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SAVE PLANET EARTH

FUTURE POWER

GREEN GADGET GUIDE

Author
Tanya Luther Agarwal

Terrapin

Note from Mr. Majid Al Mansouri

It is He, who made you trustees of the earth,
And exalted some in rank over others.
In order to try you
By what He has given you
Indeed your Lord's retribution is swift
Yet He is forgiving and kind.

Verse from Holy Quran –Surat Al Ana'am

Ayah 165 (6:165)

Climate change today is threatening our planet and in fact our very survival on earth .All countries and governments are concerned as we humans have contributed to this malaise. To find solution to any problem, we must first fully comprehend it. Hence Environment Agency – Abu Dhabi (EAD) in association with The Energy Research Institute (TERI) is adapting and bringing this save planet series of books on Climate change to children in the UAE with a hope that students as future custodians of our environment learn about what ails our mother earth, how each one us impact the environment through our actions, so that they are in a position to make appropriate decisions on matters that affect the health of our planet.

Climate change is expected to have direct and indirect impacts on earth. Scientists predict that we would lose nearly one third of our biodiversity, Sea levels would rise flooding low lying areas, face severe fresh water shortages , desertification , health issues such increased incidences of infectious diseases, heat strokes, forest fires, hurricanes and extreme and strange weather patterns to name some .

While governments are trying to fathom this new reality and looking at ways and means to tackle this global issue, it is becoming clearer to all, that only a concerted and collaborative action from each and everyone can actually help save this unique planet. United Arab Emirate too is aware of its responsibility and that is why despite being a country which is endowed with vast reserves of petroleum, a non renewable resource, and the one which contributes to climate change, it is working hard to establish the first carbon neutral city MASDAR in the coming few years and invest more on developing the renewable source of energy in the country. In addition, the country is also aiming to educate its future generation, through imbibing sound knowledge, imparting skill and helping to develop right attitude towards the environmental issues so as to prepare them to face any eventualities in the future.

We hope these books would be read by all students and would help them to understand the issue of climate change and the role that they can play in helping to save this unique planet.

CONTENTS

Squeaky Clean

If you wanted to give a present to your friend or family, you would never dream of giving a stinking, dirty rag, would you? Environmentalists around the world wouldn't either. They have come up with ideas and technologies that will bring a smile to the 'face of the earth'.

Nature is green...

We haven't been good friends to the earth for a long time now. People around the world have polluted the air, rivers, and the land; cut down forests and left thousands of species homeless; and almost exhausted natural resources like fossil fuels that took millions of years to form.

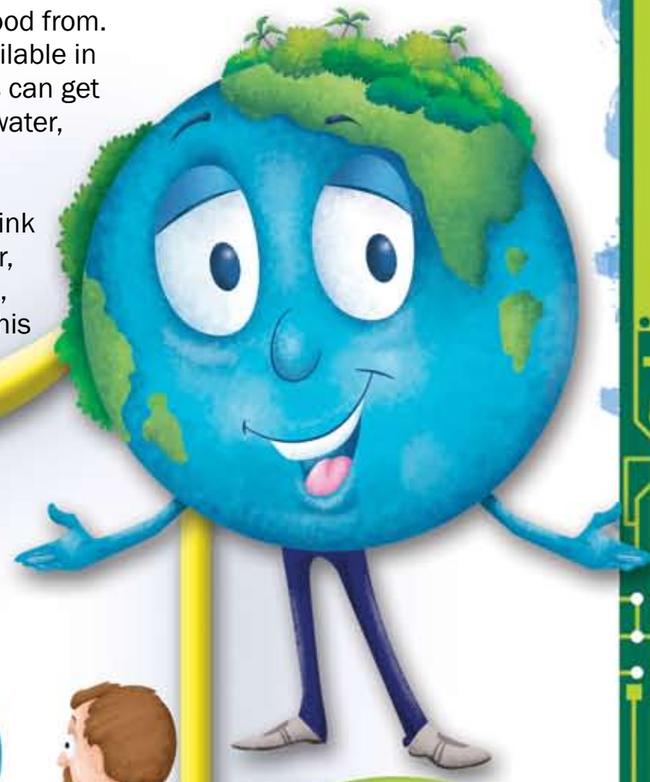
Earth-friendly people use eco-friendly products. This is the first step towards being gentle and caring toward our planet. Environmentalists suggest that we use items that are handmade, free of chemicals or that have used up very little energy in their manufacturing. Recycled jute or cloth bags, handmade paper, and chemical-free soaps and detergents are some such items.

...And green is clean!

Take a look at the plants, trees, and birds around you. They don't have factories to buy food from. They feed and grow on whatever is available in nature—naturally! If these living beings can get all they need from the sun, wind, and water, then so can we.

Smart scientists, engineers, and inventors realized this and began to think about using energy from the sun, water, wind, and ocean tides to power homes, run cars, and fly airplanes. Capturing this energy is only half the battle; the other half is about working out ways to get this to the maximum number of people and in an inexpensive package.

Clean technology is the new buzzword for ideas that will help control global warming, cut down pollution and help heal our planet.



Greening the earth

Renewable energy experts in Europe believe that 50 per cent of the world's energy demand can be met by renewable sources by 2040 if governments take measures to develop and adopt green technologies.

Let the sun shine in

You can look up to it but you cannot look at it. It is the sun, of course! The powerful heat and light from the sun is called solar energy. This energy is converted, or changed, to produce heat and electricity in a form that can be used by people.

Follow the sun!

Humans have been worshipping the sun and using its energy for thousands of years. Without the sun there would be no life on earth.

The Greeks, Romans, Chinese, Native Americans and people of other ancient civilizations positioned their homes and baths to get warmth in the winter and shade in the summer. The Romans even knew how to grow vegetables in greenhouses in winter!

AD 1–500: *Roman baths were built facing south to have enough sunlight for heat*

1767: *Swiss scientist Horace de Saussure invents the first solar collector*

1891: *Clarence Kemp patents design for the first solar water heater*

1964: *NASA launches the first solar-powered spacecraft*

7 BC: *Magnifying glass used to concentrate the sun's rays to make fire*

It's got all we need

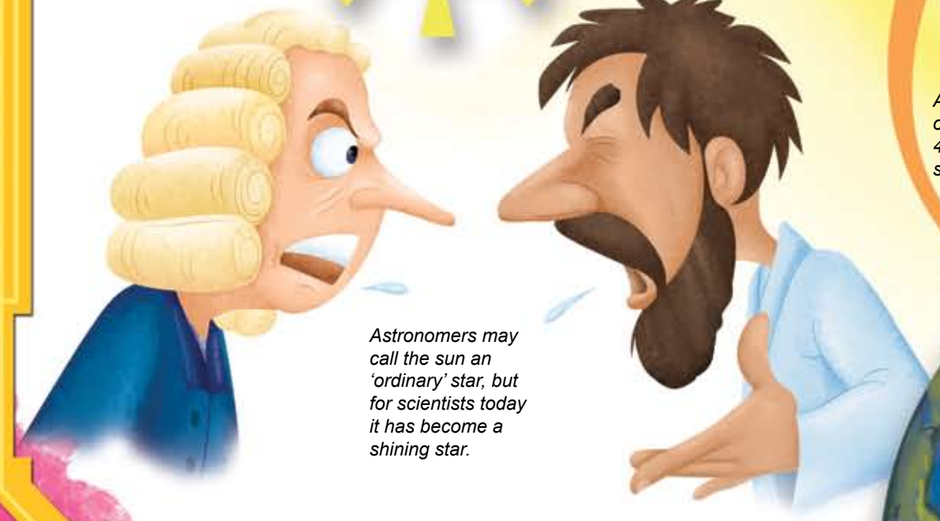
The heat and energy that we get on our planet from the sun in forty minutes is equal to the total energy used by all humans in the world in one year.

Two kinds of solar energy plants make electricity today. One uses solar photovoltaic panels that absorbs solar energy and converts it into electricity. The other uses concentrators - a device used to optimise the efficiency of solar power. Both of these, of course, depend on a sunny day!

Shades of yellow

Solar energy is safe for humans and the environment, and it is free. However, the equipment needed to convert the heat to energy is still expensive. Countries near the equator that receive a lot of sunlight can produce more solar energy than places near the poles.

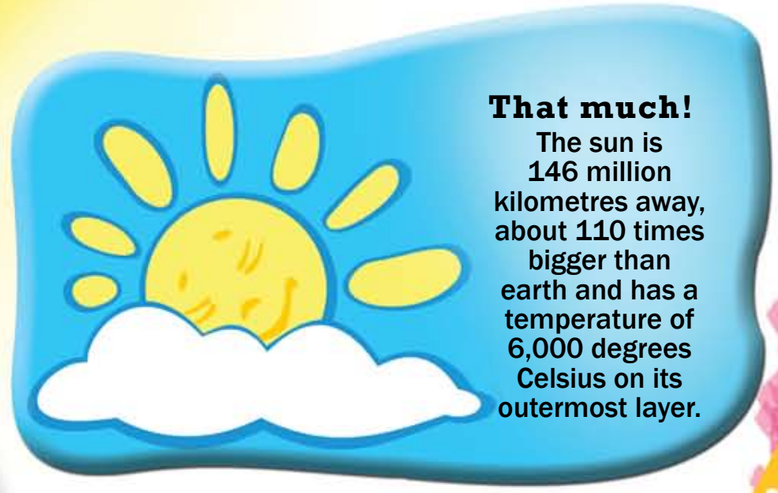
Cloudy days and nights are times when solar energy cannot be harnessed and used. This can be taken care of by providing proper energy storage.



