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Strategic guidelines on the development of renewable energy sources

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ABSTRACT

he study highlights the importance to develop the national economy through assuring energy security. The study aims to analyze how to develop renewable energy sources, determine the main priorities of Ukraine's national security policy and discover novel ways of assuring energy security due to developing the industry of renewable energy in the light of environmental safety, energy conservation and efficiency. The following scientific methods were employed: synthesis and analysis – to determine the essence and significance of RES in order to assure energy security; theoretical generalization – to single out the main stages of renewable energy development; classification – to classify the main advantages of introduction of RES, as well as the obstacles to their implementation; logical generalization – to justify the relevance, aim and objectives of the study; the method of rising from the abstract to the concrete – to develop and justify the ways of assuring energy security provided that renewable production is developed. The following results are obtained: the main conditions for developing RE are determined; some relevant issues of energy efficiency and assurance of Ukraine's energy security are justified; significant potential of Ukraine's renewable energy industry is discovered and analyzed; target values Ukraine seeks to achieve with the help of the energy generated from RES in final energy consumption are analyzed; the main criteria for developing Ukraine's fuel and energy complex are revealed and the key branch ratio values of the state's energy balance are determined.

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INTRODUCTION

The world community considers RES, which have great resource potential and are environmentally friendly, to be the most promising way of solving the problem of energy supply. The COP21 UN climate change conference held in 2015 in Paris has largely contributed to the development of RES. Indeed, 195 countries signed an agreement on the global problem of climate change, which committed them to double investment in research on clean energy during the next five years. The Paris Climate Agreement was adopted on November 4, 2016. It mainly aims to sustain global temperature below 2 degrees Celsius above pre-industrial levels and eventually decrease it to 1.5 degrees Celsius. The Agreement encourages these countries to cope with climate changes. These ambitious goals cannot be achieved without flexible opportunities for financing technologies and strengthening relevant institutions according to a level of the country's economic progress (Razumkov Center, 2018). It must be noted that Ukraine was one of the first to join the Paris Climate Agreement and to submit its proposals regarding Intended Nationally Determined Contributions (INDCs). In November 2017, the Ukrainian government approved the National Emissions Reduction Plan for Large Combustion Plants (NEPR). It is viewed as an important practical measure for the implementation of the Paris Climate Agreement, as well as progress in the implementation of European standards for environmental protection and is aimed at assuring gradual and significant reduction of emissions from thermal production (Razumkov Center, 2018). In October 2015, Ukraine published its INDC as part of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Conference of the Parties process, which indicated a target of 60% of 1990 levels by 2030, which is a 50% increase over current greenhouse gas emission levels. The Paris Climate Agreement urges these countries to periodically review greenhouse gas emissions reduction commitments. It has introduced a cyclical mechanism for updating the target guidelines of the parties. Starting in 2020, each party is required every five years to notify the UNFCCC Secretariat of its Nationally Determined Contribution to replace the INDC adopted in 2015.

Legal framework review

Quite recently, renewable energy has managed to become not only a tool for achieving the idea of low carbon development of society but is gaining more and more arguments in its favour as an economically sound alternative to fossil fuels. During 2006-2016, global energy consumption of RES has increased from 93.2 to 419.6 mill. toe or by 4.5 times. In 2015, annual global growth of renewable energy capacity exceeded a similar indicator of traditional production, which proves competitiveness of RE. In the European Union, they view RES as natural and non-fossil sources (solar, geothermal and wind energy, biomass, as well as energy generated from waves and tides, hydroenergy, gas from organic waste, gas from waste and biogas) (Directive, 2001). The International Energy Agency (IEA) indicates that RES include:

