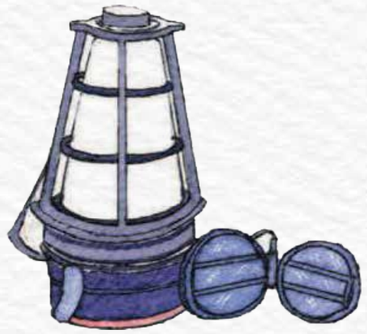
WAYS TO ACCESS ENERGY

Batteries

Batteries store energy and release it when needed. The chemicals used in many batteries are toxic and also very expensive (lead, cadmium and mercury are examples), so it is important that old batteries are recycled whenever possible. If the components are reused or disposed of safely then the dangerous chemicals will not get in the soil or food-chain.

The metal called lithium is used to make the rechargeable batteries for mobile phones, laptops, digital cameras and electric vehicles and also for medical devices like pace-makers and hearing aids. Lithium batteries hold a lot of power, have a long life, and can be very, very, small, but they are expensive.

Solar powered lanterns and wind-up radios are two popular 'clean' and affordable devices that have improved many lives. They both use rechargeable batteries.



ACTION SHEET - 68: Solar lanterns

FUN FACTS

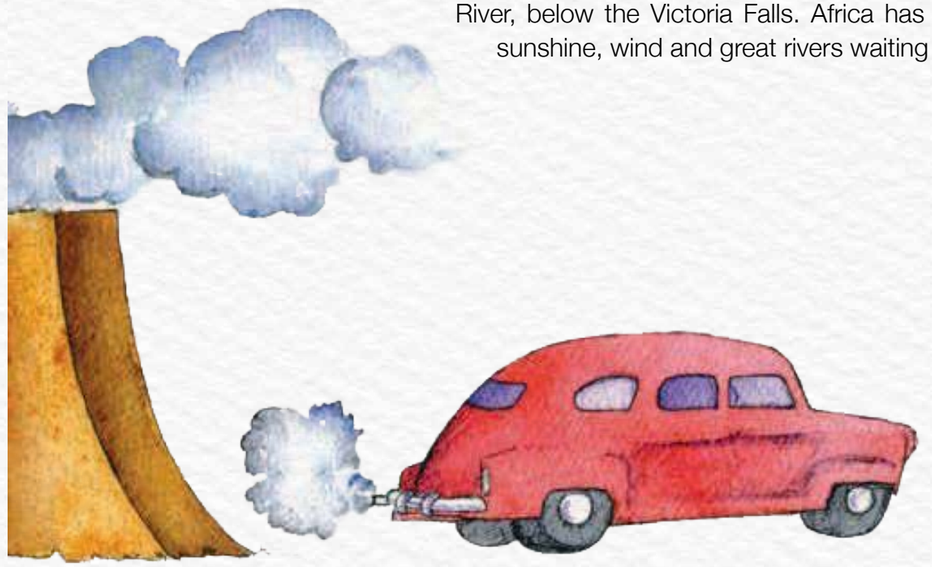
- Lithium is a soft silvery metal, which has the lowest density of all metals.
- The chemical symbol for Lithium is Li.
- Most lithium comes from Chile in South America and from Australia.
- Electric cars run on batteries. They are re-charged at home or at charging points on highways.
- After 2035 diesel and petrol cars will be forbidden in the UK - all vehicles will be electric!

Fossil Fuels

Fossil fuels are literally made of fossils – the dead bodies of trees and other organisms that died during the Carboniferous Period (about 354 – 292 million years ago). Coal is the remains of forests and swamps that covered the earth hundreds of millions of years ago. As the trees died they were buried under layers of soil and weighed down as more fell on top.

Gradually over time, pressure and high temperatures turned it into coal. Oil and natural gas was made in a similar way from the bodies of marine plankton: tiny plants and animals which floated in the sea millions of years ago and sunk to the sea floor when they died. Their prehistoric remains were buried in sedimentary rocks, where they were changed by heat and pressure into gas or oil. The bodies of plants and animals contain a lot of the chemical element carbon. Burning fossil fuels, just like burning wood, releases the carbon, as gases, into the atmosphere. This has consequences for the climate, as explained on **page 140** and in the Booklet on Energy and Climate Change.

