QUALITY, SUSTAINABILITY AND INDICATORS OF ENERGY SYSTEMS

Naim Hamdia Afgan and Maria Graca Carvalho

Instituto Superior Tecnico, Lisbon, Portugal
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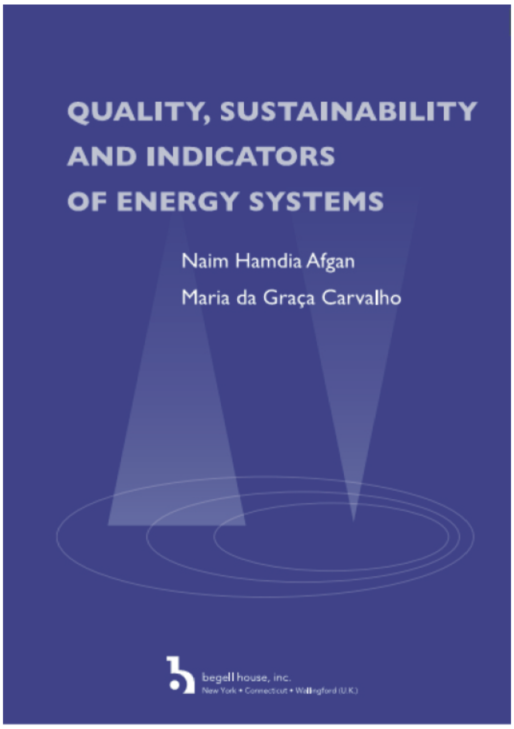
The quality of any subject is the essential characteristic of its structure, functionality, and utilization. Quality is defined as the characteristic that constitutes the basic nature of a thing or is one of its distinguishing features. In this definition, "thing" can be expressed in abroad variety of meanings. It can be a product, agglomerated products, a simple system, a complicated system, and a complex system.

The quality of products is defined by their properties, including geometrical material, financial, adaptability, lifetime, and other attributes. It is obvious that each of the properties is defined in a specific scale with respective numerical graduation. The agglomerated products are characterized by the quality of individual products but also by characteristics of a set qualifying the differences among elements. In this book special attention is focused on the quality assessment of energy.

Sustainability concept is the essential part of the book. It has moved from nature conservation to a minimization of the effects on the health of the population, an increase in social welfare, and recently to the quest for higher resource efficiency. In moving to the issue of resource productivity, there is a discontinuity in innovation that has been overlooked by most policy makers. But real innovation is chaotic. In addition, the real challenge still lies ahead, to move from a sustainable economy to a sustainable society. Technological and societal evolution has led to high anonymous systems vulnerability. The manufacturing industry is responsible for the quality of its products, not their usefulness or disposal. Sustainable production implies a cradle-to-cradle approach used by legislators and economic actors, instead of a disposal optimization for wastes. The precautionary principle will increasingly play a role in this context.



Systems analysis is both a philosophical approach and a collection of techniques, including simulations developed explicitly to address problems dealing with complex systems. Systems analysis emphasizes a holistic approach to problem solving and using mathematical models to identify and solve important characteristics of those systems. A mathematical model is a set of equations that describes the interrelations among objects. By solving the equations, it is possible to mimic or simulate a system's dynamic behavior.

The function of an energy system to convert the energy resources in the final energy form, the interaction of the system is defined by its thermodynamic efficiency. Adding some complexity to the system, one can follow the interaction of the system and its environment. A good example is pollution, which is defined as the emission of energy and material species resulting from a conversion process. With further increases in the complexity of energy systems, and establishing respective links through the boundary, there are other entity fluxes between the system and its surroundings. Because every energy system has a social function in our lives, it is possible also to establish a link between the system and its surroundings and of a social interaction between the system environments. The book is especially devoted to the evaluation of the different energy conversion systems.

Obviously, adding additional complexities to the system leads to the interaction of exchange of different fluxes. In this respect, the Onsager relation gives good examples of possible relationships among the fluxes of interaction between the system and its environment. In information theory, there are attempts to define non-linear relationships between fluxes and their relationship to the change in the system's structure.

In evaluation presented in the book, authors assumed that an energy system is a complex one that may interact with its surroundings by using resources, exchanging conversion system products, using economic benefits from the conversion process, and absorbing social consequences of the conversion process. Each interaction flux is the result of very complex interactions of the elements of the energy system within the total system and also with the system's surroundings. In presented analysis, authorse used synthesized parameters of the system in a form defined in classical analysis of an energy system. For the conversion process effect, CO_2 exhaust gas was used. The cost of electric energy will be used to measure the economic benefits of an energy system. NO_x release of the energy system will be used as the system's social indicator environment.

Multicriteria evaluation of energy systems is an exercise showing the potential possibility of analyzing complex systems. In the general terms, the complexity of energy systems can be defined as the multidimensional space of different indicators. Every energy system under consideration is an entity by itself, defined by the respective number of parameters that are deterministically related according the physical laws describing individual processes in the system. The differences expressed by the selected indicators reflect the complexities of individual structures of options under consideration. Sustainability indicators take into accounts the economic, environmental, resources, and social aspect of sustainability. They are supposed to help decision makers in the decision-making processes identify problematic areas that should be given priority. The application of the multicriteria processing to the different energy system is substantial part of the book. Special attention was devoted to the hydrocarbon fired power systems and their comparison with renewable energy system. Also, the attention was devoted to the combined water desalination and power system with intention to evaluate priority of the different option under development.

This book gives the special emphasizing to the evaluations needed for the decision makers in order to visualize the potential of the energy systems.

The book is devoted to the postgraduate students and to the specialists in the energy field. Special emphasize is devoted to specialists of the sustainability analysis and those interested for the further development of the multicriteria evaluation method.

Because an indicator represents an aggregated parameter derived from the internal parameters of the system, the general sustainability index as defined in this analysis is a measure of the system's complexity. Indicators are deterministically related to the technical and economic parameters of the system, so their aggregation only means a convolution of indicators multiplied by respective weighting coefficients. Quality measurement demonstrated in this evaluation has proved that the decision-making process strongly depends on the priority given to the specific indicators used in this analysis.

The book was edited in chapters devoted to the specific area:

Chapter 1. Introduction; Chapter 2. Sustainability; Chapter 3. Multicriteria Decision Making Methods; Chapter 4. Sustainability Assessments; Chapter 5. Sustainability Modeling of Energy Systems; Chapter 6. Potential Technology Development; Sustainable Energy Development; Chapter 7. Clean Air Technologies; Sustainability Assessment; Chapter 8. New and Renewable Energy Power Plants; Chapter 9. Water Desalination Systems; Chapter 10. Sustainability Assessment of an Aluminum Heat Sink Design; Chapter 11. Water Services Efficiency; Chapter 12. Hydrogen Energy Systems; Chapter 13. Biomass Energy Systems; Chapter 14. Solar Energy Systems.

Dr. Marina Jovanović
Vinča Institute of Nuclear Sciences
Belgrade, Serbia