

Pessimistic Theories on Fossil Fuels and Possible Alternative Energy Sources

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Abstract

For more than 40 years, people have been discussing about the 'end of oil'. In reality, the technological progress and discovery of resources at higher and higher depths, especially offshore ones, have offered and could still offer the energy needed by humanity. Prohibitive costs, as well as global warming resulted from the destruction of ozone layer, led to the search of some alternatives for obtaining energy more ecologically, in order to stop the pollution generated by burning of fossil fuels. The paper presents a synthesis of 'pessimistic' theories referring to oil crisis, as well as possible alternatives of obtaining 'clean energy'.

Key words: *fuels, energy, renewable, alternative sources*

Introduction

Petroleum and gas are part of the 120 energy sources and methods identified at present and enumerated by Wikipedia encyclopedia. The methods refer to the way of energy production, storage and conservation.

As any economic activity needs energy consumption, its availability and price, respectively the source, are elements of maximum priority.

For this reason, depending on the criteria established by the international organizations, the most efficient technologies for producing energy are periodically classified. The classification criteria require that the technologies considered to be the best meet at least the following requirements:

- to be renewable (alternative);
- to have minimum impact on the environment;
- to be approachable, permissive;
- to be credible;
- to be available, feasible;
- to be safe.

During the past years, the usage of energy has been more and more connected with the global warming. In this context, energy may have various forms: thermal, chemical, electrical, radiant, nuclear etc. Several of these energy forms may transform in other energy forms by means of

various devices: for example, from electrical energy into mechanic energy – electrical engine, from chemical energy into electrical energy – battery or electric accumulator etc.

Concepts on energy and its transformations are intensely used in explaining processes and natural phenomena, such as wind, rains, and tornadoes, generated by solar energy. Life itself is due to energetic transformations occurring in organisms, starting at cell level.

Theories on energetic resources crisis

For many years, the fall of the hydrocarbon production and the occurrence of a major energetic crisis have been predicted, having devastating effects on the economy of states depending on oil, known as „Peak Oil” and developed by the American geologist Marion King Hubbert in 1956, in a presentation delivered to the American Petroleum Institute.

This theory is based on the fundamental observation that oil reservoirs are finite and it applies to any production area. But Hubbert expanded his production decline theory to all oil fields in the world, as if the decline took place simultaneously and created a disaster. According to this major impact, oil production had ended by the end of the 20th century.

In order to support his statement, Hubbert showed a dynamics of the world oil production, which would reach its maximum in 2000, as well as the evolution of oil production for big producers known during the ‘60s (fig. 1 și 2).

According to Hubbert’s observations and other researchers’ involved in this analysis, the strong dependence on oil of modern industry, oil production decline and a possible price rise will have major implications in the economy global development.

This theory is opposed by researchers at Cambridge Energy Research Associates (CERA) who state that there is no argument to support this widely spread negative prediction. CERA believes in a fluctuating evolution, with unimportant production deviations at least by 2030, when insignificant falls of hydrocarbon production are predicted. This evolution and its duration will strongly depend on the level of investment and especially on the geopolitical context, rather than on the existing hydrocarbon resources.

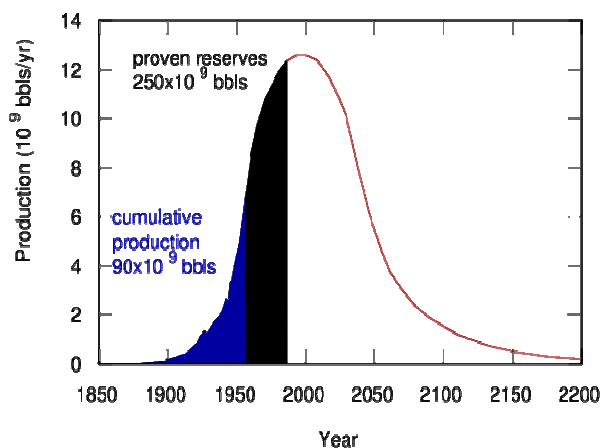


Fig. 1. Estimated oil cumulative

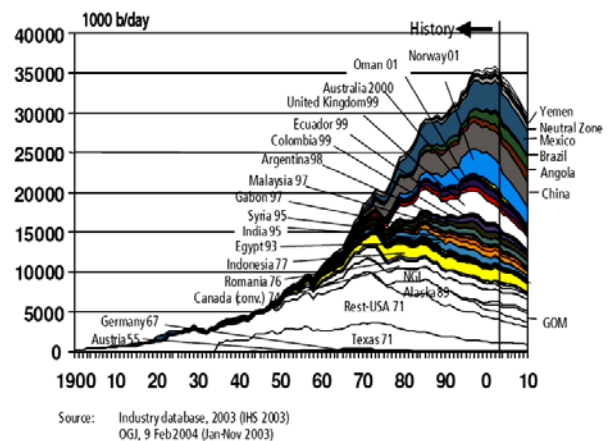


Fig. 2. Production dynamics estimated for states exporting oil

Actually, the level of oil resources is unknown; it varies depending on the efficiency of technologies of reservoir discovery, development, exploration, which, on their turn, are in continuous evolution.

