The Use of Renewable Energy Sources

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Long-lasting development represents that type of economical development which satisfies the needs of the current generation, without endangering the ability of the future generations to fulfil their own needs.

The concept serves the following objectives:

- the reconciliation between the economy and the environment, so that the process of economical development would not affect consumption and would not degrade the renewable natural resources;
- a redefinition of the relations between industrialized countries with market economies and the developing countries;
- an analysis in global terms and local action, regarding the connection between urban and local ecology and the big international ecological problems.

There are five priority sectors with an important role in long-lasting development: industry, energy, transport, agriculture and tourism.

As far as the energetic industry is concerned, long-lasting development brings forward the following objectives:

- the reorientation of the technologies used to produce energy and taking control over the risks that it presents;
- the preservation and the increase of the resource base, a decreasing of carbon monoxide emissions, the development of renewable sources of energy;
- the unification of the decision-making processes concerning the economy in general and environmental protection in particular.

Renewable energy is the energy that regenerates naturally in a relatively short period of time, deriving from a wide spectrum of resources, such as: hydraulic energy, wind energy, solar energy, geo-thermal energy and the biomass (domestic wastes, city wastes, industrial and agricultural wastes).

The biggest world debate on Planet Ecology took place in Johannesburg, South Africa, in the period 26th August – 4th September 2002. Here, the specialists attempted to find a way to diminish the amount of air, water and ground pollution, by adopting strict laws and regulations which would forbid, especially in the developed countries, the use of those technologies that lead to the occurrence of the greenhouse effect. It was decided that, by the year 2015, renewable primary energy (wind, water, sun, biomass, etc) would be increased by 15 %.

Currently, technologies for the production of energy by using renewable resources are in various stages of development and commercialization. Of the energy obtained from renewable sources in the United States, in the year 1998, 55 % came from hydraulic sources, 38% from the biomass, including city solid wastes, 5% came from geo-thermal sources, 1 % from the sun and 0.5 % from the wind.

Renewable energy resources are available abundantly around the world. Table 1 presents data regarding the energy available annually, for each meter square on the planet and five renewable sources.

The energy available annually, for each meter square on the planet

Table 1

No. crt.	The renewable energy source:	Energy delivered annually (kWh/m²)
1.	Solar	600 – 2600
2.	Geo-thermal (geezers)	160 – 200
3.	Photo-voltaic	50 – 100
4.	Biomass	15 (low caloric power) 45 (high caloric power)
5.	Wind	11 (at average wind speed) 18 (at maximum wind speed)

The energetic technologies that use renewable resources create relatively few wastes and pollutants, which would lead to the occurrence of acid rain, urban smog or health problems, and do not imply additional costs for waste storage. Solar, wind and geo-thermal energetic systems do not generate carbon dioxide in the atmosphere and the biomass absorbs the carbon dioxide during regeneration, therefore the whole process of generating, using and regenerating the biomass causes the value of the world emissions of carbon dioxide to be close to zero.

Hydraulic energy uses the power obtained from the natural fall of running waters. The conversion of hydraulic energy into electrical power is non-pollutant, involves low maintenance costs, avoids any fuel-related issues and represents a long-lasting solution. Hydraulic energy is the one that penetrated most rapidly into the energetic balances. Hydroelectric power plants ensure 19 % of the world production of electrical power. Thus, more that 99 % of the total energy produced in Norway comes from water power. The hydraulic energy produced in Brazil represents more than 90 % of the total electrical power necessary for the country. New Zealand takes more than 75 % of the energy that it needs from its waters. The countries in Latin America produce hydraulic energy representing more than 50 % of their potential.

Table 2 presents a situation of the installed capacity and the production of electrical power in hydroelectric power plants in the year 2002, for each geographical area. Hydroelectric power plants have the lowest exploitation costs and the highest rate of life comparatively to other types of power plants. The mankind have accumulated an experience of over a hundred years in building and exploiting such plants, which makes them reach very high levels of technical and economical performance. Hydraulic energy has long ceased to be a promise and it is now a certainty for all the countries in the world, whether developed or developing.

Wind energy, a clean and non-pollutant type of energy which is manifested by the movement of big masses of air, was successfully used several centuries ago, its use in the present being, however, limited due to the intermittent character of the wind flux and to the variable wind speed. In the year 2001, there were installed new wind systems of approximately 3900 MW in the world, which led to an increase of the quantity of electrical energy produced by means of the wind by 35 %. At the end of the year 2001, these installations exceeded 25000 MW. Germany alone has a installed power of almost 9000 MW, which is equivalent to twice as much electrical power as all the energy produced in Romania. Second and third place are claimed by Spain, with 3550 MW and Denmark, with 2456 MW.

The installed capacity and the production of electrical power in hydroelectric power plants in the year 2002

Table 2

Area	Installed capacity (MW)	Electrical power produced (GWh)
Europe, of which:	214,368	735,655
- Russian Federation	44,000	160,500
- Norway	27,528	121,824
- France	25,335	77,500
- Romania	5,795	17,857
North America, of which:	160,113	711,225
- United States of America	79,511	319,484
- Canada	66,954	341,312
South America, of which:	106,277	495,016
- Brazil	57,517	283,603
Asia, of which:	174,076	567,501
- China	65,000	204,300
- Japan	27,229	84,800
- India	22,083	82,237
- Turkey	10,820	34,678
Total for the world:	692,420	2,633,908

A situation of the installed capacities in wind installations and of the production of electricity in the year 2002 is given in Table 3.

