Energy Resources

Article compiled from information available on Andy Darvill's Science Site at:
http://home.clara.net/darvill/altenerg/index.htm

Most of the Earth's energy comes from the Sun

Solar power, that's obvious, but the energy in coal originally came from the Sun too. Prehistoric plants stored the Sun's energy in their leaves, and when they died and eventually formed coal seams, that energy was still there. So when we burn coal (or any fossil fuel), we're releasing chemical energy that was stored in plants millions of years ago.

The same goes for Wind and Wave power. Waves occur because of winds, and winds blow because the Sun warms our atmosphere. Warm air tends to rise, and winds are due to other air moving in to replace it.

Most power stations burn coal, oil or natural gas to run the generators. Others use uranium, or the flow of water. Electricity is sent around the country using high-voltage power lines. Nearly all of the power we use comes from large power stations, although some places such as isolated farms, or hospitals, have their own diesel generators.

Fossil Fuels

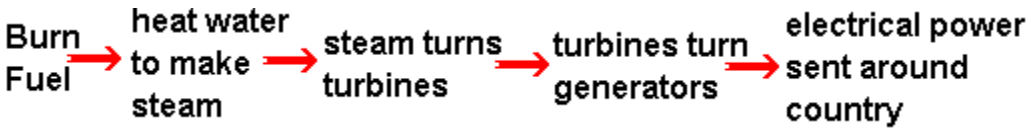
Introduction

Coal, Oil and Gas are called "fossil fuels" because they have been formed from the fossilised remains of prehistoric plants and animals.

They provide around 66% of the world's electrical power, and 95% of the world's total energy demands (including heating, transport, electricity generation and other uses).

How it works:

Coal is crushed to a fine dust and burnt. Oil and gas can be burnt directly.



More Details:

Coal provides around 28% of our energy, and oil provides 40%. Burning coal produces sulphur dioxide, an acidic gas that contributes to the formation of acid rain. This can be largely avoided using "flue gas desulphurisation" to clean up the gases before they are released into the

atmosphere. This method uses limestone, and produces gypsum for the building industry as a by-product. However, it uses a lot of limestone.

Crude oil (called "petroleum") is easier to get out of the ground than coal, as it can flow along pipes. This also makes it cheaper to transport.

Natural gas provides around 20% of the world's consumption of energy, and as well as being burnt in power stations, is used by many people to heat their homes.
It is easy to transport along pipes, and gas power stations produce comparatively little pollution.

Other fossil fuels are being investigated, such as bituminous sands and oil shale.
The difficulty is that they need expensive processing before we can use them.

The steam that has passed through the power station's turbines has to be cooled, to condense it back into water before it can be pumped round again. This is what happens in the huge "cooling towers" seen at power stations.

Some power stations are built on the coast, so they can use sea water to cool the steam instead. However, this warms the sea and can affect the environment, although the fish seem to like it.

Advantages

- Very large amounts of electricity can be generated in one place using coal, fairly cheaply.
- Transporting oil and gas to the power stations is easy.
- Gas-fired power stations are very efficient.
- A fossil-fuelled power station can be built almost anywhere, so long as you can get large quantities of fuel to it.

Disadvantages

- Basically, the main drawback of fossil fuels is pollution.
Burning any fossil fuel produces carbon dioxide, which contributes to the "greenhouse effect", warming the Earth.

- Burning coal produces more carbon dioxide than burning oil or gas.
  It also produces sulphur dioxide, a gas that contributes to acid rain. We can reduce this before releasing the waste gases into the atmosphere.
- Mining coal can be difficult and dangerous. Strip mining destroys large areas of the landscape.
- Coal-fired power stations need huge amounts of fuel, which means train-loads of coal almost constantly. In order to cope with changing demands for power, the station needs reserves. This means covering a large area of countryside next to the power station with piles of coal.

Is it renewable?

Fossil fuels are **not** a renewable energy resource. Once we've burned them all, there isn't any more, and our consumption of fossil fuels has nearly doubled every 20 years since 1900.
This is a particular problem for Oil, because we also use it to make plastics and many other products.

