

**THEORETICAL FUNDAMENTALS OF INTERNATIONAL
SCIENTIFIC AND TECHNICAL COOPERATION
IN THE FIELD OF ALTERNATIVE ENERGY****Kateryna Volkova^{1*}, Olena Korohodova²**^{1,2} National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute",
Department of International Economics, Ukraine


Abstract: The energy sector is an extremely important element in the functioning of the industry and economic development of any country. The sphere of energy in modern processes is characterized by a focus on renewable energy sources (RES) and their replacement of traditional fuel and energy resources. However, reorienting the country's energy activities to a decarbonised model is not an easy task; that is why it is advisable to make such changes with the help of international scientific and technical cooperation (ISTC) with experienced players. The aim of the study is to theoretically substantiate the specifics of international scientific and technical cooperation in energy with a focus on RES. The research was carried out using the methods of analysis and synthesis, schematic, tabular, descriptive, deduction and induction methods as well as scientific abstraction. The results of the study showed that ISTC in the field of RES needs fundamental government changes and comprehensive preliminary training. With the assistance of all the participants, phased changes will demonstrate the positive dynamics of indicators that illustrate the real impact of ISTC on alternative energy.

Keywords: alternative energy, international scientific and technical cooperation, renewable energy sources

JEL classification: F20, F40, F530, O13

¹ Kateryna Volkova, 37 Peremohy Ave., Kiev, Ukraine, 03056, katyavolkova524@gmail.com

² Olena Korohodova, PhD. in Economics, Associate Professor, Department of International Economics, 37 Peremohy Ave., Kiev, Ukraine, 03056, korohodova.olena@gmail.com,

 <https://orcid.org/0000-0003-2338-365X>

* Corresponding author: Kateryna Volkova, katyavolkova524@gmail.com

Introduction

In the current conditions of rapid globalization of the world economic system and strengthening of the protectionist tendencies of individual countries, an important task for each country is to increase the level of integration of economic relations in the most promising areas of development. Each country is characterized by different areas of potential market dominance related to location, available natural resources, climatic conditions, national characteristics, historical development, technological structure, degree of development of productive resources, and so on. That is why, in the conditions of dynamism and industrialization of the world, the process of international scientific and technical cooperation, which is one of the main features of the modern economic processes of the global development of the world market, has acquired a high level of significance.

Among the various areas of cooperation between countries, energy is one of the most important areas in the long term. International actors are strongly involved in the implementation of the decarbonisation process aimed at reducing pollutant emissions in order to combat climate change and its negative effects (Indeo, 2019). Green energy production has become the main choice for current and future development (Kadhem et al., 2019; Jicheng et al., 2021), and has become the main path of economic transformation, the sustainable development of resources and the environment, in addition to the rooting of haze problems (Wang et al., 2018). Changes in the world economy and the sustainable development agenda have a significant impact on the development and shape of the global energy sector, including international scientific and technical cooperation in the field of alternative energy. The topic of international cooperation is still not properly recognized, which was the basis for the preparation of this paper.

The aim of the article is to improve the theoretical approaches and develop practical recommendations for improving the effectiveness of international scientific and technical cooperation in the energy sphere with a focus on renewable energy sources.

Methodology

The article was prepared in the form of a literature review and is theoretical in nature. The research was conducted using methods of analysis and synthesis, schematic, tabular, descriptive, deduction and induction methods as well as scientific abstraction. In accordance with the main goal of the study, the following tasks were set:

- 1) to consider the theoretical foundations of international scientific and technical cooperation,
- 2) to study the specifics of evaluating the effectiveness of international scientific and technical cooperation,
- 3) to give the features of international scientific and technical cooperation in the fuel and energy sector.

The basis for the conclusions was both domestic and international literature, crucial for the presented topic.

Theoretical principles of international scientific and technical cooperation

International scientific and technical cooperation (ISTC) is currently the most common way to integrate a weaker country into the rapid economic, political, environmental, and demographic international market, in addition to other processes. In general, there is no disagreement among the authors about the relevance, importance, specificity of functioning and dependence on various factors of ISTC in modern conditions. Nevertheless, it should also be noted that there is no single generally accepted interpretation of international scientific and technical cooperation. Many authors justify this term from their own subjective point of view, and the essence remains the same. For a detailed analysis, consideration of the scientific points of view regarding this term (Table 1) is proposed.