The installed capacity in wind installations and of the production of electricity in the year 2002

Table 3

Area	Installed capacity (MW)	Electrical power produced (GWh)
Europe, of which:	9,325	17,176
- Germany	4,445	7,400
- Denmark	1,771	3,029
- Spain	1,593	3,750
North America, of which:	2,429	4,771
- United States of America	251	4,488
South America	57	110
Asia, of which:	1,457	2,760
- India	1,081	1,900

Solar energy can be exploited by:

- direct conversion into electricity by means of static devices for the transformation of solar radiation in electrical power;

- indirect conversion into electricity, a much more complex problem, which could be solved in two ways:

- by converting the solar rays, which represent the warm source of a classical thermal station, into heat energy, and the temperatures thus obtained ensure the boiling of the water;
- by reflecting and focusing heat by using solar collectors that would capture and focus solar energy into a fluid, which later could be used as a generator for steam of high temperature, whose function would be to activate conventional or especially designed heat-generators.

The ratio between the electrical power produced and the radiant energy incident on the surface of the modules, determines the efficiency of the solar cells. Currently, the commodity market offers predominantly modules manufactured of silicon, which play an important role in the field of technologies with semi-conductors.

The use of solar energy in order to heat human dwellings has already become an industry in which dozens of companies operate successfully. Its disadvantage is the fact that it is diffuse and non-permanent (it is affected by the day/night cycle, cloudy weather, etc) and can only be collected in sunny regions.

In al lot of countries on all continents, the *biomass* is used as fuel for thermal power stations. The term 'biomass' labels all categories of renewable fuels, from wood dust to corn cobs, from sugar cane to vegetal wastes. Domestic wastes from the big cities are another source of fuel for thermal power stations.

Power plants based on biomass produce electricity by using agricultural, industrial or domestic wastes, in burners, together with coal, crude oil or gas, or by converting the biomass into combustible gases which can substitute the burning of natural gases. The installed capacity in such plants is of approximately 20 MW and the global efficiency of the process of conversion into energy is around 20 %. The installed biomass-based capacity for energy in the world was, in the year 2001, of about 25000 MW. Research in the area focuses on doubling or even tripling the conversion efficiency, on reducing the costs and on finding a solution for storage of the emissions thus created.

For example, a farm with 900 pigs can supply organic wastes and food leftovers for a plant generating electricity and heat. The leftovers ferment and produce gas of good quality, which is used as fuel. This kind of plant working with bio-gas replaces annually 300,000 liters of Diesel fuel, simply by processing 4000 m³ of liquid dung, 2000 tones of corn wastes and 5000 tones of other wastes.

The use of biomass has several advantages: offers an efficient solution for the elimination of solid domestic wastes and reduces the emissions of carbon dioxide and nitrogen oxide, by replacing coal in thermal power stations, thus contributing to the diminishing of environmental pollution. It also has an economical benefit. According to a study carried out by the Institute of Economy and Politics of Economy and Environment and conducted by specialists from the Bocconi University in Milan, the electricity produced by using biomass has the lowest generating cost compared to any other renewable energy sources.

In the European Union, the biomass delivers around 3 % from the total energy, but with significant differences between the countries: for example, 12 % in Austria, 18 % in Sweden and 23 % in Finland.

Geo-thermal energy is the result of natural radioactivity of the ground or of the presence of hot rocks nearby some bags of lava. Geo-thermal energetic resources include overheated vapors, hot water, dry hot rocks, hot magma and heated areas on the surface of the earth. The costs for the electrical power produced geo-thermally was in the year 2001 of approximately 0.05-0.08 USD/kWh. The emissions of carbon dioxide are largely reduced: by 25 % compared to the best gas plants and by 50 % compared to the best black oil plants.

Geo-thermal energy can be:

- of high temperature (characteristic to volcanic areas), the neighbouring water-bearing beds reaching temperatures of hundreds of degrees, causing a partial vaporization which is then used in an electrical power station.
- of low temperature, accessible in any part of the world. The temperature of the earth's surface increases by 3ºC with every 100 meters in depth. The difference of temperature created could be used in district heating, by re-circulating the fluid within the heating pumps, instead of being used to produce electrical power.

Thermal-photo-voltaic energy is a relatively new method of production of electrical power, which is based on combustion cells which transform heat energy or infrared radiation, produced by burning natural gases or by concentration of solar energy, into electrical power. The main element of the new method is a solid cell of combustion with oxides, the production of energy taking place by chemical conversion of the substances, and not by burning. At a temperature of 1000ºC, the natural gas with the sulphur removed is brought in the vicinity of some thermal-photo-voltaic cells, thus forming fuel-cells in which the molecules "break up" and separate into hydrogen and carbon oxide. The hydrogen then unites with the oxygen from the air in order to form water and electrons which generate electricity.

An European specialist company estimates that, in the period 2020-2030, the contribution of conventional energy will be significantly reduced and the contribution of renewable energies to the production of electric power will increase, so that in the years 2040-2050 it will cover 30-50 % of the world energy needs.

In the 21st century, if the world's population does not increase any further and remains at its current value of 6 billion inhabitants, the world economy will have an energetic consumption of approximately nine times higher than the current energetic consumption. According to other forecasts, this century, the world's population will exceed 10 billion inhabitants and the necessary energetic consumption will be 45-70 times higher than the current one. There are hopes that renewable energy sources will answer this need to increase energetic production.

Bibliography:

1. FINTA D.; FARA S., *New and Renewable Technologies*, IPA SA, Bucharest, October 2003.

2. SÂRBU I.; KALMAR, F., *Energetic Buildings Optimization*, Bucharest, Matrix Rom, 2002.

3. * * * *World Energy Council. Survey of Energy Resources*, 2001.

4. * * * *Works of the 18th World Energy Congress*, Buenos Aires, 2001.