STUDY

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

RUSSIA'S WIND ENERGY MARKET:

Potential for New Economy Development

Tatiana Lanshina

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Russia has the potential to produce and export renewable electricity, green hydrogen and other products with a low carbon footprint.

2020 was the year of wind generation in Russia, when, despite the COVID-19 pandemic, it was possible to launch a large number of industrial wind power plants. The main obstacle to wind energy in Russia is the small domestic market, guaranteed by the program of state support, due to the lack of a climate and environmental agenda in the country.

The study pays much attention to promising market niches for wind power in Russia, such as retail electricity markets in energy-deficient areas (creation of energy cooperatives).

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in cooperation with

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CONTENTS

PREFACE

After the Paris agreement has entered into force, the world is moving towards climate neutrality. Many countries including China, the USA and the European Union, have officially declared their goal to reach climate neutrality in the coming decades. Russia hasn't officially declared this goal yet, but it has shown promising signs with the ratification of the Paris agreement and several roadmaps, e.g regarding the future of energy or hydrogen. As the energy sector is the primary source of greenhouse gas, this will have a deep impact on the way the world uses energy, and it will drive the switch towards renewable energy. While some countries, including China or Germany, have already made big steps towards a renewable and climate neutral economy, Russia has just recently started to move in this direction.

However: Four years after the first comprehensive analysis of the Russian wind energy market was undertaken, interesting new developments have happened. With today a total installed wind power capacity of around 1 Gigawatt, Russia has appeared on the global wind power map, although the country is not yet amongst the big wind power nations. In particular the past year 2020, the year of COVID-19, brought an impressive 700 Megawatt of new installations.

Yet the market size is small accounting for less than 1% of the global market. And the wind power market has been dominated by a few players, both on the equipment and on the investment side. Russia has managed to set up some wind equipment production facilities on its territory, but the country has still not started developing its own technology.

To fully understand the challenge Russia is facing, it is important to emphasize that the Russian wind power sector is still very small not only in terms of Russia but also in terms of Russia's role in global energy markets. Given the global situation where the demand for fossil fuels is gradually but completely disappearing, Russia has now taken steps in the right direction by creating a wind power market and starting to harness its enormous wind potential.

It will be crucial that the wind power sector in Russia can continue to grow sustainably, and that Russia uses its great innovative spirit to create its domestic wind industry as well, including potentially thousands of good jobs across the supply chain. In addition to the market for grid-connected wind turbines, Russia has the potential to develop the market for off-grid wind and to become the world market leader in this previously unoccupied market segment.

Another interesting option is the production of "green" hydrogen from wind and other renewable sources. Current customers of Russian natural gas will sooner or later have to decide whether to produce their own hydrogen or import from other countries. Given the existing infrastructure, Russia would have a pole position in this race for the future world market leader in the supply of green hydrogen.

After the results of the previous FES/WWEA study on wind energy a few years ago showed that Russia has an enormous wind power potential, this study now presents an in-depth analysis of the current wind sector and its strengths and weaknesses.

If the country makes wind and other renewable energies a core of its national energy strategy, not only can Russia and its citizens and communities thrive, but the whole world can benefit, directly and indirectly.

The study was supported by the Friedrich-Ebert-Foundation and the World Wind Energy Association.

Given the potential effects of decarbonizing world economies on Russia, the search for a socially just ecological transition is one of FES main focuses. Developing industries based on renewable energies could play an important role in this transition.

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SUMMARY FOR DECISION MAKERS

As of early 2021, more than 1 GW of wind power plants are in operation in Russia, with more than 700 MW of that commissioned in 2020 despite all the difficulties and restrictions caused by the new COVID-19 pandemic. On a global scale, 1 GW of wind power capacity is insignificant as this is only 0.15% of the world's installed wind power generation. In Russia, wind power accounts for only 0.4% of the capacity of all the energy system and 0.13% of generation. Russia is the only major economy in the world where wind energy is just beginning to take its first steps.

Currently, Russia supports renewable energy sources (RES) in the wholesale electricity and capacity market (WECM), as well as in the retail electricity markets, including isolated territories. Significant volumes of wind power plant (WPP) construction are observed only within the framework of support for RES in the wholesale market, which is implemented through capacity supply agreements (CSA). By the end of 2024, this mechanism will ensure the construction of 5.86 GW of renewable energy power plants, of which 60% will be WPPs. In Russia, the share of renewable energy sources, excluding large hydroelectric power plants, will be 2.5% of installed capacity and 1% of electricity production. The renewable energy CSA program is planned to be extended for 2025-2035. Its volumes have not been approved yet, but recently the amount of support in the range of RUB 400 billion rubles or USD 5.5 billion is being discussed. This will make it possible to build another 7.5 GW of RES power plants, 60% of which will be WPPs. Thus, most likely that by the end of 2035, a total of a little more than 13 GW of renewable energy capacity will be built in Russia, excluding large hydroelectric power plants, which is equivalent to 5.4% of the total installed capacity and 2.3% of electricity production.

The modest indicators shown by the RES industry in the energy sector (shares in the balances of generation and capacity) do not detract from the significant results that have been achieved in the field of localization of the production of equipment for RES, which was initially one of the key objectives of the government support program for RES. In the wind energy sector, this formal task of localization support has been completed. As of the beginning of 2021, three groups of companies have been established in Russia. They manufacture equipment for, build and operate WPPs. The year of 2020 can be considered as the year of formation of Russian wind power generation, as despite the COVID-19 pandemic, numerous industrial WPPs were put into operation for the first time and with a high localization rate (65%). Unlike many countries around the world, where the pandemic has accelerated the energy transition and increased interest in renewable energy, the pandemic situation has not resulted in any positive long-term strategic implications for the energy sector in Russia.

The main obstacle to the development of wind energy in Russia is the insignificant volume of the internal market, which is guaranteed by the government support program due to the de facto absence of a climate and environmental agenda in the country. In order for the enterprises established under the first government support program and manufacturing wind power equipment to maintain the required minimum production volume, it is necessary to build at least 4 GW of wind power plants in Russia in 2025-2035, and for progressive technological development, deeper localization, and the arrival of new vendors, the construction of 5-13 GW of wind power plants will be required.

The Russian wind energy sector needs further cuts in capital expenditures, which cannot be achieved without sufficient domestic market volumes. Without this, it will also be difficult to develop exports of equipment. The high cost of electricity generated by WPPs in Russia, in turn, is often used as an explanation for the allocation of too low quotas for the construction of wind farms. Meanwhile, in Russia the WPP-generated electricity is already cheaper than that generated by a new coal-fired power plant and by 2030, it will also be cheaper than that generated by burning natural gas. According to estimates made during the research, the production of 1 kWh of wind power in Russia currently costs an average of 6.4 rubles, or 8.8 U.S. cents.

The study pays significant attention to the search for promising market niches in the wind energy sector in Russia. Within the framework of the second CSA RES program, further deepening of the localization of the equipment production for wind farms will be required. The development of wind energy in retail electricity markets in energy-deficient areas (including through the creation of energy cooperatives), as well as in isolated areas, will be rewarding. There is potential for the production of medium-capacity wind power plants to supply these markets and develop exports. Corporate

demand for electricity from renewable energy sources is being formed in Russia. In December 2020, Russian green certificates issued according to I-REC standards became available. In addition, corporations can switch to RES through the mechanism of free bilateral contracts, a Russian analogue to power purchase agreements (PPA), for the supply of electricity in the wholesale market, as well as consider the possibility of direct contracts for buying energy in the retail market. In the near future, corporate demand may appear precisely for wind farms. In addition, Russia has the potential to become a producer and exporter of renewable electricity, and other green commodities with a low carbon footprint, such as green steel, aluminum, cement, etc., the production of which requires electricity from renewables. In the coming years, there may arise interest in creating special green economic zones, including those on the basis of existing territories with a special status, where investors will be offered tax benefits, green infrastructure, and electricity from renewable energy sources. Active energy complexes are of particular interest in this regard. The presence of its own production of equipment for wind power plants and competencies in the field of wind energy open up new opportunities for Russia in developing wind energy per se and various related industries. These niches may be of interest to companies already operating in the market and to new Russian and foreign players, as well as to regions seeking to increase their investment attractiveness and find promising areas for further industrial development.

INTRODUCTION

According to preliminary estimates by the IEA, renewable energy will account for nearly 90% of the world's new installed generating capacities in 2020. Over the year, 200 GW of new green generation was built, with wind farms accounting for 65 GW or an 8% increase over 2019. A total of 689 GW of wind power is estimated to have been installed by the end of 2020 worldwide.[1] WWEA has even higher expectations forecasting new global record wind power plants installations of over 90 GW for 2020, which will show a 50% increase over new installations in 2019[2]. In Germany, wind power generated 27% of all electricity in 2020. [3] It is expected that in 2021, the growth of the renewable energy sector will be the highest in the last 6 years. RES will become the world's largest source of electricity by 2025, after half a century of coal dominance.[4] Wind power could supply more than a third of the world's electricity by 2050 and become the main type of generation.[5] In Russia, these trends have not yet received due attention. At the moment, a decision is being made to support RES for the period up to 2035, and the volumes discussed are small and not comparable to the global pace of development of this sector.

Nevertheless, the events of the global energy sector cannot but affect the Russian market, especially in the part that concerns Russia directly. The introduction of a cross-border carbon tax by the EU is a concern both in the corporate sector and at the highest official level. The availability of production capacities and competencies in the field of wind energy can reduce the economic losses of Russian exporters from the introduction of such a tax. New international challenges can become an additional incentive for the development of green projects at the intersection of energy and industry. In Russia, especially at the regional level, there is a shortage of promising ideas that can become the drivers of economic development in the coming years. The search for and research of such opportunities is highly relevant now, and this is exactly the task of this study, which builds on a previous paper published in 2017[6].

1 IEA (2020b). Renewables 2020. Analysis and forecast to 2025. URL: https://www.iea.org/reports/renewables-2020/wind#abstract

2 WWEA (2020a). World wind capacity at 650,8 GW, Corona crisis will slow down markets in 2020, renewables to be core of economic stimulus programmes. URL: https://wwindea.org/world-wind-capacity-at-650-gw/

3 Energy-Charts (2020). Net public electricity generation in Germany in 2020. URL: https://energy-charts.info/charts/energy_pie/chart.htm?l=en&c=DE&year=2020

4 IEA (2020b). Renewables 2020. Analysis and forecast to 2025. URL: https://www.iea.org/reports/renewables-2020/wind#abstract

5 IRENA (2019). Deployment, investment, technology, grid integration and socio-economic aspects. URL: https://www.irena.org/publications/2019/Oct/Future-of-wind

6 Gsänger S., Denisov R. (2017). Perspectives of the wind energy market in Russia. URL: https://library.fes.de/pdf-files/bueros/moskau/13474.pdf.

1.

CURRENT STATE OF WIND ENERGY IN RUSSIA

Small-scale wind power was actively deployed in the USSR in the 1950s and 1960s. The USSR was the leading country in the sphere of wind energy worldwide at that time. However, the industry has never faced any ambitious goals. The formation of modern wind energy sector in Russia began only a few years ago, after the government decided to support renewable energy sources. Certain achievements have been made during that time. Government support mechanisms have been developed and improved, production facilities have been created, and the first industrial wind farms have been built. At the same time, despite its rapid start, Russia still lags significantly behind many other countries, and new actions and efforts are required to reduce this gap.

1.1. REGULATORY ISSUES

The Russian renewable energy generation market consists of four segments: the wholesale electricity and capacity market, retail electricity markets, territories isolated from the Unified Energy System (UES) of Russia, and microgeneration. Microgeneration has very limited relevance to wind power, since micro-WPPs are not a popular solution to the problem of electricity supply in the world. Therefore, the study analyzes overall national renewable energy goals and RES regulations for the wholesale and retail markets, as well as for isolated areas, with a focus on wind energy.

1.1.1. Overall Objectives in RES

Compared to other countries, the targets set for the RES sector in Russia cannot be called ambitious. Not all existing targets are being met. In accordance with Order of the Government of the Russian Federation No. 1-r of 08.01.2009 "On approval of the Main Directions of State Policy in the Field of Increasing Energy Efficiency of the Electric Power Industry based on the use of renewable energy sources for the period up to 2035," taking into account all the changes in this document, for the period till 2024 Russia plans to achieve the following RES levels in electricity generation, except for hydroelectric power plants (HPPs) with a capacity of more than 25 MW:[7]

2010 — 1.5%,
2015 — 2.5%,
2024 — 4.5% (until 2015, it was expected to reach the level of 4.5% by 2020).

The targets for 2010 and 2015 were not achieved, and the target for 2024 will also not be met. The main mechanism for RES development in Russia is the mechanism of capacity supply agreements (CSA) in the wholesale electricity and capacity market (WECM), and, as will be shown below, the RES share in generation — excluding large HPPs — will be about 1% by the end of 2024. The CSA RES mechanism has been in place since 2013. Since 2015, Russia has also been providing state support for RES in the retail electricity markets, but its contribution to the development of the RES market is not yet significant.

All Russian strategic documents assume that in the foreseeable future, fossil fuels will continue to form the basis of the Russian fuel and energy complex, and renewable energy sources, excluding large hydroelectric power plants, will make only an insignificant contribution to the energy sector development. The Energy Strategy of the Russian Federation, approved in June 2020 for the period up to 2035, specifies the task in the field of renewable energy as only "to improve the efficiency of energy supply to remote and isolated territories." As a quality indicator in achieving this goal, the Energy Strategy provides for a reduction of the economically justified production costs of 1 kWh of electricity in the territories of decentralized electricity supply by 6% by the year of 2024 and by 17% by the year of 2035, compared to 2018. In other words, creating conditions for the development of large-scale renewable energy is not the task of the Russian power engineering sector for the next fifteen years.

7 Large hydroelectric power plants occupy a significant place in the Russian electric power industry, as they account for about 17% of generation.

Renewable energy is also not given due attention in the General Scheme for the Placement of Electric Power Facilities for the period up to 2035, approved by Order of the Government of the Russian Federation No. 1209-r of 12.06.2017. The document considers the scenario of increasing the installed capacity of renewable energy generation facilities to 11.6 GW by 2035. This will account for approximately 4.5% of the country's installed capacity and about 2% of generation. Thus, the General Scheme does not provide for the implementation of the renewable energy target for 2024, even by 2035.

Development of hydrogen energy is planned in Russia. Thus, the Energy Strategy of the Russian Federation for the period up to 2035 sets targets for the export of hydrogen – 0.2 million tons by 2024 and 2 million tons by 2035. Also in 2020, Russia approved an action plan for the development of hydrogen energy until 2024. A hydrogen strategy will be developed in 2021. None of the available documents relies on the development of green hydrogen energy, which is the production of hydrogen from water through electrolysis using electricity generated from renewable energy sources or the production of hydrogen by biomethane reforming. So far, Russia intends to produce hydrogen from natural gas and using nuclear power.

Russia is developing a national system for regulating greenhouse gas emissions and a low-carbon development strategy for the period up to 2050. At that, Russia is one of the few major economies in the world that lacks a formal discussion about achieving carbon neutrality by mid-century. The EU will transfer to zero net greenhouse gas emissions and replace the linear model of economic development with a cyclical one by 2050. The administration of US President Joe Biden intends to achieve zero net greenhouse gas emissions and a transition to 100% clean energy by 2050. In 2020, China announced its intention to become carbon neutral by 2060. Japan and the Republic of Korea pledged to achieve this by 2050. Many of these goals are still only promises, but the long-term outlook is very important for investors. Such statements clearly indicate the general direction of development of the world's largest economies over the next three decades.

