Content of the subject:

Chapter I

The different energy resources

I.1. Definition of energy

Energy is an essential basis for social and economic development.

The word "energy", widely used, comes from the Greek word "energia" which means "force in action".

It exists in several forms such as mechanical energy, chemical energy, electrical energy, radiant energy, wind energy, nuclear energy, etc.

Generally speaking, a system has energy if it is capable of producing a transformation of its energy "example: the chemical energy of our cells is transformed in our muscles into mechanical energy which produces a movement" or of exchanging energy "example: heat transmitted by a radiator".

The measurement of energy is thus done through its effects and variations.

The unit used by physicists to measure energy is the joule (J). Economists rather use the ton of oil equivalent (toe), nutritionists the calorie (cal).

In electricity we use the watt-hour (Wh) or the kilowatt-hour (kWh).

Note: Energy is not created or lost: it is transformed. This is the principle of energy conservation. When a system has no exchange with the external environment, its energy is assumed to remain constant and it is said to be isolated.

I.2. Forms of energy

Energy exists in various forms, all related and each form can be converted or changed into another form.

a) Mechanical energy

Mechanical energy is due to movements "kinetic energy; for example, the energy of a car that comes from the combustion of fuel in the engine" or due to position "potential energy; for example, the potential energy of water in a dam".

b) Chemical energy

The creation or breaking of chemical bonds results in the release of energy, usually in the form of heat. For example, chemical energy derived from the respiration process that powers the human body or energy derived from gasoline.

c) Nuclear energy

Nuclear energy is energy released by nuclear reactions involving the nuclei of certain atoms of "radioactive material", either by fission or fusion of the nuclei.

For example, the energy of the sun is produced from a nuclear fusion reaction in which hydrogen nuclei fuse to form helium nuclei.

d) Thermal energy

Thermal energy is due to the movements of atoms or molecules of a body, it is obtained from several sources: sun, combustion of wood and fossils "coal, oil, gas" or electricity "Joule effect".

e) Radiative energy “radiant or luminous”

Radiative energy is very common in our daily lives; the sun lights us, a radiator heats us or a microwave oven heats our food.

The sun is a major source of radiation received on Earth. Radiative energy is the only energy t

I.3. Energy sources

Energy sources are either raw materials "oil, gas, coal, ..." or natural phenomena used to produce energy "sun, wind, ...", these sources can be classified into non-renewable and renewable energy. hat can propagate in a vacuum, in the absence of matter.

I.3.1. Non-renewable energies

A non-renewable energy resource is a resource that is destroyed during its use and/or that is renewed more slowly than the speed with which it is used. There are two families of non-renewable energy; Fossil energy and fissile energy.

I.3.1.1. Fossil fuels

The term "fossil fuel" refers to energy produced from raw materials found underground such as oil, coal, natural gas. These raw materials come from the decomposition of organic matter "plants and living organisms".

Fossil fuels now account for more than three-quarters of global energy consumption "transport, industries, heating, etc."

I.3.1.1.1 Coal

Coal is a generic term for sedimentary rocks of biochemical origin that are rich in carbon.

These rocks are fossil fuels that were formed in the Carboniferous period,

by the slow transformation of sedimented dead organisms, under the action of pressure and temperature over geological time.

I.3.1.1.2. Fuels from petroleum

Crude oil is a dark and viscous mineral oil that comes from the subsoil, and which comes from the remains of dead animals and plants, petroleum is therefore a non-renewable fossil energy source.

Refining makes it possible to isolate its various constituents and to obtain, after purification, fuels. The combustion of this fuel creates energy.

I.3.1.1.3. Natural gas

Millions of years ago, microscopic living organisms were buried in the ground and transformed into natural gas under the action of high temperature, high pressure and the absence of contact with air. Gas is a very good fuel that is used for cooking, heating water in homes, producing heat, etc. It is found in pockets at depths between 3000 and 4000 meters below the surface of the Earth.

I.3.1.2. Fissile energies

Nuclear energy is the binding energy between the constituents of the atomic nucleus. This nucleus is an assembly of protons, with a positive charge, and neutrons without a charge that are very strongly bound despite the electrical repulsion between protons.

In heavy atoms; the nucleus contains many protons that repel each other.

