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Alternative Energies!

Contents

"Switch off the lights when you leave the room!", "Turn the TV off standby!", "Who left the computer on all night?"
Does this all sound rather familiar? In households everywhere people are nagging each other to use less electricity. Have you ever really stopped and asked yourself why?

Our use of electricity and other forms of *energy* not only costs money, but it also causes bigger environmental problems. In previous issues of Conservation Education we have looked at **Energy** (Issue 13) and **Climate Change** (Issue 16) in detail, explaining all about *fossil fuels, global warming* and *greenhouse gases.*

In this issue we'll be looking at alternative, *sustainable* energy sources. Sustainable energy is energy that is efficient, won't run out and can keep going on, and on and on, and on, and on…….. and which, in the long run, won't 'cost the earth'.

There is endless clean energy all around us – here is how we can use it.....

Wind Power

♫ "Just Blew in from the Windy City"

You may well have already seen big modern 'windmills' with their massive blades spinning slowly round and round in the wind. Well they're not wind*mills* at all (mills grind grain into flour); these are called wind *turbines* and they use the wind to produce electricity. The spinning of the blades is converted into electricity via a series of gears and generators at the top of the tower. The electricity is then transferred to a cable which leads to the National Grid and is then sent onwards to local houses, schools, offices and heavy industry.

At the moment just 1% of electricity around the world is produced using wind turbines.

Here are the good things about wind power:

- ☺ It is very clean. Once built, the turbines produce no greenhouse gases.
- ☺ As long as the sun exists to create the wind, the wind won't stop forever. This is called *renewable energy.*
- ☺ The land below the turbines can be used for other purposes, such as the grazing of farm animals or growing crops.
- ☺ Small wind turbines are available to put on houses so you can produce your own clean, renewable electricity. Once installed, no more bills!

So why doesn't all of our power come from wind turbines? There are drawbacks:

- ☹ A lot of turbines are needed to produce enough energy for our needs. Large clusters of turbines are known as wind farms.
- ☹ The wind doesn't blow all day, every day, so a back-up power supply is needed for calm days.
- ☹ Many people think wind farms are ugly and spoil nice views. Turbines can be 80 metres tall (nearly as tall as the Big Ben clock tower) with two or three rotor blades that are 35 metres long. And the windiest places tend to be in open countryside.
- ☹ The turbines can be noisy, especially for people who live near them.
- ☹ Birds and bats can be killed when they fly into them. This is a problem for migrating birds like geese which regularly use the same flight path.

Fact-tastic! In the UK, an average wind turbine will produce 30 times more energy than was used to make it! Coal power stations produce only one third of the energy used to build and run

The cost of producing wind power has dropped by more than 70% since 1980 which means it is becoming a very popular 'green' energy source.

Solar Power

♫"Bring Me Sunshine…"

We live on a solar-powered planet; the ultimate source of energy on this planet is the sun; the feel of the heat of the sun on your skin is solar energy! It provides energy for plants to grow, which in turn provide food (which is energy) for animals. The sun provides us with heat and light every day, which we can use to make electricity:

There are three types of solar power:

1. PVs

You'll have seen solar powered calculators, watches and garden patio lights? The same technology can be used to provide electricity to whole buildings - just on a larger scale. This type of solar power comes from *photovoltaic cells* or *PVs.* Lots of PVs together make up solar panels on the roofs of houses and other buildings. They work by using the sunlight to split electrons from atoms (see 'nuclear power' below for more information on atoms and electrons). The energy released during this process is converted into electricity.

Fact-tastic! In Kenya there are more homes with PV systems than there are connected to the National Grid!

2. Thermal Collectors

These create hot water rather than electricity. They are made up of a series of tubes sandwiched between sheets of glass (with a black backing to absorb the sun's heat) on the roofs of houses. Water in the tubes heats up in the sunlight and starts to flow into a hot water tank. Bingo - the house has hot water! Systems like this can reduce the need for other energy sources by two thirds.

