

# The present and the future of Russian renewable energy in the green economy transition

*Elena Tarkhanova*<sup>1\*</sup>, *Elena Lyapuntsova*<sup>2</sup>, *Natalia Baburina*<sup>3</sup>, and *Anhelica Fricler*<sup>4</sup>

<sup>1,3,4</sup> Department of Economics and Finance, Institute of Finance and Economics, University of Tyumen, 6 Volodarskogo Str., Tyumen, 625003, Russian Federation

<sup>2</sup> Department of Innovative Entrepreneurship, Bauman Moscow State Technical University, 5/1 2-Ya Baumanskaya st., Moscow, 105005, Russian Federation

**Abstract.** In the recent years, renewable energy is the most actively developing area in the energy industry. The energy decarbonization and the desire to meet the Paris Climate Agreement criteria are the dominant motives of this development. Climate and energy policies, new technologies, changing prices for gas, coal and carbon, the growth of renewable energy sources continue to challenge operators, developers and utility company in energy system. Our article is devoted to these problematic issues. They are related to the renewable energy development. It is a promising direction of "green" growth around the world, including Russia. We discuss the latest trends and developments in the field of renewable energy in Russia in the conditions of global challenges. In addition, we extrapolate possible directions for the renewable energy growth in the future. Our results can be interesting and useful for researchers and experts in the strategic management field, spatial development, innovation economy and some stakeholders involved in the environment and energy system.

## 1 Introduction

Nowadays, the "green" economy is the environmental component of sustainable development. It determines the countries' capabilities for positioning in the international arena [1-3]. Russia is an active actor therein. It supports resolutions in the "green" economy development, "green" financing instruments to resolve issues of climate-resilient economic growth [4]. The drivers and frontiers of the Russian "green" economy development differ significantly from most developed countries. At the same time, Russia has undeniable advantages in natural landscapes preserving and the ecosystem services' potential. It also has huge, almost untapped opportunities for "green" growth [5].

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\* Corresponding author: [tarhanova333@mail.ru](mailto:tarhanova333@mail.ru)

The UNEP actively promotes the "green" model's formation of economic development. There are priority topics of the "green" economy in the global aspect according to the conceptual approaches of UNEP. They are the forest sector; agriculture; the water sector; the "greening" of fisheries; the energy sector (alternative energy, renewable energy (including hydropower, biofuels and biomass)); industrial production; eco-tourism; "green" transport [6,7]. These areas develop under the influence of various factors. They are climate change, economic recovery, the need to protect biodiversity and demographic processes.

The fundamental "green" growth direction is the development of alternative ("green") energy and the use of renewable energy sources [8]. In a broad sense, alternative energy is the use of energy-efficient technologies and environmentally friendly, low-carbon energy sources (including renewable sources and nuclear power plants) [9]. Consequently, energy is the core sector of the country in terms of the GDP formation, taxes, budget revenues, employment and export revenues [10]. It includes alternative energy. In this regard, there is the increasing priority of improving energy efficiency, decarbonization and diversification of the fuel and energy sector as a strategic direction for the global "green" economy [11].

Before COVID-19, all developed countries paid attention to the renewable energy development. We believe that it was due to political, economic and environmental problems. Proponents of renewable energy claim that the way and experience of development allow to reduce the renewable energy sources' cost and make it equal to traditional sources.

The electric power industry and renewable energy are the most important segments in the Russian economy [12]. The development of Russian renewable energy is determined, first, by the importance of the energy sector in economic development and ensuring the national security of the country [13]. The fact is that the territories and mineral resources of Russia are quite rich in energy resources. Despite it the development of alternative energy sources is hopeful and highly promising. This trend is very characteristic and significant for the Russian Federation regions that use imported fuel. Secondly, there is an increasing trend of depletion into the most affordable and profitable reserves of classical energy resources [13]. Third, there is global climate change and the need to reduce greenhouse gas emissions. Their growth is caused by man-made emissions from energy sector facilities [14].