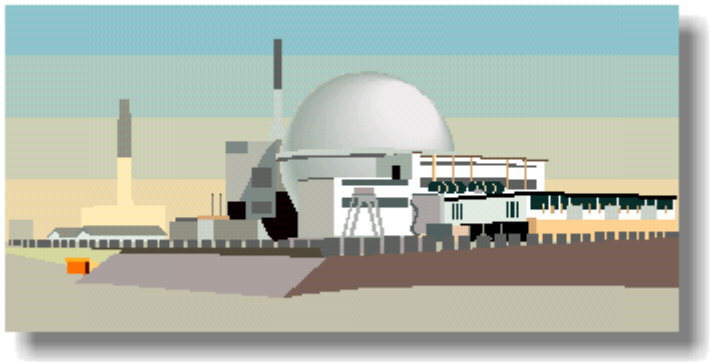
Nuclear Energy

Nuclear Power - energy from splitting Uranium atoms

Nuclear power is generated using Uranium, which is a metal mined in various parts of the world.

The first large-scale nuclear power station opened at Calder Hall in Cumbria, England, in 1956.

Some military ships and submarines have nuclear power plants for engines.



Nuclear power produces around 11% of the world's energy needs, and produces huge amounts of energy from small amounts of fuel, without the pollution that you'd get from burning fossil fuels.

How it works

Nuclear fission makes heat → heat water to make steam → steam turns turbines → turbines turn generators → electrical power sent around country

- Nuclear power stations work in pretty much the same way as fossil fuel-burning stations, except that a "chain reaction" inside a nuclear reactor makes the heat instead.
- The reactor uses Uranium rods as fuel, and the heat is generated by **nuclear fission**. Neutrons smash into the nucleus of the uranium atoms, which split roughly in half and release energy in the form of heat.
- Carbon dioxide gas is pumped through the reactor to take the heat away, and the hot gas then heats water to make steam.
- The steam drives turbines which drive generators.

Modern nuclear power stations use the same type of turbines and generators as conventional power stations.

In Britain, nuclear power stations are built on the coast, and use sea water for cooling the steam ready to be pumped round again. This means that they don't have the huge "cooling towers" seen at other power stations.

The reactor is controlled with "control rods", made of boron, which absorb neutrons. When the rods are lowered into the reactor, they absorb more neutrons and the fission process slows down. To generate more power, the rods are raised and more neutrons can crash into uranium atoms.

More details

Natural uranium is only 0.7% "uranium-235", which is the type of uranium that undergoes fission in this type of reactor.
The rest is U-238, which just sits there getting in the way.
Modern reactors use "enriched" uranium fuel, which has a higher proportion of U-235.

The fuel arrives encased in metal tubes, which are lowered into the reactor whilst it's running, using a special crane sealed onto the top of the reactor.

Carbon dioxide gas is blown through the reactor to carry the heat away. Carbon dioxide is chosen because it stops the reactor catching fire (it's around 600 degrees Celsius in there) and it doesn't turn into anything nasty when it's bombarded with neutrons.
You have to be very careful about the materials you use to build reactors - some materials will turn into horrible things in that environment.

Uranium itself isn't particularly radioactive, so when the fuel rods arrive at the power station they can be handled using thin plastic gloves. A rod can last for several years before it needs replacing. It's when the "spent" fuel rods are taken out of the reactor that you need the full remote-control robot arms and Homer Simpson equipment.

Nuclear power stations are not atomic bombs waiting to go off, and are not prone to "meltdowns". There is a lot of U-238 in there slowing things down - you need a high concentration of U-235 to make a bomb.
If the reactor gets too hot, the control rods are lowered in and it cools down.
If that doesn't work, there are sets of emergency control rods that automatically drop in and shut the reactor down completely.

With reactors in this country, the engineers cannot stop the emergency systems from shutting it down if things get out of hand - although at Chernobyl, in Ukraine, they turned off this automatic system to try something out, got it wrong, and the whole thing overheated, melted and blew up before they could stop it.

If something does go wrong in a really big way, much of the world could be affected - some radioactive dust (called "fallout") from the Chernobyl accident landed in the UK.

With AGR reactors (the most common type in Britain) there are additional safety systems, such as flooding the reactor with nitrogen and/or water to absorb all the neutrons - although the water option means that reactor can never be restarted.

Advantages

- Nuclear power costs about the same as coal, so it's not expensive to make.

- Does not produce smoke or carbon dioxide, so it does not contribute to the greenhouse effect.
- Produces huge amounts of energy from small amounts of fuel.
- Produces small amounts of waste.
- Nuclear power is reliable.

Disadvantages

- Although not much waste is produced, it is very, very dangerous.
  It must be sealed up and buried for many years to allow the radioactivity to die away.
- Nuclear power is reliable, but a lot of money has to be spent on safety - if it **does** go wrong, a nuclear accident can be a major disaster.

Is it renewable?

Nuclear energy from Uranium is **not** renewable.
Once we've dug up all the Earth's uranium and used it, there isn't any more.