Photovoltaic solar panels

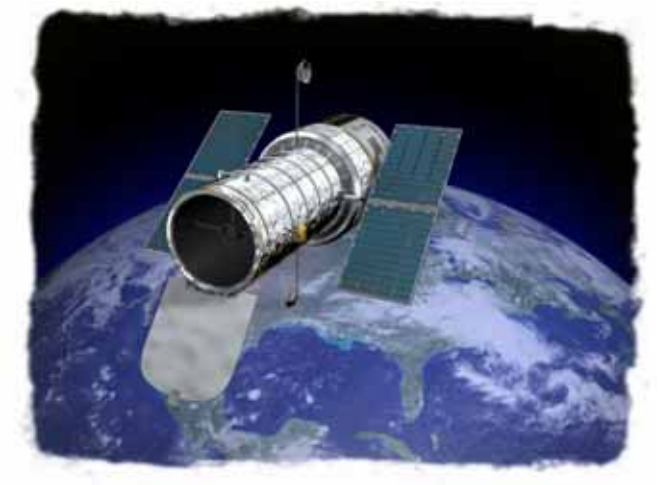
3. Passive Solar Energy

This is when a building is designed and built to make the most of the natural position of the sun. So in the Northern Hemisphere (e.g. UK, USA, China) houses can be built facing south (where the sun shines most of the day) with big windows on that side to act like a greenhouse and warm the house without having to put the heating (or lights) on as much. This can halve heating bills!

Which direction do you think houses in the Southern Hemisphere (e.g. Australia, New Zealand and Argentina) should face?

On a big scale, solar technologies are used to power whole settlements, space craft and satellites. Here are some examples:

- The largest Solar PV 'farm' in the world is about to be completed near Moura in Portugal. Each of the 2520 solar panels is the size of a house! It is expected to provide power for 30,000 homes.
- Satellites and the Hubble Space Telescope are covered in solar PV cells which power the computers, cameras and radio systems on board. Up in space there are no clouds or seasons to interfere with the sunshine!
- The robots sent to Mars have solar cells too. 'Spirit' and 'Opportunity' trundle along using solar power so they can take amazing photographs and send them back to Earth. The two robots were only meant to last for a 90 day mission – they have now been up there more than 5 years!
- The World's largest solar cooker is in Rajasthan, India. It can produce food for 10,000 people!



Hubble Space Telescope

Solar Vehicles.

Various cars, planes and boats have been powered by solar energy too:

- The first successful flight was by 'Solar Challenger' in 1981, a plane which flew with a pilot on board, for 260km and reached a height of 3,300m.
- In 2007 'Zephyr' flew for 54 hours in one go!
- In 1996 a solar boat 'sailed' from Ecuador to Japan.
- 'World Solar Challenge' is a 300km race for solar cars in Australia. In 2005 it was won by a Dutch car in less than 30 hours doing an average speed of 103kph.

So solar power appears to be absolutely brilliant! Here's why:

- ☺ The sun isn't going to run out – well not for another 5000 million years! So it is a *sustainable* form of energy (provided the materials required to make the equipment don't run out).
- ☺ No harmful gases are released once the equipment is installed.
- ☺ It works well in remote areas where there isn't easy access to the National Grid
- ☺ It works well in poorer, hot countries as it costs very little to run. A small PV cell can power a whole house.
- ☺ It works in cold and cloudy conditions too. Solar power has been used in both the Arctic and Antarctic.

But there are down sides to solar power:

- ☹ It is expensive to install – the materials are costly
- ☹ Storage and transportation of the electricity to where it is needed is difficult.
- ☹ In many countries there is too much 'dark time', especially in winter, when most power would be needed for lighting and heating.
- ☹ Large scale solar farms take up land which could be used for growing crops for food, and they are considered ugly by some people.

The Future's Bright……..

- Domestic solar systems (i.e. on people's houses) are already becoming more and more common. Look out for solar panels on a roof near you!
- Perhaps one day solar satellites could collect solar energy and beam it back to Earth! There are no clouds or seasons in space to interfere with production and this would give us an endless, vast supply of clean, renewable, sustainable energy!
- In 2010 there are plans to launch a solar plane called 'Solar Impulse' in an attempt to go right round the world. Just think – one day you could be flying off on holiday in a solar-powered plane!
- In 2004 scientists invented 'spray-on' plastic solar cells that captured infra-red rays from the sun (which means they work on really cloudy days too). It was possible to 'spray' these cells onto anything, even a t-shirt. One day you could be plugging your mobile phone in to your t-shirt to charge it up! It was extremely expensive so is not yet available but they're working on it…..

Right:
This is the largest **solar furnace** in the world at Odeillo in France. Plane mirrors reflect the sun's rays on to this larger curved mirror which in turn focuses the rays onto a small area, only the size of a cooking pot. This can reach temperatures of 3,000 degrees centigrade! This technology can be used to generate electricity, melt steel or make hydrogen fuel.

