

The System-Dynamic Model of Sustainable Development Based on the Energy Flow Analysis Approach

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Abstract : Global challenges require a transition from the existing linear economic model to a model that will consider nature as a life support system for the development of the way to social well-being in the frame of the ecological economics paradigm. The objective of the article is to present the results of the analysis of socio-economic systems in the context of sustainable development using the systems power (energy flows) changes analyzing method and structural Kaldor's model of GDP. In accordance with the principles of life's development and the ecological concept was formalized the tasks of sustainable development of the open, non-equilibrium, stable socio-economic systems were formalized using the energy flows analysis method. The methodology of monitoring sustainable development and level of life were considered during the research of interactions in the system 'human - society - nature' and using the theory of a unified system of space-time measurements. Based on the results of the analysis, the time series consumption energy and economic structural model were formulated for the level, degree and tendencies of sustainable development of the system and formalized the conditions of growth, degrowth and stationarity. In order to design the future state of socio-economic systems, a concept was formulated, and the first models of energy flows in systems were created using the tools of system dynamics. During the research, the authors calculated and used a system of universal indicators of sustainable development in the invariant coordinate system in energy units. In order to design the future state of socio-economic systems, a concept was formulated, and the first models of energy flows in systems were created using the tools of system dynamics. In the context of the proposed approach and methods, universal sustainable development indicators were calculated as models of development for the USA and China. The calculations used data from the World Bank database for the period from 1960 to 2019. Main results: 1) In accordance with the proposed approach, the heterogeneous energy resources of countries were reduced to universal power units, summarized and expressed as a unified number. 2) The values of universal indicators of the life's level were obtained and compared with generally accepted similar indicators. 3) The system of indicators in accordance with the requirements of sustainable development can be considered as a basis for monitoring development trends. This work can make a significant contribution to overcoming the difficulties of forming socio-economic policy, which is largely due to the lack of information that allows one to have an idea of the course and trends of socio-economic processes. The existing methods for the monitoring of the change do not fully meet this requirement since indicators have different units of measurement from different areas and, as a rule, are the reaction of socio-economic systems to actions already taken and, moreover, with a time shift. Currently, the inconsistency or inconsistency of measures of heterogeneous social, economic, environmental, and other systems is the reason that social systems are managed in isolation from the general laws of living systems, which can ultimately lead to a systemic crisis.

Keywords : sustainability, system dynamic, power, energy flows, development

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