ENERGY RESOURCES, A TECHNICAL AND ECONOMIC APPROACH

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Summary

The energy is to day the most important problem of the world. We need more energy that we produce, so the prices are growing and we pollute when using this energy, much mote than we expected 20 years ago. In the paper we discuss three kind of solutions: (1) finding more classical sources of energy and using them without producing more carbon dioxide; (2) finding new sources of energy, at reasonable costs; (3) reducing the consumption of energy, using new and/or better technologies.

keywords: dioxide carbon, world energy, oil, non convetional oil resource

1. INTRODUCTION

The energy was always an essential supply. It becomes more and more important as industry developed, beginning with the end of 18-th century, as population grows, as pour countries based on primitive agriculture became industrial and richer and used a much larger amount of energy (table 1).

Table 1 : World energy request, 1900 -2030 [thousand billions BTU/year]

energy request	1900	2004	2030	Forecast grow % 2004-2030
Developed countries	197.4	239.8	298.0	0,8
Undeveloped countries	150.0	206,9	403.5	2.6

Source : ftp://ftp.fao.org

Until 1973, the demand was well covered by supplies, at very low costs. But then the main oil owners discovered that their deposits of fossil combustibles, oil and gas, are limited and will exhaust at a measurable time horizons, in fact in a few decades. So, the energy price jumped 20 times in two month! But, new field of oil were discovered (as in the North Sea), the most energy consuming technologies of manufacturing were replaced, so the prices lowered then stayed stable until the year 2000.

But, at the beginning of 21-th century, the energy problem becomes again very important, due to three new factors:

- the very, very fast development of two, (eventually three) very large and, till then, very pour countries: China, India and Brazil. In China, the GDP grows, from year 2000, with 10 % per year! This grows has as result that now these three countries are the main energy demanding (fig..1)

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[www.eia.doe.gov]. The production did not follow the growing request of oil, so the prices exploded. And, very probably, it will remain here, in the optimistic forecast.

- the political instability of Middle East, Nigeria and Central America (the most important oil producers) and their anti-occidental position, contributed also to a rise of oil prices.
- the hypothesis of green house effect due to the production of larger amounts of carbon dioxide than the atmosphere can assimilate became credible. This hypothesis was suggested by scientists in the 1970 years, but until the mid of 1990-th it was strongly denied by politicians and economists. If we do not stop burning fossil fuels, the world goes to a catastrophe.

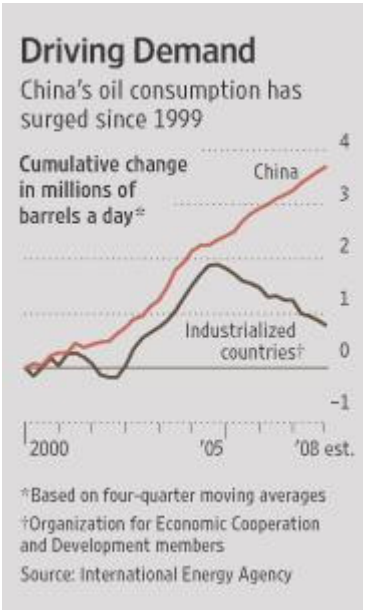

Fig. 1. The variation of oil demand [Source : www. seekingalpha.com]

The crisis could be solved by replacement of fossil fuels. Another resource of energy, abundant, cheap and not producing carbon dioxide would respond to all the three problems listed here.

Do we have such a resource ? The answer is NO, at least for a short horizon of time. But, in time, there are some solutions which could prove their applicability, especially from the economic point of view, because, technically, the most important elements are already known. We shall shortly review these solutions.

2. THE PROBLEM OF OIL SUPPLY

2.1. A lot of people says that the oil reserve are finishing. But this is not entirely true. There are reserves not discovered yet, especially in hardly accessible areas, such as Eastern Siberia, or oil existing at more than 7000 m depth. Thirty years ago, we did not have technologies available for such drills, but now they are operating. Of course, the costs are higher, but such costs can be covered by expensive oil. And the fact that the oil will be expensive is sure (Fig. 2). A more expensive oil can be obtained also starting from oil shale. [www.planetizen.com]. Oil shale are fine-grained sedimentary rocks containing relatively large amounts of organic matter from which significant amounts of oil and combustible gas can be extracted by distillation [emd.aapg.org].

