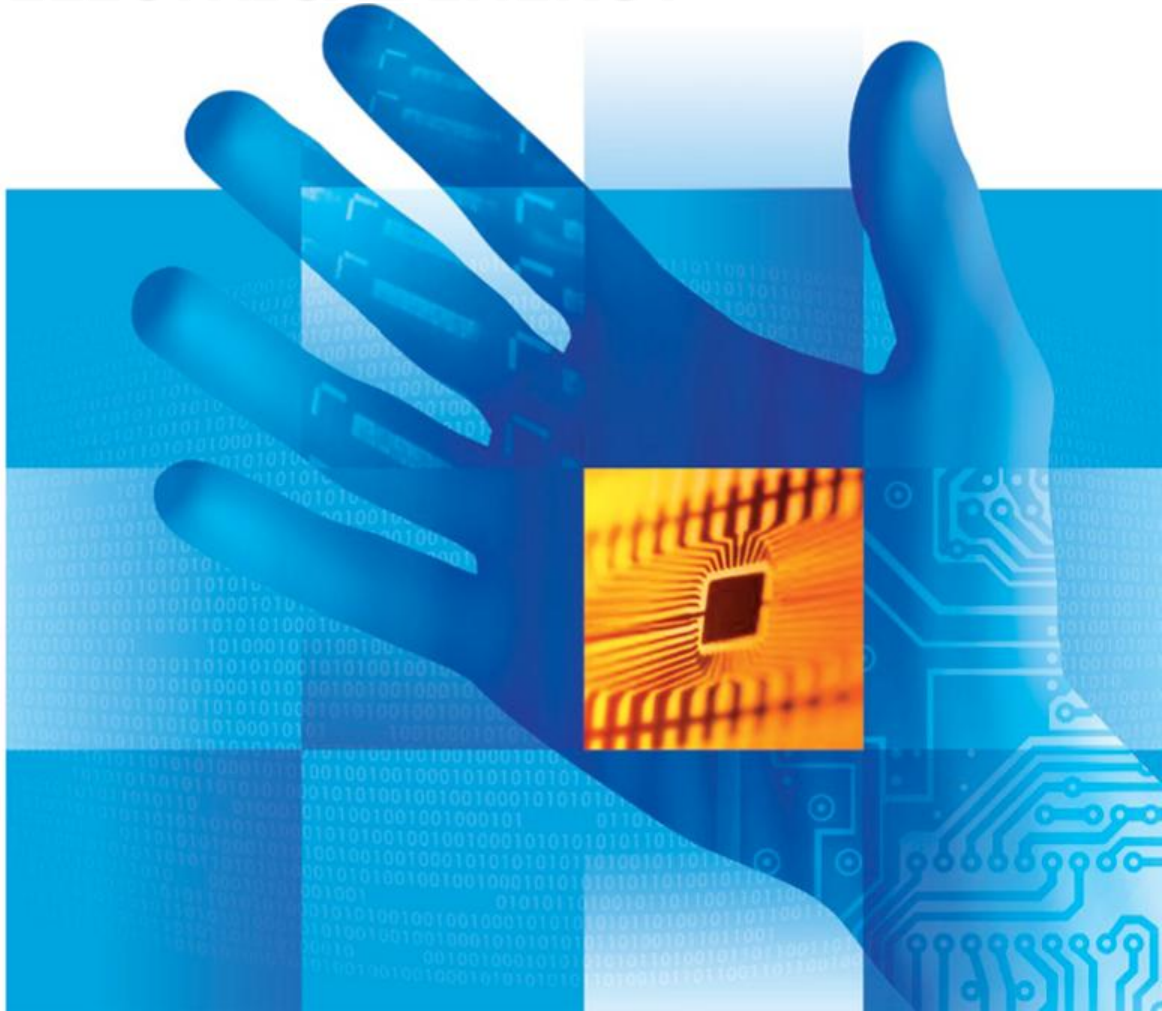
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

13. PRODUCTION AND DISTRIBUTION OF ELECTRICAL ENERGY



Doc. Ing. Stanislav Kocman, Ph.D.

17. 6. 2018, Ostrava

LECTURE PLAN

- possibilities of electrical energy production
- renewable resources of electrical energy
- distribution of electrical energy, electric energy system

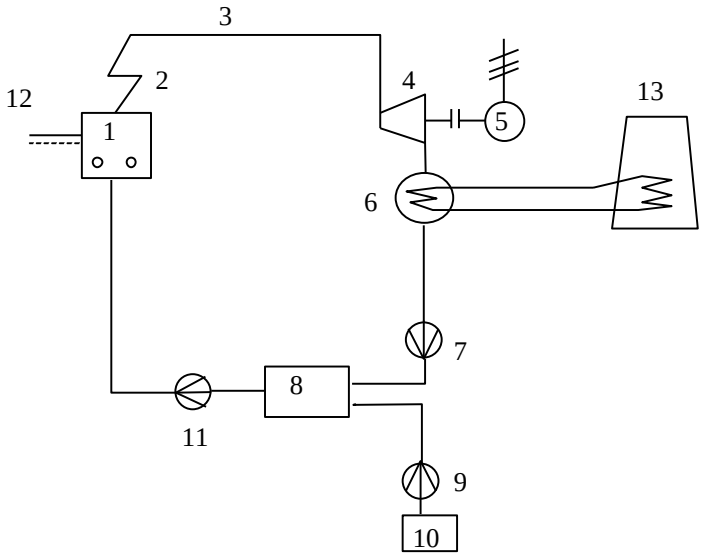
Possibilities of electrical energy production

