GB+USA

1. Eco Power – Energy from Renewable Energy Sources

We all need great quantities of energy every day. Let's take a look at normal everyday activities for this:

Our radio alarm clock wakes us up in the morning. Of course, it gets electricity from a socket outlet. We get up, switch on the electric lights, shower with warm water, which is heated by the central heating system using oil or gas. Then we dry our hair with an electric hair-dryer. The central heating system has already heated our apartment or home, so that we are not cold during breakfast. The water for the tea is boiled on the electric or gas stove. The butter is stored in the refrigerator at night and consequently is really hard. Of course, we switch on the radio or television during breakfast, so that we can find out the latest news and weather.
Then we go to school by bus or car, which requires fuel. We could continue for a long time to describe what we need energy for. The list would become infinitely long. To put it simply, we need an extremely large amount of energy.

And where does this energy come from? A majority of it is produced from the fossil fuels oil, gas and coal. A large part of our needs are covered by nuclear power. But these kinds of energy production have decisive disadvantages:

- The fossil fuel supplies are limited on the earth.
- Pollutants are created during the burning of oil and coal, which pollute our environment. CO_2 is also produced, which is responsible for the continual warming of the earth's atmosphere (greenhouse effect).
- Nuclear energy entails the danger of radioactivity being released following an accident, despite the high safety standards. Additionally, radioactive waste is created, which emits radioactivity for many thousands of years.

These are sufficient reasons for looking for alternatives, which are compatible with our environment and are available in unlimited supplies if possible. These alternative energy forms do in fact exist. We call them regenerative or renewable energy supplies. We deal with energy production from water, wind and the sun in our Eco Power Kit. Using numerous models, we see how you can generate and store electricity from them and then finally drive fischertechnik models using them too. Have fun!

2. The Term Energy

We talk about energy all the time, but what does it mean and how can we measure it?
By energy we mean the capability of a body to perform work. The measurement unit with which we measure energy and work is called joule (J).

Different energy forms exist, for example:

- Kinetic energy, the energy that is released when a body moves.
- Potential energy, the energy that a body has when it is at specific height.
- Electric energy in the form of electric power and current.

Electric energy or work is also expressed kilowatt hours (kWh). Kilo=1000, Watt=power, hours=time during which power is produced.

Example:
An incandescent bulb has a power of 100 watt. It lights for 10 hours. The energy required for this is:
100 W • 10 h = 1000 Wh = 1 kWh

To make it clear how much energy a kWh contains, let's perform the following experiment:

A bicycle generator has a power of 3 watt. When the generator is switched on, the kinetic energy of the wheel is converted into electric energy.

Task 1:
How much energy is converted during one hour of riding?
Solution:
Energy = 3 W • 1 h = 3 Wh = 0.003 kWh

Task 2:
How long do you have to ride a bicycle to convert 1 kWh (1000 Wh)?
Solution:
We can derive the following from the formula energy = power•time:
Time in hours = energy/power = 1000 Wh/3 W = 333.33 h

333.33 h correspond to 13.88 days. This means that we would have to pedal continuously for almost 14 days to convert the energy of 1 kWh, which our incandescent bulb from the previous example needs to light 10 hours.

If we now consider that a family of four has an average energy requirement of approx. 4,000 kWh per year, then we realize quickly that we will not get very far searching for environmentally compatible energy sources with a bicycle. Then we had better devote our attention to other energy sources.

3. Energy from Water

3. 1. The Kinetic Energy of Water

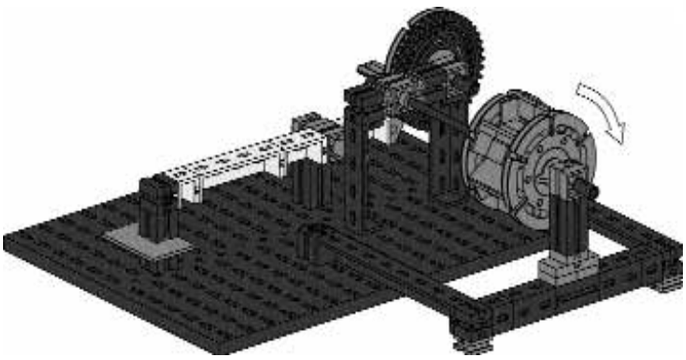
Man has been using the kinetic energy of water to drive machines directly for hundreds of years.

Task 1:
What machines can you think of that are driven directly by water power?

Solution:
- Watermills
- Sawmills
- Hammer-mills

The drive principle is the same for all these machines. The water is routed onto a waterwheel, the wheel turns and the movement is transferred directly to the respective machine.

To make the drive principle clear, now build the model of a hammer-mill (see the assembly instructions on page 4).



You can hold the waterwheel under a water faucet. Note the direction of rotation of the wheel given in the assembly instructions.

Iron, which was first made red hot, was forged with such hammer-mills in previous times.

Task 2:
What are the disadvantages of this form of using water power?

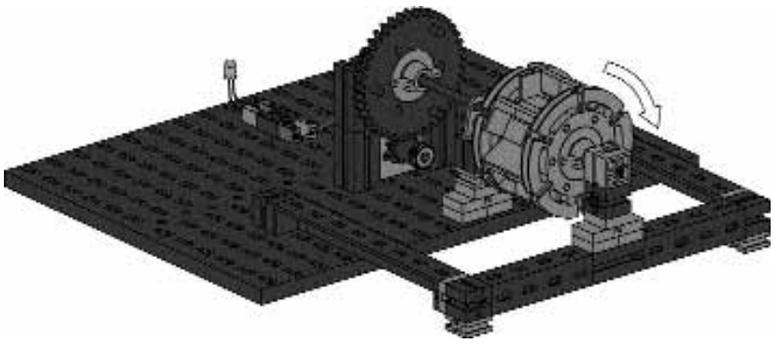
Solution:
- The energy can only be used where water flows (at rivers or streams). It cannot be transported to other places.
- The energy cannot be stored. It must be used immediately when it is available.
- The energy is only available for a limited purpose (driving a few machines).

Task 3:
How is water power used today?

Answer:
We generate electric current using water power, which is available for any number of uses.

3.2 Electric Power from Water Power

To see how this functions, now build the model of a hydraulic turbine (see the assembly instructions on page 7).



The solar micromotor is used as a generator for this. If you rotate the shaft of the motor, voltage is generated using a magnetic field in the motor, which can be tapped at the motor connections. If we connect the green LED, electric current flows and the LED lights. Because the motor shaft has to rotate very quickly, the movement of the waterwheel or the turbine wheel is converted in the relation 1:4. Hold the waterwheel under a water faucet again and let the wheel rotate so quickly that the LED lights. Note the direction of rotation again.

Caution!
- This experiment is very well suited to flooding a kitchen or bathroom. That might be a lot of fun, but it could have unpleasant results, because your parents would probably react in a strange way in such cases. When the jet of water hits the blades of the hydraulic turbine on the sides, the amount of splashed water is kept within limits and the wheel rotates ideally at the same time.
- The motor is arranged in such a way that it does not become wet when you handle the model carefully. A few splashes of water will not affect it. But you should not hold it directly under the water faucet or dip it into water.
- The LED is only for showing how electric current can be generated using the solar micromotor. It is not suitable for lighting conventional fischertechnik models. It may be operated with a maximum of 2 volts. It burns out immediately if the voltage is higher. It may not be connected to a 9 V fischertechnik current supply in any case.