Green Energy Options for Housing

Introduction

Energy used in the home accounts for 31% of all energy used in the UK. In the average UK home it splits roughly as follows: 60% for space heating, 25% for hot water for washing, and 13% for lighting and electrical appliances.

House builders have an array of technologies to choose from when considering how they should design their products to contribute to the reduction of carbon dioxide emissions, and reduce energy costs for their customers.

The table summarises the technologies, and where they are best deployed.

Technology	Space Heating (60%)	Hot Water (25%)	Lighting & Appliances (13%)
1. Insulation	Stronger		
2. Passive Solar Gain	Stronger		
3. Condensing Boilers	Stronger	Stronger	
4. Under-floor heating	Stronger		
5. Heat Pumps	Stronger	Weaker	
6. Solar Thermal	Weaker	Stronger	
7. Solar Photovoltaic	Weaker	Weaker	Stronger
8. Wind Turbines	Weaker	Weaker	Stronger
9. Grid Renewable Electricity	Weaker	Weaker	Stronger
10. District CHP	Stronger	Stronger	Stronger
11. Micro CHP	Stronger	Stronger	Stronger

STRONGER AREA OF APPLICATION
WEAKER AREA OF APPLICATION

1. Insulation

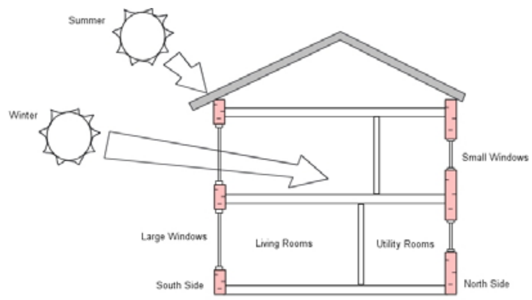
Better insulation is one of the most cost-effective methods of reducing energy bills in the home. A typical, poorly insulated 1970s home in the UK will use 13,000kWhr of energy each year for space heating. In a modern home with reasonable standards of insulation this figure can be reduced to 4,000kWhr. Sweden has pioneered the use of "super insulated" homes that lose so little heat that waste heat from cooking and lighting, and heat given off by occupants is sufficient to keep it warm.

2. Passive Solar Gain

This form of energy is often taken for granted; sunlight enters through windows, and warms the house. In an average house in the UK, passive solar gain contributes 14% of the heating demand.

Thoughtful design can improve this figure further with very little, if any, increase in the cost of building the property:

- Orienting the house so that the more often used rooms face south;
- larger windows on the south side, smaller on the north;
- using building materials that store heat by adding "thermal mass" to the house and
- laying out housing so that buildings do not over shadow each other.



3. Condensing Boilers

In a conventional boiler, the flue gases exit at 250-300ºC. A condensing boiler has extra heat exchangers that reduce the temperature of the flue gases down to 50-60ºC. At this temperature, steam (a by-product of combustion) condenses as water, giving up large amounts of latent energy. The slightly acidic water is collected and run into a drain.

Condensing boilers are £300 – 400 more expensive than conventional designs because acid resistant materials are required in the flue, and the low temperature gases may need a fan to blow them out.

Conventional boilers have a theoretical maximum efficiency of about 80%, while for condensing boilers this figure can be as high as 95%. The saving on fuel can pay back the additional cost in less than 4 years.

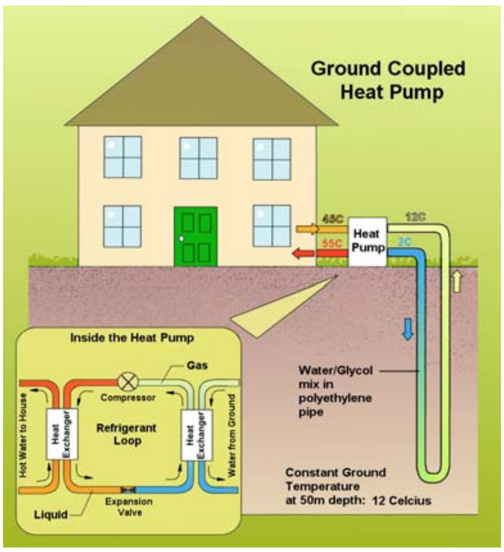
4. Under-floor heating

Under-floor heating has many benefits to the homeowner, such as silent running and greater visual appeal, but the environmental argument is that this form of heating will use some 15% less energy than the traditional wall mounted radiator system for the same level of comfort.

Pipes for warm water are built into the floor, turning its whole surface into a radiant source of heat. Because the floor area is much larger than the area of a radiator, the water temperature can be much lower, and this gives efficiencies in the boiler and lower losses in the pipes from the boiler.

Instead of heating the air as traditional radiators do, the warm floor will radiates heat direct to the occupant, who will feel just as comfortable with a slightly lower air temperature. The air temperature is also constant at all heights, unlike traditional systems, which wastefully heat the air at the ceiling far more than the air near the floor.