Power stations

- **Fossil-fuel power stations:**
  - **the electric energy is getting from the energy of a fuel (coal, gas, oil)**
- **Nuclear power stations:**
  - **the electric energy is getting from the energy of the nuclear fission**
- **Hydroelectric power stations:**
  - **the electric energy is getting from the potential energy of the water**
- **Unconventional power stations:**
  - **wind, geothermal, solar energy power stations…**

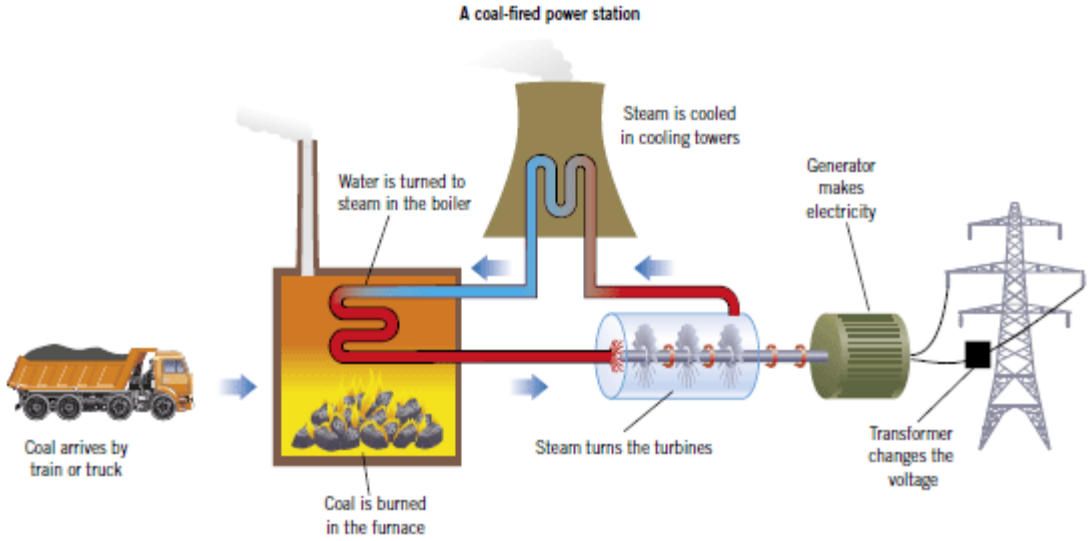
Fossil-fuel (thermal) power station

The principle



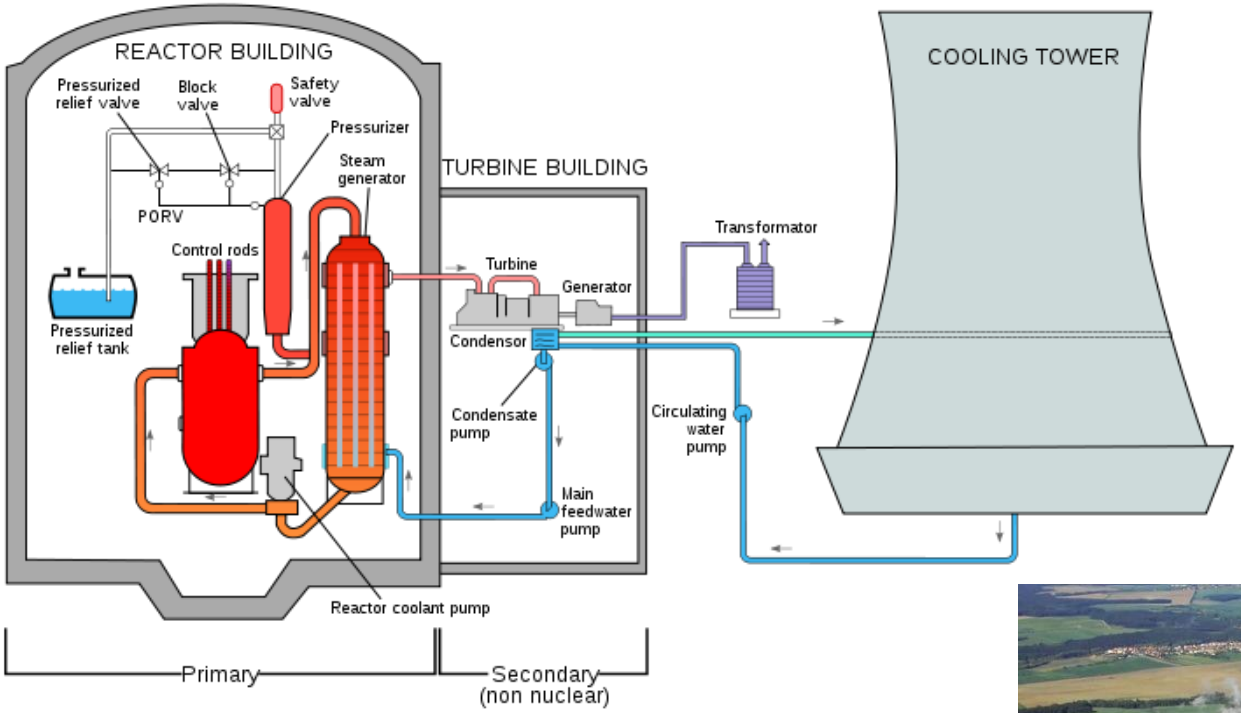
1 boiler
2 overheated steam
3 pipe-line
4 high-speed turbine
5 synchronous generator
6 steam condenser
7, 9, 11 pumps
8 water treatment
10 water tank
12 coal transport
13 cooling tower





