PREFACE

Energy Systems Research Journal: What is it and why?

Nikolai Voropai

Nikolai Voropai is president of the Melentiev Energy Systems Institute SB RAS and Editor-in-chief of Energy Systems Research Journal

Dear Colleague,

This is the first Issue of new Journal – Energy Systems Research. It is an international peer-reviewed Journal addressing all the aspects of energy systems (electric, gas, oil, heat, and others), including their sustainable development, reliable and effective operation, smart control and management, integration and interaction in a complex physical, technical, economic and social environment. Generally, energy systems research methodology is based on a system approach considering complex energy objects (power, heat, gas, oil, etc., integrated energy objects) as systems with complicated, usually inhomogeneous, structure and external ties. It is important that a new system acquires the properties, which are not found in its components. The methods and technologies of system analysis should be used as the techniques for solving system problems in energy. Such system methodology is necessary to address complex energy issues and challenges.

These basic principles of the methodology for system energy research are intuitively obvious for the experts thoroughly investigating the sophisticated modern energy systems which are the most complex artificial objects man has ever created. Meanwhile, even the Ancient Greek Philosophers had the initial understanding of the system structure of the environment. According to the figurative definition by B.S.Fleishman [1], this was a naïve systemology. In the Middle Ages, in the epoch of physicalism being the philosophy of cognition, the system views of the Ancient Greeks were completely forgotten. An objective reason for the renaissance of the systemology, intensified use and expansion of the system views in various domains of knowledge was complication of technical objects generated by the technical revolution of the 20th century, their stronger interaction and mutual influence, as well as their impact on the environment and human health, and an increasing role of man as a link of control of these complex objects.

A.A.Bogdanov [2] and L. von Bertalanffy [3] made a considerable contribution to the revival and development of the methodology for systems studies. The research by R.L.Ackoff [4], W.R.Ashby [5], J.Klir [6], M.Mesarovic [7], I.V.Blauberg and E.G.Yudin [8], V.V.Druzhinin and D.S.Kontorov [9], N.N.Moiseyev [10], B.S.Fleishman [1], to name but a few, shaped modern ideas about the methodology of systems studies, and developed the methods and technologies for system analysis. Peak of the research into the development of the systems phylosophy and methods for systems analysis in a general theoretical context and for specific system problems in different areas was observed in the 1960s-1980s. At the same period, the International Institute for Applied Systems Analysis was founded in Wien, Austria. The goal of the Institute was to conduct systems studies on urgent global problems by international groups. In the 1990s-2000s, the intensity of elaboration of general theoretical fundamentals for the systems methodology somewhat decreased, however its successful application, adaptation and extension to specific areas of research continued. The latter is objectively conditioned, because at a general theoretical level the methods and approaches are normally very abstract and have to inevitably be

specified in terms of concrete applications, which by no means diminishes the methodological and theoretical significance of such a specification.

An important area of application and expansion of the systems philosophy is energy represented by an aggregate of interrelated energy systems that constitute energy sector, and integrated energy systems. In the USSR, this trend was associated with the name of G.M.Krzhizhanovsky who headed the State Commission for Electrification of Russia (GOELRO) in the 1920s. In actuality, the electrification plan developed by this Commission was a program for the national economic development based on the electric power industry [11]. To develop the GOELRO plan, G.M.Krzhizhanovsky applied the so called comprehensive method rooted in the systems philosophy. In the 1930s, researchers in the USA devised a method for integrated energy resources planning that was also based on the methodology of systems approach, and further intensively applied in the energy system expansion planning [12 et al].

In the 1970s, L.A.Melentiev generalized and developed the comprehensive method of G.M.Krzhizhanovsky in the form of a methodology for systems studies in energy [13]. There were several objective reasons that encouraged the development of this methodology. Firstly, in the 1950s-1970s the USSR saw intensive energy development: the unique unified electric power, gas and oil systems of the country were established, and the nuclear energy and coal industries were created. There was a need for a methodology for planning the expansion and control of these complex energy objects. Secondly, this period was characterized by the emergence of rather powerful computers that were used to devise effective mathematical models for modeling, optimization and planning of the expansion and control of complex systems, including energy systems. Thirdly, creating the methodology of systems research in energy, L.A.Melentiev actively used general methodological trends in the systems philosophy and systems analysis for the research into the complex systems and problems.

It is worth noting that the comprehensive method by G.M.Krzhizhanovsky, the methodology of systems studies in energy by L.A.Melentiev and the method of integrated energy resources planning largely originated from the plan-based approach to the expansion and control of the operation of energy systems and energy sector as a whole. In the last decades of the last century, due to restructuring and reforming of energy industries on a market basis, many countries faced the need to revise and develop the systems philosophy by rationally combining market mechanisms and state regulation in the energy sector. A so-called holistic approach was proposed as an updated method for the integrated energy resource planning [14, 15, et al]. It was also necessary to specify and develop the methodology of systems studies in energy, which was related to the need to consider the increased uncertainty of external conditions; a great number of stakeholders involved in the process of expansion planning and control of energy systems, and their different, often contradictory, interests; considerably increased requirements of consumers to reliability and efficiency of energy supply, and quality of energy resources delivered to them [16, et al.].

In today's interpretation, the methodology of systems studies in energy includes the following fundamental principles:

- Study on the nature of the investigated energy systems, including an analysis of factors shaping the main objective trends in the evolution of these systems and extent to which they manifest themselves; and research into the main energy systems properties that are transformed as these systems develop. This principle is of paramount importance since the success of future investigations depends totally on the insight into the essence of the studied object, i.e. an individual energy system or their aggregate within energy sector, or integrated energy

system, as well as external conditions for the expansion and operation of the object in question.

- Creation and updating of models and methods for the research into the energy systems and planning of their rational expansion and effective operation. The models of energy systems should be updated and improved regularly to adequately consider changing properties and trends in the development of these systems, and to take into account the external conditions for their development and operation, the impact of market mechanisms and state regulation, etc. The methods for the study of energy systems and planning of their expansion and operation should consider not only the specificity of the models but also the expansion planning conditions, i.e. a great number of criteria and constraints, a contradictory nature of interests of different stakeholders involved in the expansion and operation of energy systems, etc.
- Solving of crucial expansion and operation problems that face individual and integrated energy systems, and energy sector, including: the development of state concepts, strategies and programs for energy development and investment programs for the development of energy companies; the study of national and regional energy security, reliability, survivability and controllability of individual and integrated energy systems; the determination of control actions to ensure the required levels of reliability, survivability and controllability; the study on the problems of development and operation of interstate energy interconnections and energy markets; and many other important tasks.

Our Journal – Energy Systems Research - will provide readers with access to the results of the systems research into energy. I invite you to collaborate with our Journal.

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