1) Renewable fossil fuels and biomass wastes
   a) solid biomass and animal products (biological mass, including any plant-based substances used as fuel or converted to wood, plant waste and animal waste, wood charcoal derived from solid biomass, *etc*; b) biomass gas or liquid obtained in the process of anaerobic fermentation of biomass and solid waste and burned to generate electrical energy or heat; c) municipal waste– wastes of residential, commercial and public sectors burned to generate electrical energy and thermal energy; d) industrial waste – solid and liquid materials burned to generate electrical energy and thermal energy at specialized enterprises.
2) Hydro energy– energy of water converted to electrical energy with the help of large and small hydroelectric power plants.
3) Geothermal energy – thermal energy coming from the bowels of the Earth (e.g. hot steam or water) and used to generate electrical energy or as a source of heat for heat supply systems, agricultural needs, *etc*.
4) Solar energy – the radiation of the sun, used as heat and electrical energy.
5) Wind energy – energy of wind used to generate electrical energy in wind turbines.
6) Energy from tides, sea waves and ocean – mechanical energy of tidal streams or waves used to generate electrical energy (International Energy Agency, 2018).

The problem of the country's energy dependence can be solved, first of all, due to the diversification of energy resources, optimization of the energy consumption model and the introduction of energy-efficient technologies based on RES. In Ukrainian legislation, RES were first mentioned in the Law of

Ukraine "On Energy Conservation" as of July 1, 1994. Thus, RES are sources, which constantly exist or occasionally appear as energy flows of the sun, wind, heat of the Earth, energy from the seas, oceans, rivers, biomass" (The Law of Ukraine, 1994). The generation of RE has led to the need to clearly regulate the economic, legal and organizational aspects of the RE consumption (Ukraine's New Energy Strategy, 2020). In 2003, the Law of Ukraine "On Alternative Energy Sources" was adopted, which defines the term as follows: "alternative energy sources are RES, which include solar, wind and geothermal energy, energy from waves and tides, hydroenergy, gas from organic waste, gas from waste and biogas, biomass, as well as secondary energy sources, which include blast furnace gas and coke oven gas, methane gas from exploitation of coal deposits, transformation of extractable energy potential of technological processes" (The Law of Ukraine, 2003). Therefore, according to Ukrainian legislation, alternative energy sources are somewhat broader than RES, since they aim at not only environmentally friendly renewable sources but also secondary energy sources. It must be noted that nowadays the state encourages to use renewable energy in order to replace traditional energy resources, in particular, imported natural gas and oil (Order of the Cabinet of Ministers of Ukraine, 2017). Some important aspects of renewable energy development have been studied by many foreign and Ukrainian scholars. In particular, Angelis-Dimakis *et al.* (2011) highlight some problems related to the consumption of RES as well as the tools that can be used to evaluate the use of various RES. Budzianowski and Postawa (2017) explore the effects of carbon dioxide emissions on the consumption of traditional sources. They emphasize the possibility of replacing traditional energy sources with RES, in particular by using biogas. However, Burke and Stephens (2017) introduce the concept of "energy democracy". They regard it as a value of social movement, which will facilitate the transition to renewable energy while constraining the energy programme of fossil fuels. The authors believe that such an approach will make it possible to integrate technological changes in socioeconomic and political sectors, which are based on social justice and energy innovation. Gasparatos *et al.* (2017) define the influence of RE on the ecosystem and examine the effects of this influence on the green economy. They synthesize the existing knowledge through the connection between RE and biodiversity within a framework of five factors of ecosystem changes. As a result, the authors conclude that some technologies of renewable energy can lead to negative effects. Drawing a parallel between the development of renewable energy and economic efficiency, Hirth (2013) explores the issue of changes in the market value of RE and emphasizes certain interdependence of the prices on technological solutions of renewable energy and their market value. Experimental estimates and results obtained from the regression analysis are based on the pattern of the European electricity market. Ozturk *et al.* (2010) analyze the connection between the consumption of energy, carbon emissions, economic progress and trade openness. This research justifies a long-term causal connection between carbon emissions and economic progress in the country. Supporting the idea of sustainable economic development, Barbier (2011) indicates that "green" growth cannot assure sustainable economic development, as global environmental degradation continues to aggravate the problem of the environmental deficit. The author states that the problem of sustainable development consists in overcoming a huge spectrum of market and political failures, which decrease the economic significance of this deficit. However, this issue can be solved by launching a number of innovative financial mechanisms (currency transactions, international payments, etc.). Overland (2016) pays significant attention to certain approaches to assuring energy security and eliminating energy risks. He believes it necessary to expand the access to local and regional energy services, studies the current energy situation in some leading countries and highlights the importance to set goals and indicators for monitoring energy supply development. Energy security largely depends on the minimization of potential threats. The threats to energy security of the enterprise are thoroughly analyzed in the research by Voynarenko and Mykoliuk (2017). Taking into account the world's investments in new renewable energy projects and expansion of the global investment market based on the latest indicators of growth by 2020 (about $250 billion annually), Donovan (2015) considers the experience of some countries in balancing risk, unstable market conditions and rapid changes in policies on the efficiency of energy. Thus, the financing of RE provides insiders with the possibility