Fossil fuels are not renewable because they were made slowly over a long period of time and we are using them up, very fast. All the world's oil and most of the gas could be finished by 2050. Most countries currently depend on fossil fuels and buying them from countries where they occur naturally or are processed. Producing energy locally from clean renewable sources can save a country money and protect our planet. Zimbabwe and Zambia started a project like this in 2018, a new joint hydro-electric project that will generate 1600 Megawatts of electricity, enough to meet their own needs and export! It will use energy from the Zambezi River, below the Victoria Falls. Africa has a lot of energy in its sunshine, wind and great rivers waiting to be harnessed.



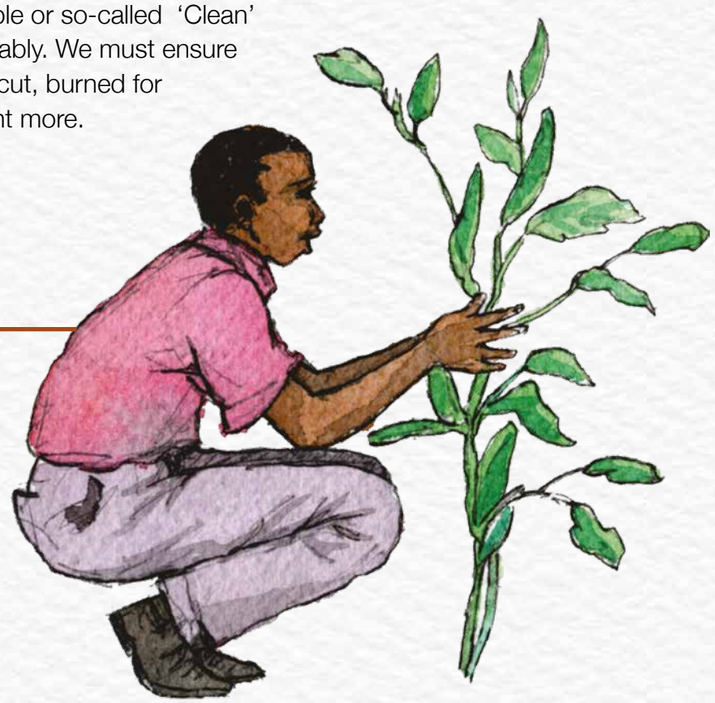
Biomass – Energy from life

Wood, charcoal, dung, agricultural and human waste, even bacteria and algae – anything that grows or is produced by living things is known as 'biomass' and can be used to make energy. Biomass energy is created from the carbon stored in the bodies of plants and animals. Like fossil fuels, biomass produces carbon gases when it is burnt or digested, however there are technologies that allow us to capture these gases, and even to make them work for us. Using modern technology, biomass can be used to generate electricity, provide fuel for vehicles, gas for cooking and heating and powering machinery.

While Biomass is considered to be a renewable or so-called 'Clean' source of Energy, it needs to be used sustainably. We must ensure that it is renewed, that means when wood is cut, burned for fuel or used to make charcoal WE MUST plant more.