Table 1. Selected approaches to interpreting concept of ISTC according to various sources

No	Source of interpretation	Essence of the term ISTC
1.	Shkola et al. (2007)	It is a form of international economic relations, which is a system of economic relations in the field of science, technology, production, trade and services, and exists on the basis of common intentions enshrined in international treaties.
2.	Krachok (2020)	The essence of ISTC in research literature is seen as one of the ways countries interact in international relations, jointly producing or trading high-tech products, as well as transferring new technologies.
3.	Kushnarenko & Kalinin (2020)	ISTC provides international programs of scientific and technical research, cooperation in the field of information, licensing, engineering, training of scientific and engineering personnel, holding scientific and technical seminars and conferences, establishing research institutes and laboratories, conducting interstate consultations on scientific and technical policy, etc.
4.	Cuff & Goudie (2001)	International cooperation refers to processes of policy coordination by which states and other entities (such as multinational corporations or nongovernmental organizations) adjust their behavior to the actual or anticipated preferences.
5.	Poruchnyk (2004)	Promising areas of ISTC are the deepening of cooperation with other countries in the field of education, the development of interstate academic contacts through the establishment of direct, direct links between educational institutions; functioning of financial-industrial groups, incubators, technopolises and technoparks.
6.	Aliieva (2017)	ISTC is an objective necessity, a result of the international division of labor and scientific progress, aimed at the joint solution of scientific and technical problems, mutual exchange of scientific achievements, production experience and training of qualified personnel.
7.	Myronchuk (2019)	ISTC is an important tool for building ties and strengthening relations between countries, and the use of scientific advances can be an effective means of influencing foreign policy.

No	Source of interpretation	Essence of the term ISTC
8.	Chernytska (2013)	ISTC should be focused on the development of local innovation associations (technology parks, science and technology parks, etc.).
9.	Kotsko (2016)	ISTC is one of the important areas of ensuring the competitiveness of market-oriented economic systems, which allows not only innovation processes to be accelerated in certain countries, dynamism in economic development to be ensured, but also quicker and more efficient integration into the international division of labor.
10.	Liubymova (2010)	ISTC means program-project cooperation between the organizational centers of two countries through the pooling of resources and the creation of joint professional groups for social development.
11.	Definition of authors	International scientific and technical cooperation can be described as an improved form of cooperation between two or more countries, which can be represented by the government, authorities, national and international organizations and groups, enterprises of any form of ownership, higher education institutions and others, for the latest development of a particular industry or to solve common problems of mankind.

Sources: Authors' own elaboration

Therefore, having combined all the scientific opinions presented in Table 1, international scientific and technical cooperation can be characterized as an improved form of cooperation between two or more countries, on whose behalf the government, authorities, national and international organizations and groups, enterprises of any form of ownership, institutions of higher education and others that carry out this activity, for the latest development of a particular industry or to solve common problems of mankind. The tools of this form of international partnership are valuable scientific developments, the improvement of existing methods of activity, invention of new rational ways of using resources, development of new technologies, the development of new systems and structures of work, etc.

The aim of international scientific and technical cooperation is to support countries and other actors in their way to invent and implement new solutions, strategies, technologies aimed at the functioning of a particular industry or to solve problems. The object of ISTC is a certain branch of the economy, which aims to develop a neglected sphere of activity, the state of which needs to be modernized, a global problem to be solved, resources (labor, natural, intellectual) and more. The subjects of ISTC are global associations of countries, international or local organizations, governments, government agencies, commercial and non-profit organizations, individuals and legal entities.

The bilateral or multilateral activities of ISTC entities, with the use of these tools, are intended to achieve this goal by solving a problem, promoting the development of the industry, the introduction of new technologies and more. In general, ISTC has several vectors, which are aimed at the independent activities of entities and their interaction. These areas and examples of their application can be seen in Figure 1.

