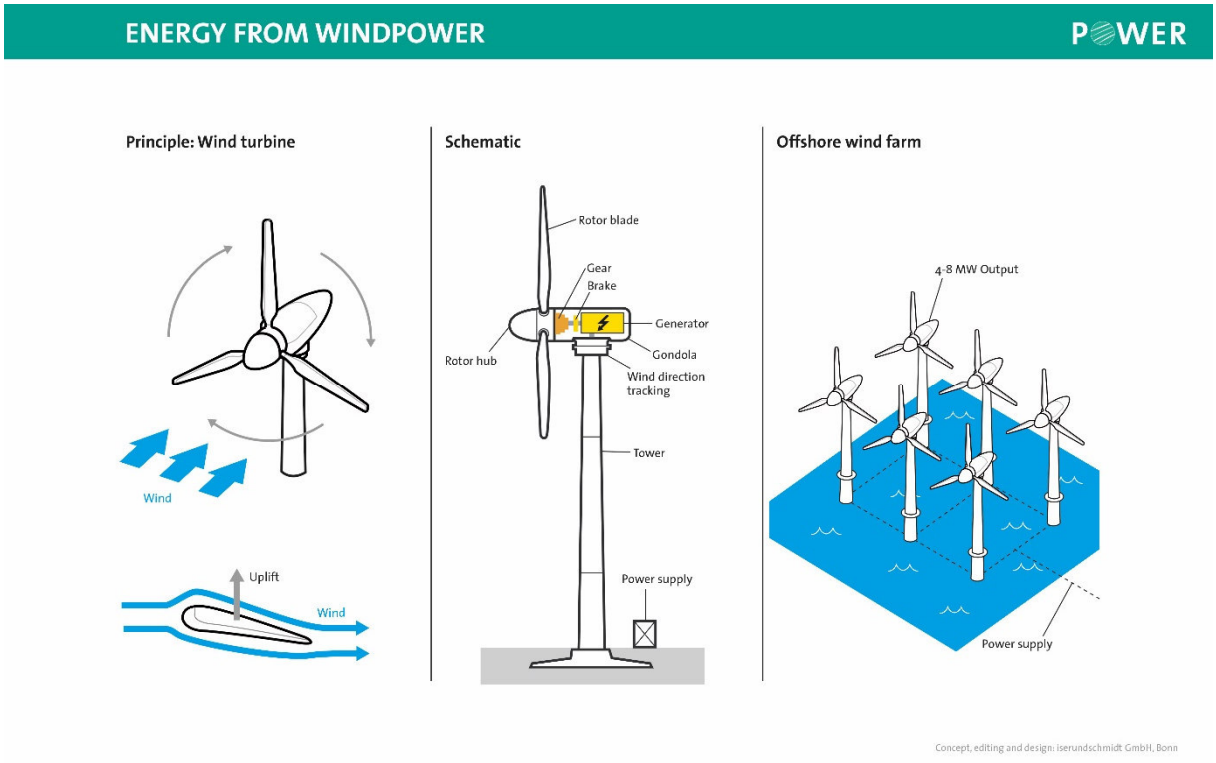
Infosheets „Renewable Energy”



Large three-bladed horizontal-axis wind turbines produce the overwhelming majority of **wind power** in the world today. These turbines have the main rotor shaft and electrical generator at the top of a tower. Wind turbine design is the process of defining the form and specifications of a wind turbine to extract as much energy as possible from the wind. A wind turbine installation consists of the necessary systems needed to capture the wind's energy, point the turbine into the wind, convert mechanical rotation into electrical power, and other systems to start, stop, and control the turbine.

The **aerodynamics of a wind turbine** are not straightforward. The air flow at the blades is not the same as the airflow far away from the turbine. The very nature of the way in which energy is extracted from the air also causes air to be deflected by the turbine. The shape and dimensions of the blades of the wind turbine are determined by the aerodynamic performance required to efficiently extract energy from the wind, and by the strength required to resist the forces on the blade.

