated calculation.

Also, as the unregulated assessment can typically increase expected energy use of a dwelling by 40%, developers are required to significantly alter their specifications, which in the majority of cases leads to concerns over economical feasibilities of new dwellings.

Baseline Energy Calculations

A baseline total energy demand has been established for the proposed development. Reductions in demand due to energy conservation measures are considered and form the basis of the renewable energy strategy which follows.

Floor plans for the Roundstone Lane, Angmering development have been used in conjunction with an outline accommodation schedule and building specifications to prepare initial preliminary SAP Calculations. SAP calculations have been carried out to Part L1A 2013.

Total Energy Demand is used in the final analysis to determine the contribution which renewable energy technology makes to total energy requirements for the development once energy conservation measures have been considered.

Energy savings are measured in terms of a reduction in CO₂ emissions and kWh, which are calculated from their association with a particular fuel source. CO₂ Conversion Factors have been taken from the approved DEFRA Carbon Factors 2015 DECC conversion (cf)1:

Activity	Fuel	Unit	Energy - Gross CV
Electricity Generated	Electricity	kWh	0.4585 kgCO ₂ e
Gaseous fuels	Natural Gas	kWh	0.18445 kgCO ₂ e



Baseline Energy Calculations (continued)

Predicted Carbon Emissions: Part L1A (2013) TER, Before Fabric Improvements

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting	Totals
Part L1A Plots (kWh/a)	1,209,284	555,114	18,450	108,526	1,891,374
CO ₂ Associated with total Energy Demand (kg/a)	223,052	102,391	8,459	49,759	383,662

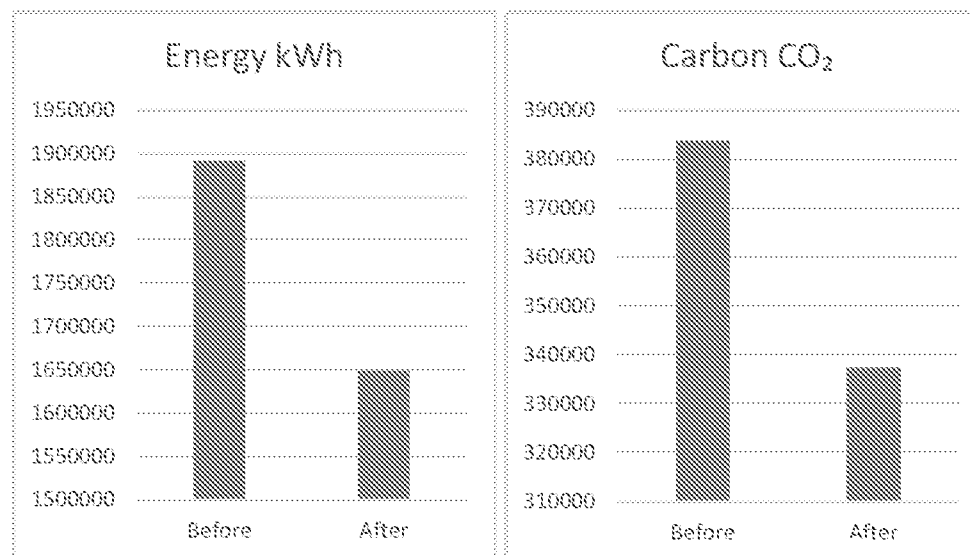
Predicted Carbon Emissions: Part L1A (2013) with improved fabric, controls and gas boilers

	Space Heating Demand	Hot Water Demand	Energy From Pumps and Fans	Energy from Lighting	Totals
Part L1A Plots (kWh/a)	980,642	547,389	18,450	102,581	1,649,062
CO ₂ Associated with total Energy Demand (kg/a)	180,879	100,966	8,459	47,033	337,338

When compared against Part L1A 2013 Building Regulations:

Total CO₂ demand for the residential units at Roundstone Lane, Angmering is calculated to be 337338 kg per annum. This represents a saving of 12.1% over the Part L1A 2013 compliant figure of 383662 kg per annum

Total energy demand for the residential units at Roundstone Lane, Angmering is calculated to be 1649062 kWh per annum. This represents a saving of 12.8% over the Part L1A 2013 compliant figure of 1891374 kWh per annum



LZC Technology Reductions

A detailed assessment, which will include the practical implications of installing each technology and quantity to achieve the required mandatory improvement in DER over 2013 Building Regulations, will be discussed in more detail later in this report, should any of these technologies be considered economically viable for the Roundstone Lane, Angmering development.

	Number of Dwellings Applied to	Energy Saved %	Carbon Saved %	Capita Cost per m ²	Cost Per kg/CO ₂ saved over 15 years	Cost per Kw Saved over a 15 year period	Considered?
Solar hot water	45	3.1%	2.9%	£30.12	£0.51	£0.09	No
Solar Photovoltaic	58	2.9%	6.5%	£20.48	£0.01	£0.01	Yes
Wind Turbines	1	0.1%	0.3%	£43.38	£0.11	£0.06	No
Biomass	246	36.4%	33.1%	£54.22	~~£0.53~~	£0.00	No
Micro CHP	246	13%	11.8%	£42.17	£0.00	£0.00	No
ASHP	246	42.3%	38.4%	£54.22	£7.49	£4.89	No
GSHP	246	56.7%	51.5%	£54.22	£10.04	£6.56	No
CHP Natural Gas	246	22.7%	20.6%	£57.35	£0.46	£0.11	No
CHP Biogas District	246	14.3%	13%	£69.40	~~£0.12~~	~~£0.01~~	No
Flue Gas Heat Recovery	246	6.8%	6.2%	£3.61	£3.24	£6.88	No
Waste Water Heat Recovery	206	7.1%	6.4%	£5.42	£0.83	£2.03	Yes
Fabric Approach	246	12.8%	12.1%	N/A	£0.00	£0.00	Yes

Technologies Not Considered

Fuel Cells: These are not yet fully commercially available.

Hydro: Small scale hydro would be inappropriate for integration into the proposed development due to the geographical location of the proposed site.

Summary

Considered Technologies

A fabric first approach has been taken on this development. By constructing to the specification as detailed on Page 16, energy demand is reduced by 12.8%, and CO₂ emissions are reduced by 12.1%.

The WWHRS systems would provide cuts in CO₂ emissions and energy reduction; they would also provide positive end user benefit. When installed to 206 of the dwellings on the development, energy demand is reduced by 7.1%, and CO₂ emissions are reduced by 6.4%. This technology is considered appropriate for this site.

Solar Photovoltaic would provide additional reduction in CO₂ emissions, energy at the lowest capital cost, and provide a benefit to the occupier in terms of fuel savings, when combined with the WWHR systems. If a total of 58kWp of Solar PV were installed across the development (say 1kWp to 58 dwellings), energy demand would be reduced by a further 2.9%, and CO₂ emissions reduced by a further 6.5%.

Combining results from WWHRS & Solar PV, energy demand is reduced by a total of 10.0%, and CO₂ emissions are reduced by 12.9%; therefore achieving the local target of 10% energy from decentralised and renewable or low carbon energy sources