of renewable energy transactions and understanding how such countries as the USA, India and China respond to the global energy challenge. It must be noted that the process of increasing energy efficiency by using RES largely depends on the intensification of relevant investments and innovation activities. In this context, one should pay attention to the research by Mykoliuk and Prylepa (2018), who interpret the concept of "strategy for assuring energy security at the enterprise", which is based on the innovative development of the enterprise in the field of energy security aimed at assuring rational and energy-efficient use of energy and natural energy resources, achieving strategic innovation-oriented goals of energy policy. Voynarenko *et al*. (2018) suggest a hierarchic model, which contains the factors influencing energy security at the enterprise and provides a detailed description of the interaction between the factors, the connection between them and the impact on energy security at the enterprise, which results in certain optimal management decisions to shape and assure energy security at the enterprise. Jacobson *et al.* (2015) studied the process of developing energy "road maps" to decrease global warming in 139 countries. The authors emphasize the need for electrification of such industries as transport, industry, agriculture, forestry, fishing through producing electricity from renewable sources. Strategic prospects for assuring energy security in Ukraine are presented by Voynarenko and Mykoliuk (2017). In addition, Mykoliuk (2018) analyzes the current capacity of providing economic entities with fuel and energy resources and systematizes relevant objectives to increase their energy security in the context of European integration. She also defines the main ways of assuring energy security in Ukraine and expanding the collaboration between Ukraine and the EU in this field. This study has been carried out in at the Khmelnytsky National University in 2017-2018.

Research problem and suggested solutions to it

Therefore, the research aims to analyze how to develop renewable energy sources, determine the main priorities of Ukraine's national security policy and discover novel ways to assure energy security through developing the industry of renewable energy in the light of environmental safety, energy conservation and efficiency. The study was conducted in Ukraine with the use of statistical information.

MATERIALS AND METHODS

Study area

The study area comprises the territory of Ukraine as well as development statistics of renewable energy in developed countries. Ukraine belongs to the countries, which partly secure their own traditional fuel and energy. As a result, there appears to be the need for significant volumes of their imports. During the last few years, the amount of TPES imported to Ukraine has amounted to about 38%, which determines its energy dependence as Middle European one. Such dependence is intensified not only by insufficient volumes of the country's own energy resources, but also their ineffective use. Therefore, the most important priority should be the principles of energy efficiency and RES development. This approach can decrease dependence on fossil fuel imports, decrease carbon dioxide emissions, stimulate economic progress and create new jobs. In this regards, the European policy is characterized by the gradual implementation of the principles of energy conservation and energy efficiency, as well as the large-scale implementation of clean technologies based on RES.

Survey method and data analysis

Therefore, the world's energy policy implies the following criteria for development (World energy insights, 2019) (Fig. 1).

