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RUSSIAN RENEWABLE ENERGY MARKET: CURRENT STATUS AND DEVELOPMENT PROSPECTS



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Arshanskaya SPP

INTRODUCTION

Despite all the difficulties caused by the world energy crisis, the global trend in the development of energy transition technologies continues to demonstrate upward dynamics. Against all fears and negative forecasts, the renewable energy sector set new records in 2022: investments in the amount of about 500 billion USD ensured the commissioning of almost 340 GW of new renewable energy generation facilities. Over the year, the total installed capacity of green energy increased by more than 9%. In the midst of crisis phenomena, as well as rising prices not only for energy carriers, but also for equipment, such statistics once again confirm that the vector in which developed and developing countries revise plans for the decarbonization of national economies through the accelerated renewable energy development was determined absolutely correctly. The share of renewable energy sources (hereinafter referred to as RES) in the global capacity additions already exceeds 83%. The IEA estimates that an additional 1,000 GW of renewable energy capacity will be commissioned globally in the next two years. Already by 2030, ambitious plans for the energy transition, primarily in countries such as China, India, the United States, countries of Europe and Africa, will lead to the growth of the global renewable energy market by more than 100% relative to current indicators. An additional incentive to bet on renewable energy will be a parallel trend in the electrification of the transport sector and the hydrogen energy development. Thus, the accelerated spread of electric vehicles, according to various estimates, by 2030 will form up to 4% of global demand for electricity. In view of the need to comply with the principles of integrity of the comprehensive low-carbon development concept, this additional demand should be met by using carbon-free energy sources, primarily renewables. The widespread use of hydrogen energy technologies, where special emphasis is placed on low-carbon or, in other words, "green" hydrogen, will also play an important role in increasing the global capacity of renewable energy generation in the future until 2050.

Over the past year, the Russian renewable energy market has continued to adapt to the new working conditions under the sanctions regime. The restrictions have become an additional factor for the growth of the capital costs for renewable energy generation projects. Despite the fact that the tendencies of price growth for equipment and components were also observed at the global level, investors in Russian projects felt this much more seriously — the growth in the cost of projects, according to various estimates, amounted to 25–35%. Investors who previously concluded capacity supply agreements (hereinafter referred to as CSA RES)[1] worked hard to build new supply chains for components and equipment, select new technology partners, and reformat financing conditions. Thanks to these efforts and the anti-crisis measures taken by the Government of Russia, in particular the granting of a non-punitive delay of up to 24 (36) months, almost all previously planned projects were retained, while their implementation was postponed for a period of 7 to 24 months. The right to refuse to fulfill obligations, which was also provided by the Government, was used by investors only in 13 contracts — for wind power plants with a total capacity of 459 MW and one small hydro power plant with a capacity of 23.7 MW. These projects had the largest deviation in construction costs from the pricing parameters used in the CSA RES. The other 92 contracts concluded before 2022 remain relevant, some of them have already been fulfilled, and others will be implemented within the next five years.

As of July 2023, the total installed capacity of renewable energy facilities in Russia exceeded the threshold of 6.0 GW. The pace of capacity commissioning in the wholesale market under the CSA RES program has slowed down comparing to the past three years. Thus, within the framework of the CSA RES support program, about 1.2 GW were commissioned annually in 2020 and 2021, and in 2022 and the first half of 2023, the volume of commissioning in this segment was limited to 610 MW. At the same time, given the difficulties faced by the industry after unprecedented sanctions, this result can be considered as a success.

In parallel, there is an acceleration in the pace of development of renewable energy generation projects within the framework of the support mechanism on the retail electricity markets. Since the beginning of 2022, the installed capacity in this segment has more than doubled, reaching 100 MW by July 2023: more than 56 MW of solar generation were commissioned, of which 44 MW were commissioned in the first half of 2023, and 12 MW in 2022. Another 475 MW of predominantly solar capacity is under implementation, with other technologies accounting for less than 20%.

The current regulation in Russia reflects the global trend to reduce greenhouse gas emissions and increase the share of renewable energy production in the energy balance. The Government of the Russian Federation faces an ambitious task of developing specific climate policy measures that will ensure, on the one hand, sustainable economic growth, and on the other hand, the country's carbon neutrality by 2060, the achievement of which is envisaged by the Strategy for Socio-Economic Development of Russia with Low Greenhouse Gas Emissions until 2050.

It is important that despite the shift in priorities towards countering crisis phenomena, the tasks of decarbonizing the economy and ensuring sustainable development have not lost their relevance. Both the government and business demonstrate a consolidated position in this area. Finally, the opinion was established that the global energy transition is inevitable, as well as the extension of the principles of carbon regulation to all jurisdictions without exception. There is renewed interest in instruments such as carbon units. In 2022, a single registry was launched in Russia, and during 2023 it is planned to launch a national system for the circulation of certificates of energy origin. Despite the period of turbulence, renewable energy in Russia remains at the forefront of technological development and attracts maximum attention of both Russian and foreign investors. The industry is confidently looking to the future, oriented towards the normalization of investment climate conditions, and expects to restore the previous pace of development over the next year.

1. CSA RES – capacity supply agreement for RES generation – an investment contract concluded between an investor who won the tender, organized by the wholesale electricity and capacity market commercial operator, and a matrix of the consumers. CSA RES provides a warranty of investment payback within 15 years period.

STATUS AND PROSPECTS OF RENEWABLE ENERGY DEVELOPMENT IN RUSSIA



Photo by Alexander Melnikov

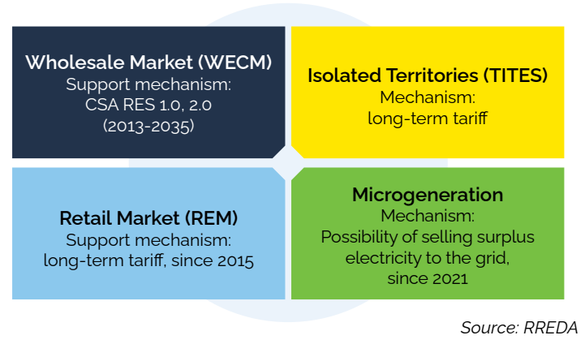
The key provisions of the state management system for the renewable energy development in Russia are defined by the Federal Law "On Electric Power Industry"[2], according to which renewable energy sources include: solar, wind, water, tidal energy, energy of waves, geothermal energy, low-grade thermal energy, biomass, including plants specially grown to produce energy, as well as biogas and gas emitted by waste in landfills, etc.[3]

In order to stimulate investment in the development of renewable energy in the Russian Federation, there is a complex of regulatory support, which includes the selection of investment projects in the wholesale electricity and capacity market (hereinafter referred to as WECM) and payment for power under the CSA RES, the selection of investment projects on the retail electricity markets (hereinafter referred to as REM) for further priority sale of renewable energy in order to compensate the losses of electric grid companies, as well as a mechanism for "balancing" electricity generation by microgeneration facilities and energy consumption by household and commercial consumers within 15 kW. In technologically isolated territorial energy systems (hereinafter referred to as TITES), there is a mechanism of investment payback in case of replacement of expensive fuel production in accordance with energy service contracts **(Fig. 1)**.

As of July 2023, the total installed capacity of renewable energy facilities operating in the Unified Energy System (hereinafter referred to as the UES) of Russia and in TITES exceeded the threshold of 6.0 GW **(Fig. 2)**.

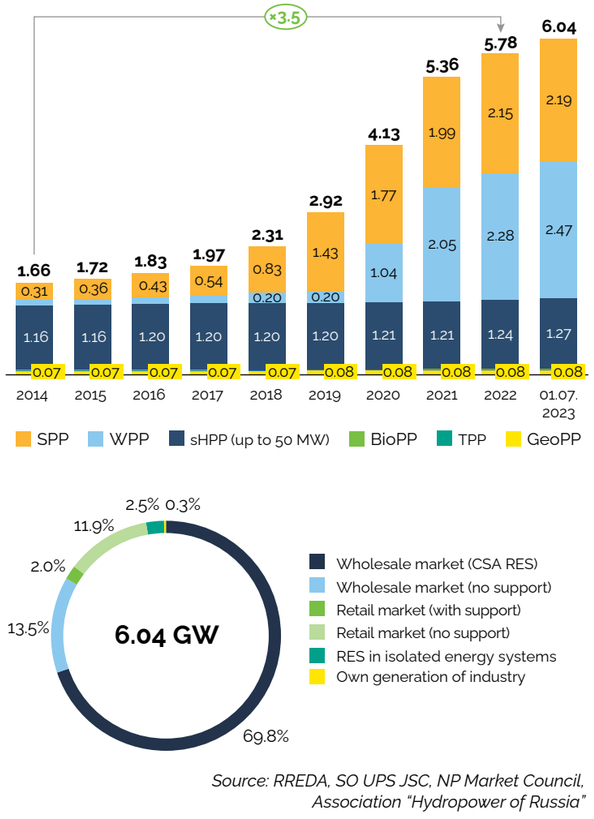
Wind power plants (hereinafter referred to as WPP) and solar power plants (hereinafter referred to as SPP), which account for 2.5 GW and 2.2 GW of capacity, respectively, as well as small hydro power

Fig. 1. Segments of the RES market in Russia and existing support mechanisms



Source: RREDA

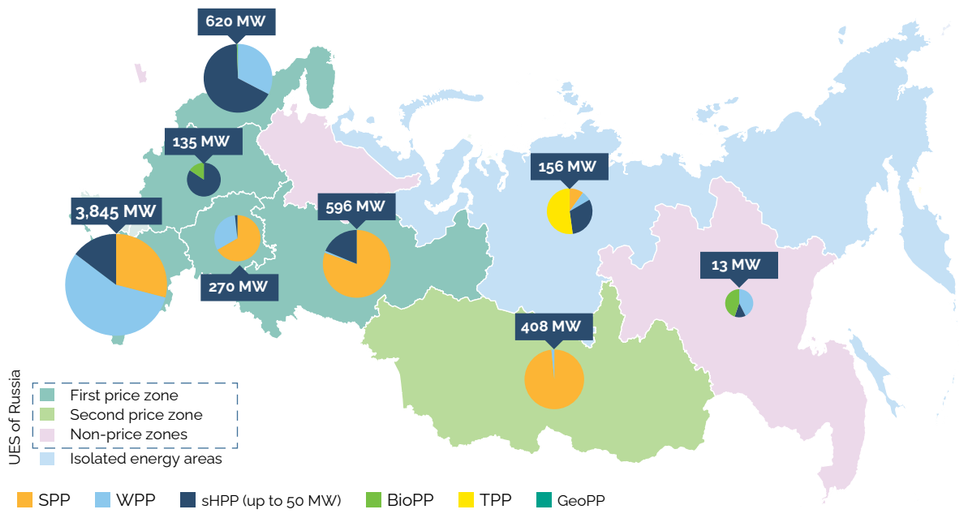
Fig. 2. Total installed capacity of renewable energy facilities in Russia, GW[4]



Source: RREDA, SO UPS JSC, NP Market Council, Association "Hydropower of Russia"

2. Federal Law No. 35-FZ dated March 26, 2003 "On Electric Power Industry".
3. In addition, renewable energy sources in Russia include production and consumption waste, with the exception of waste from the use of hydrocarbons and fuels, as well as gas generated from coal mines.
4. Excluding data for Donetsk People's Republic (DPR), Lugansk People's Republic (LPR), Zaporozhye and Kherson regions.

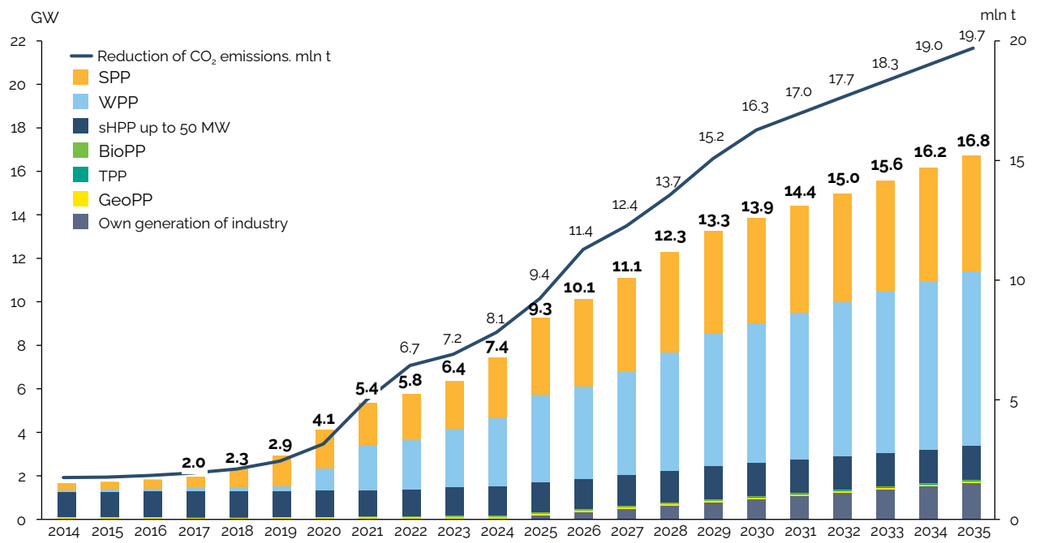
Fig. 3. Map of RES generation distribution by price and non-price zones of Russia and TITES, MW



* For the first price zone, the distribution of RES generation capacity across the IES is given.

