

Solar power

It's almost impossible to imagine life without electricity.
But what exactly is electricity and how can the sun's rays be turned into it?
You will find the answers to these intriguing questions on the following pages.



Electricity from the Sun



a. Electric Charge and Electric Current



Can you imagine life without electricity?

Electricity has become an indispensable part of our everyday lives. It powers our TVs, our computers, our light bulbs, our stoves and our MP3 players. Can you think of any more things that need electricity to work?

Electricity had existed naturally long before mankind learned to generate an electric current. Lightning, for instance, is a powerful discharge of electrical energy that builds up in storm clouds through friction. Electricity can also be found in the animal world: some fish, such as the electric eel, build up an electric charge in order to defend themselves against rivals and predators or to catch prey. Even our brains process information using electrical impulses.

Electrical appliances need a steady flow of electricity to be able to function properly. If the flow is irregular, a light bulb, for instance, will flicker on and off. We call this steady flow of electricity „electric current“; similar to the current of a river where there is a steady flow of water.

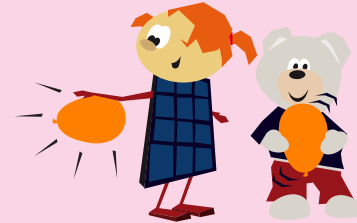


Magic Floating Balloon

With this trick, you can make a balloon stick to the palm of your hand.

You need:

A balloon and something made of wool (like a sweater or blanket)



This is how you do it:

Blow up the balloon. Then rub the balloon against the wool firmly about 20 times. (Not too firmly or the balloon might pop!) Now lift up the balloon and slowly open your hand. As if by magic the balloon will stick to your hand!

But why does it do that?

When you rub the balloon you charge it with electricity. Any particles which are not electrically charged are attracted to it. The longer you rub the balloon, the more charged the balloon will become. After a while, the balloon will lose its charge and fall to the ground.

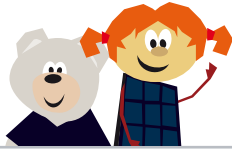
b. How do we generate electricity?



Can an apple generate electricity?

Not exactly, but it can play a role in the process. Electricity doesn't magically appear, it needs to be generated. In order to generate an electric current, we need to transform another form of energy into electric energy. That might sound complicated, but actually it's quite simple. To help us understand the principle, it might be a good idea to have a look at how the light works on your bike. An apple grows with the help of energy from the sun. When you eat an apple, your body takes on its energy and can use it to ride around on your bike, for example. As you pedal, the energy you received from the apple is converted into kinetic energy. As the bicycle wheel turns, a small wheel on the dynamo turns too. The dynamo then converts the kinetic energy into electric energy, which powers the bike's light. So the energy from the sun, which initially helped the apple to grow, has taken several different forms before being converted into the light you see when you ride your bike.

The same thing happens in the power stations that supply electricity to our homes. In a wind or water power station, the wind or water causes a turbine to turn (like the wheels on your bike), which, in turn, powers a generator (dynamo), which produces electricity. In coal, gas or oil power stations, energy which has been stored up for millions of years is released when the substance is burned and makes electricity.



Be careful!

Electricity is dangerous. Never put your fingers into a socket or touch a broken cord! It's also dangerous to remove the cover of an electrical appliance and touch the parts inside while it's plugged in! Always ask an adult to help you when you want to repair or remove the cover of an electrical appliance.



c. Electricity from the Sun

What do satellites have to do with solar power?



What do satellites have to do with solar power? Way back in the year 1839, the French physicist Alexandre Edmond Becquerel discovered that exposing certain materials to light could generate electricity. In 1905 Albert Einstein was able to provide a complete scientific explanation for this phenomenon which earned him the Nobel Prize for Physics. It was space scientists who first gave serious thought to the idea of using the sun's energy to generate electricity. They wanted to send a satellite into space but a satellite needs electricity in order to work.

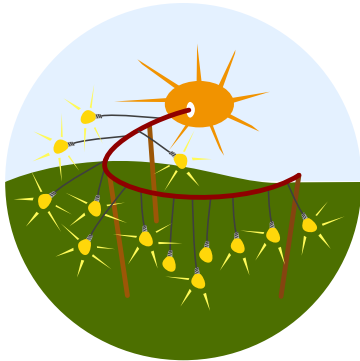
Even if they had used really strong batteries, they would have lost their power after a while. And there are no sockets in space, of course, so what were they to do? The scientists came up with the idea of using the sun to generate power for the satellites. And so the first solar power systems in the world were integrated into satellites. Today, people all over the world use the sun's energy to generate the electricity they use at home. It is, after all, completely free and solar power is good for the environment.