The EU effectively uses state strategies, programmes and plans to develop RES. In Ukraine, the main regulatory and legal documents on strategic development of renewable, alternative energy include concepts, strategies, state programmes, national action plans. It should be noted that they have been adopted by various authorities, such as Parliament, the President, the Government and in various fields (energy, environmental protection, sustainable development, national security, water resource management) (Levina , 2018). The strategic documents include the following:

1. The Strategy for Sustainable Development "Ukraine-2020" approved by Decree of the President of Ukraine as of January 12, 2015 No 5/2015.
2. The Strategy for National Security of Ukraine approved by Decree of the President of Ukraine as of May 26, 2015 No 287/2015.
3. The Concept of Implementation of State Policy on

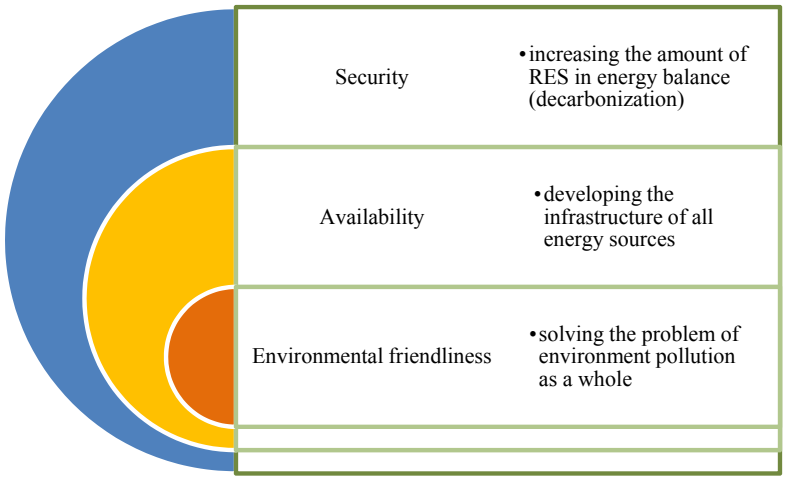


Fig. 1: The main criteria of global energy policy

Climate Change by 2030 approved by Decree of the Cabinet of Ministers of Ukraine as of December 7, 2016 No 932-p.

4. The Action Plan for Implementation of the Concept of State Policy in the Field of Climate Change by 2030 approved by Decree of the Cabinet of Ministers of Ukraine as of December 6, 2017 No 878-p.
5. Ukraine's Energy Strategy for 2035 "Safety, Energy Efficiency, Competitiveness" approved by the Cabinet of Ministers of Ukraine as of August 18, 2017 No 605-r.
6. The State Target Economic Program for Energy Efficiency and Development of Production of Energy from Renewable Energy Sources and Alternative Fuels during 2010-2020 approved by the Decree of the Cabinet of Ministers of Ukraine as of March 1, 2010 No 243.
7. The National Renewable Energy Action Plan by 2020 approved by the Cabinet of Ministers of Ukraine as of October 1, 2014, No 902 r.

It must be noted that the above-mentioned documents clearly regulate strategic guidelines on the development and increase in the consumption of RES (Energy Strategy of Ukraine, 2017). Thus, the Strategy for Sustainable Development "Ukraine 2020" indicates that RES can be developed through four vectors: 1) development vector; 2) security vector; 3) responsibility vector; 4) pride vector. These four vectors contribute to implementing 62 reforms and programs for the state's development. The development vector assures the realization of the energy reform and the program for energy efficiency. The security vector assures the realization of the program for energy independence, as well as the program for environment conservation. In addition, the program attempts to assure energy security and efficient consumption of energy through introducing relevant innovative technologies. The main objective of state policy in this field is to assure efficient consumption of energy technologies and equipment through the mechanism of implementing projects on the consumption of alternative energy sources and to diversify the sources of primary energy supply. Regarding the National Security Strategy of Ukraine aimed at realizing the priorities of the policy on national security as well as the reforms provided for by the EU-Ukraine Association Agreement and the Strategy for Sustainable Development "Ukraine 2020", the main objectives of the state policy on the national security are the following: to assure energy security through developing renewable energy taking into account priority objectives of environmental safety; to enhance energy efficiency and assure energy conservation (The National Action Plan for Renewable Energy, 2020). Accordingly, the Concept of Implementation of State Policy on Climate Change by 2030 highlights the need to coordinate decisions on climate change with decisions in all economic sectors, including energy, water resource management, land use, conservation and reproduction of ecosystems (Transforming our world, 2030). First of all, it is