Source: RREDA

Fig. 4. Forecast of the total renewable energy generation capacity and reduction of CO_2 emissions



Source: RREDA, TSA JSC, SO UPS JSC, NP Market Council.

plants (hereinafter referred to as sHPP) with a capacity of up to 50 MW (total capacity — 1.3 GW), are the leaders in the structure of the RES installed capacity by type of generation. In addition, power plants operating on the basis of biomass, biogas, landfill gas, tidal energy and geothermal energy with a total capacity of more than 100 MW are in operation.

According to the results of the last three years, more than half of the installed capacity of green generation in Russia falls on facilities operating within the framework of the CSA RES support mechanism, the share of which increased from the end of 2020 to 2023 from 58% to 70%. At the same time, since 2017, the CSA RES facilities have been making almost the entire contribution to the annual growth of renewable energy capacities in Russia, providing 94–99% of annual RES generation commissioning.



Kuzminskaya WPP

Today, 97% of RES facilities (5.87 GW) are located in the first and second price zones of the UES of Russia, while 64% of the total renewable energy installed capacity operate in the integrated energy system (hereinafter referred to as the IES) of the South, 10–11% — in the IES of the North-West and the IES of the Urals, 7% — in the IES of Siberia **(Fig. 3)**.

Despite the insignificant share of renewable generation in the UES of Russia as a whole, the share of RES generation in some regional energy systems already exceeds 10%, which, according to the System Operator (hereinafter referred to as the SO), has a significant impact on the operation of the energy system. However, to implement the energy transition and achieve carbon neutrality by 2060, the share of green generation should grow at a more significant pace. This will require the implementation of procedures that optimize the costs of integration measures and the development of the grid complex through the rational territorial location of new solar and wind generation facilities, as well as the development of a system for forecasting renewable electricity generation.

According to the results of the first half of 2023, the installed capacity of renewable energy generation in Russia is approximately 2.4% of the total capacity of all generating facilities of the Russian energy system (the CSA RES facilities account for 1.7%). With the implementation of all projects selected to date and further commissioning of facilities within the framework of the CSA RES 2.0 in accordance with the planned indicators approved by the Government for the wholesale electricity and capacity market, as well as the renewables' development in retail markets, the RES share in the total capacity of the national energy system will be 6% by 2035. The cumulative installed capacity of all renewable energy facilities in 2035 will approach 17 GW, which will reduce annual CO_2 emissions by 2035 in the amount of about 20 million tons **(Fig. 4)**[5].

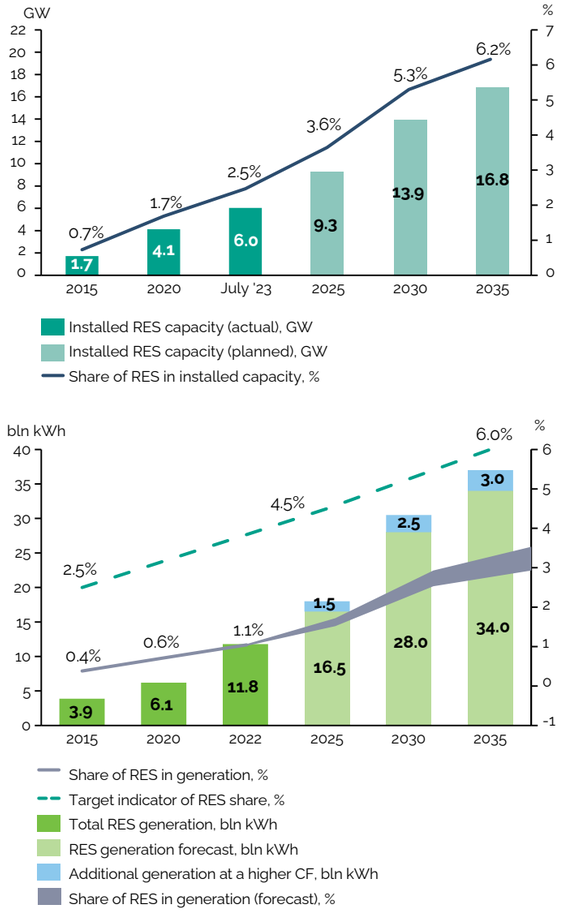
With the implementation of all projects planned within the framework of RES support programs, the RES share in the total electricity generation in Russia will be about 3% by 2035. Meanwhile, according to the main directions of the state policy in the field of increasing the energy efficiency of the electric power industry through the use of renewable energy sources for the period up to 2035, approved by Resolution of the Government No. 1-r[6], the target for the volume of renewable electricity production (with the exception of small hydro power plants with a capacity of more than 25 MW) and its consumption in the aggregate balance of electricity production and consumption is set at 6% as a minimum in 2035. The implementation of the goals set by the Government can be further facilitated by the more active development of RES facilities' construction by industrial consumers to meet their own needs or within the framework of bilateral investment

5. RREDA estimates of the previous year, according to which the capacity of renewable energy generation by 2035 was expected to be at the level of 20 GW, and the share in the total capacity was about 7%, were adjusted taking into account the results of RES projects competitive selection in 2023.
6. Resolution of the Government of the Russian Federation dated January 8, 2009 No. 1-r "On the main directions of state policy in the field of increasing the energy efficiency of the electric power industry based on the use of renewable energy sources for the period up to 2035".

agreements, the transformation of pricing rules within the wholesale electricity and capacity market can also play an important role.

Fig. 5 shows the dynamics of the actual and calculated indicator of the share of renewable energy generation in the capacity balance of the Russian energy system and in the total electricity generation in Russia until 2035.

Fig. 5. Current and forecast RES share in installed capacity and in electricity generation in Russia[7]



Source: RREDA, TSA JSC, SO UPS JSC, NP Market Council, Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009

Development of the renewable energy industry in the world by the end of 2022

According to IRENA, progress in the global energy transition continues at an accelerated pace, which is confirmed by the annual growth in the renewable energy share in the world electricity generation structure. Despite the energy crisis, renewable energy generation makes the main contribution to the power capacities' growth worldwide.

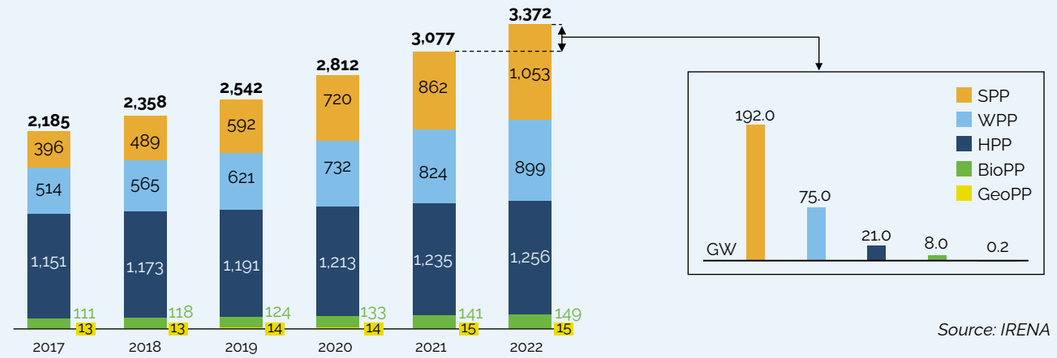
Governments around the world are taking unprecedented steps to accelerate the energy transition and reduce the dependence of their economies on traditional energy sources, setting ambitious goals for the development of renewable energy industry.

The dynamics of the renewable energy installed capacity in the world, as well as the net increase in global renewable generation capacity by type of generation in 2022 are presented in **Fig. 6**.

2022 was a record year for renewable power capacity additions globally: almost 340 GW of RES facilities was commissioned[8] (with an annual energy capacity increase of 296 GW[9]), which increased the global total installed capacity of renewable energy generation to 3,372 GW. The share of RES generation in the total volume of commissioning for 2022 was 83%[10].

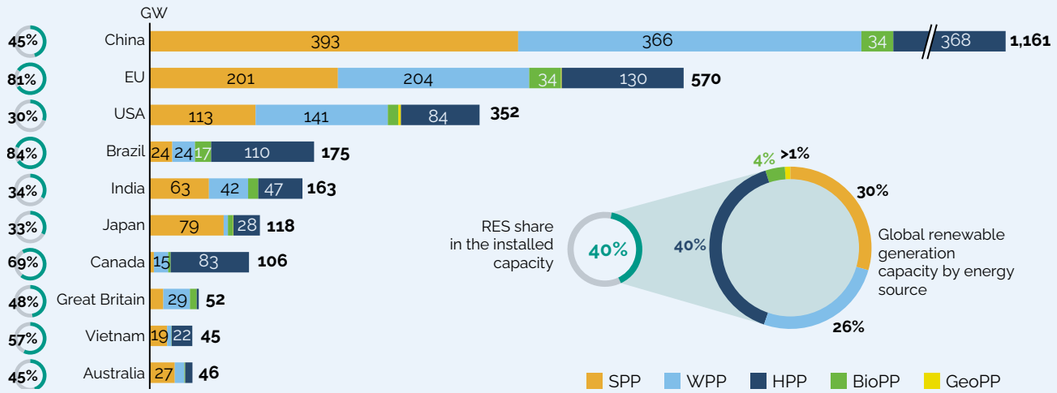
The largest contribution was made by solar and wind generation facilities: the increase in the installed capacity of SPP amounted to 192 GW (an increase of 22% year-on-year), WPP — 75 GW (an increase of 9% year-on-year). The installed capacity of HPP (excluding pumped storage power plants) increased by 21 GW over the year (an increase of 2% year-on-year), BioPP — by 8 GW, GeoPP — by only 181 MW.

Fig. 6. The global renewable generation capacity and the structure of capacity growth in 2022, GW



Source: IRENA

Fig. 7. Installed renewable generation capacity in the leading countries (at the end of 2022), GW

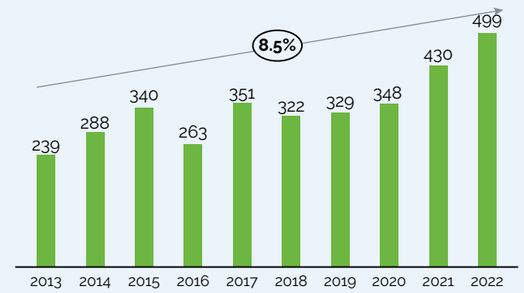


Source: IRENA

According to the results of 2022, China (1,161 GW) is the undisputed leader in terms of installed capacity of renewable energy generation, followed by the European Union (570 GW) and the United States (352 GW). For more information, see **Fig. 7**.

A joint report by IRENA and the Climate Policy Initiative[11] notes that despite numerous economic and geopolitical challenges, annual RES investment continued the positive trend that began after 2018 **(Fig. 8)**. In 2020, the investment level reached USD 348 bln, which is 5.6% more than in 2019. In 2021, USD 430 bln was invested (24% more than in 2020), and in 2022, investments increased by another 16%, reaching USD 499 bln[12].

Fig. 8. Annual investment in renewable energy (2013–2022), bln USD



Source: IRENA & CPI

7. The forecast data are the result of expert assessments by RREDA and take into account the development of RES generation projects in the wholesale and retail markets, as well as in the segment of own generation of industry.
8. IEA (2023). Renewable Energy Market Update — Outlook for 2023 and 2024.
9. Taking into account decommissioning and replacement of end-of-life equipment at RES facilities.
10. IRENA (2023). Renewable Capacity Statistics 2023.
11. IRENA&CPI (2023). Global Landscape of Renewable Energy Finance 2023.
12. Values are in current prices and exchange rates.

RENEWABLE ENERGY DEVELOPMENT IN THE WHOLESALE ELECTRICITY AND CAPACITY MARKET IN 2022 AND THE FIRST HALF OF 2023



Arshanskaya SPP

IMPLEMENTED INVESTMENT PROJECTS IN THE WHOLESALE MARKET

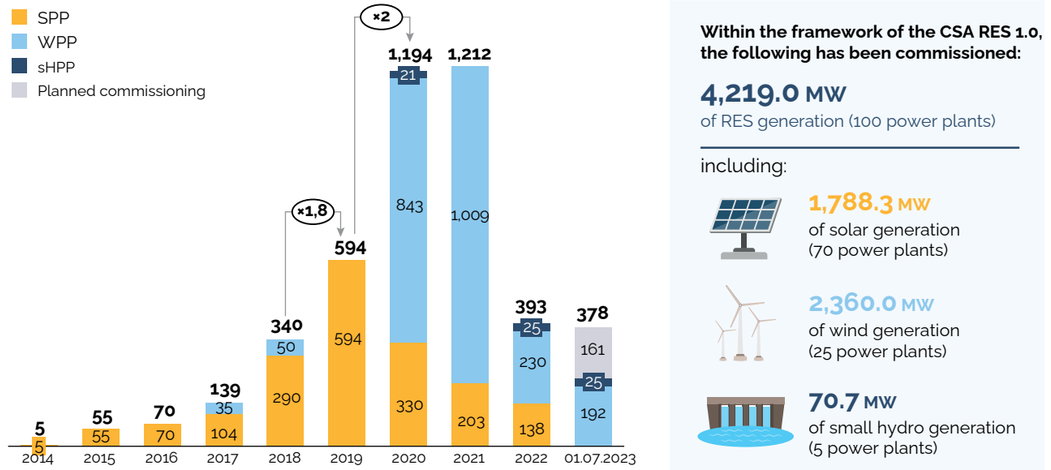
In 2022, the total capacity of facilities operating on the basis of renewable energy sources and built within the framework of the CSA RES support mechanism in the wholesale electricity and capacity market in Russia increased by 392.9 MW. Although this is significantly less than the commissioning over the past two years, given the difficulties the industry faced due to the unprecedented sanctions pressure on the domestic economy, the dynamics can be considered positive[13] **(Fig. 9)**.