Nuclear power station

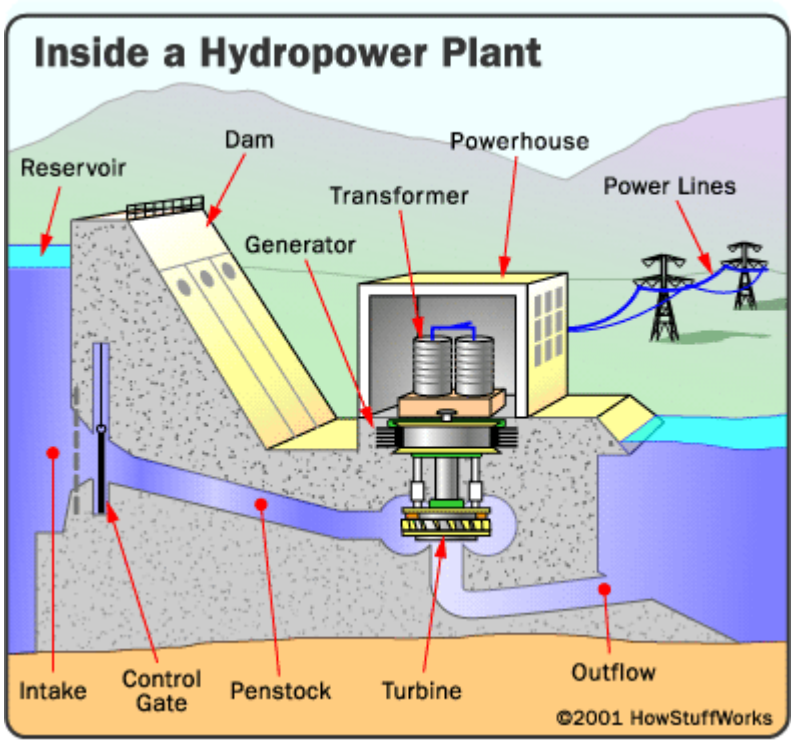
The principle

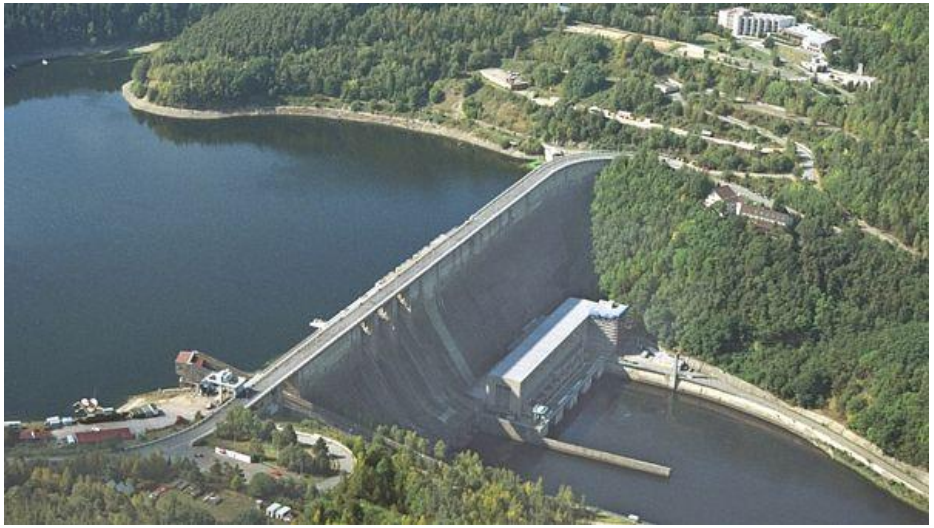




Hydroelectric (water) power station

