

The man and Energy

The energy system

Energy has by now become an inseparable partner of human beings, who use it at any time every day in all their activities. To ensure the possibility of benefiting from that resource in a simple, stable and constant way, mankind had to conduct studies and research for a long time, and only during the last decades of the 19th century did many nations, but not all, succeed in developing “energy systems” ensuring the quality and quantity of energy necessary for development. The term “energy systems” usually describes the set of production, transformation, transport and distribution processes of energy sources. Energy systems usually are very complex and call for knowledge deriving from all scientific fields to be developed and managed. Although using the energy available in our homes is easy (we push a button and the light is switched on), producing that energy and conveying it into our homes is an extremely difficult and complex task. The difficult and complex nature of the production and distribution of energy mainly derives from three factors.

Non-homogeneous distribution of primary sources

The first is that the production of the currently most exploited energy sources (fossil fuels) is concentrated under the surface of few countries, often far from the consuming countries. Therefore finding and extracting the energy source and developing ad hoc agreements between producing and consuming countries is necessary to ensure a stable and lasting provision of fossil fuels to the latter. Finally, the physical transportation of the energy sources from the producing to the consuming countries is to be taken care of.

Need to transform primary sources in order to obtain energy

Energy sources are not always usable as they are naturally (primary sources). They often need to be transformed to make their use by final users easier and more effective (witness the electric energy obtained from coal combustion, or petrol obtained by refining crude oil). Such energy sources artificially produced by human beings are called secondary sources and are the most widely known since they are used every day.

Also the processes of transformation from primary sources into secondary sources and the organization of their distribution to the final users are complex and require many people and much knowledge to be managed in the best possible way.

Safety

The problem of “the best possible” management leads to a third complexity factor: safety. In other words, all the activities making up the energy system need to be carried out in safety conditions for human beings and the environment. If control is lost over the energy sources, very serious damage to the health of human beings and the environment may ensue (just think of sea pollution caused by a damaged oil tank or the dreadful consequences of a leak of radioactive material from a nuclear power plant in case of accident). Therefore human beings constantly need to study and implement technologies capable of rendering the different stages of energy production, transportation, transformation and distribution to the final user safer. Much has already been done since the first years of intensive use of energy sources but a lot can still be done, by implementing new technological discoveries.

Energy: yesterday and today

The history of mankind has always been characterized by the search for new sources of energy: to ensure survival at first and then to improve the standard of living. At the beginning energy meant manpower, often supplied by slaves and beasts of burden; later the energy of wind (windmills) and water (water mill wheels and similar machines) started to be exploited.

Towards the end of the 19th century, thanks to the development of the industrial civilization, the need for energy was met thanks to the intensive use of coal. From the technological viewpoint a big step forward was made with the realization that heat, through the production of steam, could be transformed into mechanic energy. The first implementation of this new source of energy was the steam engine invented by Watt, which replaced traditional horses with the more modern

“horse-power”.

During the first decades of the 20th century, after a promising start of the hydroelectric energy, great oil fields were discovered in the Middle East: the “black gold” rush had started.

During the 1960s, after half a century of unmatched domination by oil, natural gas proved to be a valid alternative, especially as regards domestic use (cooking and heating) thanks to its smaller environmental impact.

At the beginning of the 1970s some countries started to develop nuclear energy, mainly to produce electricity. The development of nuclear energy, just like other alternative energy sources, can be explained by means of the marked increase in the oil prices caused by the “oil crises” which took place in 1974 and 1979 following the corresponding embargoes against the Arab oil exporting countries and, in 1990, during the Gulf war.

The range of currently available energy sources includes oil, natural gas, coal, hydroelectric energy and nuclear energy according to a variable percentage distribution depending on the country. Other sources can be added to the main sources. Although their quantity is still limited, they are renewable: geothermal energy, solar energy, wind power, the energy obtained from waste or from biomass.

The International Energy Agency (one of the main research institutes dealing with energy) expects that until 2020 the world energy consumption will increase by approximately 65% as compared to the current level. What sources will supply all the necessary energy to mankind? The availability of fossil fuels will be increasingly reduced over the years (owing to the depletion of resources) and to meet the growing demand for energy new sources will need to be exploited, especially renewable sources with a smaller environmental impact.

One of the possible alternatives to oil is hydrogen. Hydrogen is an element contained in many substances, (from water to natural gas) and widely available on Earth. Hydrogen can be used in fuel cells: a device capable of activating a chemical-electric process transforming the energy contained in hydrogen into electricity and heat avoiding combustion, which is the cause of numerous polluting emissions in the air.

The implementation of fuel cells will become possible in many sectors: transports (buses and cars), households (hot water production, heating and air conditioning) and electronics (mobile phones and computers). Currently available technologies for the production, preservation and use of hydrogen must be further tested and improved before this resource can be used on a wide scale.