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ENERGY–ENVIRONMENT–SOCIETY

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Abstract

The risks and pollution formerly regarded as local hazards have recently obtained regional moreover global world-wide character. The inadequate utilization of energy implies hazards. There is a close relationship between the production and consumption of energy on the one hand and the living circumstances on the other hand. A significant increase in energy consumption can be expected in the following years. For the adequate solution of this problem a completely different attitude to the conception of energy production and energy consumption has needed. The present article analyses the environmental effects concerning the utilization of different energy sources and deals with the connection between energy and politics, and energy and society.

Keywords: energy production, energy consumption, preservable world, environment, pollution, fossil fuels, nuclear energy.

I. Civilization has arrived at a new milestone: the nature of the interaction between energy and environment, energy and society, environment and society has changed considerably. The primitive man setting fire in his cave did not endanger his neighbour with the smoke of his fire but his own health. However, *risks and pollution that were formerly regarded as local hazards have recently obtained regional, moreover, global, world-wide character.*

The whole range of problems should not just be considered according to particular national interests, but also as potential causes of international political conflicts, social problems. Problems and chances of different regions, like developed, developing and underdeveloped, are inseparably connected with each other. With population growth energy consumption became a destructive power.

There is a bilateral relationship between energy and the welfare of mankind. On the one hand energy is a source of our welfare. Technologies based on reasonable energy consumption create welfare on the Earth, while unreasonable unlimited energy consumption can turn our environment into a wasteland or what's more endanger all human life on the Earth. Mankind

have been aware up to present days of the positive impact of energy on our welfare. However, in the last 20-30 years we have had to face its negative consequences as well. Lifeless waters, vanishing forests, oil-crisis are all sources of economic and social, political, international problems as negative consequences of misuse of energy.

Energy industry has become an organic part of the social production system, it produces large amount of income, while utilizes significant part of power sources.

Sources of energy are grouped in *Table 1.*

Table 1
Sources of energy

Primary/natural sources of energy		Secondary/synthetic sources	
Traditional sources	Non-traditional or alternative sources	Traditional sources	Non-traditional or alternative sources
Coel	sun	electric	chemical
oil	wind	energy	hydrogen
gas	tides	petrol	methanol
wood	geothermal	kerosine	electrochem.
hydro	heat-gradient	synthetic fuels	MHD
nuclear	biomass		nuclear fusion
energy	biogas		
(fission)			

The proportion of consumptions within the primary and secondary source consumption is continuously changing. Due to technological revolution consumption of electric energy is gradually growing. *The internal structure of energy production and energy consumption have changed.*

II. *There is a close relationship between the production and consumption of energy on the one hand and the living circumstances on the other hand*, in which the previously mentioned bilateral relationship can be traced. Direct proportion between energy and welfare has been replaced by a more complex relationship. Quality of life is not only influenced by welfare, consequently the relationship between the quality of life and energy consumption becomes more complex. There is a continuous demand for sustaining a balance between energy consumption and energy production. Depending to what level this balance is achieved living standard and life quality are greatly influenced.

There is and interdependence between energy consumption and GDP in different countries. The ratio of energy production per capita and GDP per capita are the so called *energy-utilization efficiency.* Its magnitude de-

pends on technical development fundamentally, on the market recognition of the products and on some other aspects, due to the above mentioned non-linear relationship. Regarding national economies, it fundamentally depends on the shares of different industrial sections within the industrial GDP. Generally, the higher the GDP is, the bigger the share of electric energy is within all consumption. Therefore, in case of a possible decrease or stagnation of the total energy consumption in time scale, electric energy consumption can increase.

There are significant differences within the energy consumption per capita, the so-called specific energy consumption in different countries. According to some opinions this value has reached a still tolerable limit in the developed countries, which cannot increase any further for mankind's good. Specific energy consumption in underdeveloped and developing countries may be by more than one order of magnitude lower than this value, and nothing can prevent them from intending to reach the same high value in the long run.

In 1990 the population of the Earth was 5.32 billion. According to estimates there will live 7 billion people on the Earth in 2000, and 8.2 billion in 2025.

These factors altogether will result in a considerable growth of energy consumption on the Earth even if energy consumption per capita in developed countries will not increase further or slightly decrease. Therefore the danger mentioned in the introduction will not be over, but will grow in the following years, decades. *That is why we need to have a totally different attitude to the conception of energy production and energy consumption.*

It must be a basic requirement that *mankind should be the master of our planet and not its exploiter*, because tolerance of nature to waste products and other consequences of energy production is limited.