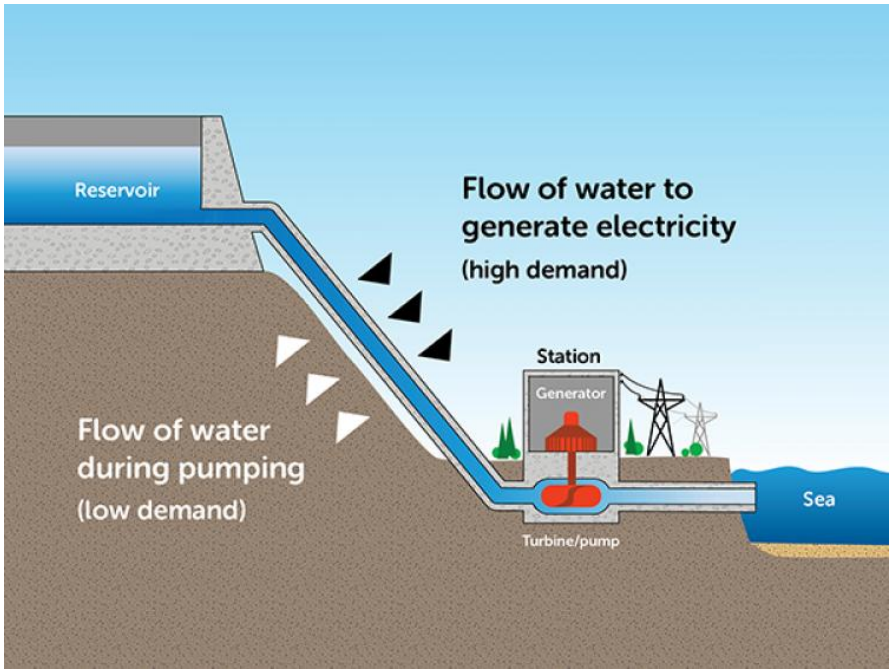
The principle

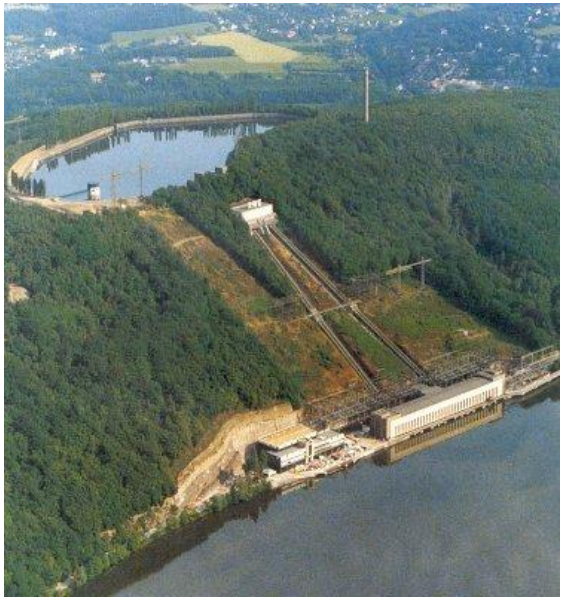




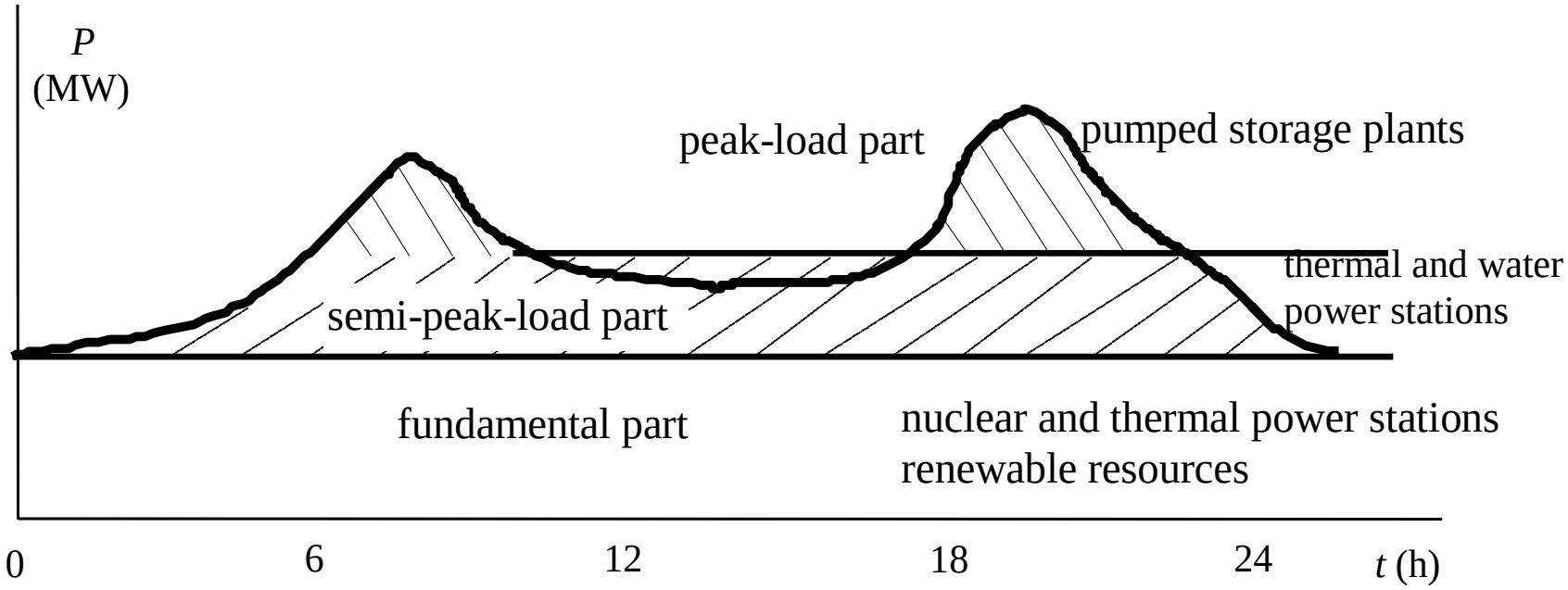
Pumped hydroelectric storage power station