Nevertheless, Russia practically does not use such promising renewable energy sources as solar and wind energy. These sources accounted only 0.2% of all Russian electricity production in the first half of 2020. In general, Russian traditional companies in the energy sector are responsible for the greenhouse gas emissions in most cases. They follow market and regulatory signals and set goals to reduce greenhouse gas emissions — decarbonization [15].

In our research, we aim to identify priority trends into the renewable energy development in the world. Based on it, we can make a comparative assessment of these trends with the situation in the Russian renewable energy sector.

The purpose of this article is to study the features and trends of the renewable energy development in Russia, to determine the prospects and reserves for its growth in the future. The second article's section presents materials and methods. The third section is devoted to results and discussion. The fifth article's section is a conclusion.

## **2 Materials and methods**

The renewable energy industry in Russia is analyze in this study. The comparative analysis of RES in Russia and in the world is carried out. We estimate the RES' share in the total volume of energy and the installed capacity of Russian RES in our study. We sum up the results of eight years for this industry development in Russia.

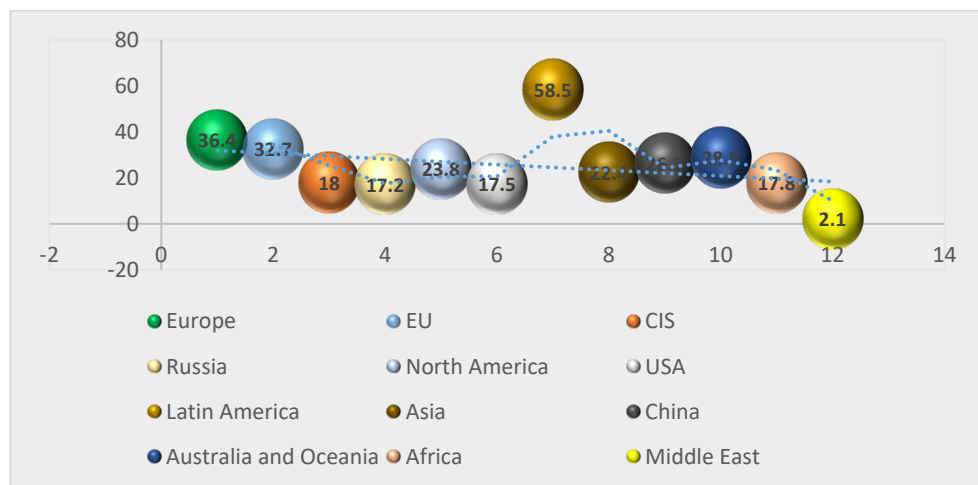
The research methodology is based on the methods of calculating the dynamics and structure indicators. They characterize the renewable energy data and comparative analysis.

We use specific data from the Federal State Statistics Service regarding the unified energy capacity of Russia to achieve these goals. We use data from the Consulting Group "Techart". It describes the renewable energy market in Russia and the world for the period 2012-2019.

### 3 Results and discussions

The renewable energy in Russia makes a step forward over the past few years. We can state the fact that today our country is far behind the leading countries and the Eastern Europe countries. It is after studying the dynamics of the renewable energy development in Russia. In the world there is rapid growth of renewable energy sources. The share of renewable energy in energy production for the period 2003-2018 increased from 2% to 25.6%. In Russia the studied period is characterized by a slight increase in the volume of electricity produced from renewable sources. The increase for the period 2012-2019 was 11.8%.

The largest contribution of RES to electricity generation is observed in Latin America and the smallest contribution is in the Middle East according to Figure 1. The RES' share in electricity production in Europe is 36.4%, in the EU-32.7%. The leaders in terms of RES growth among European countries are Germany, the United Kingdom and Portugal. The number of EU countries that will not have coal-fired generation will reach 21 in 2030 year. This trend will continue in the future. In 2030 year, up to 80% of the EU's electricity can be produced without the use of fossil fuels regardless of whether the European economy faces a prolonged economic crisis or a rapid recovery. At the same time, 60% of electricity will be generated on the basis of renewable energy sources (including hydroelectric power plants) [16].



