DOI: 10.26565/2310-9513-2019-9-11

УДК 339.94:620.92(477+83)

PROSPECTS FOR IMPROVING TECHNOLOGY IN NON-CONVENTIONAL ENERGY DEVELOPMENT

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This article discusses the prospects for the development of the implementation of scientific and technical cooperation (STC). On the example of interstate cooperation between Ukraine and Chile, there are approaches to improving the procedure for developing cooperation priorities. The current state of these relations does not reflect real trends in the development of international economic relations (IER) in the vector of strengthening the scientific and technical component.

The subject of research of the article is formation of scientific and technical cooperation priorities between Ukraine and Chile. The goal is to develop the approaches of foreground international economic relations formation in relation to the conditions in relation to the conditions of Ukraine and corresponding to the needs of overcoming crisis socio-economic phenomena based on the intensification of scientific and technical cooperation.The objective is to research the dynamics of the actual non-conventional energy production as one of the priority areas of cooperation between Ukraine and Chile. As part of this study, theoretical, methodological and system-logical methods for analyzing primary sources are used, including statistical materials, regulatory documents, scientific publications for descriptive and structural analysis to assess the initial state of international economic relations primary level and methods for forming trends in their development prospects.

The following results were obtained: on the basis of phased analysis of the priorities formation for the development of Ukraine, was proposed an approach for analyzing the similarity of the integrated development of national economies. Conclusions: the results of the analysis allowed in the framework of interstate cooperation between Ukraine and Chile to highlight the promising area of development of non-traditional renewable energy.

Keywords: economic relations, non-traditional renewable energy, innovative susceptibility, priorities of international economic relations, scientific and technical cooperation.

1. Introduction.

International economic relations influence the economic development of the world economy subjects. With the emergence and development of the world economy, international economic relations are constantly expanding and deepening the sphere of their existence, acquiring new forms, however, when implemented, they become relatively independent phenomenon, obeying their own laws and have their own specifics in realizing the potential of international economic relations. One of the forms of international economic relations, which determines their growing dynamics in modern conditions, is international STC [1]. STC basically has the intangible form of economic relations and is conditioned by the mutually beneficial exchange of scientific and technical knowledge, intellectual property, experience and scientific and technical development programs, engineering services, etc., and plays an increasing role in the intensification of scientific and industrial development of the subjects of world economic relations.

2. Literature review and problem statement.

An analysis of the research indicates significant attention to the problem of developing priorities for the development of scientific and technical cooperation in the framework of international economic relations. The topic was actively studied and developed by many prominent academics Sidorov V., Babenko V., Matyushenko I. and others. The field of non-conventional energy sources technologies in the process of effective global and domestic development studied by academics Dyuzhev V.,Voitko S., Dzhedzhula V. and Vytvytska O., Matyushenko I. and others. However, A number of issues, in particular, the problems of developing priorities for scientific and technical cooperation, taking into account the objective conditions of states and the needs and prospects for their scientific and technological development, need further theorizing

and methodological elaboration. A theoretical and methodical conceptual integrated approach to the formation of these priorities and the corresponding measures that implement it and increase the innovative susceptibility of the subjects of production and economic activity to the non-conventional energy sources technologies is necessary [2].

The priorities of interstate scientific and technical cooperation influence the economic development of the subjects of the world economy. With the emergence and development of the world economy, scientific and technical cooperation is constantly expanding and deepening the sphere of its existence, acquiring new forms. However, when implemented, they become relatively independent phenomenon obeying their own laws and have their own specifics in realizing the potential of international economic relations in general. It is one of the active forms of international economic relations, which determines their growing dynamics in modern conditions, is international scientific and technical cooperation. It has intangible form of economic relations and conditions by the mutually beneficial exchange of scientific and technical knowledge, intellectual property, experience and programs of scientific and technical development, engineering services, etc. [3, 4]. All this plays an increasing role in the intensification of scientific production development of the subjects of world economic relations.

3. The aim and objectives of the study.

Analyzing of the approaches of foreground international economic relations formation in relation to the conditions of Ukraine and corresponding to the needs of overcoming crisis socio-economic phenomena based on the intensification of STC. In order to study the dynamics of the actual non-conventional energy production as one of the priority areas of cooperation between Ukraine and Chile.