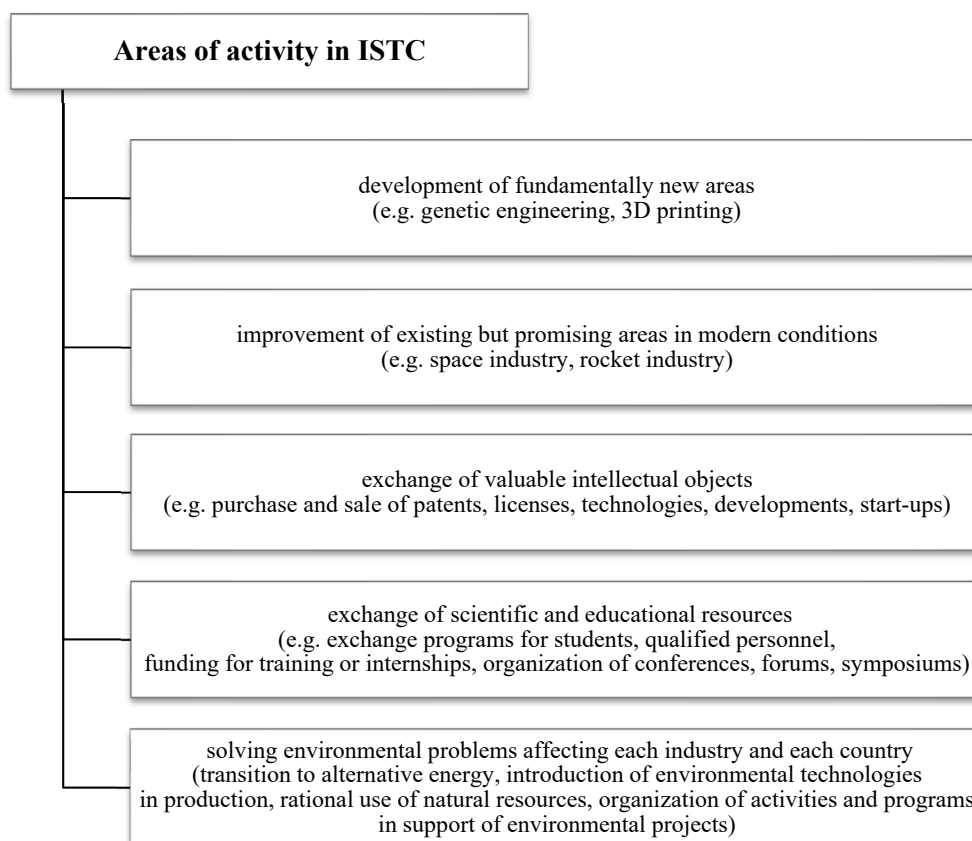


Figure 1. Classification of ISTC activities

Source: Authors' elaboration based on (Spyrydonov, 2006)

International scientific and technical cooperation is becoming increasingly more widespread in connection with the development of science and technology. It aims to integrate countries that are unable to develop independently at the current pace, in global processes, flows, and systems with the support of countries in leading positions on the world stage. In other words, powerful developed countries with financial, scientific and technological potential establish partnerships with countries that have a high level of resources, but are not able to initiate such integrations on their own. The world community has always focused on the pressing problems of humanity that are occurring around the world and affect every area of activity. It is critical that all forces are immediately directed in the form of scientific and technological cooperation between the most developed countries to prevent a catastrophe or to achieve something fundamentally new that will change the further course of mankind. In the current environment, ISTC is expanding in the field of resource conservation and environmental friendliness, as it is a problem of the depletion of natural resources and a critically high level of environmental pollution.

Evaluating the effectiveness of international scientific and technical cooperation

According to its specifics, ISTC, like any example of cooperation, aims to achieve a specific result, which is defined as the goal of such a partnership for any activity. This goal, as well as the format of cooperation, has a fairly broad profile of use and implementation, and therefore is assessed differently. Due to this, there is no single recognized method for evaluating the effectiveness of ISTC, but there are different methodologies of the approach, depending on many factors.

Evaluation of the effectiveness of international scientific and technical cooperation can be based on various criteria. In general, the mechanism of managing the effectiveness of ISTC can be interpreted as a series of economic incentives and organizational measures aimed at the convergence of different approaches to the formation of management systems, which increases the level of effectiveness of ISTC (Spyrydonov, 2006; Korogodova, 2009). The interpretation of these aspects can be shown in the form of a diagram, as presented in Figure 2.