The Solar Updraft Tower is a system which has been tested in Spain. It's a giant chimney (990m tall – taller than the world's tallest building) with a huge circular greenhouse at the base. Hot air from the greenhouse rises up the chimney with enough force to turn turbines. These are connected to generators which produce energy.

Concentrated Solar Power (CSP)

This is a new system where giant movable mirrors called heliostats are used to reflect the sun's rays and concentrate the heat onto a vessel containing water or another liquid, similar to oil. This creates steam to turn turbines and generate electricity. The best place for this technology to be used is in the desert.

- Within 6 hours deserts receive more energy from the sun than the whole of the world's population uses in a year. Every year 1 square km of desert receives an amount of solar energy equivalent to 1.5 million barrels of oil. This means that only 1% of the world's deserts would need to be used to meet the world's current energy needs.
- According to DESERTEC, 90% of people live within 2,700 km of a desert and could be supplied with solar electricity from there. Developing countries such as China and India could avoid the use of fossil fuels in their development by moving straight over to this technology.
- It is possible to store the solar heat in melted salts so electricity can still be generated when it is not sunny.
- Another advantage of CSP is that sea water could be desalinated to provide fresh drinking water in arid regions using the waste heat from CSP plants. It could also be used to water plants for food which could be grown in the shaded areas underneath the mirrors.

There are 4 main systems of Concentrated Solar Power Technology:

1. **The Solar Tower** is a new system currently being tested in Spain. It could provide enough energy for 600,000 people. It's a giant concrete tower, 40 storeys high surrounded by 624 heliostats at the base all focused on the top of the tower where it can heat up water pipes, to create steam which is blasted through turbines.
2. **Trough Systems** use curved mirrors to focus light onto a tube containing oil or a similar fluid that carries the heat to a place where it can be used to create steam and generate electricity.
3. **Frensel Mirrors** work in the same way as the trough system but instead these are are long, flat mirrors placed at different angles. Sometimes they are focused onto photo-voltaic solar panels.
4. **Dishes** of mirrors track the sun (a bit like a giant television satellite dish) which track the sun. They each have a Stirling engine at their focal point which works by using an external heat source (unlike a standard internal-combustion engine which may run off petrol or diesel) to convert the heat energy into electricity.

Heliostats

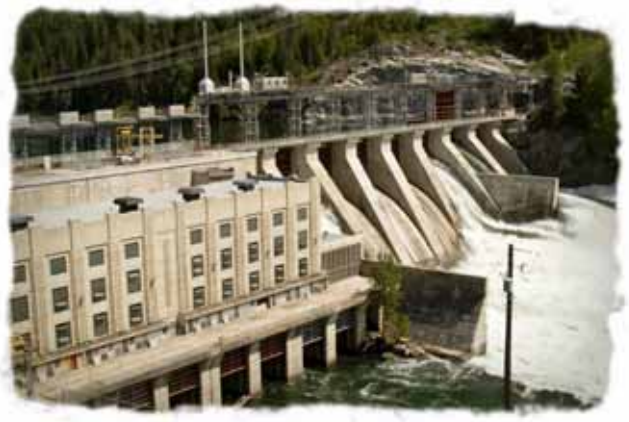
- See the website www.trec-uk.org.uk for further information.

Hydro-electric Power

"Water, Water Everywhere…"

Water power goes back 2500 years when water wheels where first used to power mills. The rotating wheel would be attached to a mechanism which could grind wheat into flour, or weave wool. Water mills were very common until electricity became easily available in the 19th century.

Modern water power is called hydro-electric power (HEP) and water is used to generate electricity. There are many different ways to do this:



A hydro-electric dam in action

Dams, Reservoirs and Rivers:

The most common form of HEP is when a *dam* is built across a river and a huge lake or *reservoir* forms behind the dam. Water is then let out through the dam where there are turbines that spin as the water flows through them. The turbines are connected to generators and these produce electricity. This power is then transported along cables and distributed to homes, offices and factories.

15% of the world's renewable energy is produced like this – more than any other renewable energy source.

- The first dam was built on the Fox River, Wisconsin, USA in 1882 and the energy was used to power electric trams.

Wave Power:

Waves are formed when the wind blows across the surface of the sea. There is a lot of power in waves and this can be used to make electricity. There are different types of wave electricity generators:

Oscillating Water Columns (OWCs) are situated at the shore and the waves crash into them, sending water up a concrete column, forcing air through a turbine at the top of the column.