The principle





Daily diagram of the electric energy consumption

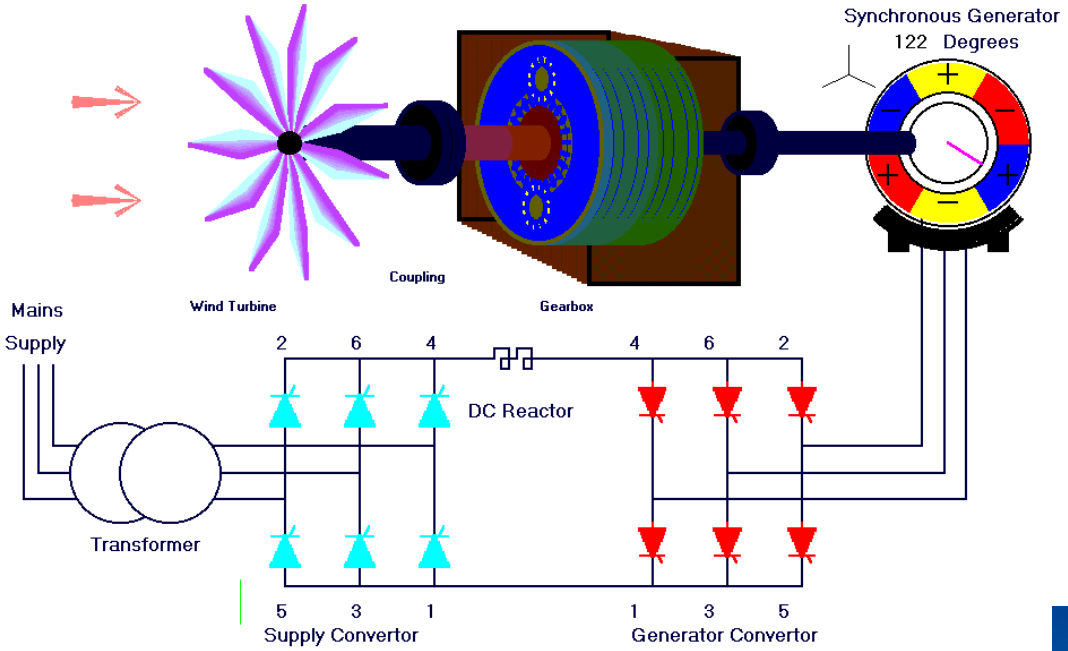


Renewable resources of electrical energy

- **Solar energy:**
  - in solar cells or in solar power plants
- **Wind energy:**
  - wind turbines
- **Marine energy:**
  - from ocean waves
- **Geothermal energy:**
  - hot steam from underground
- **Biomass energy:**
  - green natural waste

Wind power station (turbine)

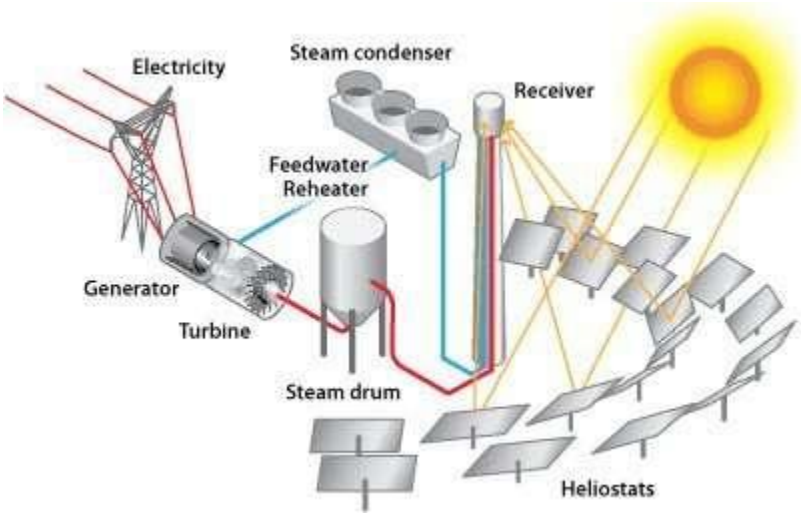
The principle

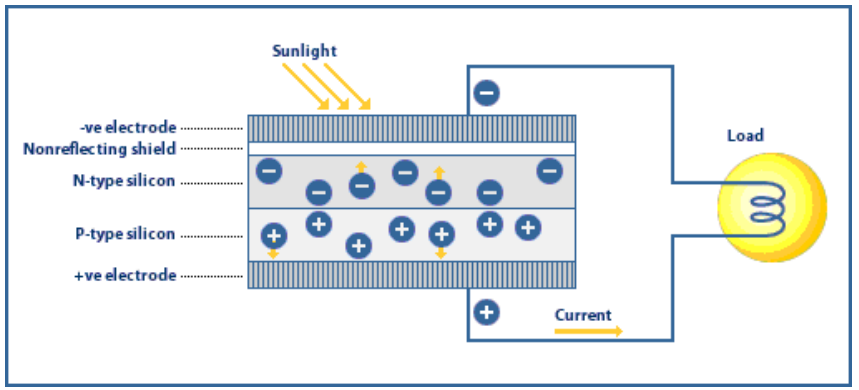




Solar power station (cells)