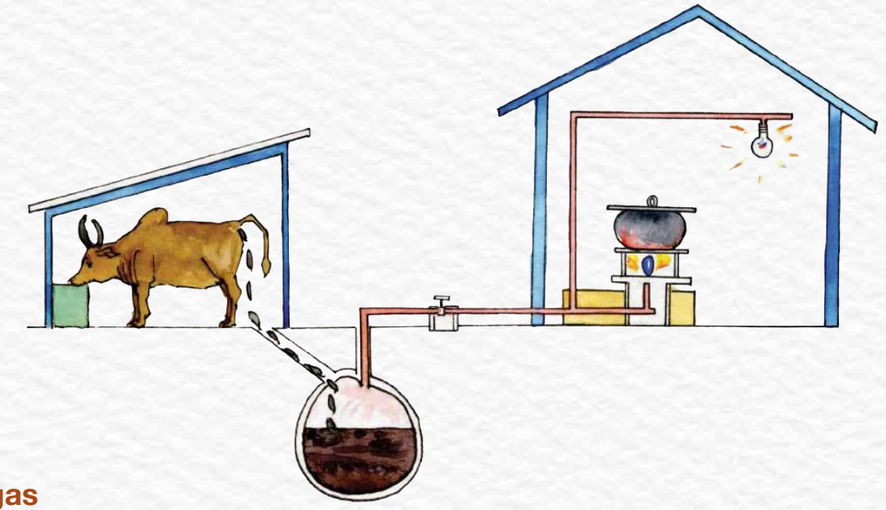
don't forget

IF YOU BURN WOOD, PLANT A TREE!



Burn Dung

Animal faeces or dung is waste material, but we can get energy from it, and make it work for us. It is one of the fuels of the future. Cow dung that is left to decompose naturally produces methane, a smelly gas which is 21 times as bad for the climate as carbon dioxide. Capturing and using this gas is a clever way to stop methane getting into the atmosphere and to solve energy problems at the same time. The PACE Climate Change booklet explains how African countries are providing power for factories and cities using this kind of biogas.



Biogas

Biogas is gas made from the breakdown of organic matter, including dung, by bacteria in the absence of air (the process is called anaerobic digestion or fermentation). A smelly pond or marsh producing methane or a cow's wind – are all biogases.

Biogas factories use special sealed digesting chambers to speed up the process of breaking down the waste. The chambers have two products - biogas which is captured and bottled to burn for lighting and cooking and other uses, and slurry which is used as fertiliser on farms. Digesting chambers can be made by local artisans. As the material breaks down it gets hot. The high temperatures kill any dangerous bacteria (similar to the process of making compost).

Methane can also be made using municipal garbage, from waste foodstuff and other organic remains that are usually discarded on rubbish dumps and landfill sites. Biogas can be made in people's homes, by schools, farmers or by businesses.

Human waste can also be used to make biogas. If toilet waste is channelled into a biodigester you'll end up with cooking gas for free, safe fertiliser – free, better sanitation and healthier kitchens.

fun facts

- $1m^3$ of biogas can cook 3 meals for a family of five or six.
- Biogas can fuel power stations. It is burned to heat water, producing steam that powers turbines which generates electricity.
- There are 880 biogas plants in Kenya.
- Tanzania uses biogas from municipal and industrial waste to produce grid electricity and make fertliser.

Biofuels

Biofuels are liquid or gas fuel made from processed plant material. Bioethanol and biodiesel are common examples. They are used instead of petrol or diesel in cars, trucks, generators, even aeroplanes.

Biofuel is big business in some parts of the world. Large bioreactors use waste from sawmills, waste cooking grease and old cooking and motor engine oils, even crop residue. It is broken down into sugars and fermented into alcohol. Brazil makes 16 billion litres a year. There is a more complicated chemical process that is used to make biofuel from algae. But the simplest method uses sugars like sugarcane and vegetable oils like palm, sunflower, groundnut, soya, corn and coconut. The oils and sugars can be extracted using a hand press like the ones used to extract oil to eat. Then it is fermented, the same as making wine or beer, to produce ethanol, which is the alcohol in wine and beer. Glycerin which is also useful is a by-product. Locally made biofuel can be used in an ordinary diesel engine, in fact it will make your engines last longer!

You may be starting to realise that there are good jobs for people who have studied biology, microbiology and chemistry and lots of opportunities to make more use of the resources around us!

Biochar

Biochar has been central to life on John and Anna's small holding in north western Kenya for more than twenty years. At Spencer's Farm biochar has provided clean energy and clean drinking water for local households, halted deforestation, improved soil and helped fight climate change. Biochar is a fantastic way to use the energy in wood, at no cost and actually reduce CO2 emissions at the same time. What could be better?