**Fig.1.** The RES' share in electricity production in countries on 01.01.2019, (%)

Comparing the development of alternative energy in the EU and Russia, we can note that strict regulations are prescribed in an administrative and command style. The share of renewable energy in the total balance of electricity generation in 2020 should be 20%, in 2030 – 30% and so on. It is according to the EU Renewable Energy Directive (Renewable Energy Directive EU) adopted by the European Commission in 2009 for all EU states.

The exception is China, which considers the energy decarbonization from the point of view of relevance, regardless of the Paris Climate agreement. It is within the alternative energy development program. Investments in renewable energy allow Chinese companies to

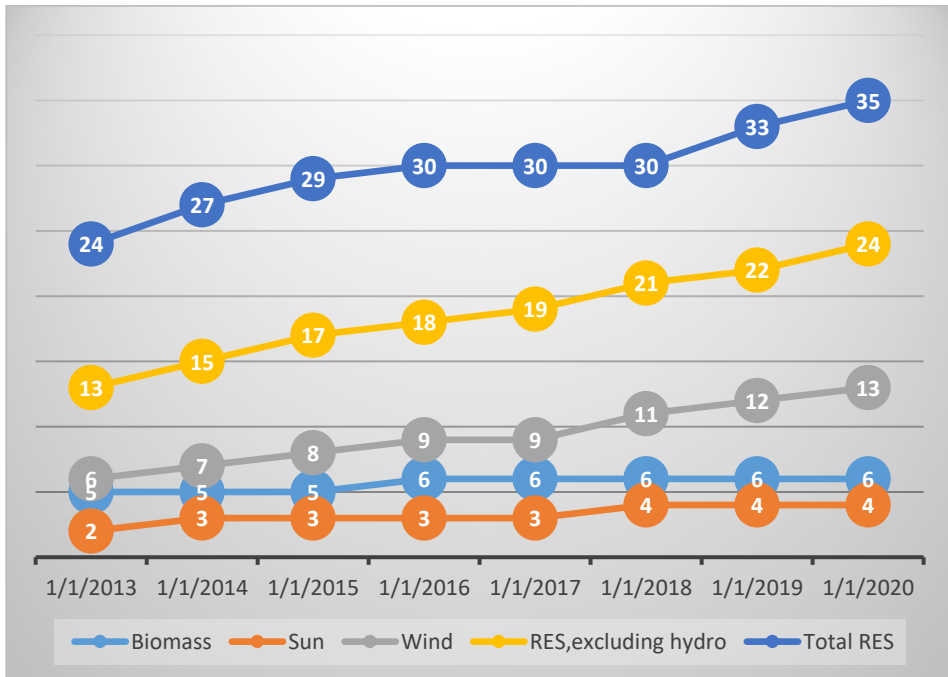
diversify sales of their products abroad in order to an overbooked domestic market and adopt some advanced technologies in offshore wind power generation [17].

Today, China is a favorite in the construction of hydroelectric power plants and hydro-accumulating power plants. They are quite efficient, sustainable and flexible in the operation of industrial, megawatt-class energy storage devices. This is due to the fact that in this country, the system operator is the owner and operator. It is the central dispatch department which is responsible for regulating the operation and stability of the combined power system. All owners of other power plants' types pay for these services at tariffs set by the state. Of course, this circumstance determines China's ability to introduce a large number of new renewable energy power plants without using budget financing [18, 19].

Renewable energy will account about 53% of Europe's energy supply in 2030. At the same time, most countries plan to implement their individual national plans in the field of energy and climate [20].

Currently there is an increase in the number of solar and wind power plants under construction around the world. They are in Europe, the United States, Australia, Asia, Africa and South America.