1.1.2. Support for RES in the Wholesale Electricity and Capacity Market

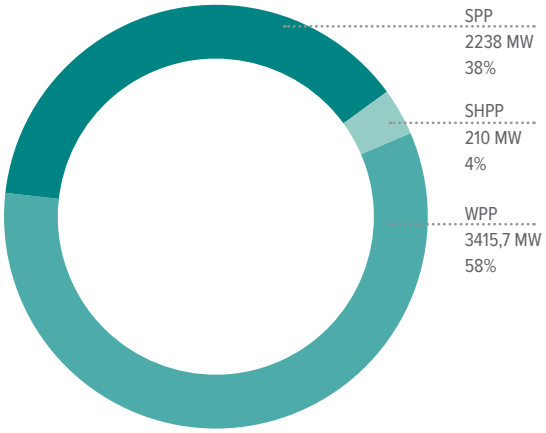
The first renewable energy support program on the wholesale electricity and capacity market (WECM) for the period of 2014-2024 was adopted in 2013. Admission to participation in the program is on the basis of an annual competitive selection (tender) for 4-5 years in advance, the maximum limit of which is approved in advance by the government for each type of generation. Three types of renewable energy projects can participate in the tenders: photovoltaic solar power plants (SPP), mainland wind power plants (WPP) and small hydroelectric power plants (SHPP) with a capacity of up to 25 MW. Tenders are held separately for each type of generation. Buyers in the wholesale market conclude contracts for the supply of RES capacity (CSA RES) with the winners. Projects are selected by the Wholesale Electricity Market Trading System Administrator on the basis of minimum specific capital costs. In this case, the specific capital costs of the projects submitted for the tender shall not exceed the limit values approved by the government for each type of generation. Selected projects are guaranteed a yield of 12%-14% per annum in the course of 15 years. The CSA RES facilities receive a capacity fee, which is secured through increased consumer payments in the wholesale market, and a fee for electricity. The capacity fee is calculated according to a special formula, taking into account the capital costs declared at the competitive selection. It accounts for 80%-90% of the revenues of a CSA RES facility. Upon expiration of CSA RES (15 years), the facility receives only the electricity fee. Support for renewable energy sources in the wholesale electricity and power market (WECM) is similar to support for thermal (TPP) and nuclear power plants (NPP), as well as large hydroelectric power plants (HPP), which are also financed with the help of CSA.

By the end of 2024, 5.86 GW of renewable energy generation will be built in Russia, excluding large hydroelectric power plants. This would be equivalent to 2.5% of installed capacity and 1% of electricity generation. About 60% of the program will be covered by wind energy, and almost 40% by solar energy. The planned volume of commissioning of small HPPs is insignificant (Figure 1).

The renewable energy support system in the wholesale electricity market (WECM) provides for fines, for example, for delays in the commissioning of new power plants, for deviations from the regulatory installed capacity utilization factor (CUF), and non-compliance with the localization requirements for the production of RES equipment in Russia. Localization was the main goal of the first CSA RES program. Currently, in order to receive a full capacity fee, it is necessary for a wind farm to provide localization at a level of no less than 65%. If this requirement is not met, the capacity fee is reduced by 55%.

Figure 1.

Renewable energy facilities to be built in Russia under CSA RES by 2024



Source: Order of the Government of the Russian Federation No. 1-r of 08.01.2009 "On approval of the Main Directions of State Policy in the Field of Increasing Energy Efficiency of the Electric Power Industry based on the use of renewable energy sources for the period up to 2035," in the current version.

A total of 8 selections of RES projects were conducted over the period of eight years from 2013 to 2020, where 105 WPP projects were selected, excluding projects that were selected but will not be implemented. The most recent selection took place in November 2020, and all wind farms are to be commissioned by the end of 2024. According to estimates by Russia Renewable Energy Development Association (RREDA), the GDP growth as a result of the implementation of the first CSA RES program will amount to RUB 1.01 trillion with the investment multiplier of 2.21. This means that every ruble invested in the RES industry will generate 2.21 rubles of GDP.[8]

In March 2021, there was no certainty regarding the RES support in the WECM for the period after 2024, which made it difficult to plan the activities of the wind energy market participants. In 2019, a decision was made to extend the CSA RES program until 2035, but the scope of this program has not been approved yet. Discussion on the scope of the second CSA RES program for the period of 2025-2035 started from RUB 700 billion (USD 9.6 billion at the current exchange rate) and then this amount was reduced to RUB 400 billion (USD 5.5 billion). For comparison, during the first stage of RES support through the CSA, investments in generation facilities and production capacity will amount to about RUB 700 billion. In 2025-2035 it will be possible to build about 7.5 GW of RES power plants for RUB 400 billion. (Figure 2)

In October 2020, the Ministry of Economic Development proposed another reduction in the program -- to RUB 200 billion (USD 2.7 billion) -- due to concerns that the increase in electricity tariffs could not be kept within the limits of inflation. In January 2021, the Ministry of Energy and the Ministry of Economic Development tentatively agreed on the program volume of 306 billion rubles (USD 4.9 billion). In the official correspondence, it is assumed that these funds will be used to build 4.6 GW of renewable energy generation in the period from 2025 to 2035, of which 59% is proposed to be allocated for wind energy. Meanwhile, in early February 2021, the Ministry of Industry and Trade insisted that the volume of the second CSA RES program should be at RUB 400 billion, and this still remains the main option.

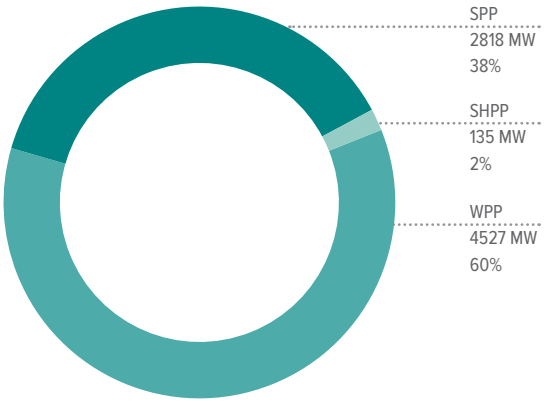
The volume of the second CSA RES program of 400 billion rubles was recognized by industry participants as the minimum possible to maintain in the market those manufacturing facilities that have been created in Russia so far. Such financing would allow commissioning of about 400 MW of wind farms per year, a number which will not make Russia an internationally relevant wind power player, as it represents only around 0.5% of the world market for wind turbines. Given that there are three groups of companies in the Russian wind energy market right now and construction of 150-200 MW per year for each of them is the minimum acceptable, even RUB 400 billion of the RES support program may be insufficient for the healthy development of the wind energy sector. There is a risk that with such a level of support, 1-2 groups of companies will leave the market, which will entail the loss of production facilities, jobs, and competencies. And the already low level of competition which is a driver of cost reduction and technical innovation in the leading wind power markets may completely vanish.

Despite the fact that the main parameter of the second CSA RES program – the amount of support – is still unknown, decisions on some rules for the period up to 2035 have already been made. The first official document regulating the second CSA RES program was published in October 2020. It was Order of the Government of the Russian Federation No. 2749-r of 24.10.2020, which amended Order of the Government of the Russian Federation No. 1-r of 08.01.2009 "On approval of the Main Directions of State Policy in the Field of Increasing Energy Efficiency of the Electric Power Industry based on the use of renewable energy sources for the period up to 2035." In March 2021, the Resolution of the Government of the Russian Federation of 05.03.2021 No. 328 was published, which amended the Rules for the wholesale electricity and

8 Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

Figure 2.

RES facilities to be built in Russia under CSA RES-2 in 2025-2035, preliminary distribution



Source: RREDA data.

capacity market, approved by the Resolution of the Government of the Russian Federation of 27.12.2010 No. 1172. According to the amendments, it is planned to increase the localization requirements and introduce requirements for the export of equipment for the period of 2025-2035. From 2024 onwards, the localization requirements will not be presented as a percentage but in points. For wind energy, the target is 87 points for the period of 2025-2030 and 102 points for the period of 2031-2035. As for exports, WPPs should provide no less than 5% of exports in 2025-2029, at least 10% in 2030-2032, and at least 15% in 2033-2035. The value of the export target for the generation facility is defined as the ratio of the export revenues of industrial products attributable to the generation facility to the total capital expenditures for the construction of the generation facility.

The penalty for non-compliance with localization requirements has been increased - up to 75% of the capacity payment. The penalty for non-compliance with the requirements for the export of equipment will be 10% of the payment for capacity in 2025-2029, 21% – in 2030-2032 and 33% – in 2033-2035. The key innovation of the new rules is the transition to the selection of projects by price per 1 kWh (efficiency indicator), taking into account capital and operating costs and the volume of production, and not only by capital costs, as before.

The new requirement for equipment export is a serious challenge for investors in wind power generation, and equipment manufacturers must ensure compliance with the export requirements while electricity generators will pay fines for non-compliance with these requirements. This seems not logical and counterproductive. Such requirements are in contrast to the experience of successful wind technology exporting countries, the success of which is usually based on a strong domestic market and technological leadership. Clients outside the domestic markets purchase equipment due to its competitiveness. Export requirements may also hamper efforts of new Russian companies to enter the market with their products. Moreover, Russia still has little experience in exporting wind power equipment. In the spring of 2020, Vestas Manufacturing Rus shipped the first 48 blades to Denmark for export. The customer was one of the Vestas partners in Denmark.

1.1.3. Support for RES in Retail Electricity Markets

Support for renewable energy sources in retail electricity markets began to work in Russia in 2015 after the entry into force of Order of the Government of the Russian Federation No. 47 of January 23, 2015 "On Amendments to Some Acts of the Government of the Russian Federation on the Promotion of Renewable Energy Sources in Retail Electricity Markets." This document defines the rules for the inclusion of renewable energy facilities in regional schemes and programs for the development of the electric power industry on the basis of competitive selections in the subjects of the Russian Federation. If a RES facility is included in the regional scheme and the regional program for the development of the electric power industry and if such facility passes the qualification procedure, it is granted the right to set a special tariff for the sale of electricity in favor of the territorial grid organization to compensate for its network losses for 15 years. The possibilities of implementing RES projects in retail markets are limited by the maximum allowable amount of chargeable generation from RES at the level of 5% of total grid losses.

According to the Renewable Energy Development Association (RREDA), the potential of renewable energy in the retail market in Russia is 3 GW.[9] This potential has so far not been fully realized because the support mechanism allowed grid companies to enter into a power purchase agreement after the construction of the power plant, and this created risks for investors regarding the connection of the power plant to the grid and risks regarding the size of the tariff. In addition, unlike the wholesale electricity and capacity market, there are no targets set for renewable energy genera-

9 Russia Renewable Energy Development Association (RREDA) (2020a). Renewable energy market in Russia: current status and development outlook. URL: https://rreda.ru/bulletin

tion inputs in retail markets. According to RREDA, in the period from 2015 to 2020, only about 350 MW of capacity was selected at tenders in 14 regions of Russia.[10]

Resolution of the Government of the Russian Federation No. 1298 of August 29, 2020 "On the Promotion of Renewable Energy Sources, Amendments to Some Acts of the Government of the Russian Federation, and the Annulment of Some Provisions of Certain Acts of the Government of the Russian Federation" obliged grid companies to sign a power purchase agreement with a RES generation facility immediately after the tender results are announced, i.e. before the construction. This removes the risk of network failure to connect the constructed power plant, which was previously quite high, as well as the risk of tariff approval at a level that would not allow for the project payback. In addition, the new document increases the transparency of the mechanism for supporting RES in retail markets. In particular, regional tenders will now be held in all regions that have approved them, at the same time and under the same rules. The selection criteria will be the minimum single-rate cost of producing 1 MWh of electricity (levelized cost of electricity or LCOE), rather than unit capital costs, as before. The tariff will be set on the basis of this price.

1.1.4. Support for RES in Isolated Areas

Isolated territories are not connected with the UES of Russia and are classified as retail electricity markets. Diesel power plants (DPP) form the basis of power generation in such areas. The peculiarity of the renewable energy market in the non-UES areas is that due to the high cost of diesel generation, it can develop almost without additional financial support from the government or consumers. On the contrary, due to development of this market, it is possible to save budget funds spent on subsidizing expensive electricity generated by diesel power plants. Since the power supply of isolated areas is characterized by specific context, the possibilities of supporting power generation there should be considered separately.

Many RES projects in isolated areas are implemented through a traditional commercial or government contract for the procurement of equipment. Aside from this, the most important mechanism for the development of RES in the non-UES areas is the energy service contract. Russian Federal Law No. 261-FZ of 23.11.2009 "On Energy Saving and Improving Energy Efficiency, and on Amendments to Certain Legislative Acts of the Russian Federation" provides for the possibility of modernizing electricity generation facilities through the mechanism of energy service contracts. The subject of such a contract is "the implementation by the contractor of actions aimed at energy saving and increasing the energy efficiency of utilizing energy resources by the customer." The energy service contract shall contain a provision regarding the amount of energy savings, including the monetary terms.

Resolution of the Government of the Russian Federation No. 64 of January 30, 2019 "On Amendments to Certain Acts of the Government of the Russian Federation on the Regulation of Prices (Tariffs) for Electric Energy (Power) Supplied in Technologically Isolated Territorial Electric Power Systems and in Territories Not Connected to the Unified Energy System of Russia and Technologically Isolated Territorial Electric Power Systems, and Annulment of Certain Acts of the Government of the Russian Federation" provided generation facilities and energy supplying organizations with the opportunity to keep the electricity tariff unchanged for 5 years in case of saving fuel costs, including through the transition to hybrid generation using renewable energy sources. This increases the economic attractiveness of the implementation of hybrid generation projects.

Also in 2019, the Action Plan for the modernization of ineffective diesel (fuel oil), coal generation in isolated and hard-to-reach areas was approved. It provides for the collection and disclosure of information about generation facilities in such areas and competitive selections of projects for modernization, including those based on renewable energy sources. The winner of the tender must enter into a long-term contract with a fixed price for the supply of electricity.

1.2. LOCALIZATION OF EQUIPMENT PRODUCTION FOR WIND ENERGY

Wind power plants were produced in the USSR since the 1920s. In the 1950s-1970s, the volume of serial production of wind turbines with a capacity of up to 100 kW was several thousand units per year, and this was unique on the global scale.[11] The Central Aerohydrodynamic Institute (TsAGI) developed wind turbines

10 Russia Renewable Energy Development Association (RREDA) (2020b). The government intends to support the retail market of renewable energy generation with a comprehensive approach. URL: https://rreda.ru/novosti/tpost/ge9taucs4s-gosudarstvo-namereno-podderzhat-roznichn

11 Gsänger S., Denisov R. (2017). Perspectives of the wind energy market in Russia. URL: https://library.fes.de/pdf-files/bueros/moskau/13474.pdf.

of various capacities and for various applications.[12] However, Soviet wind turbines were used mainly for agriculture and the development of virgin lands. After the start of active construction of nuclear power plants and large hydroelectric power plants in the 1970s, interest in wind energy in the USSR was lost, while in the world due to the oil crisis of 1972-1973, it began to grow. In the late 1980s, the USSR attempted to revive wind energy at a new technological level. The attempt failed due to the political crisis and the collapse of the Soviet Union.[13] By the beginning of the implementation of the first CSA RES program (in the early 2010s), Russia was assembling single wind turbines with a capacity of up to 250 kW, including those after being used abroad.