III. We have our chances to fulfil this task. There are significant possibilities in both fields of energy production and energy consumption. In order to be able to utilise these possibilities we should analyse precisely on the basis of the same principle our present situation, our future we will face and clearly define the goal to be reached. There are two possible trends of development: *'resignation' and 'preservable world'* are competing with each other. The trend of 'resignation' continues present tendencies while the conception of 'preservation' anticipates that issues of worldwide environmental protection will be treated internationally from a different attitude by the mid 90s.

IV. Considering energy consumption, the above described problem could be solved by saving energy, by increasing and consistent spreading of energy-saving technologies, introducing new consuming habits through learning a new consuming behaviour and in some other ways, like reform

of industrial structure. This all creates tasks in the fields of technological development, modernizing the price system and in others.

Nowadays, at the end of XX. century we are in the third period of the industrial revolution, which can be characterised by the spreading of computers, modern materials, optical electronics and biotechnology. We cannot be aware yet of what influence this process will have on energy consumption, but obviously, this influence will also depend on to what extent public opinion accepts the attitude of 'preservable world'. Most probably the structure of energy-production and energy consumption will go through further changes. Due to new technologies electric energy will have even larger share within the whole energy consumption.

However, all the above mentioned solutions aiming at energy saving are expensive. Establishing the balance between energy consumption and energy production through considering energy saving requires investment capacities just like increasing energy production.

There is a very complex relationship between the value of the savings and the invested sum depending on a lot of factors. Small savings can be produced, if we are smart enough, with hardly any investment, but large savings have high specific price. Thus the relationship between the value of savings and the money demanded for investment is not linear, but a curve with a rising slope.

Therefore, the consequence of the latter fact is that *decreasing energy consumption has not only technical limits, which is quite obvious, but also economic ones. This economic limit is lower than the technical one.* The space of introducing measures for decreasing energy consumption could be also restricted, because of both technical and economic reasons. In this respect economic limit is also below technical one.

This fact should be emphasized because several illusions exist related to this matter, especially among the 'professional environmentalists'. In most instances the only or decisive difference between the attitude of professionals in energetics and 'professional environmentalists' is just where they place the above mentioned economic and technical limits.

Energy saving, energy-saving technologies, new consuming habits – as opposed to some opinions – *in many cases are causing pollution*, which decreases – or possibly equalizes – the benefits for the environment gained from the lower energy production. (It is well known that if we use well-shutting windows and doors in houses, we can lower the demand for heat and the pollution caused by heating. However, as a consequence of better shuts and less airing the radon concentration will or may increase in the flats which causes extra radiation risk for the dwellers. If we burn straw instead of coal or hydrocarbon the pollution caused will be less. But if burning straw will result in less manure production and consequently more

use of chemical fertilizers, thus excess environmental pollution is produced. The issue needs a complex approach.)

V. There are significant reserves for decreasing environmental hazards regarding energy consumption.

The character and the amount of environment pollution can be influenced by the ration of the consumption of different energy sources or by means of technological development within a certain type of energy.

Burning *fossil fuels* (coal, oil and natural gas, etc.) we produce sulphur dioxide, carbon monoxide, carbon dioxide, nitrogen oxides, coal fly ash and parallely a series of hazardous elements which enter the atmosphere. Acid rains caused by sulphur dioxide emission are strongly responsible for destruction of forests and of the whole environment in general. This hazard is stronger near the sources of emissions, but if there are more sources the problem becomes regional. We are aware of the role what carbon dioxide plays in creating the so-called *greenhouse effect*, which leads to gradual warming of the atmosphere. This problem is world wide, i.e. global. The above mentioned hazards could be reduced by decreasing the proportion of fossil-fuel consumption and increasing their utilization efficiency (by modernization of burning technologies). There is a significant emission of radioactive materials of natural origin produced by coal-fired furnaces and power plants. With some coal types this radiation can exceed emission of nuclear power plants under normal operation. This is characteristic of most Hungarian coal fired power plants due to the high content of uranium, thorium and their decay products in the coal. This is demonstrated on *Table 2. Fig. 1* which show the result of measurements made by the staff in the Institute of Nuclear Techniques of Technical University of Budapest.