Some of these nuclei "for example uranium or thorium" can become unstable and break up, releasing part of their binding energy. This is the fission of the atom.

In very light atoms; two nuclei can fuse to form a heavier but more stable atom, releasing considerable energy. This is the fusion, for example of hydrogen nuclei into helium nuclei.

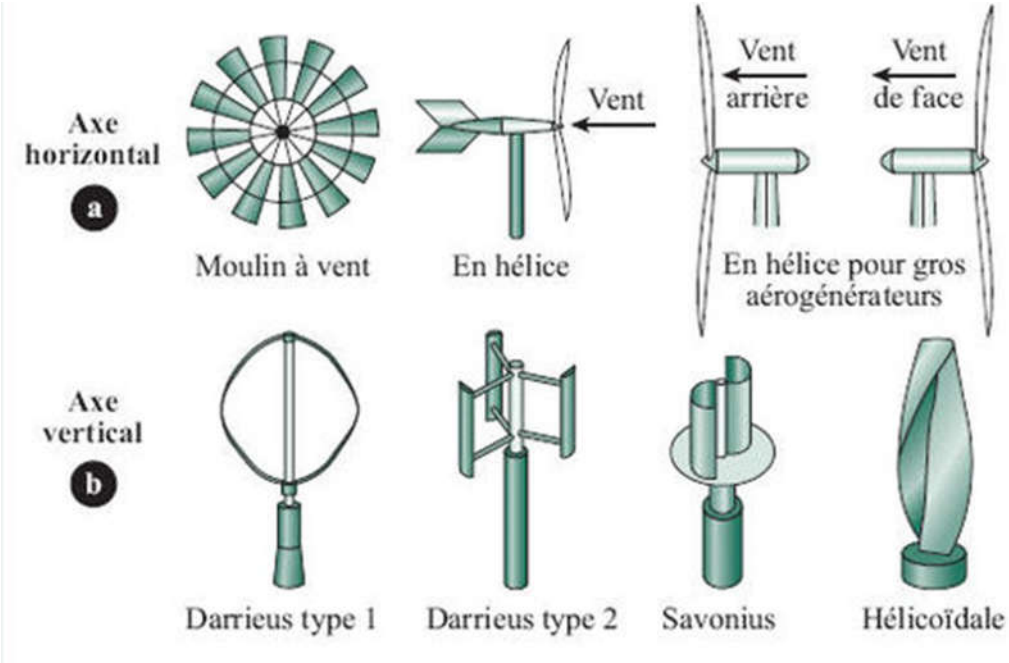
I.3.2. Renewable energies

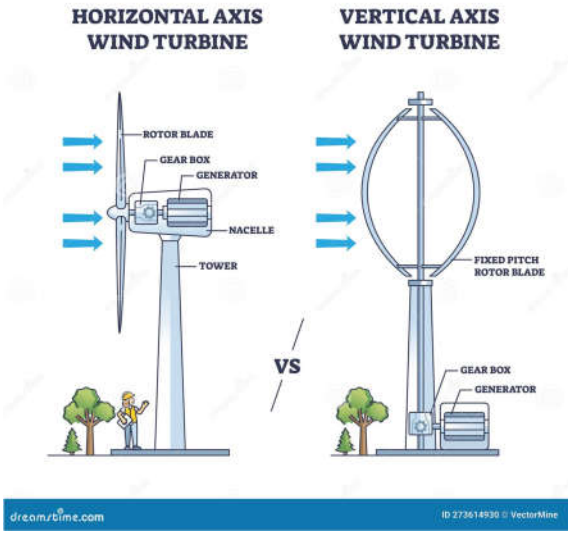
A renewable energy resource is a resource that is not destroyed during its use and/or that has the capacity to renew itself naturally, at least at the same speed as it is used. These resources depend on elements that nature constantly renews: wind, sun, wood, water, the heat of the Earth, etc.

I.3.2.1. Wind energy

The word "wind" comes from the Greek Aeolus, the god of winds. The term also means "fast", "lively" or "inconstant".

Wind energy is an indirect form of solar energy. The absorption of solar radiation in the atmosphere creates differences in temperature and pressure that set the air masses in motion, creating wind.