4. Substantial statement of the problem.

In our opinion, the principles of international scientific and technical cooperation need a broader justification, taking into account specific conditions. If we take as a basis the concept of specificity of a subject (country) from the point of view of historical, political, economic development, peculiarities of territorial and climatic conditions, question arises which priorities to choose in a particular scientific and technical cooperation between states. That is, the above shouldbe considered when choosing one or another direction of economic and STC? If this is relevant, then at first glance a certain contradiction arises: why the priorities in the formation of an international STC should not be limited only to the orientation towards the scientific and technical level reached in a certain sphere by the advanced country, and the above conditions and circumstances should be taken into account [5]. Based on the provisions of economic psychology, we tearfully use methods of analysis similar to the subjects. In our opinion, the rationale may be as follows:

- the experience of past similar stages of historical, political and economic development of a country that has achieved certain levels of scientific, technical and economic development is more valuable for a country that has also passed similar stages, and which is faced with the task of developing a socio-economic innovation strategy;
- it facilitates the understanding of the relevant causes, conditions and circumstances, the experience of which should be adopted by this particular country;
- it is necessary to take into account the similarity of natural and climatic conditions, since, if they are similar, they make a significant adjustment to the conditions and circumstances of the implementation of the respective strategies.

It is necessary to highlight the factors that determine priorities in the formation of an international NTC:

a) historical and political stages, including armed conflicts, characterizing the formation of a nation, state structure, socio-economic policy orientation under various regimes of political power in the field of production, corresponding forms of IER;

b) economic factors that characterize the economic level at various stages of development of a given country, including the growth rate of the gross national product, monetary policy, inflation rates, business fluctuations, employment and purchasing power of the population, etc.;

c) factors of resource potential, which include the scale of the territory, the value of minerals and other resources, demographic indicators, natural climatic zones, etc.;

d) priorities of the socio-economic and environmental policies [6].

In the context of the unstable political and economic situation in Ukraine, the experience of countries that implement a successful exit strategy from the crisis and the establishment of stable economic development are interesting. One example of such countries is Chile. Despite the territorial distance, Chile went through similar stages of historical, political, socio-economic development. Namely: the formation of the Chilean nation took place in the process of struggle for independence and territory (17-19 centuries). Chile has passed a difficult path of economic development from the raw material orientation of industry to the modern technological level, which was accompanied by political crises, Fig. 1.

Chile has significant reserves of natural resources (copper, nitrate, iron ore, nitrates, precious metals, molybdenum, hydropower, etc.), developed industry and agriculture. Most products are exported.

In the process of economic development, Chile went through stages of political instability, civil opposition, reforms, crises and upsurges.

In turn, Ukraine has gone through similar stages in its development: the formation of the Ukrainian nation in the struggle for independence, the establishment of independence in the course of civil

wars and struggle for territories, development stages from the raw materials orientation of industry to the modern technological level.

Chile's experience is characterized by the fact that industry reforms, agriculture combined with political instability, civil confrontation periodically led to severe crises and negative socio-political consequences, including those on ethnic and cultural grounds. Chile's political elite is heterogeneous and there is a split along the line of conservatism-liberalism and attitudes towards socialist transformations and dictatorship [4]. Similar problems of political instability, conflicts, reforms, split of the political elite, including non-ethnic-cultural grounds, occur in Ukraine.

However, given the similarity of the initial conditions (the territory of Chile is 756.102 km^2, Ukraine is 603,628 km^2, the population of Chile is about 20 mln. ppl., Ukraine is about 40 mln. ppl.)[8], the similarity of factors, conditions and circumstances of development Chile has GDP for 2017 of 452,1bln.dol. and GDP per capita of more than 24,000 dol. Ukraine is lagging far behind (GDP for 2017 is 95,93 bln. dol., GDP per capita is 2,262 dol.) [9].

Currently in Ukraine the political and socio-economic systems are in crisis. Since the 90s in Ukraine, despite certain periods of overcoming the crisis, there has been a decline in scientific, technical and technological development.