CERA states that there have been already known resources four times higher than the present consumption need, in this class including both conventional (oil reservoirs in sands and bituminous schist) and unconventional sources. Although oil production has been limited during the last years, CERA considers that it can rapidly increase.

The ultra heavy oil from reservoirs in Canada and Venezuela benefits from great investments at present, as the global price of oil has increased, this leading to the efficiency of some reservoirs' exploration, which, in the past, were not explored.

Also gas liquefaction projects have developed a lot, especially in the Middle East, or coal liquefaction in South-East Asia and Australia. A biofuel market has also been rapidly developed mainly in the USA, Brazil and Germany.

Fossil fuels and their impact on the environment

There are three types of fossil fuels: coal, crude oil and gases, all these resulted from the decomposition of plants and animals in the absence of oxygen, in millions of years. Getting energy is done by the burning process, that generates an inevitable pollution of the atmosphere.

World energy consumption in 2004 was estimated at 15 TW, of which 87% was provided by fossil fuel, i.e. oil, gas and coal reservoirs. Burning these fuels produces greenhouse gas in different quantities, which fall into the category of the six greenhouse gases regulated by the Kyoto Protocol, the Law no. 3/2001 and the Order of Ministry of Environment and Water management no. 1122/2006.

The incriminated greenhouse gases are:

- CO₂ with potential 1 in global warming of earth. CO₂ is the reference gas for other involved gases;
- CH₄ with potential 21 equivalent CO₂;
- N₂O with potential 310 CO₂ equivalent;
- hydrofluorocarbons HFC-s with potential 14011700 CO₂ equivalent;
- Perfluorocarbons PFC-s with potential 6500....9200 CO₂ equivalent;
- Sulphur hexafluoride SF₆ with potential 23900 CO₂ equivalent.

The first free gases from these are also present in the fossil fuels composition: oil, gases and coal. It is estimated that the greenhouse effect, which is blamed for global warming and suspected for possible major climate changes, would only be halved by keeping only 450 ppm the level of emissions of harmful gases into the atmosphere. The coal, oil and gases, in this order, are the most obvious pollutants of the environment from the impact on the environment point of view.

The advantages of using fossil fuels are:

- The technology for fossil fuels is existing and for transition to the another type of fuel a transition period would be necessary;
- Obtaining electricity from fossil fuels use implies a simple burning process and because of this reason it is extensively used in power plants. The fuel gases are more efficient than coal in electricity producing in terms of energy efficiency and impact on the environment.
- The distribution of fossil fuels is widespread in the world.

The disadvantages of using fossil fuels are:

- The emission of large quantities of polluting gases into the atmosphere. It is noted that the plants which operate with coal annually produce:
 - 3700 billion tons of CO₂, considered the main cause of global warming;
 - 10000 tons of SO₂, the main cause of acid rains;
 - 500 tons of micron particles, which are involved in the atmosphere, the main cause of some chronic diseases such bronchitis, asthma etc, which can produce some time even premature death;
 - 10200 tons of NO_x, the main cause of smog;
 - 220 tons of hydrocarbons from volatilization process of organic compounds that affect the ozone layer.
- Dependence of oil created the monopolization of world markets, socio-political instability and, many times, wars;
- Are non-renewable sources, with declining production, which creates economic dependences;
- The extraction of fossil fuels has become increasingly difficult, expensive and dangerous;
- The use of fossil fuels increasingly and irretrievably affects the environment;
- The storage of fossil fuels often produces accidents which lead to explosions and atmosphere, soil and underground pollution.

Renewable sources of energy

In the category of renewable energy sources are signing up solar, eolian, hydro, biomass, biofuels, geothermal, wave and tidal, nuclear fusion, brownian motion energies etc.

Solar energy

The emitted radiations from sun have an energy of 235W/m², from this 168 W/m² are absorbed by earth. This makes that the earth became warm and the temperature increases by aprox. 14 °C which is the average difference between day and night ground temperature. This energy has been taken seriously into consideration at the end of the 90s, when more and more countries have started to use photovoltaic energy for electricity generation, currently reaching over 3% from all non-pollutant energy produced worldwide.