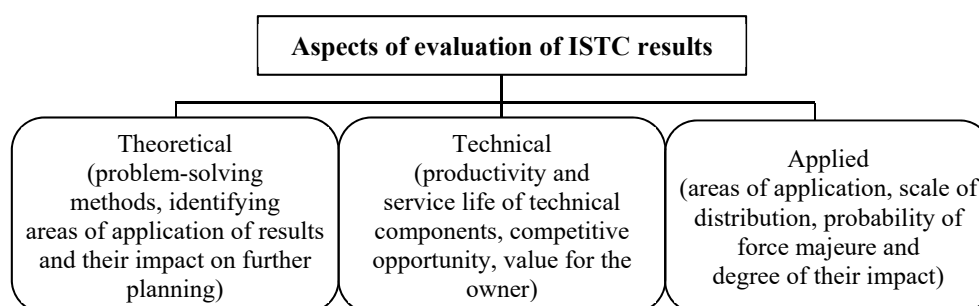


Figure 2. Characteristics of aspects of evaluating ISTC effectiveness

Source: Authors' elaboration based on (Spyrydonov, 2006; Korogodova, 2009)

Therefore, from Figure 2 it can be concluded that evaluation of the effectiveness of ISTC should be carried out, taking into account the various criteria of a particular project and in stages. Only then will it be possible to cover all the possible potential results. Nevertheless, it should be noted that for each case the individual evaluation process is important, i.e. the application of the aspects shown in Figure 2 depends on the nature and direction of ISTC.

A no less important element in assessing the effectiveness of ISTC is the consideration of independent factors, such as the human factor, which characterizes the level of literacy and skills, economic climate of ISTC member countries, political orientation of the government in a particular field of activity and more. These potential factors influencing ISTC can be combined into several groups, which can be seen in Table 2.

Thus, the information in the Table proves once again that in assessing the effectiveness of scientific and technological cooperation between countries, it is important to assess the indicators grouped into five different categories. In addition,

taking these factors into account is more important as a preventive feature to minimize the negative factors. Therefore, the future forecast, taking into account the current situation, is part of a set of methodologies for assessing effectiveness.

Table 2. Classification of factors influencing ISTC

No	Group of factors	Characteristic
1.	Economic	<ul style="list-style-type: none"> - state and trends of economic development in the world, region, state - indicators of the financial and credit system, - inflation rate, employment - the tax system - pricing policy - purchasing power of the population - ideology and the effectiveness of economic reforms
2.	Political	<ul style="list-style-type: none"> - compliance of legislative acts with the state and prospects of entrepreneurial activity in the state, the international community - stability of the formation and development of the market economic system - role of public organizations in the system of development and decision-making by legislative and executive authorities - level of corruption of authorities - degree of openness of the economy - level of democracy, etc.
3.	Social	<ul style="list-style-type: none"> - quality of life of the population - level of education quality - average salary - level of employment and unemployment - number, structure, density, reproductive characteristics of the population (birth rate, mortality) - ethnic homogeneity, religion, culture, moral values, traditions, rituals - behavioral characteristics of consumers
4.	Scientific and technical	<ul style="list-style-type: none"> - R&D costs - level of awareness of citizens - level of implementation of the latest developments and technologies - availability of ICT - state and development of scientific and technological progress in the world community, in the state, in industries, in regions - human resources potential of science - competitiveness of scientific and technical products
5.	International factors	<ul style="list-style-type: none"> - production and scientific and technical cooperation - organization of joint ventures, export and import of products - sale of licenses and know-how - provision of engineering consulting services - development of joint projects - purchase of modern equipment, information, communication and management tools, resource, energy and environmentally friendly technologies - creation of joint venture zones - financial support for the creation of high-tech processes

Sources: Authors' elaboration based on (Gerasymchuk et al., 2007; Skorobogatova & Novikova, 2019)

Features of ISTC in fuel and energy industry in terms of Industry 4.0

The fourth industrial revolution, otherwise known as “Industry 4.0”, has in recent years become widespread, relevant and influential in the most important areas. It has had a significant impact not only on production, but also on scientific and technological activities. Thus, the main characteristics of Industry 4.0 can be considered to be the digitalization and automation of the contemporary world (creation of artificial intelligence, cloud technologies, large data sets, virtual reality, process robotics, etc.). In other words, it is the so-called center, which involves the transformation of industrial (and not only) activities. Nonetheless, experts note that Industry 4.0 has already experienced its most successful times, and now the world community has turned the vector of orientation to a new era – the so-called “Society 5.0”. Its main advantage over its predecessor is that it focuses not only on the digitalization of production, process automation and increased business activities, but also on the ability to balance rapid economic progress with acute social problems (Aquilani et al., 2020) and the UN Sustainable Development Goals.