In the EU, there is a high rate of the electric power industry's transformation. Energy supply from wind and solar exceeded coal production (Figure 2) in 2019. The following graph shows the growth of the renewable energy share in the period 2010-2019 years. Here solar, wind energy and biomass are separately highlighted.

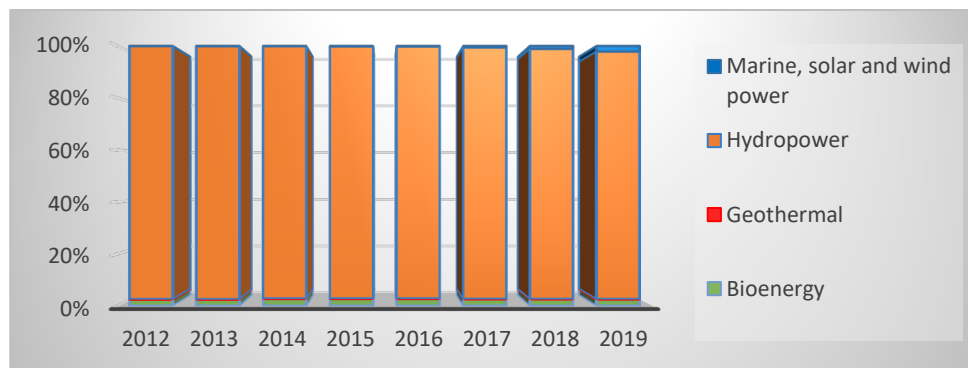


**Fig.2.** Change in the RES' share in the total volume of electricity produced in the EU for the period 2012-2019, (%)

The renewable energy share in the European electricity production has a 35% record. About 17% is generated by solar and wind energy. The solar and wind energy developed at a faster pace than coal in 2019. The coal-based electricity production declined by 24% in just one year. It was less than half of the 2007 year's level in 2019. There is a reduction in

production based on coal by 32%, brown coal-by 16%. As a result, the CO<sub>2</sub> emissions in the energy sector had a record of 12% reduction in 2019. It has been achieved in the European energy sector since 1990.

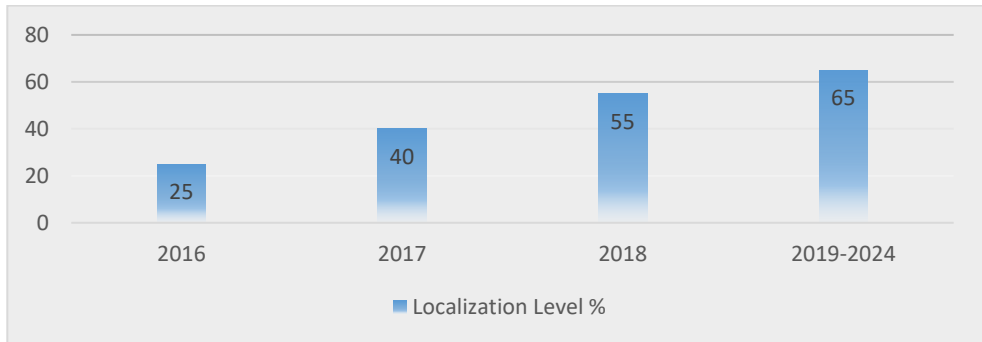
Figure 3 illustrates the structure of the installed capacity for RES in Russia. According to the figure, Russia's RES is mainly represented by hydropower (about 97% of the installed capacity). We can see that the contribution of solar, marine and wind energy is insignificant in contrast to other countries (a totally 2.12%).



