

June 21, 2011 (Tuesday) 55th EOQ Congress

CONCURRENT SESSIONS
KEMPINSKI HOTEL CORVINUS

Tuesday 13:30 – 17:30
Erzsébet tér 7-8, Budapest V.

SALON REGIOMONTANUS

Tuesday 15:30 – 17:30

15.2. CORPORATE SOCIAL RESPONSIBILITY AND SUSTAINABLE DEVELOPMENT I.

Session Chair: *Györgyi Nyikos, Ministry of National Development, Hungary*

16.50 Thermodynamic Limits of Sustainable Development

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THERMODYNAMIC LIMITS OF SUSTAINABLE DEVELOPMENT

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It seems so, as the times pass, people like different kind of empty catchwords. One of the newest popular slogan is the sustainability. We are talking about sustainable economy, sustainable democracy, sustainable trade, sustainable development, world wide. However, even in 1971, a Romanian mathematician, Nicholas Georgescu-Roegen has written an interesting book titled “The Entropy Law and the Economic Process”.

The main idea of his work is related to the energy forms of an closed system. This issue deals with the two types of energy, with the “bounded” and “free” energy of the system based on the second law of thermodynamics. He uses the second law of thermodynamics in the scope of economical and other processes too. It means, all the processes – not only the physical phenomena – occur in our existing universe depend on to the thermodynamics laws. There is no way to escape from this trap. We would have to recognize our situation and to measure our nature destroying activities even in the 70’ years...

The first concept of sustainable development related to the name of Norwegian prime minister, Go Bruntland. By the original idea, of the sustainable development meant so kind economical and technical evolution, suited to the demand of modern ages as high level as it possible, without any harm for the life quality and surviving chance of the next generations. A society planned by these principles – mentioned above – could be provides the necessary natural resources and keeps up the existence of the intact ecosphere.

In deed, there is possibility to build up this kind of a society? World wide there are plenty of studies, books, conferences dealing with the decrease, or running out of natural resources, scrutinising the probability of troubles faced to the mankind in the future and searching the way, how have to be handle these problems. Let me list a few names: René Guénon, Rachel Carlson, Lawrence E. Joseph, László Antal Z., Zsolt Hetesi, László Végh, Dorottya Szám, Marie-Monique Robin, Susan George, Donella Meadows, Jorgen Randers, Dennis Meadows, Guy Turcsany, Gergely Tóth, Katalin Martinás and others. These authors have warned seriously to one of the harm of civilisation to the increasing demand of consumption leading to the uncaused recourse of natural resources. Only one example: amongst the expensive vehicles the cabriolet type automobiles in the car industry satisfy not a realistic claim, but serve only the luxury demand (Gergely Tóth). Producing, trading and using of these cars have resort to the environment, as the important products and services for the societies.

Let me mention just for example the case of energy sector. As the Hungarian scientist, Hetesi, the availability of the mineral oil stock of the Earth could be critical within 50 years. The positive energy balance is the one of the most important condition of the exploitation of energy resources. It means that, we have to get more energy than we invested into the mining. The quotient of the energy invested and energy retrieved is the EROEI value (Energy Returned On Energy Invested). One hundred years before this quotient was 1:100, namely in

that time one barrel mineral oil gave so many energy, which was enough to mine 100 barrel mineral oil. Until the year 2000, this quotient has decreased to 1:8 (figure 1. yellow arrow). The main reason is the drying of the well exploitable oil fields.

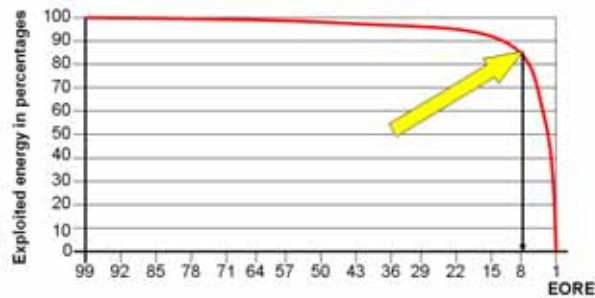


Figure 1. Curve of energy returned of energy invested in the case of crude oil exploitation (Hetesi et al.)