Biochar is similar to charcoal, but is actually made while cooking, it is a by-product of a simple model of improved cook stove. Biochar stoves make very little smoke, require only twigs of wood and cook well.

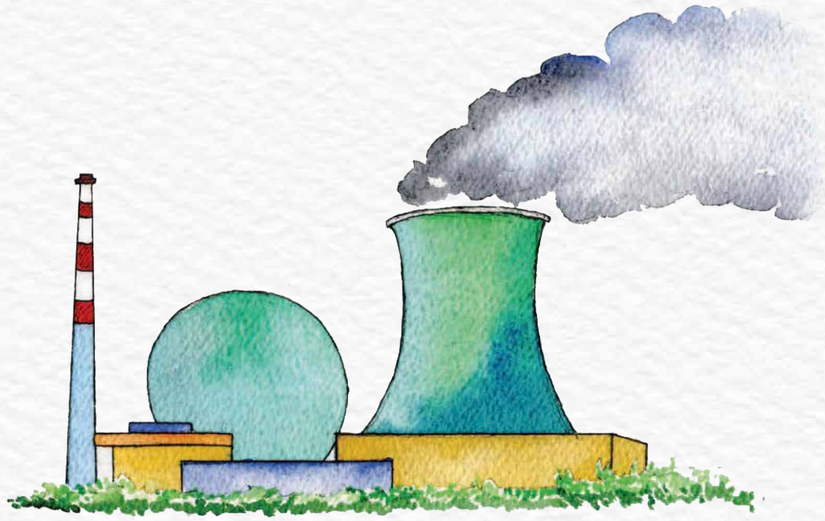
Biochar is wood that has been 'burned' with very little oxygen present. The process is called pyrolysis. The presence of just some oxygen causes the tars and oils in the wood to burn away. As they burn heat and a clean, hot flame is created. A light, brittle structure like charcoal, remains. This is biochar, it is made up of carbon. It can be used to filter water to make it safe for drinking. It is added to compost to reduce odour and to soil to increase productivity, especially poor soils.

ACTION SHEETS - 68: Solar Lanterns, 60: Solar Cooking, 64: Solar Water Heating, 67: Planting Trees for Fuelwood, 66: Biogas

Watch the films Energy, Biogas and Water Energy

Nuclear Power

Nuclear energy is the energy inside atoms. Atoms are the tiniest particles of things and there is enormous energy holding them together. This energy can be used to make electricity. The process is called nuclear fission and it takes place inside massive machines called nuclear reactors housed in nuclear power stations. They use uranium. Uranium atoms are split releasing energy as heat. The heat is used to boil water, producing steam that drives turbines to produce electricity.



Some countries favour nuclear power, others do not. About 17% of world electricity is produced in this way. Seventy percent of France's energy comes from nuclear power, about 20% for the UK and USA. Less than 2% of Africa's energy comes from nuclear power. South Africa has the only nuclear power station on the continent, it is at Koeberg, 30 km north of Cape Town and has two reactors that generate 5% of South Africa's electricity.

fun facts

- The chemical symbol for uranium is U.
- Uranium is a heavy metal.
- Uranium is naturally radioactive. It is found in rocks in the earth's crust.
- Many African countries have uranium reserves.
- Niger, Namibia and South Africa together mine up to 18% of annual global production.
- Most uranium is mined in Kazakhstan (39%), Canada (22%) and Australia.