Eolian energy

The need to reduce CO₂ emissions into the atmosphere has made the wind energy a preferred source of millions of people, so that in Romania was installed in 2004 a wind turbine of 660 W at Strejnic, near Ploiesti, and after this the activity was extended especially in Dobrogea.

Worldwide, the electricity generated by wind exceeded 10000MW in 1999 and the statistics show that about 70% from the wind energy is produced in Europe. The experts expect that the wind energy will become one of the most important power sources of the 21st century.

Hydroenergy

Water is another important source of energy, which has always showed its power in both human benefit and loss. Hydropower is the main alternative source, providing more than 80% of total electricity generated by renewable sources. Other hydropower forms are represented by wave and tidal energy. For example in Russia and France there are functional capacities from 240kW to 400kW, while in the British Severn Estuary and Canadian Bay of Fundy these reach 8000, respectively 30000 MW

Geothermal energy

Geothermal energy can be found everywhere, but it is dissipated in the depth of the Earth. It can be found at the surface by means of geothermal waters, which can be used for generating electricity.

Romania has a significant geothermal potential, but insufficiently explored and managed. On the other hand, in 2000 in USA 2200 MW were obtained from geothermal energy, thus compensating 60 million oil barrels.

Biomass

Biomass gives the possibility of changing refuse and some renewable sources, such as cereals or other plants and wastes resulted from agriculture into electrical energy. Methane is obtained from the decomposition of organic refuse and it can be captured and used for producing electric energy.

Plants and wood can be directly burnt, as well as fossil fuels, or may be used for producing energy or alcohols.

The advantages of using biomass are:

- Waste recycling is encouraged and the theory according to which nothing is wasted on Earth is applied, the result being that less fossil resources are required;
- There is a lot of biomass on Earth and it is renewable; theoretically, we will always have raw material for producing biomass, as organic wastes will always be produced by every house;
- The impact on the environment is low, if not direct combustion of biomass is used and other methods are used, such as fermentation and pyrolysis; these do not release gas, being considered 'clean' technologies.

Disadvantages of using biomass are:

- Pollutant gas into the air if direct combustion is used and no filters are used;
- Producing liquid fuel from biomass is cheaper than from oil, but alcohol production from biomass is more expensive;
- Some researchers consider that the price of fuels from biomass does not take into account the expenses needed for biomass production farms;
- The direct competition with lands on which food products are grown and their high prices: for example, in Germany, agricultural products are protected by higher taxes applied to biofuels.

Biofuels

Biofuels are derived from biomass and represent renewable energy, unlike other natural resources of coal, oil, gas and nuclear energy.

USA state policy states reduction of state dependence on non-renewable natural resource by wide scale usage of biofuels.

Advantages of producing and using biofuels:

- they are biodegradable and have a relatively low impact on the environment;
- they develop agricultural markets for soya and cereals production;
- the used raw material is often supplied by dead animal bodies;
- biofuel production is in continuous development for replacing oil and gas and is based on cheaper raw materials.

Nuclear energy

Recent research shows the possibility that through ‘cold fusion’, actually the nuclear fusion of the deuterium, of obtaining heat excess, releasing helium and a small quantity of neutrons. The research is part of the international ITER program, in which the European Union, USA, Japan, Russia, China and South Korea are part of, the purpose being the reproduction on Earth of stellar fusion model. Geoff Cordey, British expert in nuclear fusion states that ‘nuclear fusion is the only durable future energy source, as the other natural resources, such as oil and coal, are about to finish’.

Brownian energy

It has been announced for many years the creation of an electromagnetic/electrostatic (Thestatika) generator based on the Pidgeon’s electrostatic machine in 1989. The source of this machine is the Brownian movement of molecules that compose the air, movement fed, on its turn, by the sun. This invention has not been checked yet, the experimental results cannot be reproduced and it cannot be used as the action of the sun lacks.

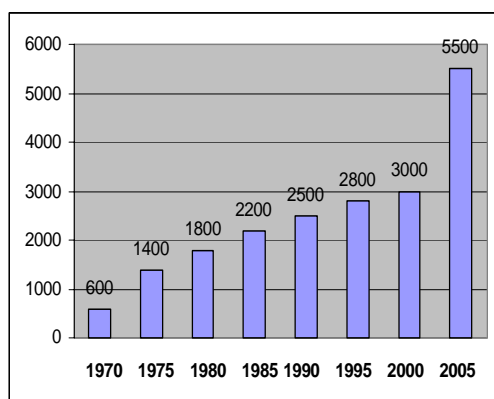


Some researches argue that this machine will have the same destiny as the ones suppressed by politicians and powerful industrialists who see their profits threatened by ‘free energies’. Opinions are diverse, but one thing is sure: sooner or later humanity will be forced to use the new technologies in order to survive.