Despite the decrease in annual commissioning volumes, last year the solar energy sector demonstrated the successful implementation of investment projects without lagging behind the planned deadlines: 137.6 MW of solar generation started to sell electricity and capacity at the wholesale market, as a result of which by July 1, 2022, all SPP projects planned under the first stage of the RES support program (CSA RES 1.0) were completed and put into operation. In 2023, there were no commissioning of SPP under the CSA RES. In the wind energy sector, three wind power plants with a total capacity of 422.4 MW were commissioned in 2022 and in the first half of 2023[14] (230.4 MW in December 2022 and 192.0 MW in March-July 2023). In the small hydropower segment, commissioning occurred in December 2022 and April 2023, when two sHPP with a cumulative capacity of 49.8 MW were launched.

Since the start of the RES generation support program at the WECM, as of July 2023, 100 RES generation facilities with a total capacity of 4,219.0 MW have been commissioned and started supplying capacity, including: 70 solar power plants — 1,788.3 MW, 25 wind power plants — 2,360.0 MW, five small hydropower facilities — 70.7 MW. For all qualified generating facilities of the CSA RES, the Ministry of Industry and Trade of Russia confirmed the fulfillment of local content requirements in the amount required to pay for capacity in full.

The change in the geopolitical situation and the unprecedented sanctions imposed against Russia have made adjustments to the implementation of investment projects for

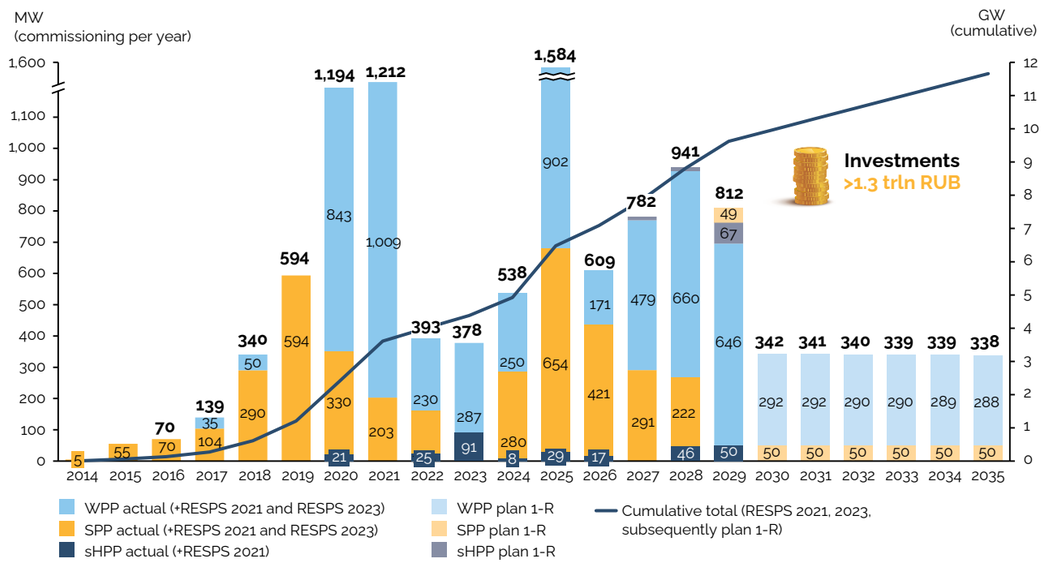
Fig. 9. Renewable generation capacity additions by technology (CSA RES), MW



Source: RREDA, SO UPS JSC, NP Market Council (Register of qualified facilities)

13. Earlier in 2020 and 2021, the volume of RES commissioning under the CSA RES program reached its peak and amounted to 1,194 MW and 1,212 MW, respectively.
14. For 530 MW of WPP with a planned start of power supply on 01.12.2022, in accordance with Decree of the Government No. 912, the commissioning date was postponed to a later date.

Fig. 10. Actual and planned indicators of CSA RES commissioning based on the results of past selections and further commissioning forecast according to Resolution No. 1-r until 2035[17]



Source: RREDA, TSA JSC, Resolution of the Government No. 1-r

the construction of renewable energy generation facilities. In March 2022, as anti-crisis measures, the Government approved[15] the right of investors to postpone the commissioning of facilities, as well as to refuse to implement projects without appropriate penalties.

More than 900 MW of new power capacity was originally planned for 2023 based on the results of all past competitive RES projects' selections (hereinafter referred to as RESPS), but as a result of the investors' right to postpone the commissioning, the planned volume of commissioning decreased to 378 MW (including four hydro generation facilities with a total capacity of 65.8 MW planned to be launched in previous periods and for which the commissioning dates were not postponed). According to the results of the first half of 2023, the duration of the breach of the capacity delivery start date in relation to these facilities ranges from 33 to 38 months[16].

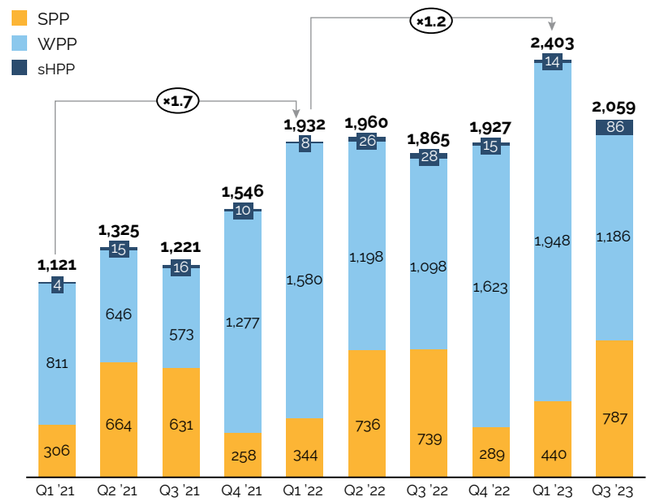
It is expected that in 2023 the pace of new RES generation commissioning will slightly exceed the indicators of the crisis year 2022, while since 2024 there will be an increase, and in 2025 it is even possible to exceed the pre-crisis level of 2021 — the volume of commissioning will be about 1.6 GW **(Fig. 10)**.

Taking into account the postponement of the scheduled capacity delivery start dates, the first stage of the CSA RES 1.0 support program will end in 2026. As a result of CSA RES 1.0, 5.4 GW of renewable energy generation will operate in Russia, of which 78% of the planned volumes have already been implemented. Meanwhile, all SPP projects in the amount of 1,788.3 MW, planned within the framework of the CSA RES 1.0, were successfully implemented by July 2022.

Taking into account the projects selected at the tenders in 2021 and 2023 as

15. Decree of the Government of the Russian Federation dated May 20, 2022 No. 912 "On Amendments to Certain Acts of the Government of the Russian Federation in order to Establish Specifics for Legal Regulation of Relations in the Spheres of Electricity, Heat, Gas, Water Supply and Sewerage".
16. FSC (2023). Report on the implementation of selected investment projects under the CSA RES and CSA SMW for the first quarter of 2023.
17. Plan 1-r assumes that all volumes after the selection of 2023 will be awarded according to the limiting performance indicators established by Resolution of the Government of the Russian Federation dated January 8, 2009 No. 1-r. In the future, the forecast is further decrease by 10-20% in price bids.

Fig. 11. Electricity generation at qualified CSA RES facilities, mln kWh



Results of 2022:

7,689 mln kWh
renewable electricity generation (within the framework of the CSA RES)

+47%
increase in RES generation year-on-year

0.70%
share of RES generation in the total consumption in the UES of Russia

Results of the 1st half of 2023:

4,462 mln kWh
renewable electricity generation (within the framework of the CSA RES)

0.80%
share of RES generation in the total consumption in the UES of Russia

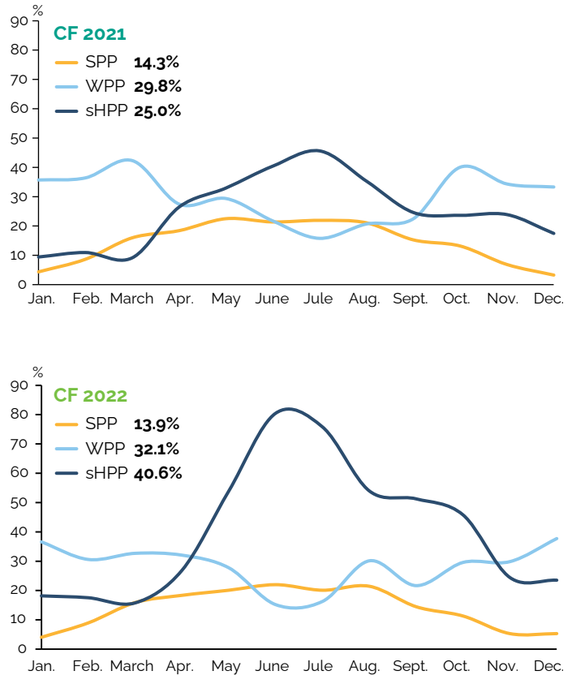
Source: RREDA, SO UPS JSC, TSA JSC

part of the second stage of the CSA RES 2.0 support program, the total renewable generation installed capacity will reach 9.5 GW by 2030.

As the total capacity of RES facilities in Russia grew, the volume of renewable electricity generated also increased. Electricity generation by facilities built within the framework of the CSA RES in 2022 amounted to 7,689 million kWh **(Fig. 11)**, which is almost 50% more than a year earlier and corresponds to 0.69% of the total electricity generation in the UES of Russia. According to the results of the first half of 2023, the share of solar, wind and small hydro generation within the framework of the CSA RES in the electricity consumption in the UES of Russia reached 0.8%[18].

According to the results of 2022, the average capacity factor (hereinafter referred to as CF) of power plants was as follows: for SPP — 13.9%, WPP — 32.1%, sHPP — 40.6% **(Fig. 12Fig. 13)**. The distribution of the average annual CF by technology and constituent entities of the Russian Federation is presented in Fig. 13.

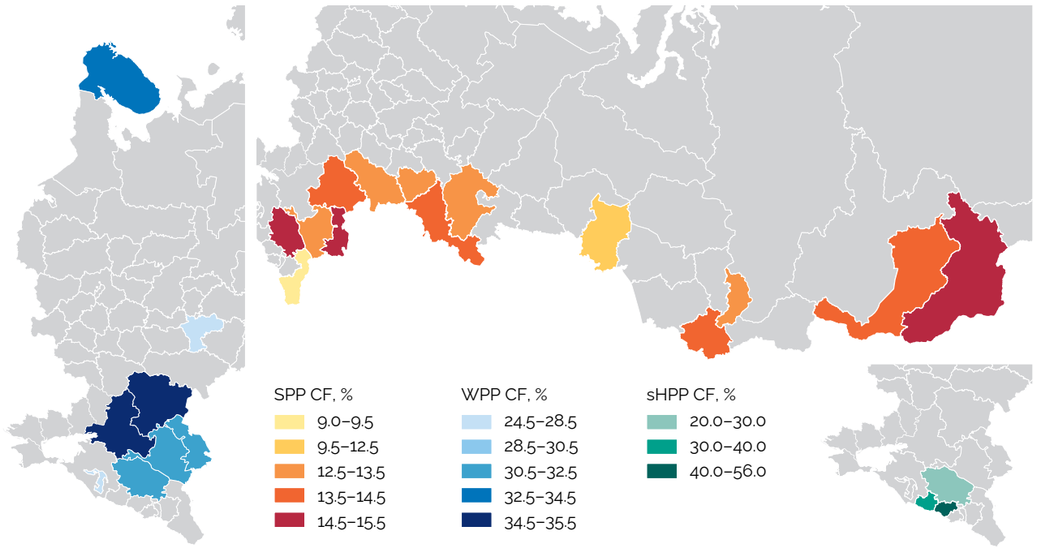
Fig. 12. Capacity factors of CSA RES projects by months of 2021 and 2022, %



Source: RREDA, SO UPS JSC, TSA JSC

18. As part of the quarterly reports, RREDA monitors the electricity generation of all power plants operating within the framework of the CSA RES.

Fig. 13. Distribution of average annual CF of CSA RES projects by constituent entities of the Russian Federation in 2022, %



Source: RREDA, SO UPS JSC, TSA JSC

During 2022, for wind power plants operating under the CSA RES, commands of the dispatcher of the System Operator (hereinafter referred to as SO) to unload power plants were issued for 49 hours. The maximum limit on the power supply to the grid under the SO dispatcher's commands was 372 MW. Unloading commands for WPP were issued for facilities operating in the IES of the South — in the Astrakhan and Rostov regions, the Stavropol territory, as well as the republics of Adygeya and Kalmykia.

For solar power plants operating under the CSA RES, the SO dispatcher's commands to limit the power supply to the grid were given from April to September 2022 (with the exception of July) for a cumulative total of 20 hours per year. The maximum limit on the SPP power supply was 26 MW, with the most frequent unloading commands issued in the IES of the South (in the Republic of Kalmykia and the Astrakhan region). A command was also given to limit the operating mode of a SPP operating in the IES of Siberia (in the Republic of Buryatia), with a maximum limit of 1 MW.