important to increase the energy generated from RES as defined by the National Renewable Energy Action Plan by 2020. The Concept requires that the amount of energy generated from RES in the total structure of energy consumption must reach 11% by 2020 and gradually increase afterwards. The action plan for realizing the Concept of Implementation of State Policy on Climate Change by 2030 involves preparing and submitting to the Cabinet of Ministers of Ukraine a draft act on the adoption of the National Energy and Climate Change Plan during 2021-2030.

RESULTS AND DISCUSSION

The aim of Ukraine's Energy Strategy for 2035 "Safety, Energy Efficiency, Competitiveness" is to meet the needs of economy and society for fuel and energy in a technically reliable, safe, cost-effective and environmentally friendly way to improve living conditions of the population. The Strategy proposes some effective solutions to the problem by 2020 and identifies strategic guidelines on the development by 2035. Ukraine's Energy Strategy should be realized in three main stages: Stage 1 – by 2020 (radical progress is expected to be achieved in the field of RE by increasing its share in total consumption up to 11% through the implementation of stable and predictable policy on the development of RES and investment attraction); Stage 2 – by 2025 (steady expansion of the use of all types of renewable energy, which will become one of the tools for assuring the state's energy security); Stage 3 – by 2035 (RES are expected to develop at the most dynamic pace compared to other types of energy, which will increase their share in the structure of TPES up to 25%). Accordingly, the aim of the State Target Economic Program for Energy Efficiency and Development of Production of Energy from Renewable Energy Sources and Alternative Fuels during 2010-2020 is; a) to create relevant conditions to adjust a level of energy intensity of Ukraine's GDP to a level of developed countries and EU standards; to decrease the level of GDP energy intensity during the validity period of the Program up to 20% compared to 2008 (annually by 3.3%); to assure efficient consumption of fuel and RES and enhance the competitiveness of the national economy; b) to optimize the state's energy balance in which the amount of energy obtained from RES and alternative fuels will have amounted to at least 10% by2015 through reducing the share of imported fossil organic types of energy sources, in particular natural gas, and replacing them with alternative energy resources, including secondary ones. The National Renewable Energy Action Plan by 2020 indicates that the consumption of RES is considered to be an extremely essential area in energy policy of Ukraine aimed at preserving traditional fuel and energy resources, as well as the environment. Increasing the use of RES in Ukraine's energy balance will, in turn, increase the level of diversification of energy sources and, therefore, strengthen the state's energy independence. As defined by the Treaty establishing the Energy Community, Ukraine has undertaken to implement Directive 2009/28/EC. Therefore, those target values, which should be achieved due to the consumption of RES up to no less than 11%, are the following (Statistical Review of World Energy, 2018). (Table 1).

The obtained results show that it is on the agenda to improve the structure of fuel and energy balance in Ukraine, to increase its level of energy independence, to enhance competitiveness of the national economy, to renovate fixed assets in the Ukrainian electricity industry, to reduce greenhouse gas emissions and provide employment in the energy sector. According to international law, several terms are used for designating alternative energy sources, namely renewable, new, non-traditional ones. The United Nations Economic and Social Council (ECOSOC) resolution approved in 1956 is the first international act in this area, which divides all energy sources into ordinary and new ones. In turn, the EU countries use the terms alternative sources and RES. The term "alternative energy sources" is quite common in Ukrainian legislation. Some scholars such as (Sak,