From the above, we can conclude that both countries have natural and industrial potential, however, if Chile shows growth rates, then in Ukraine the growth rates are declining. Based on the above, there is a different level of synergy, at first, of similar factors. Accordingly, Chile's experience should be used in studying the mechanisms of synergistic interaction of these factors in the process of institutional reform.

The existing trade turnover between Ukraine and Chile can be characterized as follows: according to the International Trade Center, in 2017, the total volume of total trade in goods between Ukraine and Chile was 42,1 million dollars.with a negative balance of 34,5mln.dol. Exports amounted to 3,8 mln. dol.; imports – 38,3mln. dol. At first glance, the indicators point to the unpromising economic relations between Ukraine and Chile [10].

However, in the conditions of a modern innovative economy, economic relations may have a priority not in commodity items, but in intellectuals and organizational communication systems of their realization. This means the exchange of experience, licenses, know-how, rapid expansion of scientific, technical and technological cooperation. It is through this that it is possible to solve the issues of raising the technological level of various industries and the national economy as a whole, the tasks of its accelerated technological re-equipment, expanding export opportunities and reducing imports, developing technical and economic ties between countries based on specialization and cooperation in the production of various types of products [10].

In our opinion, one of the potential areas is the exchange of experience, knowledge and technologies in the field of the formation and implementation of the strategy for the development of non-conventional renewable energy (NCRE). Prerequisites for this are the following circumstances:

- both in Ukraine and in Chile there are various climatic conditions that imply the development of certain types of NCRE;
- both in Ukraine and in Chile there are sufficient potentials of sources of NCRE;
- both Ukraine and Chile have a comparable research and production potential that can be used to implement the NCRE technologies;
- both Ukraine and Chile, at about the same period, since the 2000s, have embarked on the path of development of the NCRE.

However, the growth rate of NCRE in Chile is significantly higher than in Ukraine, as we presented in Table 1.

The table shows that in Chile, the growth rate of NCRE generation based on solar, wind energy and bioenergy is much higher than in Ukraine. The Figure 2 illustrates this.

In the process of analysis, the dynamics of average values and trends of total indicators of NCRE production of Chile and Ukraine show the field of growth of potential innovative susceptibility to NCRE technologies in the process of mutual scientific and technical cooperation between the subjects of international economic relations.

Justifying the prospects of interstate cooperation between Ukraine and Chile, we made an analysis of the comparative dynamics of the volume of NCRE production. Based on these sources, there are comparative figures for the period from 2000 to 2017. According to Table 3, there are graphs, which presented in Fig. 2, which really reflects the dynamics of these processes. If the starting conditions for the development of NCRE were relatively similar, then, as we consider the entire period, we should conclude that the growth rates of various types of renewable energy in Chile significantly exceed Ukrainian ones.

Analyzing the comparative dynamics of trends in NCRE production, we can conclude that the Chilean dynamics substantially exceed the Ukrainian one, which implies a corresponding analysis of the conditions and forms of state support for these processes. Fig. 2 presents the interpretation of the dynamics of NCRE development based on mathematical methods, in particular the logarithmic smoothing of graphs and their corresponding transformations into averaged trends. This made it possible to visualize graphically the field of potential innovative susceptibility (IS) of the development of the use of NCRE technologies by business entities of Ukraine.