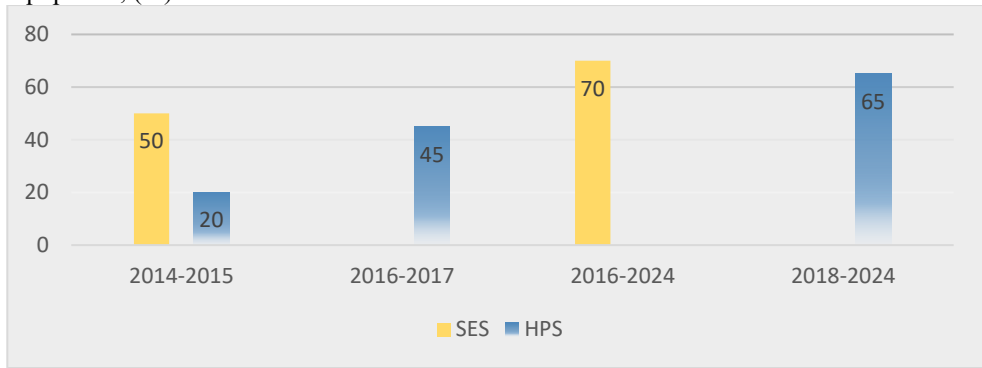
**Fig. 3.** Structure of installed capacity for Russian renewable energy sources in 2012-2019, (%)

The Russian wind energy industry has a huge potential in the geographical features and opportunities for climatic using. It allows to predict its further active development. The technical potential of the Russian wind energy industry is 80 ' 000 TWh per year according to the International Renewable Energy Agency IRENA. The production of 6'218 TWh is economically profitable. The Far East has the greatest economic potential (about 30%) for the wind energy development. The Northern Economic Region has 14% and Western and Eastern Siberia has 16%. The possibilities of the steppe expanses in southern Russia and the Arctic should be estimated [21].

Russia is a global driver of "green" growth. Based on these prospects for the wind energy development it should be stated that the production of its equipment is an undoubted catalyst for the renewable energy development here. The government adopted an Order No. 1472-r for stimulating the production of renewable energy and support the domestic production of the necessary equipment. It defines targets for the degree of the production localization for wind, hydro and solar energy equipment. According to this document, the target indicator for wind energy is 65% in 2019-2024, for SES it is 70% in 2016-2024 and for hydroelectric power plants it is 65% in 2018-2024 period (Figure 4,5).



**Fig.4.** Target indicators for the degree of the production localization for the wind power equipment, (%)

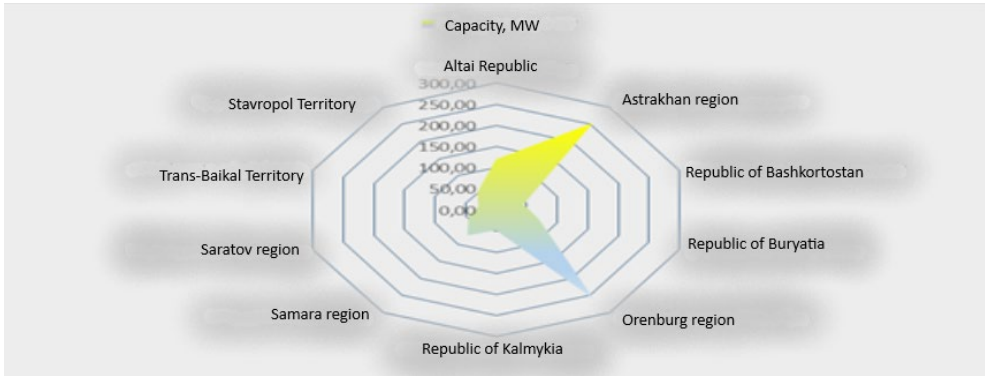


**Fig.5.** Target indicators for the degree of production localization for HPS and SES equipment, (%)

These targets in Russia determine the companies' ability to participate in the contracts' program for the renewable energy capacity provision. It is possible to achieve the localization level in wind energy according to the expert opinion of the Wind Industry Association (RAWI). It can be with 21% of design, construction and installation work at the wind farms, 18% of blades' production, 13% –towers' production, 17% –generators, gearboxes and hubs' production, 8% –inverters' production and 4% – transformers' production.