Fig. 3. Electromagnetic/electrostatic generator-Thestatika

The technologies for non-pollutant fuels production

Taking into account the necessity of environmental protection which has become a global problem of humanity, as has previously shown, the increasing tendency to use the non-pollutant fuels can be observed in the world as well as an agriculture that would not use chemical



fertilizers. This led to the search of other raw materials except crude oil, such as natural gas, and to the appearance of excess capacity for ammonia production plants.

Both in Romania and abroad, a big part of natural gas extracted from reservoirs is processed as methanol and ammonia. Worldwide, in the last years, the methanol plants capacities has increased and, in same time the ammonia production has stagnated. Figure 4 presents the evolution of worldwide methanol production capacities which is the substitute fuel for *gasoline*.

Fig. 4. Capacities of methanol plants, t/d

The methanol requirement increasing with approx. 2-4% per year and reducing its production costs led to a consumption of 33 mil. tons/year in 2005. This is mainly because, by productivity increasing, the methanol price has become competitive with fuel price of fuels from oil.

This issue is examined in detail in „Monitorul de Petrol și gaze” no.11/2006, which shows the share of investment spending for equipment for a methanol plant of 5000t/day, on technological phases:

- gas stream purification 2%;
- reforming 54%;
- synthesis 30%;
- distillation 14%.

The authors highlight that the reforming part of plant has the biggest share and because of this the process is economic if existent reformers are used, when there is this possibility. And, as noted above, there are ammonia plants which are no longer used and are made up of reformers. This can create a new plant for methanol production as fuel. This methanol is a mixture of methanol and higher alcohols and other oxygenate compounds.

Octamix – Lurgi process for methanol production as fuel uses a syngas with H_2/CO ratio slightly higher than 1 and a particular catalyst different from that used for methanol synthesis.

To get a substoichiometric ratio of H_2/CO a well gas is used, which contains higher hydrocarbons, or CO_2 is introduced in the autothermal reformer. CO_2 change into CO at the higher temperature. This is possible only in the new methanol plants which also use oxygen in the autothermal reformer.

Diesel could also be replaced with dimethylether (DME) considered an environmentally friendly fuel for diesel engine. DME can be obtained from methanol by the Haldor Topsoe process.

This process places the DME reactor near the methanol plant, so the recirculated gas (all or only a part) passes the reactor and produces DME before the methanol is separated from recirculated gas. (in this way a thermal energy saving is realized, with separation and vaporization of liquid). Also, it is known that the purge gas from methanol production is burned in the reformer (replacing a part of methane used as fuel), although their calorific value is less than 1/3 of calorific value of methane.

The authors analyzed the ammonia and methanol plants from Romania, made using the following procedures:

- Kellogg – most of ammonia plants;
- Sybeta – at the chemical fertilizer factories in Craiova, Slobozia and Turnu Magurele;
- IITPIC – Romanian conception for methanol production in Craiova and Victoria.

IITPIC is the former Institute of Engineering Technology and Design for Chemical Industry Bucharest, which has patents for methanol and ammonia production and also for advanced separation of methanol from recirculated syngas. The Romanian process for ammonia and methanol production uses two reformers GHR (Gas heated reformer), which allows all the carbon and hydrogen from raw material to be included in finite products, so no longer removes the burned gas into atmosphere (the process is environmentally friendly or „green”).

Conclusions

The world oil crisis, announced and discussed for over 40 years, can be somewhat fought against and „compensated” by the discovery and development of the exploitation of new reservoir, especially off-shore, in more difficult conditions. It would seem therefore that the energy needs of humanity could be provided with corresponding costs, at least for the next years due to the technological progress.

The complex issue of the environmental protection, the reducing of pollutant emissions and reducing of the global warming as a result of the energy production by fossil fuels burning, led to the search and discovery of some alternative sources of energy: solar, wind, hydro, nuclear and also to search some new technologies for producing biofuels considered to be non-pollutant.

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Teorii pesimiste asupra combustibililor fosili și posibile surse alternative de energie

Rezumat

De peste 40 de ani se vorbește în termeni ultimativi despre „sfârșitul petrolului”. În realitate, progresul tehnologic și descoperirea unor resurse la adâncime din ce în ce mai mare, în principal marine, au asigurat, și probabil ar putea asigura în continuare pentru o vreme necesarul de energie al omenirii. Costurile prohibitive, ca și încălzirea globală datorată distrugerii stratului de ozon, au condus la căutarea unor alternative de obținere mai ecologică a energiei, care să elimine poluarea generată de prin arderea combustibililor fosili. Lucrarea prezintă o sinteză a teoriilor „pesimiste” referitoare la criza petrolului, precum și posibile alternative de obținere a „energiei curate”.