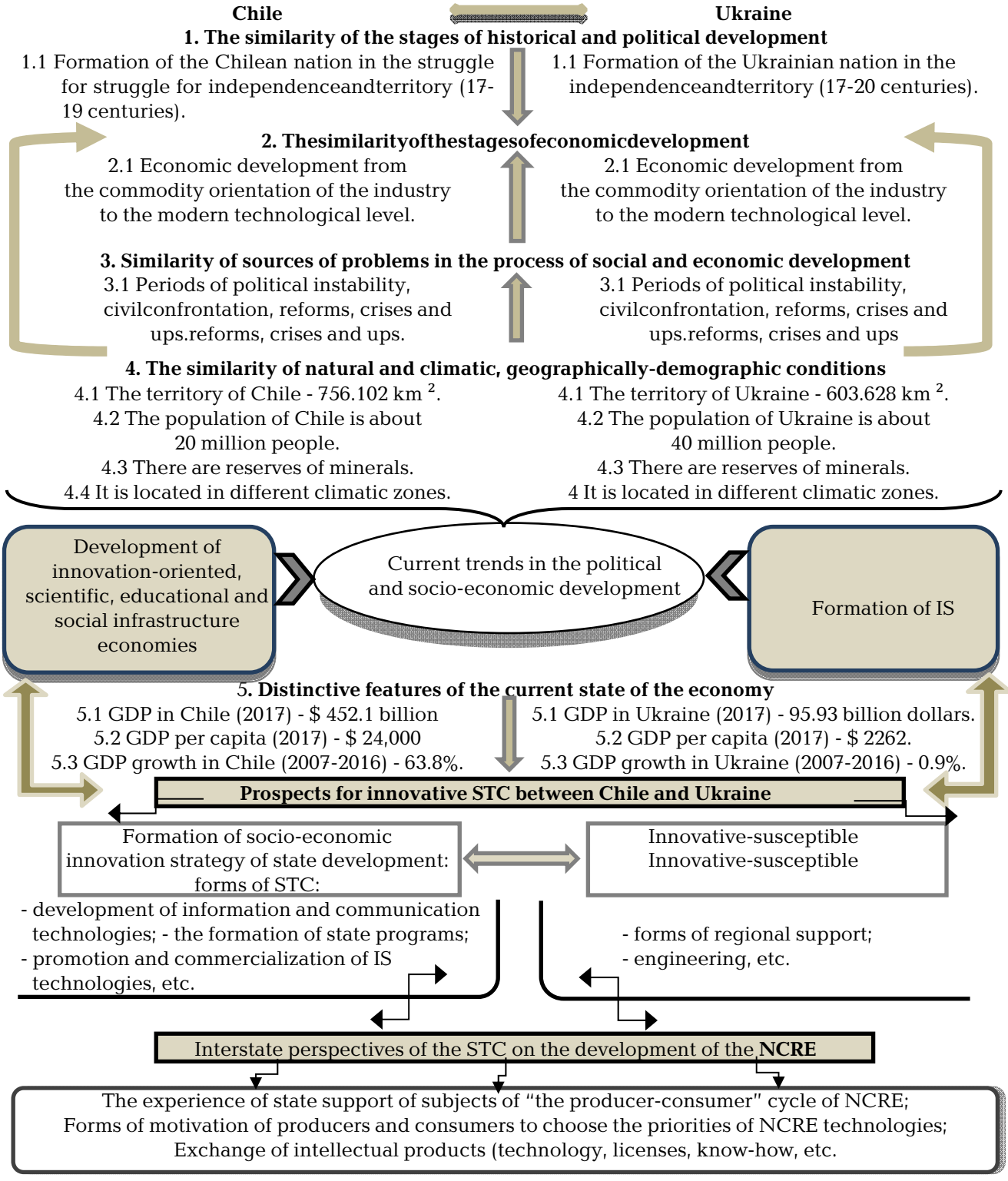

Fig.1. Scheme describing the desirability of selecting IER priorities between Chile and Ukraine
Source: created by authors after [7-9, 11, 12]

This field of innovative susceptibility represents a segment of the innovative information space for the formation of priorities in the interstate scientific and technical cooperation in NCRE field. In particular, on current issues of convergent technologies, it also touches upon the issues of NCRE in terms of using elements of NBIC technologies within its framework. Among thems hould pay attention to:

1. Whether any party have elements of NBIC-technologies in NCRE field, then this immediately becomes a priority of interstate cooperation.

2. In fact, NCRE technologies already use elements of NBIC technologies. For example, solar

collectors have the prospect of nano-coatings. Bio-technologies provide unconventional energy generation technologies from organic waste.

3. A promising direction from the point of view of the NBIC is the creation of energy-saving complexes based on a combination of generating technologies on a traditional and non-traditional basis.