Against this background, the level of relevance and the degree of discussion on the topic of renewable energy in recent times is growing. The need to move to “green” energy activities has grown to such an extent that communities have begun to actively develop international cooperation in this area, and “green” organizations to implement a number of different types of support to countries in need. In addition to “green” actors in the field of energy cooperation, strategically important world alliances and associations play an important role. Among these is the European Union (EU).

The EU is one of the main players in the market for green energy and environmental protection in general. The EU long ago established a number of the highest international environmental standards that EU citizens adhere to and require from potential EU member states. The organization and governments of the member countries have set clear goals for controlling European environmental policy and the further vision of its development until 2050 with the support of special research programs, legislation and funding (European Union priorities 2019-2024, 2019). In general, the EU's policy on alternative energy is considered a priority in the direction of sound action regarding destructive transformations of the environment, rules for the use of natural resources (especially combustible) and introduction of the production and consumption of renewable energy.

A European green course has been introduced to meet the conditions of the green energy strategy through the development of investment cooperation and the use of appropriate financial instruments. Thus, the climate law agreed by the members of parliament and EU member states in April 2021 envisages, first of all, a 55% reduction in EU emissions by 2030, compared to 1990, which is perceived as the baseline. In addition, comprehensive support is provided for countries in need, establishing permanent international scientific and technical cooperation with them. Such support includes investments in abandoned energy entities or the construction of new ones, the joint development of special environmental routes, assistance in the introduction of new “green” technologies, establishment and implementation of environmental standards, support for integration into international “green” structures and networking with

new international partners. These points in the aggregate sense are the implementation of components of the law on climate, provided by the EU's green course on decarbonisation of the energy sector of the economy (Kravchenko, 2021).

Thus, the President of the European Commission Ursula von der Leyen announced structural changes in the EU legal framework in the first place, as well as some changes to the Energy Tax Directive and the Renewable Energy Directive, carbon footprint regulation and greenhouse gas emission reduction limits. The legislative changes mentioned above concern the acts of the European Commission on the promotion of investment processes in the energy sector, which will be able to ensure fair competition in the same sector. An example of such changes is the billion-euro global project to develop Europe as the first climate-neutral continent (EU green energy program, 2021).

An example of ISTC between the EU and a specific country in the energy sector is the UK-EU Trade and Cooperation Agreement, which focuses on renewable energy and green technologies. This form of cooperation involves monitoring by specialized, empowered committees to implement the terms of the Agreement and the correctness of all actions, and if necessary, mutual agreement to amend the form of such cooperation, to promote a more positive impact on the UK energy sector and achieve the ultimate goal (Brown & Massie, 2021).

As noted, the impact of ISTC on the implementation of projects in the field of alternative energy is important due to the spread and influence of the principles of a new era – Society 5.0. “Green” energy cooperation does not have fundamental features, but it is characterized by the representation of a specialized organization, union or association, which initiates, controls and supports the transition to carbon-free activities.

Conclusions

International scientific and technical cooperation is becoming ever more widespread in connection with the development of science and technology. It aims to integrate countries that are unable to develop independently at the current pace, in global processes, flows, and systems with the support of countries with leading positions on the world stage. In other words, powerful developed countries with financial, scientific and technological potential establish partnerships with countries that have a high level of resources, but are not able to initiate such integrations on their own. It is proposed to evaluate the effectiveness of ISTC as follows: to conduct a preliminary analysis of the country or area to which ISTC will be directed according to the criteria listed in Table 2; to examine indicators that mainly reflect the situation in the field of cooperation in order to monitor their dynamics in the future; to conduct comprehensive preparation for the planned changes with the involvement of all direct and indirect participants; to make gradual changes as agreed and monitor changes in the same indicators that characterize the partnership.