During the implementation of the first CSA RES program in Russia, the production of equipment for modern wind power generation was set up from scratch. It became a new branch of power engineering in Russia. Through the transfer of foreign technologies with the maximum involvement of Russian companies in the supply chain, the production of components for modern wind turbines with a unit capacity of 2.5-3.8 MW was set up. Under the first CSA RES program, it was possible to attract over 40 billion rubles of investments in new production facilities. The production potential of the created industrial cluster allows manufacturing equipment for 0.9-1.2 MW of wind power plants per year.[14]

By the beginning of 2021, three groups of significant investors were operating in Russia, each of which attracted its own technology partner to localize the production of multi-megawatt wind turbines:

1) Wind Energy Development Fund of Fortum and RUSNANO. The technology partner is the Danish company Vestas. In 2018, RUSNANO and Vestas, with the participation of Avilon LLC, organized the production of blades for wind turbines with a capacity of 3.4-4.2 MW by Vestas Manufacturing Rus in Ulyanovsk. The production capacity is 250-300 blades per year. Vestas and RUSNANO have also localized the assembly of nacelles for wind turbines in Dzerzhinsk, Nizhny Novgorod Region, at the site of German company Liebherr, and production of towers in Taganrog, Rostov Region. As of the beginning of 2021, the level of localization of wind farm equipment, confirmed by the Ministry of Industry and Trade of Russia, was more than 65%. The consortium is also developing education in the field of wind energy. In 2019, the RUSNANO Fund for Infrastructure and Educational Programs (FIEP) in partnership with the Bauman Moscow State Technical University (MSTU) and the Ulyanovsk State Technical University created two educational programs that train more than 100 specialists in the field of wind energy.

2) NovaWind JSC, a division of Rosatom State Corporation. The technology partner is the Dutch company Lagerwey (owned by the German company Enercon since 2018). Atommash, Rosatom's power engineering center, localized production of a generator stator, rotor, and main bearing for a wind turbine, generator, hub and nacelle in Volgodonsk, Rostov Region. 254 jobs were created and the production capacity is 96 wind turbines per year. It is possible to produce 2.5 and 4 MW wind turbines. VetroStroyDetal LLC in Volgodonsk, Rostov Region, manufactures modular steel towers for wind turbines of NovaWind JSC. About 50 jobs were created under this project. As of the beginning of 2021, the level of localization of windmill equipment, confirmed by the Ministry of Industry and Trade of Russia, was more than 65%.

3) PJSC Enel Russia. The technology partner is Siemens Gamesa, a joint venture between the German and Spanish companies of the same name (59% Siemens, 41% Gamesa). Production of steel towers for wind turbines was localized in 2018 at the VRS Towers plant in Taganrog (51% owned by the Spanish Windar Renovables and 24.5% each by RUSNANO and Severstal). The plant also manufactures towers for wind farms of the Wind Energy Development Fund. In addition, a nacelle assembly facility was set up in the Leningrad Region on the basis of gas turbine production by Siemens Gas Turbine Technologies (SGTT). Russian electrical engineering concern Ruselprom was selected as the supplier of generators for wind turbines and SVEL Group, as the supplier of power transformers.

Materials from Russian suppliers are used for the production of wind turbine components. For example, in the production of blades Vestas Manufacturing Rus LLC in Ulyanovsk uses fiberglass produced by OS Steklovolokno JSC in Gus-Khrustalny. Components and materials for wind turbines are manufactured in Moscow, St. Petersburg, Yekaterinburg, Petrozavodsk,

12 Yermolenko G. et al. (2014). Development of grid-connected wind power plants in Russia through the example of the pilot project of grid-connected WPP Mirny in the Yeisk District of the Krasnodar Krai // Energeticheskiy Vestnik. No. 17, pp. 20-30.

13 Bezrukikh P.P. (2010). Wind energy (reference and methodological manual). Moscow, Publishing House Energia, 320 p.

14 Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

Vladimir, Gus-Khrustalny, Dzerzhinsk, Lipetsk, Usmani, Cheboksary, Penza, Ulyanovsk, Togliatti, Syzran, and Taganrog. Ten Russian universities are already training specialists in the field of renewable energy, including RES, namely the above-mentioned Bauman Moscow State Technical University (MSTU) and the Ulyanovsk State Technical University, Moscow Power Engineering Institute, Gubkin Russian State University of Oil and Gas, St. Petersburg State University, Kuban State Agrarian University, South Ural State University, Ural Federal University, Nizhny Novgorod State Technical University, Tomsk Polytechnic University.[15]

One of the mechanisms of government support for localizing the production of equipment for wind power plants in Russia is special investment contracts (SPIC), provided for by Federal Law No. 488-FZ of 31.12.2014 "On Industrial Policy in the Russian Federation." One of the parties to the SPIC is an investor who, within a certain period of time, undertakes to create a mass production of industrial products using modern technologies in Russia. The other parties are the Russian Federation, the subject of the Russian Federation, and the municipality, which undertake to provide the necessary conditions for the implementation of the project and provide a number of benefits, such as tax benefits. Participation of authorities at all levels is mandatory. Competitive selection of participants is carried out for the conclusion of SPIC. The contract between Vestas Manufacturing Rus LLC, the Ministry of Industry and Trade of the Russian Federation, and the Ulyanovsk region became the first SPIC of the Russian industry of energy equipment manufacturing. The result of this project was the creation of a production of composite blades for wind turbines in Russia. As part of SPIC, Russia's first production facility for wind turbine towers was organized, the VRS Towers plant. A special investment contract was concluded between Severstal, VRS Towers LLC, the Russian Federation, and the Rostov region. Also under the SPIC mechanism, NovaWind JSC and the Russian-Dutch enterprise Red Wind B.V. established production of generators and nacelles in Volgodonsk, Rostov Region.

It should be noted that it is the localization of production, and not the generation of clean electricity itself, that is the main goal of the first CSA RES program. The main interest in the field of renewable energy both at the federal and regional levels has been and remains the creation of production facilities, transfer of modern technologies, and creation of permanent jobs. Despite the fact that the first CSA RES program will be in effect until the end of 2024, these tasks can be considered as completed now, although so far little activities can be found in R&D which would lead to the development of domestic technologies.

1.3. WIND POWER GENERATION

During the first four years of RES support in the WECM, not a single wind power plant could be put into operation due to excessive requirements for localization of equipment production and fluctuations in the ruble exchange rate in 2014, which increased the capital costs of the projects. Then the localization requirements were lowered. A coefficient for the currency component of planned capital expenditures was introduced into the calculation of the price for the capacity of RES generation facilities that won the first tenders. These events made it possible to start the implementation of the first construction projects of large wind farms in Russia.

Russia's first wind farm in the wholesale electricity and capacity market - Ulyanovskaya WPP-1 - was commissioned in the Ulyanovsk Region in January 2018 by Fortum. It consists of 14 wind turbines with a capacity of 2.5 MW each, located on 97 hectares. The total capacity of the wind farm is 35 MW. Wind turbines of the Chinese company Dongfang Electric Wind Company Limited were used at this facility. The second wind farm in the Ulyanovsk region (Ulyanovskaya WPP-2) was already built by the Wind Energy Development Fund, established on a parity basis by Fortum PJSC and Rusnano Group in 2017. Ulyanovskaya WPP-2 began supplying electricity to the WECM in January 2019. It consists of 14 wind turbines with a capacity of 3.6 MW each, the total capacity is 50 MW. This project is the first completed the Wind Energy Development Fund project and the first wind farm to use Russian equipment.

In 2020, six wind farms of the Wind Energy Development Fund started operating. The Sulinskaya wind farm, with a capacity of 100 MW, was put into operation in the Rostov region in March 2020. The power plant consists of 26 wind turbines with a capacity of 3.8 MW. In May 2020, the Wind Energy Development Fund commissioned the 100 MW Kamenskaya wind farm in the Rostov Region. The wind farm consists of 26 wind turbines with a capacity of 3.8 MW. In June 2020, the Gukovskaya WPP (Rostov Region) with a capacity of 100 MW began supplying electricity to

15 Russian Association of Wind Power Industry (RAWI) (2020). Review of the Russian Wind Energy Market and Russian regions ranking 2019. URL: https://rawi.ru/2020/03/obzor-rossiyskogo-vetroenergeticheskogo-ryinka-za-2019-god-razmeshhen-na-sayte-ravi/ and company materials.

the WECM. It consists of 26 wind turbines with a capacity of 3.8 MW. In December 2020, in the Republic of Kalmykia, the Wind Energy Development Fund commissioned the Tselinskaya and Salynskaya wind farms, each with a capacity of 100 MW. A total of 48 turbines with a capacity of 4.2 MW were installed in the Republic of Kalmykia. Also in December 2020, the Wind Energy Development Fund commissioned the first phase of the Cossack wind farm in the Rostov Region. Its capacity is 50 MW (12 wind turbines with a capacity of 4.2 MW), it will be increased to 100 MW in the future.

In March 2020, the first wind power plant of NovaWind JSC – Adygea Wind Power Plant with a capacity of 150 MW – was put into operation. It consists of 60 wind turbines of 2.5 MW each, located on a 14-hectare site. In January 2021, NovaWind JSC began generating electricity at the 210 MW Kochubeyevskaya wind farm in Stavropol Krai. Kochubeyevskaya is currently the largest wind farm in Russia. It consists of 84 units.

In November 2020, the Yustinskaya WPP (Republic of Kalmykia) of WPP Breeze began supplying electricity to the wholesale electricity and capacity market. Its capacity is 15 MW. The power plant consists of 25 units with a capacity of 600 kW each. The units were manufactured specifically for this project with a localization level of 40%.

In total, by the end of 2020, two groups of companies, the Wind Energy Development Fund (which includes Fortum, the company that built the first Russian wind farm) and NovaWind JSC, as well as Breeze Wind Farm built and started operating 10 wind farms in Russia with a total capacity of 800 MW.[16] The degree of localization of equipment of NovaWind's WPPs as well as the WPPs of the Wind Energy Development Fund (excluding the Ulyanovsk Region wind farms) has been confirmed by the Ministry of Industry and Trade of Russia at the level of more than 65%.

For the reasons outlined above (inflated localization requirements at the beginning of the first CSA RES program and the ruble devaluation in 2014), the actual commissioning of WPPs is significantly behind the schedule. The exception is 2020, when, despite the pandemic of the new coronavirus infection, the real volume of power plant commissioning turned out to be higher than originally planned based on the results of selection (Figure 3). Since the production of equipment in Russia has already been established, the shortcomings of the initial CSA RES program have been eliminated, and the return of invested funds to investors under the CSA programs is guaranteed, the planned volumes of commissioning of wind power plants in WECM will most likely be met in full by the end of 2024.

In the years 2021-2022 the Wind Energy Development Fund plans to put into operation the second stage of the Cossack wind farm in the Rostov Region (50 MW), Kotovskaya and Novoalekseevskaya wind farms in the Volgograd Region (105 MW), Kholmskaya, Chernoyarskaya and Staritskaya wind farms in the Astrakhan Region (176 MW), as well as Izluchnaya and Manlanskaya wind farms in the Astrakhan Region (164 MW). All new Wind Energy Development Fund wind farms will have turbines with a capacity of 4,2 MW each. NovaWind is building Karmalinovskaya and Bondarevskaya wind farms in Stavropol Krai (180 MW) and Marchenkovskaya wind farm in the Rostov Region (120 MW). In 2021, the first wind farm of the third group of companies, the 90 MW Azov wind farm of Enel Russia in the Rostov Region, is expected to be commissioned. The wind farm will consist of 26 SG 3.4-132 turbines. It was planned that the Azov wind farm will begin supplying electricity to the wholesale electricity and capacity market in December 2020, but due to the pandemic restrictions, the commissioning of the facility had to be postponed. In addition, Enel Russia is building wind farms in Stavropol Krai and Murmansk Oblast. The size of the Wind Energy Development Fund project portfolio is 1.8 GW, of NovaWind JSC is 1.2 GW, and of Enel Russia is 0.4 GW.

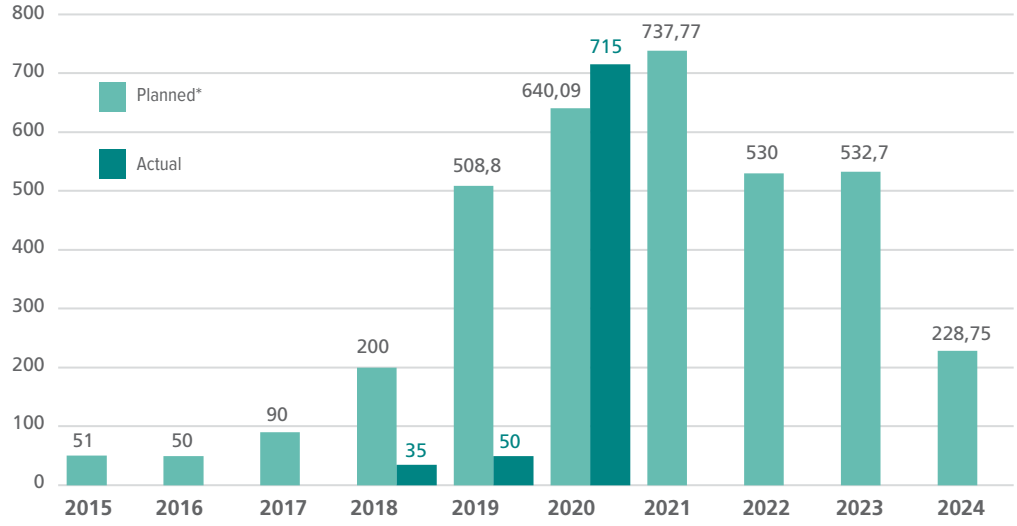
At the moment we can already draw some conclusions about the efficiency of the first large Russian wind power plants and their role in the energy sector of the regions. In 2019, Ulyanovsk WPP-1 and WPP-2 generated 87.5 million kWh and 118.6 million kWh of electricity, respectively, which corresponds to the installed capacity utilization factor of 28.5% and 27.5%. The remaining large wind farms were put into operation in 2020, and data on their annual production is not yet available. The regulatory installed capacity utilization factor for wind farms in the Russian wholesale electricity market is 27%. Both the regulatory and actual CUF indicators in Russia are lower than the world average. Thus, according to Lazard, in 2019 the CUF of new onshore WPPs was 38%-55%.[17] Ulyanovsk WPP-1 and WPP-2 account for about 8% of all electricity generation in the region.

16 Excluding Rosatom's Kochubeyevskaya WPP, which was commissioned in January 2021.

17 Lazard (2019). Lazard's levelized cost of energy analysis - version 13.0. URL: https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf

Figure 3.

Planned * and actual commissioning of wind power plants in WECM in Russia in 2015-2024, in MW



* Based on the results of the competitive selection of CSA RES projects.

Note: the total volume of planned installations on this chart is 3,569 MW, which exceeds 3,415.7 MW included in the current version of Order of the Government of the Russian Federation No. 1-r of 08.01.2009 "On approval of the Main Directions of State Policy in the Field of Increasing Energy Efficiency of the Electric Power Industry based on the use of renewable energy sources for the period up to 2035." This can be explained by the fact that a number of WPP projects selected in the first tenders were not implemented, the corresponding CSA RES were terminated, and the released capacity volumes were transferred to subsequent selections.

Source: author's calculations.

The governor of the Ulyanovsk region, Sergey Morozov, said that in the future the share could increase to 30% due to the construction of new wind farms.[18]

By the end of 2020, the share of renewable energy in the installed capacity of Russian power plants, excluding hydroelectric power plants, was 1.1%, and the share of wind energy was 0.4% (Figure 4). In the balance of electricity production as of early 2021, renewables accounted for about 0.5%, solar and wind for 0.4%, and wind alone for 0.13%. For comparison, in the first half of 2020, the share of solar and wind generation in global electricity production was 9.8%. During the same period, Germany produced 42% of all electricity from wind and solar power plants, the United Kingdom 33%, the United States 12%, and China and India 10% each.[19] Russia is the only major economy in the world where the share of solar and wind generation is still close to zero.

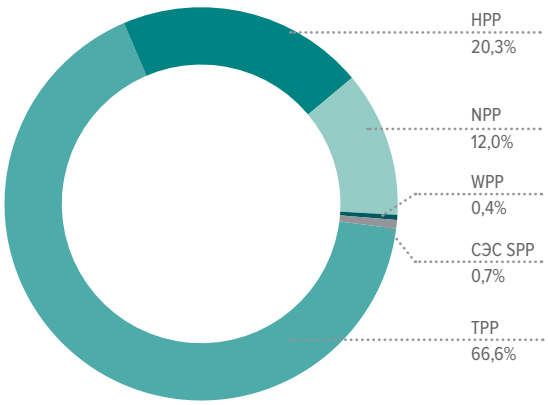
All wind farms currently operating in Russia are shown in the table (Table1) and on the map below (Figure 5). As follows from this data, before the CSA RES program, only small low-capacity projects were implemented in Russia, mainly in isolated regions. The year 2020 can be considered the year of establishment of the large-scale wind energy industry. For the first time, a considerable number of large wind generation facilities were put into operation, with a high localization rate of 65%.