HORIZONTAL AXIS WIND TURBINE
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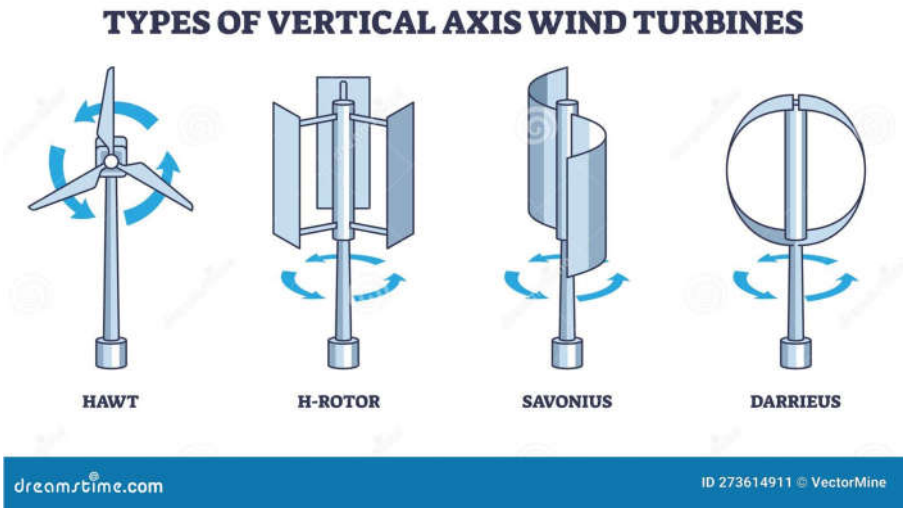
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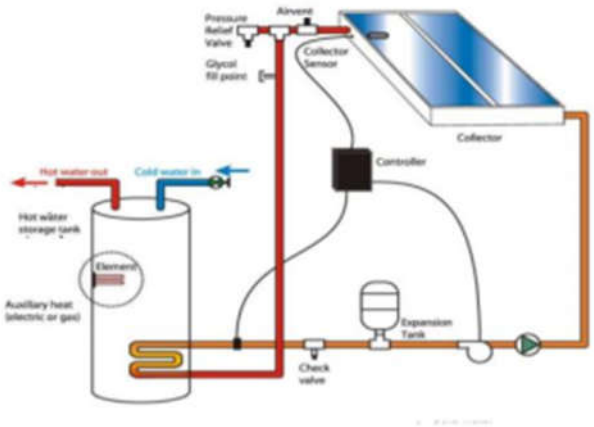
I.3.2.2. Solar energy

Solar energy, produced by the sun's radiation on the Earth, represents an inexhaustible and 100% green natural source. It is used directly in three ways; thermodynamics, thermal and photovoltaics, which are the subject of new developments to improve their performance and economic competitiveness.

Research in this context, for several years, has been oriented to extend applications and reduce costs.



1: Solar hot water system configuration

I.3.2.2.1. Solar thermal energy

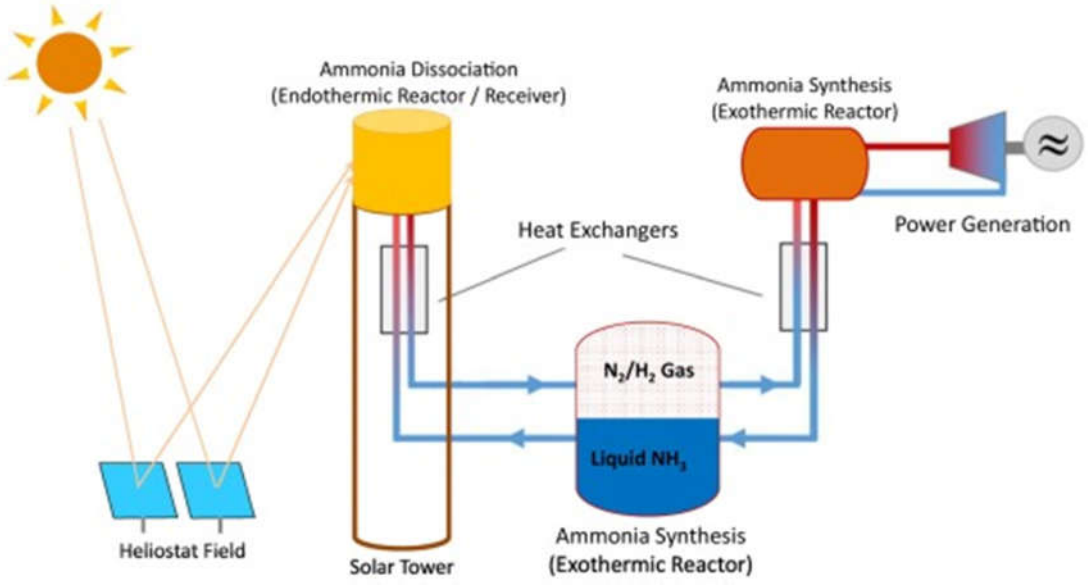
Solar thermal energy takes advantage of the sun's radiation, through solar thermal collectors, in order to convert it into heat. This heat is mainly used for heating domestic hot water and heating premises. The installation of solar thermal panels makes it possible to meet part of the domestic hot water and heating needs, and also allows significant savings to be made, with relatively low maintenance and operating costs.

