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ASPECTS REGARDING ENERGY CONSUMPTION

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Abstract
This paper approaches topical issues regarding energy supply and consumption, highlighting the sources, the major factors to be harmonized and offers solutions regarding the means of approach in choosing the energy source/ system as well as its sustainability.

Key terms: energy efficiency, energy saving, sustainability.

1. Introduction

All human activities (of research, design, production, maintenance, socio-cultural, industrial, agricultural, transportation, recreation etc.) are energy consumers (energy off all kind, including intellectual – which is not measurable but it counts. A lot.). We might say that nowadays society is ”powered” by energy and follows the general equation:

$$CE = ECCN + TESD(F) + RLCC + LOG \quad (1)$$

Where:

CE = Consumed Energy

ECCN = Energy Covering Current Needs (for everyday life)

TESD(F) = Technical, Economic and Social Development (for the Future)

RLCC = Raising the Level of Civilization and Comfort

LOG = Love of Gain

It is no longer a secret that ”In order to exist, the world needs energy to use (only) for peace full purposes”. However, the reality of our days shows us another facet as well, described as:

$$IER \cap IUR \cap GWR \rightarrow CRISIS \quad (2)$$

Where:
IER = Irrational Exploitation of Resources
IUR = Irrational Utilization of Resources
GWR = Generalized Waste of Resources

This way of approaching existence, translated by the need to ensure permanently the necessary energy, given the general progress, but also to ensure a durable development, is of recent date. In 1983 the United Nations established the World Commission on Environment and Development – WCED (also known as the Brandt Commission), that stated that ”durable development is the one that ensures the needs of the present without compromising the possibility of future generations to satisfy their own needs”. (Cf: World Commission on Environment and Development – *Our Common Future*, Chapter 2: *Towards Sustainable Development*, 1987). WCED also stated that:

- ”development does not mean high profits and improved living standards for a small percent of the population, but the raising of living standards for all”,
- ”development should not imply the destruction or reckless usage of our natural resources, nor the pollution of the environment.”

The reality nowadays shows a couple of major inconvenient aspects such as crisis (energy, financial, economic, social, moral etc.) and changes (climatic, technical, conceptual). The major contribution to the current situation belongs to the human being (for polluting the planet, waisting and draining the natural resources, creating and inducing instability, insecurity, injustice etc.). In consequence, it is the task of the human beeing to remedy the situation, by acting responsibly and honestly (based on acknowledging the reality and with the help of new technologies).

Means of approach

Approaching only the energy aspect, the need to save energy and find new resources (as a result of the energy crisis), we can highlight the factors that make and determine the link with sustainability (a notion that can be considered as a necessary

optimisation of future actions): social, economic and environmental factors. In figure 1 we can see the interaction of these factors and the reciprocal conditioning.

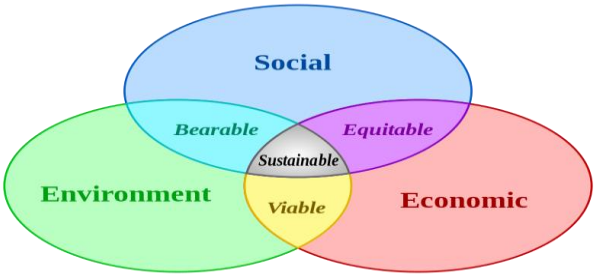


Fig. 1 – Approach of energy saving
(See: http://en.wikipedia.org/wiki/Sustainable_development)

In order to obtain the right resolution, for each factor we will take into consideration the specific behaviours/ characteristics:

SOCIAL:
- institutional operability,
- equality and equity,
- consultation and participation,
- level of education,
- social mobility.

ECONOMIC:
- family incomes,
- business productivity,
- stability & protection,
- equity & official support,
- efficiency.

ENVIRONMENT

- availability and accessibility of natural resources,
- biodiversity,
- measures to prevent pollution,
- ecosystem health,
- climatic conditions.

Comments:

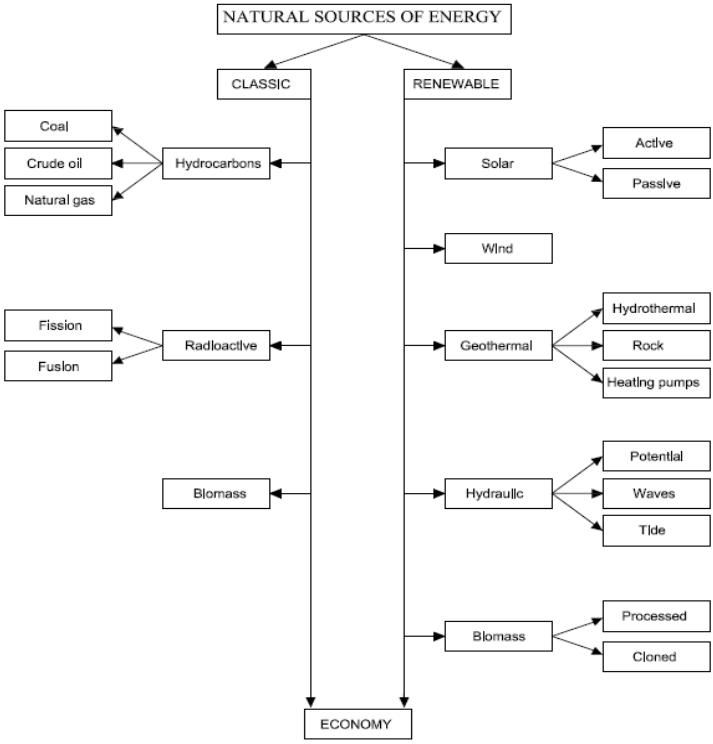
From the start we must state that the human being disposes of two categories of energy:

a) human (intellectual and metabolically),

b) natural (classic and renewable sources).

Observation: The “artificial” sources of energy are obtained as combinations of both a) (especially intellectual) and b) energy categories.

To stay true to reality we must also notice the strong ”collaboration” between the human metabolic energy and the energy from renewable natural sources, that stimulated and developed the intellectual energy which human beings used to ”discover” and put to use the classic natural sources and to cleverly utilize the renewable natural sources (”renewable” is of course a figure of speech, as they are not infinite in duration, but depend on the life expectancy of the Earth and the Sun – to say the least).



The natural sources of energy are presented below, in figure 2.

Worldwide, the natural energy resources (limited in quantity and very unevenly distributed) – see figure 3 – indicate basically the future lines of action for a stable production of energy.

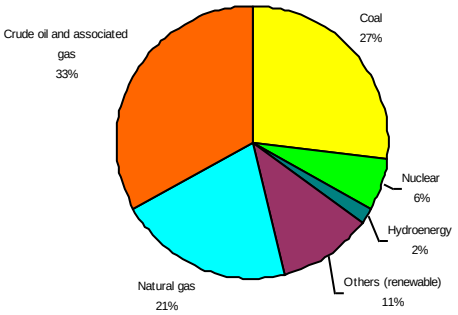


Fig. 3 – Worldwide production of energy from primary sources
(See: http://www.iea.org/textbaze/nppdf/free/2010/key_stats_2010.pdf)

We can notice that the amount of hydrocarbons used in the production of energy reaches about 81%, so we continue to rely mainly on this kind of resources. To estimate the future of hydrocarbons-based consumption we use the relation:

$$E = RR/ MEP \quad (3)$$

Where:
E is the ensured consumption, in years;
RR – known Resource Reserve, in MJ;
MEP – estimated Multiannual Energy Production, in MJ/ year

The degree of ensuring the classic (fossil) resources at a global scale - by a current estimation based on known deposits - is

worrying from the point of view of an ”optimistic” sustainable and durable development. We are left with:

- 48 years for crude oil and associated gases,
- 60 years for natural gases,
- 150 years (and plus) for coal.

In particular for Europe the situation is quite concerning, as the total amount of hydrocarbons used in the production of energy is 19%, while the reserves only reach 3,33%. This makes Europe dependent of the import of hydrocarbons.

For Europe, the structure of energy consumption and CO2 emissions – see figure 4.a, as well as for buildings – see figure 4.b, is relevant and must concern the specialists in this field.

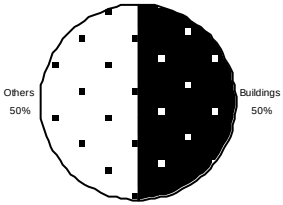


Fig. 4.a – Energy consumption and CO2 emissions

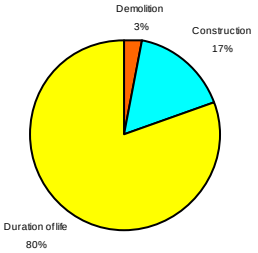


Fig. 4.b – Energy consumed in the life cycle of a building

Sources for figures 4.a and 4.b:

Bob, C., Bob, L. – *Sustainability of New and Strenghtened Buildings, WSEAS International Conference Sustainability in Science Engineering*, Timisoara, May 2009:

Khasreen, M. M., Banfill, P. F. G., Menzies, G. F. – *Life Cycle Assesment and the Environmental Impact of Buildings, Journal Sustainability*, 1, 2009.

In order to be utilized, energy must be ensured, produced and delivered to the consumer and that means an additional consumption of energy – see figure 5. This is also the case for all sources and resources of primary energy (only the proportion of losses and technological consumptions differs).