The principle



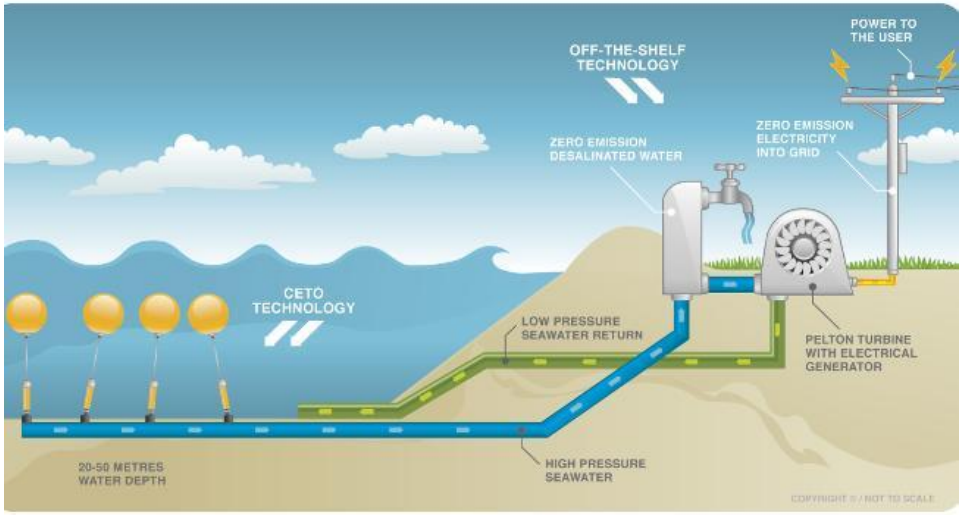






Marine power station

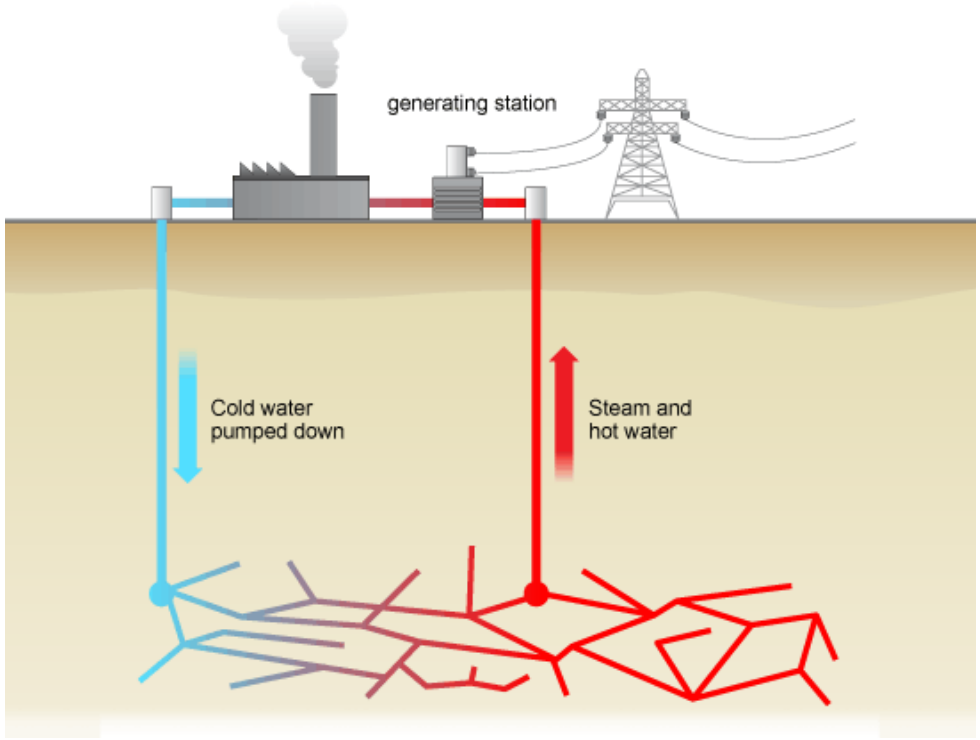
The principle





Geothermal power station

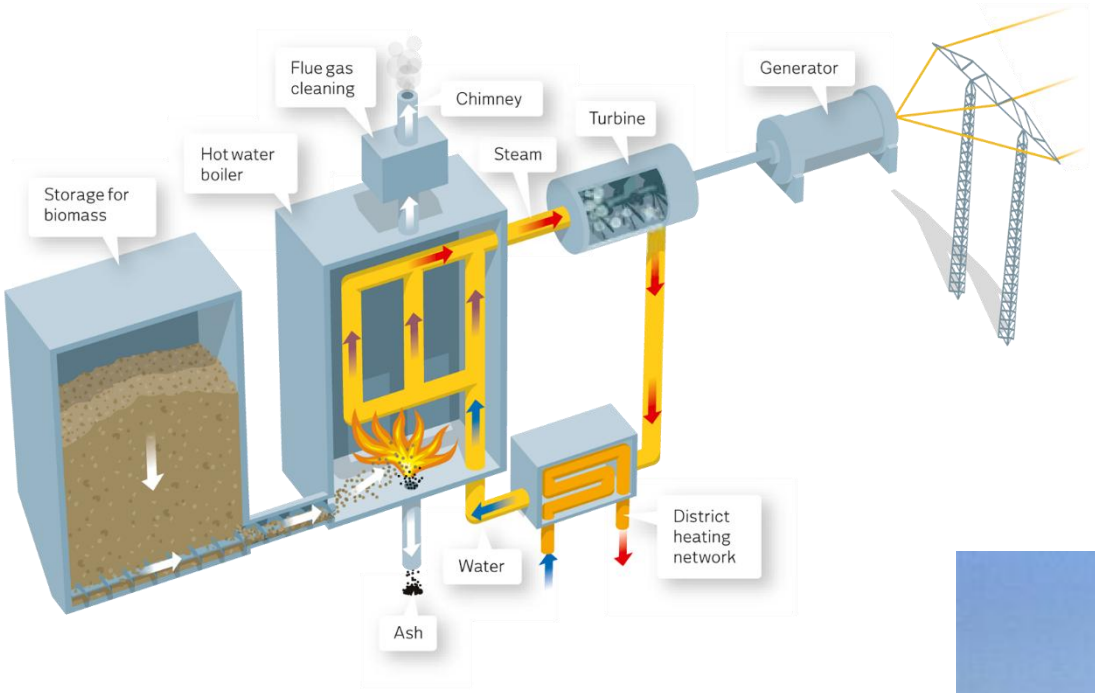
The principle





Biomass power station

The principle



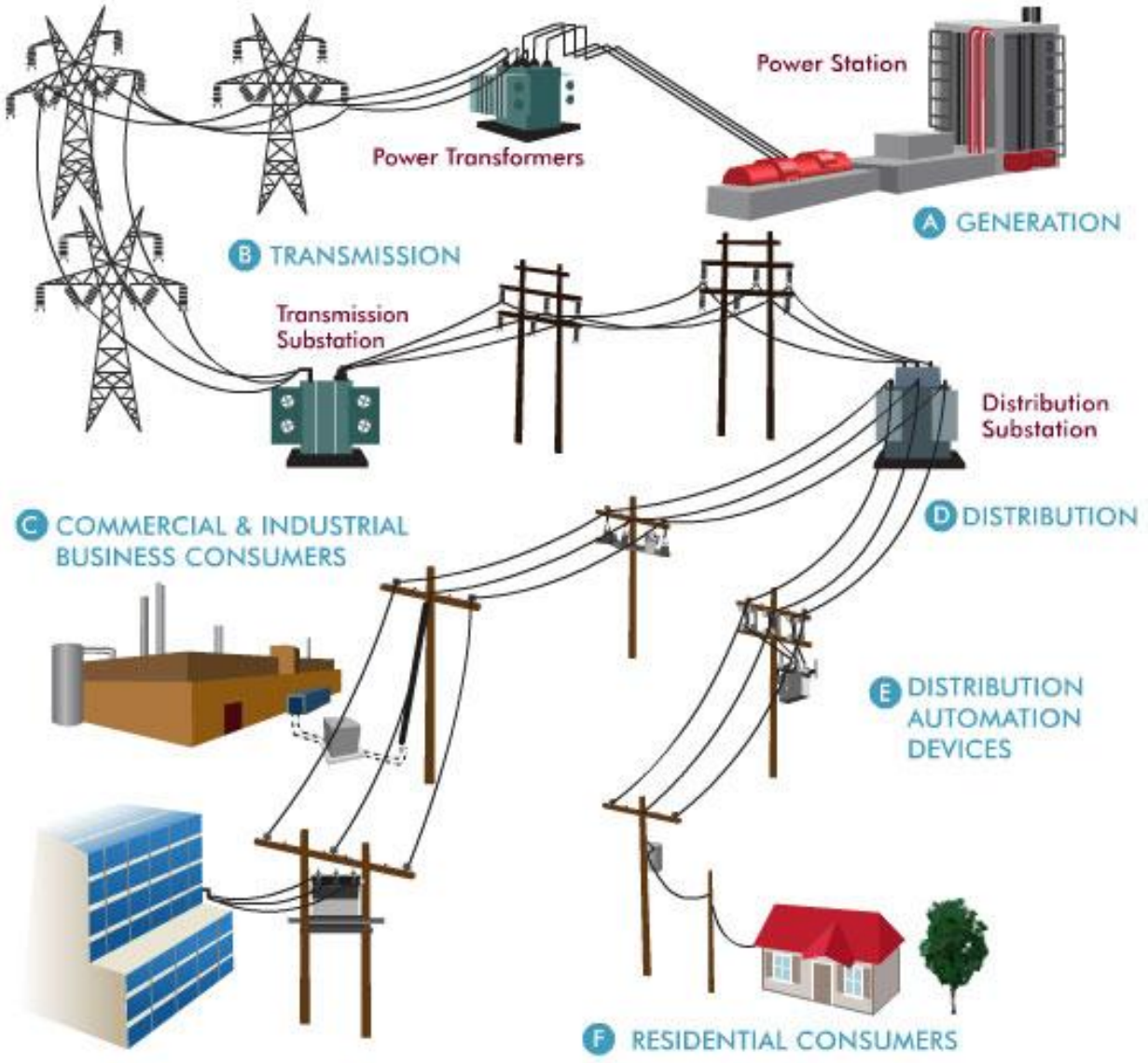


Distribution of electrical energy, electric energy system

Power system

- **Transmission system**– to transmit very large power among main nodes of power system (400, 220 kV)
- **Distribution system**– to distribute electrical energy from supply node into industrial, traffic networks and into tertiary branch

