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The contribution of clean energetics based on energy technology (EnergyTech) to the reduction of production waste and the fight against climate change: Legal regulation issues

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Introduction

Energy technology is high technology in the fuel and energy complex, which are to ensure its sustainable development. Similar to high-tech segments of other sectors of the economy, for example, high-tech finance (FinTech), high-tech education (EdTech), and high-tech medicine (MedTech), it is expedient to use the term “EnergyTech” for high-tech energy.

Clean energy powered by EnergyTech is the way to achieving SDG7. The essence, features, and accumulated experience of passing this way in the global economy are studied in sufficient detail from the standpoint of business and economy, society, and environmental protection. At the same time, clean energy based on EnergyTech remains poorly studied from the standpoint of legal regulation, although it plays an important role in its development since it forms the necessary institutional framework for this. The existing literature (Wei et al., 2019; Qu et al., 2021; Solgi et al., 2022) dwells on the technologies of clean energetics based on EnergyTech. These technologies are widely known and accessible, but the level of high technology does not explain the essence and regularities of the transition to clean energetics based on EnergyTech.

The problem is that high technologies in energetics could be used for various purposes. For example, in countries where the export of fossil fuels largely determines the international production specialization (e.g., countries of OPEC and OPEC+), high technologies could be used to optimize the production and distribution processes for oil and gas energy (Schwalm et al., 2013; Chen et al., 2021; Quan et al., 2022). Unlike them, countries that import energy resources demonstrate a striving toward successful results in the use of high technologies for the development of clean energetics (Yin et al., 2021; Liu et al., 2022).

Therefore, the high-tech character of the economy does not predetermine a quick rate of its transition to clean energetics and does not guarantee its contribution to the reduction of production waste and the fight against climate change. This means that the use of high technologies in the energy economy is a mandatory, but not sufficient, condition for assigning it to EnergyTech. There is a need for more complex criteria, which would allow for a more precise outlining of the sphere of EnergyTech and the determination of a path to it.

EnergyTech is a progressive concept that is based on the philosophy of sustainable development and envisages the systemic character of the advantages of high technologies in energetics for the economy, society, and environment (Jia et al., 2022a; Nasser et al., 2022a; Jamali and Yari, 2022; Khan et al., 2022; Li and Haneklaus, 2022; Ramli et al., 2022).

The existing views on the use of high technologies in energetics (Dinh et al., 2021; Yang et al., 2021) elaborate mainly on the socio-economic advantages, while environmental advantages remain poorly studied and uncertain—this is a research gap. The existing view of the development of energetics from the position of technologies does not describe the causal connections of the transition to clean energetics based on EnergyTech or the advantages for the environmental economy in the form of a decrease in production waste and the fight against climate change. Therefore, it should be replaced by a new—institutional—view, which describes systemic and in-depth causal connections.

This paper strengthens the scientific framework of the hypothesis based on the research materials of Bolgova (2017), Chen et al. (2022), Huang et al. (2022), Inshakova et al. (2020), and Li et al. (2022). The hypothesis is as follows: institutes play an important role in the process of the transition to clean energetics based on EnergyTech and greatly determine its contribution to the reduction of production waste and the fight against climate change. The purpose of this paper is to determine the institutes of transition to clean energetics based on EnergyTech. This paper is aimed at strengthening the scientific and methodological basis for the reduction of production waste and the fight against climate change from the position of legal regulation. For, we support the hypothesis on the institutional nature of the transition to clean energetics based on EnergyTech.

Literature review

The fundamental base of this paper is the theory of clean energetics. The issues of transition to clean energetics based on EnergyTech have been studied in detail in the existing literature. Haoyang et al. (2022) substantiate the predicament of clean energy technology promotion in China in the carbon neutrality context, describing lessons from China's environmental regulation policies from the position of the evolutionary game theory.

Islam et al. (2022) prove the close interconnection between the demand for minerals and clean energy transitions. Naeem et al. (2022) substantiate the differences in the asymmetric efficiency of dirty and clean energy markets pre and during COVID-19. Doblinger et al. (2022) describe the substantial effect of global manufacturing shifts on long-term clean energy innovation (by the example of a study of wind energy suppliers).

Sun and Dong (2022) prove the connection between the decomposition of carbon emission reduction efficiency and the potential for clean energy power (based on the evidence from 58 countries). Martí-Ballester (2022) outlines renewable energy mutual funds as a prospective way toward clean energy-related sustainable development goals. Saleh (2022) sees clean energy and a green environment as global trends in technologies and nanomaterials for the removal of sulfur organic compounds. Nasser et al. (2022b) prove that techno-economic factors are of critical importance for clean hydrogen production and storage using a hybrid renewable energy system of PV/wind under different climatic conditions.

However, the causal connections of the transition to clean energetics remain unclear because the existing literature is limited by the technical issues of clean energetics. In practice, sustainable development of the energy economy based on clean energetics is a complex system, which includes the fuel and energy complex (SDG 7) and EnergyTech (SDG 9), aimed at the fight against climate change (SDG 13) and protection of ecosystems (SDG 14 and SDG 15) (Khoruzhy et al., 2022; Mustafin et al., 2022; Wang et al., 2022; Zhi et al., 2022).

This system is socio-economic and is, thus, based on social institutes—norms of law (SDG 16), sustainable territories (SDG 11), and responsible consumption and production (SDG 12) (Jia et al., 2022b; Fu et al., 2022; Wu et al., 2022). Inadequate elaboration and ambiguity of the specified social nature of clean energetics is a literature gap.