Actually, it's not that simple - we can use "fast breeder" reactors to convert uranium into other nuclear fuels whilst also getting the energy from it - but these reactors are unstable, and used for making nuclear weapons rather than for generating electricity commercially.

Solar Energy

Solar Power is energy from the Sun

We've used the Sun for drying clothes and food for thousands of years, but only recently have we been able to use it for generating power.

The Sun is 150 million kilometres away, and amazingly powerful.

Just the tiny fraction of the Sun's energy that hits the Earth (around a hundredth of a millionth of a percent) is enough to meet all our power needs many times over.

In fact, every minute, enough energy arrives at the Earth to meet our demands for a whole year - if only we could harness it properly.

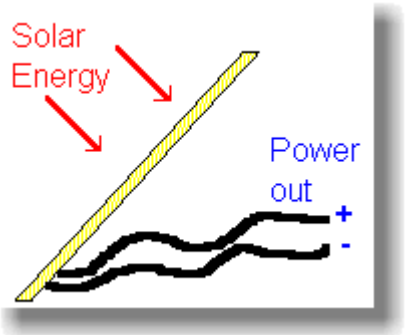
How it works

There are three main ways that we use the Sun's energy:-

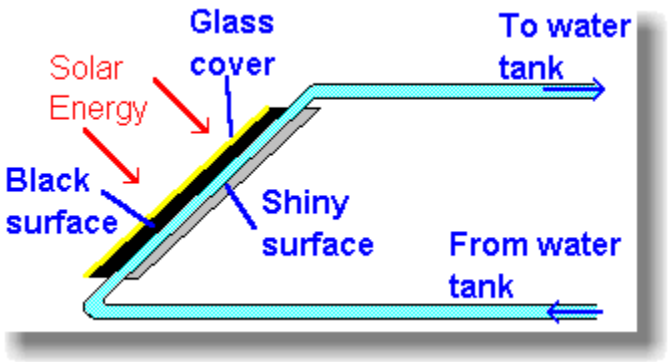
1. **Solar Cells** (really called "photovoltaic" or "photoelectric" cells) that convert light directly into electricity.

In a sunny climate, you can get enough power to run a 100W light bulb from just one square metre of solar panel.

This was originally developed in order to provide electricity for satellites, but these days many of us own calculators powered by solar cells.



2. **Solar water heating**, where heat from the Sun is used to heat water in glass panels on your roof.



Water is pumped through pipes in the panel. The pipes are painted black, so they get hot when the Sun shines on them.

This helps out your central heating system, and cuts your fuel bills. However, in the UK you must remember to drain the water out to stop the panels freezing in the winter.

This means you don't need to use so much gas or electricity to heat your water at home.

Solar heating is worthwhile in places like California and Australia, where you get lots of sunshine.

3. **Solar Furnaces** use a huge array of mirrors to concentrate the Sun's energy into a small space and produce very high temperatures.

There's one at Odellio, in France, used for scientific experiments.

It can achieve temperatures up to 33,000 degrees Celsius.

More details

Solar cells provide the energy to run satellites that oribt the Earth. These give us satellite TV, telephones, navigation, weather forecasting, the internet and all manner of other facilities.

In California, the **Solar One** power station uses the Sun's heat to make steam, and drive a generator to make electricity. The station looks a little like the Odellio solar furnace (see picture above), except that the mirrors are arranged in semi-circles around the "power tower".
As the Sun moves across the sky, the mirrors turn to keep the rays focussed on the tower, where oil is heated to 3,000 degress Celsius, The heat from the oil is used to generate steam, which then drives a turbine, which in turn drives a generator capable of providing 10kW of electrical power.

Solar One was very expensive to build, but as fossil fuels run out and become more expensive, solar power stations may become a better option.

Advantages

- Solar energy is free - it needs no fuel and produces no waste or pollution.
- In sunny countries, solar power can be used where there is no easy way to get electricity to a remote place.

Disadvantages

- Doesn't work at night.
- Very expensive to build solar power stations.
  Solar cells cost a great deal compared to the amount of electricity they'll produce in their lifetime.
- Can be unreliable unless you're in a very sunny climate. In the United Kingdom, solar power isn't much use, as you need a very large area of solar panels to get a decent amount of power.

Is it renewable?