'Nodding Ducks' float up and down on the surface of the sea and their movement causes a shaft to move, which is attached to a turbine which turns and creates electricity.

The Sea Snake – or Pelamis Wave Energy Machine. This is a semi-submerged device which has many hinged joints which move with the water. This movement triggers hydraulic motors and these are attached to generators which create electricity. It is 120m long and 3.5m wide. If lots were moored together it could create a 'wave farm'.

Fact-tastic!

99% of Uganda's electricity is produced using water power!

Each generator in the Hoover Dam on the Colorado River in the USA produces enough electricity to power 100,000 homes. There are 17 generators in total!

The Three Gorges Dam in China is the biggest HEP plant in the world. The dam is 185m high and 2km wide.

The Hoover Dam

OTEC (Ocean Thermal Energy Conversion). The surface of the sea, which is warmed by the sun, can be as much as 20°c warmer than deep down. Using a series of pipes and pumps, the warmer water passes through a heat exchanger and heats a special fluid until it boils, expands and turns to vapour. The expansion causes a turbine to turn, thus generating electricity. The hot vapour is then pumped through the cooler waters deeper in the ocean where it cools, turns back into liquid and re-circulates through the whole system again.

Fact-tastic!

Using OTEC, it has been estimated that 1km² of the oceans in the Tropics could contain as much energy as 2700 barrels of oil!

Tidal Power

The tides of the sea come in and out twice a day, every day, all year round. In areas where the tide goes out a long, long way and comes right back in to the shore, it is called a big *tidal range*. In a few such places a barrage has been built across the mouth of a big river – an *estuary* – and in the barrage there are tunnels with turbines in. So the water flows freely through the turbines, creating electricity.

An example of a *tidal barrage* is the Rance Barrage in Northern France, which was completed in 1966. More are being planned, such as on the Severn Estuary in south west England.

So it would seem that water power is a pretty good alternative to fossil fuels, wouldn't it? But, as always, there are pros ☺ and cons ☹ to using water to make electricity:

The pros:

- ☺ 70% of the Earth's surface is covered in water so there's plenty to make electricity with!
- ☺ The *water cycle* is a continuous process which ensures that there is always going to be water stored, flowing or falling somewhere on the planet. So water power is renewable!
- ☺ No greenhouse gases are released once the equipment is installed so it is a clean source of power (*see below)
- ☺ Micro-HEP schemes are popular in buildings built near rivers so they can produce their own electricity.
- ☺ HEP schemes often produce more power than is needed. The surplus can be sold to the National Grid so people can make money as well as electricity!

And the cons:

- ☹ HEP schemes affect the river or ocean habitats and local people.
  - Dams reduce the river flow downstream, and create a lake where there used to be a river upstream. This affects the specially adapted local wildlife such as fish and invertebrates.
  - In China at the Three Gorges Dam project, 19 cities and 300 villages were flooded which meant that 2 million people had to find somewhere else to live.
  - In Brazil 2400km² of rainforest was destroyed to make way for the Tucurui Dam.
  - Tidal barrages cause sediment to build up in the estuary. This means that the valuable wetland and mudflat habitats slowly dry out and the birds, animals and plants that live there are affected.
- ☹ The wave energy systems are often damaged in big storms. This means the production of storm-proof OWCs, Nodding Ducks and Sea Snakes is very difficult and expensive.
- ☹ *It has recently been discovered that large reservoirs give off quite a lot of carbon dioxide and methane, two of the worst greenhouse gases.
- ☹ Decent dams can only be built in areas where there are big rivers and mountains to provide all the 'ingredients' for an efficient power supply.

So what is the future for HEP?

1. Research is underway on '*marine current turbines*' which are basically like wind turbines but under the sea! Underwater currents could spin the turbines and create electricity.

2. *Tidal lagoons* are an option too. These would involve building long walls with turbines in round shallow bays on the coast. The tide would turn the turbines as it comes in and out. This would cause less damage to the nearby habitats than estuary barrages as there wouldn't be a river to disrupt. It is estimated that just 25 tidal lagoons could produce 25% of Britain's electricity.

Geothermal Energy

"geo" = rocks; "thermal" = heat

The Earth is made up of different layers, from the unbelievably hot core (up to 6000°c!) to the hard crust on the surface, on which we all live. In some places, this crust is quite thick (up to 70km thick) and in others e.g. Iceland it is very thin (6km). Here, the hot molten rock is not far underground and it can work its way up to the surface through cracks and faults in the crust. Rain seeps into these cracks and heats up – instant hot water right under your feet! Iceland gets 90% of its hot water like this.

