



TISHK UNIVERSITY

FACULTY OF ENGINEERING

Department of INTERIOR DESIGN

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INDS 414 SUSTAINABILITY and the INTERIOR ENVIRONMENT

Lecturer

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MSc in Sustainable Building Technology

Renewable Energy Sources

What Renewables are?

- These are resources found in nature that are self-regenerating:
- These sources are normally used to produce clean (or green) energy. This production does not lead to climate change and does not involve emission of pollutants.
- A related term is sustainable energy: this concept refers to generating energy with an awareness of the future, i.e. in a way that would enable future generations to meet their energy needs too. The concept is related not only to renewables, but also to energy efficiency.

Renewable energy is growing in importance and popularity:

- because of the desire and necessity to avert irreversible climate damage
- because of increasing oil prices;
- because of the unreliability of non-renewable resources (e.g. the depletion of oil wells).
- In view of all these and other factors, governments worldwide support renewables with various incentives.
- This, in turn, encourages entrepreneurs to make large-scale investments in renewable energy.

Main types of renewable energy

- Solar energy
- Wind energy
- Hydropower (water power)
- Biofuels
- Geothermal energy

There are many sources of renewable energy, but all of them, except geothermal energy, are more or less directly related to the sun: the main source of clean and sustainable energy for the earth.

Solar Energy

Apart from the everyday applications of solar energy, such as room lighting, it is harnessed by two quite different methods: **photovoltaics** and **solar thermal**.

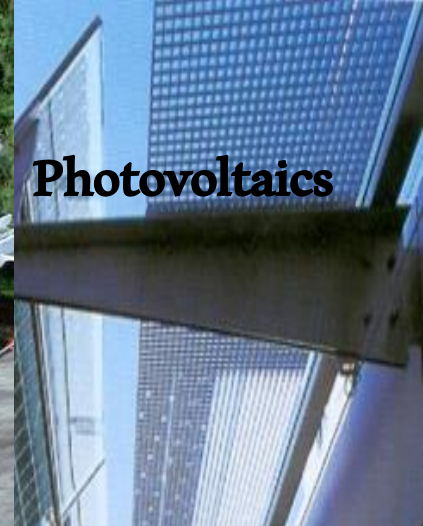
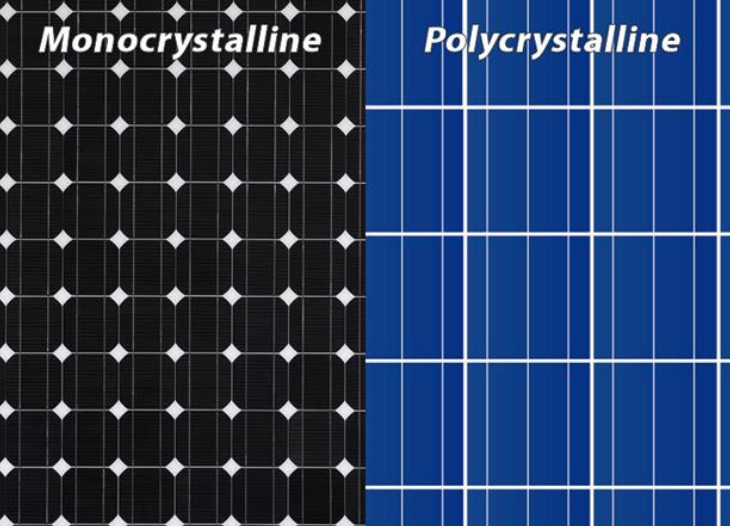
Photovoltaics (PV): the application of solar cells to convert sunlight directly into electricity. When PV cells are assembled, they form a PV module (or panel). An installation of panels is called a PV array. Solar cells are often made from wafers: slices of semiconductor material, such as silicon crystal.

World leaders in PV use:

Germany, USA, Spain

Monocrystalline

Polycrystalline



Photovoltaics



- **Active solar techniques** include the use of photovoltaic panels and solar thermal collectors to harness the energy.