Utilization of crude oil in energetics has very similar hazards to the environment as all the previously discussed sources. Because of uneven distribution of oil sources on the Earth, lot of countries are in an import-dependent situation, which can lead to political destabilization, in extreme cases to military conflicts (e.g. the latest Gulf crisis).

Nuclear power plants less disturb the balance of climate and oecology beyond all comparison. According to most expert's opinions, in case of normal operation it produces electric energy with minimal pollution to the environment. The two major arguments against them are: potential risks of extraordinary accidents, and the treatment and safe deposition of radioactive waste with low medium and high activity. If these two problems were solved, in a generally acceptable way, the importance of nuclear plants could increase rapidly. In fact, both these problems have been solved just the public awareness and approval is missing. There are completely safe nuclear power plant types operating at present which are fundamentally

Table 2
Specific activity of different coal types [Bq/kg]

Coal type	^{238}U series	^{232}Th series	40 K
Hungary			
Oroszlány region	99	24	163
Ajka region	120-480	12-35	56-190
Borsod region	38-52	32-62	190-264
Pécs region	175	127	560
Várpalota region	220	20	30
Visonta region	20	15	80
Komló region	150	97	384
Dorog region	40	36	194
Tata region	100-140	30	162-270
Canadian	12	8	26
Germanian	15-37	7-19	–
Pennsylvanian (USA)	15	12	148
Russian (Don region)	18-107	–	–
Indian	19-52	19-75	37-526

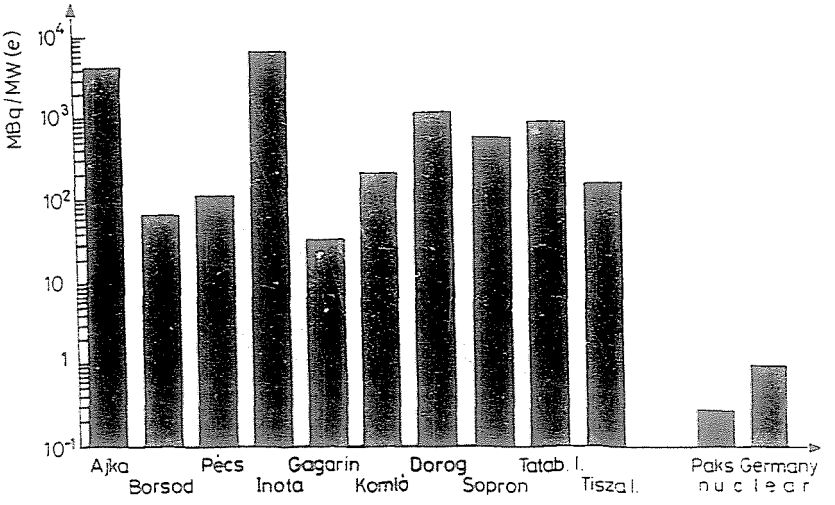

Fig. 1. Radioactive emission per unit of electric energy in 1988.

different from those belonging to the type of Chernobyl units, which had undergone a severe accident. Nevertheless, modernization of nuclear power plants, further increasing of their safety should be our every-day task. We have reliable technologies for treating nuclear waste and in technical respect we can consider the problem of final deposition to have been solved. It would be a breakthrough in the public attitude if the radioactive isotopes

with long half-life could be transferred into isotopes with shorter half-life (transmutation). Among all the ways of producing electric energy, nuclear energy creates much more fear in the public than it would be reasonable if being aware of the objective data about a possible danger.

The approach to the renewable sources of energy (water, bio-, solar, etc.) is very different depending on the matter. However, it is undisputable that all of them have original risks to the environment — as opposed to the general belief – they all pollute nature directly and or indirectly and to a different extent. They mean considerable risk for human life.

This is demonstrated in *Fig. 2*, which sums up the results of 11 different studies concerning the risks at work and in general. The figure shows evidently, that opposing the general opinion, solar energy can cause quite a significant risk.