For the reasons described in section 1.1.3, wind power has not yet been developed in the retail electricity markets of Russia. There are only three wind generation facilities in the Market Council (regulator of electric power markets in Russia) registry, containing qualified generation facilities operating on the basis of RES in the retail electricity markets: WPPs in the Orenburg and Belgorod Regions, as well as in the Republic of Bashkortostan. In addition, in 2018, the Ushakovskaya wind farm was built in the Kaliningrad Region (Table 1). The capacity of all four facilities is 9.575 MW.

In isolated power systems, the use of wind energy in

Figure 4.

Installed capacity of UES power plants as of January 2021 by generation type, in %



Source: System Operator (2020a). Unified Energy System of Russia: Interim Results. URL: https://so-ups.ru/fileadmin/files/company/reports/ups-review/2020/ups_review_1220.pdf.

Russia is also still very limited, despite the recognition of the viability of this practice at all levels. In the decentralized power supply zone, only 26 wind farms

18 Business Review (2019). The share of green electricity in the Ulyanovsk Region has reached 8%. URL: https://uldelo.ru/2019/05/23/dolya-zelenoi-elektroenergii-br-v-ulyanovskoi-oblasti-b-dostigla-8-b

19 Ember (2020). Wind And Solar Now Generate One-Tenth Of Global Electricity. URL: https://ember-climate.org/project/global-electricity-h12020/

Table 1.

Wind power plants in operation in Russia, as of March 2021

No.	Name of WPP	Number of wind turbines	Type of wind turbine	Capacity, MW	Year of commissioning	Administrative subject*	
1	Kochubeevskaya WPP	84	L100 2.5 MW	210	2021	Stavropol Krai	CSA RES (wholesale market)
2	Adygea WPP	60	L100 2.5 MW	150	2020	Republic of Adygea	
3	Sulinskaya WPP	26	VESTAS V-126-3.8 MW – H87	100	2020	Rostov Region	
4	Kamenskaya WPP	26	VESTAS V-126-3.8 MW – H87	100	2020	Rostov Region	
5	Gukovskaya WPP	26	VESTAS V-126-3.8 MW – H87	100	2020	Rostov Region	
6	Tselinskaya WPP	24	VESTAS V-126-4.2 MW – H87	100	2020	Republic of Kalmykia	
7	Salynskaya WPP	24	VESTAS V-126-4.2 MW – H87	100	2020	Republic of Kalmykia	
8	Cossack WPP, 1st phase	12	VESTAS V-126-4.2 MW – H87	50	2020	Rostov Region	
9	Ulyanovskaya WPP-2	14	VESTAS V-126-3.6 MW – H87	50	2019	Ulyanovsk Region	
10	Ulyanovskaya WPP-1	14	DF2.5MW-110	35	2018	Ulyanovsk Region	
11	Yustinskaya WPP	25		15	2020	Republic of Kalmykia	
12	Ushakovskaya WPP	3	Enercon E70 E4	5,1	2018	Kaliningrad Region	Retail market
13	Tamar-Utkul WPP	7		2,725	2013 - 4 wind turbines 2016 - 3 wind turbines	Orenburg Region	
14	Tyupkildy WPP		Hanseatische AG ET 550/41		2001	Republic of Bashkortostan	
15	Krapivenskiye Dvory WPP	3		0,1	2010	Belgorod Region	
16	Anadyrskaya WPP	10	WIND TURBINE-250SM	2,5	2003	Chukotka Autonomous Okrug	Decentralized energy supply
17	Wind farm in the settlement of Ust-Kamchatsk	4	Vergnet GEV-C	1,18	2013 2015	Kamchatka Krai	
18	Wind farm in the settlement of Tiksi	3	Kamai KWT300	0,9	2018	Republic of Sakha (Yakutia)	
19	Wind farm on Bering Island	2	Vergnet GEV-C	0,55	2013	Kamchatka Krai	
20	Wind farm in the settlement of Novikovo	2	renovated Vestas	0,45	2015	Sakhalin Region	
21	Wind farm in the settlement of Labytnangi	1	Wind turbine of Tyulgansky electromechanical plant	0,275	2014	Yamalo-Nenets Autonomous Okrug	
22	Wind farm in the settlement of Amderma	4	Arctic version of Ghrepower-50	0,2	2016	Nenets Autonomous Okrug	
23	Ostaninskaya WPP	10	FL2500	25	2013	Crimea*	Built before 2014
24	Sakskaya WPP	180	3 wind turbines T600-48 155 wind turbines USW 56-100 22 wind turbines USW 56100	20,83	1998	Crimea*	
25	Tarkhankutskaya WPP	127	127 wind turbines USW 56100 6 wind turbines T600-48	17,25	2001	Crimea*	
26	Presnovodnenskaya WPP	55	3 wind turbines AN Bonus 600 kW 52 wind turbines USW 56-100	7,39	2006	Crimea*	
27	Donuzlav WPP	63	USW 56-100	6,77	1992	Crimea*	
28	Sudakskaya WPP	35	USW 56-100	3,76	2001	Crimea*	
29	East Crimean WPP	17	2 wind turbines T600-48 15 wind turbines USW 56-100	2,81	2009	Crimea*	
TOTAL							1.1 GW

* The data presented corresponds to the official data used by the Russian Federation. Crimea, according to international law, is not part of the Russian Federation

Sources: RAWI (2020). Review of the Russian Wind Energy Market and Russian regions ranking 2019. URL: https://rawi.ru/2020/03/obzor-rossiyskogo-vetroenergeticheskogo-ryinka-za-2019-god-razmeshhen-na-sayte-ravi/ and company materials.

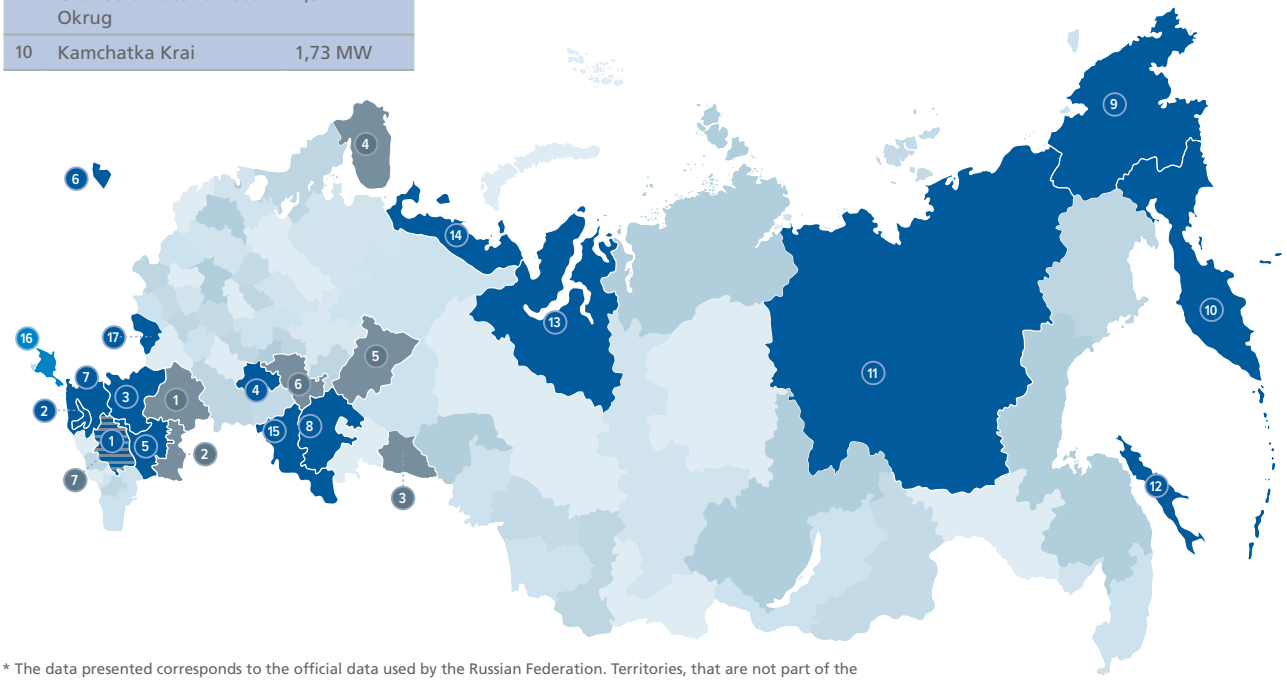
Figure 5.

Map of wind power facilities in Russia, March 2021, MW

	Administrative subject*	Constructed
	Built	
1	Stavropol Krai	210 MW
2	Republic of Adygea	150 MW
3	Rostov Region	350 MW
4	Ulyanovsk Region	85 MW
5	Republic of Kalmykia	215 MW
6	Kaliningrad Region	5,1 MW
7	Krasnodar Krai	4,8 MW
8	Republic of Bashkortostan	1,65 MW
9	Chukotka Autonomous Okrug	2,5 MW
10	Kamchatka Krai	1,73 MW

	Administrative subject*	Constructed
	Built	
11	Republic of Sakha (Yakutia)	0,9 MW
12	Sakhalin Region	0,45 MW
13	Yamalo-Nenets Autonomous Okrug	0,275 MW
14	Nenets Autonomous Okrug	0,2 MW
15	Orenburg Region	2,725 MW
16	Crimea*	83,81 MW
17	Belgorod Region	0,1 MW

	Administrative subject
	Planned for construction
1	Volgograd Region
2	Astrakhan Region
3	Kurgan Region
4	Murmansk Region
5	Perm Krai
6	Republic of Tatarstan
7	Stavropol Krai



* The data presented corresponds to the official data used by the Russian Federation. Territories, that are not part of the Russian Federation according to international law, are represented in a different color

with a total capacity of 6 MW (Table 1) are currently in operation.

In 2020, the first wind farm (5.1 MW Kulikovskaya WPP in Kaliningrad Region) in Russia was dismantled to be replaced by the new Ushakovskaya WPP built in 2018, of the same capacity. Kulikovskaya WPP was built in the early 2000s. It consisted of 20 wind turbines with a capacity of 225 kW, manufactured by Vestas and previously used; and one Wind World wind turbine of 600 kW. Ushakovskaya WPP consists of three wind turbines. In 2019, it produced 10 million kWh of electricity, which corresponds to the CUF of 22.5%.

1.4. THE IMPACT OF THE COVID-19 CRISIS ON WIND ENERGY IN RUSSIA AND AROUND THE WORLD

The COVID-19 pandemic has had a tremendous impact on the global economy and individual industries. According to IMF estimates, in 2020 global GDP decreased by 4.4%,[20] Russian GDP by 4%.[21] The economic crisis triggered by the pandemic is the worst since the Second World War. In different countries of the world, it was

20 IMF (2021). Real GDP growth. URL: https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/WEOWORLD

21 IMF (2020). Russian Federation: Staff Concluding Statement of the 2020 Article IV Mission. URL: https://www.imf.org/en/News/Articles/2020/11/23/mcs112420-russia-staff-concluding-statement-of-the-2020-article-iv-mission

necessary to temporarily stop production and close down enterprises in the service sector. International mobility of people was limited for most of the year, and restrictions on movement within countries were also imposed. According to preliminary IEA estimates, global energy demand fell by 5% in 2020, while investments in the energy sector declined by 18%.[22]

This unusual situation provokes structural changes both in the global economy and in the global energy sector. For example, during the pandemic, the process of global energy transition received an unexpected acceleration. According to preliminary IEA estimates, oil consumption in 2020 decreased by 8%, coal by 7%, natural gas by 3%, and electricity by 2%.[23] At the same time, renewable energy consumption increased by 1% and electricity generation from renewable energy sources grew by 7%.[24] In many countries, renewable energy generation has priority access to the grid. In addition, the operation of RES facilities is cheaper than the operation of conventional generation facilities due to lower operating costs and the absence of a fuel component. Low energy demand and underutilization of the grid expand the choice between different facilities and types of generation.

During the pandemic, many international and non-profit organizations, large corporations and individual decision-makers urged governments to get out of the crisis by supporting green sectors, including RES. The renewable energy sector has become much more attractive for the major oil and gas corporations, which suffered huge losses in 2020 due to the decline in demand and prices for fossil fuels. For several decades, the oil and gas sector has been investing in renewable energy and other clean technologies. Meanwhile, never before has any of the sector leaders planned to increase investments in low-carbon technologies tenfold alongside the 40% reduction of the hydrocarbon business. [25] Most of the largest economies in the world (China, USA, EU, Brazil, Japan, the Republic of Korea) have in one form or another expressed their intention to move to carbon neutrality or zero net greenhouse gas emissions by 2050-2060. In the EU, there is strong public pressure to reach climate neutrality well before 2050. Since about 80% of global greenhouse gas emissions result from the burning of fossil fuels in energy and industry, it would be reasonable to assume that fuel and energy will be a key sector in the transformation of the global economy after the pandemic. According to BNEF, global greenhouse gas emissions from burning fossil fuels fell by 8% in 2020, and they may have already peaked in 2019.[26] Thus, the pandemic may not only become a shock for the world economy, but also an incentive to change the usual paradigm of the linear economy, and 2020 may become a watershed year in the global energy transition.

Despite all these global trends and changes, the impact of the pandemic on the energy transition in Russia has been rather negative than positive. The commissioning of some renewable energy facilities was delayed, and the launch of a number of power plants had to be postponed until 2021. Production was limited, contacts with foreign specialists were constrained, there were problems in the movement of personnel and the delivery of equipment, and administrative procedures were temporarily slowed down. At the same time, companies that have delayed the commissioning of power plants because of COVID-19 have to pay fines for failure to meet deadlines. Investors and RREDA have repeatedly proposed to introduce a non-punitive delay in the launch of new facilities for 3-6 months due to force majeure. However, such a measure has not yet been introduced.

There are no long-term strategic implications of the pandemic for the energy sector in Russia. The goal of the Russian energy policy is still to maintain the country's position in the field of traditional energy based on fossil fuels. In addition, the deterioration of macroeconomic indicators forces the government to reduce support for any industries that are not recognized as a priority, including support for renewable energy. The additional burden on energy consumers or on the state associated with the development of renewable energy sources is now considered at the government level not as a necessity, but as an extravagancy, despite the potential gradual loss of major international buyers of coal, natural gas and oil. At the same time, an indirect positive impact of the pandemic on the energy transition in Russia is possible in the near future. The COVID-19 crisis and the accumulated environmental and climate problems are forcing countries around the world to seek green solutions to the crisis and place higher demands on the products of their economic partners, including Russia.

22 IEA (2020a). World Energy Outlook 2020. URL: https://www.iea.org/reports/world-energy-outlook-2020

23 Ibid.

24 IEA (2020b). Renewables 2020. Analysis and forecast to 2025. URL: https://www.iea.org/reports/renewables-2020/wind#abstract

25 BP (2020). From International Oil Company to Integrated Energy Company: bp sets out strategy for decade of delivery towards net zero ambition. URL: https://www.bp.com/en/global/corporate/news-and-insights/press-releases/from-international-oil-company-to-integrated-energy-company-bp-sets-out-strategy-for-decade-of-delivery-towards-net-zero-ambition.html

26 BNEF (2020). New Energy Outlook 2020. URL: https://about.bnef.com/new-energy-outlook/

2.