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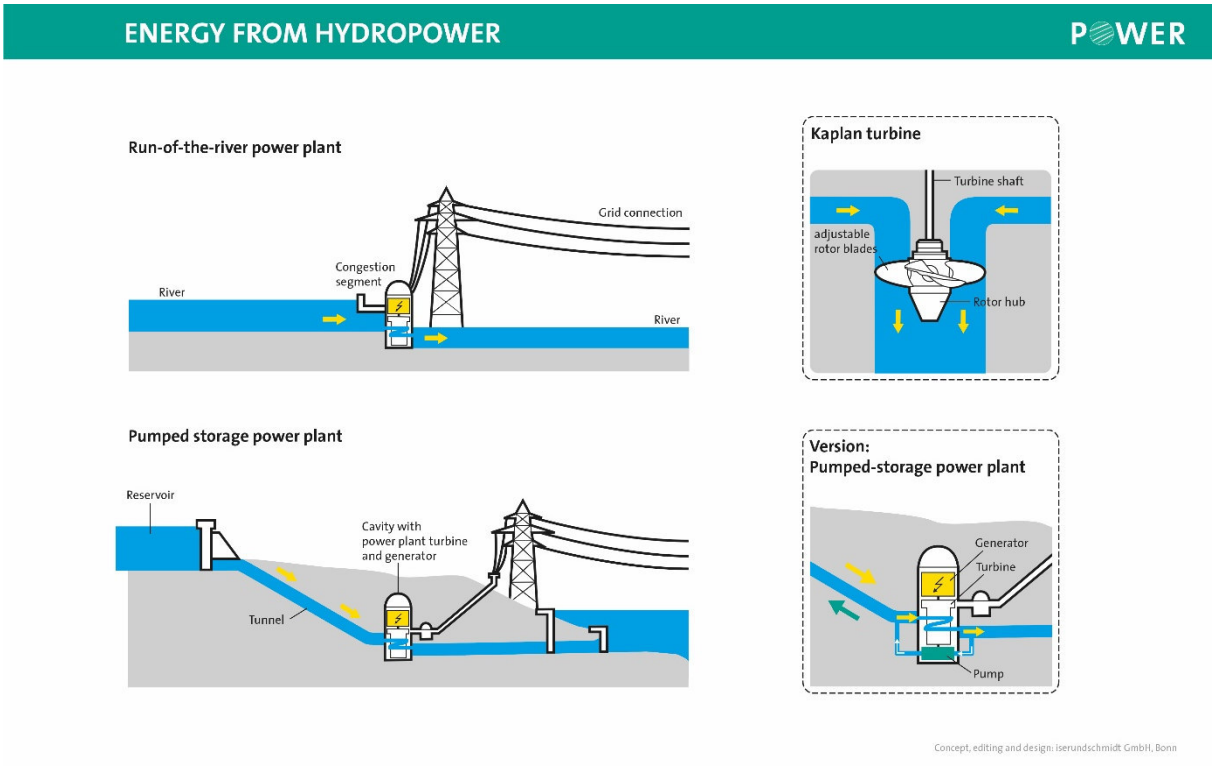

Hydroelectricity is electricity produced from hydropower. With a dam and a reservoir hydro stations are also a flexible source of electricity, since the amount produced by the station can be varied up or down very rapidly (as little as a few seconds) to adapt to changing energy demands. Once a hydroelectric complex is constructed, the project produces no direct waste.

Run-of-the-river hydroelectric stations are those with small or no reservoir capacity, so that only the water coming from upstream is available for generation at that moment, and any oversupply must pass unused. A constant supply of water from a lake or existing reservoir upstream is a significant advantage in choosing sites for run-of-the-river.

Pumped-storage power plants produce electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, the excess generation capacity is used to pump water into the higher reservoir. When the demand becomes greater, water is released back into the lower reservoir through a turbine.