Astronomers may call the sun an 'ordinary' star, but for scientists today it has become a shining star.

As of now, we capture only 1 per cent of this 4.6-billion-year-old star's power.

Not all of the sun's energy hitting the earth stays here. One-third of it reflects back into space.



That much!

The sun is 146 million kilometres away, about 110 times bigger than earth and has a temperature of 6,000 degrees Celsius on its outermost layer.

The big thing: Solar cookers

In 1767, Swiss geologist and physicist Horace de Saussure cooked fruit in a glass box. Mountaineer Samuel Langley used a box cooker while scaling Mount Whitney in 1881. Simple, basic solar cookers are as popular as ever today, especially in developing countries.

Sun catchers

There are three basic solar cookers and hundreds of variations of these. The cooking time is longer, but since the food does not get overcooked there is no need to watch over the cooking.

The curved concentrators, or parabolics, need to be adjusted towards the sun as well as watched over. Burned food and fingers are very much a reality with these cookers!

Panel cookers are a combination of the box cooker and the parabolics. They are simple in design and inexpensive.

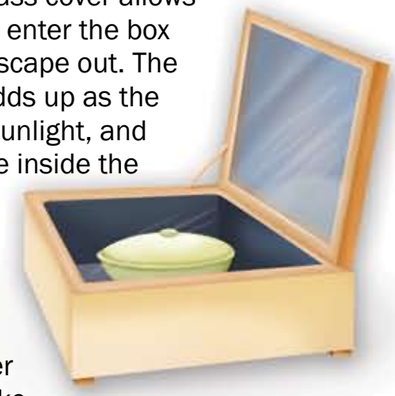
Horace de Saussure observed that "a room, a carriage, or any other place is hotter when the rays of the sun pass through glass". This set him thinking about inventing a solar box cooker.

Panel cookers cook food faster than box cookers, but in smaller quantities. Sometimes, the food needs to be stirred for even heating.

Parabolic cookers prepare food faster and at higher temperature. Large quantities of food can be cooked at a time.

How it works

Heat from the sun enters the solar box directly through the glass cover. Sunlight also bounces off the reflector into the box. Inside the box, the heat is absorbed, or soaked up, by the black paint on the cooking pot and base of the box. The glass cover allows heat to enter the box but not escape out. The trapped heat adds up as the box sits in the sunlight, and the temperature inside the box rises. This heat cooks the contents in the pot. Similarly the parabolic cooker uses material like aluminium which has a good heat retention value on its surface. Perhaps The best way to start building a parabolic solar oven is by using a ready-made satellite dish where the inside is coated with an aluminum sheet.



Box cookers cook food at medium to high temperatures and can hold two or more vessels.

Make custard while the sun shines

• 1 egg • 1 cup milk
• 2–3 tablespoons sugar
• ¼ teaspoon salt • ½ teaspoon vanilla

Mix all ingredients and place in a dark covered pot out in the sun. Bake it for one-and-a-half hours. Let it cool before serving.

The other big thing: Passive solar homes

It may be called passive but it's actually full of energy. And, it's all about how much your house can face up to. The Greeks, Romans, and Chinese used intelligent designs for their homes and buildings without installing any kind of mechanical equipment or technology—making 'passive' use of energy.

The ancient cave dwellings in Mesa Verde, Colorado, received warmth from the winter sun but were shaded by the hill against the summer sun!

The Baths of Caracalla, dating back to the third century, had large south-facing windows

PASSIVE SOLAR HOME

Flooring and walls made of thermal mass

South it is!

A simple design can warm a house or cool it when needed. Places that have clear skies during winter months are the best spots for passive solar homes. Such homes typically have south-facing large windows, blinds, moveable awnings, bricks, and tiles and stones in their walls or floors. The idea is to capture the light, absorb the heat, and to allow the breeze in and circulate to balance the temperature of the house. Shady trees and landscaping are also important features of a passive solar home.

What's in and what's out

Eighty to 98 per cent of sunlight that hits white materials or objects reflects, or bounces off. Dark-coloured materials absorb 40–95 per cent of the sunlight that hits them. That is why wearing white clothing in the summer and dark clothing in the winter is a smart thing to do.

How it works

When sunlight enters a house through a window, it hits objects in the room. Some heat in the sunrays gets absorbed, or soaked up, by the thermal mass, made of bricks, concrete, plaster, stone, and furniture inside the house. Windows, floors, and walls collect, store, release, and spread out this heat. This heat is trapped and stored in the day during winter. In the evening, as the air cools outside, the trapped heat is slowly released by the thermal mass inside, and the house has a comfortable temperature. During summer, the thermal mass absorbs the warm air inside, cooling the house.

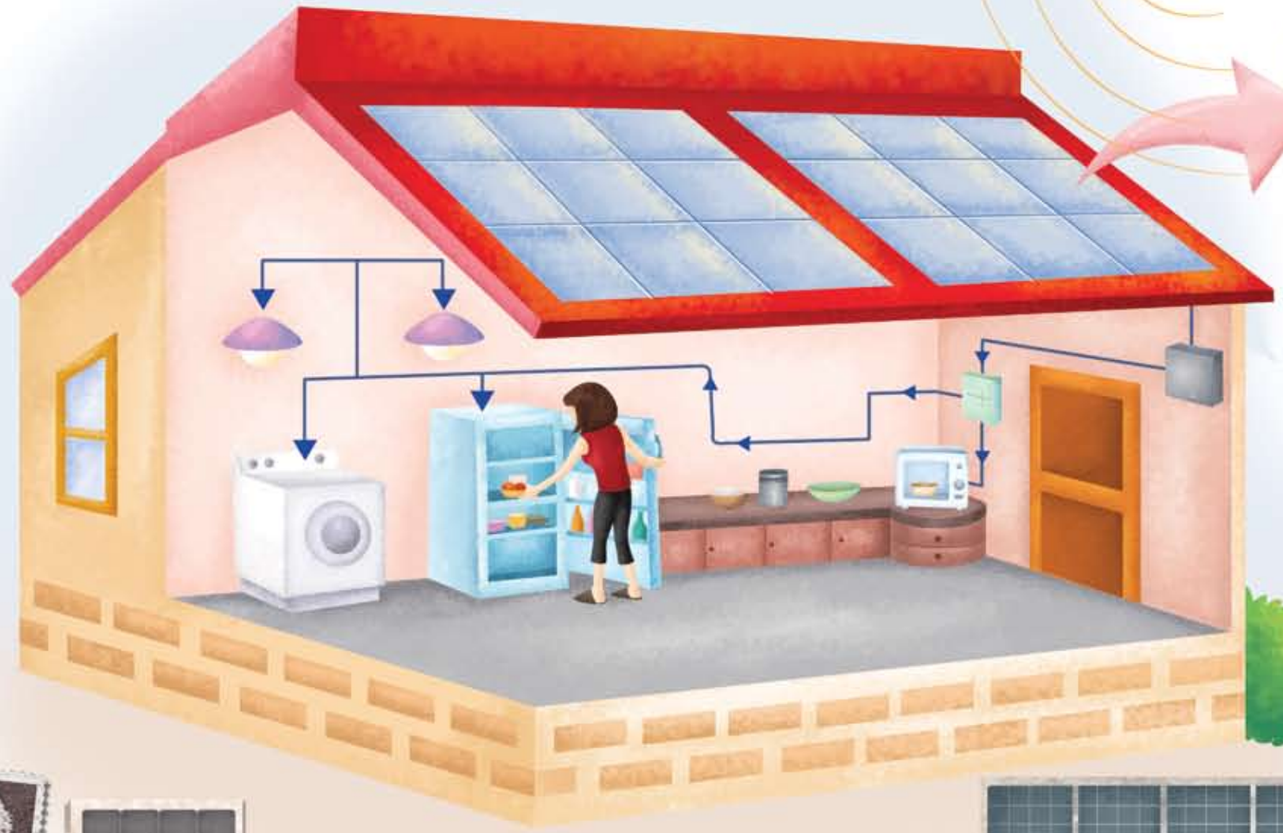
The in thing: PV cells

About fifty years ago, scientists developed cells or panels to turn sunlight into electricity. They called them photovoltaic or PV cells. 'Photo' means light and 'volta' means electricity. Together they bring sunshine into homes!

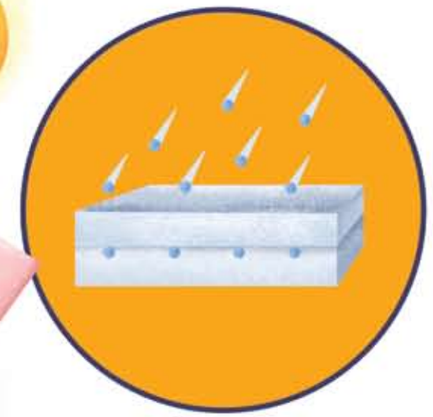
All charged up!