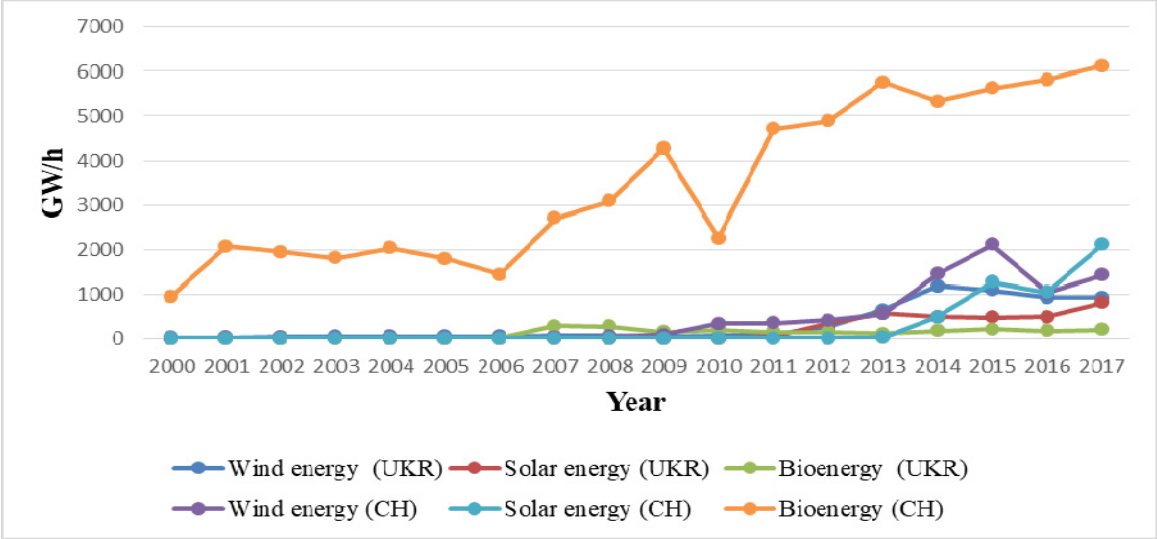

Fig. 2 Comparative dynamics of energy production from various NCRE sources of Chile and Ukraine for 2000-1017
Source: author's based on [10, 14-17].

