“HUNGER FOR ENERGY” AND “ECOLOGICAL INFARCT” AS MAIN PROBLEMS OF HUMANITY

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ABSTRACT

The paper considers the importance of the electric energy in recent world with its positive and negative effects; the main non-renewable energy resources and their exhaustion; renewable energy resources and main problems of their utilization. The methods of problems solution are discussed. The place of Russia in «the electric power world» is shown.

Keywords: electric energy, non-renewable energy resources, pulsed power

I. INTRODUCTION

It is well known that humanity has a lot of the big problems like illnesses, disasters, poverty and so on. But there are two problems which are concerning each of us and which have grown up to scale that rises the question: ”Whether the scientific and technical progress threatens to destroy the civilization because of its harmful effect. Journalists have named them “Hunger for Energy” and “Ecological Infarct (Heart Attack)”. It means exhaustion of power generating resources and dangerous pollution of biosphere. Both problems are close mutual connected since about 40% air pollution causes by the electric energy production,

On another hand, a necessary condition for scientific, technological and social progress of human civilization is an increase in the electric energy consumption, mastering of new methods of energy production, and increasing efficiency of energy consumption.

II. PLACE THE ELECTRIC ENERGY IN RECENT WORLD

Humanity has spent approximately 1 mln TWh of energy of all types during its lifetime. It is very important that about 65-70% of this amount has been spent in the last 30-35 years. In the prehistoric epoch eachuman used his/her muscular force and the energy of fire and spend nearly the same amount of energy. At present, the non-uniformity of energy consumption per capita is huge. For example, about 15,000 kWh of electrical energy is spent per capita in Norway, whereas in the most African countries only 100 kWh are spent per capita.

Power engineering and progress in electrical power production are of great importance, because they increase the labor efficiency and hence the gross output. Fig.1 shows the dependence of the gross national population income (NI) on the energy consumption (EC) recalculated per capita (NI in US dollars, EC in British Thermal Unit, Btu=1.055 kJ).

The fuel and power complex with it main component- electrical power engineering- is the biggest branch of economy in many countries. For example, in 2004 year the fuel and power complex of Russia ensured about 26% of the gross domestic product, more than 37% of the revenue item of the budget, and about 56% of currency income. In future these expenses will grow, including the portion allocated for the fulfillment of ecological safety requirements [1].

Recently the relationship of power engineering with the biosphere becomes more clearly pronounced because the power and energy that human has learned to produce artificially become comparable to natural ones. Actually, the power of all systems producing energy is no less than 10TW, which is approximately equal to power of such natural phenomena as sea and ocean tides (2-3 TW) and even of such colossal forces of nature as earthquakes (1,5-100 TW) [2]. Nowadays people feel the consequences of sometimes extremely unfavorable effects on the environment in their everyday life. According international agreement which was called Kyoto Protocol, countries have committed themselves to control and restrict polluting emissions into atmosphere.

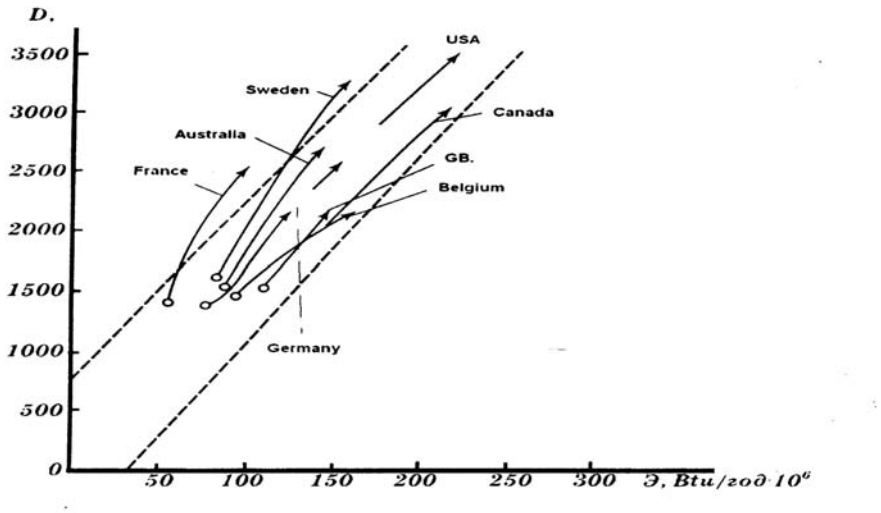

Fig. 1. Correlation between the energy consumption and the gross income

III. THE ENERGY RESOURCES

There are two types of energy sources, namely non-renewable and renewable. The important difference between these two types of power energy is their effects on the biosphere. Power engineering based on non-renewable sources results in additional heating of the Earth and polluting the atmosphere. Renewable power sources don't heat our planet; therefore this type of energy is called *non-adding*. The non-adding energy can be called *waste-free*, whereas the adding energy should be considered as the *energy polluting the habitant.* Today about 96% electric energy is produced by means of transformation non-renewable power generating sources and power of the big rivers. The last is renewable energy sources but it is considered, as a rule, separately.