From January to June 2023, restrictions on the power supply to the grid at the SO command were given for WPP facilities — in January and April for 8 hours with a maximum restriction of 53 MW, for SPP — in April for 7 hours with a maximum restriction of 67 MW.



Photo by Alexander Melnikov

WIND POWER PLANTS

At the first stage of the CSA RES 1.0 support program, the main investors in wind power projects were the Wind Energy Development Fund[19], NovaWind JSC (Rosatom State Corporation) and EL5-Energo PJSC.

According to the planned power supply start dates in 2022, wind power plants with a total installed capacity of 533.4 MW were to be commissioned, as well as 200.7 MW of WPP planned for commissioning in 2021[20] that were overdue. At the end of the year, about a third of the planned installed capacity was delivered, including Berestovskaya WPP — 60.0 MW and Kola WPP — 170.4 MW. In March 2023, the commissioning of the Kola WPP last stage with a capacity of 31.95 MW was completed. For the remaining planned capacity additions with a capacity of 473.4 MW, investors received a delay in the planned date for the start of power supply for a period of 7 to 24 months. As of July 2023, there were no lags in new commissioning plans.

In 2022, NovaWind JSC (Rosatom State Corporation) managed to promptly rebuild logistics and build new supply chains, thanks to which the Berestovskaya WPP, consisting of 24 wind turbines with a capacity of 2.5 MW each, in the Stavropol territory was implemented on schedule and began supplying electricity and capacity to the WECM. In June and July 2023, the region also saw the first and second stages' launch of the Kuzminskaya WPP (NovaWind JSC) with a capacity of 100 MW and 60 MW, respectively. This is the sixth wind power plant in the Stavropol territory. The total volume of NovaWind JSC completed projects today is 940 MW — since 2020, the company has built eight WPP in the south of Russia.

At the end of 2022, the volume of electricity generation at six WPP of NovaWind JSC with a total capacity of 720 MW (excluding the Berestovskaya and Kuzminskaya WPP) exceeded 1.94 bln kWh. This electricity saved more than 680 thousand tons of $CO_{2\text{-eq}}$ emissions. The most significant contribution to the company's generation was made by the largest wind power plant in Russia — the Kochubeyevskaya WPP, providing over 0.5 bln kWh of green electricity.

According to the results of the first half of 2023, since the company's first wind power commissioning, electricity generation by NovaWind JSC's wind power plants amounted to about 4.5 bln kWh.

Taking into account the postponement of the CSA RES projects' implementation, another project is planned to be commissioned by the end of 2023 — the Trunovskaya WPP of NovaWind JSC with a capacity of 95.0 MW in the Stavropol territory.

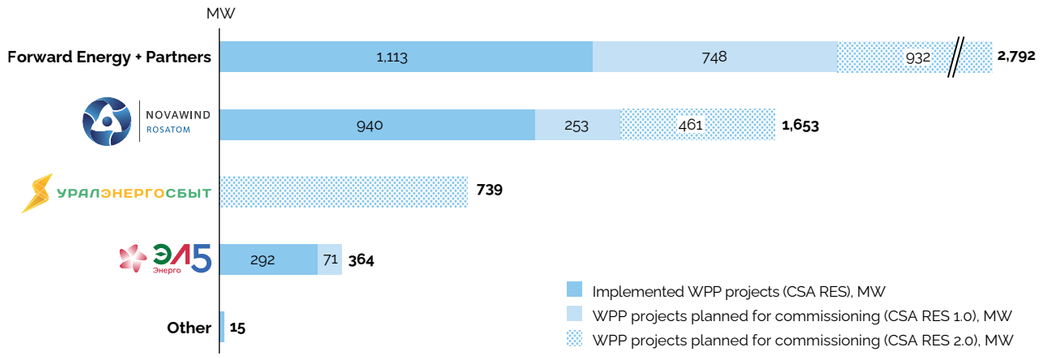
Last year, EL5-Energo PJSC implemented its second wind energy project — the Kola WPP, which also became the first wind energy facility in the Murmansk region and the most powerful wind farm above the Arctic Circle in the world. The first stage of the Kola WPP with an installed capacity of 170.4 MW (84% of the design capacity) was put into commercial operation on December 1, 2022, the commissioning of the second stage with a capacity of 31.95 MW took place in 2023. The Kola WPP, equipped with 57 wind turbines of 3.55 MW each, will be able to generate about 750 mln kWh of electricity annually, which will reduce $CO_{2\text{-eq}}$ emissions by about 600 thousand tons per year. The wind farm's equipment is designed taking into account the specifics of operation at extremely low temperatures[21].

Forward Energy PJSC (formerly Fortum PJSC) did not commission wind power plants during 2022 and the first half of 2023. Such a long pause was largely caused by the suspension of operations in Russia by Vestas, which closed all previously built production facilities producing localized equipment.

In accordance with the results of the two past competitive projects' selection within the framework of the second stage of the CSA RES 2.0 support program, the main investors'

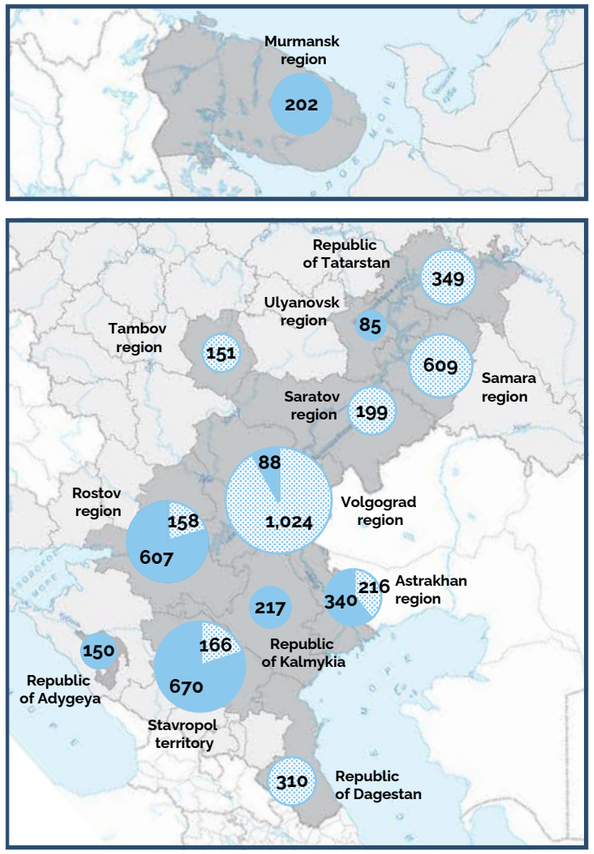
19. The Wind Energy Development Fund, established on a parity basis by Fortum PJSC and RUSNANO Group, has been fully controlled by Fortum since April 2022.
20. The Kola WPP with a capacity of 201 MW in the Murmansk region was supposed to start supplying power to the market from December 1, 2021, however, due to the occurrence of force majeure circumstances that led to the impossibility of fulfilling obligations under the CSA, EL5-Energo PJSC (formerly Enel Russia PJSC) received a deferral of fines for failure to complete the facility commissioning until March 2022.
21. The blades of wind turbines are equipped with icing detection systems that allow detecting the risk of icing in advance and automatically stopping their rotation.

Fig. 14. Distribution of wind investment projects (CSA RES 1.0 and 2.0), MW



Source: RREDA, TSA JSC, NP Market Council (Register of qualified facilities)

Fig. 15. Distribution of wind investment projects (CSA RES 1.0 and 2.0) by constituent entities of the Russian Federation, MW



Source: RREDA

composition has been slightly updated: in 2023, NovaWind JSC and Vetroparki FRW LLC (part of Forward Energy PJSC's management circuit) were joined by Uralenergosbyt LLC (50% owned by Forward Energy PJSC), which took the entire volume of awarded capacity at RESPS 2023 — 738.6 MW **(Fig. 14)**.

As of July 2023, 25 wind power plants operate in the wholesale electricity and capacity market in eight constituent entities of the Russian Federation with a total capacity of 2,360.0 MW, of which the largest volume of implemented projects was recorded by Forward Energy PJSC — 1,112.6 MW and NovaWind JSC — 940.0 MW; EL5-Energo PJSC owns 292.4 MW, WPP Briz LLC — 15.0 MW. In total, within the framework of the CSA RES 1.0 program, 1,071 MW of WPP projects remain to be implemented, including NovaWind JSC — 252.5 MW, Forward Energy PJSC — 747.7 MW, EL5-Energo PJSC — 71.3 MW. Also, according to the results of the CSA RES 2.0 selections held in 2021 and 2023, an additional 2,131 MW of wind power capacity is scheduled for implementation with planned commissioning in 2025-2029.

Today, the largest volume of wind projects has been implemented in the Stavropol territory, the Rostov and Astrakhan regions. Together, these three regions account for more than two-thirds of the total installed capacity of WPP in the UES of Russia, built under the CSA RES. Following the results of all past RESPS, commissioning is also planned in the Volgograd and Samara regions, the republics of Dagestan and Tatarstan, etc. The distribution of selected wind generation projects by constituent entities of the Russian Federation, the implementation of which is planned until the end of 2029, is presented in **Fig. 15**.

In 2022, the issue of import substitution began to play a special role. After a number of foreign companies announced the suspension of investments in new projects and the withdrawal from the Russian market in the spring of last year, enterprises localizing the production of renewable energy equipment in Russia began to experience serious problems. Investors faced difficulties in fulfilling previously signed contracts for the supply of equipment by foreign suppliers, with restrictions on the presence of foreign experts for commissioning. All this led to bringing the task of import substitution in the Russian fuel and energy complex to the first place.

In the wind energy sector, the Danish company Vestas, a supplier of equipment for wind power plants, announced its withdrawal in 2022, which led to a halt in blade production at the Vestas Manufacturing Rus plant in Ulyanovsk[22]. The departure of Vestas has had a negative effect, but it is expected that by 2025 serial production of wind turbine blades will again begin on the territory of the Russian Federation. In March 2023, Rosatom announced its intention to start production of blades for its own WPP. The local blades' manufacturing will be located in Ulyanovsk and make it possible to restore the industrial competences for production of composite blades by vacuum infusion method, which were lost after the departure of the Danish company Vestas.

In the Russian wind power industry, a program is being implemented to deepen localization and expand industrial cooperation with domestic suppliers. Today, the local content of products made by the wind energy division of Rosatom State Corporation — NovaWind JSC — is 68%[23].



Photo by NovaWind

Manufacturing facilities for production of the main components of wind turbines are located in the city of Volgodonsk. The local manufacturing of generators, the assembly of hubs and nacelles are organized at the NovaWind production site, the manufacturing of towers is at the site of VetroStroyDetal (technological partner). In addition, NovaWind JSC has developed a software and hardware complex for wind turbine control (APCS) on a new component base. The development of permanent magnets' production also remains a priority — by 2027, the Rosatom division — TVEL — plans to complete the project for creation of a full-cycle production of neodymium magnets based on the domestic mineral resource base.

As a result of new industrial projects' implementation in the supply chains of components for wind turbines, NovaWind JSC plans to increase the local content of generating facilities to 75%.

22. In early March 2022, Vestas suspended its new business activities in Russia. The decision of Vestas to leave (dated April 5, 2022) concerned the company's plants in Ulyanovsk and Dzerzhinsk, as well as customer support.
23. Hub assembly, generator, cooling system, nacelle frame, nacelle assembly, tower, transformer, design and survey works, installation, electrical installation.

SOLAR POWER PLANTS

According to the results of the first stage of the CSA RES 1.0 support program, the main investors in solar generation projects were: Hevel Group, Solar Systems LLC, Forward Energy PJSC and Vershina Development LLC. Within the framework of the second program at the tenders of 2021 and 2023, the selections' winners were the structures of Unigreen Energy Group and Solar Systems LLC **(Fig. 16)**.

In the solar energy sector, by July 1, 2022, all projects planned under the first stage of the CSA RES support program were installed. Hevel Group last year commissioned the final 100 MW of the company's solar generation under the CSA RES 1.0, including the second and third stages of the Dergachevskaya SPP (35.0 MW) in the Saratov region, the second stage of the Chitinskaya SPP (15.0 MW) and Chernovskaya SPP (35.0 MW) in the Trans-Baikal territory, as well as the Yuzhno-Sukhokumskaya SPP (15.0 MW) in the Republic of Dagestan.

In the first half of 2022, Forward Energy PJSC installed the second stage of the Arshanskaya SPP in the Republic of Kalmykia. With the second stage commissioning (37.6 MW), the installed capacity of the power plant reached 115.6 MW, which ensured the facility's status as the largest SPP in Russia[24] (the first stage with an installed capacity of 78 MW was implemented at the end of 2021).

As of July 1, 2023, 70 solar power plants with a total capacity of 1,788.3 MW were built in the UES of Russia, operating in 14 constituent entities of the Russian Federation. The largest volume of all projects implemented within the framework of the CSA RES falls on three regions, which provide 50% of the total solar installed capacity in the wholesale market in the UES of Russia. The three leaders include the Orenburg region with a total installed capacity of solar generation amounting to 370 MW, the Astrakhan region with 285 MW, and the Republic of Kalmykia with 234 MW.