COMPETITIVENESS AND POTENTIAL OF WIND ENERGY

Wind is currently one of the cheapest sources of electricity in the world. With that in mind, the belated start of the development of wind energy in Russia, its low contribution to installed capacity and generation, as well as the absence of ambitious plans for the future raise questions. To answer them, this section analyzes the economic aspects of wind power generation and identifies opportunities for increasing the competitiveness of this industry in Russia.

2.1. COST OF WIND POWER GENERATION

It is widely believed in Russia that generation from renewable energy sources is noncompetitive. This is noted in the new Energy Strategy of the Russian Federation for the period up to 2035: "The main problem with the use of renewable energy sources in the Russian Federation is their insufficient economic competitiveness in relation to other technologies for the production of electrical energy." Until now, there have been quite few attempts to estimate the cost of electricity from Russian wind power plants primarily due to the limited number of implemented projects. Since the competitiveness of wind energy and renewable energy in general is a cornerstone in Russia, this study analyzes the present cost of wind power on the basis of the results of competitive selection of wind power plants within the framework of CSA RES.

2.1.1. Calculation Methodology and Data

The cost of electricity production at new power plants is usually estimated using the levelized cost of electricity (LCOE). This indicator takes into account the plant's life cycle costs and cost of capital, but discards the transportation and distribution costs. That is, the LCOE shows the cost of electricity at the input to the grid. The evaluation is carried out according to the following formula:

$$LCOE = \frac{\sum_{t=1}^{n} \frac{CAPEX_t + OPEX_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}, \text{ где}$$

where

$CAPEX_t$ – capital costs in the year t,
$OPEX_t$ – operating costs in the year t,
F_t – fuel cost in the year t (if there is a fuel component in the generation),
E_t – the amount of electricity produced in the year t,
r – cost of capital (usually WACC or weighted average cost of capital is used),
n – the facility life.

The unit capital costs for WPP projects selected in the early years of the RES support system in WECM in Russia were close to the global average in terms of USD at the exchange rate in effect at that time. However, as it quickly became clear, they turned out to be underestimated, and for this reason, as well as due to excessive localization requirements, it was not possible to build and commission any wind farms in Russia until 2018. The unit capital costs of the projects selected in 2016 were already significantly higher than before, even in USD (40% higher than worldwide), despite the ruble devaluation in 2014. At subsequent tenders, the planned values of unit capital costs in Russia decreased and at tenders in 2018-2019, projects with unit capital costs below the world level were selected (Figure 6).

At first glance, this indicates a rapid increase in the competitiveness of the Russian wind power industry. However, it should be noted that the implementation of the selected projects is planned for the forthcoming four to five years. If we break down the values of planned specific capital costs of the selected WPP projects by the years of their planned commissioning and compare them with the world values for the same years, we will get a completely different picture (Figure 7). Unit capital expenditures for the Russian wind power projects that were planned to be implemented by 2021 are 20-50% higher than the global average. The average unit capital costs of Russian projects are not expected to fall below the global average unit capital costs until 2023-2024.

The actual capital costs may differ significantly from the planned ones, and the possibility that Russian

wind power projects with equipment localized at low market volumes may require less investment than similar projects abroad is questionable. For these very reasons, it is advisable to analyze the project portfolios of each of the participants of the wind energy market. Average planned capital expenditures for each group of companies, weighted by the volume of commissioned capacities, range from 87,000 to 117,000 rubles or from USD 1,200 to 1,600 per 1 kW at the current exchange rate. That is, the capital specific costs in the Russian wind power industry are 10-15% higher than globally. This is normal and even expected for a fledgling industry.

Regulatory operating costs of RES facilities are prescribed in Resolution of the Government of the Russian Federation No. 449 of May 28, 2013 "On the Mechanism to Stimulate the Use of Renewable Energy Sources in the Wholesale Electricity and Capacity Market." For WPP, they are set at 118,000 rubles/MW per month for 2012, with subsequent indexation by the value of the consumer price index. Given the actual inflation rate, the fixed monthly operating costs of the wind farm in 2020 should have been about 195,500 RUB/MW or USD 2,700/MW. This is equivalent to USD 32.5/kWh per year. According to the 2020 Lazard Present Value of Electricity Survey, global wind power operating costs in 2020 ranged from USD 27 to USD 39.5 per kWh per year. These values in Russia are at the global level.

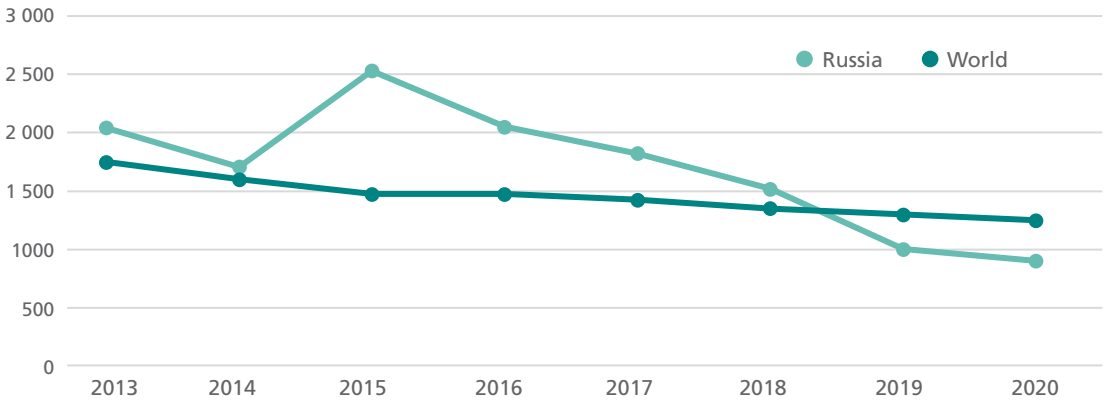
Resolution of the Government of the Russian Federation No. 449 of May 28, 2013 established the installed capacity utilization factor, which determines the volume of electricity generation for renewable energy facilities in the wholesale market. For wind farms, the CUF value is 0.27. Since the bulk of the revenue of the generation facilities in Russia is due to the capacity fee (about 80%-90%), there is no significant incentive for renewable energy facilities to exceed the standard CUF. This was also confirmed by the 2019 operation results of the first Russian WPPs. Their CUF slightly exceeds the standard. According to Lazard, the CUF of new wind farms globally ranged from 0.38 to 0.55 in 2020. So, the Russian CUF values are significantly lower than the world ones.

The rate of return on capital invested in a renewable energy generation facility was established by Resolution No. 449 at the level of 14% per annum for objects selected in tenders before January 1, 2016, and at 12% per annum for objects selected in tenders after January 1, 2016. To calculate the present value of electricity from wind generation facilities in Russia, the cost of capital is assumed to be 12% per annum. This is significantly higher than what is commonly used for global research. For example, Lazard uses the cost of capital of 7.7% per annum in its calculations.[27]

27 Lazard (2020). Lazard's levelized cost of energy analysis – version 14.0. URL: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Figure 6.

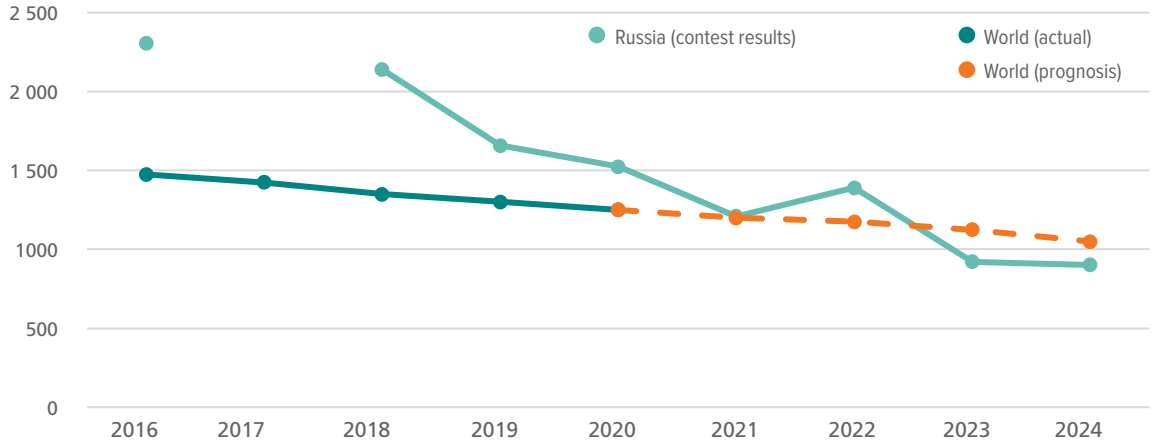
Average capital costs per 1 kW of installed wind power capacity in Russia (planned, in the year of the tender) and in the world (expert assessment), in USD.



Sources: Calculations based on ATS data (2020). Project selection results. URL: https://www.atsenergo.ru/vie/proresults and Lazard (2020). Lazard's levelized cost of energy analysis – version 14.0. URL: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

Figure 7.

Average capital costs per 1 kW of installed wind power capacity in Russia (planned, in the year of planned commissioning) and in the world (expert assessment), in USD.



Note: excluding unrealized volumes of the first tenders in 2013-2014, which were later transferred to new selections
Sources: Calculations based on ATC data (2020). Project selection results. URL: https://www.atsenergo.ru/vie/proresults and Lazard (2020). Lazard's levelized cost of energy analysis – version 14.0. URL: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

The facility life of a wind power plant is usually 20 years. In this research, we also took it equal to 20 years, despite the fact that the return on investment under CSA RES is 15 years.

2.1.2. Results of Calculations

The results of LCOE calculations for wind electricity in Russia are shown in the figure below (Figure 8). As follows from this figure, in 2020, LCOE at wind farms in Russia, in accordance with the planned costs, should have been more than double of the global average. As shown in the previous chapter, this can be explained by higher capital costs due to the lack of competition, a lower CUF, and higher cost of capital in Russia. The average LCOE for facilities to be commissioned in Russia in 2020 was estimated at RUB 6.4, or 8.8 US cents, while the global average value in 2020 was estimated at 4 US cents. If all the selected Russian CSA RES projects were implemented in 2020 and their capital expenditures were equal to the costs averaged across company portfolios and weighted by the volume of commissioned capacities, the LCOE would be 5.2-6.7 RUB/kWh or 7.2-9.3 US cents/kWh. Thus, the cost of electricity generation by wind farms in Russia is currently 5-7 RUB/kWh.

Previously, the Market Council,[28] the Russia Renewable Energy Development Association,[29] and the International Energy Agency[30] attempted to estimate the LCOE for the Russian wind energy sector. The Market Council estimated the LCOE for Russian wind energy in 2018 at 10-12 RUB/kWh (16-19 US cents), by 2022 the value of this indicator should not have dropped below 8 rubles (13 US cents at the 2018 exchange rate). According to the Russia Renewable Energy Development Association estimates, the LCOE for generating 1 kWh of electricity from wind energy was about 6 rubles or 8 US cents in 2020, according to the IEA – 5-7 rubles or 7-10 US cents, depending on the cost of capital. The LCOE estimates for wind power in Russia by this research coincide with the results obtained by RREDA and IEA.

According to estimates by RREDA and Vygon Consulting, the LCOE for a new WPP in Russia is already lower than for a new coal-fired power plant. By 2030, electricity from WPPs will equal in cost to electricity from new combined-cycle gas turbine (CCGT) plants.[31] In 2020, the LCOE for electricity from a new CCGT was 3.6 RUB/kWh, which is almost twice lower than for electricity from a new wind power plant. Meanwhile,

28 Market Council (2018). On the results of the fulfillment of the instructions of the Supervisory Board of the NP Market Council Association.

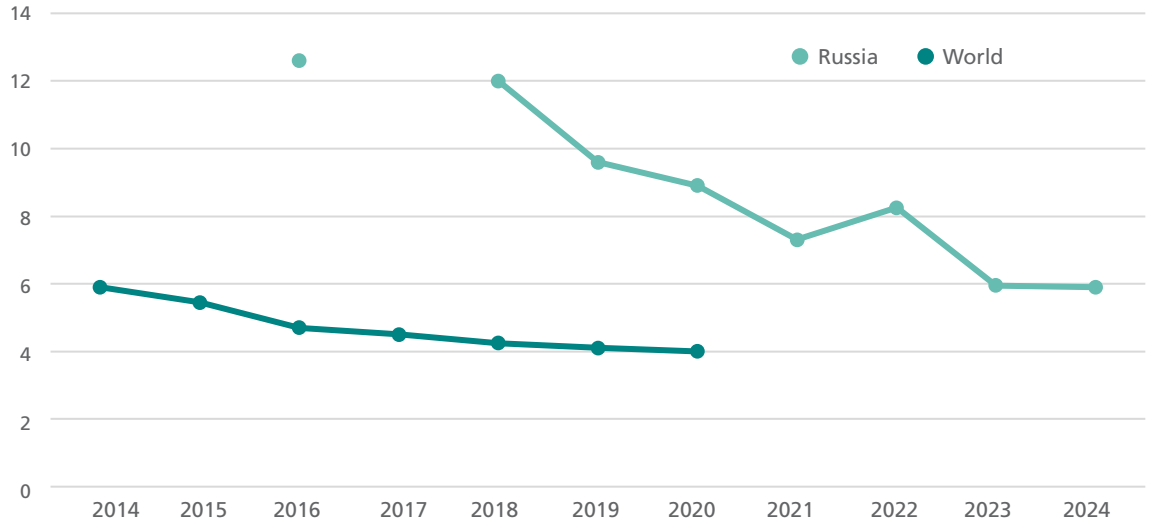
29 Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

30 IEA (2020). Levelized cost of electricity calculator. URL: https://www.iea.org/articles/levelised-cost-of-electricity-calculator

31 Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

Figure 8.

Levelized Cost of Electricity (LCOE) generated by wind farms in Russia and in the world, US cents per 1 kWh



Note: calculations for Russia are made taking into account the planned unit capital expenditures for the projects that passed the competitive selection to conclude CSA RES for each year of the planned commissioning of facilities, and excluding the unrealized volumes of the first tenders of 2013-2014, which were later carried over to new selections.
Sources: Calculations based on ATS data (2020). Project selection results. URL: https://www.atsenergo.ru/vie/proresults and Lazard (2020). Lazard's levelized cost of energy analysis – version 14.0. URL: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

by 2030, the LCOE for a new CCGT will increase to 5.3 RUB/kWh, while the LCOE for wind electricity will drop below this value due to increased wind power efficiency.[32] In addition, the Russian electricity market is designed in such a way that any new power plants (including fossil fuel power plants) do not pay off without special WECM tariffs. Over the past 5 years, 85% of the capacities in the pricing zones of the wholesale market were commissioned under the CSA or their analogues, while the CSA RES accounted for only a few percent of all commissioned capacities.[33] Thus, the development of the energy sector in Russia is completely determined by the regulators through the approval of special programs, such as CSA, and the administrative distribution of the capacities built under these programs between various types of generation. In such circumstances, given Russia's abundance of fossil fuel resources and the historically established emphasis of the Russian energy system on the development of such fuel, RES are allocated minimum quotas. That is, despite Russia's lagging behind other countries in terms of capital costs, CUF, and cost of capital, it is already impossible to explain the slow development of wind energy in Russia solely by its low competitiveness.

For retail electricity consumers, many of whom pay more than 7 rubles/kWh for electricity and sometimes up to 10-11 rubles/kWh, the cost of wind generation at 5-7 rubles/kWh may prove attractive in the near future. The corporate energy transition can be complicated by the fact that such consumers usually do not need large wind farms consisting of multi-megawatt wind turbines, while Russia has not yet established the production and operation of wind turbines with a capacity of several hundred kilowatts, which may be in the highest demand by such consumers. This problem can be solved by combining consumers into pools, as well as by developing competencies in the production and operation of wind turbines with a capacity of several hundred kilowatts.