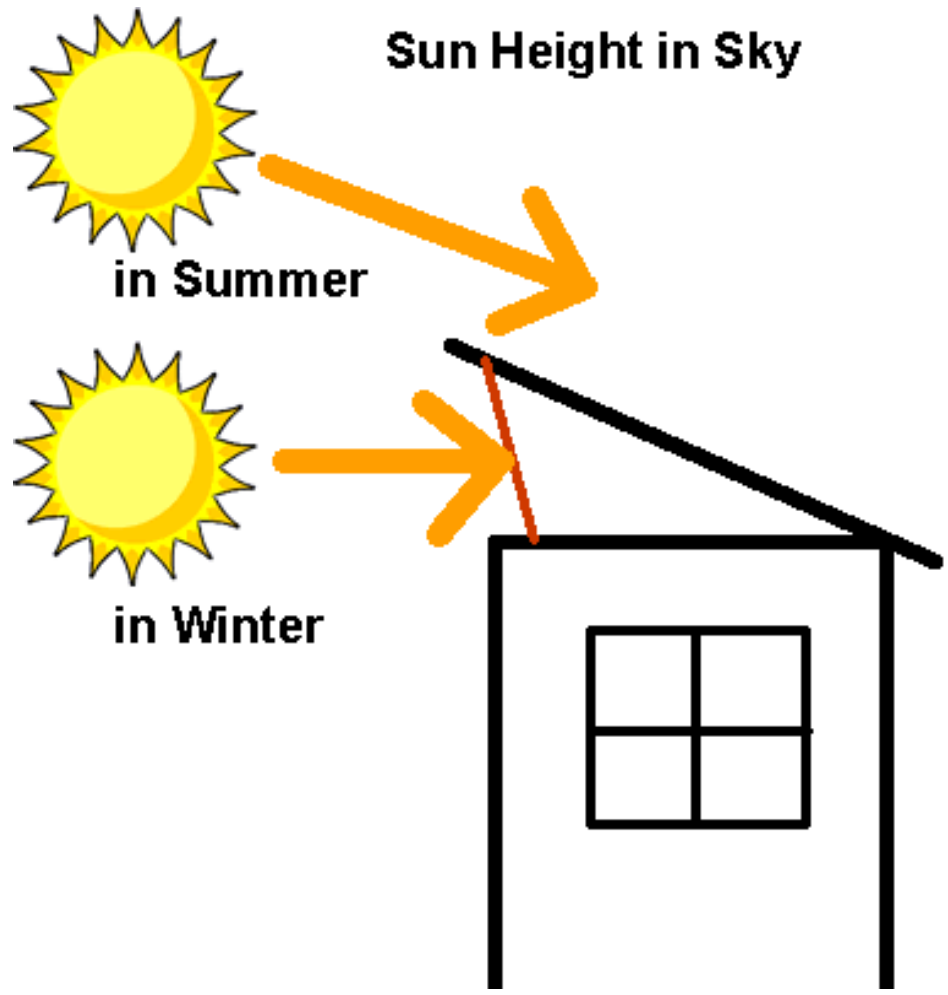
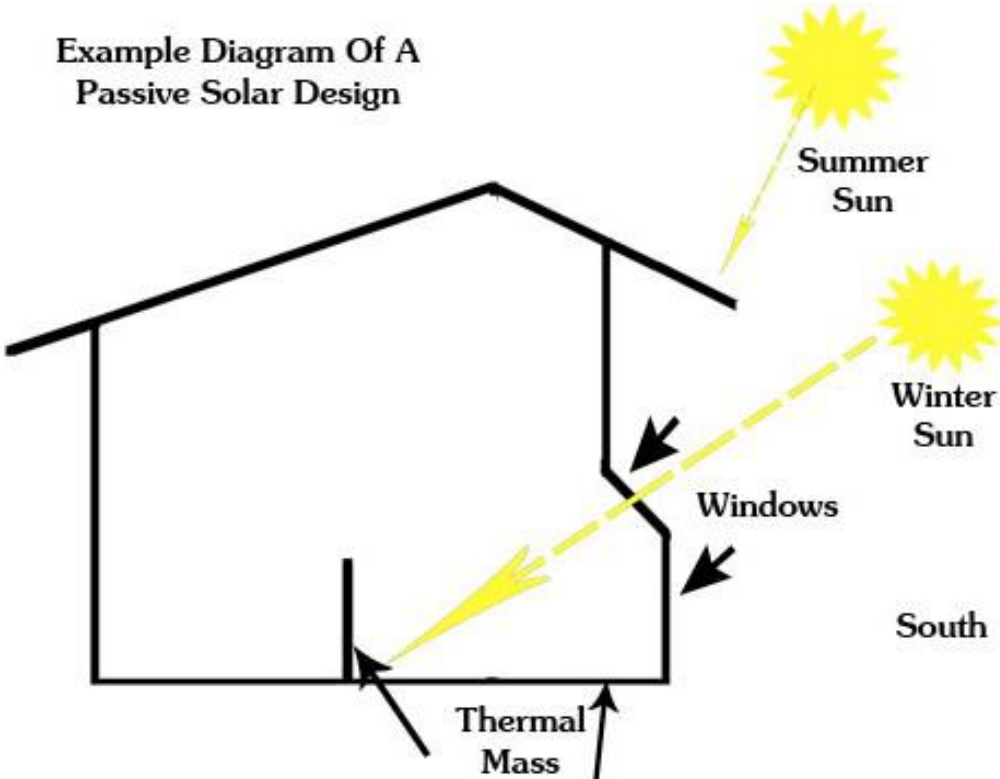
- **Passive solar techniques** include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