The steam from this hot water can also be used in geothermal power stations to produce electricity.

But of course there are both good things and bad things about geothermal energy:

- ☺ It works 24 hours a day, every day. And it is renewable.
- ☺ No fossil fuels are used so no extra greenhouse gases are pumped into the atmosphere.
- ☺ No transport is needed to get the power to houses – it is right underfoot!
- ☺ These countries don't need to buy in expensive fuels like coal, oil and gas from other countries.

The downsides are:

- ☹ Only a few places in the world are situated where the earth's crust is thin enough to use geothermal energy. It is difficult and expensive to transport geothermal energy to places away from where it is produced.
- ☹ The hot spots are not necessarily stable and conditions can change abruptly as the *plates* in the earth's crust shift.

Fact-tastic!

It has been estimated that the potential geothermal energy in the whole world is 50,000 times greater than all the oil and gas in the world!

Geothermal heat-pumps

On a smaller, cooler scale, energy can be produced in places where the crust is thicker, by using the soil temperature. In the winter the soil is warmer than the air and in summer it is cooler than the air. Pipes are dug into the soil and the air in the pipes flows through *heat exchangers*, like in the back of a fridge, to heat buildings in the summer and cool them down in winter.

Biomass Energy:

"bio" = life; "mass" = quantity of matter (stuff!)

Biomass is the general name for materials that come from plants and animals, such as wood (from trees), and it has been a source of energy for thousands of years. The first fire was estimated to have been lit around half a million years ago! Burning wood is the most common form of biomass energy in the world; in fact one third of the world's population relies on biomass energy.

Other than wood, biomass fuels include crops of plants grown especially, such as 'Elephant Grass" (*Miscanthus)*, which grows very tall, very quickly. Even waste from agriculture such as straw (the stalks of a wheat crop) can be burned to create energy to heat water e.g. in Denmark.

In Western Australia 12 million Mallee Shrubs (a type of eucalyptus) are being planted to provide biomass fuel. The leaves will be used to make eucalyptus oil and the stalks for biomass. Nothing will be wasted. The roots of the plant will also help prevent *soil erosion* and improve the quality of the soil by reducing the salt levels.

In the USA paper factories burn the waste sawdust to provide heat and power to neighbouring districts. This is known as 'combined heat and power' generation. It is better than normal power stations because waste from the paper industry is put to good use and no new fossil fuels are required.

Biogas Energy

A very similar idea to using biomass is to burn the gas that comes off rotting plant and animal remains (pongy!), rather than burning the matter itself. It is used just like Natural Gas in conventional power stations: to heat water to create steam, which is then used to turn turbines and generate electricity.

The gases – usually methane and carbon dioxide (CO_2) - are gathered by slowly heating the biomass in an airtight container called a *biodigester*. Gases are given off, which are then collected and used to produce energy. This process is called '*gasification*'. The waste left is often used as fertiliser for farmland.

An example of a UK biogas power system is at Minworth sewage works in the West Midlands. The methane given off by the sewage is used to power the whole sewage treatment works! Any surplus electricity is sold to the National Grid.

Fact-tastic! Trials in the USA have shown that the biogas from the manure from 500 cows can produce enough electricity to power 100 homes (without the smell)!

Methane is also often collected from pipes in landfill sites.

Another source of biogas being considered is sea kelp. This seaweed can grow up to 60cm per day so would provide a very good supply of fuel for gasification if it was grown commercially.

So why are biomass and biogas being considered as alternative types of energy to fossil fuels?

- ☺ These fuels can be sustainable, as long as the crops used are replanted at the same rate as they are harvested.
- ☺ When used in biogas plants methane, which is 22 times more damaging to the environment than CO_2, does not escape into the atmosphere.
- ☺ The waste from industry is put to good use and not left in landfill to decompose.
- ☺ Any CO_2 given off during energy production is taken up by the replacement crops so a balance of CO_2 is maintained. This is called '*carbon neutral'*.
- ☺ Biomass energy can be used worldwide

But, of course, this idea isn't perfect:

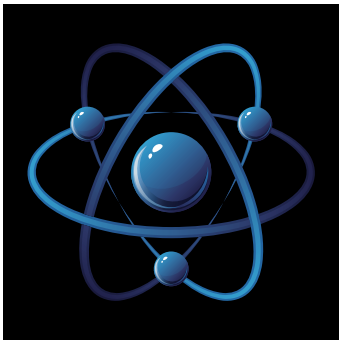
- ☹ Growing the crops takes up valuable farmland that could be used to grow food.
- ☹ Biomass and biogas power stations only produce a limited amount of energy.
- ☹ Harvesting and collecting the fuel uses lots of energy! The machines need fuel……

Fact-tastic!

