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Editorial

Can we break the addiction to fossil energy?

1. Introduction

Some questions are not easy to answer. All the same, most readers of Energy are likely to share a series of common concerns about possible future energy shortages, the environmental consequences of massive fossil energy use, the poor performance of existing policies on energy efficiency, the difficulty of replacing fossil by renewable energy sources, the fragility of societal structures and their energetic metabolic pattern, the seriousness of the crisis affecting world economic and social stability… in other words, they are worried about our energy future.

The growing information about declining reserves of oil and natural gas (leaving coal as the only abundant form of fossil energy) are not making the picture any rosier. In fact, in spite of the early warnings of Hubbert (whose curve made it possible to predict the end of cheap fossil fuels in the 1970s), world economies are still heavily dependent on traditional fossil fuels. In face of this predicament, several strategies have been implemented, such as diversification of energy sources by typology and geographical origin, strengthening international competition for control of available reserves, and increased investments in efficiency and renewable sources, but so far these efforts have not generated the desired re-assuring feeling that the problem is under control. To all this we have to add a large dose of uncertainty about the future availability of fossil reserves, which not only depends on the actual physical quantity or quality of the reserves, but also (and mainly) on international markets and strategies. Other sources of uncertainty also play an important role, such as demographic variables, geo-political conflicts, possible effects of climate change, and the financial crisis. For all these reasons it is extremely difficult to predict or even guess the "best" strategy for the development of renewable energies sources; a fact that makes it difficult to obtain large investments in this field.

Industrialized societies have been designed on the basis of fossil fuel use. Their structures, their patterns of production, their transportation sector, and their agricultural and service sectors are all extremely energy intensive, meaning that a shift to a lower level of energy use is hardly imaginable, let alone achievable in the short term. Developing economies are more or less following the typical growth pattern completed by developed countries, but with the difference that a quick massive industrialization is hampered by large population size, shortage of resources at world level, and the increasing concern for the already-overstressed environment. All the same, it is hard to imagine that developing countries will choose a different development path while relatively cheap fossil fuels are still available. Thus, in spite of the large number of proclaims and rosy scenarios of reduced emissions, the addiction of the world economy to fossil fuels is here to stay. The dreamed-of transition to a low-carbon economy is going to be neither simple nor smooth. In this situation, besides the issues of how much fossil energy is still available and what alternative energy sources might possibly be capable of replacing oil, there is another crucial issue to tackle: We must develop as soon as possible effective methods to identify and understand how external and internal constraints affect socioeconomic dynamics. This implies developing new analytical methods capable of supplying useful indicators for decision making under uncertainty.

2. Workshop results and the papers presented in this special issue

Once again, the International Workshop on Advances in Energy Studies gathered a critical mass of interdisciplinary scholars to stress the energy problem in its multi-dimensional feature, staying away from simplistic and purely technological solutions and mono-dimensional indicators used to suggest "one-size-fits-all" strategies. Indeed, the guiding concept of integrated assessment requires checking the performance of the various options in relation to their biophysical feasibility, economic viability and social acceptability across multiple scales of analysis. In this context, we have selected and peer-reviewed papers that provide an overview of the topics presented and the expectations emerged during the Workshop.[1]

The first group of papers in this special issue addresses the large-scale issues of energy accounting, conventional energy constraints, and difficult task of renewables where used to replace the existing fossil energy supply:

Giampietro and Sorman [1] question the usefulness of the present single-scale statistical energy accounting schemes. They provide a critical appraisal of existing applications (national accounting, flow charts) and suggest an innovative multi-scale representation based on the distinction between primary energy sources, energy carriers and final end uses.

Mayumi and Tanikawa [2] provide fundamental criticism to the possibility of implementing a rigorous protocol of "net energy accounting". Their argument is built on the conceptualization of

[1] A second set of contributions, selected on the basis of their specific characteristics, is published in the Elsevier Journal "Ecological Modelling", thus totaling 23 papers out of the 89 oral and poster presentations given during the Workshop. Special issues dedicated to previous Workshop editions were published in Energy 31(1–2), 2006 and Energy 34(3), 2009.

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material production and consumption in the economy developed by Georgescu-Roegen (bioeconomics).

Tverberg [3] links the recent non-growth of oil supply to the severe economic crisis at world level. The paper suggests that due to Peak Oil, the increased oil consumption of emerging economies is reducing the accessibility of oil to OECD countries, thus worsening their financial crisis (without growth it is impossible to repay debts).

Dittmar [4] provides an overview of the state and present perspectives of nuclear (fission and fusion) power generation. He highlights unsolved management, safety and investments problems, and concludes that even not considering the consequences of the Fukushima accident, we can say that nuclear energy should not be considered a solution to our energy needs.

Suomalainen et al. [5] develop a new modelling approach to the assessment of wind variability at different temporal scales, in order to generate a better understanding of the resource profile and useful design information.

Xin Li et al. [6] analyze the recent growth of wind power in China, focusing on the lack of suitable grid infrastructure for power delivery to end-users. In particular, the paper points out the difficult integration of intermittent wind energy within a coal-dominated energy system. This coupling determines the occurrence of too frequent ramp ups and downs generating inefficiencies, which may result in higher CO_2 emissions by coal power plants.