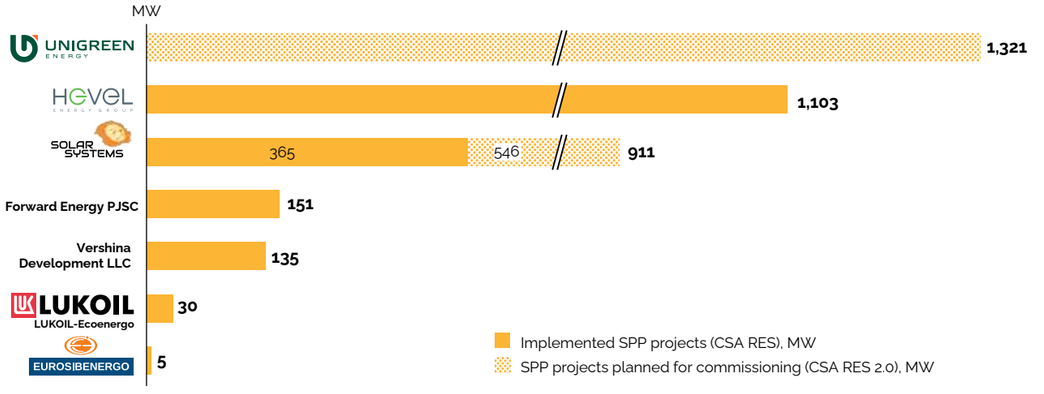
In accordance with the results of the tenders held within the framework of the CSA RES 2.0 in 2021 and 2023, significant volumes of solar energy commissioning are also planned in the Trans-Baikal territory, the Astrakhan region, the Republics of Dagestan and Buryatia. In the Trans-Baikal territory alone, SPP projects with a total capacity of 1,042 MW will be additionally implemented.

The distribution of commissioned and planned solar capacities is presented in **Fig. 17**.

Since 2023, solar power plants have been implemented according to the rules of the second stage of the CSA RES 2.0 support program. Following the results of RESPS 2021, the launch of 380 MW of solar power generation was originally planned for the current year. However, for all SPP projects selected in 2021, the start date for commissioning was postponed for a period of 7 to 24 months in accordance with the investors' right to postponement.

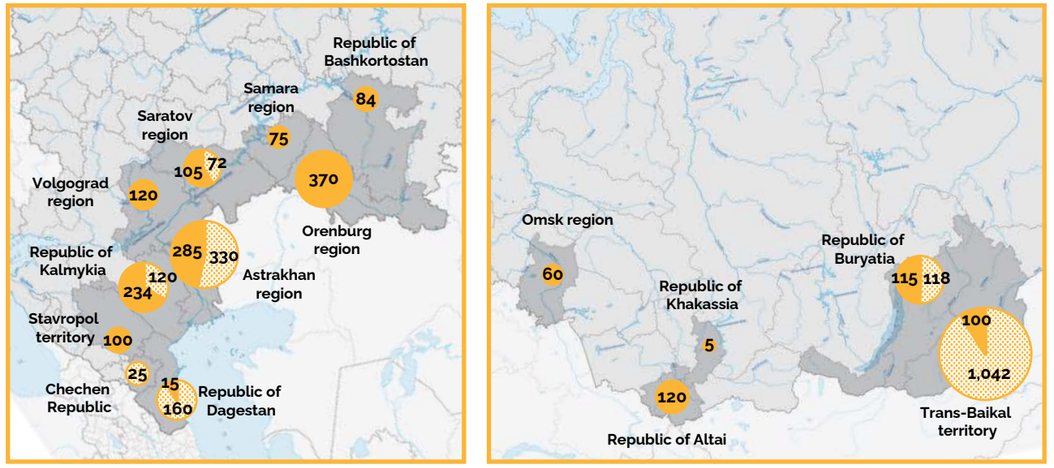
In total, according to the results of the selections held in 2021 and 2023 within the framework of the CSA RES 2.0, more than 1,860 MW of SPP projects are planned for implementation.

Fig. 16. Distribution of solar investment projects (CSA RES 1.0 and 2.0), MW



Source: RREDA, TSA JSC, NP Market Council (Register of qualified facilities)

Fig. 17. Distribution of solar investment projects (CSA RES 1.0 and 2.0) by constituent entities of the Russian Federation, MW



Source: RREDA

In 2022, the solar energy sector was also active in import substitution. After the Government of the Russian Federation approved the decision to extend the RES support program until 2035, industry participants made crucial investment decisions to create new production facilities. In order to fulfill their obligations in terms of deepening the localization and increasing the volume of industrial exports of renewable energy equipment, the Russian companies Hevel and Unigreen Energy are jointly implementing a project to create the largest industrial complex in Russia for serial production of silicon wafers (1.3 GW per year) and photovoltaic cells (more than 1 GW per year) in the Kaliningrad region.

The fourth modernization was completed at the Hevel LLC manufacturing facility in Novocheboksarsk in 2022 to expand the product line and increase its competitiveness in foreign markets.

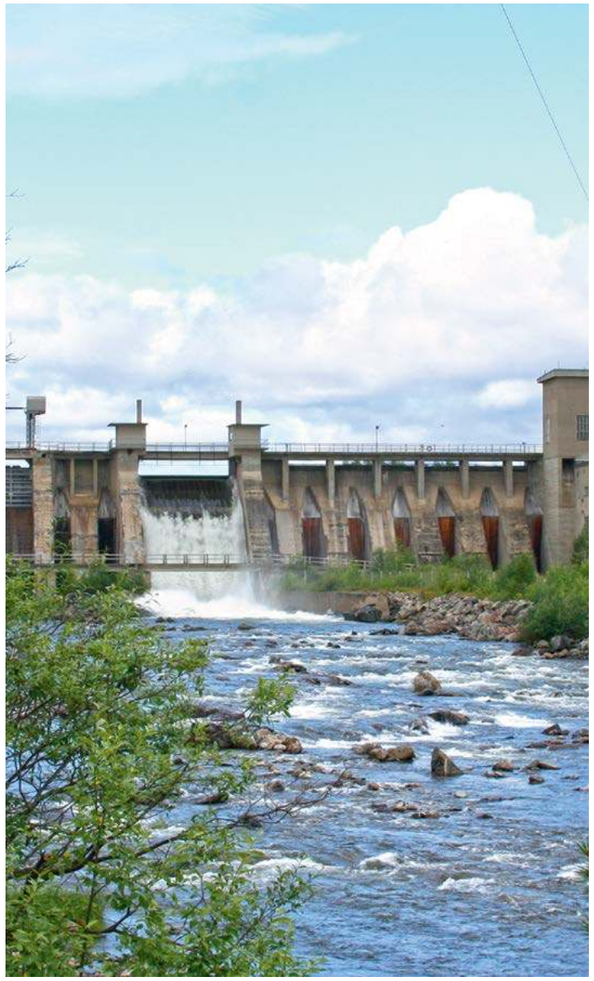


Akhtubinskaya SPP

Solar Systems LLC did not manufacture any products in 2022 due to reconstruction for deepening localization and increasing production efficiency. Solar Silicon Technologies LLC, a manufacturer of mono- and multicrystalline silicon ingots and wafers, is considering the possibility of producing photovoltaic solar modules using PERC and TopCon technologies. The production plan in 2024 is 400 MW per year.

24. Previously, the status of the largest SPP built within the framework of the CSA RES was borne by the Staromaryevskaya SPP (Solar Systems LLC) with a capacity of 100 MW, located in the Stavropol territory.

SMALL HYDRO POWER PLANTS



Janiskoski sHPP

RusHydro PJSC, NordHydro JSC, TGC-1 PJSC, EuroSibEnergo JSC **(Fig. 18)** became the main investors in small hydro generation projects (taking into account the refusals to implement projects) within the framework of the first CSA RES support program. In the second stage of support based on the results of RESPS 2021, the entire volume of awarded projects will be implemented by RusHydro PJSC.

During the implementation of the CSA RES 1.0 support program, investors' interest in implementing small HPP projects was insignificant: from 2014 to 2020, in accordance with the quota provided for by Resolution No. 1-r, 14 small hydro generation projects with a total installed capacity of about 210 MW were selected. However, initially, when approving the support program in 2013, the Resolution envisaged commissioning of a cumulative capacity of 750 MW. Due to the lack of interest from investors, this volume was redistributed to SPP and WPP construction projects, and the quota for small hydro power was reduced by more than three times.

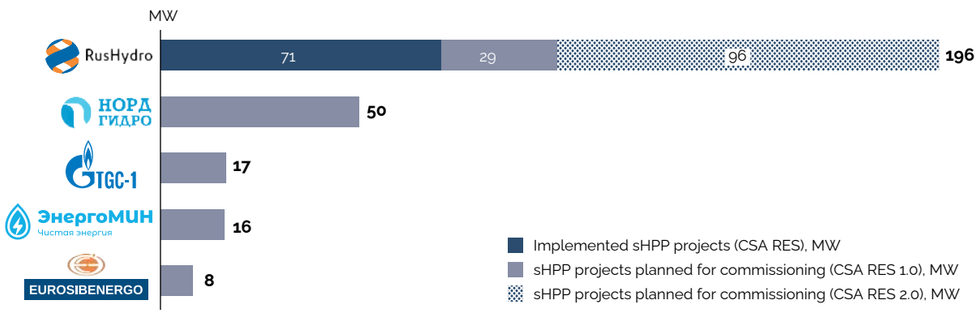
As part of the second stage of the CSA RES 2.0 support program, the support volume for sHPP projects is 30 bln RUB (in 2021 prices), which, according to marginal estimates, can ensure commissioning of another 200 MW of small hydro power facilities by the end of 2029. At the first competitive selection of CSA RES 2.0 in 2021, three new small hydro power projects with a capacity of 96 MW were selected for construction in the republics of Kabardino-Balkaria, Chechnya and Dagestan. At the RESPS 2023, no applications were received from investors for sHPP projects. One of the reasons is considered by the investment community to be the insufficient level of marginal prices for hydro power facilities to ensure payback, even though for sHPP facilities with a capacity of up to 25 MW in 2022, these indicators have been already increased and exceed the values for SPP and WPP by 31% and 100%, respectively.

The commissioning of the first three small hydro power plants operating within the framework of the CSA RES mechanism took place in 2020. The next launch of facilities occurred in 2022. In December last year, the first station of the Krasnogorskaya small HPP complex[25] (RusHydro PJSC), the Pravokubanskaya HPP (Krasnogorskaya sHPP-2), was commissioned on the Kuban River in the Karachay-Cherkess Republic, after which in April 2023 the launch of the complex was completed with the commissioning of the Krasnogorskaya sHPP-1. The installed capacity of each sHPP is 24.9 MW (two hydraulic units — 12.45 MW each).

As of May 2023, five small hydro power plants with a total installed capacity of 70.7 MW operate within the framework of the CSA RES, all facilities are in the regions of the North Caucasus Federal District, where there are some of the most favorable natural conditions for operation of small HPP.

In 2022, the opportunity for non-punitive delay in commissioning was exercised by three companies with respect to 174.6 MW of small hydro generation projects[26]. According to the carried-out transfers, new dates for the capacity supply start of the projects are planned for 2024–2029. For one facility with an installed capacity of 23.7 MW, selected under the first support program, a refusal to implement the project was initiated.

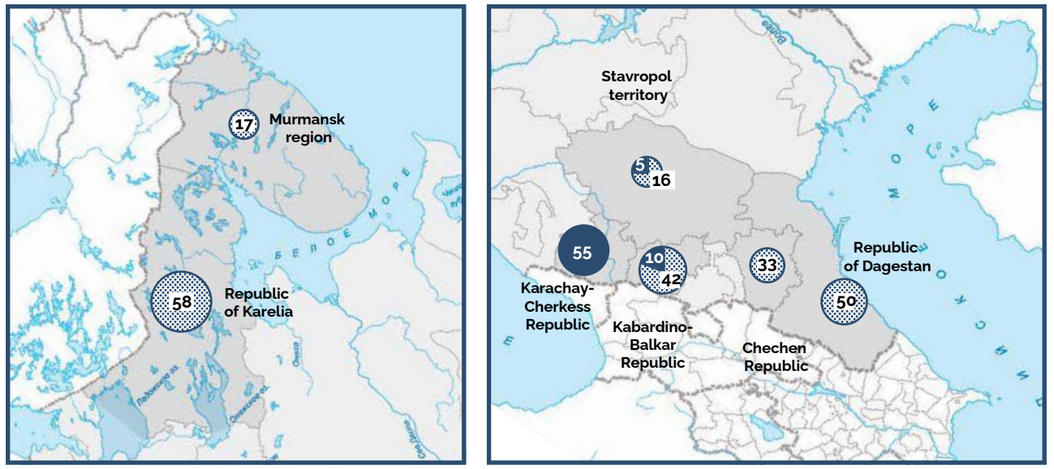
Fig. 18. Distribution of small hydro power investment projects (CSA RES 1.0 and 2.0), MW



*There are no data on scheduled commissioning of facilities for EnergoMIN LLC; the company did not use the non-punitive delay in commissioning.

Source: RREDA, TSA JSC, NP Market Council (Register of qualified facilities)

Fig. 19. Distribution of small hydro power investment projects (CSA RES 1.0 and 2.0) by constituent entities of the Russian Federation, MW



Source: RREDA

25. According to the System Operator, the operation of the Krasnogorskaya sHPPs, united by one dam, will provide more than 10% of energy consumption in the power system of the Karachay-Cherkess Republic, remove seasonal capacity constraints of the Zelenchukskaya HPP-PSPP, smoothening fluctuations in the water level in the Kuban River associated with changes in the operating modes of this station. This will make it possible to increase electricity generation at the existing Cascade of Kuban HPPs by 250 million kWh annually.
26. The adopted Decree of the Government of the Russian Federation dated May 20, 2022 No. 912 allowed a non-punitive delay in commissioning of sHPP facilities for 30 months without a corresponding reduction in the capacity supply period (15 years are retained).