PV cells can be as small as half-an-inch to about four inches across. They are arranged on a panel to make a solar module. Depending on how much electricity needs to be produced, modules are linked to one another to make a solar array.

Although developed to power space satellites in the 1950s, PV cells have now found their way into people's homes. From calculators to wrist watches, PV cells are being used to capture solar energy to work household gadgets and to generate electricity.



When photons in the sunlight hit the solar cells, the energy created is absorbed by electrons.



When the energy is strong enough, the electrons become free and move around the panels as an electrical current, which can be used to run appliances!

How it works

Sunlight is made up of energy particles called photons. Solar cells are made up of silicon (melted sand), which has electrons in them. When photons in the sunlight hit the solar cells, they create energy. This energy is absorbed, or taken in, by the electrons.

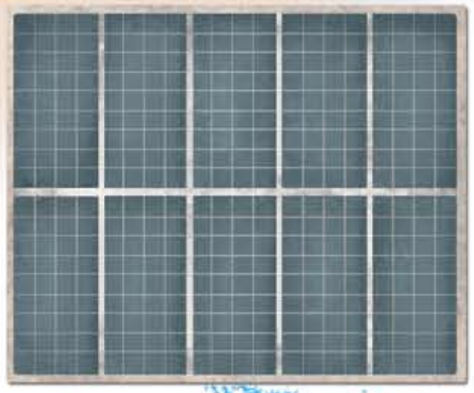
If the energy is strong enough, the electrons become free and loose and move around the panels as an electrical current. Each solar cell has a positive and a negative layer just like in a battery. The current in the electrons makes them move towards the positive and negative layers, and they carry an electrical current with them. This current moves through wires to a battery that stores the electricity. If homes produce more electricity than they need, owners can sell the surplus to the town network through the utility grid.

Genius in Spotlight

Although Albert Einstein is best known for his 'Theory of Relativity' he won the Nobel Prize in 1921 for his work on photovoltaics.

Solar module

PV cell



Solar array

The next big thing: Solar power

The promise of sunshine makes scientists think up of brilliant, bright projects for bettering our world.

Banish those bugs!

Remote villages around the world that do not have clean drinking water facilities now only need a bottle to make bottled water. Alberto Medo and Francisco Gomez Paz have designed a solar bottle that heats up enough to make the water inside it safe to drink. The solar bottle is transparent on one side to let the light in and dark on the other side to keep the heat in.

Coming soon

It's surely hot in a desert, but by 2011 it will be one of the hot spots of solar generation in the world. In the Mojave Desert, California, thousands of mirrors, called 'heliostats', will angle for a spot in the sun to produce 500 megawatts of clean energy that could possibly light up 3,75,000 homes in the state.

Solar energy promises a bright future!

Spray power

Want to go solar? No problem. Just spray it on. Or better still, print it and paste it. Researchers at the University of Toronto are working on a new spray-on solar technology that can be applied to any surface—clothing, roof of a car or building, boats, cell phones, and tents. Any surface can turn into a super solar power station. That's not all. Researchers are also hopeful that someday people will be able to print the solar panels from a simple inkjet home printer and paste it wherever they need it!

Blow the light on

A combination of two or more things is usually very interesting. This one is interesting and productive. Outside the Panasonic Centre in Tokyo stands an amazing streetlight that gets 100 per cent of its power from solar and wind power. The design is called 'Seagull'. During the day it collects solar energy through PV cells and stores it in a battery, and can be used to power devices. Currently, it is being used in streetlights in Tokyo.

Speedy light

It takes only about eight minutes for solar energy to travel from the sun to the earth.

Blowing in the wind

If you have ever stepped out on a windy day, you must have noticed how difficult it is to walk against the direction of the wind. The sheer power and force of the wind can knock an umbrella out of your hand. Storms with high winds can uproot houses, while gusty winds can even rattle an airplane.

Forecast: Windy

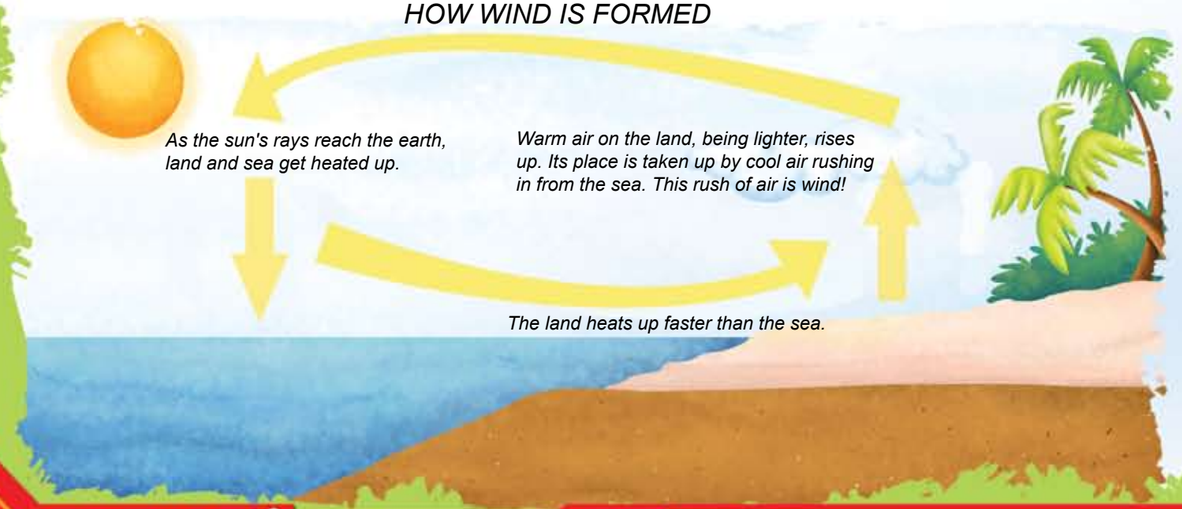
Air is everywhere around us, and when it moves, it creates wind. The sun heats the mountains, seas, hills, and the plains on the earth's surface. The land is not flat and even everywhere on the planet. So all places on earth warm up to different temperatures. When the earth's surface is warmed, hot air rises because it is lighter, and cool air takes its place. This movement causes wind to blow. Wind is measured by the speed with which it blows.

Why the wind?

Wind has power, force, and energy. From sailboats on the Nile in 5000 BC to windmills for pumping water in China, wind energy has also been used by people for various purposes down the ages. Today, wind turbines produce electricity.

Over 1.6 billion people across the world, or about a quarter of the world's population, face energy shortage. By the year 2050, people's energy demand around the world is expected to double from what it is today. To add to the problem, pollution from the use of fossil fuels and fumes from cars and industries are warming our planet. From now on, every country needs to think of not just providing energy to its people but also ensuring that the energy is clean and non-polluting. Wind energy promises to be just that!

HOW WIND IS FORMED



The good, the bad, and the ugly

Wind energy is clean, free, renewable, and non-polluting. However, turbines produce electricity only when the wind blows. Using wind energy does save and cut down the use of fossil fuels such as coal and petroleum, but the machinery and technology of wind turbines are slightly costly.

Some people see these machines as beautiful towers, while others find their sight unappealing. Birds crashing into the blades are worrisome to environmentalists. Whatever the opinion, wind turbines continue to move, and their technology only gets better with time.

Monster at sea

A German company is putting together the largest wind turbine in the world, to be placed in the North Sea. Its blades measure 126 metres—more than the length a soccer field! Once the blades get moving, the turbine will power five thousand homes.

Sir Bani Yas Island

The big thing: Windmills

The Persians were the first to use windmills way back in the seventh century to grind grain and to pump water from the ground for irrigation. In Europe, windmills were developed in the twelfth century, and in China, a century later. The first wind farm in the Middle East was built in the UAE, on Sir Bani Yas Island in August, 2004.

Wind catchers

There were three classic windmill designs that can be seen even today. Post mills were the earliest kind, used in Europe to grind cereals. The body of this mill was balanced on a large post so that the entire mill could rotate to catch the wind. The wide bottomed smock mills followed as an improvement. These were shaped like the dresses worn by farmers at the time, and made of wood. These six or eight sided mills were larger and only their roofs moved with the wind. Finally, the tower mills came with an even smarter design. Although the roof moved in the same way, the mill itself was made of brick or stone which made them fire proof and weather proof. The windmill is no longer what it used to be. Neither are the farms where they once stood. Modern day windmills are sleek in design, gigantic in size, and do a lot more than grind cereals!