This technique is inexhaustible, non-polluting, clean and does not release greenhouse gases. However, the investment cost of a solar thermal installation is relatively high.

I.3.2.2.2. Thermodynamic solar electricity

Thermodynamic solar energy is one of the direct use modes of solar energy.

This technique involves transforming the energy of solar radiation into heat, through collectors "parabolic or parabolic cylinder collectors", whose role is to concentrate solar radiation on a single focus, to heat a fluid "oil or molten salts from 250 to 1000°C" and produce electricity by means of a thermodynamic cycle. This fluid vaporizes water, which drives a turbo-alternator, as in conventional thermal power stations.



I.3.2.2.3. Photovoltaic energy

Photovoltaic energy is based on the photoelectric effect "discovered in 1839 by Edmond Becquerel", to create a direct electric current from radiation. The first photovoltaic cell appeared in 1954. To do this, it uses photovoltaic panels, composed of solar cells that transform light energy into electrical energy. Photovoltaic conversion is based on the absorption of photons in a semiconductor material that provides electrical charges, therefore current, in an external circuit.

I.3.2.3. Hydroelectric energy

Hydraulic energy, the world's leading renewable energy, represents nearly 90% of the world's renewable electricity production.

Hydraulic energy produces electricity using the driving force of watercourses.

Water at altitude has gravitational potential energy; this energy is captured and transformed in hydroelectric dams. When the water is stored, simply open the valves to start the electricity production cycle. The water rushes into a pipe and heads towards the hydroelectric power station located below.

Hydraulic power station

I.3.2.4. Biomass

Biomass is the 2nd renewable energy in the world. It is solar energy stored in organic form through photosynthesis.

It can produce electricity and heat through the combustion of waste and residues of plant or animal organic matter. The term biomass covers a very broad range of materials: wood, waste from wood processing industries, agricultural waste, fermentable fraction of household waste and agri-food industries, landfill biogas or methanization products "slurry, sewage sludge, landfills, etc.".

Includes three main families:

a) Wood energy "solid biomass":

this technique is used in power plants, whose operating principle is the same as that used in conventional thermal power plants operating with coal, oil or gas... except that the fuel used as a heat source is solid biomass. But it can also be used by the boiler of an individual house.

b) Biogas "wet biomass": these are the gases that are released from organic matter when it decomposes (through fermentation). Wet biomass plants are factories "large installations called digesters", equipped with large tanks that do not let air in, to promote fermentation. These biogases are used for heating and to produce electricity.

c) Biofuels: a biofuel is a plant fuel or agrofuel assimilated to a renewable energy source, with combustion producing only CO2 and water vapor and little or no nitrogen oxides and sulfur "NOx, SOx", it is created from the transformation of non-fossil organic materials such as plant materials produced by agriculture "beet, wheat, corn, rapeseed, sunflower, potato, ... etc.".

I.3.2.5. Geothermal or aerothermal energy

Geothermal energy uses the highest temperature of the Earth's subsoil to produce heat or electricity. Low-temperature geothermal energy is used for heating buildings. High-temperature geothermal energy can produce electricity.