The world community always focuses on its attention on the pressing problems of humanity that are happening around the world and affect every area of activity. It is critical that all forces are immediately directed in the form of scientific and technological cooperation between the most developed countries to prevent a catastrophe or to achieve something fundamentally new that will change the further

course of mankind. In the current environment, ISTC is expanding in the field of resource conservation and environmental friendliness as the problem of the depletion of natural resources and critically high levels of environmental pollution is now one of the most serious for any country in the world. To solve this problem and stabilize the environmental situation, countries and organizations are constantly developing integrated approaches and fundamental projects, which are elements of ISTC.

The main limitation in this paper is its theoretical character – a lack of empirical research. However, it is a challenge for the authors to extend the research in future to the practical aspect, and to perform appropriate analyses based on primary data.

References

- Aliieva, P. I. (2017). *Management Mechanisms for the Development of International Scientific Cooperation in Ukraine*. <http://29yjmo6.257.cz/bitstream/123456789/5643/1/alieva1.pdf>
- Aquilani, B., Piccarozzi, M., Abbate, T., & Codini, A. (2020). The Role of Open Innovation and Value Co-creation in the Challenging Transition from Industry 4.0 to Society 5.0. *Sustainability*, 12(21), 8943. DOI: 10.3390/su12218943
- Brown, M., Massie, K. (2021). *UK/ EU Trade and Cooperation Agreement*. Energy Chapter. <https://10hundred.mayerbrown.com/uk-eu-tradeand-cooperation-agreement-energy-chapter/>
- Chernytska, T. A. (2013). Regional Dimensions of International Scientific and Technical Cooperation. *Mizhnarodna ekonomichna polityka*, 1(18), 105-127.
- Cuff, D., & Goudie, A. S. (2001). International Cooperation. *Encyclopedia of Global Change*. Oxford University Press. DOI: 10.1093/acref/9780195108255.001.0001
- European Green Deal. *EU Green Energy Program* (2021). https://ec.europa.eu/info/strategy/priorities-2019-2024/european-greendeal_en
- European Union. *EU Priorities 2019-2024*. <https://european-union.europa.eu/>
- Herasyimchuk, V., Rozenplenter, A., & Kryvda, V. (2007). *Economics and Organization of Production*. Pidruchnyk "Znannia".
- Indeo, F. (2019). ASEAN-EU Energy Cooperation: Sharing Best Practices to Implement Renewable Energy. *Global Energy Interconnection*, 2(5), 393-401. DOI: 10.16/j.gloei.2019.11.014
- Jicheng, L., Jinga, Y., Yua, Y., & Qiushuang, W. (2021). An Evolutionary Game Approach for Private Sectors' Behavioral Strategies in China's Green Energy Public-Private Partnership Projects. *Energy Reports*, 7, 696-715. DOI: 10.1016/j.egy.2021.09.201
- Kadhem, A. A., Wahab, N. I. A., & Abdalla, A. N. (2019). Wind Energy Generation Assessment at Specific Sites in a Peninsula in Malaysia Based on Reliability Indices. *Processes*, 7(7), 399. DOI: 10.3390/pr7070399
- Korogodova, O. O. (2009). *The Mechanism of Efficiency Management of the Enterprises of the Recreational Complex*. Avtoref. dys. kand. ekon. nauk, 20 p.
- Kotsko, T. A. (2016). *Policy of Development of International Scientific and Technical Cooperation and Problems of Ensuring Economic Security of the State*. Mizhnarodne naukovno-tekhniche spivrobotnytstvo: pryntsy, mekhanizmy, efektyvnist: zbirka prats XII (XXIV), p. 24.
- Krachok, L. I. (2020). International Scientific and Technical Cooperation in the Agricultural Sphere: Essence, State and Features. *Vseukrainskyi zhurnal «Prybutkove svynarstvo»*, 6(82), 12-18. DOI: 10.32839/2304-5809/2020-6-82-3
- Kravchenko, D. S. (2021). Prahmatyzm polityky jes u sferi «zelehoji» enerhetyky. *Proceedings of the International Scientific Conference of the 'The Eu Principled Pragmatism: Consequences for Eastern and South-Eastern Europe: Political, Economic, Legal And Communication Aspects'*, 21-22 May 2021, Kyiv, p. 200-203. https://e-learning.iir.edu.ua/pluginfile.php/5069/mod_book/chapter/903/PROCEEDINGS_EU_PRINCIPLED_PRAGMATISM_2021.pdf#page=200
- Kushnarenko, N. P., & Kalinin, V. V. (2020). *International Scientific and Technical Cooperation as a Basis for Innovative Development of the World Economy*. Materialy XIII mizhnarodnoho biznes-forumu, 107-109. <https://knute.edu.ua/file/MjlxNw==/068ad75efd7a4c5bd9212b0851fd3d90.pdf>

