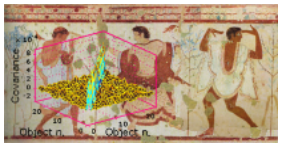

Sustainability and Thermodynamics

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Introduction

Our society is too much consuming so that our resources are going to become always more and more limited. Sustainability is a magic word almost never respected by humans. Two innovative revolutionary processes are so necessary a change of life style more respecting of nature and others (our freedom ends where that one of our nexts begins) and a technological jump which starting from a renewed consideration of the values of the matter looks at its evaluation at the top level. So traditional thermodynamics based on free energy and entropy concepts seems not sufficient: surely it is the basis of any other conceptual building, but the consumption processes not only mean to lower the available energy level as quantity but also overall as quality. The commercial value cannot respect this attempt of evaluation of our society sustainability. So we need to enrich it with new basis, starting from the consideration of the secondary reactions always coupled to the primary one in the energy production, starting from the unperfect industry production processes, starting from the energy (direct and indirect) consumed to produce an object compared to that one obtained by its consumption, considering: extraction of raw materials, transport costs, storage of wastes.

So a new thermodynamics is growing up to suggest to us a better behaviour in the perspective of lowering the unbalance between costs and benefits including within the latter ones that our future generation can still have guaranteed an acceptable degree of life.

Discussion

Describing the story of thermodynamics therm from a famous encyclopedia [1]: "In 1824, Sadi Carnot studied the improvements developed for steam engines by James Watt and others. Carnot utilized a purely theoretical perspective for these engines and developed new ideas [2].

In the 1870s, Josiah Willard Gibbs unified a large quantity of 19th century thermochemistry into one compact theory. Gibbs's theory incorporated the new concept of a chemical potential to cause change when distant from a chemical equilibrium into the older work begun by Carnot in describing thermal and mechanical equilibrium and their potentials for change. Gibbs's unifying theory resulted in the thermodynamic potential state functions describing differences from thermodynamic equilibrium".

"In 1873, Gibbs derived the mathematics of "available energy of the body and medium" into the form it has today [3]. The physics describing exergy has changed little since that time. The term exergy was suggested in 1956 by Zoran Rant [4] by using the Greek ex and ergon meaning "from work"."

There is one other therm , realtively new, connected with previous [5]: "The term Emergy was originally coined by David M. Scienceman in collaboration with the late Howard T. Odum. Odum used 'emergy' to mean both sequestered energy and emergent property of energy use [6]. However Scienceman also used the term 'emergy' to refer to the concept of energy memory, a concept which motivated Scienceman and B.M. El-Youssef [7]."

Sustainability is also a not new concept, citing Howard and Elisabeth Odum; The prosperous way down [7]: "Principles that appear to govern all systems including human societies were used to consider the time of economic descent ahead. These include the energy laws, the emergy concept, the maximum empower principle, the universal energy hierarchy, the conservation

and hierarchical distribution of materials, the spatial organization of centers, and the pulsing paradigm. Population and cities, energy consumption and climate change, agriculture and environment, information and electric power, capitalism and economic policies, structures and materials, human life and standard of living are dealt with in this paper as interconnected aspects of the same problem, i.e. the necessary descent phase of human economies, due to decreasing resource base. We expect much of the resource use, culture and public policy appropriate for the growth period to be replaced with a new set of ethics and policies affecting each scale of time and space during descent. Decisive changes in attitudes and practices can divert a destructive collapse, leading instead to a prosperous way down".

Conclusion

More and more papers are available in international journals around this arguments, as Emergy as a function of exergy [9], Emergy indices and ratios for sustainable material cycles and recycle options [10], Toward a scenario analysis framework for energy footprints [11], Derivation of Energy-Embodiment Functions to Estimate the Embodied Energy from the Material Content [12], Promise and problems of emergy analysis [13], and finally the "must read", A thermodynamic framework for ecologically conscious process systems engineering [14].

Thermodynamics analysis of goods and objects are necessary for sustainability and to develop a life style more respecting of nature and with a "future".

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