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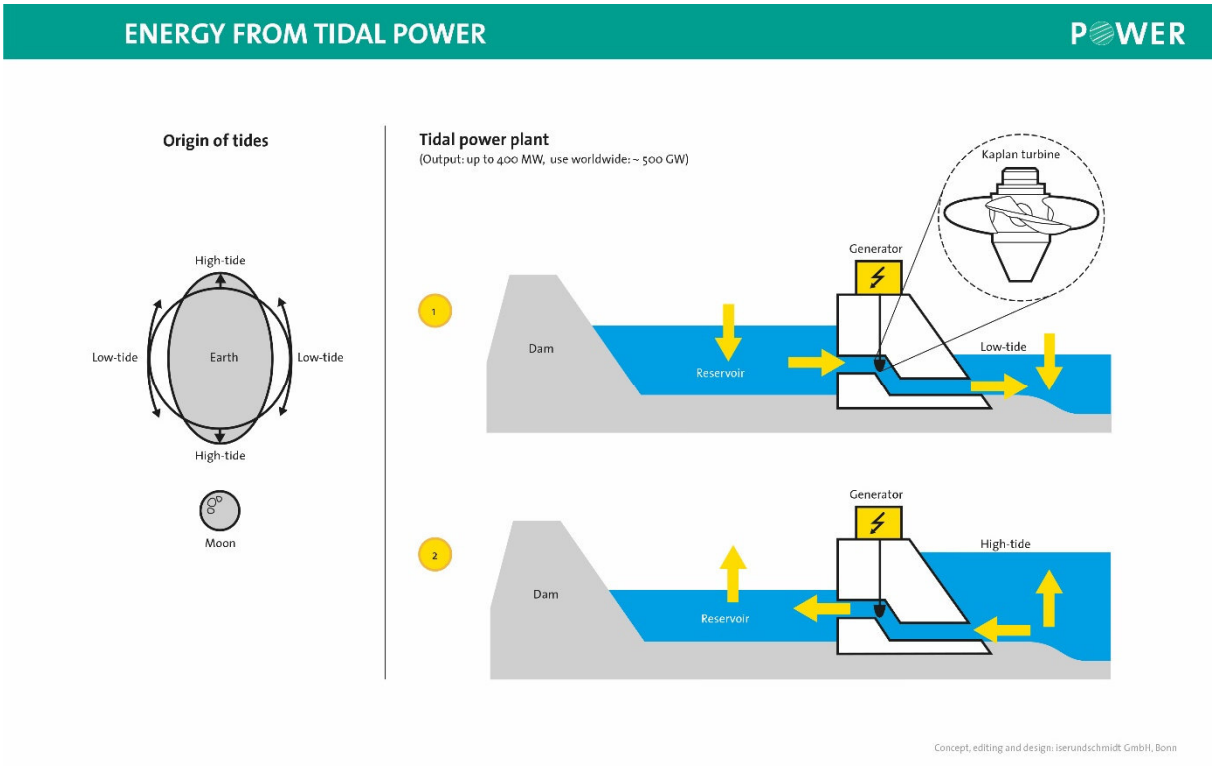

Tidal forces are periodic variations in gravitational attraction exerted by celestial bodies. These forces create corresponding motions or currents in the world's oceans. Due to the strong attraction to the oceans, a bulge in the water level is created, causing a temporary increase in sea level. As the Earth rotates, this bulge of ocean water meets the shallow water adjacent to the shoreline and creates a tide.

Tidal barrages make use of the potential energy in the difference in height (or hydraulic head) between high and low tides. When using tidal barrages to generate power, the potential energy from a tide is seized through strategic placement of specialized dams. When the sea level rises and the tide begins to come in, the temporary increase in tidal power is channeled into a large basin behind the dam, holding a large amount of potential energy. With the receding tide, this energy is then converted into mechanical energy as the water is released through large turbines that create electrical power through the use of generators. Barrages are essentially dams across the full width of a tidal estuary.

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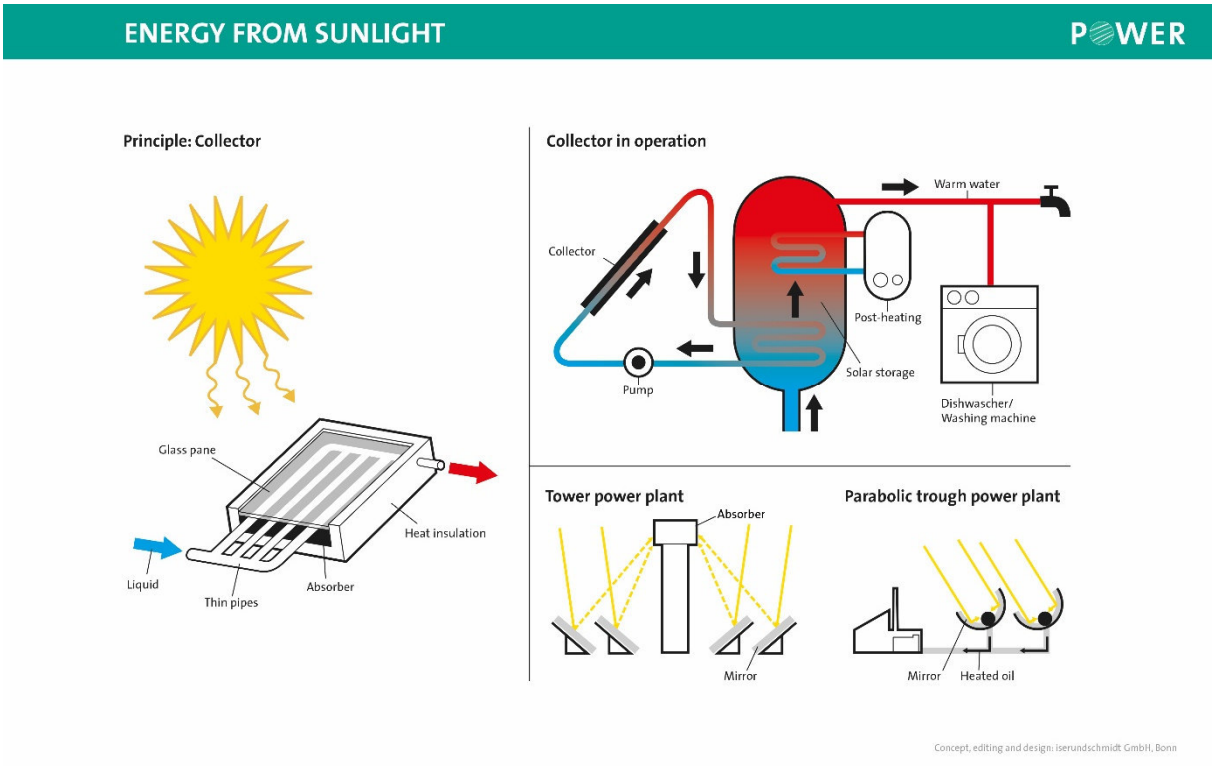

