Sustainable Energy?

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There is a rather widespread illiteracy regarding energy, even within technical professional communities, namely, of engineers dealing with energy and yet the relevancy of energy can only be absolute, as its meaning in Greek shows: the *cause of the motion*, meaning the *cause of life*.

Yet, most of the energy used by humanity so far is or has been originating, directly or indirectly, somewhere and somehow, from the Sun (solar radiation). With time some of that energy has been stored as fuel reservoirs (oil, gas and coal) as consequence of major changes of biomaterial by solar energy through millennia. Other derived energy from the Sun, in relatively stable global dynamic equilibrium, kept being under the form of mass flows associated to the water down the rivers from higher soil reservoirs or to the air under the wind generated by short-term diverse thermal conditions in different parts of the Atmosphere and the earth movement itself. And, also the energy from the biomass which, beyond the basis for the formation of the fossil fuels referred above, covered great areas of the Continents' surface with a vegetal carpet, by converting the solar radiation with an efficiency of an order of magnitude of around 1% or less. Biomass has been used for millennia to assure the fire - which discovery was a major milestone in the history of Man - to, namely, prepare meals and provide heat for comfort.

A few centuries ago, the discovery of electricity and of the thermal machines, namely the Otto and Diesel engines, led to the emergency of the designated "industrial revolution", a major step that led towards the technological and economic World of today mainly supported on the fossil fuels. Large sectors of industrial activity as well as the urban life and the explosion of mobility led to the use of the current high levels of fossil fuels. All that led to the generalization of high air pollution cases in many industrial and urban areas, a huge environmental problem of heavy consequences to health. And yet, the rising of the CO2 concentration as a component of the atmospheric air affecting the balance of solar radiation 'in' and 'out' of the Planet has created a major problem of overheating for the whole Planet, which will entrain in an associated climate change on Earth, already in course.

Once assessed that CO2 concentration in the air tends to increase as a result of the current trend in the use of fossil fuels, something had be done to find alternative ways for clean energy, namely for electricity. The planning and management of cities in general and the promotion of new ways of converting the thermal energy from the Sun into electricity should support the economic activity and provide cities with proper mobility and general living and amenity conditions.

The solar energy is an environmentally clean energy that can also be partly used directly, for instance, by making progresses in designing buildings - one of the economic sectors with the highest energy use – to make them less 'energivores', and using solar radiation, a quite accessible vector, to take advantage of its conversion technologies into electricity, heat, and other usable forms.

Here, where we are today: a time of shifting energy resources at the Planetary scale, from fossil to renewable and, in parallel, a trend towards a more efficient use of the energy made

available to the users. There may emerge economic problems associated with the change towards the new technologies in the economy since energy is a relevant factor for the economy and for the society wellbeing.

Other type of emerging problematics emerged in association to the envisaged reduction of oil or coal consumption. On the one hand, those are mineral reserves that are abundant in some regions of the Planet and which exploitation is of great economical benefit for the producing countries. On the other hand, there are also difficulties associated to nuclear energy's environmental impact and security, which end up by requiring a major technological investment without waiving the uncertainties in regards to their safety.

Yet, in the context of the energy of the Globe succinctly described above, the point here is to respond to the question of the title now into a clearer formulation: how to make the society of which we part of, converge towards a sustainable energy?

The world political leaders converged on an agreement in Paris 2016 leading to the reduction of CO2 emissions, through the so called 'decarbonization' of the economy by expressing their target result in reducing of 1,5°C the growth of Earth's temperature until 2040. For that purpose, one can expect some consistency on the development and diffusion of solar technologies and of other clean energy technologies but, also, on socio-political measures of planning and managing cities focused on buildings, mobility and economical activities in order to reduce the energy use in parallel with the substitution of fossil fuels to reach the target result.

So, sustainable energy, what?

And, the answer shall be:

To promote:

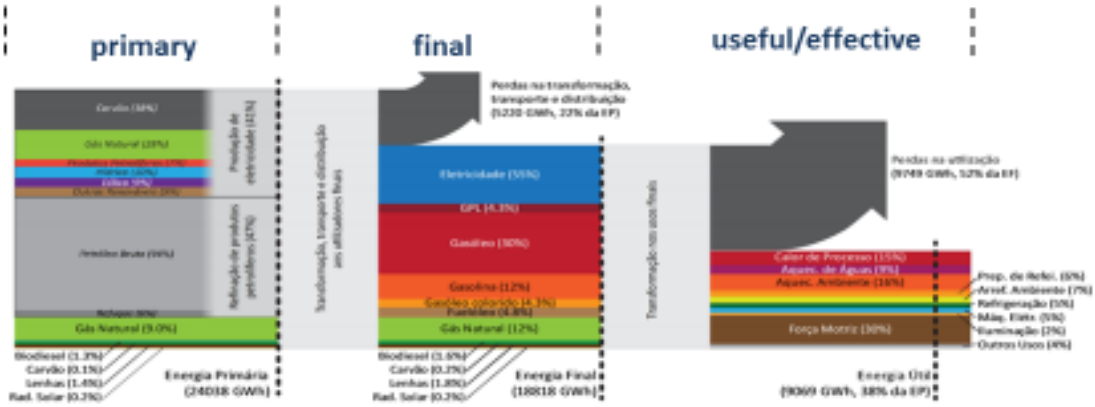
- Clean energy sources technologies, as explained above;
- Energy efficiency in all use chain from the energy resource down to the energy service; and
- Energy sufficiency in order to reduce the ultimate energy demand without loss of quality of services.

In our current courses at FEUP the three themes above must emerge with all evidence, the first two appealing more to the technologies themselves while the last one appealing more to soft societal behaviors, which does not necessarily mean less density and sophistication of knowledge. This branch of the sustainability through energy may include societal concerns so diverse as, comfort, health, urban planning, management and monitoring and controlling and in other different domains such as urban and landscape work, mobility and traffic management and urban quality of life (noise, air quality, traffic jams, etc.).

In conclusion, when we evoke the Paris Agreement (2016) we cannot relax on the simple substitution of the conventional energy sources thinking of the common 'imbecility' of the so called 'energy production', which, in reality does not exist… Still, a lot remains for the culture, knowledge, intelligence and professional ethics as well as for urban politicians to do regarding the link between energy and living prosperously and healthy. At the end, doing so, the energy overall will be remarkably and fatally more sustainable.

Energy, what and what for?

Energy demand: users (not consumers!) are part of the energy chain value



- Only 40% of primary energy turns out to be 'useful energy' or 'energy service'