Hevoskoski sHPP

For the current year 2023, four hydro power facilities with a total capacity of 65.8 MW remain to be commissioned, while there is no exact information on their launch dates, the planned date for the capacity supply start is already 33 to 38 months overdue.

According to the information from RusHydro, construction is also underway on the Bashennaya sHPP (10.0 MW) and the Cherekskaya sHPP (23.4 MW), scheduled for commissioning in 2025, the Verkhnebaksanskaya sHPP (23.2 MW) and the Nikhaloyskaya sHPP (23.0 MW), planned for commissioning in 2028, as well as the Mogokhskaya HPP (49.8 MW), planned for commissioning in 2029.

The TGC-1 PJSC project of the Arktika sHPP with an installed capacity of 16.5 MW is also under implementation with a planned commissioning in 2026. The company will complete the development works for construction of a facility as part of the hydro power plants' cascade on the Paz River by the end of 2023. Arktika sHPP will be the first hydro power plant in the Murmansk region built since the late 1980s.

The territorial distribution of the sHPP projects selected within the framework of the CSA RES is presented in **Fig. 19**.

In addition to the hydro power generation facilities commissioned as part of the CSA RES support program, Russia also has more than 100 power plants with a total capacity of 1.2 GW, belonging to the small hydro power plants' category (with an installed capacity of up to 50 MW), of which 29 facilities with a capacity of 815 MW operate in the wholesale electricity and capacity market. These facilities were mainly built in the USSR, have an average age of over 55 years, but still play an important role in the power supply of a number of Russian regions[27].

27. According to the Association "Hydropower of Russia", the hydropotential of 2 million small rivers of the country (200 bln kWh/year) is used only by 4.5%. The most promising Russian regions for construction of small HPP include the North Caucasus, Northwest Russia, southern Siberia and the most of the Far Eastern Federal District.

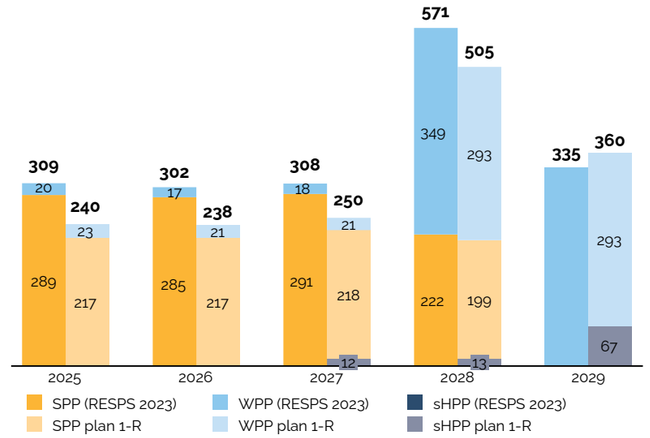
COMPETITIVE SELECTION OF RENEWABLE ENERGY PROJECTS IN 2023 (RESPS 2023) AND FORECAST UNTIL 2035

The second stage of the renewable energy support program (CSA RES 2.0)[28] applies to RES investment projects with a scheduled capacity supply start date in 2025-2035 (for SPP — since 2023). The first selection was held in September 2021. No competitive selections for the construction of renewable energy generation facilities were held in 2022 pursuant to a decision of the Government of the Russian Federation. Market players used the time to adapt to the new business conditions affected by the foreign sanctions, reorientation to new logistics routes for the supply of components and equipment, and to search for new technology partnerships.

The second competitive selection of investment projects within the second stage of the CSA RES 2.0 support program (RESPS 2023) took place in 2023. In accordance with the standard WECM procedure for selecting renewable energy generation projects, bids were submitted, as always, in two stages: the first stage — in the period from March 22 through March 28, 2023 (all eligible tenderers may bid at this stage), the second stage — from March 29 through April 4, 2023, with April 4, 2023 set as the bidding deadline (bids admitted at the first stage may be adjusted at the second stage). Same as during the previous selection in 2021, solar generation projects were provided an opportunity to extend the bidding deadline by up to three business days[29].

At RESPS 2023, a high level of competition was noted: a total of 135 applications were accepted for participation in the competitive selection. Out of them, 70 are for wind generation projects and 65 are for solar generation projects. No applications were received for small hydro power generation projects. The total amount of requested support exceeded the available quota by more than four times. The total installed capacity of renewable energy projects submitted for selection has surpassed the bar of 7 GW **(Fig. 20)**.

Fig. 20. The results of RESPS 2023 and the minimum volume of selection by Resolution No. 1-r*, MW



Solar power plants

RESPS 2023	Plan 1-R	Excess over plan
24 facilities 1,086.5 MW	850 MW	+236 MW

Wind power plants

RESPS 2023	Plan 1-R	Excess over plan
17 facilities 738.6 MW	650 MW	+88 MW

Small hydropower plants

RESPS 2023	Plan 1-R	Excess over plan
No applications received	90 MW	—

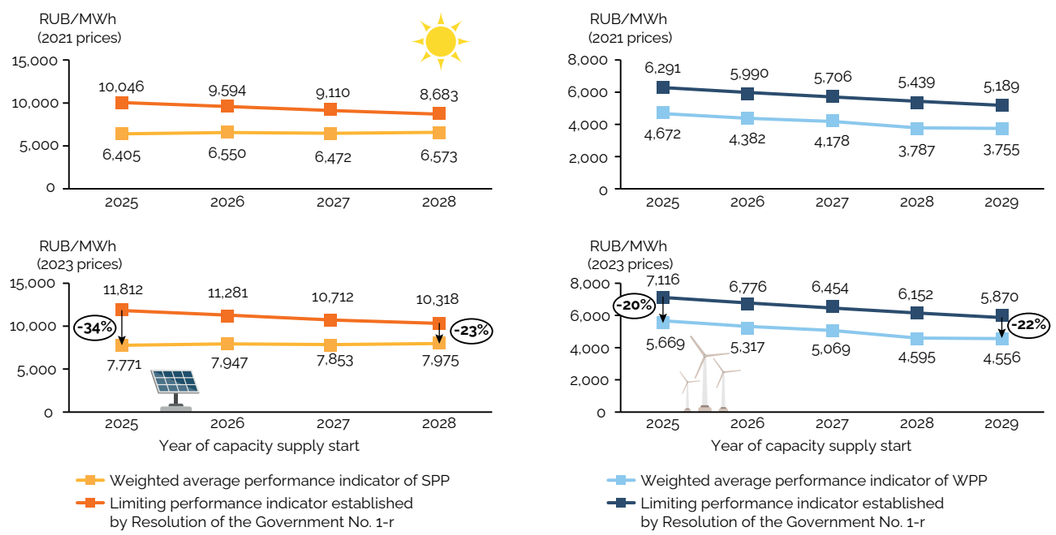
*The minimum volume of commissioning for the current selection according to the limiting performance indicators established by Resolution of the Government of the Russian Federation No. 1-r was 1.6 GW.

Source: RREDA, TSA JSC, Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009

28. Since 2021, the selection of renewable energy investment projects (with the scheduled commissioning year: 2023 — for SPP, 2025 — for WPP, and 2027 — for sHPP) has been subject to new regulations, with the rules of operation of these projects to be affected as well.

29. Resolution of the Government of the Russian Federation No. 594-r dated March 24, 2022 "On Amendments to Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009" provides for the next competitive selection of SPP projects subject to Section 205(1) of the Wholesale Market Rules — an extended "open" selection stage.

Fig. 21. Price parameters of SPP and WPP projects at RESPS 2023, RUB/MWh



Source: RREDA, TSA JSC

According to the results of RESPS 2023, 1,825.1 MW of solar and wind power plants were selected. In the solar generation sector, the total capacity of the selected projects amounted to 1,086.5 MW, in the wind generation sector — to 738.6 MW. In total, 41 renewable energy generation facilities were selected with the capacity supply start in 2025–2029 and a total amount of required annual revenue of 3.4 to 20.7 bln RUB (in 2021 prices) cumulatively from 2025 to 2029, respectively. The total amount of support awarded at RESPS 2023 until 2035 amounted to about 110 bln RUB (in 2021 prices).

Solar projects will be implemented by the following companies: Unigreen Power LLC (776.0 MW), Solar Retail LLC (292.4 MW), Solar Ulyanovsk LLC (18.1 MW)[30]. New solar power plants will appear mainly in the Trans-Baikal territory (726.4 MW of total capacity) and the Astrakhan region (270 MW). It is also planned to commission 72 MW in the Saratov region and 18.1 MW in the Republic of Buryatia.

In the wind generation sector, Uralenergosbyt LLC became the only winner of the selection in 2023. In total, the company will commission 738.6 MW of wind capacity, which will be located in the Samara region (372.6 MW), the Republic of Tatarstan (349.0 MW) and the Saratov region (17.0 MW).

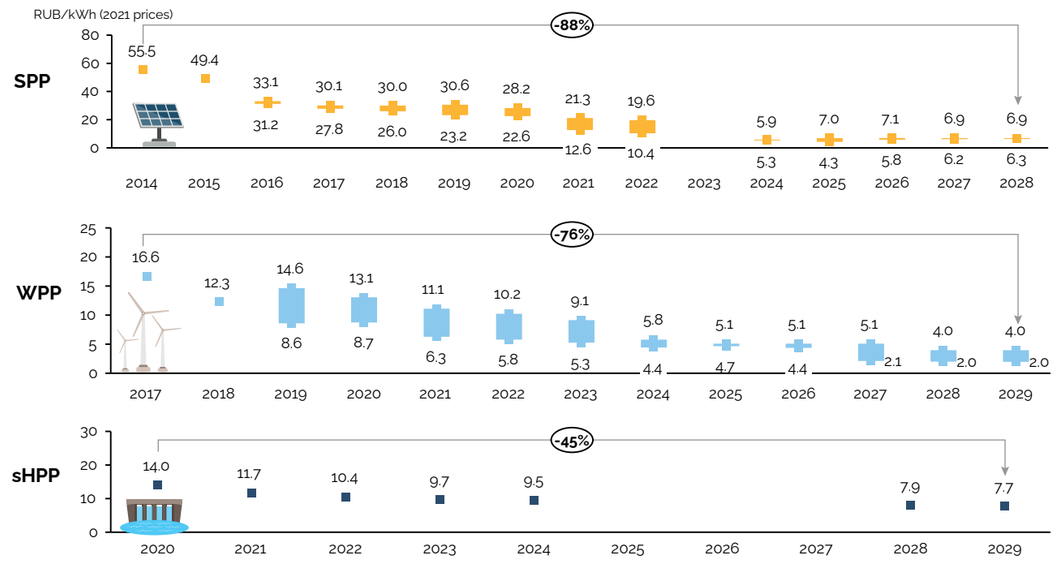
According to the results of the second stage of renewable energy projects' competitive selection in 2023, the minimum cost of electricity (performance indicator) of wind power plants decreased by 17–32% relative to the applications of the first stage and by 20–32% relative to the limiting performance indicators (depending on the year of commissioning).

According to the results of the final (extended) stage of the competitive selection of SPP projects, which was terminated at the fifth interval of corrective applications' submission, the minimum cost of solar electricity (performance indicator) decreased by 25-37% relative to the applications submitted at the previous stages and the limiting performance indicators. At the end of open bidding, the weighted average price in the solar generation sector was set in the range of 7,771-7,975 RUB/MWh (in 2023 prices) for all years of commissioning, and in wind generation — in the range of 4,556-5,669 RUB/MWh (in 2023 prices) also for all years of commissioning **(Fig. 21)**.

Since 2014, according to the results of all the selections conducted, the straight-line electricity price for SPP has decreased in 2021 by 88% in money terms, and for WPP — by 76% **(Fig. 22)**.

30. Solar Retail LLC and Solar Ulyanovsk LLC are structures of Solar Systems LLC.

Fig. 22. Straight-line prices of SPP, WPP, sHPP based on the results of CSA RES competitive selections, RUB/kWh



Source: RREDA, TSA JSC

The next competitive selection of investment projects for the construction of renewable energy generation facilities — RESPS 2024 — is scheduled for 2024. According to standard deadlines, the selection of investment projects should be completed no later than June 30. Under the current rules, the selection will be: for SPP — with a selection horizon for five years ahead, for WPP — six years ahead, for sHPP — for each year from the third to the seventh calendar year following the year of selection.

In accordance with the basic limiting performance indicators and the limits of the annual support for the use of renewable energy, approved by Resolution No. 1-r, RESPS 2024 will award an annual support in the amount of 5.2 bln RUB (in 2021 prices), which corresponds to the selection of over 430 MW of RES capacities. The installed capacity of investment projects will be higher if the electricity cost in the bids of selection participants decreases. This innovation of CSA RES 2.0 has already demonstrated its effectiveness in the selection of 2021. Due to the reduction in the cost of electricity in applications by more than 50–70% of the limiting values, the total selected capacity volume was increased by almost 100%. At RESPS 2023, more than 1.8 GW of power capacities were selected, of which about 300 MW is additional capacity in excess of the program's planned indicators, achieved through reduced price bids in the selection process.

By the end of 2029, within the framework of the first and second stages of the CSA RES support program, according to the results of all past RESPS of 2013–2023 (taking into account refusals of obligations)[31], 9.50 GW of renewable energy generation will be commissioned, including 5.56 GW of wind generation, 3.65 GW of solar generation and 0.3 GW of small hydro generation.