When we talk about using the sun's energy to generate electricity, we use the term „solar power“. This expression comes from the Greek word „solaris“, which means „of the sun“. There are lots of expressions which begin with „solar“, such as solar energy, solar power and solar cell. Can you think of any more?





d. Endless amounts of Solar Energy



Can we generate solar power in rainy areas too?

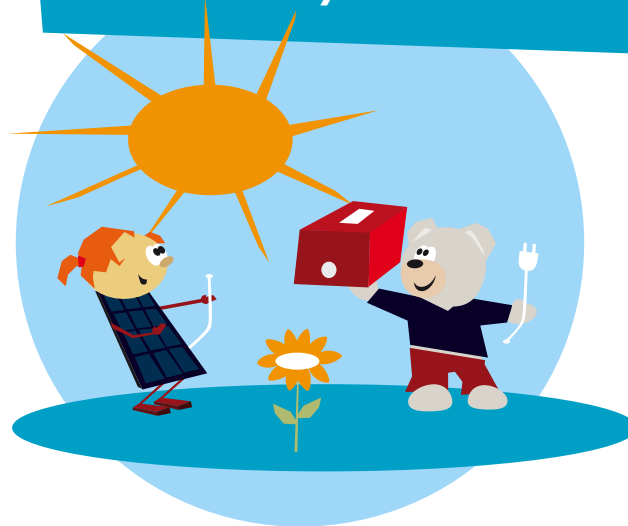
There is an energy source which supplies around 3,000 times more energy than the whole human race needs. It doesn't produce hazardous waste or harmful gases. What is it? It's the sun! Just one square meter of the sun generates enough energy to power 1,000,000 bright light bulbs.

But in some areas, the sun doesn't shine every day. In fact, it's often rainy or cloudy in some parts of the world.

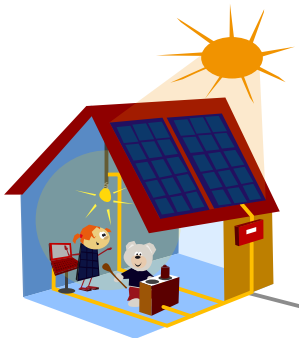
But even so, most areas still receive enough energy from the sun for most of their energy needs. Making electricity from oil, gas and coal produces gases which are harmful to the people and the environment. And, these resources will soon be used up. On the other hand, the sun will continue to provide us with its free and clean energy for billions of years. We just have to use it!



How a Solar Power System Works



a. The Solar Power System



How can we generate electricity from the sun?

The electricity which we use at home or at school is produced by enormous power stations. Fortunately, we don't need to build a big power station in our backyard to be able to generate electricity from the sun. Solar power systems hardly take up any space at all, so we can install them almost anywhere we want. First, we have to install solar modules on the roof. These catch the sun's rays and turn them into electricity

The type of electric current generated by solar modules is known as „direct current“ (DC). For our sockets at home, however, we need „alternating current“ (AC). This is why we need an „inverter“. An inverter is a device which converts the electric current into a form we can use at home. Finally, all we need to do is connect the modules, the inverter and the sockets using electrical wiring and start using the electricity! And the best thing about it is, that once the system is installed, we no longer have to pay for our electricity, because the sun sends it to us free of charge.

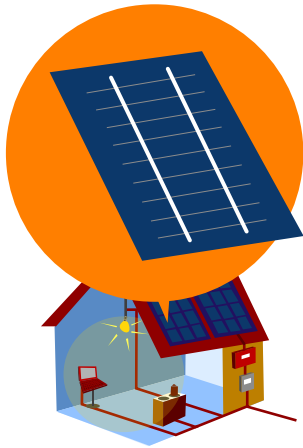


Solar Trees

Sometimes there isn't enough space on a roof for solar modules. Or there's a large tree near the house which would stop the sunlight getting to the modules. It'd be a shame to cut the tree down, so instead, the modules can be mounted on a stand where the sun can get to them better. This is called a „solar tree“. Some solar trees can even rotate to face the sunlight all day. This type can generate large amounts of electricity.



b. The Solar Module



How is light converted into electricity?

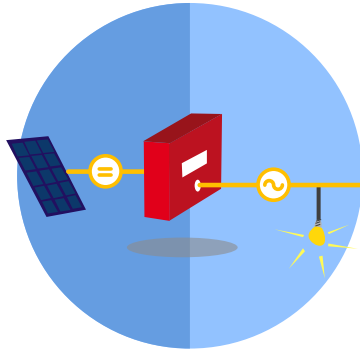
Do you know how you can tell whether a house uses sunlight to generate electricity? You guessed it: by the solar modules on the roof. They look a bit like dark blue panes of glass or skylights. They are made from a material called silicon. Silicon is useful because it can collect the sun's rays and convert them into electricity. As soon as sunlight hits the solar module, the electrons in the silicon start to move around. Electrons are very tiny, very fast moving particles which are invisible to the naked eye; we can't even see them under a microscope! As the excited electrons whiz around inside the module, they flow through special little wires and create electric current.

