Basic Knowledge
Energy Systems

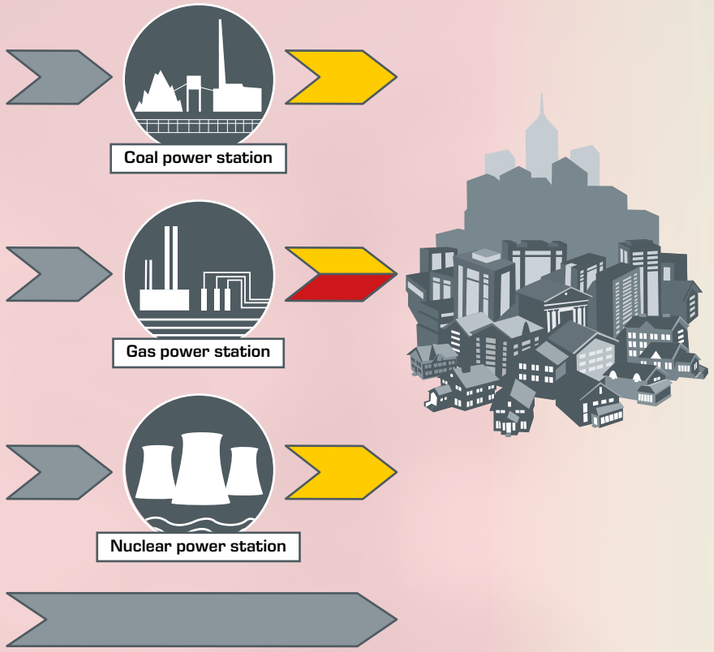
For a long time, fossil fuels have been used almost exclusively as an energy source. Electricity was generated in a few central power stations. Heat was mainly supplied by coal stoves, oil heaters or gas boilers. Oil and coal require local provisioning. Gas is stored in pressure vessels when there is no connection to the gas network.

The expansion of renewable energies has led to many small decentralised energy producers, such as wind power plants and photovoltaic installations, being set up. This led to a complex system with new challenges such as the varying availability of solar energy and wind energy. Effective storage is necessary in order to be able to use these energy sources to cover the base load.

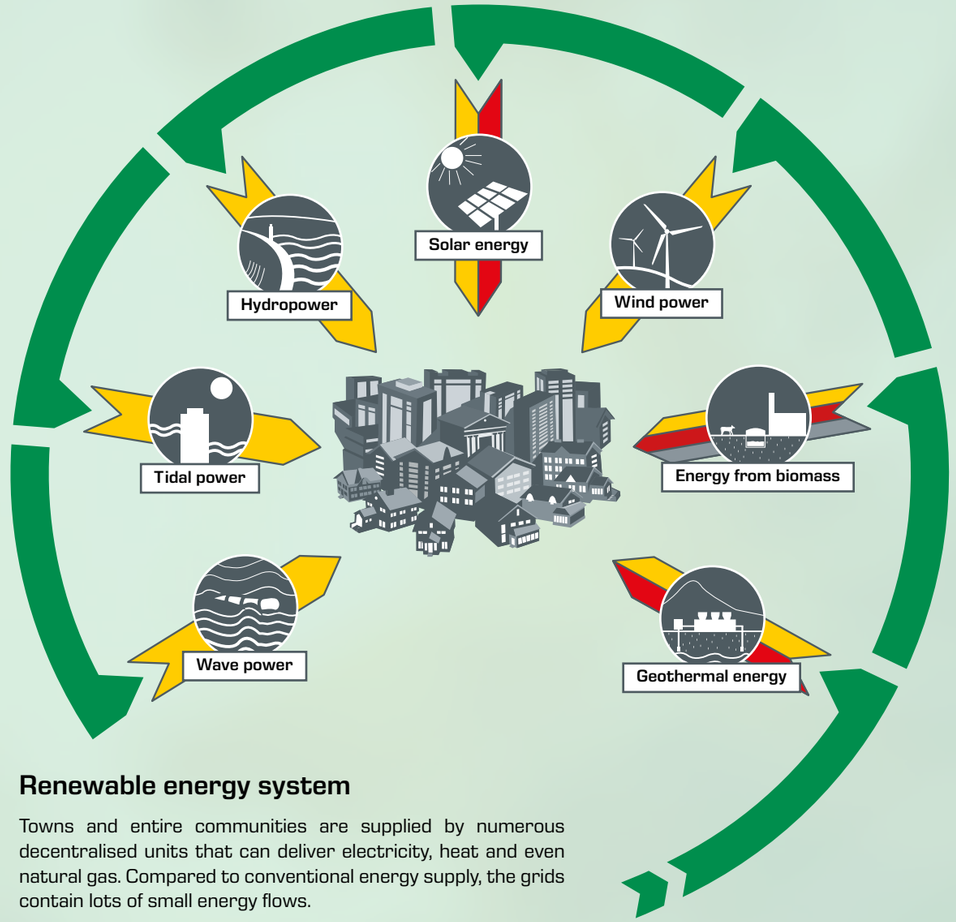
Storage systems can be based on potential energy (e.g. pumped storage), pressure energy (e.g. compressed air storage), thermal energy (e.g. hot water reservoir) or electrochemical energy (e.g. accumulator). Depending on the available energy, conversion into a storable form is also required, and reconversion if necessary. In the event of excess energy, electricity and gas can also be fed into the general utility grids. Balancing feed-in and consumption is a complex task and requires professional management.