The total renewable generation capacity, built within the framework of the CSA RES in the period from 2014 to 2035, is projected at 12–13 GW. Meanwhile, the constructed renewable energy generation facilities will provide a reduction in annual CO_2 emissions by 2035 in the amount of about 15 mln tons.

31. In accordance with the decision of the Government, investors were granted the right to refuse to implement projects without penalty, which was used by Forward Energy PJSC (refusal of 459 MW of wind generation projects) and Yuzhenergostroy LLC (refusal of a small hydro power project with a capacity of 23.73 MW).

MEASURES OF STATE SUPPORT FOR THE RENEWABLE ENERGY INDUSTRY IN 2022–2023



Berestovskaya WPP

The geopolitical and macroeconomic conditions that emerged in 2022 made adjustments to the development of the renewable energy industry in Russia. Under the sanctions regime, market participants were forced to adapt to new working conditions, reorient to new logistics routes for supply of components and equipment, and also look for new technological partnerships in connection due to the withdrawal of foreign equipment suppliers from the Russian market. In addition, a sharp rise in the prices of components, equipment, and logistics services took place in 2022: the cumulative increase in capital expenditures for investment projects for the construction of WPP and SPP in the period from 2021 to 2022 amounted to 24% and 29% year-on-year, respectively. All these factors have called into question the possibility of introducing RES generation projects within the specified time frames or even the possibility of their implementation at all.

In order to support the domestic sector of renewable energy generation and stimulate the further renewable energy development in the face of sanctions pressure, the Government of the Russian Federation adopted important anti-crisis decisions aimed at leveling the risks that have arisen. In accordance with the Decree of the Government of the Russian Federation dated May 20, 2022 No. 912, investors in CSA RES projects were granted the right to non-punitive delay in the fulfillment of obligations for construction of renewable energy generation facilities for 24 months (for sHPP — for 30 months), as well as the right to refuse to implement projects without paying penalties[32].

The right to postpone the previously scheduled dates for the commissioning of renewable energy facilities without the application of penalties in 2022 was used by investors in relation to projects with a total installed capacity of 3,137 MW, of which 1,335 MW under the CSA RES 1.0 support program and 1,802 MW under the CSA RES 2.0 support program. Due to the fact that within the framework of the CSA RES 1.0 all projects of solar generation were implemented on time, the bulk of the postponements of delivery dates fell on wind generation projects — 1,256 MW (the postponement period was 7–24 months[33]), as well as part of the small hydro power projects — 79 MW (for 12–24 months). Under the CSA RES 2.0 support program, the postponement of commissioning was granted to all selected solar generation projects with a total capacity of 775 MW (for a period of 7–24 months), as well as to all small hydro generation projects — three facilities with a total capacity of 96 MW will be commissioned a year later than originally planned. In terms of wind power projects, the deadlines were postponed for 932 MW of energy capacities for a period of up to 24 months.

For investor projects, which were less affected by the withdrawal of foreign manufacturers who had previously localized their production in Russia, the postponement amounted to 7-12 months. Companies that lost suppliers of localized equipment and faced the problem of the need to redesign wind farms for new equipment and search for new technical solutions took advantage of the maximum period of 24 months.

It is important to note that at the competitive selection of investment projects of the CSA RES in 2021, the price bids of the selected wind investment projects were significantly lower than the limiting performance indicators approved by the Resolution of the Government of the Russian Federation dated January 8, 2009 No. 1-r. In the current macroeconomic and geopolitical conditions, the implementation of projects with such low performance indicators would not be possible. In this regard, Forward Energy PJSC was forced to abandon the implementation of part of the wind generation projects selected in the 2021 tender with the minimum declared performance indicators in the range of 1,717-1,988 RUB/MWh, with a total installed capacity of 459 MW[34]. The amount of support planned for the terminated CSA RES of Forward Energy PJSC was returned to the competitive mass for selection of renewable energy investment projects in 2023.

The right to refuse to fulfill the obligation under CSA RES was also used by Yuzhenergostroy LLC in relation to the 23.73 MW small hydro power plant project planned to be commissioned as part of the CSA RES 1.0 support program.

By the decision of the Government of the Russian Federation dated June 1, 2022 (Decree No. 999), competitive selection of RES generation projects in the wholesale and retail markets in 2022 was canceled[35]. Selection in the wholesale market took place in March-April 2023, and selection of projects in retail markets is tentatively scheduled for October-November 2023. The pause was necessary for investors to adapt to the new working conditions, to rebuild the supply chains of components and equipment.

Decree of the Government of the Russian Federation dated February 6, 2023 No. 164 adjusted the selection horizon for which competitive solar generation projects' selection are held within the framework of the CSA RES: under the new rules, the selection horizon is increased from three to five years following the year in which the selection is held[36]. Thus, in 2023, the selection for solar projects' construction took place in relation to facilities with a commissioning period until 2028 inclusive. The transition to five-year selection for solar generation will allow equipment manufacturers to increase the planning horizon, which in the long term will create conditions for guaranteed loading of existing and under-construction manufacturing facilities, ensuring the achievement of local content requirements approved by the Government of the Russian Federation.

Along with anti-sanction measures in 2022, the Government of the Russian Federation adopted decisions in order to provide additional support for small hydro power projects within the framework of the CSA RES program. Resolution of the Government of the Russian Federation dated March 24, 2022 No. 594-r adjusted the basic limiting performance indicators of hydro generation facilities[37]. Two distinct categories of sHPP projects have been identified: with an installed capacity of 25 to 50 MW and up to 25 MW, for which new straight-line price limits are established (approximately 40% higher than for sHPPs in the 25 to 50 MW category). However, despite the expected increase in the interest of investors in the hydro power sector to participate in competitive selections due to such a significant increase in the limiting performance indicators, not a single application for sHPP projects was received at RESPS 2023. This indicates that a comprehensive revision of the concept of implementing support for small hydro power within the framework of the CSA RES program is needed.

32. Decree of the Government of the Russian Federation dated May 20, 2022 No. 912 "On Amendments to Certain Acts of the Government of the Russian Federation in order to Establish Specifics for Legal Regulation of Relations in the Spheres of Electricity, Heat, Gas, Water Supply and Sewerage".
33. Except for the Berestovskaya WPP with the capacity of 60 MW, scheduled for commissioning on December 1, 2022 and commissioned at the end of December 2022.
34. Based on the results of RESPS 2021, 48 WPP facilities with a total capacity of 1,851 MW were selected. Taking into account the right to refuse to implement projects, exercised by investors in 2022, projects with a total installed capacity of 1,392 MW are planned for implementation as of January 1, 2023.
35. Decree of the Government of the Russian Federation No. 999 dated June 1, 2022 "On Amendments to Certain Decrees of the Government of the Russian Federation Concerning Competitive Selection of Investment Projects for Construction of Generating Facilities Operating on the Basis of Renewable Energy Sources in the Wholesale and Retail Electricity Markets...".
36. Decree of the Government of the Russian Federation dated February 6, 2023 No. 164 "On Amendments to Certain Decrees of the Government of the Russian Federation Concerning Circulation of Capacity in the Wholesale Electricity and Capacity Market".
37. Resolution of the Government of the Russian Federation dated March 24, 2022 No. 594-r "On Amendments to Resolution of the Government of the Russian Federation dated January 8, 2009 No. 1-r".

RENEWABLE ENERGY DEVELOPMENT ON RETAIL ELECTRICITY MARKETS



Hevoskoski sHPP

CHANGES IN LEGISLATION

The renewable energy generation support mechanism on the retail electricity markets was adopted in 2015 and consists in the obligation of priority purchase by grid organizations (in isolated power systems — by the guaranteeing supplier, while maintaining the reliability of energy supply) of the electricity produced by the renewable energy facilities at special tariffs imposed by regional tariff authorities (Basic Provisions for the Functioning of Retail Markets[38]). The list of recipients of such support measures is formed on the basis of the results of regional competitive selections held on a voluntary annual basis in the constituent entities of the Russian Federation.

In 2020, the renewable energy generation support mechanism on the retail electricity markets was improved, and since 2021, retail RES projects have been selected according to the principles of technological neutrality and minimization of the straight-line price declared at the selection[39]. The declared price of the selected project is indicated in the Register of Renewable Energy Generating Facilities (until 2023 — in the section "Regional Prospective Development Programs and Schemes for Electric Power Industry" (hereinafter referred to as PDPS) of the region of the Russian Federation) and is the basis for setting the tariff. As a result of the selection, territorial grid organizations (hereinafter referred to as TGO) are obliged to conclude a purchase agreement with the selected project and purchase electricity at the imposed tariff. However, the target indicator for the volume of RES generation commissioning on the retail market is not established, RES projects are selected within 5% of the forecasted network losses in the territory of the particular region of the Russian Federation, and the costs of purchasing network losses from RES generation facilities are taken into account when setting transmission tariffs for TGOs.

In February 2022, the Order of the Federal Antimonopoly Service of Russia updated the Methodological Guidelines for setting tariffs and limit levels of tariffs for electric energy (capacity) produced at qualified renewable energy generating facilities in retail markets[40]. The procedure for establishing maximum levels of tariffs for RES electricity purchased to compensate for grid losses in the UES of Russia and maximum levels of tariffs for electricity in the TITES or in the territory not connected with the UES of Russia and the TITES has been determined. The document entered into force in September 2022.

However, the parameters necessary to determine the maximum levels of prices (tariffs) for electricity purchased to compensate the network losses were established by Resolution of the Government No. 1-r dated January 8, 2009 only for the period until 2024. In March 2022, in order to further develop the sector, the Government extended the mechanism for supporting renewable energy generation in retail markets until 2035. The limit values for capital and operating costs for the corresponding period have been approved in the Main Directions of the state policy in the field of increasing the energy efficiency of the electric power industry based on the use of renewable energy sources[41]. In addition, the Resolution instructed the Ministry of Energy to annually monitor the dynamics of renewable energy development both in the wholesale electricity and capacity market and on the retail electricity markets, including microgeneration market development.

38. Decree of the Government of the Russian Federation dated May 4, 2012 No. 442 "On the Functioning of Retail Electricity Markets, Full and (or) Partial Restriction of the Mode of Electricity Consumption" (together with the "Basic Provisions for the Functioning of Retail Electricity Markets", "Rules for Full and (or) Partial Restriction of the Mode of Electricity Consumption").
39. Projects based on solar, wind generation, small hydro generation, biomass, biogas and landfill gas with a capacity of 300 kW to 25 MW compete in the annual competitive selection organized by the authorities of the constituent entities of the Russian Federation,
40. Order of the FAS of Russia dated February 14, 2022 No. 104/22 "On approval of the Methodological Guidelines for setting prices (tariffs) and (or) maximum (minimum and (or) maximum) levels of prices (tariffs) for electric energy (capacity) produced at qualified generating facilities operating on renewable energy sources and purchased to compensate for losses in electric grids, as well as for setting prices (tariffs) for electric energy (capacity) produced using qualified generating facilities operating in technologically isolated territorial electric power systems or in territories not technologically connected with the Unified Energy System of Russia and technologically isolated territorial electric power systems" (registered with the Ministry of Justice of Russia on August 26, 2022, No. 69798). The Order of the Federal Antimonopoly Service of Russia dated September 30, 2015 No. 900/15, which previously regulated similar legal relations, becomes invalid.
41. Resolution of the Government of the Russian Federation dated March 24, 2022 No. 594-r "On Amendments to Resolution of the Government of the Russian Federation dated January 8, 2009 No. 1-r".