The estimated proven reserves of *coal* are 3,000 bln. ton of standard fuel (or 24,4 mln. TWh electric energy). Russia and USA have the greatest amount of proven coal reserves. Modern technology makes economically attractive the extraction of only 50% of the total amount of proven coal reserves. These reserves are enough for 200-250 years.

The volume of oil and gas reserves and their distribution among the different countries you can see in Table 1. According to the pessimistic prognosis oil and gas reserves are enough only for 30-40 years, according to the optimistic prognoses- for 70-90 years.

Table 1. Global explored oil and gas reserves

Country, region	Oil reserves, bln ton	Gas reserves, tln m^3
Russia	6.653	48.0
USA	2.888	4.6
Canada	0.675	1.8
Mexico	3.4	08
Western Europe	2.5	4.3
Africa	7.0	7.3
Countries of Middle East	56.0	42.0
Asian-Pacific region	5.9	9.5
Eastern Europe and countries of the former USSR (without Russia)	1.3	6.0
South and Central America	12	6.3
Total	139.183	144.0

According to the International Atomic Energy Agency the total amount of uranium that can be produced at a sufficiently low cost (less than 40 dollars per 1 kg) is 1500 thou ton. It is enough for some decades.

As far as the water power of rivers is concerned, today nearly 50% of it is used already for the electric energy production. The main characteristics of hydro-power engineering are shown in Table 2.

Table 2. Waterpower resources in the indicated countries

State	Power, GW		State	Power, GW	
	For average annual water discharges (50% coverage)	For minimum water discharges (95% coverage)		For average annual water discharges (50% coverage)	For minimum water discharges (95% coverage)
Russia and	249.4	79.5	France	5.8	3.4
CIS USA	53.9	25.0	Italy	5.2	2.8
Canada	25.1	15.85	Switzerland	3.8	2.4
Japan	13.2	5.6	Spain	5.0	2.9
Norway	20.0	12.0	Germany	3.7	1.5
Sweden	8.9	2.9	England	1.2	0.6

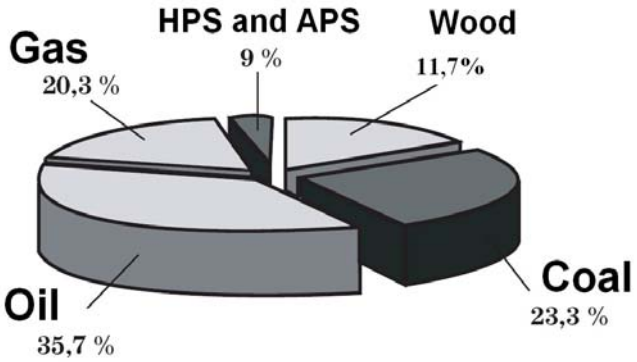

Fig. 2. Shares of energy resources of different types in the global generation of primary energy

In Fig.2 is shown shares of energy resources of different types in the global generation of the primary energy in 1998 year (not only electric energy).

The reserves of one more energy source-peat- are also significant. For a 25% moisture content, they amount to 225-261 bln ton. Because of low calorific value, peat has not yet found wide application in electrical power engineering.

IV. MAIN METHODS OF PROBLEMS SOLUTION

There are three main methods of preventing the threats to humanity which I have been named in title of report:

A) to develop power engineering based on utilization renewable power sources,

B) to search for and to master new methods of electric energy production,

C) to increase the efficiency of utilization of energy resources (energy-saving equipment, technologies, buildings, transport, and behavior of population).

Other methods like limitation of the rapid growth of energy consumption due to self- limitation, decrease of the rate of population growth are very difficult for realization (they are almost unreal).

The complex of the first three methods is being used in large scale today.

D) Utilization of renewable resources. Unfortunately, simultaneously with advantages the renewable power sources possess the big disadvantages.

First of all, unconventional units (power station) yield the units based on conventional power sources (non-renewable) in the majority of technical specifications and commercial efficiency because of low specific power by unconventional renewable power sources.(For example, see table 3).

Table 3. Average floor area, in m^2, required for annual production of 1-MW electric energy on power stations of the indicated type

Atomic power stations	630
Heat-and-power stations based on:	
liquid fuel	870
natural gas	1500
coal	2400
Solar power stations	100 000
Hydroelectric power stations	265 000
Wind power stations	1 700 000

Only one the renewable energy source brings the big contribution to electric energy production- the energy of rivers water, see Table 2.

There are some other disadvantages of renewable power resources:

-daily, seasonal and random (caused by weather conditions) time variations; these stations generate electric power only when it appropriate for them rather than when required;

-fixed geographical location (Obviously, tidal energy can found at sea and ocean coast, whereas the geothermal energy is generated by natural springs of hot water and vapor and thermal anomalies; solar and wind energies are widespread everywhere, but their utilization is most expedient in regions with maximum solar irradiation and maximum wind velocities, respectively).