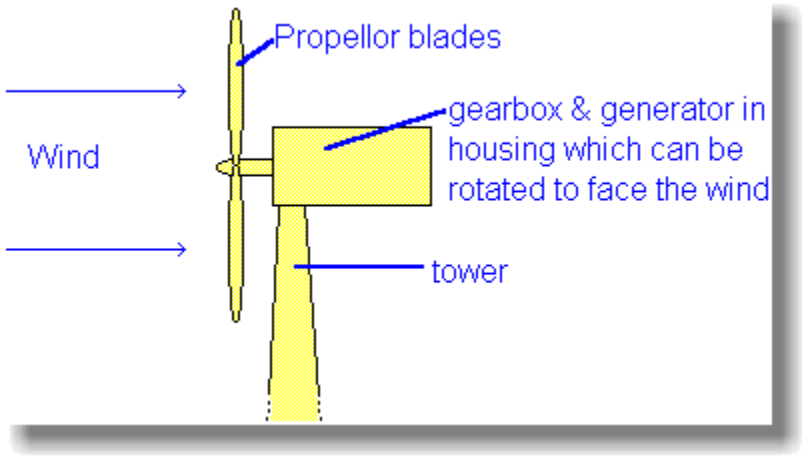
Solar power **is** renewable. The Sun will keep on shining anyway, so it makes sense to use it.

Wind Energy

Wind power - energy from the air

We've used the wind as an energy source for a long time. The Babylonians and Chinese were using wind power to pump water for irrigating crops 4,000 years ago, and sailing boats were around long before that.

Wind power was used in the Middle Ages, in Europe, to grind corn, which is where the term "windmill" comes from.



How it works

The Sun heats our atmosphere unevenly, so some patches become warmer than others. These warm patches of air rise, other air blows in to replace them - and we feel a wind blowing. We can use the energy in the wind by building a tall tower, with a large propellor on the top.

The wind blows the propellor round, which turns a generator to produce electricity. We tend to build many of these towers together, to make a "wind farm" and produce more electricity. The more towers, the more wind, and the larger the propellors, the more electricity we can make.

It's only worth building wind farms in places that have strong, steady winds, although boats and caravans increasingly have small wind generators to help keep their batteries charged.

More details

The best places for wind farms are in coastal areas, at the tops of rounded hills, open plains and gaps in mountains - places where the wind is strong and reliable.

To be worthwhile, you need an average wind speed of around 25 km/h. Most wind farms in the UK are in Cornwall or Wales.

Isolated places such as farms may have their own wind generators. In California, several "wind farms" supply electricity to homes around Los Angeles.

The propellors are large, to extract energy from the largest possible volume of air. The blades can be angled to "fine" or "coarse" pitch, to cope with varying wind speeds, and the generator and propellor can turn to face the wind wherever it comes from.
Some designs use vertical turbines, which don't need to be turned to face the wind.

The towers are tall, to get the propellors as high as possible, up to where the wind is stronger. This means that the land beneath can still be used for farming.

Advantages

- Wind is free, wind farms need no fuel.
- Produces no waste or greenhouse gases.
- The land beneath can usually still be used for farming.
- Wind farms can be tourist attractions.
- A good method of supplying energy to remote areas.

Disadvantages

- The wind is not always predictable - some days have no wind.
- Suitable areas for wind farms are often near the coast, where land is expensive.
- Some people feel that covering the landscape with these towers is unsightly.
- Can kill birds - migrating flocks tend to like strong winds. Splat!
- Can affect television reception if you live nearby.

Noisy. A wind generator makes a constant, low, "swooshing" noise day and night, which can drive you nuts. An entire wind farm makes quite a racket!
Then again, the small modern wind generators used on boats and caravans make hardly any noise.

Is it renewable?

Wind power **is** renewable. Winds will keep on blowing, it makes sense to use them.

Tidal Energy

Tidal power - energy from the sea

The tide moves a huge amount of water twice each day, and harnessing it could provide a great deal of energy - around 20% of Britain's needs.

Although the energy supply is reliable and plentiful, converting it into useful electrical power is not easy.

There are eight main sites around Britain where tidal power stations could usefully be built, including the Severn, Dee, Solway and Humber estuaries.

Only around 20 sites in the world have been identified as possible tidal power stations.

How it works

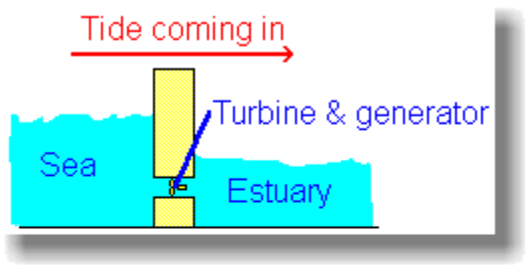
Tidal power works rather like a hydro-electric scheme, except that the dam is **much** bigger.