Electrical power network

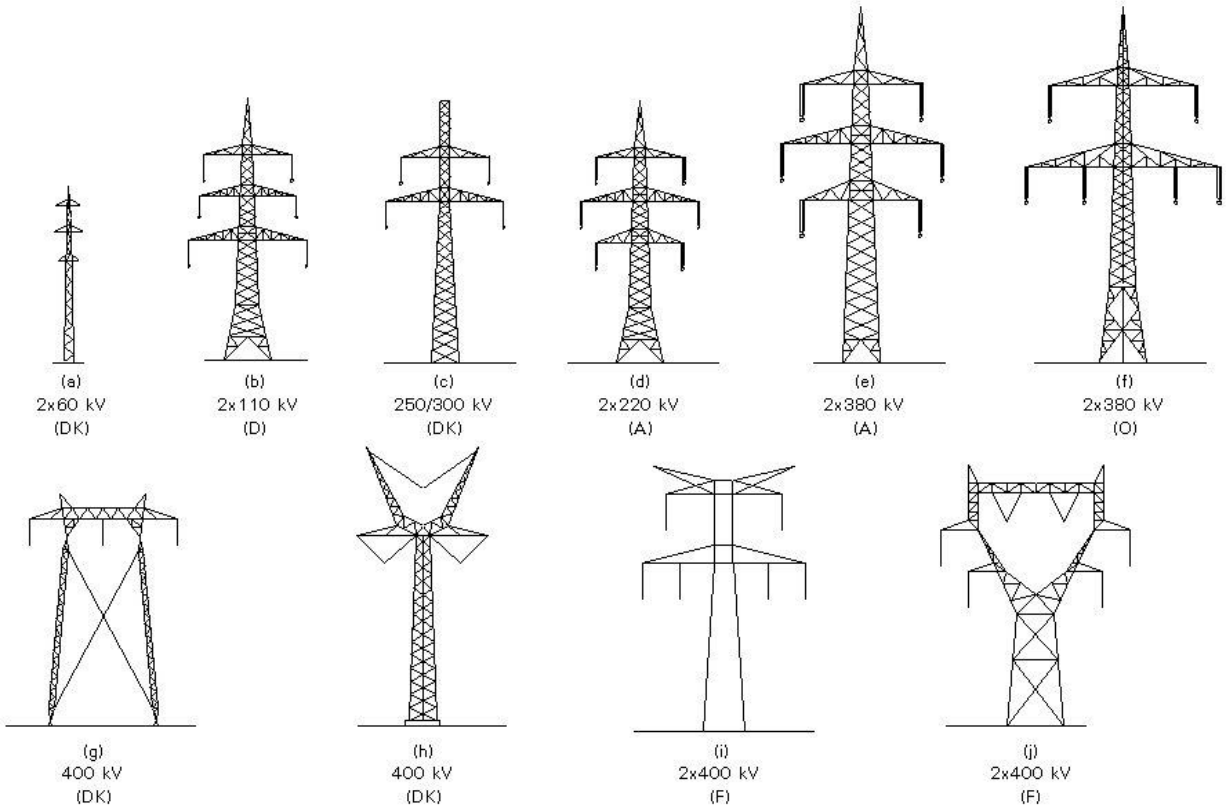


Voltage levels in power systems

Voltage Level	Value Level Mark	System	Valid Section
Low Voltage Level	Below 1000V	AC	Secondary distribution
Medium Voltage Level	1000V to 69kV	AC	Primary distribution
High voltage Level	Below 100kV	AC	Secondary transmission
Extra High Voltage level	230kV to 800kV	AC, DC both	Primary Transmission
Ultra High Voltage Level	800kV to 1000kV	AC, DC both	Primary transmission
	Over 1000kV	HVDC is preferable	Primary Transmission

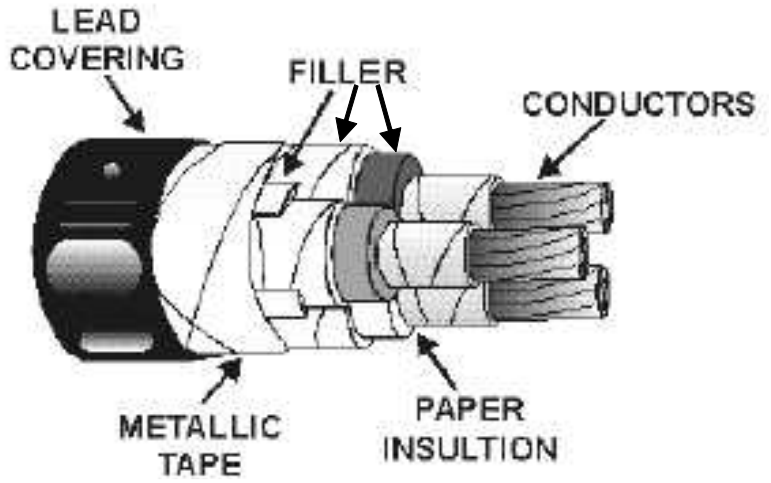
Power line

- **Open-wire (overhead) line – transmission system and distribution system of UHV, EHV, HV, and MV, LV of power lines in sparsely built-up areas and for electrical traction: line of bare (uninsulated) conductors**



- **Cable line – distribution systems of HV, LV in urban and industrial agglomerations, public networks of LV**







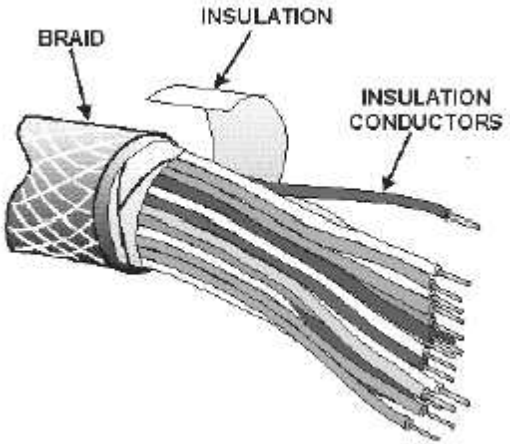




Communication line

- **Communication, telecommunication, computer networks, instrumentation and control, coaxial cables…**









Requirements on electrical power lines

- **good electrical conductivity**
- **economy**
- **allowable warming (insulation)**
- **mechanical strength and ruggedness**
- **insulation of sheathing or covering**
- **permissible voltage drop**
- **immunity against short-circuit currents**

Problems in power lines

- **losses, power factor, capacity, system stability, load balancing, failure protection, maintenance**