good to know

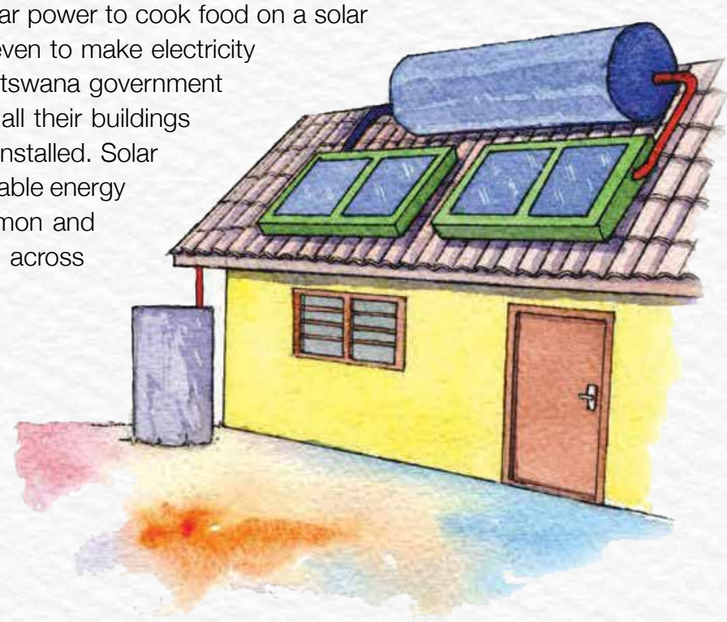
Renewable and Non-renewable energy

Solar, wind, water - these are all renewable sources of energy. Unlike fossil fuels (oil, coal, gas) which take millions of years to form, renewables are ever-present or can be grown or made again and again. Renewable sources of energy include the sun, the wind, water, human and animal waste. You have to buy or build equipment to harness energy from the sun, wind or water in order to make household energy. But, once this is paid for the only cost is maintenance. No bills! and locally produced renewable energy is more reliable than grid power in many areas.

Solar energy: Get on the sunny side

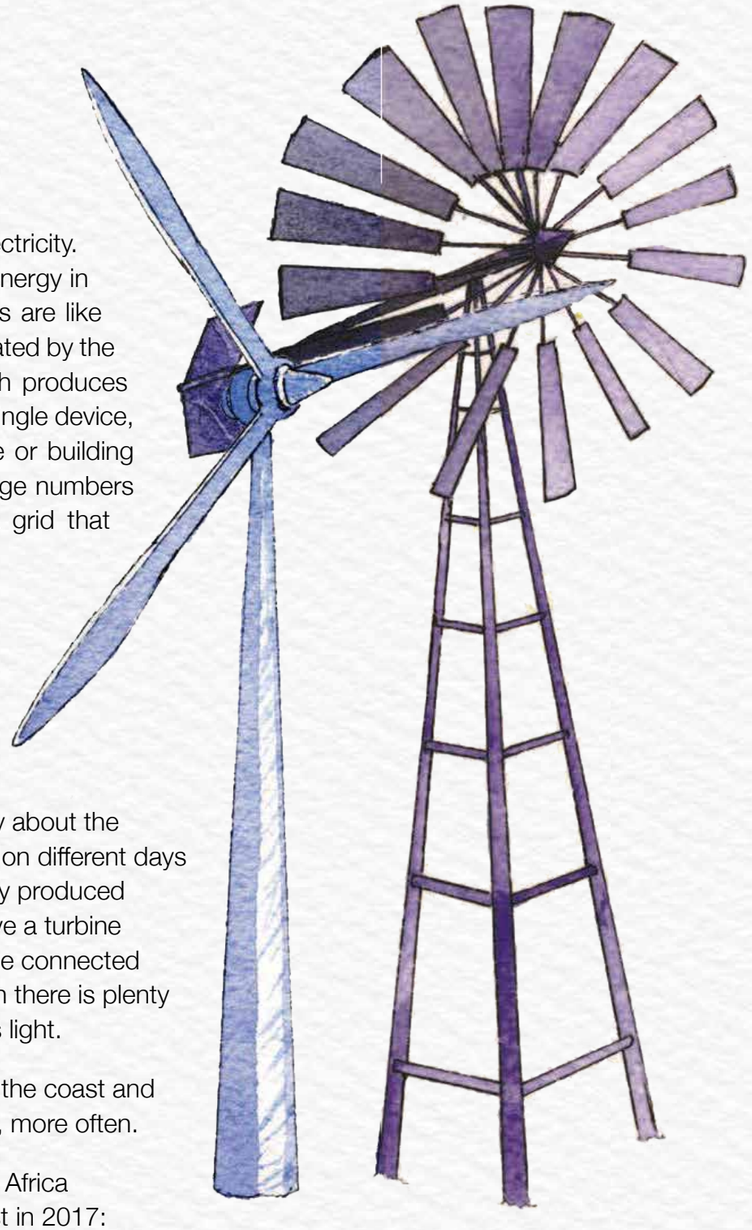
The sun is a huge ball of fire, a mass of energy, of material burning up in outer space, 93 million miles away. It takes 8 minutes for light from the sun to reach us here on Earth. In the centre of the sun, it is 15,000,000°C and it's been burning for the last 4.6 billion years. This energetic star can be used to make household energy. Solar energy is in many ways the perfect power source. It won't run out for another 5 billion years! Sitting in the sky sometimes it seems friendly, sometimes too hot and deadly, but it is always there for free.