Active Solar Techniques

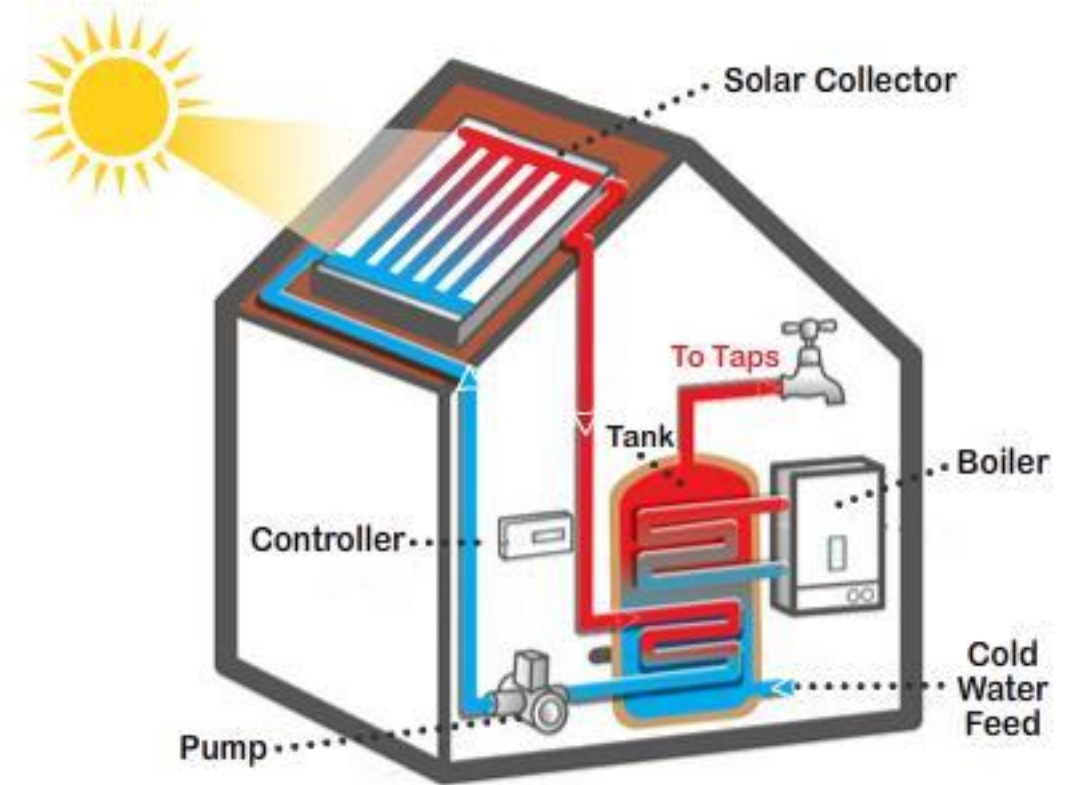


Passive Solar Techniques

Example Diagram Of A Passive Solar Design



Solar thermal energy (STE): a technology that uses solar energy to produce thermal energy, i.e. heat. There are low-,medium-, and high-temperature solar thermal collectors. The first two types are flat plates generally used to heat water. High temperature collectors concentrate sunlight with mirrors or lenses and are mostly used to produce electricity. This technique is known as **concentrated solar power CSP.**



Wind Energy

The energy of wind is harnessed with wind turbines.