Table 1: Prospects for increasing the amount of energy generated from RES

Production of energy from renewable sources	2017	2020
Energy generated from RES in electricity industry, GWh	20678	26000
Energy generated from RES in heating systems, thous. Gcal	41390	58500
Energy generated from RES in the transport sector, thous. toe	351	505

2016; Shkarlet, 2016; Bobrov, 2012) express this term as quite accurate since the energy from these sources was, is and will be used alternatively with coal, oil and gas. Presently, there is no unambiguous understanding of what alternative sources should include. In the EU, alternative sources first included liquefaction and gasification of solid fuels, exploitation of geothermal deposits and use of solar energy. Subsequently, the documents began to separate legal regulation of production, transportation, use and consumption of electricity generated from RES from renewable fuels in transport. In accordance with Directive 2001/77/EU (Directive 2001/77/EU, 2001), these sources include wind, the sun, waves and other sources of hydroenergy, sources of geothermal energy, etc. Directive 2009/28/EU (Directive 2009) considers RES as a whole and indicates that renewable nonfossil energy sources include wind, solar, aerothermal, geothermal and ocean energy, hydroenergy, biomass, gas from organic waste, gas from clarified wastewater and biogas. It must be noted that aerothermal energy is obtained as heat in the atmospheric air, geothermal energy – as heat from the bowels of the Earth, hydrothermal energy – as heat from the water surface, biomass – a biological share of products, and biological waste from agriculture, including plant and animal substances, forestry and related industries, fisheries and aquaculture, as well as biological part of industrial and household waste. According to the IRENA, the term "renewable energy" includes all kinds of energy, which are continuously generated by RES (bioenergy, geothermal energy, hydroenergy, ocean energy, including tidal energy, wave and thermal energy of the ocean, solar energy, and wind energy) (IRENA, 2009). Therefore, the IEA identifies such types of renewable sources as biomass energy, geothermal energy, hydroenergy, ocean energy, solar energy, wind energy. In Ukraine, Art 1 of the Law of Ukraine "On Alternative Energy Sources" (The Law of Ukraine, 2003) regards alternative energy sources as renewable ones, which include solar energy, wind energy, geothermal energy, wave energy and tidal energy, hydroenergy, biomass energy, gas from organic waste, gas from waste treatment facilities, biogas and secondary energy resources, which include blast furnace gas and coke oven gas, methane gas from exploitation of coal deposits, transformation of extractable energy potential of technological processes". Having studied the report published by the IRENA in 2015 and other sources (REMAP-2030, 2015), it can be concluded that Ukraine has a powerful potential of renewable energy, which amounts to more than 98.0 mill. toe per year (SAEEECU, 2018). Possessing an impressive potential of RES estimated at 98 mill. toe, Ukraine is currently using only 5% of it. According to the provisions of Ukraine's Energy Strategy for 2035, as well as the obligations to the Energy Community and the objectives of the National Renewable Energy Action Plan by 2020, Ukraine must obtain 11% of the final consumption of energy from RES. However, this objective was mainly set for political reasons without an objective evaluation of viable investment opportunities, so the probability of its implementation is rather low. In 2006, there was almost no renewable energy in Ukraine. With the introduction of a stimulating "green tariff" at the legislative level in 2009, it started to rapidly develop at an average growth rate of 31% annually. During 2009-2013, an established capacity of RES objects has increased from 0.13 GW to 1.19 GW or by more than 9 times (Fig. 2).