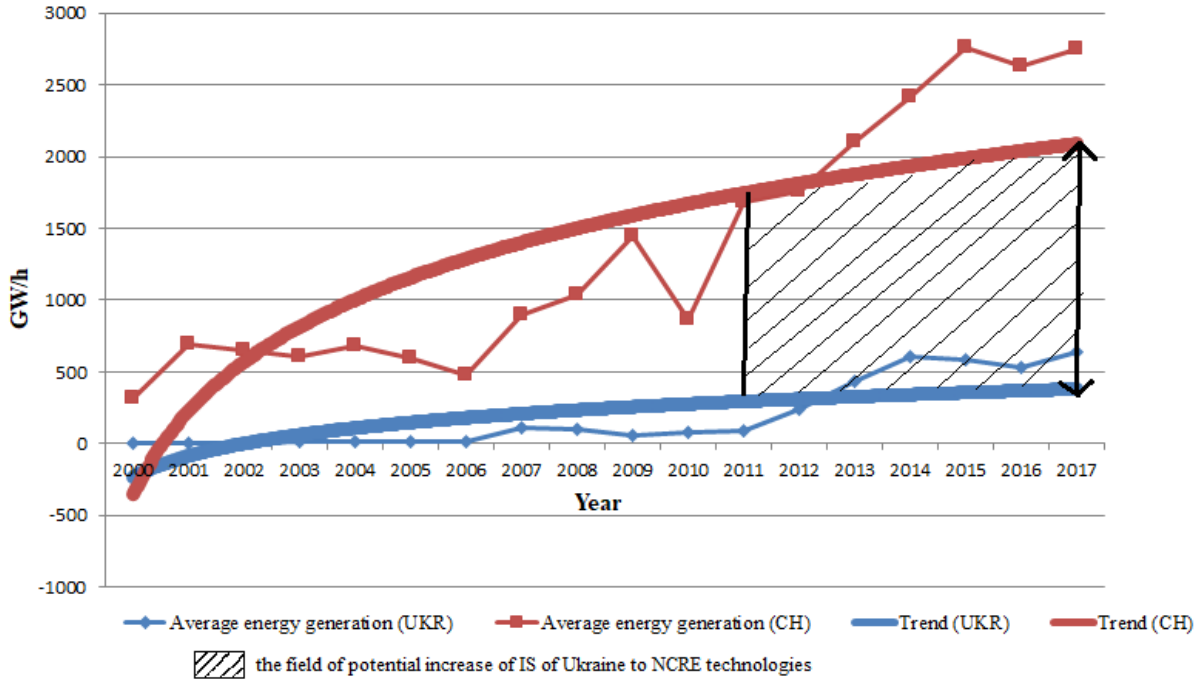

Fig. 3 Dynamics of average values, trends in NCRE production over the years (2000-2017) and the growth prospects of innovative susceptibility to NCRE in the process of the scientific and technical cooperation between Chile and Ukraine
Source: author's based on [10, 14-18]

This is especially important for improving the efficiency of existing traditional energy generation [19].

For example, it is possible that energy-saving complexes based on, for example, a gas boiler house, will systematically include a solar system and a heat pump, which will allow, as experience shows, to reduce the average annual consumption of fossil fuels by 40%. At the same time, elements of NBIC technologies are used to some extent. All this shows serious scientific production and organizational-economic prerequisites for the formation of the priorities of the scientific and technical cooperation between Ukraine and Chile in NCRE field.

Table 1

Dynamics of actual energy production from NCRE (2000-2017) in Ukraine / Chile, GW/h

Источник НВЭ	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Growth rate
Windenergy	6	16	22	31	33	38	35	45	45	41	49	89	258	637	1172	1084	924	915	152,5
	0	7	7	7	7	7	7	9	38	79	332	338	409	554	1443	2114	491	804	202,7
Solar energy	0	0	0	0	0	0	0	0	0	0	1	30	334	563	483	475	164	190	26,8
	0	0	0	0	0	0	0	0	0	0	0	0	0	8	490	1261	1029	1419	264,4
Biomassenergy	0	0	0	0	0	0	0	281	264	139	188	134	134	106	169	199	1041	2115	0,7
	941	2068	1944	1807	2031	1790	1431	2696	3083	4274	2249	4703	4874	5761	5327	5615	5812	6124	6,5
Total NCRE production	6	16	22	31	33	38	35	326	309	180	238	253	726	1306	1824	1758	1579	1909	119,3
	941	2075	1951	1814	2038	1797	1438	2705	3121	4353	2581	5041	5283	6323	7260	8990	7882	9658	8,8
Average NCRE production	2	5,3	7,3	10,3	11	12,6	11,6	109	103	60	79,3	84,3	242	435	608	586	526	636	
	314	692	650	605	679	599	479	902	1040	1451	860	1680	1761	2108	2420	2996	2627	2746	

Source: author's based on [10, 14-18]

5. Conclusions and future work.

On the basis of a phased analysis of the formation of priorities for the development of Ukraine, we propose an approach for analyzing the integrated development of national economies. According to the authors, this will allow a more reasonable approach to the selection of priorities for intergovernmental cooperation, including the development of relevant areas of development. The results of the analysis made it possible in the framework of interstate cooperation between Ukraine, the EU and Chile to identify a promising area for the development of non-traditional renewable energy.

In general, in Ukraine the development of certain areas of NCRE (such as solar and wind power) began within the framework of world trends (including the EU) much earlier than in Chile. However, up to the present, there have been no institutional changes in the attitude towards the NWE technologies in the country.

In Chile for a relatively short period 2007 – 2017 institutional changes have occurred in the sphere of innovation susceptibility to NCRE technologies, which affect a wide range of factors, including political, legal, and socio-economic factors. Separately, it is possible to single out a complex of factors of scientific and technical cooperation with various advanced actors of the world economy on NCRE issue.

Accordingly, within the framework of world development, including trends in the EU, there is a prospect for the development of the scientific and technical cooperation between Chile and Ukraine on NCRE issues, including:

1. The formation of priorities and the role of state programs of scientific and technical cooperation in the development of national economies.
2. Organizational and economic forms of scientific and technical cooperation in NCRE field between Chile and Ukraine and the EU.
3. The experience of state support of subjects of producer-consumer NCRE cycle, taking into account the best international practices, including the EU.
4. Forms of development of producer and consumer motivation; selection of priorities for NCRE technologies taking into account the experience of advanced economies, including EU countries.
5. Exchange of intellectual products (technology, licenses, know-how, etc.).