5. Heat Pumps



Heat pump technology is used in a refrigerator to move heat out of the cabinet and cool it down. The same type of system can pump from the environment into a house to provide heating in a very energy efficient way. Low temperature heat is taken from the environment near the house, and turned into higher temperature heat for the house.

Heat can be taken from the environment via a loop of pipe with water circulating in it. This loop is either buried in trenches in the ground, or in a bore hole as shown in the diagram. Some systems use large fans to exchange heat with the air, although air temperature is subject to greater variations than the ground.

Typically the heat pump is driven by electricity, and for every unit of electrical energy that is put in, three to four units of heat energy enter the house.

The ratio of energy in to energy out is called the coefficient of performance (COP). The COP is best when the temperature difference between the environment and the hot water temperature is low. For this reason, heat pumps work best for space heating, and are especially good in combination with under-floor heating, which uses lower temperature water.

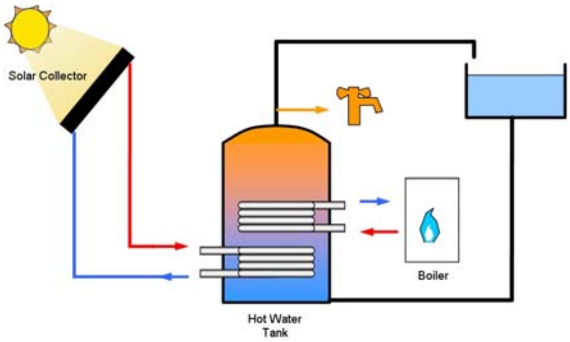
6. Solar Thermal Systems

When light strikes a dark surface, it is absorbed, and its energy turned into heat – the surface warms up. The heart of a solar thermal system is a black surface that does just that.

Everything else around it is there to make sure that the heat ends up going somewhere useful rather than being lost to the environment.

The black surface will have water flowing behind it to take away the useful heat as quickly as possible. The back and sides of the solar panel are thickly insulated. The top surface is glazed to allow light in, but prevent heat loss.

Well insulated systems can collect useful amounts of heat even on cloudy or cold days, although a backup boiler is typically required for periods of very dull weather.



Currently systems cost in the region of £3 - 4,000 and can provide up to 60% of a household's hot water – so payback is around 40 years.

7. Solar Photovoltaic

Photovoltaic (PV) cells have become commonplace on devices such as calculators and watches. Semiconductor materials like those used in silicon chips convert light directly into electricity. The most efficient commercially available systems can convert up to 16% of the light energy that strikes them into electrical energy.

PV generates DC current, so before it can be used in the home, it needs to be converted to AC, with an inverter. It is likely that supply will exceed demand in the house during the daytime, and either storage batteries will be needed, or with a second meter it is possible to sell energy to the grid.

Costs have been coming down for PV, but systems are not yet economically viable in areas that are connected to the electricity grid. Viridian has calculated the payback to be in the region of 200 years.

8. Wind Turbines

It is possible to buy smaller wind turbines for domestic use. A windmill at the top of a tower turns an alternator, and generates DC electricity. Conversion to AC and storing the electricity for times of demand are considerations for wind power just the same as for Photovoltaics.

Turbines need to be installed some distance from buildings, trees or other barriers which would interfere with the wind. There are also likely to be planning restrictions on the erection of tall towers in built up areas. For these reasons they are most likely to be practical in more remote locations.

9. Grid Renewable Electricity

Since the government has placed a renewable electricity obligation on the electricity companies, many have started to offer green electricity to consumers. Homeowners can purchase their electricity on plans that guarantee that the energy they consume will be matched by the purchase of equivalent energy from renewable energy sources such as wind farms or hydroelectricity.

Large wind turbines such as those found in commercial wind farms are now extremely competitive with fossil fuel based generation, and there is often no cost penalty to the consumer for choosing green electricity.

10. District Combined Heat and Power

Combined heat and power (CHP) is a very efficient way of generating electricity. Fuel is burnt to raise steam, which drives a turbine to generate electricity. Waste heat from the process is recovered and used to provide heat and hot water to local housing. In this way 80% of the energy in the fuel is put to good use, rather than 60% in the most efficient plants that produce electricity alone.

Of course if the fuel used is a fossil fuel, it is the increased efficiency that is attractive, however some district CHP facilities use wood from managed forestry to produce truly renewable energy.

11. Micro Combined Heat and Power

A number of companies are working on systems for the home that burn fuel (usually natural gas) and generate electricity before recovering the heat to heat the house. They can be thought of as a new type of boiler that gives a little bit of electricity on the side.

The technology varies in the way that the electricity is generated. Some use a Stirling cycle engine that works on heating and cooling air in cylinders to drive pistons, others use tiny versions of the gas turbines used in larger power stations.