With regard to the military aggression of the Russian Federation, new capacities of RES were not introduced during 2014-2015. On the contrary,

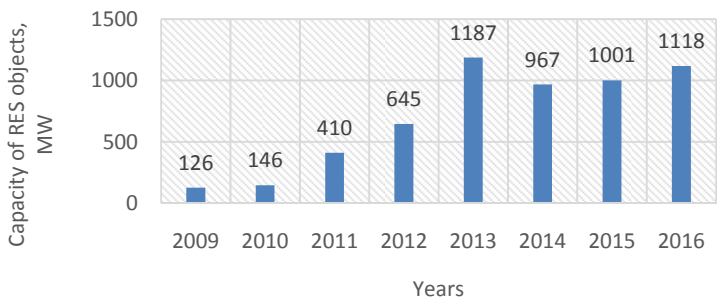
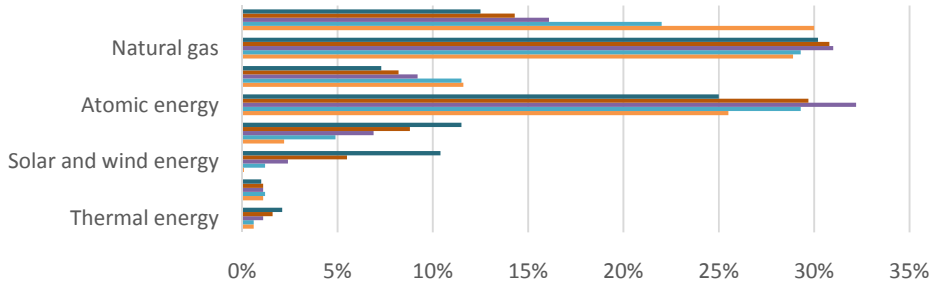


Fig. 2: The values of the established capacity of RES, working under the "green" tariff during 2009-2016, MW



	Thermal energy	Hydroelectric power station	Solar and wind energy	Biomass, biofuels and waste	Atomic energy	Oil products	Natural gas	Coal
2035	2.1%	1%	10.4%	11.5%	25%	7.3%	30.2%	12.5%
2030	1.6%	1.1%	5.5%	8.8%	29.7%	8.2%	30.8%	14.3%
2025	1.1%	1.1%	2.4%	6.9%	32.2%	9.2%	31%	16.1%
2020	0.6%	1.2%	1.2%	4.9%	29.3%	11.5%	29.3%	22%
2015	0.6%	1.1%	0.1%	2.2%	25.5%	11.6%	28.9%	30%

2035 2030 2025 2020 2015

Fig. 3: Expectation of Ukraine's TPES and the amount of RES in % during 2015-2035

Ukraine has lost 407 MW of capacities from solar power plants in the Crimea. In 2016, however, an economic situation somewhat improved, which made it possible to build 120.6 MW of new capacities, mostly solar energy (99.1 MW) and wind energy (11.6 MW). Small hydroenergy plants and those producing energy from biomass and biogas were built approximately 3 MW each. The main criterion, which creates opportunities for developing fuel and energy complex of Ukraine and defines the key sectoral ratios of the state's energy balance includes the volume and the structure of TPES. According to the Razumkov Center, it is expected that by 2020 Ukraine will have gradually reduced the volume of TPES mainly by reducing the energy intensity of GDP due to energy efficiency measures, in particular in the industry. Compared to 2015, the volume of TPES will decrease from 90.1 Mill. toe to 82 mill. toe or approximately by 9%. Therefore, the expectation of Ukraine's TPES and the amount of RES in % during 2015-2035 (Fig. 3). The analysis of Fig. 3 shows that there is expected to be an increase in the amount of RES in TPES. The Razumkov Center states that the amount of RES will have amounted to 8% by 2020, 12% – by 2025, 25% – by 2035. However, the share of traditional energy sources is expected to gradually decrease. The share of coal is expected to gradually decrease from 30% in 2015 to 12.5% in 2035 or by 15 Mill. toe, which corresponds to the pan-European concept of low carbon development. Taking into account the tendency towards using domestic mineral raw materials in Ukraine, the share of natural gas will continue to preserve its dominant position and will have amounted to approximately 29% of TPES by 2035. With regard to the prospects of nuclear energy, its share will have increased up to 32.2% by 2025 due to a higher level of use of the established capacity of nuclear power units at the prolongation of their exploitation periods. After 2025, one can expect negative growth in the capacity of nuclear blocs as the result of the prevailing tendency to close those, which exhausted their reserves. Therefore, the share of atomic energy is expected to have gradually decreased up to 25% by 2035.

