

- hydropower;
- wind energy;
- tidal energy;
- geothermal energy.

*Hydrogen as a source of energy and fuel:*

- distributed in the lithosphere (17 hydrogen atoms per 100 other atoms) and practically inexhaustible reserves in water;
- high energy content exceeding 3.5 times the energy content of oil;
- simplicity and low cost of transportation (hydrogen transmission is cheaper than electricity transmission);
- environmental cleanliness of combustion products.

Low-cost production of hydrogen: electrolysis of water, pyrolysis of water in a plasma torch, biomass treatment with water vapor, photodegradation of water in the presence of enzymes, thermochemical and thermoelectrochemical cycles of water decomposition.

The criterion of economical use of energy of all kinds is the energy use coefficient equal to the ratio of the amount of energy theoretically necessary for the production of a unit of production ( $W_t$ ) to the amount of energy practically spent on it ( $W_p$ ).

$$\eta = W_t / W_p$$

For high-temperature endothermic processes, the heat energy utilization coefficient does not exceed 0.7, that is, up to 30% of the energy is consumed with the reaction products in the form of heat losses.

*The rational use of energy* in chemical production means the application of methods that increase the coefficient of energy use.

These methods can be reduced to two groups:

- 1) the development of energy-saving technologies;
- 2) the improvement of energy use in production processes.

*The first group of events* includes:

- development of new energy-efficient technological schemes;
- increased activity of the catalysts;
- replacement of existing methods for separating production products into less energy-intensive ones (for example, rectifications for extraction, etc.);
- creation of the combined power technological schemes uniting the technological operations proceeding with allocation and absorption of energy (heat).

*The second group of energy saving measures* include:

- reduction of heat losses due to effective thermal insulation and reduction of the radiating surface of the equipment;
- reduction of resistance losses in electrochemical industries;
- use of *secondary energy resources (SER)*.

*SER (secondary energy resources)* are divided into:

- combustible (fuel), representing the chemical energy of waste from technological processes of fuel processing and combustible metallurgy gases;
- thermal SER, representing the physical heat of the exhaust gases and liquids of technological units and waste from the main production;
- SER of overpressure, representing the potential energy of gases and liquids exiting process units operating under overpressure.

*Directions for the use of SER (secondary energy resources):*

- fuel;
- thermal;