Nevertheless, in spite of these difficulties and disadvantages this direction of electric power production is being developed fast enough and successfully. For example, the annual rate of growth of wind power utilization for electric energy production exceed 25%.

B) There is one more of possible way to satisfy the world's population energy needs. That is mastering of controlled fusion of light elements-controlled thermonuclear fusion. That is virtually inexhaustible power source. If this method of energy production is put in a service, it will means the appearance of the artificial small suns on our planet capable to satisfy energy needs of many people generations. Unfortunately, today this huge energy source is realized in H- bomb.

After about 40-years separate investigations and developments in this area the scientists and engineers of European Community Countries, USA, Russia and Japan decided in 1987 year to start join design of the experimental thermonuclear system. They called it International Thermonuclear Experimental Reactor (ITER). Later China and South Korea joined to them.

According to the experts estimate, the cost of the project will be about 16,0 bln. dollars. Only from Russian party more than 200 institutions are involved in the project implementation. (The share of Russia is summary expenses is 17%. According to the agreement between the all project participants (2005) ITER will be built in France. The experts promise to create of a demonstration thermonuclear power station only by the 40-s of present century because of huge difficulties on the way of putting into practice this brilliant idea.

There is other method to realize the controllable thermonuclear reaction. This is so- called inertial thermonuclear fusion. But situation with method is almost the same as with tokamak's:

- very huge dimensions of installation,
- a lot of principle difficulties and problems,
- very high the price of the project.

C) The very fruitful methods of two main problems solution are energy saving and the increase of the energy production and utilization efficiency [3, 4].

In Fig.3 is shown the potential of energy- saving in different branch of Russian economics.

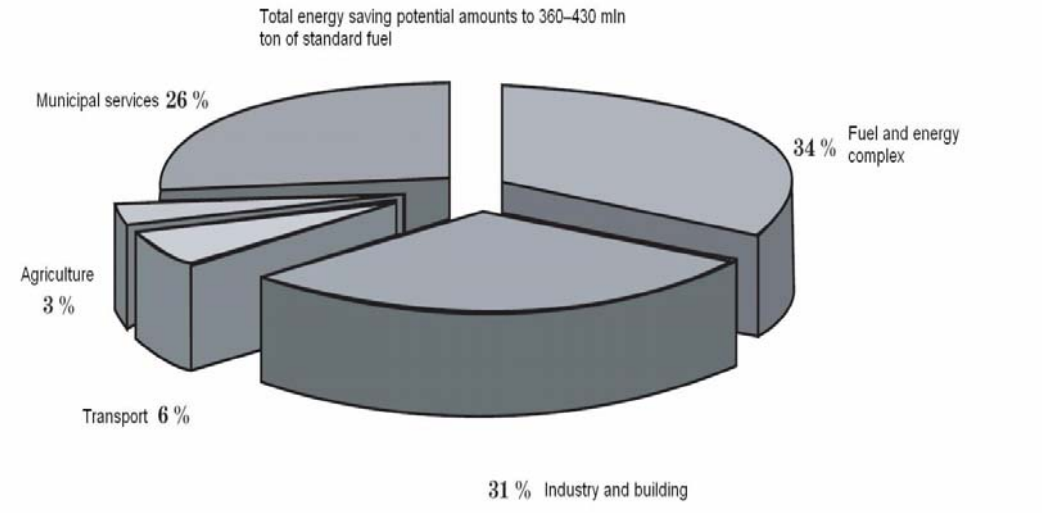

Fig. 3. Energy saving potential in different branches of the Russian economy

The world tendencies in the last 2-3 decades clearly demonstrate that the energy- saving policy yield very good results. The rate of increase of power resources consumption slows down, which provides the basis for optimism. Thus, the world energy consumption increased by 2.6 bln. ton of standard fuel in 1963-1973 years, whereas in subsequent decade it increased only by 1.7 bln. ton.

The average annual increment of energy consumption in the world is 1%, for USA it is 0,4%, and for western European countries, Japan and South Korea it is 0,25%. The critical period for changing the attitude to energy saving started in the early 70-s under conditions of oil crisis.

There is a new trend from the middle of last century, which has been marked by ever- increase share of electric energy which is direct consumed in

technological processes. The most part of these processes are based on the use of direct transformation of electric energy into mechanical or chemical energy and are characterized by high effectiveness of energy consumption.

Relatively low voltages (from units to the tens of kV) are used in electro-erosion, magnetic- impulse, and electron- ion technologies.

The high-voltage technologies, which use, as a rule, impulse voltage can be divided into two big groups: electrodischarge technologies and electroexplosive technologies [1]. The first group include more than 10 methods of materials and articles treatment. The main application of electroexplosive technology is the production of the nanopowders from metals and alloys.

For the last 35-40 years the synthesis of high- voltage engineering and applied physics resulted in the formation of new scientific and technological branch which is called Pulsed Power [5, 6].

Complex approach to the solving of the main problems is the only way for humanity.

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