Solar heating is the conversion of sunlight into heat for heating water or other liquids using a solar thermal collector. A sun-facing collector heats a working fluid that passes into a storage system for later use. They are active (pumped) and passive (convection-driven). They use water only, or both water and a working fluid. They are heated directly or via light-concentrating mirrors. They operate independently or as hybrids with electric or gas heaters.

Solar power towers are a type of solar furnace using a tower to receive the focused sunlight. It uses an array of flat, movable mirrors (called heliostats) to focus the sun's rays upon a collector tower (the target).

A **parabolic trough power plant** uses solar thermal collectors that are straight in one dimension and curved as a parabola in the other two, lined with a polished metal mirror. The sunlight which enters the mirror parallel to its plane of symmetry is focused along the focal line, where objects are positioned that are intended to be heated.

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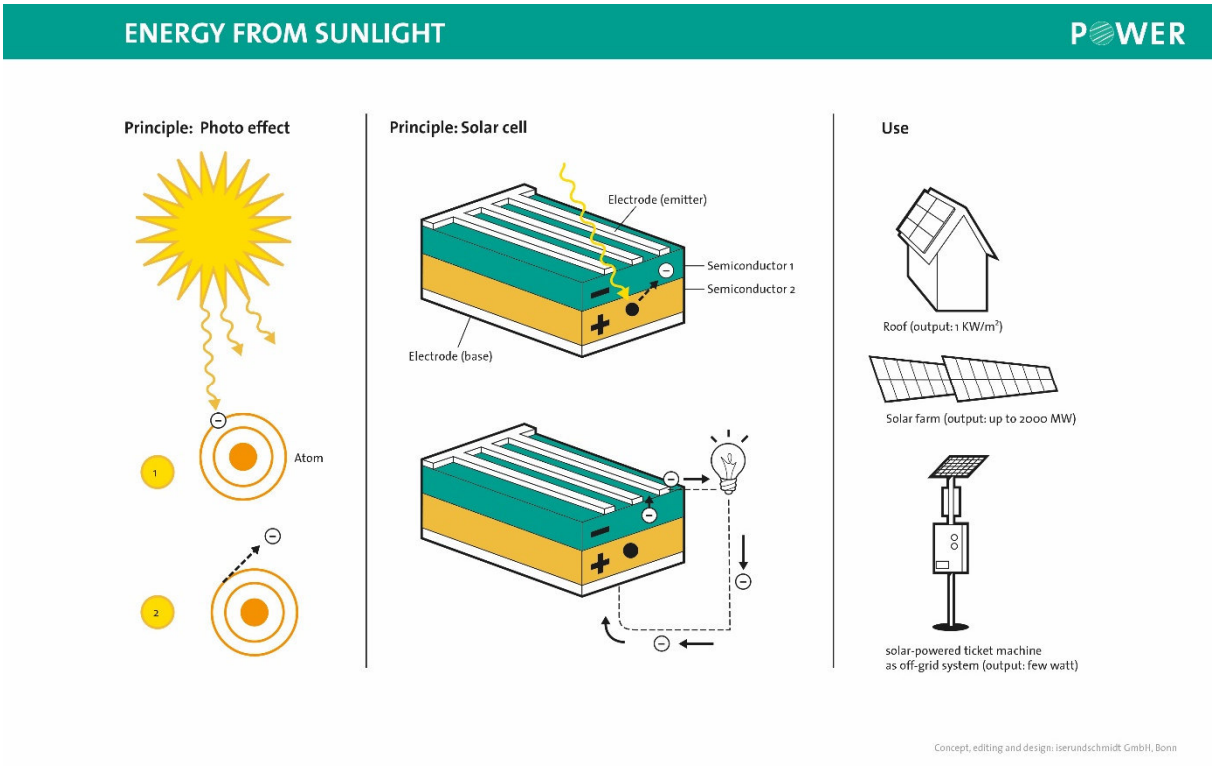