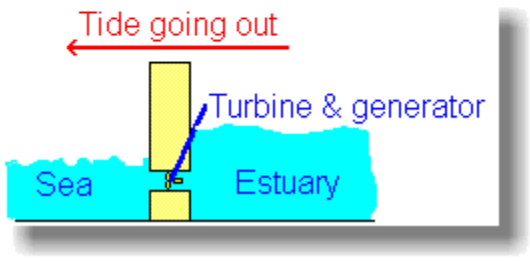
A huge dam (called a "barrage") is built across a river estuary. When the tide goes in and out, the water flows through tunnels in the dam.

The ebb and flow of the tides can be used to turn a turbine, or it can be used to push air through a pipe, which then turns a turbine. Large lock gates, like the ones used on canals, allow ships to pass.

If one was built across the Severn Estuary, the tides at Weston-super-Mare would not go out nearly as far - there'd be water to play in for most of the time.

But the Severn Estuary carries sewage and other wastes from many places (e.g. Bristol & Gloucester) out to sea. A tidal barrage would mean that this stuff would hang around Weston-super-Mare an awful lot longer!





More details

The largest tidal power station in the world (and the only one in Europe) is in the Rance estuary in northern France. It was built in 1966.

A major drawback of tidal power stations is that they can only generate when the tide is flowing in or out - in other words, only for 10 hours each day. However, tides are totally predictable, so we can plan to have other power stations generating at those times when the tidal station is out of action.

There have been plans for a "Severn Barrage" from Brean Down in Somerset to Lavernock Point in Wales.

It may have over 200 large turbines, and provide over 8,000 MegaWatts of power (that's over 12 nuclear power station's worth). It would take 7 years to build, and could provide 7% of the energy needs for England and Wales.

There may be a number of benefits, including protecting a large stretch of coastline against damage from high storm tides, and providing a ready-made road bridge. However, the drastic changes to the currents in the estuary could have huge effects on the ecosystem.

Advantages

- Once you've built the dam, tidal power is free.
- It produces no greenhouse gases or other waste.
- It needs no fuel.
- It produces electricity reliably.
- Not expensive to maintain.
- Tides are totally predictable.

Disadvantages

- Very expensive to build.
- Affects a very wide area - the environment is changed for many miles upstream and downstream.
  Many birds rely on the tide uncovering the mud flats so that they can feed.
- Only provides power for around 10 hours each day, when the tide is actually moving in or out.
- There are very few suitable sites for tidal power stations.

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another option is to use offshore turbines, rather like an underwater wind farm. This has the advantage of being much cheaper to build, and does not have the environmental problems that a tidal barrage would bring.

There are also many more suitable sites.

Find out more about the world's first offshore tidal power station at www.marineturbines.com/technical.htm

Is it renewable?

Tidal energy **is** renewable. The tides will continue to ebb and flow, and the energy is there for the taking.

Hydro-Electric Power

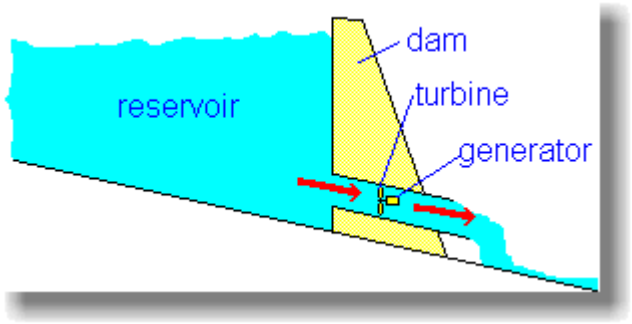
Hydro-electric power is generated from falling water

We have used running water as an energy source for thousands of years, mainly to grind corn.

The first use of water to generate electricity was in 1882 on the Fox river, in the USA, which produced enough power to light two paper mills and a house.

Nowadays there are many hydro-electric power stations, providing around 20% of the world's electricity. The name comes from "hydro", the Greek word for water.

How it works



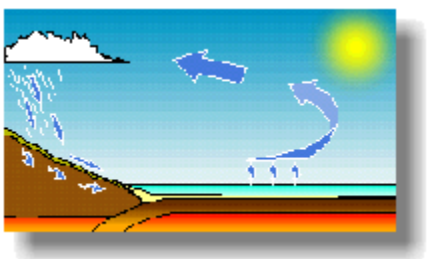
A dam is built to trap water, usually in a valley where there is an existing lake. Water is allowed to flow through tunnels in the dam, to turn turbines and thus drive generators.