ПЕРСПЕКТИВИ ВДОСКОНАЛЕННЯ ТЕХНОЛОГІЙ В СФЕРІ РОЗВИТКУ НЕТРАДИЦІЙНОЇ ВІДНОВЛЮВАНОЇ ЕНЕРГЕТИКИ

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У даній статті розглядаються перспективи розвитку реалізації форм науково-технічного співробітництва. На прикладі міждержавного співробітництва України і Чилі показані підходи до вдосконалення процедури вироблення пріоритетів співпраці. Показано, що існуючий стан даних відносин не відображає реальних тенденцій розвитку міжнародних економічних відносин по вектору посилення науково-технічної складової.

Предметом дослідження статті є формування пріоритетів науково-технічного співробітництва між Україною і Чилі. Метою статті є вироблення підходів формування пріоритетів міждержавних економічних відносин з урахуванням умов України і відповідає потребам подолання кризових соціально-економічних явищ на основі інтенсифікації науково-технічного співробітництва. Завдання полягає в тому, щоб дослідити динаміку фактичного нетрадиційного виробництва енергії як одного з пріоритетних напрямків співпраці між Україною і Чилі. В рамках цього дослідження використовуються теоретичні, методологічні та системні методи аналізу первинних джерел, в тому числі статистичні матеріали, нормативні документи, наукові публікації для описового і структурного аналізу для оцінки початкового стану первинних рівнів міжнародних економічних відносин і методів формування тенденції в їх перспективах розвитку. Отримані наступні результати: на основі поетапного аналізу формування пріоритетів розвитку України був запропонований підхід для аналізу подібності комплексного розвитку національних економік.

Висновки: результати аналізу дозволили в рамках міждержавного співробітництва між Україною та Чилі виділити перспективну область розвитку нетрадиційної відновлюваноїенергетики.

Ключові слова: економічні відносини, нетрадиційна поновлювана енергетика, інноваційна сприйнятливість, пріоритети міжнародних економічних відносин, науково-технічне співробітництво.

ПЕРСПЕКТИВЫ СОВЕРШЕНСТВОВАНИЯ ТЕХНОЛГИЙ В СФЕРЕ РАЗВИТИЯ НЕТРАДИЦИОННОЙ ВОЗОБНОВЛЯЕМОЙ ЭНЕРГЕТИКИ

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В данной статье рассматриваются перспективы развития реализации форм научно-технического сотрудничества. На примере межгосударственного сотрудничества Украины и Чили показаны подходы к совершенствованию процедуры выработки приоритетов сотрудничества. Показано, что существующее состояние данных отношений не отражает реальных тенденций развития международных экономических отношений по вектору усиления научно-технической составляющей.

Предметом исследования статьи является формирование приоритетов научно-технического сотрудничества между Украиной и Чили. Целью статьи является выработка подходов формирования приоритетов межгосударственных экономических отношений применительно к условиям Украины и соответствующей потребностям преодоления кризисных социально-экономических явлений на основе интенсификации научно-технического сотрудничества. Задание состоит в том, чтобы исследовать динамику фактического нетрадиционного производства энергии как одного из приоритетных направлений сотрудничества между Украиной и Чили. В рамках этого исследования используются теоретические, методологические и

системные методы анализа первичных источников, в том числе статистические материалы, нормативные документы, научные публикации для описательного и структурного анализа для оценки начального состояния первичных уровней международных экономических отношений и методов формирования тенденции в их перспективах развития.

Получены следующие результаты: на основе поэтапного анализа формирования приоритетов развития Украины был предложен подход для анализа подобия комплексного развития национальных экономик. Выводы: результаты анализа позволили в рамках межгосударственного сотрудничества между Украиной и Чили выделить перспективную область развития нетрадиционной возобновляемой энергетики.

Ключевые слова: экономические отношения, нетрадиционная возобновляемая энергетика, инновационная восприимчивость, приоритеты международных экономических отношений, научно-техническое сотрудничество.

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