The **photoelectric effect** is a phenomenon in physics. The effect is based on the idea that electromagnetic radiation is made of a series of particles called photons. When a photon hits an electron on a metal surface, the electron can be emitted.

When **photovoltaic cells** are exposed to sunlight, many photons pass right through or are absorbed by the solar cell. When enough photons are absorbed by semiconductor 2 of the solar cell, electrons get excited and are free to move to semiconductor 1. Where these two layers are in contact, an electrical field is created between them. This electrical field provides impulse and direction to electrons, which resulting in a flow of current when the solar cell is connected to an electrical circuit or load.

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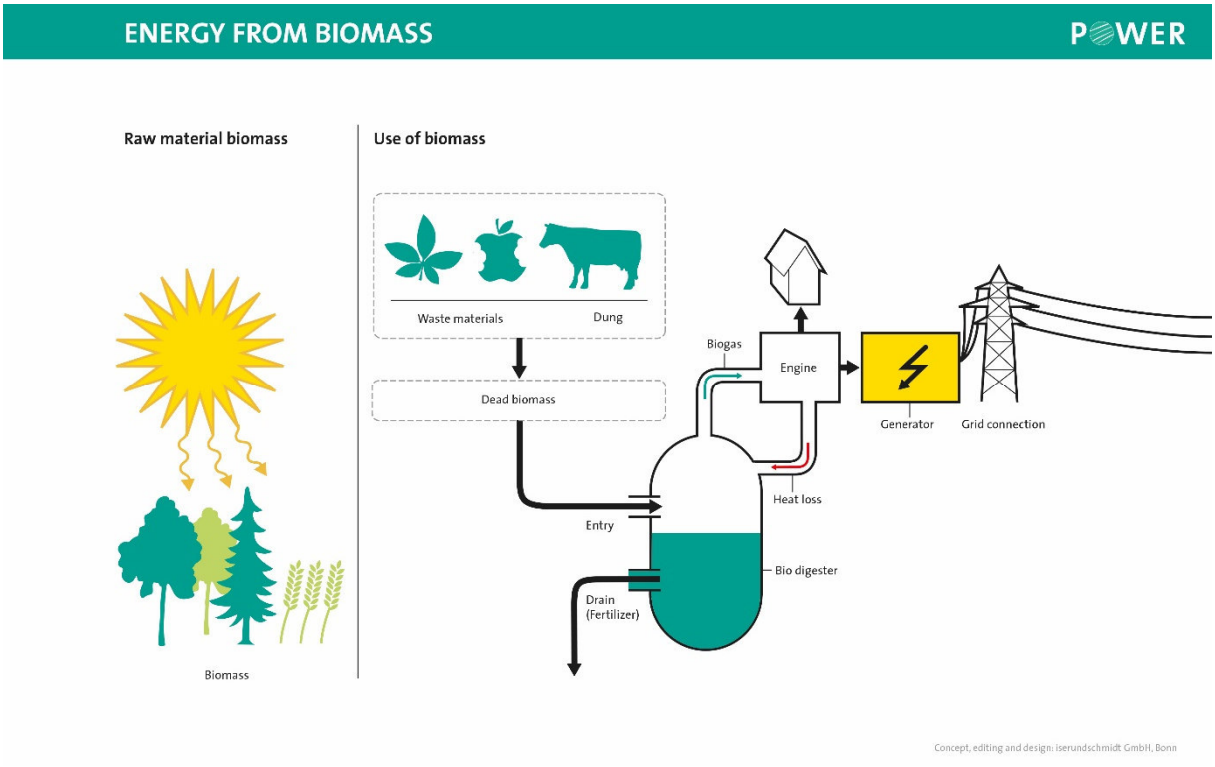

Biogas from **sewage sludge** treatment can used to run a gas engine to produce electrical power. Some waste heat from the engine is then used to heat the digester. The waste heat is, in general, enough to heat the digester to the required temperatures. Farm biogas plants using animal waste and energy crops are expected to contribute to reducing CO_2 emissions and strengthen the power grid. Bio gas production by **anaerobic digestion** is popular for treating biodegradable waste because valuable fuel can be produced while destroying disease-causing pathogens and reducing the volume of disposed waste products. The methane in bio gas burns more cleanly than coal, and produces more energy with less emissions of carbon dioxide. The harvesting of bio gas is an important role of waste management because methane is a greenhouse gas with a greater global warming potential than carbon dioxide.