They are usually grouped in **wind farms** (sometimes called **wind parks**).

There are **onshore** farms (which, however, are often near water); nearshore farms (on land or on sea within several km of a coast); and **offshore** parks (ten km or more from land).

Wind energy currently generates only 1% of all electricity on a global scale, but its share is growing rapidly. In Denmark, for example, wind already accounts for 19% of the total electricity production

Since wind is intermittent, turbines can't constantly work at their full capacities. The ratio of actual annual productivity to the theoretical maximum capacity is called **capacity factor**. It typically reaches 20% to 40%.

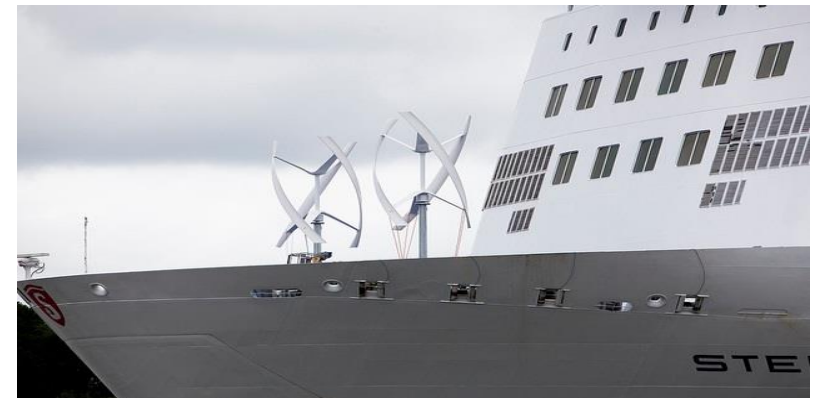
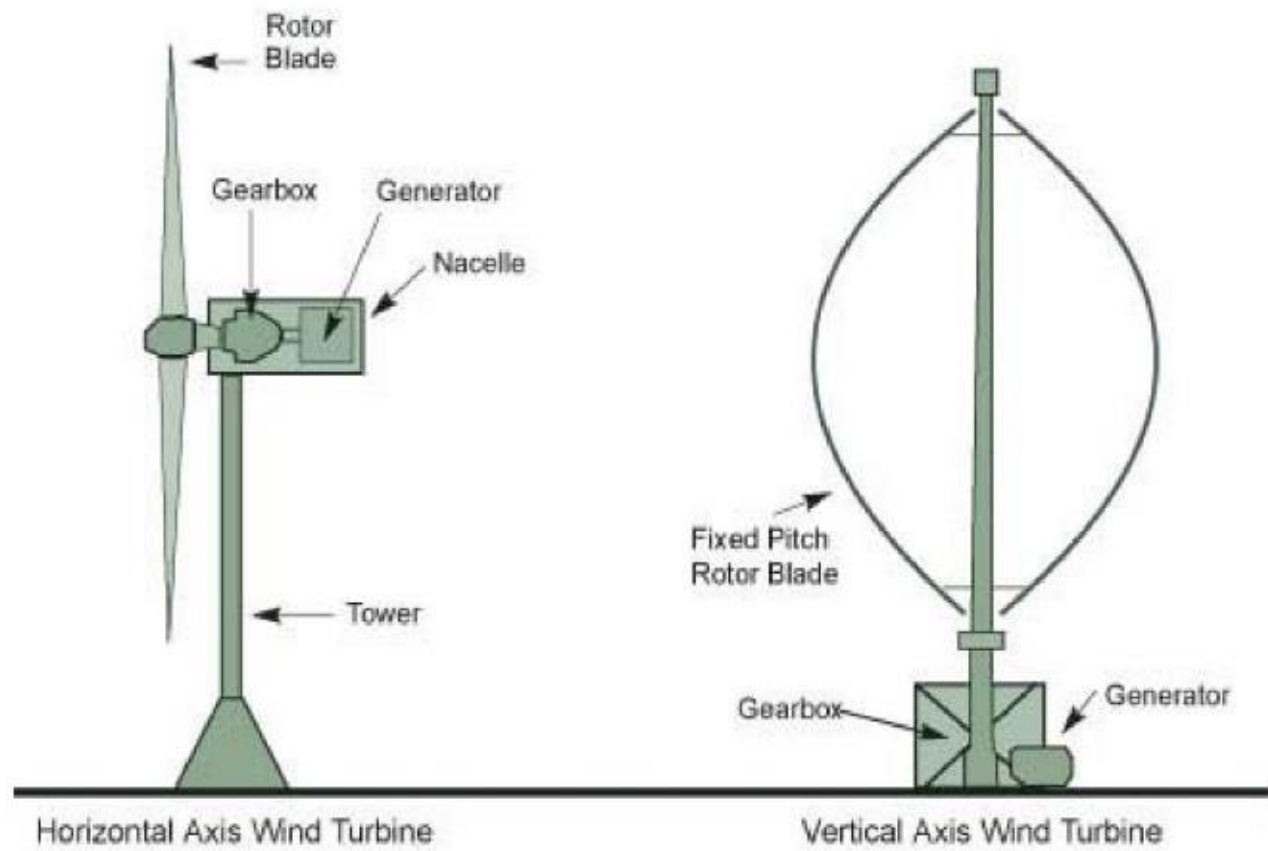
World leaders in wind energy use:

Germany, USA, Spain, India



Types of Wind Turbines:

- Horizontal Wind Turbines
- Vertical Wind Turbines



Hydropower

Hydropower (also called hydraulic or water power) is derived from the force of moving water.

Since water is much denser than air, its movement generates more energy than wind does.

Electricity generated with hydropower is called **hydroelectricity**.

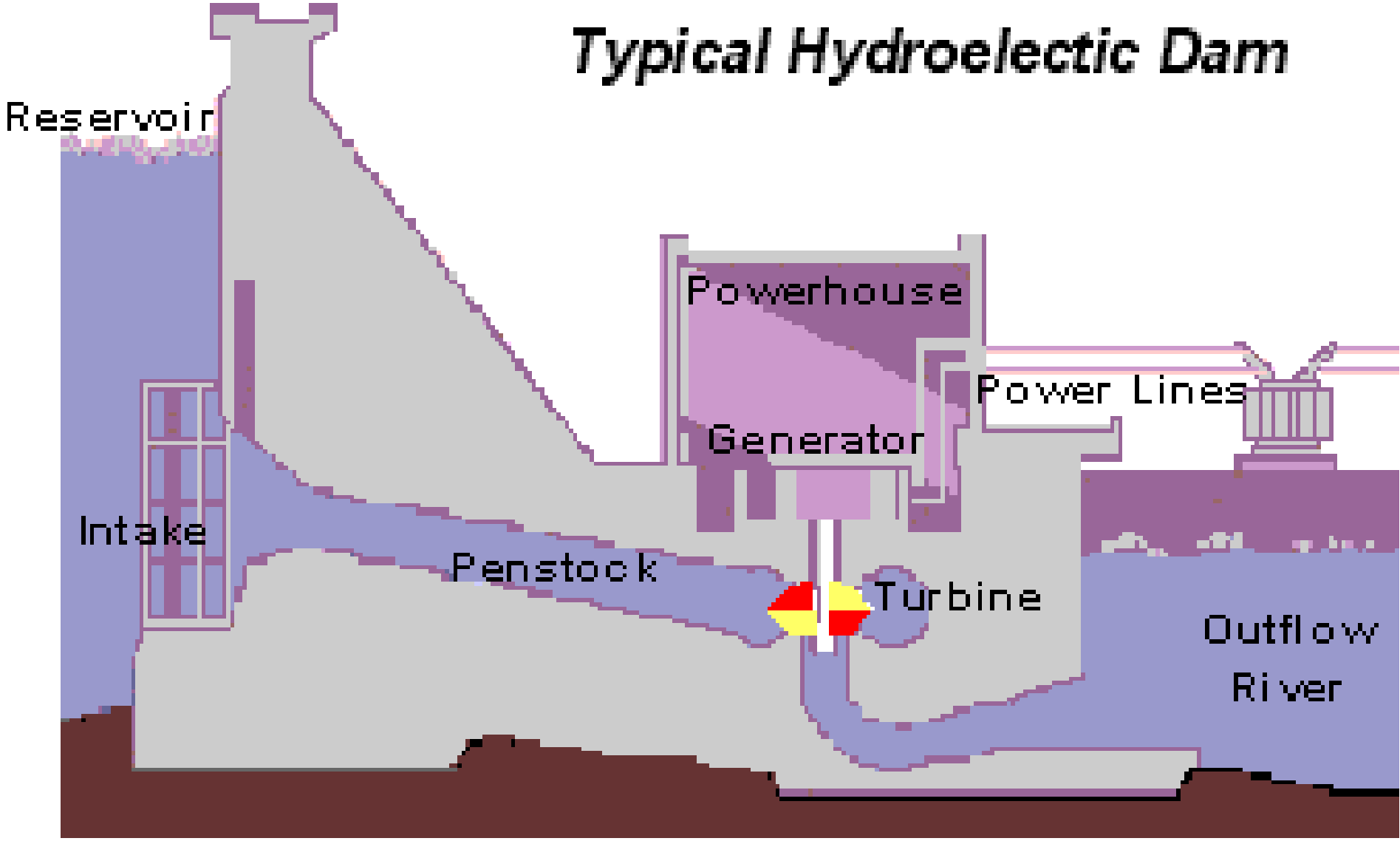
Hydropower supplies some 19% of all electricity in the world. It is generally far cheaper than fossil fuels or nuclear energy.