Notice that the dam is much thicker at the bottom than at the top, because the pressure of the water increases with depth.

Hydro-electric power stations can produce a great deal of power very cheaply. The huge "Hoover Dam", on the Colorado river, supplies much of the electricity for the city of Las Vegas.

More information at http://www.hooverdam.com/,
and there's a good explanation of how hydro power works at http://www.fwee.org/Tours.html.

Although there are many suitable sites around the world, hydro-electric dams are very expensive to build.



However, once the station is built, the water comes free of charge, and there is no

waste or pollution.

The Sun evaporates water from the sea and lakes, which forms clouds and falls as rain in the mountains, keeping the dam supplied with water.

More details

Gravitational potential energy is stored in the water above the dam. Because of the great height of the water, it will arrive at the turbines at high pressure, which means that we can extract a great deal of energy from it. The water then flows away downriver as normal.

In mountainous countries such as Switzerland and New Zealand, hydro-electric power provides more than half of the country's energy needs.

An alternative is to build the station next to a fast-flowing river. However with this arrangement the flow of the water cannot be controlled, and water cannot be stored for later use.

Advantages

- Once the dam is built, the energy is virtually free.
- No waste or pollution produced.
- Much more reliable than wind, solar or wave power.
- Water can be stored above the dam ready to cope with peaks in demand.
- Hydro-electric power stations can increase to full power very quickly, unlike other power stations.

Electricity can be generated constantly.

Disadvantages

- The dams are very expensive to build. However, many dams are also used for flood control or irrigation, so building costs can be shared.
- Building a large dam will flood a very large area upstream, causing problems for animals that used to live there.

- Finding a suitable site can be difficult - the impact on residents and the environment may be unacceptable.

Water quality and quantity downstream can be affected, which can have an impact on plant life.

Is it renewable?

Hydro-electric power **is** renewable.
The Sun provides the water by evaporation from the sea, and will keep on doing so.

Energy from Pumped Storage Reservoirs

Pumped Storage Reservoirs - storing energy to cope with big demands

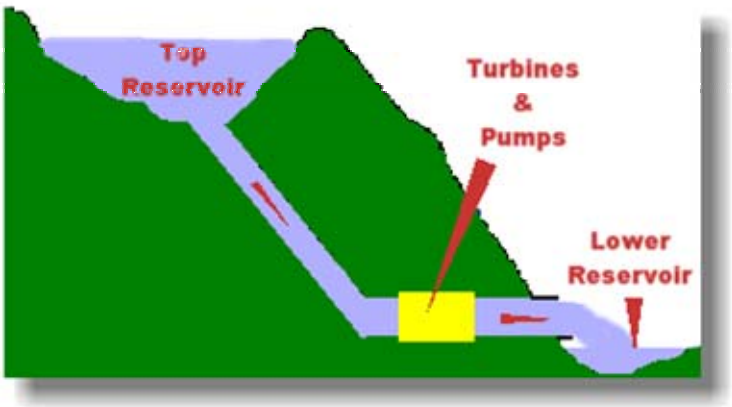
Pumped storage reservoirs aren't really a means of generating electrical power. They're a way of storing energy so that we can release it quickly when we need it.

Demand for electrical power changes throughout the day. For example, when a popular TV programme finishes, a huge number of people go out to the kitchen to put the kettle on, causing a sudden peak in demand.

If power stations don't generate more power immediately, there'll be power cuts around the country - traffic lights will go out, causing accidents, and all sorts of other trouble will occur.

The problem is that most of our power is generated by fossil fuel power stations, which take half an hour or so to crank themselves up to full power. Nuclear power stations take much longer.

We need something that can go from nothing to full power immediately, and keep us supplied for around half an hour until the other power stations catch up. Pumped storage reservoirs are the answer we've chosen.



How it works

Between 1976 and 1982 at Dinorwig, in North Wales, a huge project was built. Yet there's little to see as you drive past, as most of it is deep inside a mountain.

Water is pumped up to the top reservoir at night, when demand for power across the country is low.

When there's a sudden demand for power, the "headgates" (huge taps) are opened, and water rushes down the tunnels to drive the turbines, which drive the powerful generators.

The water then collects in the bottom reservoir, ready to be pumped back up later.

Dinorwig has the fastest "response time" of any pumped storage plant in the world - it can provide 1320 MegaWatts in 12 seconds. That's a lot of cups of tea!

More details about Dinorwig

When water is pumped up to the top reservoir (called "Marchlyn Mawr") we are storing gravitational potential energy in it. The greater the height, the more energy is stored.
This is one of the reasons that the Dinorwig site was chosen - there was a big height difference between two existing lakes, so less work was needed to build the station.