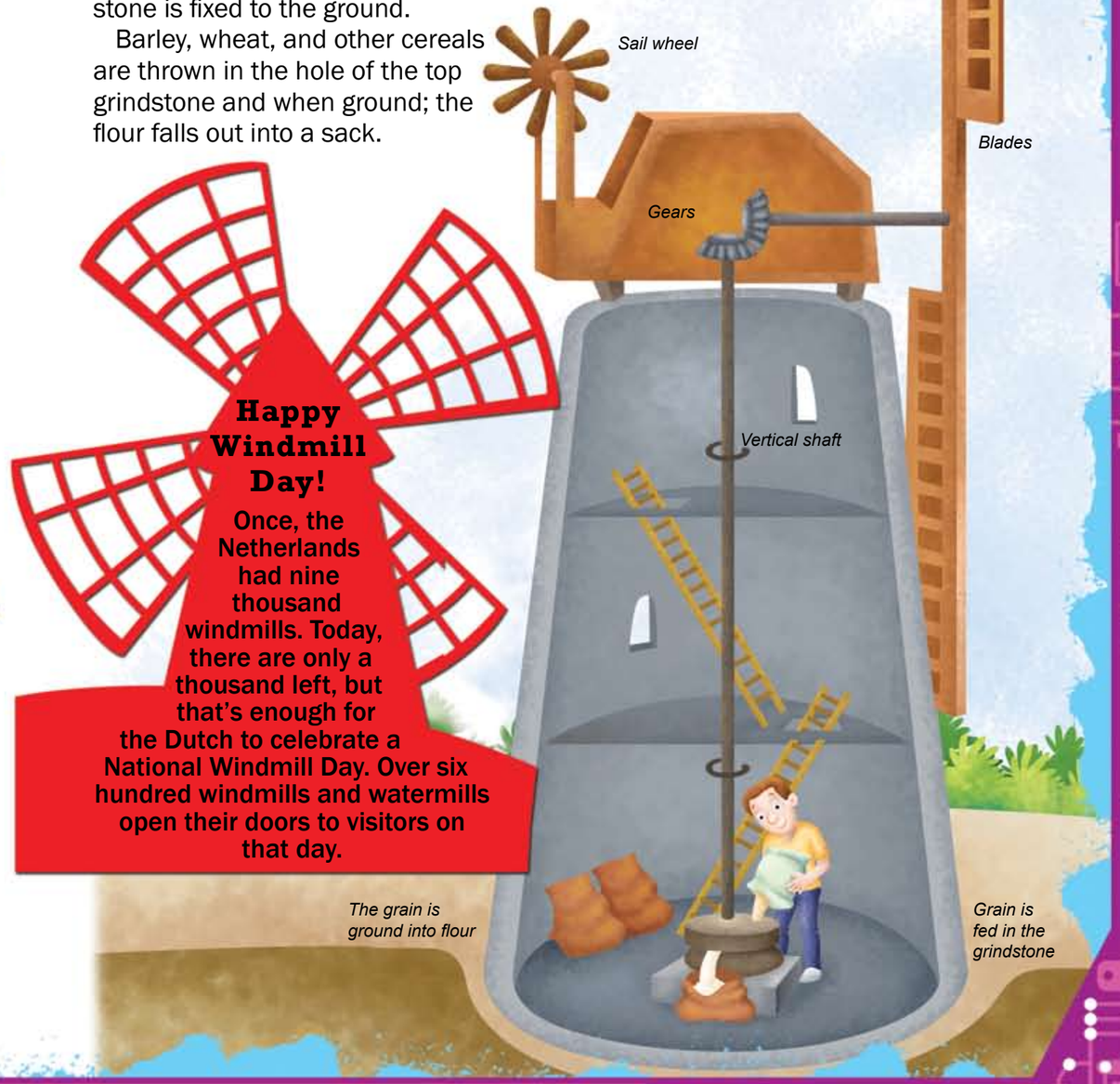
Smock windmill

Post windmill

Smock mill: How it works

When the wind blows, the blades rotate on a horizontal shaft. This horizontal shaft is connected to a gear system, which turns the vertical shaft. The small sail wheel also moves with the wind and it turns the top of the windmill and blades to face the wind. This makes the gears move, but vertically, or up and down. The vertical shaft is connected to a grinding stone. The moving gears rotate this shaft and the top half of the grinding stone. The bottom half of the grinding stone is fixed to the ground.

Barley, wheat, and other cereals are thrown in the hole of the top grindstone and when ground; the flour falls out into a sack.



Happy Windmill Day!

Once, the Netherlands had nine thousand windmills. Today, there are only a thousand left, but that's enough for the Dutch to celebrate a National Windmill Day. Over six hundred windmills and watermills open their doors to visitors on that day.

The in thing: Wind turbines

The single and two-blade turbines may save the cost of a blade or two but do not balance and perform as well.

The three-blade turbines are the most popular design simply because they are the most efficient.

From the twelfth century windmill to the nineteenth century wind turbine, it has been a seven-hundred-year-long journey. The first windmill for electricity production was set up in Cleveland, US, in 1888. As with all other technologies, wind turbines have become more sophisticated not just in their looks but also their power.

One, two or three?

There are wind turbines with just one blade, and then there are wind turbines with more than one blade.

Wind turbines stand on tall towers on land or in the sea, at least thirty metres or higher. One such turbine can light up 1,500 homes. Several wind turbines in a place are called wind farms that together produce enough electricity for thousands of homes.

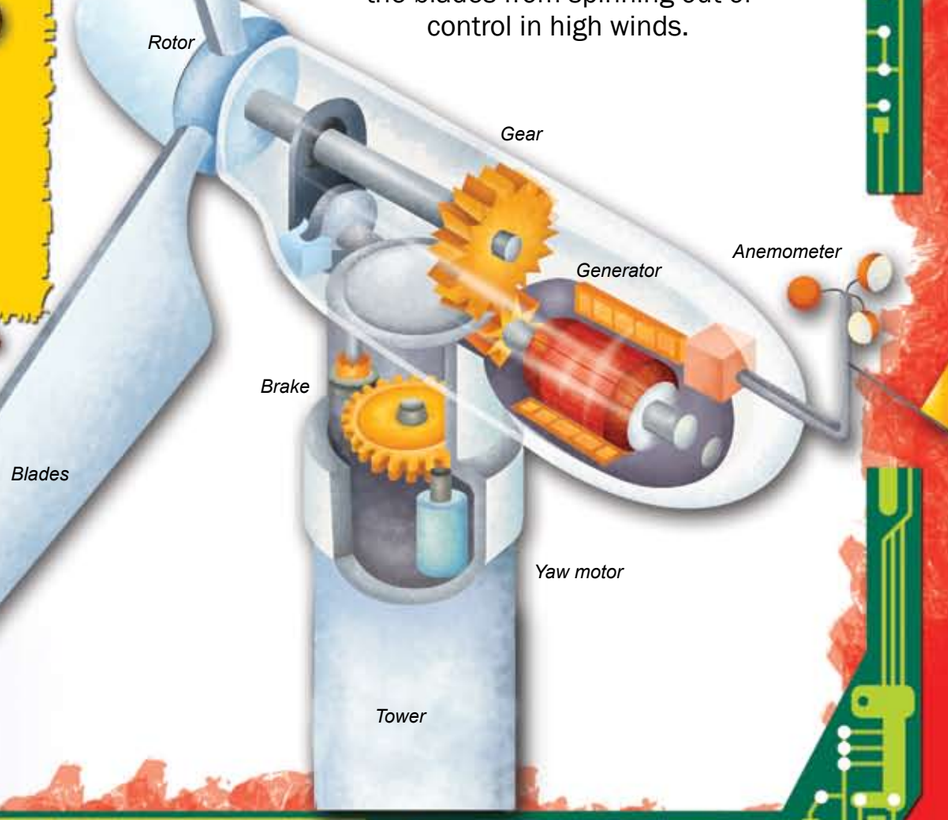
Anemometer

It is an instrument that measures the speed of wind.

How it works

The yaw motor automatically turns the turbine to face the wind. When wind blows, it passes through the blades and makes them spin. The propellers, or blades, are attached to a rotor. The rotor turns a shaft, which powers a generator. The generator changes the motion into electricity. Since the power or voltage of this electricity is weak, the generator gives it a boost so that the electricity can move through underground cables. These cables connect to electric substations and from there to homes.

As more air passes through the blades, more electricity is produced. The brake system stops the blades from spinning out of control in high winds.



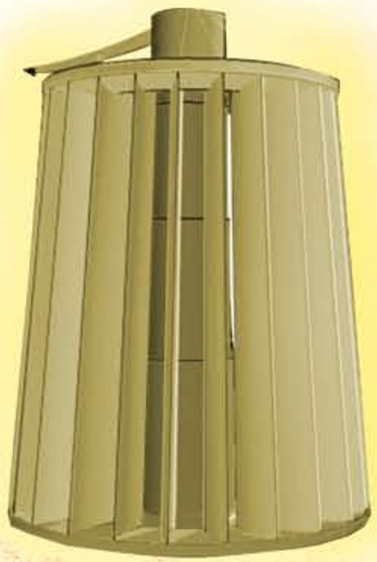
The next big thing: Wind power

The cost of wind energy has come down by 85 per cent in the last twenty years. The forecast: windy days ahead, as this resource is becoming the world's fastest growing energy and also the most affordable.