Hydroelectricity is mostly generated in dams. Water is first collected in dams, then let flow through turbines. A great advantage of this technology is that the amount of energy produced can be easily adjusted to the level of demand by controlling the outflow of water.

World leaders in

***Hydropower use: China, Brazil,
Canada, USA, India***

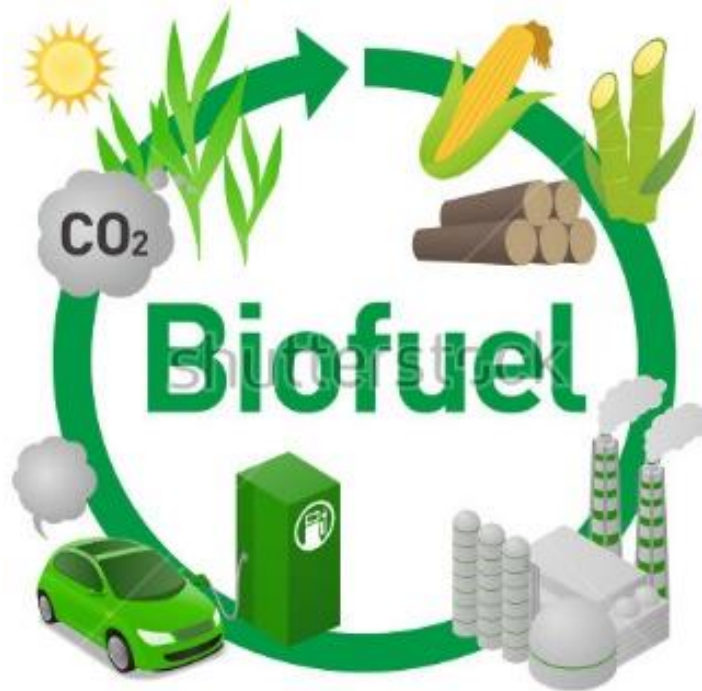
Typical Hydroelectric Dam



Biomass and biofuel

Biomass consists of living or recently dead organisms or other biological material, i.e. **carbon**.

Biomass is used to produce biofuel. The most common material for biofuels are photosynthetic plants. A plant especially grown to be used for biofuel manufacturing is known as an **energy crop**.