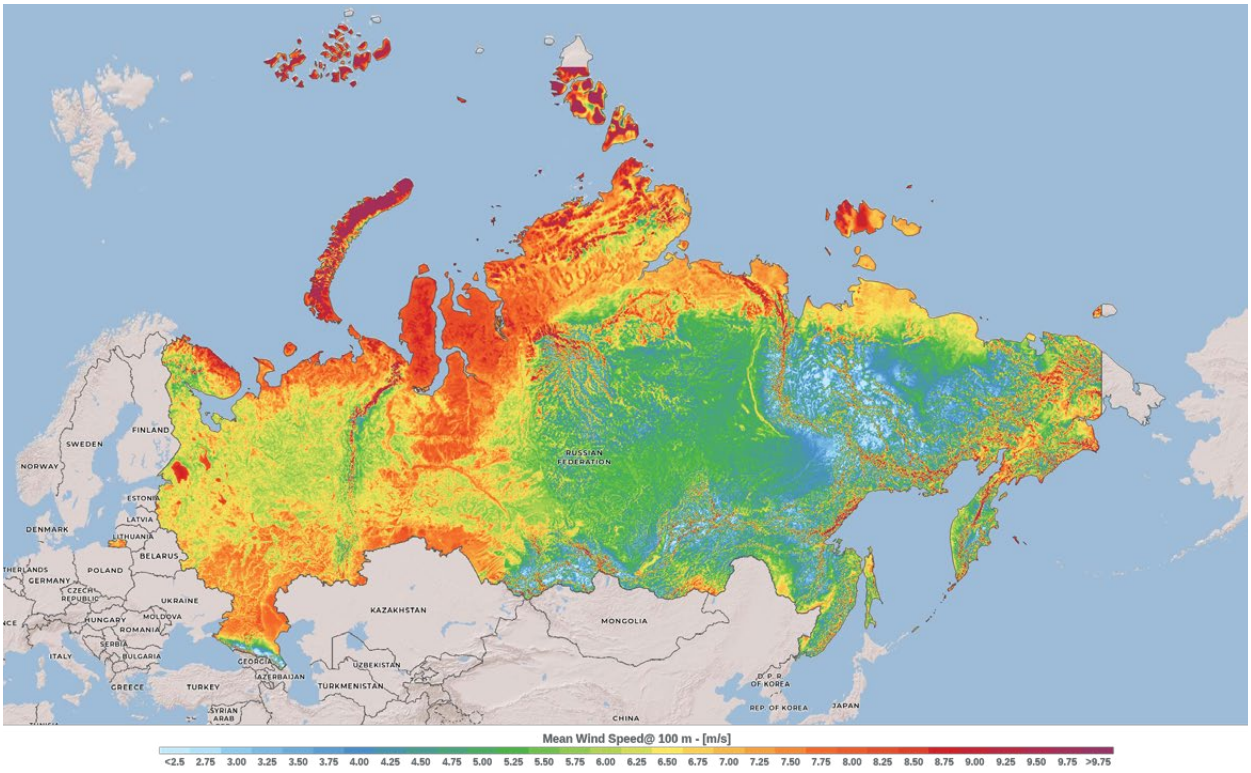
The cost of Russian wind power generation can and should be reduced through the following ways. First of all, it can be achieved by reducing capital costs. To solve this problem, Russia needs a growing domestic market and, accordingly, significant volumes of commissioning of wind farms. This task cannot be solved through exports, because to develop exports it is expedient for Russian equipment to be at least within the world average price range. Therefore, the expansion of the second CSA RES program is required alongside the creation of opportunities for new (eventually also domestic) players to come and competition to

32 Vygon consulting (2020). „The new renewable energy support program will be able to make green electricity cheaper than traditional generation by 2030," concludes VYGON Consulting. URL: https://vygon.consulting/pressroom/press-about-us/1748/

33 Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

Figure 9.

Average annual wind speed in Russia at a height of 100 m, m/s



Note: Global Wind Atlas data does not cover parts of the Chukotka Autonomous Okrug
Source: Global Wind Atlas. URL: https://globalwindatlas.info/

grow, especially in the production of wind turbines. Secondly, this can be done by increasing the real CUF. Thirdly, the cost of capital can be reduced. In many ways, this task is difficult to accomplish because of the overall macroeconomic situation in Russia. Nevertheless, some reduction in the cost of capital is possible through the attraction of funds from institutional and other (e.g., local companies, cooperatives, etc.) investors and the provision of preferential loans to wind generation facilities.

2.2. TECHNICAL AND ECONOMIC POTENTIAL

In 2015-2017, a group of researchers from the Higher School of Economics, Moscow State University, and IVT RAS conducted an assessment of the technical potential of RES in Russia. The results of the study showed that the development of wind energy is most expedient in the Republic of Kalmykia; Stavropol and Krasnodar Krais; Rostov, Volgograd, and Astrakhan Regions; North Caucasian, Northwestern, Ural, Siberian, and Far Eastern Federal Districts; in the Arctic, Kamchatka Krai, and Sakhalin Region – that is, in many regions of the country. The technical potential of wind energy throughout Russia, defined as the amount of electricity that can be generated from the energy of the wind stream at the current level of technology development taking into account limitations of locating wind power plants by types of land, was estimated at 17,100 billion kWh at a height of 100 meters (the height of the tower of the modern wind farm).[34] For comparison, electricity generation by the Unified Energy System of Russia amounted to 1,081 billion kWh in 2019.[35] Consequently, the technical potential of wind energy in Russia exceeds the volume of national electricity consumption by 17 times, and these are conservative assessments.

The map below (Figure 9) shows the distribution of

34 Yermolenko B., Yermolenko G., Proskuryakova L. (2017). How high is the technically feasible RES potential in Russia? // Russian Fuel and Energy Complex, No. 9, pp. 22-27.

35 System Operator (2020b). Unified Energy System of Russia. URL: https://so-ups.ru/functioning/ees/ees-2020/

the average wind speed in Russia by region at a height of 100 meters. The starting wind speed for wind turbines is usually 2.5 m/s and the average annual speed of 5-7 m/s is considered to be sufficient for the development of wind energy. As follows from the map below, almost throughout the entire territory of Russia the average annual wind speed exceeds 5 m/s. The Far East, the coastline of the Arctic Ocean, the south of the European part of Russia, and the south of Siberia along the border with Kazakhstan are distinguished by particularly high wind speeds.

In addition to the technical potential, it is also customary to distinguish the economic potential of RES, which is a subset of the available technical potential, for which the costs required to produce electricity are lower than the available income or below the reference costs, which may be, for example, gas generation costs.[36] That is, the development of such potential is economically feasible. However, there are a number of difficulties in assessing economic potential at the regional or national level. In particular, the rationale for calculating available income or choosing a benchmark can be very controversial and particular for different regions and even districts.

The economic potential of wind energy in any country is limited by a number of objective factors, such as the demand for electricity, the availability of more economically accessible and technically developed energy supply alternatives, and logistics peculiarities. We can regard these factors as market constraints, which are difficult to assess objectively on a national scale. Moreover, in practice, the real potential of wind power generation depends not so much on its cost compared to this or that benchmark, as on the interest of federal and regional authorities to act as partners ready to create and improve the legal framework necessary to implement RES, to take into account the interests of the industry and create conditions for its successful development.

The generation of clean electricity itself is not regarded as attractive at the federal or regional levels in Russia at the moment, though the value added through the lifetime of a wind farm is an important economic factor, and should not be neglected. The environmental and climate change agendas, as well as the sustainable development agenda, are just beginning to take shape in the country. In 2019, Russia ratified the Paris Climate Agreement, and at the end of 2020, it announced its first nationally determined contribution to the implementation of the Paris Agreement, according to which it intends to reduce greenhouse gas emissions to 70% of the 1990 level by 2030 taking into account the maximum possible absorption capacity of forests and other ecosystems.[37] However, in reality, this goal implies a significant increase in emissions. In 2018, greenhouse gas emissions including land use, land-use change and forestry (LULUCF) amounted to 52.4% of the 1990 level.[38] In 2020, several official[39, 40] and civil[41] reports on the implementation of the Sustainable Development Goals in Russia were published, while before that this topic was practically not discussed at a high official level.

In such conditions, the production of wind power can be attractive for a territory in two cases. First of all, if the construction of wind farms opens up opportunities for the emergence of local production of products that are also in demand outside the region. Wind farms create from several to several dozen permanent jobs, while an industrial enterprise can create hundreds of new jobs. Secondly, wind energy may be of interest in energy-deficient regions.

The Ulyanovsk Region became a pioneer in the development of wind energy in Russia, because its government and infrastructure organizations were among the first to recognize the opportunities for developing their industrial base and creating new jobs in the new legislation on renewable energy sources. As a result, the region launched preparations for creating a new industry and attracting investors. In the course of this work, three wind measuring complexes were installed, wind monitoring was carried out, land for wind farms was purchased, and transport infrastruc-

36 Brown et al. (2016). Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results // NREL. URL: https://www.nrel.gov/docs/fy15osti/64503.pdf

37 UNFCCC (2020). Nationally determined contribution of the Russian Federation. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Russia%20First/NDC_RF_ru.pdf

38 UNFCCC (2020). Russian Federation. 2020 National Inventory Report (NIR). URL: https://unfccc.int/documents/226417

39 Analytical Center under the Government of the Russian Federation (2020). Voluntary National Review of the Implementation of the 2030 Agenda for Sustainable Development. URL: https://sustainabledevelopment.un.org/content/documents/26421VNR_2020_Russia_Report_Russian.pdf

40 Audit Chamber (2020). Report on the results of the expert analysis event „Analysis of the public administration system for the implementation of the sustainable development agenda for 2019 and the elapsed period of 2020." URL: https://ach.gov.ru/upload/iblock/761/76119231ce487594c1301b38be450c96.pdf

41 COURSE (2020). 2020-2030: A Decade of Action for the SDGs in Russia. URL: http://kurs2030.ru/

ture was improved to ensure the possibility of delivering large-sized cargoes. Regional authorities also began taking an active part in negotiations on improving the regulatory framework for renewable energy sources at the federal level. Thus, the Ulyanovsk Region took a proactive stance and carried out the maximum preparation of all the necessary conditions both for building the first wind farms and establishing equipment production.

It should be noted that the emergence of the wind energy industry contributes to the development of industrial cooperation in the region. Thus, the enterprise AeroComposite-Ulyanovsk is located in the Ulyanovsk Region. It manufactures primary elements of aviation structures and units from composite materials using vacuum infusion. The Vestas Manufacturing Rus production workshop was opened on the territory of the AeroComposite-Ulyanovsk plant. Ulyanovsk also hosts the production subsidiary of the Danish plant Hempel, which produces paints. The plant supplies paints for the blades made by Vestas Manufacturing Rus. There are opportunities to start purchasing components (for example, bearings) from manufacturers located in the Ulyanovsk Region.

There is fairly strong competition between the regions for rewarding productions. About a decade ago there were just a few regions in Russia with industrial parks and support systems. Now there are several dozens of them. Development corporations have been established in the regions to facilitate the implementation of investment projects and development of industrial territories. There are 36 special economic zones (SEZs) operating in the country. Two more will soon start operating in the Omsk Region and the Krasnoyarsk Krai offering tax benefits and customs preferences.

For the Republic of Adygea, the construction of a large wind farm turned out to be important due to a substantial energy shortage, as only 10% of the consumed electricity is produced in the region. The 150 MW Adygea wind farm, commissioned in 2020, will reduce the region's energy deficit by 20% and increase the stability of the power system at peak loads. Shortage of capacities has long been one of the main problems that poses a threat to the implementation of investment projects in the actively developing Krasnodar Krai. The region is planning to build solar and wind power plants in the near future. This will partially solve the problem of energy shortages.

The introduction of a cross-border carbon tax by the EU in the near future or the fact that customers outside Russia want to decrease their purchases of polluting energy carriers may become a significant incentive for the RES development in Russia, including wind energy. Russian exporters will be interested in investing in renewable energy to save on carbon duties. The entire Russian economy will also be interested in this as it is more profitable to invest the financial resources in the development of green industries within the country than allowing the duties to be paid abroad.

3.

POSSIBILITIES FOR WIND ENERGY DEVELOPMENT IN RUSSIA

The key barrier to the development of wind energy in Russia is the lack of a clear goal-setting and understanding of modern energy economics at the federal level. Also, electricity consumers in WECM have a significant opposition to the development of renewable energy sources within the CSA RES framework. They explain this by the fact that they already pay too much for electricity and capacity, while RES technologies in Russia are still prohibitively expensive. The share of renewables in final price of electricity in the peak year of payment for the first CSA RES program (2025) will be only 3.3%, [42] and electricity from wind farms in Russia is no longer excessively expensive, as shown in the previous section.

However, the development of modern wind energy is a very multifaceted and multidimensional phenomenon. Therefore, despite the fact that all industry participants in Russia focus on the CSA RES program, and only this program so far allows the introduction of wind farm in volumes and scale distinguishable from the mathematical error, the prospects of the industry stretch far beyond the CSA RES and beyond the production of equipment for wind farms and its exports. They also concern the development of a variety of innovative multisector projects, including the production of green hydrogen and other low-carbon materials (green metals, green cement, and green ammonia), as well as the creation of such new market segments for Russia as corporate demand for wind power generation.

3.1. PRODUCTION AND EXPORT OF EQUIPMENT

Three groups of wind energy enterprises, which have localized the production of equipment for wind power plants in Russia, will soon face a difficult task to determine the ways of their further development. At the low volume of the domestic market, it is quite challenging to maintain the functioning of enterprises and carry out technology upgrades. The export requirements are clear but not properly formulated. According to the requirements, wind farm investors should essentially be responsible for the export capabilities of the wind farm equipment manufacturers. This does not help Russia to become a global player in wind energy technologies and is accomplishable only for a vertically integrated structure. It will give companies the wrong signals.

Within the framework of the second CSA RES program, it is possible to deepen the localization of the production of equipment for multi-megawatt class wind turbines, but this requires more substantial volumes of the program. Since the potential of the cluster for the production of equipment for wind turbines created in Russia allows the production of 0.9-1.2 GW/year and production of 0.45-0.60 GW/year is minimally acceptable for it, it is advisable to increase the second CSA RES program so that in 2025-2035 5-13 GW of wind farms would be built in Russia, more than 4.5 GW that are discussed at the moment. According to IRENA's REMAP 2030 scenario, by 2030, Russian onshore wind capacity can attain 23 GW[43], which implies almost 20 GW of new wind power plants in addition to the first CSA RES program. The global wind energy market will grow rapidly in the coming years and Russia will have the opportunity to export equipment for wind energy. Meanwhile, for the healthy development of the newly established industrial cluster, it is impossible to rely only on exports as a reliable domestic market with understandable volumes is needed. Without this, it is impossible for Russian companies to enter highly competitive global markets.

From the viewpoint of international trade development, export of equipment for RES and, in particular, for wind power generation is one of the most attractive spheres for three reasons. Firstly, wind power has been growing at an average 12% per year in terms of installed capacities over the last five years.[44] Such impressive growth rates are typical for very few sec-

42 HSE, CSR, Vygon Consulting (2018). Analysis of the system effects of the RES support program 1.0. Choice of solutions to continue supporting renewable energy beyond 2024. URL: https://www.np-sr.ru/sites/default/files/4_analiz_sistemnyh_effektov.pdf

43 IRENA (2017). REMAP 2030: Renewable Energy Prospects for the Russian Federation. URL: https://www.irena.org/publications/2017/Apr/Renewable-Energy-Prospects-for-the-Russian-Federation-REmap-working-paper.

44 WWEA (2020). Global Wind Installations. URL: https://library.wwindea.org/global-statistics/

tors of the economy. Secondly, wind energy is already a large and significant industry on a global scale. At the same time, its potential remains great as in 2020, it accounted for about 6.5% of global generation[45] and in many countries wind energy is just beginning to develop. Thirdly, since a significant part of the major economies, both developed and developing, have over the past one or two years clearly indicated their intention to decarbonize and shift towards ultimately 100% RES, the energy transition is becoming an inevitable global process and wind energy will play a significant role in this process.