The transformation of light into electrical energy is called the „photoelectric effect“. It comes from the Greek word „photos“, meaning „light“.





c. The Inverter



Can an electric current change direction?

Solar modules collect energy from the sun and convert it into an electric current. But if we want to use this electricity at home we also need a device called an „inverter“. This is a device containing lots of cables, switches and wires. It has a very important job to do. The electricity generated by the solar module flows through the cable in the form of a direct current (DC). We call it „direct current“ because all the electrons travel in the same direction. But we can't use this current in the home because our appliances need an „alternating current“ (AC). We call it „alternating“

because the electrons don't travel in the same direction, but constantly change direction inside the cable.

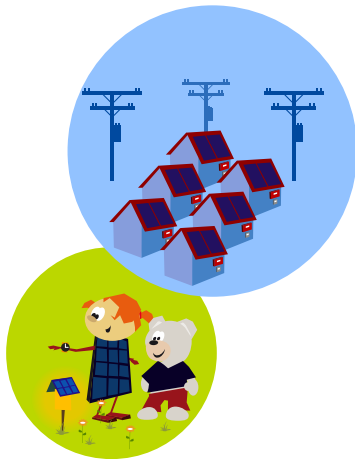
And this change of direction happens an amazing 60 times per second. Once the direct current has been converted into alternating current, it can be connected to our sockets and used. This process of converting direct current into alternating current is known as „inversion“, which is where the name „inverter“ comes from.



What can Solar Power be used for?



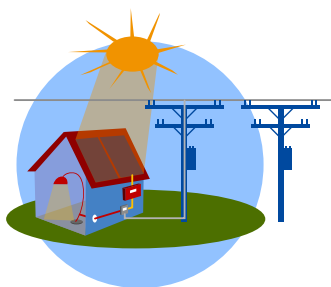
a. Solar Power Systems



What kinds of solar power systems are there?

Solar power has lots of different uses. For instance, there are solar-powered wrist watches, pocket calculators, garden lights, and radios. Sometimes you can see small solar modules on electronic traffic signs or parking meters. More and more people are choosing to use solar energy in their homes because of its many advantages. Most importantly, the sun's energy is free for everyone in the world to use and it supplies us with electricity without harming the environment. In many countries around the world, people also have the opportunity to earn money by selling solar power.

b. Selling Solar Power



How can we earn money from solar power?

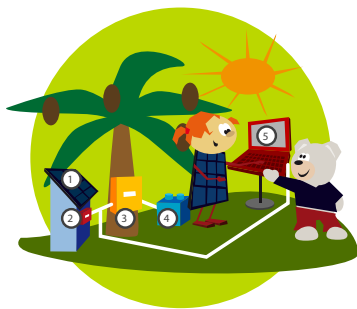
Normally your parents have to pay a lot of money for the electricity that you use at home. But did you know that this can also work the other way around? In some areas, people can earn money by selling their solar electricity. In America and in many other countries, politicians have decided that people who produce energy from the sun should be rewarded, because



they are doing something good for the environment. For this reason, whoever has a solar power system can sell their electricity. Rather than using their electricity themselves, they feed it into the local electrical system or „grid“ so that their neighbors can use it too. A special meter measures the amount of solar energy that they feed into the local electrical grid and they earn money in return. People who own solar power systems also use the electricity that has been generated for themselves.

You may ask why they don't use all of the electricity themselves, rather than selling some of it. The reason for this is that in some places, people can sell the solar electricity for more money than they pay for the electricity from a power station. So some people who produce electricity from the sun can earn money at the same time.

c. Island Solar Power Systems



How can remote, isolated houses be supplied with electricity?

There are many countries in the world where having electricity is not something that can be taken for granted. Houses with no electricity supply are often in areas which are far away from big cities. Across the world, there are currently around two billion people who live without electricity. There are also houses in America, for example some remote vacation cabins, which are not connected to the electrical grid.

These houses can be supplied with electricity by what is known as an „off-grid“ or „island“ solar power system. The sun's rays are captured by the solar module (see (1) on the picture) and are then converted into alternating current using an inverter (2). The electricity can then be used right away to power a computer (5), for instance, or any other electrical appliance. But what happens at night when the sun isn't shining? To solve this problem, batteries (4) are used. A second inverter (3) is installed which makes it possible to charge up the batteries while the sun is shining. The electricity flows through this second inverter into the battery, where it is stored and released whenever it is needed, at night for example.

Have a closer look at the picture to get a better idea of how the whole process works.