Geothermal energy

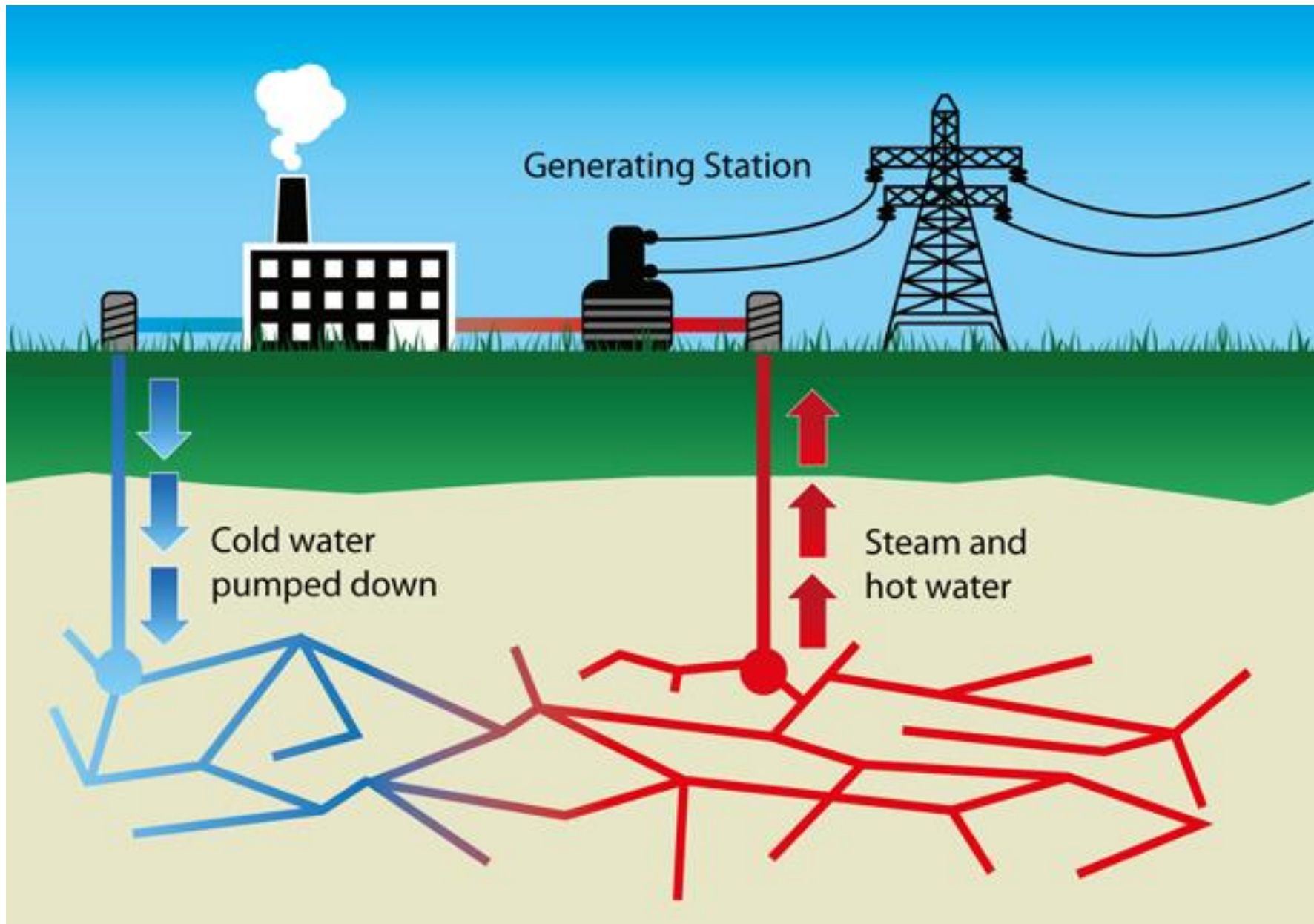
This type of energy is obtained by tapping the heat of the earth, which is mostly in the form of hot water and steam. Various technologies are used to get to the heat under the earth's surface at different depths.

Several meters under the earth's surface the temperature is between 10° and 16°C . In winter this heat can be brought to buildings with pipes.

Another technology uses deep wells in hot rock in which fluid is heated to produce steam, which then drives turbines to generate electricity. The facilities that enable this process are called dry steam, flash steam and binary-cycle plants.

Geothermal power stations are expensive to build but their operating costs are low. A significant advantage is that geothermal energy is not dependent on weather conditions.

A major disadvantage is the risk for land stability in the region where such a plant is constructed.



So, in a word...

A plethora of renewable energy is all around us, with even more ways to make use of it.

