Energy and fuels

Alternative (renewable) energy sources

- Unlike the limited deposits of fossil and nuclear fuels that the earth will never deplete, there are *many renewable forms of energy* that can be exploited to obtain usable power.
- Some of the major sources of renewable energy include:
  - Hydro-electric power
  - Wind energy
  - Solar energy
  - Geothermal heat
  - Biomass energy
  - Tidal/Ocean energy

Hydro-electric power

- Ancient Greeks were first that used the *water wheel* to produce work (mill wheel).
- Technological innovations on the water wheel were introduced in the 1800s – *wheel* was used to drive manufacturing equipment and tools.
- The first hydroelectric plant was constructed at Niagara Falls, USA (1879).
- Norway generates 99% of its electricity with hydropower, New Zealand 75%.
- **Advantages**
  - Rivers exist everywhere rain falls.
  - No fossil fuels are used.
  - The "fuel" is essentially free.
  - No waste.
  - Dams also provide flood control.
  - No greenhouse gases are released.
  - Lakes provide an environment for fish.
  - Lakes provide a source of recreation and tourism.
- **Disadvantages**
- Dams hold back silt and debris.
- Dams hold back nutrients.

- Dams prevent needed spring floods.
- Silt will eventually fill the lakes, leaving the dams useless.
- Dams „collect" heavy metals and other toxic pollutants.
- Creating new dams causes radical changes to the local ecosystem.

Wind energy

- **Disadvantages**
  - Turbines work only in breezy (windy) areas.
  - High initial capital cost (still expensive construction).
  - Large land areas are needed for generator "farms."
  - Turbines use less than 5% of the land they require.
  - Many turbines needed to produce a meaningful amount of power.

Solar energy

- **Advantages**
  - Non-polluting.
  - No moving parts to break down.
  - Little maintenance, no supervision.
  - 20 - 30 year of operating life.
  - Require no extra construction and minimal land area.
  - Function safely and quietly.
  - Useful for developing and remote areas. Small communities can be served by a single system.
  - Costs are decreasing by about 5% per year.
- **Disadvantages**
  - Photovoltaic cell hardware is expensive: ($5 - $10 per watt).
  - Requires direct sunshine.

Geothermal heat

- = derived from the heat contained within the Earth.
- = created by pressure and radioactive decay deep inside the planet.
- "Near" the earth's surface it is hot enough to melt rock, sufficient to boil water and drive a steam turbine.
- Some locations pour hot water, hot rocks or steam at the surface which can be used as an energy source.
- The supply of heat is virtually *inexhaustible*.

- Geo-thermal energy is the third largest source of current renewable energy, behind hydropower and biomass, ahead of solar and wind power.
- Example: **Heat Pump**
  - „*Ground-source heat pumps*" use the Earth as a heat source in the winter and a heat sink in the summer.
- Another example: **Dry Steam**
- Utilize the steam from existing geysers =>
- => pressurized steam drives the turbine.
- Steam exits with little pressure
- *= oldest form* of geothermal electrical power production.
- Plants emit steam and small amounts of gases into the atmosphere.

Biomass

- = organic matter that has stored solar energy through the process of photosynthesis.
- Burning fossil fuels uses "old" biomass (e.g. coal and oil) and converts it into "new" CO_2 that contributes to the greenhouse effect.
- Burning "new" biomass contributes **no** new CO_2 to the atmosphere if we replant harvested biomass. CO_2 is then returned to the cycle of new growth.
- Most of the biomass fuels used today come from *wood products, dried vegetation and crop residues (remains)*.
- = one of the most used renewable sources of energy in recent years
- Accounts for almost 15% of the world's total energy supply.
- **Disadvantages**
  - = cannot be consumed faster than it can be produced.
  - Clear-cutting can lead to groundwater contamination, floods, and soil erosion => change the ecosystems.
  - = generate pollution.
  - Some materials used for biomass (e.g. garbage) have a low energy density and generate a wide variety of pollutants.

Tidal energy

- Wave power converts the energy released in crashing waves.
- Tidal energy works on the same principal as the water

wheel.

- Differences in water elevation are caused by low and high tides.
- Engineers build a dam or barricade across an estuary to block the incoming and/or outgoing tide.

Tidal energy – ocean currents

- Ocean currents are another source of constantly renewed energy.
- The world's first marine current turbine is located near the coast of GB.
- The 11 meter-long rotor blade produces 300 KW.
- Rival of wind power ⇔ currents are more reliable than wind.

Keywords

- Hydro-electric power, Wind energy, Solar energy, Geothermal heat, Biomass energy, Tidal/Ocean energy
- maintenance costs, inexhautible, radioactive decay, heat pump, dry steam, heat source, ecosystem, crop residues,