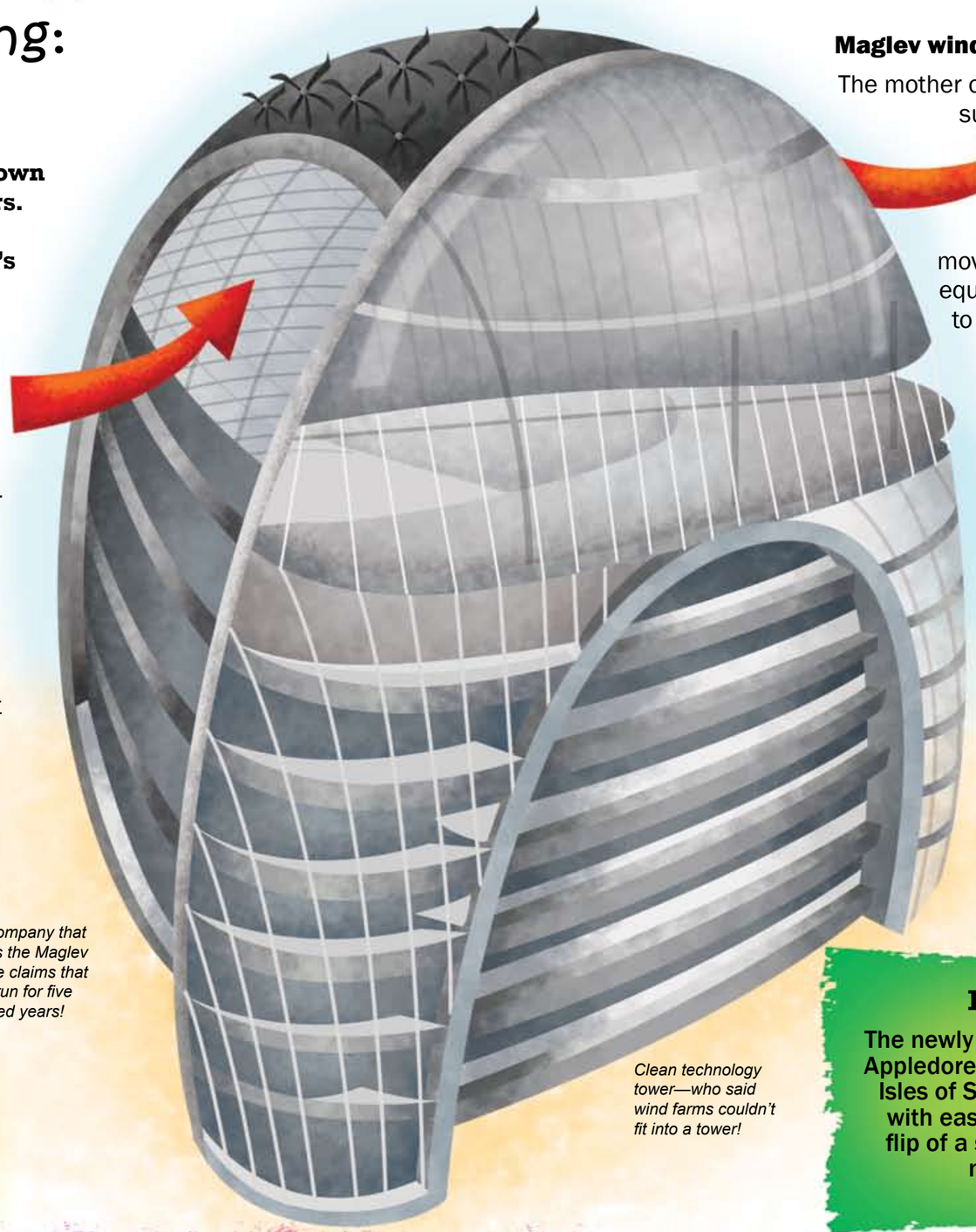
Win(d)–Win(d) situation

Germany is the leader in using wind energy for electricity. The country gets 10 per cent of its power from the wind. Although the US ranks second in the order of wind energy use, it needs to get more power from it. India ranks third in using wind energy, followed by the UK. Denmark produces 20 per cent of its power from wind energy.

As more countries join in, there's only good news 'in the wind' – a cleaner planet for us all!



The company that makes the Maglev turbine claims that it will run for five hundred years!



Clean technology tower—who said wind farms couldn't fit into a tower!

Maglev wind turbine

The mother of all wind turbines is the Maglev Wind Turbine. This superpower structure is made in Arizona, US, and will finally stand tall in central China at a whopping cost of fifty-three million dollars!

Magnetic levitation is a technology that uses enormous electromagnets to float and move the blades of the turbine. One such turbine is equal to 1,000 standard wind turbines and is expected to power 750,000 homes.

Clean technology tower

This tower will be different. It is not the architecture or the establishments in it that will make it different. It is the built-in wind turbines at the corners of the tower that will make it a highly energy-efficient building.

Architects Adrian Smith and Gordon Gill have designed this building for the city of Chicago, US. The idea is to capture the wind at the highest speed, especially on top of the tower, which will have a dome with a large opening for the wind to enter. The dome is to be layered with solar panels to capture solar energy. All that wind, which would otherwise simply blow away, will be used to cool the inside of the tower.

It's a breeze

The newly installed wind turbine at Appledore – the largest of the nine Isles of Shoals – can be lowered with ease by one person at the flip of a switch, staying clear of migrating birds.

What-a-power! Hydro energy

Still, trickling, flowing or gushing—water has more than just thirst-quenching ability. It is produced quietly by nature and sustains all life on the earth. Moving water has enough energy to power equipment—from small water mills to larger-than-life hydropower plants.

Water goes around comes around

It is nature's way of making sure that there is plenty of water for all living things on the earth. The sun's rays warm water in rivers, lakes, and oceans. It evaporates and rises into the sky as water vapour, which cools and forms clouds. When the air cannot hold any more droplets, the clouds release them as rain or snow, which fall on land and water bodies. This water cycle gives our planet the water it needs.

The moment water moves in rivers and waterfalls or even in oceans, its stored energy, or potential energy, turns into kinetic, or motion, energy that can be tapped and turned into electricity or into useful mechanical power. That is hydropower, or the power of water!

From olden days to new ways

In ancient times, water wheels made from wood stood where a steady flow of water fell from a height. These water wheels had paddles that turned with the force of water grinding corn and hulling rice. Over the centuries, water wheels were used for iron casting, paper making, and rock crushing and mining.

By the early 1800s, the water wheel was modified into a water turbine, and in the later 1800s, into a generator. The hydro turbine was developed in the nineteenth century to move industrial machines, and today small and large versions of it produce electricity for single homes as well as large communities.

Liquid energy

Hydro energy can also be created with turbines from water in a dam, and waves (tidal energy) in the ocean. Water power is clean energy and more reliable than solar or wind energy simply because water can be stored, unlike wind or sunshine. Although the power stations are expensive to build, they are inexpensive to run. The US is the largest producer of hydropower in the world, followed by Canada.

Coal facts
Hydropower prevents the burning of 120 million tonnes of coal each year.

THE GREEKS, ROMANS, AND EGYPTIANS USED WATER WHEELS AS FAR BACK AS 500 BC.

THE CHINESE HAD DEVELOPED WATER WHEELS TO PERFORM VARIOUS DIFFERENT TASKS BY AD 1.