Thus, the development of the Ukrainian economy implies a steady expansion of the use of all RES, which is one of the tools for assuring the state's energy security. In the short and medium term (by 2025), Ukraine's Energy Strategy for 2035 (The Ukraine's Energy Strategy, 2017) predicts an increase in the

amount of RE up to 12% of TPES and at least up to 25% by 2035 (including all hydroenergy and thermal energy).

CONCLUSION

The conducted research proves that the main objective of strategic development for Ukraine is to assure energy security, which is based on the development of RES and to reduce emissions into the environment. This creates new economic and technological challenges for Ukraine and presents new opportunities for discovering and implementing innovative solutions while shaping new policies on energy assurance. The European Energy Community requires that the target should be met by Ukraine is 11% of RES in total energy consumption by 2020, which requires that its own legislative framework for renewable energy should be adjusted to the EU norms and standards. However, Ukraine has a powerful potential of RE, which is more than 98.0 Mill. toe per year. Presently, Ukraine is using only 5%. The EU experience will enable Ukraine to actively develop renewable energy industry relying on the effective legislative framework developed by the leading world experts, as well as the possibility of attracting investments from the EU in RES in Ukraine. Today, the following aspects might delay the development of RES in the country: the need for significant initial investments in the construction of new renewable production capacities, remoteness from the networks, possible legislative barriers at the local level, the frequency of production of some RES, the need for production reserves etc. However, the potential of economic, social and environmental effects far exceeds the existence of some problems on the way to implementation. First and foremost, this is a real opportunity for Ukraine to achieve energy independence, increase the potential of renewable resources, minimize greenhouse gas emissions, apply inexhaustible sources of renewable energy, reform energy infrastructure and introduce innovative technologies, etc. The development of RE is considered to be the most important factor in assuring energy security in Ukraine at the legislative level. Considering the declared expectations of RE development, one can assume cost-cutting of RES and growth of their economically justified potential. The main measures for the realization of strategic goals in the development of RES are the following: to promote a stable and predictable policy on the construction of SPP and WPP; to conduct international communication campaigns to encourage foreign strategic and financial investors to enter the Ukrainian market of RES; to construct and install capacities of RES; to increase the consumption of biomass in producing electrical and heat energy by promoting the consumption of biomass as a fuel; to inform about the possibility of using biomass as a fuel in individual heat supply, as well as the possibility of creating competitive biomass markets. Further research should aim to suggest the ways how to implement the strategy for assuring Ukraine's energy security through the transition to RES. Since the issue of developing the strategy for assuring energy security is related to Ukraine's energy dependence on other countries, limited energy resources, as well as a rapid increase in their value, one should strive to discover new ways to minimize the energy intensity of products, as well as the volumes of fuel and energy consumption and ensure their efficient and rational use.

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CONFLICT OF INTEREST

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATIONS

%	Percent
ECOSOC	United Nations Economic and Social Council
EU	European Union
GDP	Gross Domestic Product
GW	Gigawatt
IEA	International Energy Agency
INDCs	Nationally Determined Contributions

IRENA	International Renewable Energy Agency
Mill. toe	Million tonnes of oil equivalent
MW	Megawatt
NERP	National Emissions Reduction Plan
RE	Renewable energy
RES	Renewable energy sources
SPP	Solar power plants
Thous. Gcal	Thousand gigacalories
Thous. toe	Thousand tonnes of oil equivalent
TPES	Total primary energy supply
UNFCCC	Nations Framework Convention on Climate Change
WPP	Wind power plants

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