1m³ of biogas can produce enough power to light a 100w bulb for 6 hours, cook 3 family meals or drive a car 15km.

Nuclear Power

Nuclear power probably causes the most debate as to whether it should be used or not.
The science of nuclear power is complicated, so let's make it as simple as we can.



- ★ Everything around us (known as elements) is made of matter.
- ★ Matter is made up of tiny particles called *atoms.*
- ★ Every atom has a central part called the *nucleus.*
- ★ The nucleus is made up of *protons* and *neutrons.*
- ★ *Electrons* float around the nucleus.

There are two types of nuclear reaction: *Nuclear Fission* and *Nuclear Fusion:*

1. Nuclear Fission

This reaction is used in nuclear power stations. Nuclear fission occurs when radioactive atoms are deliberately split by scientists. Uranium, the fuel used, is an unstable or *radioactive* element, which means the nuclei of the atoms split easily.

When a uranium atom is split, lots of energy is released as the nucleus breaks up and fragments (protons and neutrons) crash into other atoms of uranium, which then split, releasing lots of energy and sending more fragments crashing into other atoms, which then split, and so on and so on. This is called a *chain reaction* because, once it gets going, it keeps going on and on and on and on, getting hotter and hotter until it is brought under control by cooling.

All the energy produced is used to heat water to produce steam, which turns turbines and generates electricity.

The first atom was split in 1939 and the first nuclear power station was opened in Russia in 1954. Now there are more than 400 nuclear power stations around the world, producing 16% of the world's power. 20% of the UK's electricity is produced from nuclear power.

Some submarines have been powered using nuclear power. They can travel under the sea for a lot longer than 'normal' submarines because the fuel lasts so much longer and they don't have to surface to refuel very often. The submarine Nautilus, launched in 1954, was the first submarine to make it all the way to the North Pole under the ice. It travelled 3000km in one journey without refuelling. Nowadays, a nuclear submarine can stay underwater for months at a time – in fact they could stay under indefinitely – the only reasons to surface would be to stop the crew going mad and to get more food supplies!

Fact-tastic! 1kg of radio-active uranium can release more energy than 2.5 million kg of coal!

☺ So nuclear power is popular already, produces loads more energy compared to other forms of energy; no greenhouse gases are given off during energy production – just lots of heat. So in a way it is a type of 'green' energy, isn't it?

What do you think?

Decisions, decisions!

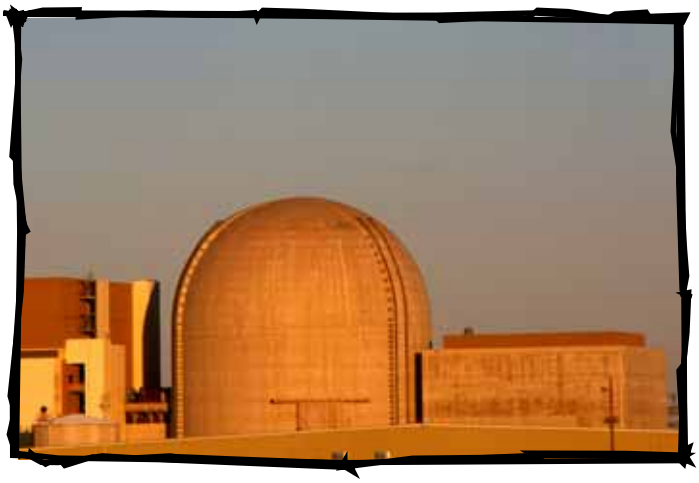
✓ Some environmentalists think nuclear power is the best alternative to fossil fuels as it is the only low-carbon energy source which is developed and reliable enough to use now on a big scale. If the world multiplied its nuclear power output by 3 times, it would reduce greenhouse emissions by 25%.

X But for others, the issue of waste and safety are too risky for nuclear power to be considered a good thing.

Have a class debate – discuss all the issues of nuclear power and at the end take a vote to see who is for and who is against nuclear power!