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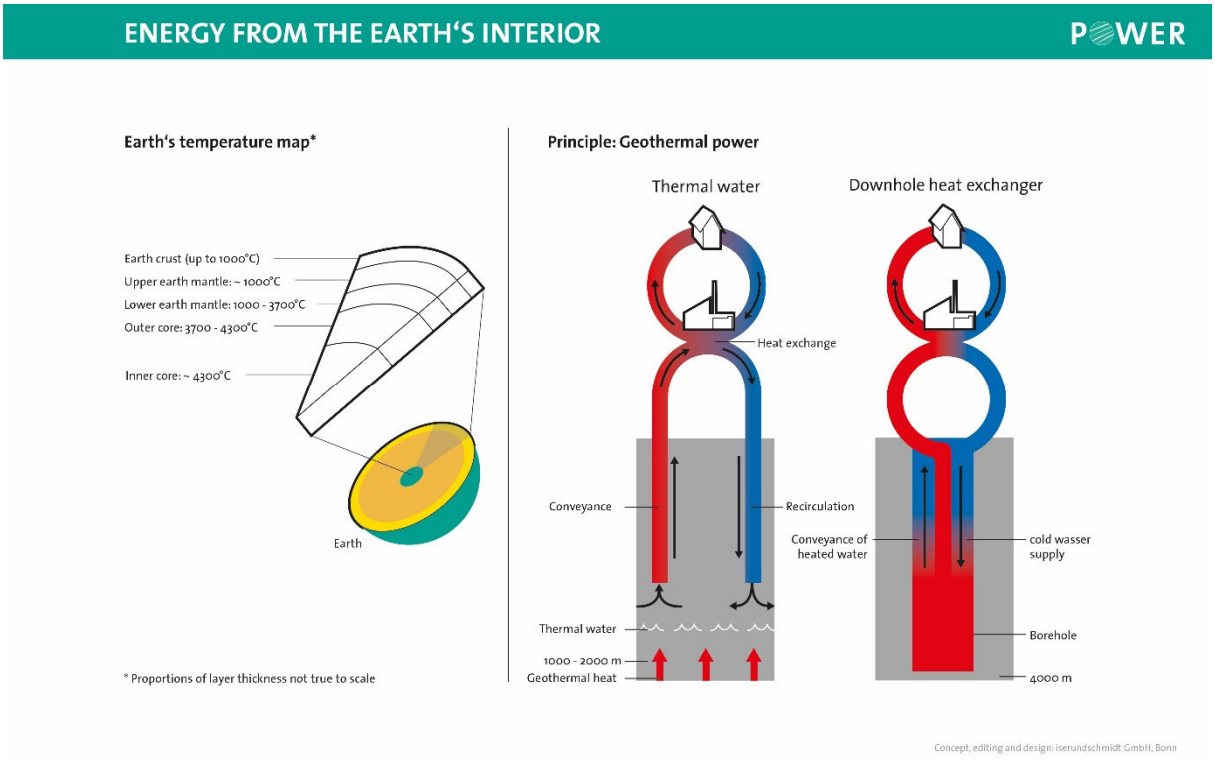

A **thermal power plant** is a power plant where steam is used to drive a steam turbine. This turbine is connected to an electrical generator. After this, the water is condensed, and may be used again. There are different procedures that can be used to heat the water. In areas where hot springs or geothermal reservoirs are near the Earth's surface, hot water can be piped in directly to heat homes or office buildings.

Geothermal water is pumped through a heat exchanger, which transfers the heat from the water into the building's heating system. The used water is injected back down a well into the reservoir to be reheated and used again.

A **downhole heat exchanger**, also called a borehole heat exchanger, is a heat exchanger installed inside a borehole. It is used to capture or dissipate heat to or from the ground. Downhole heat exchangers are used for geothermal heating, sometimes with the help of a geothermal heat pump.

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