At the 1:8 EROEI ratio there is a harm, while the exploitation of the crude oil may become lost its profitable. This situation is expectable within a few years, when may arise a significant crude oil deficit.

Meadows et al., in their several times issued book, titled “Limits to Growth”, detailed scrutinise the adverse ecologic anthropogenic changes raised in the last decades.

Let we study, the exact science, the physics, within it, the thermodynamics which kind of chances gives for the mankind in the future related to the sustainability of development? It could be interesting to thinking on the Second Law, generally how sketches the limits of sustainable development.

The First Law of thermodynamics the so cold “energy remaining” law, the Second Law is the principle of the “increasing of entropy” in an isolated (closed) physical system. The idea of entropy was introduced by Claude Clausius. In the Carnot-cycle between the T_1 and T_2 temperatures, in the isotherm part of the cycle via reversible way changed heat amounts, are proportional with the absolute temperature. This expresses the next differential quotient:

$$dS = \frac{dQ_1}{dT_1} = - \frac{dQ_2}{dT_2}$$

In the differential equation “S” means the entropy. The entropy referred to a structured system, means certain disintegration of the structure, therefore the entropy is the measure of anarchy. The disintegrating system could be a physical, ecological whether ethical regime. Without mathematics deduction of this law, now we have to accept that, every action occurring in an isolated system, increases the entropy. In other words, increases it’s inner disorder.

If we consider the ecologic system of the Earth as isolated structure respecting the fossil energy sources and the wastes originated from the industrial producing, it is logical, if we exhaust all the available resources, the consequence could be increase the entropy of the Earth, namely could be disintegrate the structure of biosphere. To discuss this topic it is interesting data the opinion of the Hungarian theoretic physician, Béla Lukács. He tells that the Earth is considerable as an opened system, while impacting and dissipating cosmic radiation energy. As his theory, the capability of the Earth to support the human population can be analysed, as a semi-opened thermodynamic system.

Our Earth the most amount of radiation energy gets from the Sun. It’s surface exposed almost 7000 times more energy, than the whole mankind uses world wide today.

Let us survey – by the opinion of Béla Lukács – the energy balance of Earth-Sun system! The Earth gets and absorbs Q_{Sun} amounts of energy from the Sun, when the temperature on the Sun's surface is approximately 5700 °K. The Earth this absorbed energy converts and dissipates back into the Cosmos. It is the Q_{Earth} . If the Earth shouldn't do it, the crust of Earth should be very warm. It means the two heat amount is equal:

$$Q_{\text{Sun}} = Q_{\text{Earth}}$$

So the energy dissipated equal with the absorbed amount of heat, but the temperature of dissipating surface approx only 280 °K! What does it mean? Let us substitute the temperature values into the differential equation mentioned above:

$$dS_{\text{Sun}} = \frac{dQ_{\text{Sun}}}{d(5700)}$$

$$dS_{\text{Earth}} = \frac{dQ_{\text{Earth}}}{d(280)}$$

It is important to mention, the “d(5700) and “d(280)” symbols are very-very small – infinitesimal – amounts, but the ratio between them is $5700/280 = 20,36$ (approx. 20). Let us consider the amount of entropy originated from the radiation of Sun, impacting into the surface of Earth and the dissipated amount! The entropy deficit of the planet approx 20 times less, than the impacting entropy continuously. Namely the entropy of the Earth perpetually decreases. This process occurs until the Sun finishes its working. The consequence from this theory, if the mankind should govern their processes under sober and environment-meaning way, there would be possibility to live peaceful and welfare life together the nature. If we won't do it, there could be fatal changes in our niche (the niche is the theoretical territory, where a creation is living).

The pathetic world wide known slogan, “Save the Earth” has a banality colour. We shouldn't save the Earth. We have to save rather our niche and our race. While the Earth can save itself (or herself...), based on the thermodynamics principles outlined above, of course under very long time. The mankind hasn't time to wait for the repairing of the nature. Namely the Earth has capability to reconstruct his injured ecosystem, even if the lack of mankind...

The Human has a duty to reduce the utilisation of already existing resources, and to measure the consumption to keep our world to show for our grandchildren's grandchildren, to avoid the life chances for long-long millennia for the next generations in our wonderful world.

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