The cons:

- ☹ Uranium is dug up from underground, a bit like coal is. Although we have supplies to last thousands of years, it could become inaccessible or too expensive to use. So nuclear power is not really classed as renewable.
- ☹ The uranium has to be extracted from ores in rocks and undergo a lot of treatment before it can be used in a power station. These processes, along with transportation, use a lot of energy and release lots of greenhouse gases.
- ☹ Safety is the biggest problem of nuclear power:
  - The waste left behind after nuclear fission is radioactive, which causes serious health problems. It can remain radioactive for hundreds of thousands of years. At the moment, nuclear waste is sealed in strong, airtight boxes and buried underground.
  - There is the risk of a major explosion if anything goes wrong in a nuclear power station. A famous example was at Chernobyl, Ukraine in 1986 when an enormous explosion in one of the reactors sent a radioactive cloud across Europe. Tens of thousands of people died later from radiation. The nearby town is still abandoned as it the radioactivity is still there, more than 20 years later.
- ☹ Nuclear power stations are expensive to build, because they have to be made safe. Their walls are made of concrete 1 metre thick and the fully automated computerised back-up safety systems are expensive to install.
- ☹ When a power station reaches the end of its safe life, they have to be *decommissioned* or shut-down very carefully. This can take years and is another very expensive process.
- ☹ There is concern that explosive and radioactive material might get into the wrong hands such as terrorists, who could use it to harm people. Or terrorists might attack a nuclear power plant to cause a radioactive explosion.
- ☹ All the money being spent on nuclear power could be being spent on improving other, safer energy sources such as solar or wind power.



A Nuclear Power Station

2. Nuclear Fusion

Nuclear fusion is the opposite of fission. It's when the nuclei of two atoms (such as hydrogen) are joined to form a heavier one (helium). It is the process that is constantly happening in the sun – which is very bright and hot as a result.

This process requires very hot temperatures and for the nuclei to be travelling at incredibly high speeds. It is known as a *thermo-nuclear reaction*.

Scientists are currently researching the possibilities of using nuclear fusion as a source of alternative energy. There are lots of test reactors in existence - like the Russian 'Tokomak' which is a doughnut-shaped chamber which is capable of producing temperatures up to 510 million °c!

Fact-tastic! Nuclear fusion creates 8 times more energy (as heat) than nuclear fission – the sun is 500 million °c at its core!

But nuclear fusion is not practical to use on a big scale yet. If it was easy, affordable and safe to produce then it would definitely be an answer to the world's energy problems. Here's why:

- ☺ An enormous amount of energy is produced from not much 'fuel'
- ☺ Hydrogen is the most abundant element on Earth and won't ever run out – it is renewable.
- ☺ The waste product (helium) is *inert*, or harmless.

But (and it's a big but, unfortunately):

- ☹ The process needs a huge amount of energy (from fossil fuels?) in the first place, in order to create the incredible heat necessary for the reaction. Not a simple problem to solve.
- ☹ It's ridiculously expensive!

Greener Transport?

Energy is not just about electricity and heating. Another use of energy is transport – cars, buses, trains, boats, planes, motorbikes etc all need some sort of fuel to make them go. At the moment most run on petrol or diesel, which are derived from oil, one of the main fossil fuels.

Transporting goods and people by land, water and air is responsible for 25% of the world's greenhouse emissions, and this is increasing all the time.

Apart from solar-powered transport and nuclear submarines, here are some other options for greener travel:

Biofuels

Plants, such as sugar cane, corn, sunflowers and soy beans can be used to power cars. They are turned into fuel and put into cars with specially designed engines (so don't try this at home!). *Ethanol* and *biodiesel* are types of biofuel.

25% of car fuel in Brazil is ethanol made from sugar cane.

Fact-tastic! Some cars can run on vegetable oil that has been used in chip shops to cook fish and chips. Now that's recycling!

There are, of course, drawbacks:

So why use plants instead of fossil fuels?

- ☺ Any crops used as fuel can be replanted. So long as they grow fast enough and enough are planted, the fuel won't run out.
- ☺ Any CO_2 given off when used in the cars will be re-absorbed by the replacement crops. It could be carbon neutral.
- ☺ Biofuels are not too expensive to produce – they do not need to be mined like fossil fuels.