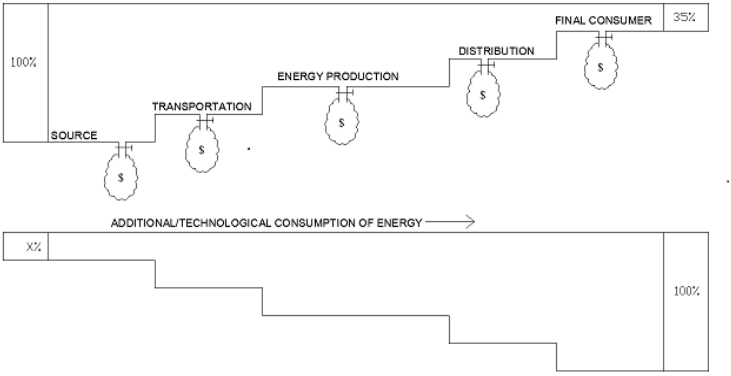


Fig. 5 – Losses and additional consumptions in the process of utilizing energy sources

From figure 5 result the main directions for a more efficient use of energy sources such as: ”ensuring” the source, shortening the transportation and distribution chain, perfecting all technological processes (from source to consumption) while protecting the environment.

It is obvious that the unconventional, renewable sources of energy benefit from much attention (especially the solar and wind energy – much easier to harvest than the hydraulic or even geothermal energy and the ”tempting” heat pumps). Even if these types of energy sources are considered to be ”clean” we must take

into consideration their emplacement, their functional needs and especially their upstream components.

One of the ways to asses the environmental protection is the Carbon Footprint – CF, that serves to discover the emission sources with greenhouse effect of the "entity" (process, activity, action, individual, organization, industry etc.). We must notice that, according to STAS ISO 14064 – "Greenhouse gases", both direct and indirect emissions are taken into account when calculating the CF of an entity. The direct emissions "belong" strictly to the entity while the indirect emissions come from upstream and/or downstream. The main greenhouse gases identified are quantified by equivalation in tonnes of CO_2.

In order to determine the CF (see Retezan, A., Dobosi, Ioan Silviu, *Energy Consumption Controlled by Carbon Footprint*, at ICEE Conference, Iasi, 2015) we use the following relation:

$$\text{CF [t } CO_2\text{ /day… year]} = 1/1000 \sum_{1}^{n} \text{Emission [kg/ day…year]} =$$

$$= 1/1000 \sum_{1}^{n} \text{Functioning X [m. u. X/ day… year]} \cdot$$

$$\text{Factor of emission}_{1} \text{ [kg } CO_2\text{/ m. u. X]} \qquad (4)$$

Where m. u. X is the measurement unit for the functioning of the entity (of the energy source).

Taking into consideration that the "theory" of sustainability also applies to the existing situations (by means of upgrading technologies, rehabilitations, modernizations etc.), figure 7 presents in a synthetic way the means of approach for optimizing the energy, financial, comfort and efficiency aspects. (Cf. Bob, C., Dencsak, T – *Building Sustainability. Civil Engineer Approach*, Lambert Academic Publishing, Saarbrucken, Germany, 2010).

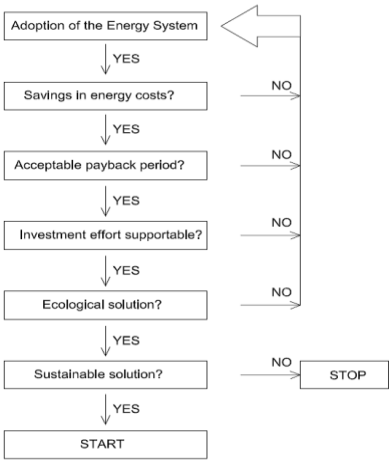


Fig. 6 – Procedure for adopting an energy system

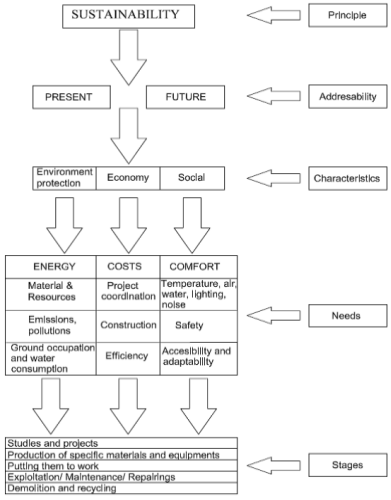


Fig. 7 – Means of approach for sustainability in constructions and the afferent installations

We must notice the complexity of the factors taken into account, the stages of action, the necessities and characteristics, addressability as well as the importance of studies and projects (Experience can`t replace them but it can justify them).

Final considerations

Real life is based on market economy and governed by laws which, for the aspect regarding energy for buildings and afferent installations, need coherent and responsible strategies and policies (technical, economic, social etc.), designed to ensure the environment protection, ambiental comfort, efficient and sustainable use of energy – despite all partisan interests (that seek profit).

Singular and local, pinpoint approach of a problem in energy and especially extrapolating it without analyzing the general context – upstream and downstream – may lead to serious mistakes and irreversible errors.

In order to ensure the energy needed for all human activities we must use every source available, with the condition of harmonizing all elements: social, economic, ecologic (protection of the environment) and guaranteeing sustainability. Energy is vital for constructions/ buildings and there are real possibilities to reduce consumption, save energy, ensure comfort and protect the environment (also by lowering the carbon footprint). The means and techniques exist, all we have to do is put them into practice with professionalism.

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