Russia has the potential to export equipment for wind power plants when it is logistically feasible, for example, to neighboring CIS countries, where there is no production of such equipment. It is also promising to develop exports to countries that already purchase equipment for energy and mechanical engineering from Russia, such as Kazakhstan, Vietnam, Turkey, Eastern European countries, etc. Renewable energy equipment has a higher added value than fossil energy resources. Consequently, the development of relevant technologies and exports should be recognized as a task of national importance.

In addition to the production and export of multi-megawatt wind turbines, there are opportunities in Russia for the production of medium-sized wind turbines with a capacity from several hundred kilowatts to a megawatt. This market niche is practically vacant at the moment. Such wind turbines can be used in the retail electricity markets, to meet corporate demand for renewable energy, and even for the implementation of CSA RES projects, if the CUF requirements are waived. There is also potential for the development and production of medium-sized wind turbines for harsh climatic conditions.

3.2. ELECTRICITY GENERATION

Electricity production from renewable energy sources is traditionally of low interest in Russia due to the absence of climate and environmental agenda at the national level. At the same time, WPPs in WECM are close to being competitive. There are also market niches in Russia where the production of electricity from wind farms is economically profitable in certain situations, for example, in retail electricity markets and in isolated territories. Finally, in the coming years, in view of the global trend toward decarbonization, we can expect the emergence of a climate and environmental agenda in Russia and the revision of low RES plans for the period up to 2035.

3.2.1. FEDERAL LEVEL

Non-competitiveness of RES in Russia is often stated as the main obstacle to a more active development of the industry and an increase in the CSA RES. However, there is no justified approach to determining quotas for various types of generation in the country as distribution is decided by administrative bargaining between the main groups of influence in the energy sector. When allocating quotas, it would be advisable to take into account which generation technologies will be in demand globally in the near future or to switch to mixed tenders based on the criterion of the minimum cost per kWh, so that the choice of the type of generation is made by the market.

In the near future, the goal of large-scale wind energy in Russia will be to reduce the cost of electricity production. One of the solutions is to increase the market size by approving high volumes of the second CSA RES program and by creating competition for reducing capital costs. Capital expenditures can also be reduced by eliminating localization requirements and opening the market to foreign companies. An alternative could be the abolition of the CUF requirements. This will create opportunities for the localization of medium-sized wind turbines (less than 1 MW) with a lower CUF and lower capital costs. The second solution is to reduce the cost of capital, for example, by attracting a broader range of investors, from local (e.g., local enterprises) to institutional investors. Foreign institutional investors, in particular pension funds and insurance companies, show considerable interest in renewable energy assets. They need reliable and highly profitable assets with long investment horizons. Russian non-state pension funds can also be attracted to financing of CSA RES as this will provide them with guaranteed high returns, and some of them already have experience in investing in green projects. The problem of expensive financing in Russia can also be solved by subsidizing interest rates on renewable energy projects and providing government guarantees. Reducing the cost of capital, in turn, will allow wind farm investors to free up some funds and use them to reduce capital costs.

It is also possible to reduce expenditures and the real cost of kWh generated by WPPs, by way of simplifying the process of obtaining suitable land plots by the winners of tenders. The land usually needs to be converted in its purpose from agricultural to industrial.

45 Author's calculations based on IEA data (2020b). Renewables 2020. Analysis and forecast to 2025. URL: https://www.iea.org/reports/renewables-2020/wind#abstract

This is followed by the process of connecting a WPP to the grid. A 100% guarantee is required that the winners will be able to carry out these procedures quickly and without unnecessary costs. A similar problem was successfully solved in Kazakhstan in 2017, when the country made the transition from support for renewable energy through a feed-in tariff to support through auctions. In accordance with the Order of the Minister of Energy of the Republic of Kazakhstan No. 466 of 21.12.2017 „On Approval of the Rules of Organization and Conduct of Auction Bidding, including qualification requirements for bidders, the content and procedure of application, types of financial support for the application to participate in the auction and conditions of their deposit and return, the procedure for summing up the results and determining the winners," prior to the competitive selection of RES projects, the local executive bodies of regions, cities of national importance, and the capital city shall reserve land plots and connection points to the electricity grid for the planned renewable energy generation facilities.

It should be mentioned that auctions might be not the best option to promote renewable energy. They showed mixed result in several markets, e.g. in Germany[46]. The level of competition is a major success factor of auctions; in markets with low competition this mechanism is less suitable, and feed-in tariffs should be considered as an alternative. The possibility of introducing feed-in tariff was repeatedly discussed in Russia, however, in 2013, a competitive selection was approved as a mechanism to support renewable energy sources on WECM, followed by the conclusion of CSA RES with winners. This was justified by the fact that a similar mechanism is used in Russia to finance the construction of conventional generation facilities.

3.2.2. REGIONAL LEVEL

In the conditions of possible approval of the excessively low volumes of the second CSA RES program for the healthy development of the Russian wind energy market, the retail RES market can become attractive for wind energy. Regions are reluctant to conduct competitive selections to include renewable energy generation facilities in their schemes and programs for the long-term development of the electric power industry due to the fact that in this case they will have to set a feed-in tariff for such facilities, which may be higher than the usual one and which will have to be paid for by the territorial grid company. Regions can be interested in conducting competitive selections and implementing renewable energy generation projects in retail markets by way of organizing the production of components for wind farms on the basis of existing or new enterprises in the region. It is important that the products of manufacturing enterprises are in demand not only in the region of localization but also beyond its borders.

In the retail market, it is advisable to use not only multi-megawatt wind turbines but also smaller devices with a capacity of several hundred kilowatts. This can become an incentive for establishing and developing the production of components for such units in Russia. At present, this niche is not occupied by anyone: in Russia there is no mass production of components and no widespread usage of medium-power wind turbines.

In contrast to WECM, not only major groups of companies but also small companies can enter the retail market with RES projects. In addition, in accordance with the current RES support system in retail markets, the volume of electricity generation by qualified generation facilities shall not exceed 5% of the total volume of electricity losses in the subject of the Russian Federation. In many regions, 5% of network losses would be equivalent to just a few megawatts of installed capacity. For major players in the wind energy market, such volumes cannot be of interest. However, they may be of interest to small market participants. In order to increase competition and attract large companies, it is advisable to increase the 5% limit on grid losses to 15-20%.

The emergence of renewable energy cooperatives and other forms of citizen-driven or community energy projects can play an important role for the development of wind energy in retail markets. This practice is common in Europe and in some other countries. An energy cooperative is a business model in which citizens jointly own a generation facility. Members of the cooperative can not only provide themselves with electricity, but also earn by selling this commodity to the grid or to other citizens who are not members of the organization. The creation of energy cooperatives is beneficial to the regions, since it allows local communities to earn money from electricity production.[47] Cooperative members usually live in the same municipality or region and for this reason, energy cooperatives

46 AURES (2019). Auctions for the support of renewable energy in Germany. URL: http://aures2project.eu/wp-content/uploads/2020/04/AURES_II_case_study_Germany_v3.pdf.

47 IRENA (2020). Stimulating Investment in Community Energy: Broadening the Ownership of Renewables. URL: https://coalition.irena.org/-/media/Files/IRENA/Coalition-for-Action/IRENA_Coalition_Stimulating_Investment_in_Community_Energy_2020.pdf.

are often actively involved in local social development. There are no legislative obstacles to the creation of RES cooperatives in Russia, and only the first precedent is needed to trigger their development.

There are many small towns in Russia that are far away from generation facilities, sometimes they are several hundred kilometers away. Electricity losses in transportation over such distances can exceed 30%. In such cases, it is advisable to switch to distributed generation by means of wind power, possibly with the creation of a cooperative of local investors. In some cases, the feed-in tariff that will be required to return the funds invested in the wind farm may be lower than the current electricity tariffs.

3.2.3. ISOLATED AREAS

The development of wind energy in the zones of decentralized energy supply is rewarding for Russia. These zones are supplied by diesel generation, which is characterized by such bottlenecks as the lack of a developed infrastructure for fuel delivery, numerous outdated diesel generators, high levels of greenhouse gas emissions and harmful substances, and high energy costs. There are about 900 diesel power plants (DPP) in Russia used for supplying power to residents in isolated areas. In addition, there are also DPPs supplying power to industrial facilities. The cost of 1 kWh of electricity at a diesel power plant can exceed 200 rubles or USD 2.7. Since the real cost of electricity from diesel generation is too high for consumers, the energy supply of isolated territories is subsidized from regional budgets in the amount of up to 60-65 billion rubles or USD 0.8-0.85 billion per year and is also covered by certain groups of consumers through cross-subsidization.[48] Subsidizing distributed generation in isolated areas is a significant problem for regional budgets.

Many areas of isolated energy supply in Russia are located in the Far North and equivalent territories, and they are characterized by a high wind potential. Complete replacement of diesel generation by wind energy in such areas is currently technically impossible. However, through the introduction of hybrid wind-diesel complexes it is possible to save up to 40%-50% of diesel fuel. Such complexes consist of wind turbines, diesel generators as the basic type of generation, and energy storage units. Energy service contracts can be used as a basis for introducing hybrid wind-diesel complexes in isolated areas. Under such contracts, the funds invested in the project are returned through savings in fuel costs.

The development of wind power in isolated areas in Russia is insufficient and there is no trend towards mass introduction of hybrid wind-diesel complexes. This is largely due to the traditional climatic and logistical difficulties in such territories, including low temperatures and strong gusty winds conditioning the use of specific equipment, as well as a short navigation period by water (2-3 months for many northern regions), long distances between settlements, and undeveloped road infrastructure. At present, there is a fairly limited range of low-power wind turbines designed for integration with diesel generators and capable of operating effectively in harsh weather conditions. Local operating organizations are not always interested in saving diesel fuel. It is also a major challenge to attract qualified personnel to work at wind-diesel complexes. DPPs are often settlement-forming enterprises employing personnel with low qualifications. The operation of a modern wind-diesel complex requires fewer personnel than in the case of diesel power plants but with higher qualifications. It is challenging to bring personnel from other regions since not all qualified employees are ready to relocate to a remote region with a harsh climate.

Wind power in isolated Russian areas is rewarding not only in terms of developing generation and saving diesel fuel but also in terms of organizing the production of equipment for wind turbines operating in severe weather conditions, as well as in terms of developing competencies in the construction and operation of such installations. In Russia, there are more people living in the Far North than in similar conditions in any other country. Nevertheless, other countries also have settlements in harsh geographical and climatic conditions, in particular, in the north of the United States and Canada, and in the north of Europe. In many of these countries, the power supply to isolated communities is also still provided by DPPs and the issue of the high cost of electricity has not been solved. If Russian companies manage to develop their competencies and competitive advantages in the field of energy supply to isolated areas using wind turbines, their products and services may be in demand abroad. In addition, this experience and expertise can be applied not only in areas with a harsh climate but also in any isolated areas, which significantly expands the potential area of interest.

48 Analytical Center under the Government of the Russian Federation (2017). Power supply of isolated territories. Energy Bulletin. URL: https://ac.gov.ru/archive/files/publication/a/14142.pdf

3.3. NEW MARKET NICHES

In addition to the traditional areas of renewable energy development such as the production of electricity in the wholesale and retail electricity and capacity markets and the production of equipment for renewable energy, new Russian wind energy related areas that have previously not attracted much attention, may become rewarding in the near future.

Offshore Wind Energy

The development of offshore wind energy in Russia for energy supply does not look attractive in the near future. Russia has the largest land area in the world, with vast territories of the Middle and Lower Volga that are well suited for the development of onshore wind energy. Offshore wind energy is characterized by higher costs. Therefore, given that the potential of onshore wind farms has not yet been practically developed in Russia, the large-scale development of offshore wind power plants may be premature. On the other hand, the underdeveloped onshore wind generation is sometimes a reason for the accelerated development of offshore wind energy. Globally, offshore wind power is now in a phase of active growth, with capital costs declining more rapidly than in the sphere of onshore wind power. In 2020, 5.3 GW of offshore wind farms were installed worldwide, accounting for 8% of all new wind farms. Offshore wind energy may be of interest from the point of view of developing Russia's export potential, both in terms of equipment and electricity exports. Russian oil and gas companies and companies from some other sectors (for example, shipbuilding) possess many competencies required for the offshore wind energy. Therefore, the implementation of pilot projects in Russia may be possible, at least for the purposes of developing the competencies in demand in the world market.

Export of Clean Electricity

It may be rewarding in Russia in order to export electricity, to build wind farms, including the offshore ones near the borders with other countries with a demand for clean electricity. In January 2021, it became known that Finland may refuse to buy Russian electricity in connection with the transition to carbon neutrality by 2035. Finland is the largest importer of Russian electricity.

Voluntary Corporate Demand

Voluntary corporate demand for renewable energy sources is gradually beginning to take shape in Russia. For its implementation, the country has been using the mechanism of free bilateral contracts of the wholesale market for several years. It is similar to Power Purchase Agreements (PPA) used for the purchase of electricity from renewable energy facilities in other countries. However, in order to use this mechanism, the buyer of renewable electricity must be a subject of WECM, and there are relatively few such companies. Usually, when corporate demand is realized through the free bilateral contracts, the utility company of the beneficiary concludes a free bilateral contract with a renewable electricity generator while the beneficiary signs an letter of intent with the generator. Also, the implementation of corporate demand for renewable energy is theoretically possible through the conclusion of direct contracts in the retail electricity market. Such contracts would eliminate the need for end buyers of renewable electricity to enter WECM. However, this mechanism has not yet been tested in the Russian market.

In 2020, Russia received another opportunity to meet corporate demand for renewable electricity, through renewable energy certificates issued in accordance with I-REC international standard. The green certificate is an energy attribute certificate (EAC) that confirms that 1 MWh of electricity was generated from a renewable source. These certificates are not tied to physical electricity supplies and to purchase them, the buyer does not have to be a WECM subject. In December 2020, EN+ Group issued Russia's first I-REC certificates for solar generation and hydroelectricity. Some companies that own wind farms in Russia have already joined the I-REC register.

So far, the mechanisms of voluntary corporate demand for renewable electricity available in Russia are relatively inexpensive and for this reason, they cannot provide a return on investment in renewable energy facilities. However, as the ambitions of foreign corporate consumers of electricity are constantly growing and as similar requests are beginning to establish among some Russian companies it can be expected that in the near future, corporations in Russia will not only switch to RES but will encourage the construction of new renewable energy generation facilities, including wind farms. This can be done both through the existing free bilateral contract mechanisms and renewable energy certificates that are already in operation in Russia, and through direct corporate investments in wind farms. Small and medium-sized enterprises in Russia have long been switching to their own generation. Gas turbines are the most popular while the demand for solar power plants is gradually appearing, and wind power plants

may also be attractive for energy supplies to small and medium-sized enterprises in the coming years. In this case, corporate consumers can be combined into pools to present the significant volumes of demand required for large wind farms with multi-megawatt wind turbines. Medium-capacity wind turbines (several hundred kilowatts) may also be in demand among corporate consumers.

Active Energy Complexes (AEC)

Active energy complexes consist of distributed generation facilities (which can be wind farms), energy storage facilities, and load management systems. Such solutions are used to supply power to commercial and industrial consumers. AECs can be connected to the energy system, and they also provide the opportunity of local electricity trade. Russia is already planning to create such complexes in pilot mode. Since wind power is a renewable energy source with variable power generation, the implementation of any wind power projects with energy storage devices is advisable. This is already a trend all over the world. Variable solar and wind generation is increasingly being supplemented by energy storage devices. It can also be an incentive for the development of the Russian energy storage industry.