To fill in the revealed gap, this paper strengthens the scientific framework of the hypothesis on the existence of interconnection between social institutes and clean energetics based on EnergyTech. This hypothesis is supported from the position of legal regulation. Thus, this paper helps understand differences in the development of clean energetics based on EnergyTech in developed and developing countries, given the specifics of their institutes.

Materials and methods

This paper describes the strengths and weaknesses of the hypothesis on the existence of the interconnection between social institutes and clean energetics based on EnergyTech. To support the scientific evidence base of this hypothesis, this paper identifies the specific institutes that form the basis of the transition to clean energetics based on EnergyTech for the reduction of production waste and the fight against climate change.

This paper presents the authors' view of the interpretation of recent results in the sphere of study of EnergyTech and demonstrates the strengths of this scientific hypothesis. The hypothesis is supported from the position of legal regulation, through the prism of which the interconnection between the institutes of EnergyTech and the transition to clean energetics is described. Determination of the institutes of transition to clean energetics based on EnergyTech is performed with the help of the methods of classification and systematization.

Results: Determining the institutes of transition to clean energetics based on EnergyTech

From the position of high technologies, the contribution of clean energetics to the reduction of production waste and the fight against climate change is studied and elaborated in the studies by D'Agata et al. (2020), Li et al. (2022), Rahman and Islam (2020), Salman and Ahmed (2020), and Wu et al. (2021). The essence of the scientific hypothesis is as follows: the connection between 1) the development of high technologies and the transition to clean energetics based on EnergyTech, and 2) this transition and its contribution to the reduction of production waste and the fight against climate change is explained and determined by the institutes. As a result of systematization and interpretation of recent results in the sphere of EnergyTech, we determined the following institutes of transition to clean energetics based on EnergyTech:

– Institute of modernization of infrastructure to accelerate the transition to clean energetics based on the expansion of access to electricity and information and communication technologies (EnergyTech). Energy transit requires the implementation of large infrastructural projects in the energy sphere and high-tech sphere, i.e., in EnergyTech;
– Institute of "healthy" competition in EnergyTech. Amid the Fourth Industrial Revolution, it is necessary to reconsider the principles of competition and anti-monopoly law;
– Institute of public–private partnership in EnergyTech as a market of tomorrow. The creation of a market of tomorrow in most cases—especially during the implementation of large infrastructural projects, in particular, in the energy sphere—requires cooperation between the public and private sectors.

Discussion

The results obtained contribute to the development of the theory of clean energetics by specifying the causal connections of the transition to it based on EnergyTech and the achievement of the advantages for the environmental economy in the form of reduction of production waste (pollution) and the fight against climate change.

This paper proves that the transition to clean energetics and its contribution to the reduction of pollution and the fight against climate change is determined not only by technologies (in addition to Qu et al., 2021; Solgi et al., 2022; Wei et al., 2019), corporate social responsibility (in addition to Davoodi et al., 2021; Ghanem and Crosbie, 2021), and state ecological standards (in addition to Jang and Yi, 2022) but also by EnergyTech institutes, the influence of which is undervalued in the existing literature.

The following hypothesis has been proven: the issues of legal regulation play an important role in the transition to clean energetics based on EnergyTech and its contribution to the reduction of production waste and the fight against climate change. Unlike Bolgova (2017), Chen et al. (2022), Huang et al. (2022), Inshakova et al. (2020), and Li et al. (2022), we provided reasoning in favor of the fact that this role is different in developed and developing countries.

Conclusion

The use of the institutional approach allowed revealing the specifics of developed and developing countries, which consists in different effectiveness of the institutes of the energy economy in the aspect of the support of EnergyTech. On the whole, in both categories of countries, an important role of the institutes of transition to clean energetics to production waste reduction and the fight against climate change was established, and the interconnection of these processes from the position of legal regulation was specified.

This paper's contribution to the literature consists in demonstrating the advantage of the institutional approach to studying the transition to clean energetics and its contribution to the reduction of production waste and the fight against climate change, which lies in the possibility of a thorough study of the causal connections between these processes and their results.

The practical significance of the conclusions made is connected to the substantiation of the essential difference of the transition to clean energetics, which is manifested at the level of institutes. The strengthening of the hypothesis on the key results of institutes, which is achieved in this paper, allows improving the practice of legal regulation of EnergyTech through the development of its institutes and overcoming their limitations and ensuring systemic advantages: reduction of production waste and the fight against climate change at the same time. Due to this, the paper allows for a more detailed and effective programtargeted approach to the development of clean energetics based on EnergyTech institutes. The novelty and scientific contribution of this paper lie in its revealing the network effect of the institutes and substantiating their perspective role as a bridge between high technologies and sustainable development of energetics, which supports the complex advantages of production waste reduction and the fight against climate change.

However, the results obtained are limited by the institutes of the energy economy, while the development of EnergyTech can and probably is under the systemic influence of the whole set of institutes of the modern economic systems. New knowledge on the contribution of clean energetics based on EnergyTech to the reduction of production waste and the fight against climate change, which was obtained in this paper, raised a new question—on the presence of potential of this contribution with other institutes. This question remains open. In future studies, it is expedient to expand the list of the studied institutes and strengthen the evidential base of the offered hypothesis.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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