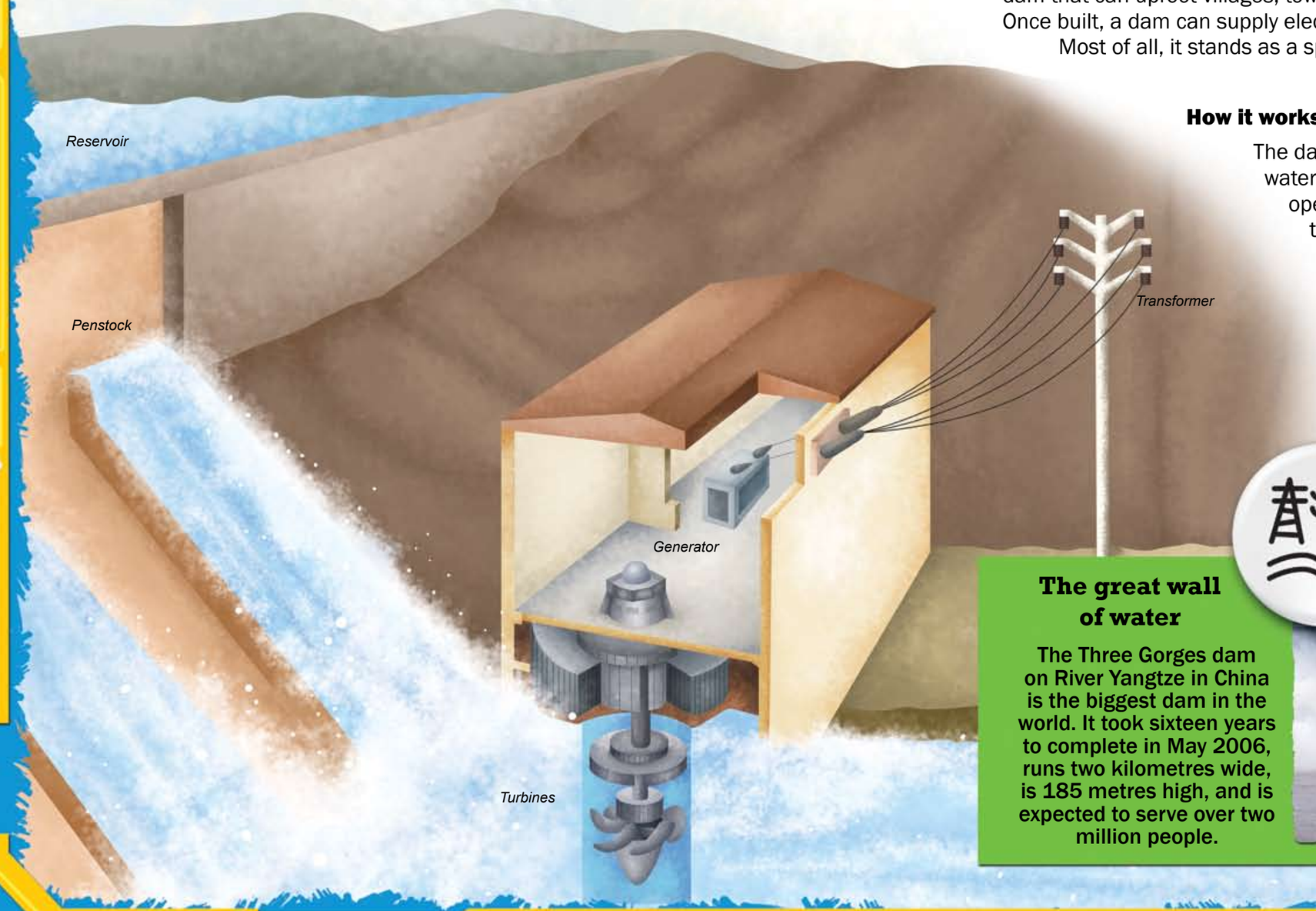
BY THE 1800s, WATER WHEELS HAD BEEN MODIFIED INTO TURBINES.

IN THE LATE 1800s, THE FIRST HYDROELECTRIC DAM WAS BUILT.

The big thing: Hydroelectric dams

Take water, let it flow and make electricity. Of course, in reality it isn't that simple, but the idea behind a hydroelectric dam is.

HYDROELECTRIC PLANT



Tall, wide, and electric!

The most common method of producing hydro energy, and large amounts of it, is by getting it from a hydroelectric dam. Today, hydroelectric power makes up 20 per cent of the world's electricity. Norway gets 99 per cent of its electricity from water, while New Zealand, 75 per cent.

If a dam can light up many homes, it can also displace and destroy several others. Although the technology itself is a clean one, it is the construction and location of the dam that can uproot villages, towns, forests, and the species that live there. Once built, a dam can supply electricity on demand and jobs to hundreds of people.

Most of all, it stands as a spectacular and imposing feat of engineering!

How it works

The dam acts as a blockade and traps and holds back the water in a reservoir. Gates on large tunnels, or penstock, open and allow gushing water to flow through to a turbine(s). The high pressure in the water pushes against the blades of the turbine and makes them turn. The turbine is connected to a generator. As the turbine spins, it moves the generator, which produces electricity. A transformer converts the current to a usable level. Transmission lines carry the electrical current from the hydroelectric power plant to substations, which then distribute electricity to homes, schools, and offices.

The flow of water is easily controlled and is increased or decreased depending on requirement. The same quantity of water that flows out of the reservoir is steered back into the reservoir without being polluted.

The great wall of water

The Three Gorges dam on River Yangtze in China is the biggest dam in the world. It took sixteen years to complete in May 2006, runs two kilometres wide, is 185 metres high, and is expected to serve over two million people.

The next big thing: Hydropower

For some it may be just a glass of water, but for smart minds out there, water can power the future.

Turbo toilet

Those long hours spent in the toilet by so many people could actually be justified and generate some good—electricity! A gadget called Benkatine Turbine, which can be attached to the flushing mechanism of a toilet, produces electricity when the toilet is flushed.

The turbine works in the same way as it does in a hydroelectric dam. When the flush is pulled, the turbine rotates and makes electricity. The makers of this device claim that the turbine can produce energy in any pipe that has water flow in it, including sewers and gutter drains.

The Benkatine Turbine produces electricity every time the toilet is flushed!

When time just flows by...

It's a clock and a thirsty one at that. This clock starts ticking moments after it is filled with water and works by allowing current to pass through it. It can run for weeks without a refill. Some brands now offer an alarm, countdown timer, and thermometer—all watered in with the clock!

Water-powered calculators run just as well as water clocks. Just one cap full of tap water can run a twelve-digit, full-function calculator for months.

Water...ring, ring!

If cell phones were one of the greatest inventions of the last century, then water-powered cell phones will be in the next decade. Electronic giant Samsung has developed a cell phone that will work on a water-powered cartridge in place of a regular battery. A hydrogen fuel cell that will hold the water will need to be charged every fifth day, but the company is working towards not having to charge the cartridge at all! The first such phones are expected to hit the stores in 2010.

Simple alternatives such as the water clock and water calculator can keep thousands of toxic batteries out of landfills.

Does time just flow with the water clock?!

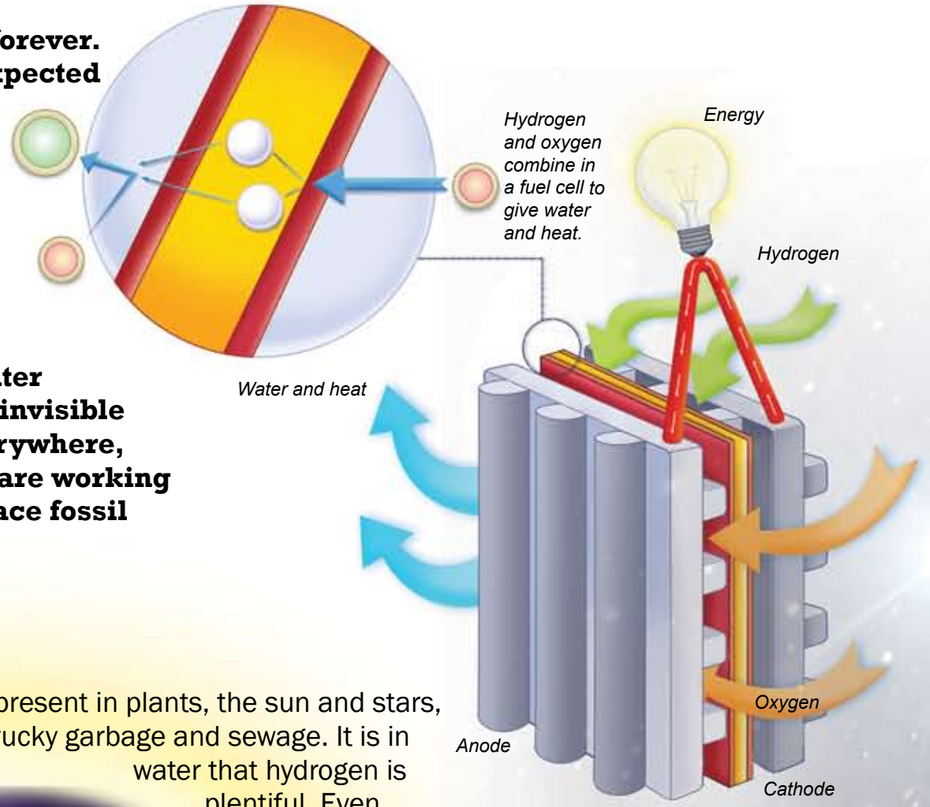
Soon, you could be charging your cell phone with water!

Into thin air?

Each day, the sun evaporates one trillion tonnes of water.

All that gas! Hydrogen energy

Nothing lasts forever. The earth is expected to run out of oil and gas reserves in forty to seventy years, unless more places that have them are discovered. Enter hydrogen—an invisible gas that is everywhere, and scientists are working on how to replace fossil fuels with it.



The power of H

Hydrogen gas is present in plants, the sun and stars, and even in the yucky garbage and sewage. It is in water that hydrogen is plentiful. Even so, hydrogen is always found in combination with other elements and never by itself. To get hydrogen alone, it has to be produced by industries. Hydrogen can be converted into usable energy through fuel cells and by burning it through turbines. Hydrogen can power vehicles and produce electricity without giving out any pollution.

Hydrogen gas is high on energy

All charged up!

A fuel cell is a battery like device that converts chemical energy into electrical energy. In a fuel cell, hydrogen combines with oxygen to produce electricity. While fossil fuels release polluting gases when burned, hydrogen fuel cells give out only heat and water. There will be more hydrogen in our homes, transportation, and electronics as scientists work on how to store and carry hydrogen to near and far facilities.

Ten hydrogen fuel cell buses will be plying in London by 2010.