It should be noted that in Russia, a restrictive criterion is introduced in the wind energy field along with the target indicators. It is the minimum size of the installed capacity factor (ICF). The result of restrictive measures is the new industry formation with an export orientation.

Russia, on the one hand, significantly lags behind most other countries in the solar energy production. It has a significant potential for the solar energy development on the other hand. Nevertheless, 2019 year was the peak year for the Russian solar energy's development (the installed capacity of the SES is 1,362, 72 MW) (Fig. 6).



**Fig. 6.** The landscape of solar generation developments in the Russian Federation in 2019, (MW)

The “Hevel” Group of companies built 13 solar power plants in 2019 (total capacity is 323.5 MW). The “Solar Systems” company built 6 solar power plants (total capacity is 100 MW). The “Vershina Development” company built 7 solar power plants (total capacity is 105 MW). The main part of the SES is located in the Astrakhan and Orenburg regions.

The projected production of new solar generation in Russia can be more than 1.5 billion kWh per year. This volume allows us to provide energy to three regions such as the Altai Republic. The current support program for renewable energy sources allows to achieve the 2 GW volume of solar generation in 2024.

## 4 Conclusions

This article examines renewable energy and its growth opportunities. Russian renewable energy shows an increase in the part of hydropower, solar and wind energy over the period presented in the study. The current prevailing predominance of hydropower is accompanied by a slight increase in the industry. It is due to the additional commissioning of new hydroelectric power plants. Renewable energy shows limited potential in Russia. This is due to the high cost of renewable energy sources with low cost for oil and gas; climatic features and length of daylight hours; area and population density.

The opportunities and reserves for the renewable energy growth, as well as energy conservation and energy efficiency are quite huge in Russia. The potential of renewable energy in Russia and in the world is not sufficiently estimated. The economically available potential of renewable energy sources reaches about a third of all extracted fossil fuels. The technical potential is 25 times greater. Using only the economic potential of renewable energy sources increases their share in the energy balance to at least 25%. It frees up significant additional volumes of oil and gas for domestic processing and export (primarily in the chemical industry). Russia, as well as the EU countries, should be interested in the development of alternative energy, renewable energy sources (RES). They are solar and wind generation, small hydropower, energy production from biomass and others. It should be based on the understanding of the need to reduce the negative impact on nature.

The problems of developing renewable energy are mainly related to the fact that it is not always possible to develop renewable energy in Russia. In some regions there is little sun or wind power is not enough. And there is an opposite situation. In some particular region there are enough natural opportunities, but there is an energy abundance. In addition, the main problem of the modern renewable energy’s development in Russia is the low level of its financing.



Effective measures to promote the renewable energy development in Russia are tax incentives and preferential project financing; the issuance of "green certificates", confirming the generation of electricity from renewable energy sources; the development of renewable energy in remote and isolated regions. These measures' implementation is possible only with the parallel development of the institutional framework and investment in the technical re-equipment for "traditional" energy. In addition, the importance of behavioural practices, skills and technologies should be estimated in the renewable energy development. They are characterized by resource conservation, including energy conservation.

The current economic model for economic development is the "green" economy model. The global technological modifications taking place all over the world and aimed at changing the "green" economy model require technological alterations in the Russian energy sector. They require more progressive development of renewable energy. It is necessary to increase the energy and resource efficiency of the Russian economy and to define target indicators for the renewable energy development. Due to our research, we can track the dynamics of the renewable energy market as it develops today. It is possible to design a strategy for its development, taking into account the growth of renewable energy sources and reducing carbon emissions. We conclude that the volume of wind and solar energy in Russia continues to grow. It is by the relative decarbonization of the Russian Unified Energy System. We can talk about Russia as a major exporter of second-and third-generation biofuels in prediction of the alternative energy development and renewable energy in the long term. The immediate future is the small hydroelectric power plants and installations that use biomass.

All in all, the prospects and reserves for the renewable energy growth have significant potential in Russia. They are subjects for a further study.

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