Humans have been slow to take advantage of the sun's energy. You can't hold the sun in your hand or put it into a tin can or a petrol pump so it's difficult to sell. You can use solar power to cook food on a solar cooker, heat your water and home, even to make electricity with photovoltaic technology. The Botswana government have made it a legal requirement for all their buildings to have solar water heating systems installed. Solar energy systems for homes and renewable energy village power systems are now common and widely available in many countries across Africa.



Wind Power

The movement of air can be used to make electricity. Wind turbines are used to convert the kinetic energy in wind to mechanical (electrical) energy. Turbines are like windmills but with blades, as the blades are rotated by the force of the wind, they turn a generator which produces electricity. Small turbines are used to power a single device, larger ones make electricity for a single house or building and commercial turbines, often arranged in large numbers as a 'wind farm' are usually connected to a grid that carries the electricity to whole regions.



Wind turbines work most efficiently when they are 30m or more above ground, where the blades can capture faster, less turbulent air. For this reason, commercial wind turbines can be up to 100m above the ground.

The amount of wind we get each year is usually about the same, but it varies at different times of the day, on different days and between seasons. The amount of electricity produced depends on the strength of the wind. If you have a turbine for your house, business or community it can be connected to a battery that will store electricity made when there is plenty of wind so that it can be used when the wind is light.

- In Africa big wind farms are commonest on the coast and hilly areas, where there is more strong wind, more often.
- Egypt, Tunisia, Morocco, Kenya, and South Africa have big wind farms. Kenya built the biggest in 2017: 365 turbines, covering 40,000ha, employing 200 people.
- Namibia's power plans include wind. A new wind farm was built in 2018 and two more are on the way.
- Senegal, Ghana and Mozambique are installing wind farms.
- Denmark in northern Europe generates 40% of its electricity using wind power - 31,000 people work in its wind industry.

Water Power

If you stand in a river or the sea or just pour some water on your hand you can feel the energy in moving water. It is called hydro power and can be turned into electricity using turbines and generators, using a similar system to wind energy. Water passes through the turbines making its blades spin. The turbine is connected to electromagnetic generators which produce hydroelectricity. When the water is falling, by gravity it has potential energy; when it is flowing, in the sea for example it has kinetic energy. Hydroelectricity is 'renewable energy' because the water cycle which provides the moving water is continuous, fuelled by the sun and by gravity.

Hydroelectricity is an important source of energy, especially in Africa where most countries have built very large hydro-electric plants on big rivers. The Zambezi, Nile and Congo are great sources of energy. Some countries make more than 90% of their electricity from hydro, examples are Ethiopia, Malawi, Mozambique and Zambia.

Hydroelectric plants come in all different sizes. Small scale equipment that use water from a river or stream can be set up locally at little cost and are not difficult to use.

- Pico hydro uses turbines that produce up to 5 kilowatts of electricity, enough for one or a group of houses or a workshop.
- Micro hydro units produce 5-100 kilowatts.

This picture shows a micro-hydro system, which produces energy for a community in Kenya. 18 kilowatts of power is produced to provide light and power to 180 homes. They set up, own and manage the plant themselves.

Can you think of the advantages and disadvantages of hydroelectricity?