High on hydrogen

Auto makers like Honda, Peugeot, Toyota, and General Motors have given to the world hydrogen fuel cell cars. For all those extreme bumper-to-bumper traffic days, there are also buses, trucks, and scooters that can give their eco-friendly owners 'green' peace of mind. Boeing has already tested the first manned fuel cell flight in a two-seat glider to prove that hydrogen can go higher.

New green car

The 'LifeCar', the world's first pollution-free sports car, was unveiled at the Geneva Motor Show 2008. The car is powered by a fuel cell, and the only bi product is harmless water vapour.

Nature's bounty: Bioenergy

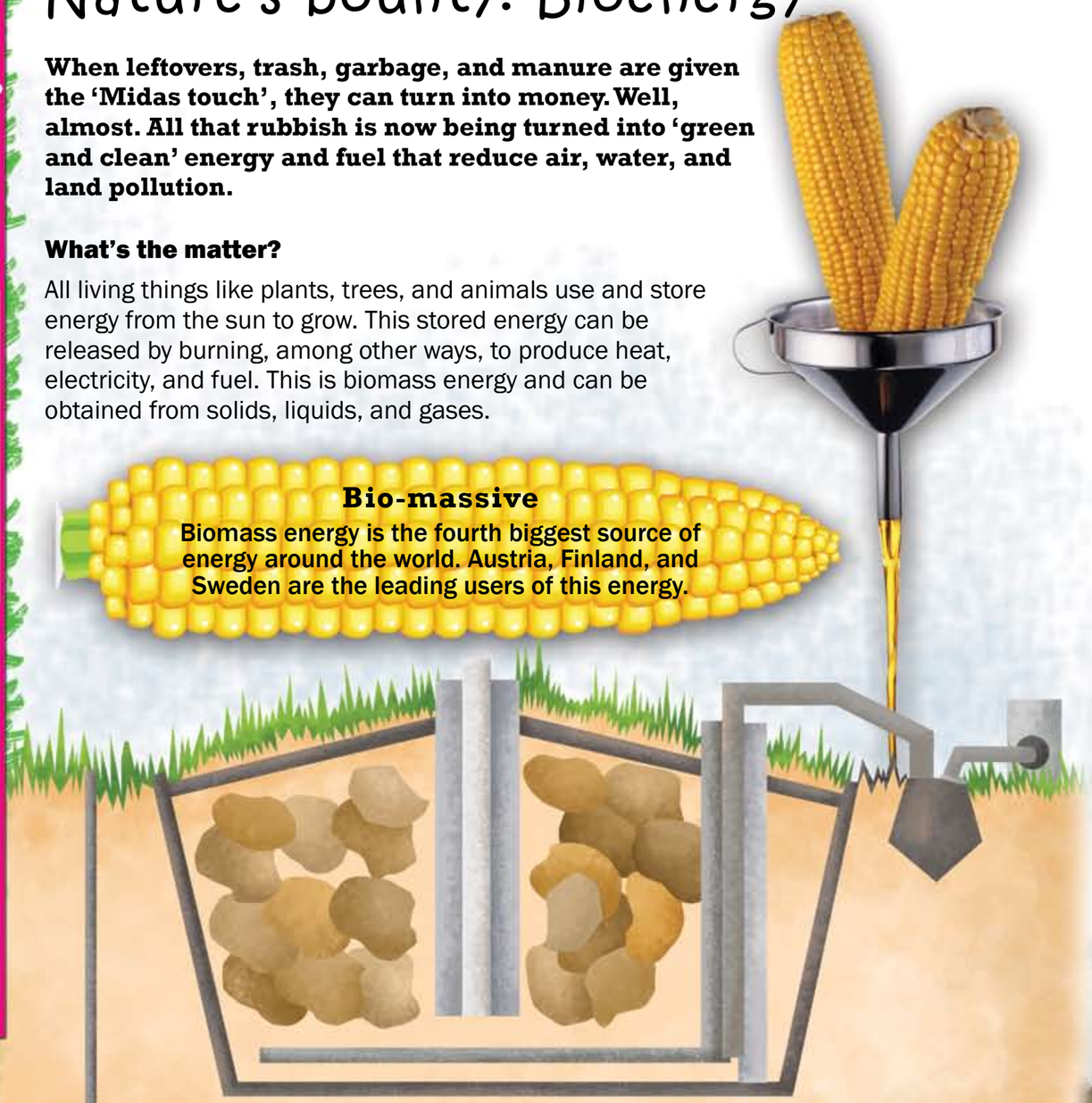
When leftovers, trash, garbage, and manure are given the 'Midas touch', they can turn into money. Well, almost. All that rubbish is now being turned into 'green and clean' energy and fuel that reduce air, water, and land pollution.

What's the matter?

All living things like plants, trees, and animals use and store energy from the sun to grow. This stored energy can be released by burning, among other ways, to produce heat, electricity, and fuel. This is biomass energy and can be obtained from solids, liquids, and gases.

Bio-massive

Biomass energy is the fourth biggest source of energy around the world. Austria, Finland, and Sweden are the leading users of this energy.



Trash is fast becoming a source of renewable energy. Garbage in landfills gives out methane gas. Pipes collect the gas; chambers process it into usable energy; and the supply is carried to power homes and industries.

Trash to treasure

Wood chips, logs, fruit pits, agricultural waste, seaweed, dead trees, sawdust, used tyres, and cow dung are processed to generate energy or heat. This heat is used to turn turbines to make electricity.

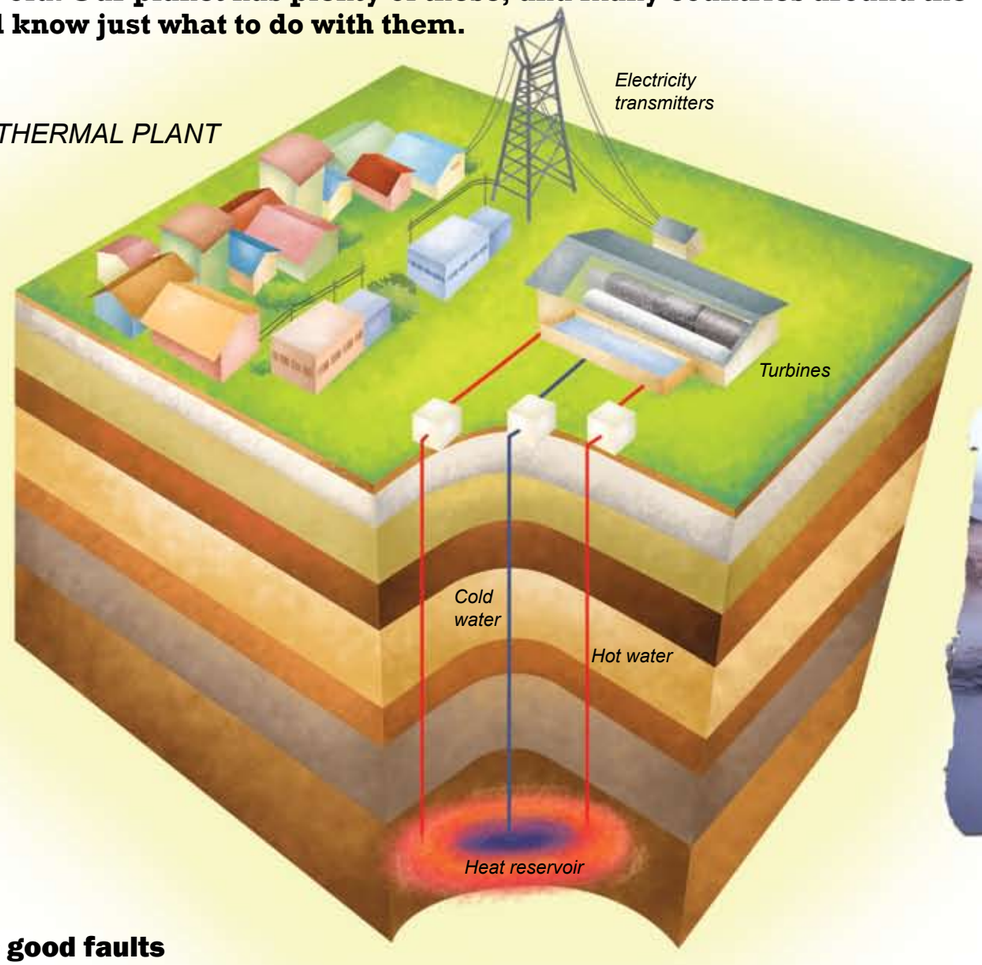
Juicy sugar canes, healthy soyabean, and crunchy corn are being grown not just for our meals but also as fuel for cars and vehicles. This fuel not just works out to be cheaper than conventional fuel but is also greener because it emits lesser greenhouse gases. Your physician may shudder at the thought of greasy oils in your food but leftover cooking grease and vegetable oils can now be used directly in diesel engines of vehicles. When these oils are heated, their thickness is reduced, and can be used directly in a diesel engine, or they can be chemically processed to produce fuels such as biodiesel. Wood and its byproducts can also be converted into biofuels.

From kitchen wastes to sugar cane, scientists are trying to find more ways to produce energy from nature.