An energy system consists of the following sub-areas:

- generation
- conversion
- storage
- transport
- reconversion
- consumption



Conventional energy system



Renewable energy system

Towns and entire communities are supplied by numerous decentralised units that can deliver electricity, heat and even natural gas. Compared to conventional energy supply, the grids contain lots of small energy flows.

- fossil fuel
- electrical energy
- thermal energy
- renewable energy

Surplus electricity

One feature of renewable energies is the surplus electricity produced, which is created for example when photovoltaic installations feed their peak output into the grid at midday. In order to keep the voltage constant, renewable energies therefore often have to be throttled. This potential can be used in an optimised energy system. As soon as more electricity is produced than is consumed, the surplus can be used to operate an electrolyser, for example. In this process, hydrogen and oxygen are obtained from water. The hydrogen can then be mixed with natural gas or natural gas is produced in downstream methanation. The formerly surplus energy is therefore available at another time and location.

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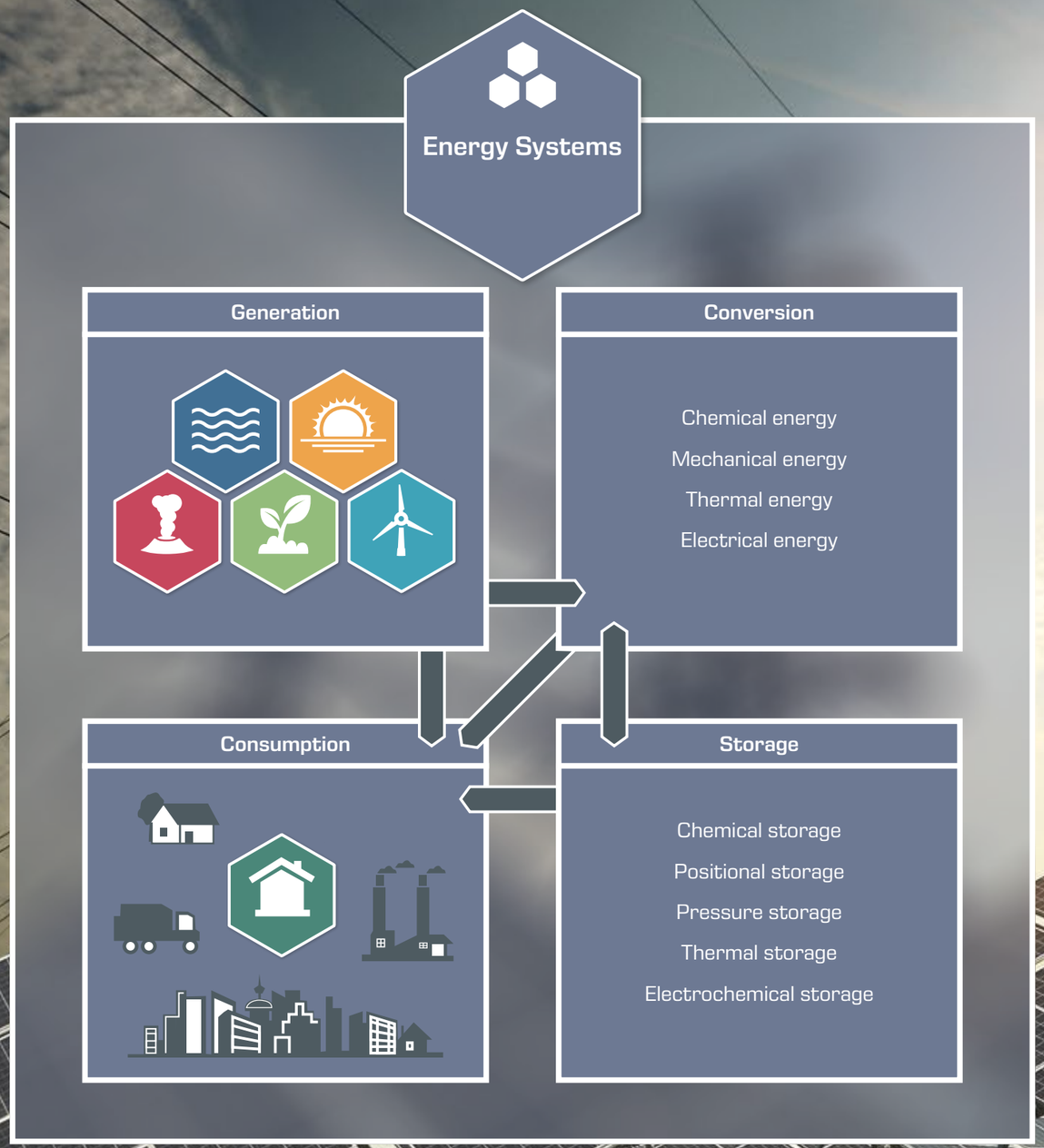

Example of an energy system

Generation

The first step in the example is the generation of electrical energy by wind power or photovoltaic plants. At the same time, biogas is obtained from waste from agricultural products.

Conversion

The second step, besides direct usage or storage, is to convert the gained energy into an energy form that can be transported or stored. This may be electrical or chemical and include mechanical energy as an intermediate stage. Another advantage is that the by-product of the biogas plant, CO_2, can be used as energy by the conversion.

Storage

The third step is storage in the energy form generated previously. Storage can take place on site in suitable tanks or by feeding into the public gas network. Following transport or storage, the energy is converted into the final energy and, depending on the conversion site, either transported to the consumers or used directly.

Consumption

The last step is consumption of the final energy in households, industrial plants or even for mobility purposes.