Production of Green Hydrogen and other Low-Carbon Products

Wind energy can become a supplier of electricity for the production of green hydrogen. Such projects may be of interest to regions that are poor in minerals, but at the same time have good transport accessibility and a developed industrial base. The cost of hydrogen production from renewable energy sources is still higher in comparison with other energy sources. However, potential importers are primarily interested in green hydrogen. In particular, the Hydrogen Strategy for Climate Neutral Europe, adopted as part of the EU Green Deal in July 2020, focuses on hydrogen produced primarily from solar and wind power; the use of other types of low-carbon hydrogen is acceptable only in the intermediate stages of the EU's transition to a carbon-neutral economy by 2050. Moreover, European buyers of green hydrogen may demand only the green hydrogen produced at new renewable energy facilities, and not at those that were previously planned within the framework of state support systems. This is required by the principle of complementarity, which is contained in the European Hydrogen Strategy.

Although green hydrogen has not yet attracted significant interest in Russia at the official level, unlike in the case of hydrogen produced from natural gas or nuclear power, the first plans to produce hydrogen using wind power are already beginning to emerge in Russia. The production of green hydrogen and other green commodities could be an additional incentive for the development of offshore wind generation in Russia. For example, such projects seem to be promising in the Sakhalin Region, which intends to become a territory of advanced low-carbon development. A number of companies are already planning to implement major green projects in this region, including the organization of green hydrogen production.

The new EU Green Deal involves a significant transformation of production processes in the EU countries and the transition from a linear economy – where products are produced from primary resources and then consumed, followed by waste disposal – to a cyclical economy, where the waste of some industries is raw material for others, and all the resources used are as renewable as possible. In particular, emphasis will be placed on the decarbonization and modernization of energy-intensive industries, in particular, steel and cement production. [49] Creating conditions for the production of low-carbon steel, aluminum, cement, and other products through the use of wind power can become a competitive advantage for Russian regions. In this case, the WPP generation should be considered not just as electricity production but as part of the industrial complex.

Creation of Special Green Economic Zones

Many Russian regions are in search of promising areas for further industrial development. Given the global trends in decarbonization, the growing demand for low-carbon products abroad and the prospect of introducing a system of carbon import duties in the EU, it makes sense for Russian regions with a developed industrial sector, high logistics accessibility and good wind potential to work out the possibility of creating special green economic zones where investors will be offered tax incentives, as well as industrial sites with communications and green infrastructure with the possibility of RES electricity consumption, including from wind farms. Investors, in turn, should be obliged to localize in Russia the production of low-carbon goods using modern technologies. Russia already has dozens of special economic zones and territories of advanced development. Renewable energy projects can be developed in existing territories with a special status.

49 European Commission (2019). The European Green Deal. Sustainable industry. URL: https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6724

CONCLUSION

2020 was a year of significant achievements in the field of wind energy in Russia. More than 700 MW of wind farms were commissioned in the country, which together with the previously built wind farms is more than 1 GW. The production of equipment for modern large wind farms has been created in recent years. Individual wind generation projects have been implemented in isolated areas. However, wind power accounts for only 0.4% of the capacity of the entire energy system and 0.13% of generation in Russia. Russia is lacking a vision on how to make use of its huge wind and solar energy potential and become a renewable energy superpower. Unlike many other countries in the world, the COVID-19 pandemic in Russia has not yet had a stimulating effect on the decarbonization and energy transition process.

The development of wind energy in Russia is currently observed mainly in the wholesale electricity and capacity market through the CSA RES mechanism. As part of the first CSA RES program, designed for 2014-2024, 5.86 GW of RES power plants will be built in Russia, including 3.4 GW of wind farms. It is highly probable that in the near future the amount of support for 2025-2035 will be approved, and it will be insufficient for a healthy development of the industry. The volume of the second CSA RES program is likely to amount to RUB 400 billion (USD 5.5 billion). This will allow to build 7.5 GW of RES power plants in 2025-2035 including 4.5 GW of WPP and this volume is the minimum to keep the already very small number of players in the market. In order to fully load the production of renewable energy equipment created in Russia in recent years, the quotas for wind power plants should be 5-13 GW.

The costs of wind generation in Russia are obviously higher than in the rest of the world. This is due to the small size of the market, the lack of competition and the localization of equipment production, which is a prerequisite for receiving government support in the wholesale electricity and capacity market. The costs can be reduced in different ways — by increasing the volume of quotas allocated to renewable energy sources in the wholesale electricity and capacity market, by subsidizing interest rates and attracting a broader range of investors, from community based up to institutional investors, by allowing a wider range of players to the market, including small companies with medium-sized wind turbines. Nevertheless, the cost of electricity from WPPs in Russia already averages 6.4 rubles, or 8.8 U.S. cents. This makes it possible to consider the possibility of its development in the retail electricity markets, where WPPs have not yet been developed, as well as in the sector of corporate consumers. In these sectors, it is also rewarding to develop and organize the production of medium-sized wind power plants (from several hundred kilowatts to 1 MW). It should be noted that the process of shaping corporate demand for renewable energy has already begun in Russia. Mechanisms such as free bilateral contracts in the wholesale market, less tested direct contracts in the retail market, and renewable energy certificates issued under the I-REC Standard are now available nationwide.

Despite the conservative nature of its energy policy, Russia cannot remain aloof from global trends. In addition, some events have a direct impact on the Russian economy. For example, the introduction of a cross-border carbon tax by the EU creates risks for Russian exporters. This factor raises concerns both in the corporate sector and at the highest government level. Having a manufacturing base and competencies in wind energy can mitigate these risks. In addition, the demand for goods produced with the use of electricity from renewable energy sources will increase in the world in the near future. This means that there may be prospects in Russia for the production of such goods as green hydrogen, ammonia, green metals, green cement, etc. There may be interest in the creation of special green economic zones (including through the use of the potential of existing special economic zones and territories of advanced development), where investors will be offered tax incentives, green infrastructure, and electricity from renewable energy sources. Many Russian regions are now in search of investment ideas, which in the future may become drivers of economic development, and these ideas may be in demand.

LIST OF INTERVIEWED EXPERTS

Alexander Badelin, General Director of Activity LLC

Igor Bryzgunov, Chairman of the Board of the Russian Association of Wind Power Industry (RAWI)

Sergey Vasin, General Director of the Ulyanovsk Region Development Corporation

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REFERENCES

1) AURES (2019). Auctions for the support of renewable energy in Germany. URL: http://aures2project.eu/wp-content/uploads/2020/04/AURES_II_case_study_Germany_v3.pdf.

2) Brown et al. (2016). Estimating Renewable Energy Economic Potential in the United States: Methodology and Initial Results // NREL. URL: https://www.nrel.gov/docs/fy15osti/64503.pdf

3) Ember (2020). Wind And Solar Now Generate One-Tenth Of Global Electricity. URL: https://ember-climate.org/project/global-electricity-h12020/

4) Energy-Charts (2020). Net public electricity generation in Germany in 2020. URL: https://energy-charts.info/charts/energy_pie/chart.htm?l=en&c=DE&year=2020

5) European Commission (2019). The European Green Deal. Sustainable industry. URL: https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6724

6) Global Wind Atlas. URL: https://globalwindatlas.info/

7) Gsänger S., Denisov R. (2017). Perspectives of the wind energy market in Russia. URL: https://library.fes.de/pdf-files/bueros/moskau/13474.pdf.

8) IEA (2020a). World Energy Outlook 2020. URL: https://www.iea.org/reports/world-energy-outlook-2020

9) IEA (2020b). Renewables 2020. Analysis and forecast to 2025. URL: https://www.iea.org/reports/renewables-2020/wind#abstract

10) IMF (2020). Russian Federation: Staff Concluding Statement of the 2020 Article IV Mission. URL: https://www.imf.org/en/News/Articles/2020/11/23/mcs112420-russia-staff-concluding-statement-of-the-2020-article-iv-mission

10) IMF (2021). Real GDP growth. URL: https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/WEOWORLD

11) IRENA (2017). REMAP 2030: Renewable Energy Prospects for the Russian Federation. URL: https://www.irena.org/publications/2017/Apr/Renewable-Energy-Prospects-for-the-Russian-Federation-REmap-working-paper.

12) IRENA (2019). Deployment, investment, technology, grid integration and socio-economic aspects. URL: https://www.irena.org/publications/2019/Oct/Future-of-wind

13) IRENA (2020). Stimulating Investment in Community Energy: Broadening the Ownership of Renewables. URL: https://coalition.irena.org/-/media/Files/IRENA/Coalition-for-Action/IRENA_Coalition_Stimulating_Investment_in_Community_Energy_2020.pdf.

14) Lazard (2019). Lazard's levelized cost of energy analysis - version 13.0. URL: https://www.lazard.com/media/451086/lazards-levelized-cost-of-energy-version-130-vf.pdf

15) Lazard (2020). Lazard's levelized cost of energy analysis – version 14.0. URL: https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

16) UNFCCC (2020). Russian Federation. 2020 National Inventory Report (NIR). URL: https://unfccc.int/documents/226417

17) Vygon consulting (2020). "The new renewable energy support program will be able to make green electricity cheaper than traditional generation by 2030," concludes VYGON Consulting. URL: https://vygon.consulting/pressroom/press-about-us/1748/

18) Analytical Center under the Government of the Russian Federation (2017). Power supply of isolated territories. Energy Bulletin. URL: https://ac.gov.ru/archive/files/publication/a/14142.pdf

19) Analytical Center under the Government of the Russian Federation (2020). Voluntary National Review of the Implementation of the 2030 Agenda for Sustainable Development. URL: https://sustainabledevelopment.un.org/content/documents/26421VNR_2020_Russia_Report_Russian.pdf

20) Russia Renewable Energy Development Association (RREDA) (2020a). Renewable energy market in Russia: current status and development outlook. URL: https://rreda.ru/bulletin

21) Russia Renewable Energy Development Association (RREDA) (2020b). The government intends to support the retail market of renewable energy generation with a comprehensive approach. URL: https://rreda.ru/novosti/tpost/ge9taucs4s-gosudarstvo-namereno-podderzhat-roznichn

22) Russia Renewable Energy Development Association (RREDA), Vygon Consulting (2020). On systemic effects of the implementation of renewable energy investment incentive programs in Russia (CSA RES). URL: https://rreda.ru/vygon_consulting

23) ATS (2020). Project selection results. URL: https://www.atsenergo.ru/vie/proresults

24) Bezrukikh P.P. (2010). Wind energy (reference and methodological manual). Moscow, Publishing House Energia, 320 p.

25) Business Review (2019). The share of green electricity in the Ulyanovsk Region has reached 8%. URL: https://uldelo.ru/2019/05/23/dolya-zelenoi-elektroenergii-br-v-ulyanovskoi-oblasti-b-dostigla-8-b

26) Yermolenko B., Yermolenko G., Proskuryakova L. (2017). How high is the technically feasible RES potential in Russia? // Russian Fuel and Energy Complex, No. 9, pp. 22-27.

27) Yermolenko G. et al. (2014). Development of grid-connected wind power plants in Russia through the example of the pilot project of grid-connected WPP Mirny in the Yeisk District of the Krasnodar Krai // Energetichesky Vestnik. No. 17, pp. 20-30.

28) COURSE (2020). 2020-2030: A Decade of Action for the SDGs in Russia. URL: http://kurs2030.ru/.

29) HSE, CSR, Vygon Consulting (2018). Analysis of the system effects of the RES support program 1.0. Choice of solutions to continue supporting renewable energy beyond 2024. URL: https://www.np-sr.ru/sites/default/files/4_analiz_sistemnyh_effektov.pdf

30) Russian Association of Wind Power Industry (RAWI) (2020). Review of the Russian Wind Energy Market and Russian regions ranking 2019. URL: https://rawi.ru/2020/03/obzor-rossiyskogo-vetroenergeticheskogo-ryinka-za-2019-god-razmeshhena-sayte-ravi/ and company materials.

31) UNFCCC (2020). Nationally determined contribution of the Russian Federation. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Russia%20First/NDC_RF_ru.pdf

32) System Operator (2020a). Unified Energy System of Russia: Interim Results. URL: https://so-ups.ru/fileadmin/files/company/reports/ups-review/2020/ups_review_1220.pdf

33) System Operator (2020b). Unified Energy System of Russia. URL: https://so-ups.ru/functioning/ees/ees-2020/

34) WWEA (2020a). World wind capacity at 650,8 GW, Corona crisis will slow down markets in 2020, renewables to be core of economic stimulus programmes. URL: https://wwindea.org/world-wind-capacity-at-650-gw/

35) WWEA (2020b). Global Wind Installations. URL: https://library.wwindea.org/global-statistics/

36) Market Council (2018). On the results of the fulfillment of the instructions of the Supervisory Board of the NP Market Council Association.

37) Audit Chamber (2020). Report on the results of the expert analysis event "Analysis of the public administration system for the implementation of the sustainable development agenda for 2019 and the elapsed period of 2020." URL: https://ach.gov.ru/upload/iblock/761/76119231ce487594c1301b38be450c96.pdf

LIST OF ABBREVIATIONS

AEC - Active Energy Complexes

ATS – Administrator of trading system

BNEF – Bloomberg New Energy Finance

CCGT - combined-cycle gas turbine

CSA – Capacity Supply Agreements

CSR - Center for Strategic Research

DPP - Diesel power plants

EAC - Energy attribute certificate

FBC - free bilateral contracts

FIEP - Fund for Infrastructure and Educational Programs

HPP - hydroelectric power plants

HSE – Higher School of Economics

CUF capacity utilization factor

IEA – International Energy Agency

I-REC – International Renewable Energy Certificate

IRENA – International Renewable Energy Agency

IVT RAS – Federal Research Centre for Information and Computational technologies

LCOE - Levelized cost of electricity

LULUCF - Land use, land-use change and forestry

MSTU - Bauman Moscow State Technical University

NPP - Nuclear power plant

PPA - Power Purchase Agreement

RAWI – Russian Association of Wind Power Industry

RES – Renewable energy sources

RREDA - Russia Renewable Energy Development Association

SGTT - Siemens Gas Turbine Technologies

SHPP - Small hydroelectric power plant

SPIC - Special investment contracts

SPP - Solar power plant

TPP – Thermal power plant

TsAGI - The Central Aerohydrodynamic Institute

UES - Unified Energy System

UNFCCC – United Nations Framework Convention on Climate Change

WACC - Weighted average cost of capital

WECM - Wholesale electricity and capacity market

WPP - Wind power plant

WWEA – World Wind Energy Association

LIST OF FIGURES

LIST OF TABLES

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RUSSIA'S WIND ENERGY MARKET:

Potential for New Economy Development

As of early 2021, more than 1 GW of wind power plants are in operation in Russia, more than 700 MW of which was commissioned in 2020, despite all the difficulties and restrictions caused by the COVID-19 pandemic. In Russia, wind power accounts for only 0.4 per cent of the capacity of the whole energy system and 0.13 per cent of generation. Russia is the only major economy in the world in which wind energy is just beginning to take its first steps. The main obstacle to the development of wind energy in Russia is the insignificant volume of the internal market, which is guaranteed by the government support programme because of the de facto absence of a climate and environmental agenda in the country.

This study pays significant attention to the search for promising market niches in the wind energy sector in Russia. The development of wind energy in retail electricity markets in energy-deficient areas (including through the creation of energy cooperatives), as well as in isolated areas, will be rewarding. There is potential for the production of medium-capacity wind turbines to supply these markets and to develop exports. Corporate demand for electricity from renewable energy sources is forming in Russia. In December 2020, Russian renewable energy certificates issued according to the I-REC Standard became available. In addition, corporations can switch to renewable energy sources through the mechanism of free bilateral contracts for the supply of electricity in the wholesale market. In the near future, corporate demand may emerge precisely for wind farms.

Russia has the potential to become a producer and exporter of renewable electricity and other green commodities with a low carbon footprint, such as green steel, aluminium, cement and so on. In the coming years, interest may emerge in creating special green economic zones, including in existing territories with special status, where investors will be offered tax benefits, green infrastructure and electricity from renewable energy sources. Active energy complexes are of particular interest in this regard.

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