- ☹ They still produce Carbon Dioxide and other greenhouse gases when used in the cars so they are not totally green.
- ☹ If all the vehicles in the world converted to using biofuels, a huge amount of land would be needed to grow the crops on. Vast areas of valuable rainforest habitat have already been destroyed in Brazil to make way for biofuel crops.
- ☹ If forests are cut down and replaced with biofuel crops, less CO_2 is absorbed from the atmosphere than if it remained as a forest.
- ☹ The production and application of fertilisers etc for the crops uses energy and gives off greenhouse gases. It is estimated that 74 'units' of fossil fuel energy are used to produce 100 ethanol 'units'.

Hydrogen Power

Hydrogen power is considered as the most exciting development in energy production in recent years because of the real potential it has to answer our energy problems.

Hydrogen is usually 'attached' to other elements [e.g. water (H_2O)], but once separated it can be combined with oxygen from the air in a *fuel cell* to create a chemical reaction that releases energy.

It is already being used to power rockets into space and there are some prototype cars around already– like the hydrogen-fuelled BMW that reaches speeds of 225km/hour. By 2020 BMW hope that 25% of their cars will run on hydrogen.

- ☺ Hydrogen is a very lightweight gas packed full of energy and it is the simplest and most abundant element in the universe. It won't run out so is renewable.
- ☺ The only waste products of hydrogen power are oxygen (from the separation process) and water (from the fuel cells when they produce power).
- ☺ No greenhouse gases are given off when it is used

So what's stopping us using it all the time?

- ☹ The process of separating the hydrogen in the first place (*electrolysis)* requires lots of energy.
- ☹ Storing any decent amounts of the hydrogen would require a fuel tank several times bigger than the car itself.

So what we need is a really efficient, safe and environmentally friendly way to separate out and store hydrogen and the fuel of the future would be sorted! All you need is lots of water and renewable energy - Iceland could use its geothermal power; United Arab Emirates could use solar power!

Or perhaps one day nuclear fusion could be used to power electrolysis?

Who knows, soon may be lighting up your classroom, powering your Wii and recharging your mobile phone! Perhaps it will be piped to our houses much the same way as gas is now.

Alternative Energy – The Future

Imagine it's the year 2045 (that's only 36 years away – how old will you be?):

Some scientists have estimated that the world's reserves of oil will have run out. The world population will have reached approximately a whopping 9 billion (it was 6.7 billion in 2009). Will sea levels have risen and drowned cities? Will we be wearing shorts and t-shirts and basking in warm temperatures in January in the UK because of Global Warming?

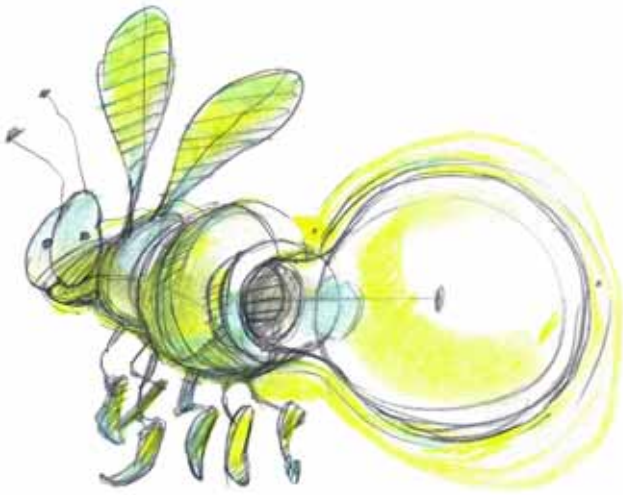
Will we be using alternative energy in our homes, schools, office, factories and cars? Let's hope so! But which one(s)? Chances are it will be a combination of many. The future of world energy relies on a mixture of politics, economics, available technology and people's attitudes. Attitudes and lifestyles need to change if we are to protect our planet by changing the way we use energy.

If **everyone** cut down on their use of energy from **now** the reduction in greenhouse gases would be enormous. Not only would the rate of climate change slow down but the supplies of fossil fuels would last that bit longer to give us enough time to develop green alternative energy. It would also save money on fuel bills! So where's the catch? There isn't one!

This is where education and spreading the word is essential. **You** can help spread the word!

Fact-tastic! In 1999 1.3 billion low-energy light bulbs installed in houses and offices around the world saved the energy and greenhouse emissions equivalent to 28 coal-fired power stations!

In the UK, TVs and DVD players left on standby use approximately £163 million worth of electricity in one year! (2003). So – go and turn off that TV!



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