Biomass gasifiers are widely used, especially in villages in India. The biogas that is produced can power machines and generate electricity.

Spring it on: Geothermal energy

Dust and gas can hardly interest anyone, more so if they are four billion years old. Our planet has plenty of these, and many countries around the world know just what to do with them.



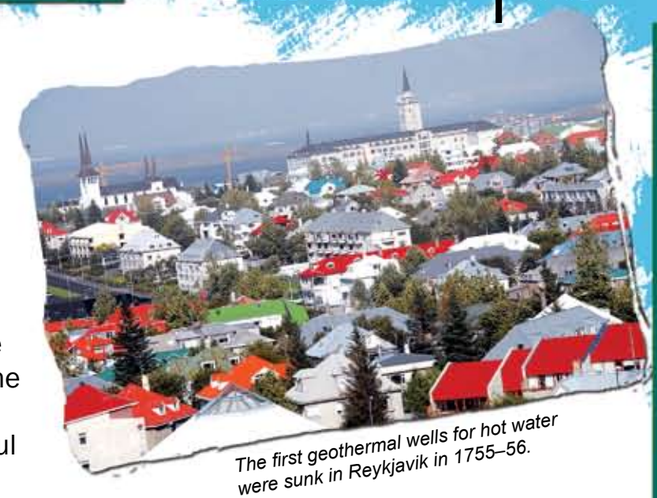
Some good faults

Deep in the earth's core, dust and gas sizzle at 4,982 degree Celsius and continuously push their way up to the surface. Steam and hot water at temperatures over three hundred degree Celsius burst out through cracks and faults in the earth as hot springs or geysers. This power from the earth is called geothermal energy.

The Romans used water from hot springs and geysers to treat skin disorders as well as to heat their buildings. Native Americans and New Zealanders have eaten hot meals cooked on hot springs for thousands of years. The Japanese have been relaxing in these hot waters for just as long now.

Dig the power!

Geothermal energy is not just about dipping and relaxing in all that hot water. It is also about lighting up homes. The most widely used process to generate electricity is by drilling wells about three kilometres deep down into hard rocks. Under these rocks is the geothermal reservoir. Pipes reach the underground reservoir and suck up steam or hot water, which is powerful enough to spin turbines that move generators to make electricity. If hot water is used, it is returned to the earth to be heated again, naturally!



The first geothermal wells for hot water were sunk in Reykjavik in 1755–56.

Smoke rising from a geothermal spring.

Blow hot, blow cold

When you think of Iceland, you would hardly imagine anything warm. But the city of Reykjavik has many buildings and pools heated directly from geothermal steam or hot water. Many northern latitude countries use the energy under roads and pavements to melt winter ice.

Like wind and solar energy, geothermal energy is clean, but it scores over both as it is available throughout the day and night and in all seasons.

Top ten users and makers

Geothermal energy is produced in over twenty countries around the world. The bigwigs are Iceland, US, Philippines, Italy, Germany, France, Indonesia, Mexico, New Zealand, and Japan.

City of joy

Earth lovers have imagined such a place for a long time now—a city that uses the earth's resources intelligently and keeps the planet healthy, clean, and green. In 2009, Masdar, in the United Arab Emirates, will become the first city in the world to take care of all its energy, food, and living needs using clean, eco-friendly technologies.

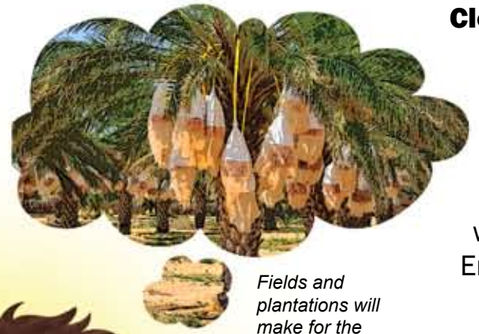
Electric public transportation will be used, with zero carbon emissions vehicles.

0 carbon + 0 waste = Masdar

Masdar will be a compact city spread over six square kilometres and home to researchers, scientists, students, policy-makers, and professionals from around the world. The government of Abu Dhabi, World Wide Fund for Nature (WWF), BioRegional's One Planet Living programme, and architects Foster and Partners have come together to build a zero-carbon and waste-free city. The Masdar Institute of Technology will open its doors to students in 2009, while the city is built over the next ten years. Once complete, over 45,000 people will live there while 60,500 people will come in as daily visitors.

Solar and wind power will produce 100 per cent of the city's energy for heating and cooling.

Masdar will be every earth lover's dream come true.



Fields and plantations will make for the perfect research grounds for scientists and also grow plants for biofuels.

Close to nature

Masdar's stone and mud walls and building rooftops will be fitted with photovoltaic panel to capture solar energy. Ninety-nine per cent of waste, which would otherwise find its way to a landfill, will be recycled, composted, and reused. Energy will be generated from waste. All building materials like wood, sand, and bamboo will be eco-friendly. Shaded walkways and compact streets will make walking outdoors cooler and convenient. All transport connections will be within two hundred metres from any point in the city. Masdar will be a car-free city. A light railway system will connect the city to Abu Dhabi. Driverless cars will transport a maximum of four people at a time on tracks below street level. All wildlife and their habitats will be protected.

Organic food available in food stores and restaurants will be grown outside the city and watered by recycled waste water from the city.

To the source

'Masdar' in Arabic means 'the source.'

Did you know?

Electricity travels at the speed of 299,338 kilometres per second. If there were a light switch on the moon for a lamp on the earth, it would take only 1.28 seconds to light up the lamp!

The world's greenest countries that have the lowest pollution levels, highest water purity, and best conservation efforts are:

1. Switzerland
2. Sweden
3. Norway
4. Finland
5. Costa Rica
6. Austria
7. New Zealand
8. Latvia
9. Colombia
10. France

About two billion people in the world live without electricity.

It's not just in restaurants that there is a charge for fish. Electric eels are highly charged invertebrates that can produce enough current to light twelve household lamps.

Photovoltaic cells are made with silicon which comes from sand. One tonne of silicon generates as much electricity as 500,000 tonnes of coal. Those golden sandy beaches are sure to look 'green' when you see them next.

An average wind speed of twenty-two kilometres per hour is all that is needed to turn wind into electricity – that is slightly faster than a squirrel can run!

Make your own solar water purifier

More than one billion people around the world do not have clean water to drink, and almost three million children die of disease caused by drinking polluted water. A simple setting in the sun can wash away those germs and give you safe drinking water at no extra cost. It can also desalinate salt water.

You need:


Large clear bowl


Salt


Drinking water


Empty glass

Cling wrap or clear plastic food covering

Small rock or pebble

Spoon to stir

Putting it together:

1 Pour water in the bowl. Add salt and mix well.

2 Place the empty glass in the centre of the bowl.

3 Cover the bowl with the cling wrap loosely so that it caves in a little bit. Press it down on the sides of the bowl so it sticks. (Hint: Use cello tape to stick cling wrap to the sides of the bowl if needed.)

4 Place the pebble on the cling wrap and directly above the glass.

5 Keep the bowl out in the sun.

6 The heat of the sun is absorbed by the water. The plastic covering keeps the heat trapped inside. The heated water begins to evaporate and turns into water vapour, which rises. When the water vapour reaches the plastic, it condenses and turns back into water. The sloping plastic guides the water drops to the centre, below the pebble and just above the glass. The water drips down into the glass. Clear and clean water becomes ready to drink.

Glossary

Biofuel— fuel that is obtained from plants and other living matter

Biomass— plant material, vegetation or agricultural waste used as a fuel or energy source

Compost— mixture of rotting matter that is added to soil as fertilizer for plants

Energy— power to do work

Fuel cell— device that turns hydrogen into fuel

Fossil fuel— coal, petroleum, and natural gas, which are dug out from the earth and used as fuel

Global warming— increase in the earth's average temperature

Geothermal— relating to the heat inside the earth; 'geo' means 'earth' and 'therme' means 'heat'.

Geyser— hot spring that throws out water at intervals

Horizontal— flat or level

Hydroelectric energy— energy that is obtained from water, usually by building a dam over a river

Hydrogen— a colourless gas that is present in water in combination with oxygen. The chemical symbol for hydrogen is H.

Hydropower— energy produced by moving water

Insulation— a material that reduces or prevents the transmission of heat or sound or electricity

Invertebrate— animals that do not have a backbone

Megawatt— a unit of power equal to one million watts

Organic food— food grown without the use of fertilizers

Passive solar energy— making use of sunlight, without using any equipment to convert it into energy

Renewable energy— energy produced from a source that is inexhaustible, or does not run out. For example, solar energy, wind energy, and so on.

Reservoir— natural or artificial place where water is collected and stored for use

Resource— source of supply

Rotor— rotating part of an engine

Technology— application of a skill or knowledge

Thermal mass— material within a house, such as concrete or brick, which absorbs and holds heat and reduces energy costs

Turbine— type of motor that moves by the action of water, steam or gas

Volt— unit to measure the strength of an electric current

Yaw— movement of the tower top turbine, which allows the turbine to stay into the wind

Zero carbon— where carbon is not given out

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