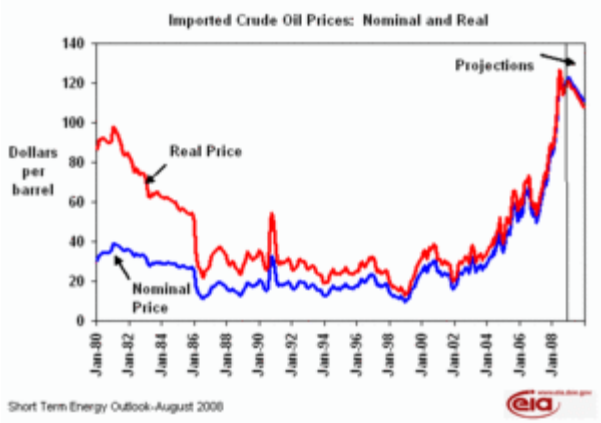

Fig.2. *Real and nominal oil prices. [Source : en.wikipedia.org]*

There are enormous amount of oil shale, which can give more than 5 trillions barrels of oil. To day, the oil production from conventional resources is around 100 millions barrels/day and the reserves are estimated at 1.1 trillions barrels [en.wikipedia.org].

Another available technology consists of underground coal gasification [www.ogj.com] (the technology which allowed Germany to continue the war between august 1944 and may 1945).

So, we can provide oil, but what about carbon dioxide? It can be retained by some technologies developed in the last ten years and known as *carbon sequestration*. Some power plants already used them [fossil.energy.gov].

2.2. Another solution could consist of using recyclable carbon, i.e. fuels based on carbon taken from the atmosphere and not from underground reserves. So, the amount of free carbon dioxide would remain constant. We have here the *gasohole*, a mixture of gas and alcohol obtained from grains or the *biodiesel*, obtained from vegetal fats. Also such fuels are now economically available; probably their use will be limited by the needs of land for food production. The world population grows, his needs grow faster, and so more and more food has to be produced.

3. NON-CONVENTIONAL ENERGY RESOURCES

The second important way to avoid energy penury consists of using non conventional resources, i.e. resources whose conversion in useful energy is more expensive, usually due to the lack of technical experience. Such technologies are studied from the years 1950. The first economically interesting results are obtained in the last ten years [adsabs.harvard.edu].

3.1. The wind power is the form of energy which, starting from the year 2000, is produced at competitive costs. The investments in research and development, sustained especially by Denmark, were of about tem billions dollars until economically interesting results appeared. Now, there are estimations that in Dobrogea can be installed in the next future wind farm having a capacity of producing electricity larger than three groups from the nuclear power plant from Cernavoda, at much smaller investments. It is very interesting to see what it will happen.

3.2. The solar power is the second interesting way to replace fossil combustibles. For hot water, it works for more than ten years. Now, in Romania, such a device pays its investment in some 8 years and in future this time will shorten. Photo electric cells has yet to wait, the electricity produced remains very expensive. But, the third technology, producing electricity by steam obtained with large mirrors evolved after a 30 years pause. The problem consisted of very large surfaces blocked by the mirrors. But such surfaces exist in airport and now they began to be used. Again, is a way to be watched [www.treehugger.com].

3.3. People speak a lot about hydrogen who could replace classical combustibles. But hydrogen, as gas stocked and burned is not an acceptable solution to day. The solution is to start from hydrocarbons, transfer the hydrogen in a combustion cell and obtain electricity. So, we come back to hydrocarbons. But the solution is really interesting because, by this way, the yield in producing electricity is double comparing with a classical engine for a car. Toyota Prius is a good example, but the same example shows that the investment is still expensive.

3.4. The most promising way to produce energy is nuclear fusion. Scientifically, we can solve the problem. Technically, we try to do so [news.bbc.co.uk]. Economic data do not exist yet, but very probably the costs will not be excesive. So, in the next thirty years or so, we will be able to say that we solved both problems: energy and planet heating due to the green house effect.

4. ENERGY-EFFICIENT TECHNOLOGIES

Perhaps, the best solution is not to produce more energy, but to need less. To day, the yield of a car is 25 %, so three quarts of the gasoline is burned useless. A power point burning classical combustibles has a yield of 33...36 %, so, again we are loosing two third of the fuel. But things are evolving in the good sense. In the last years, a new type of thermal power plant, using supercritical steam, has a yield of 48 % that means a 40 % improvement [www.alstom.com]. The mileage of cars is also continuously improving. The houses are loosing less and less heat, due to a much better insulation of walls. The light bulbs are also less consuming, the home appliances (refrigerators, freezers, cleaners, etc) also [www.consumerreports.org].

5. CONCLUSIONS

Al these changes lead to two main conclusions:

- Always when a major crisis appears, people find the solution to solve it; usually, even more solution are proposed until a major innovation impose himself. It is very important that our students understand that there are no problems without solutions, always more than one; these solutions has to be searched, find and compared.
- Very frequently, some of these solutions are already known, but are not used because too expensive; every raise in the costs of raw materials or other change in environmental conditions allows them to enter to the market. Some times, the new solution, in time, became even cheaper or simpler, due to technologic achievements. So, in such cases, the economic aspects are the as important as the technical ones.

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