The water falls 600 metres on its way to the turbines, so it's under a great deal of pressure when it arrives. For this reason, the

tunnels are lined with steel at the bottom end.

Each of the six generators is capable of producing 288 MegaWatts of power at 18,000 Volts, which is stepped up to 40,000 Volts by transformers and sent along underground cables to be fed into the National Grid.

Dinorwig has "pump/turbines", which can be used both as pumps for getting water from the lower to the upper reservoirs, and as turbines for generating electrical power.

There is a complex system of gutters in the roof of the caves, to collect water that drips down through the rock. Carol Vordeman worked on this part of the station - helping to design this was one of her first engineering jobs before she moved into television.

You can find out more about the Dinorwig station from First Hydro's web site.

Advantages

- Without some means of storing energy for quick release, we'd be in trouble.
- Little effect on the landscape.
- No pollution or waste

Disadvantages

- Expensive to build.
- Once it's used, you can't use it again until you've pumped the water back up.
  Good planning can get around this problem.

Is it renewable?

It's not really a power station, but a means of storing energy from other power stations. So the question doesn't apply.

Wave Energy

Wave Power - energy from the wind on the sea

Ocean waves are caused by the wind as it blows across the sea. Waves are a powerful source of energy.

The problem is that it's not easy to harness this energy and convert it into electricity in large amounts. Thus, wave power stations are rare.

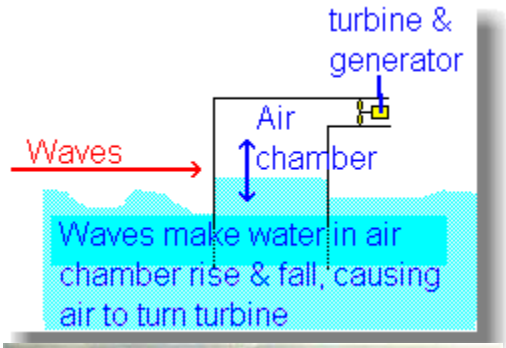
How it works

There are several methods of getting energy from waves, but one of the most effective works like a swimming pool wave machine in reverse.

At a swimming pool, air is blown in and out of a chamber beside the pool, which makes the water outside bob up and down, causing waves.

At a wave power station, the waves arriving cause the water in the chamber to rise and fall, which means that air is forced in and out of the hole in the top of the chamber.

We place a turbine in this hole, which is turned by the air rushing in and out. The turbine turns a generator.



A problem with this design is that the rushing air can be very noisy, unless a silencer is fitted to the turbine. The noise is not a huge problem anyway, as the waves make quite a bit of noise themselves.

For more information, see www.wavegen.co.uk, who operate a commercial wave power station.

More details

Once you've built it, the energy is free, needs no fuel and produces no waste or pollution.

One big problem is that of building and anchoring something that can withstand the roughest conditions at sea, yet can generate a reasonable amount of power from small waves.
It's not much use if it only works during storms!

A company called **Wavegen** now operate a commercial wave power station called "Limpet" on the Scottish island of Islay,

Another method

A company called **Ocean Power Delivery** are developing a method of offshore wave energy collection, using a floating tube called "Pelamis".

This long, hinged tube (about the size of 5 railway carriages) bobs up and down in the waves, as the hinges bend they pump hydraulic fluid which drives generators.

Find out more, including an interactive model, videos and technical details at http://www.oceanpd.com/

Advantages

- The energy is free - no fuel needed, no waste produced.
- Not expensive to operate and maintain.
- Can produce a great deal of energy.

Disadvantages

- Depends on the waves - sometimes you'll get loads of energy, sometimes nothing.
- Needs a suitable site, where waves are consistently strong.
- Some designs are noisy.
- Must be able to withstand very rough weather.

Is it renewable?

Wave power **is** renewable.

Geothermal Energy

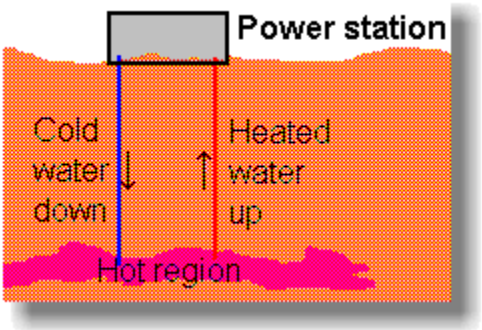
Geothermal Energy is energy from heat inside the Earth.