Blumsack and Fernandez [7] assess the potential of smart grids in increasing the efficiency and performance of electricity distribution. Their focus is on energy savings from higher efficiency, price-responsive electricity demand, and finally better and much needed integration with renewable energy power plants.

The second group of papers focuses on the interplay of bioenergy and food alternatives. The shift from first generation bioenergy based on food crops to the second generation of bioenergy based on biomass non-competing with food production was one of the main topics of the Workshop. Several authors developed analyses and case studies in relation to possible technological improvement, use of residues, whereas other focused on a needed shift to different and more sustainable production patterns.

Buonocore et al. [8] investigate a Swedish bioenergy production system that integrates urban wastewater treatment, willow farming and a Combined Heat and Power plant (CHP).

Fahd et al. [9] suggest adopting a biorefinery perspective for the integrated production of bioenergy and biomaterials production from residues and non-food crops. In addition to bioenergy, a set of co-products (high market value biomaterials) and services (reclamation of marginal and polluted land) at regional level are required to make the process more attractive.

The more technical aspect of conversion kinetics of organic municipal solid waste into bio-hydrogen and bio-methane is addressed by Kvesitadze et al. [10]. Their analysis identifies physical-chemical conditions for better performance, options for cost-effective technology improvement and finally scale-factors making possible the adoption in industrial processes.

Agostinho and Ortega [11] compare two systems of production in Brazil: single-product bioethanol produced in large-scale monocultural farms versus small-scale multi-functional farms. The study characterizes differences in performance in terms of economic and environmental trade-offs.

The crucial issue of how an increased production of agro-biofuels may affect food supply at the world level is addressed by Nonhebel [12]. After estimating the future increase in the demand of both food and liquid fuels, the paper shows that the impact of bioenergy on food and feed production would be huge, if existing trends are not corrected. Large scale agro-biofuel production will decrease food security in several parts of the world.

A case study of changes in the energetic metabolic pattern in Argentina, in the last two decades, is used by Recalde and Ramos-Martin [13] to link a quantitative biophysical analysis of societal energy metabolism to a quantitative economic analysis into an integrated analysis of performance. The study points out that the existing path of development of this country is unlikely to ensure long-term sustainability.

3. Concluding remarks

What came out of the Workshop was a shared concern about the lack of effective conceptual frameworks making it possible for our society to address the energy problems associated with a new "energy reality" to be faced in the third millennium. Humankind will have to learn how to adapt and change quite quickly, in times of hard competition for fossil energy sources, economic turndown and increasing environmental problems. But let's assume for a moment that the miraculous discovery of a "silver bullet" capable of producing an unlimited supply of energy at very low cost will make it possible to run the economy without any significant downsizing. Still a business-as-usual economy capable of pursuing the goal of perpetual growth will keep generating billions of cars, increasing the amount of land covered by roads and parking lots, increasing the extraction of minerals for industrial activities, increasing the amount of sediments moved to the oceans by agricultural production as well as the material moved around because of construction and industrial sectors, increasing the use of water (already facing a situation of "peak water"), increasing the pressure on disappearing forests and ocean ecosystems already in critical conditions (Millennium Ecosystem Assessment [14]). Sustainability cannot be tackled a single issue at the time! From the discussions held during the Workshop it clearly emerged that energy (peak oil) and climate change are just two symptoms of a more profound global crisis. When dealing with phenomena associated with complex dynamics it is necessary to adopt holistic visions, complex evaluation procedures and flexible policy tools.

As a matter of fact, the pages of the newspapers and the screens of the television news are increasingly occupied by news referring to environmental, economic, and energy crises in a continuous rotation. This is a clear sign of a systemic crisis of the business-as-usual model of economic growth that has reached the sustainability limits. There is nothing intrinsically bad with economic growth; it worked pretty well for those that managed to improve their material standard of living without excessive environmental degradation or social injustice. The problem of perpetual economic growth resides with the finite scale of our planet and with the fragility of social fabric that cannot be stressed too much by sudden changes. Unlimited economic growth is simply impossible on a limited planet and a forced total "westernization" of humankind toward a common pattern of production and consumption of a common set of goods and services is certainly not desirable. Sustainability requires cultural diversity and a diversity of metabolic patterns. The sooner modern society will reflect on this point the sooner it will become possible to discuss alternative paths of development.

As surprising as it may be, we do not have a word to specifically refer to qualitative progress that is not associated with growth. As a consequence, the proposed terms, such as de-growth, way-down or downsizing, always bear a "negative" meaning. A sustainability revolution should start with a semantic shift towards the awareness that the words we use are not neutral. They have a built-in judgment of value according to the dominating paradigm. For this reason, our effort should be aimed not only at finding better analytical tools for studying our sustainability predicament, but also at establishing a new sustainability discourse in our society.Put

it another way, we need a new approach to control the quality of the process used to produce and consume scientific knowledge in decision-making (on the technical side), and an expansion of the perceptions, epistemologies and languages used to frame sustainability issues (on the cultural side).

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