- Liubymova, K. O. (2010). *Implementation of Mentoring Schemes for Small and Medium Enterprises in Ukraine*. *Mizhnarodne naukovo-tehniczne spivrobitnytstvo: pryntsypy, mekhanizmy, efektyvnist Materialy*, 6(18), 28.
- Myronchuk, O. A. (2019). *Transformation of International Scientific Cooperation in the Context of Globalization*. In: O. V. Zernetskoï (ed.). *Tsinnisnyi vymir rozvytku tsyvilizatsii i hlobalizatsiia: zbirnyk naukovykh prats*, (p. 179-188). Institute of World History of the National Academy of Sciences od Ukraine.
- Poruchnyk, A. M. (2004). Innovative Potential of Ukraine and Its Realization in International Scientific and Technical Cooperation. *Mizhnarodna ekonomichna polityka*, 1, 94-121.
- Shkola, I. M., Kozmenko, V. M., & Babinska, O. V. (2007). *International Economic Relations*. 2-he vyd., pererob. i dopovn., Knyhy, XXI.
- Skorobohatova, N. Ye., Novikova, A. P. (2019). Multi-Criteria Assessment of the Effectiveness of International Scientific and Technical Cooperation at the Macro and Micro Levels. *Aktualni problemy ekonomiky ta upravlinnia: zbirnyk naukovykh prats molodykh vchenykh*, 13, 12 p.
- Spyrydonov, I. A. (2006). *International Scientific and Technical Cooperation*. Navch. posibnyk Svitova ekonomika.
- Wang, B., Wang, Q., Wei, Y.-M., & Li, Z.-P. (2018). Role of Renewable Energy in China's Energy Security and Climate Change Mitigation: An Index Decomposition Analysis. *Renewable and Sustainable Energy Reviews*, 90, 187-194. DOI: 10.1016/j.rser.2018.03.012

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TEORETYCZNE PODSTAWY MIĘDZYNARODOWEJ WSPÓŁPRACY NAUKOWEJ I TECHNICZNEJ W DZIEDZINIE ENERGII ALTERNATYWNEJ

Streszczenie: Sektor energetyczny jest niezwykle ważnym elementem funkcjonowania przemysłu i rozwoju gospodarczego każdego kraju. Sferę energetyki w nowoczesnych procesach charakteryzuje koncentracja na odnawialnych źródłach energii (OZE) i zastępowanie nimi tradycyjnych zasobów paliwowo-energetycznych. Jednak przeorientowanie działań energetycznych kraju na zadania związane z dekarbonizacją nie jest zadaniem łatwym, dlatego wskazane jest dokonywanie takich zmian przy pomocy międzynarodowej współpracy naukowo-technicznej (ISTC) z doświadczonymi graczami. Celem opracowania jest teoretyczne uzasadnienie specyfiki międzynarodowej współpracy naukowo-technicznej w energetyce z ukierunkowaniem na OZE. Badania przeprowadzono z wykorzystaniem metod analizy i syntezy, metod schematycznych, tabelarycznych, opisowych, dedukcyjnych i indukcyjnych oraz abstrakcji naukowej. Wyniki badania pokazały, że ISTC w zakresie OZE wymaga fundamentalnych zmian rządowych oraz kompleksowych szkoleń wstępnych. Z pomocą wszystkich uczestników, etapowe zmiany zademonstrują pozytywną dynamikę wskaźników, które ilustrują rzeczywisty wpływ ISTC na energię alternatywną.

Słowa kluczowe: energia alternatywna, międzynarodowa współpraca naukowo-techniczna, odnawialne źródła energii

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