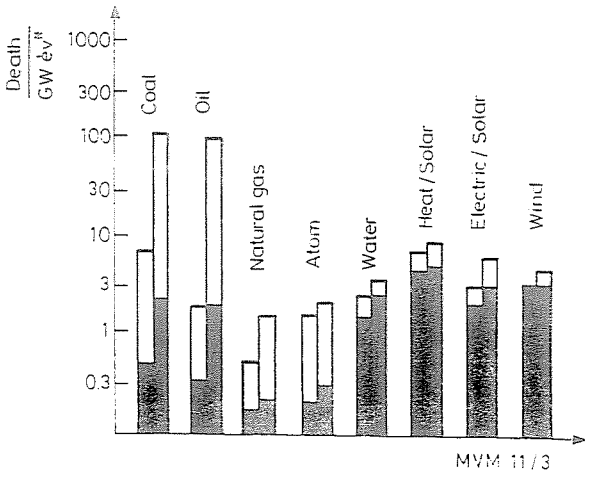

Fig. 2. Risk analisis according to sources of energy
*6000 lost working days — 1 lost human life. The dark column is the min value the emply — max.

Car traffic has a leading role in pollution. It is even more dangerous that most of their pollution is concentrated in big cities. Therefore there has been a long-time research and development project on electric and hydrogen powered cars. *Table 3* demonstrates specific emission values of cars with different fuels.

Let me remind about the well-known study issued by Rome Club 20 years ago: 'The limits of Expansion'. The study warned the world that the growing consumption of the non-reprodicable natural sources will cause

Table 3
Specific emission of motor vehicles with different fuels

Fuel	Emission g/km			
	NO_x	CO	CH	CO_2
Petrol	2.50	15.36	1.82	370.0
Petrol + H_2	0.52	1.87	2.17	
Hydrogen gas (compressed)	0.16	0.15*	0.06*	
Hydrogen (liquid)	0.35			
Metal-hydride	1.40	0.29*	0.10*	

* carbon monoxide and hydrocarbon are produced from the machine oil

serious problems in the future. The report also listed several negative points about energetics. In the first half of this year they issued a new report: 'The First Global Revolution – report by the Council of Rome Club'.

According to the part of the new report which deals with the safety of energy supply and environmental issues the biggest danger on the earth is the warming effect. It is caused by the greenhouse effect of carbon dioxide and other gases and can lead to climatic consequences which will influence food production and raise the level of the sea. For the last hundred years the level of world-oceans has risen by 10-20 cm, while the average temperature of the atmosphere has been rising. Therefore the Council supports such measures which would lead to decrease of the greenhouse effect. According to them it seems reasonable to decrease the consumption of mineral fuels, to launch tree replantation programmes – expecially on the tropics – and develop new energy sources together with more efficient utilization.

Focusing on the prospects of the energy sources they make the following remarks:

- Crude oil is an essential energy source, which should be retained as a raw material for petrolchemical industry.
- Although we have large supply of coal, it seems to become rather dangerous because its warming effect on the Earth unless new technologies can significantly limit this negative effect.
- The so-called soft energy sources (wind, sun, tides and geothermics) can produce 8–10% of the world's energy demand by the end of the century, exceeding than this value is very unlikely.
- The industrial utilization of nuclear fusion is still far ahead.
- It is quite possible that nuclear fission is the only method to decrease, at least partially, the chances of global temperature rise and thus avoiding a possible crisis within some decades. According to the report the production of nuclear energy, the development of breeder reactors are essential to be utilized. It has been troubling lots of ex-

perts to face the problem of increasing the number of nuclear plants with their obvious hazards and the problem of storing nuclear waste. However, we have to accept, although reluctantly, that utilization of coal and oil is probably more dangerous for the society, regarding their carbon dioxide emission, than nuclear energy. Consequently, there are effective arguments for retaining nuclear option and developing the fast neutron breeder reactors. Practical implementation of these possibilities, however, can solve only part of the problems. It seems almost impossible to mobilise enough capital and labour necessary for constructing a number of nuclear power plants enough for reducing carbon dioxide emission.

IV. The relation of energetics and politics is quite remarkable, sometimes even decisive. There have been lots of examples to support this in the last period. This is quite inevitable since the conditions for it are provided by the interdependence of energetics and public opinion, politics and public opinion.

All the previously discussed issues can prove how complex the relations of energetics, nature and society are, and that their character always changes. It is our responsibility to find the best solutions for the problems occurring from these relations. Urgent measures have to be taken on both national and international basis. This can happen only if a wide-range conciliation is achieved about the essence of the problem, the possible risks and the chances for action. This conciliation will be able to serve the long-term interests of mankind if people's general awareness of the whole complex problem grows.

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