ADVANCED ECONOPHYSICAL ANALYSIS FOR OPTIMIZATION OF TRANSITION TO SUSTAINABLE ENERGY DEVELOPMENT - ELABORATION OF THE MAIN COMPONENTS

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Energy governs the world - our development is governed by energy transformations. That is why it is vital to have the adequate Strategy of Sustainable Energy Development and the roadmap for its implementation. The subject of the paper is the elaboration of the scientifically based (mainly on Thermodynamics) Strategy of Sustainable Energy Development and subsequent theoretical and experimental optimization of energy mix main components.

As it comes from the thermodynamic analysis, the main parameter for optimization should be the increment (gain) of free energy ΔG (Gibbs's energy). We sustain that this gain of free energy ΔG is a universal integral parameter which finally characterizes the result of any activity, inclusively can serve as a numerical criterion of sustainability. From this position it is elaborated the Strategy of Sustainable Energy Development (3D-Strategy), based on the principles of Decentralization, Diversification and Decarbonization. Directly or indirectly these principles also come from the thermodynamic analysis. From the 3D-Strategy the algorithm of optimal configuration is derived for the main components of the energy mix. Additionally taking into account the local (regional) objective "boundary conditions", it is possible to ensure the optimal configuration of the mix and also to optimize each component [1].

Optimization of the mix components is a complex multifactor problem, and it assumes, in necessary cases, elaboration of cutting-edge technologies. In the limits of the presentation our engagement is - to define the main vectors and to elaborate (for the key, in our opinion, technologies) the bases only - conceptual designs.

We optimize "energy transfer, or transportation problem" - in accordance with the criterion of maximum free energy gain ΔG (introducing calculable transportation parameter - critical radius of efficiency R_{cr}). The thermodynamic base of this analysis ensures absolute objectivity (for example, independence from the current fuel prices etc.). The respective theory is universal (applicable for any transportation product - beginning with foods and potable water and up to the "light helium" - 2He3 - from the Moon). In our field of vision falls - as a particular case of fossil fuels transportation - the "South Stream" project, as an example. We demonstrate scientifically that this project is inefficient from all points of view. The correct solution (with maximal gain of free energy ΔG) for this case would be, in our opinion, the arrangement - instead of a sub-aquatic pipe - of the coastal LNG terminal (gas transport hub), which would effectively contribute to the gas market development.

Sustainability means promotion of renewables - as non-carbon technologies. But non-constancy of renewables actualizes extremely the problem of energy accumulation. Optimization of the solutions for the "accumulation" problem is also one of the main goals.

It is presented a general review of the main components for the optimal energy mix (complex, exhaustive theoretical and, in necessary cases, experimental motivations and confirmations exceed the possibilities of the present paper). We argue that especially long-term sustainability of the Nuclear Power can contribute decisively - together with the optimal mix of progressing renewables - for solving the most important challenges which humanity is facing – energy supply, food supply and climate change. Nuclear power generation has a huge potential for perfection, and most of it - is related to complex, secure and efficient radionuclides' utilization [2, 3].

Special attention is paid to the place of direct transformation methods - PV and thermoelectricity - in the optimal energy mix.

References

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