The centre of the Earth is around 6000 degress Celsius - hot enough to melt rock. Even a few kilometres down, the temperature can be over 250 degrees Celsius.

In general, the temperature rises one degree Celsius for every 36 metres you go down.

In volcanic areas, molten rock can be very close to the surface.

Geothermal energy has been used for thousands of years in some countries for cooking and heating.



The name "geothermal" comes from two Greek words: "geo" means "Earth" and "thermal" means "heat".

How it works

Hot rocks underground heat water to produce steam.
We drill holes down to the hot region, steam comes up, is purified and used to drive turbines, which drive electric generators.

There may be natural "groundwater" in the hot rocks anyway, or we may need to drill more holes and pump water down to them.

The first geothermal power station was built at Landrello, in Italy, and the second was at Wairekei in New Zealand. Others are in Iceland, Japan, the Philippines and the United States.

In Iceland, geothermal heat is used to heat houses as well as for generating electricity.

If the rocks aren't hot enough to produce steam we can sometimes still use the energy - the Town Hall in Southampton, England, is partly heated this way.

More details

Geothermal energy is an important resource in volcanically active places such as Iceland and New Zealand.
How useful it is depends on how hot the water gets. This depends on how hot the rocks were to start with, and how much water we pump down to them.

Water is pumped down an "injection well", filters through the cracks in the rocks in the hot region, and comes back up the "recovery well" under pressure. It "flashes" into steam when it reaches the surface.

The steam may be used to drive a turbogenerator, or passed through a heat exchanger to heat water to warm houses. A town in Iceland is heated this way.

The steam must be purified before it is used to drive a turbine, or the turbine blades will get "furred up" like your kettle and be ruined.

Advantages

- Geothermal energy does not produce any pollution, and does not contribute to the greenhouse effect.
- The power stations do not take up much room, so there is not much impact on the environment.
- No fuel is needed.
- Once you've built a geothermal power station, the energy is almost free.
  It may need a little energy to run a pump, but this can be taken from the energy being generated.

Disadvantages

- The big problem is that there are not many places where you can build a geothermal power station.
  You need hot rocks of a suitable type, at a depth where we can drill down to them.
  The type of rock above is also important, it must be of a type that we can easily drill through.
- Sometimes a geothermal site may "run out of steam", perhaps for decades.
- Hazardous gases and minerals may come up from underground, and can be difficult to safely dispose of.

Is it renewable?

Geothermal energy **is** renewable. The energy keeps on coming, as long as we don't pump too much cold water down and cool the rocks too much.

Energy from Biomass

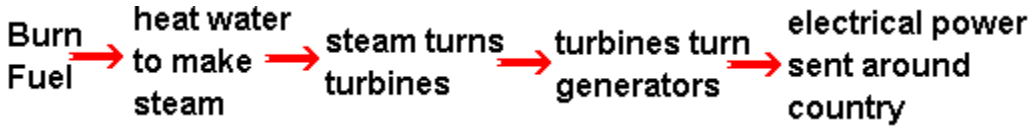
Biomass - energy from organic materials

Wood was once our main fuel. We burned it to heat our homes and cook our food. Wood still provides a small percentage of the energy we use, but its importance as an energy source is dwindling.

Sugar cane is grown in some areas, and can be fermented to make alcohol, which can be burned to generate power in the same way as coal. Alternatively, the cane can be crushed and the pulp (called "bagasse") can be burned, to make steam to drive turbines.

Other solid wastes, can be burned to provide heat, or used to make steam for a power station. "Bioconversion" uses plant and animal wastes to produce fuels such as methanol, natural gas, and oil.
We can use rubbish, animal manure, woodchips, seaweed, corn stalks and other wastes.

How it works



The fuel is burned, which heats water into steam, which turns turbines, which in turn drive generators, just like in a fossil-fuel power station.

More details :- Sugar cane

Sugar cane is harvested and taken to a mill, where it is crushed to extract the juice. The juice is used to make sugar, whilst the left-over pulp, called "bagasse" can be burned in a power station.

The station usually provides power for the sugar mill, as well as selling electricity to the surrounding area.

Advantages

- It makes sense to use waste materials where we can.
- The fuel tends to be cheap.
- Lless demand on the Earth's resources.

Disadvantages

- Collecting the waste in sufficient quantities can be difficult.
- We burn the fuel, so it makes greenhouse gases.
- Some waste materials are not available all year round.

Is it renewable?

Biomass **is** renewable, as we're going to carry on making waste products.
We can always plant & grow more sugar cane and more trees, so those are renewable too.