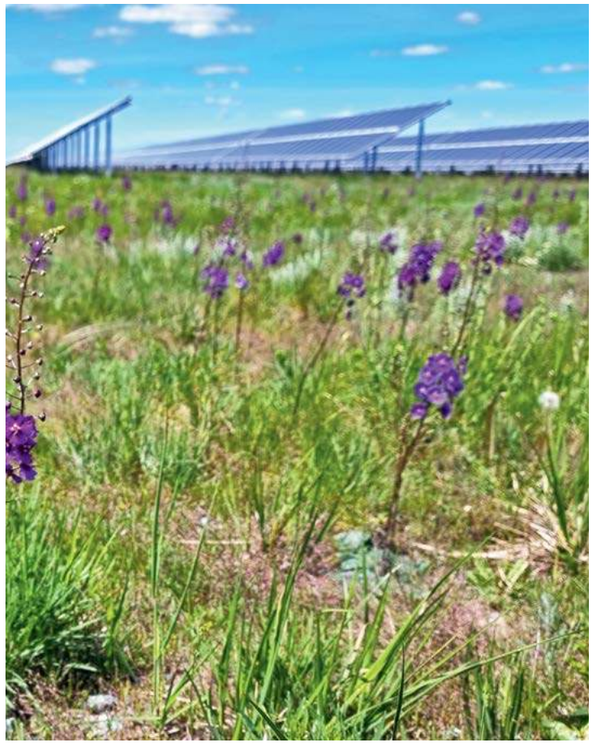


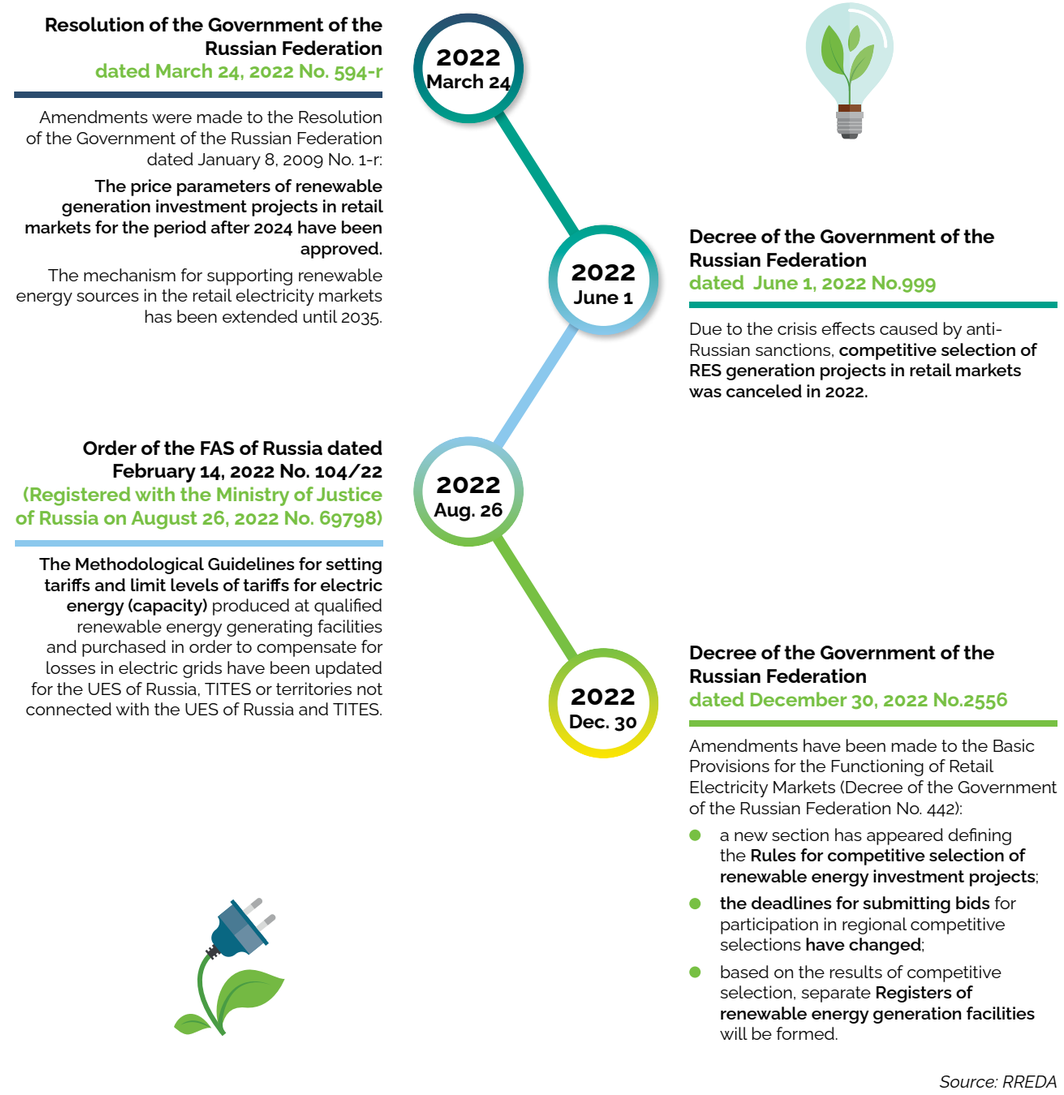
Photo by Dmitry Lebedev

In accordance with Decree of the Government of the Russian Federation dated June 1, 2022 No. 999[42], competitive selection of projects for construction of renewable energy generating facilities in retail electricity markets in 2022 was canceled. However, it was clarified that the announced but incomplete selections may be successfully finalized in case the regional authority makes certain decision. The results of the projects' selection completed in 2022 are not subject to revision and adjustment.

An important innovation in 2022 was the definition of a new model for planning long-term development in the electric power industry, under which centralized planning for the development of power systems is performed by the System Operator (since January 1, 2023 — for the UES of Russia, since January 1, 2024 — also for TITES). The relevant amendments to the Federal Law "On Electric Power Industry" were made in June 2022[43]. The new system changes the list of planning documents and the periods of their validity. Thus, instead of the previously annually published PDPS of the UES of Russia (for seven years ahead) and PDPS of the constituent entities of the Russian Federation (for five years ahead), a single Prospective Development Program and Scheme of Electric Power Systems of Russia (PDPS of EPS of Russia)[44] is introduced, published annually with a planning horizon of six years. As a follow-up to Federal Law No. 174, Government Decree No. 2556 was adopted in December 2022[45], which approved an updated procedure for competitive projects' selection for construction of generation based on the use of renewable energy sources on the retail electricity markets. With the issue of the Decree, a section appeared in the Basic Provisions for the functioning of retail electricity markets, defining the Rules for competitive selection of investment projects for RES generation facilities' construction. In connection with the transition from regional development schemes to a single PDPS of EPS, information on selected projects for construction of renewable energy generation facilities in retail markets, previously presented in a special section of the PDPS of the region of the Russian Federation, since 2023 should be formalized in the regional Registers of generating facilities operating on the basis of renewable energy. The regional executive body authorized to select projects will annually send information on electric energy production facilities operating on the basis of renewable energy sources included in the register based on the project selections' results to the System Operator. In addition, the deadline for submitting bids for participation in regional competitions has been postponed from March to November, the selection should be held before November 30, and the deadline for accepting bids should be determined no earlier than November 10 of the corresponding calendar year[46].

The chronology of regulatory changes in terms of the implementation of RES generation projects in retail markets is presented in **Fig. 23**.

Fig. 23. Legislative changes for RES generation projects in retail markets in 2022



Source: RREDA

42. Decree of the Government of the Russian Federation dated June 1, 2022 No. 999 "On Amendments to Certain Decrees of the Government of the Russian Federation Concerning Competitive Selection of Investment Projects for Construction of Generating Facilities Operating on the Basis of Renewable Energy Sources in the Wholesale and Retail Electricity Markets and Concerning Establishment of Certain Specific Features of State Regulation of Prices (tariffs) in the Electric Power Industry in 2022 and 2023".
43. Federal Law No. 174-FZ dated June 11, 2022 "On Amendments to the Federal Law "On the Electric Power Industry" and Certain Legislative Acts of the Russian Federation".
44. For the first time, the key document of the new system for the long-term development of the electric power industry — the unified Scheme and Program for the Development of Electric Power Systems of Russia for 2023–2028, developed by the System Operator and replacing the schemes and programs for the development of the electric power industry of the constituent entities of the Russian Federation — was approved by Order No. 108 of the Ministry of Energy of Russia dated February 28, 2023 "On Approval of the Scheme and Program for the Development of Electric Power Systems of Russia for 2023–2028".
45. Decree of the Government of the Russian Federation dated December 30, 2022 No. 2556 "On Approval of the Rules for Development and Approval of Documents for the Prospective Development of the Electric Power Industry, Amendment and Invalidation of Certain Decrees and Certain Provisions of Certain Decrees of the Government of the Russian Federation".
46. Certain provisions of the Decree of the Government of the Russian Federation dated October 17, 2009 No. 823 were declared invalid, the entire document ceases to be valid since January 1, 2024.

IMPLEMENTED INVESTMENT PROJECTS AND PROSPECTS OF RENEWABLE ENERGY GENERATION ON THE REM

In 2022, as part of the renewable energy generation support mechanism on the retail electricity markets, 12.33 MW of power capacities were put into operation in the UES of Russia. In the Republic of Bashkortostan, the first and second stages of the Agidelskaya SPP of Kuray Solar LLC (part of Solar Systems LLC) with a total capacity of 9.98 MW were launched, and in the Krasnodar territory — the SPP on the territory of the Krasnodar CHPP of LUKOIL-Kubanenergo LLC with a capacity of 2.35 MW. According to the results of the first half of 2023, the construction and procedure for the technical connection of a complex of nine solar power plants of 4.9 MW each was also completed in the Labinsky district of the Krasnodar territory (total capacity — 44.1 MW, owner — Renewable Energy Sources LLC, part of Hevel Group)[47].

By the end of 2023, in accordance with the results of the past competitive selection, another 86 MW of retail RES generation are planned to be commissioned. In terms of solar generation projects, Solar Systems LLC is building Ulyanovskaya SPP (19.6 MW) in the Ulyanovsk region and Tikhoretskaya SPP (16.0 MW) in the Krasnodar territory. In the Krylovsky district of the Krasnodar territory, it is expected to launch a SPP with a capacity of 1.02 MW in the territory of Kavkaz LLC: construction work was completed in 2022, today the generating facility is in the process of qualifying and obtaining a tariff solution. In addition, in settlements isolated from the UES in the Tomsk region, a complex of automated hybrid plants with a total capacity of 5.6 MW (based on solar generation) is planned to be commissioned this year. On the retail wind generation sector, a project to construct the Makhachkalinskaya WPP with an installed capacity of 12.5 MW is being implemented in 2023 by Makhachkalinskaya WPP LLC (part of EcoEnergy Group) together with NovaWind JSC. The WPP will include five wind turbines with a capacity of 2.5 MW, produced by NovaWind JSC, and will be the first operating wind power plant in the region.

In total, as of July 2023, the total installed capacity of qualified renewable energy generation facilities on the retail markets selected within the support mechanism is 56 MW. If the Labinskaya SPP complex commissioned in July 2023, for which a tariff has not yet been established for the current year, is taken into account, the total capacity of all facilities is 100 MW, of which 81 MW are facilities commissioned as a result of competitive selection, and the remaining 19 MW are facilities built without competitive procedures (including before 2015), qualified and selling the generated electricity to the grid at a special tariff[48].



Photo by Artem Tsenenko

Tariffs for electricity (capacity) produced by renewable energy generation facilities and purchased to compensate the grid losses are established (adjusted) by regional tariff regulation bodies in accordance with the Methodological Guidelines annually. Thus, in 2023, some renewable energy facilities that lost their status of the qualified facility or were decommissioned and for which an appropriate tariff was established in previous years, were not included in the list of facilities operating within the framework of the support mechanism on the retail electricity markets. For 2023, special tariffs were not imposed for six such RES generation facilities with a total capacity of 19.4 MW, including for the 0.1 MW WPP in the Belgorod region (decommissioned) and for the active degassing station of the

47. In 2024, Renewable Energy Sources LLC plans to launch a similar complex with an installed capacity of 44.1 MW in the Seversky district of the Krasnodar territory.

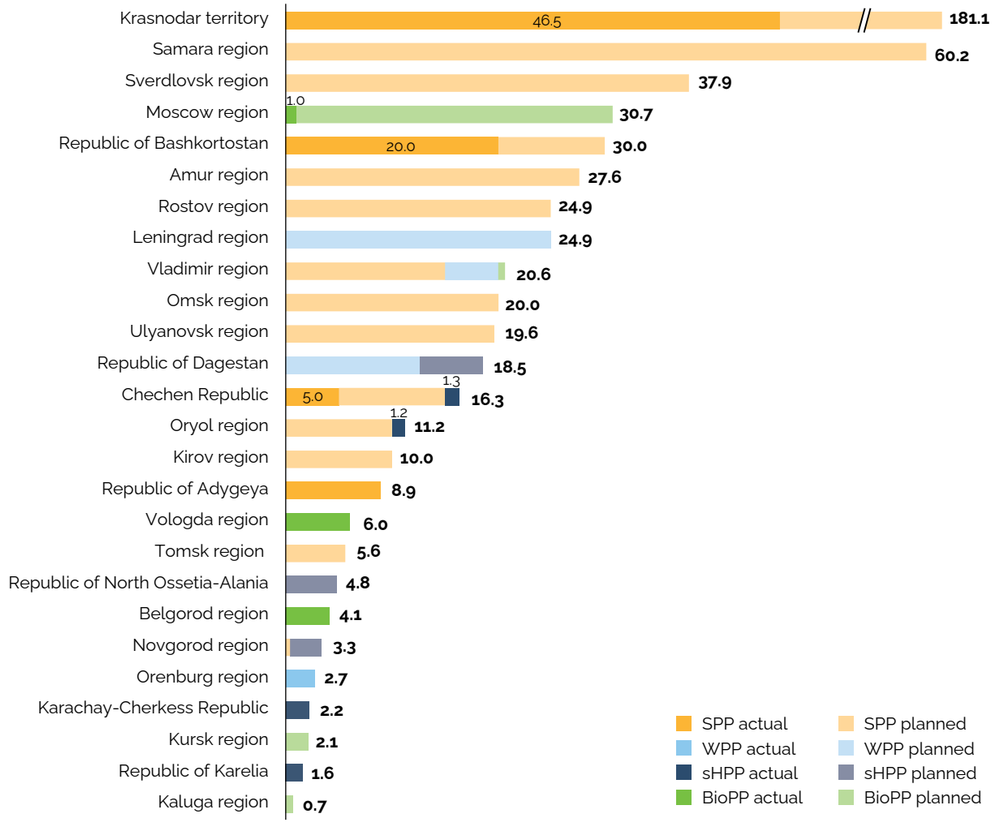
48. In the period from 2013 to 2015, after the introduction of the rule on the priority purchase of losses from qualified RES facilities and before the introduction of the mandatory procedure for competitive selection in retail markets, RES facilities built earlier outside the support mechanism were qualified.

Table 1. List of RES generation facilities for which the tariff for electricity purchased to compensate for grid losses is set for 2023

Facility name	Installed capacity, MW	Location	Facility owner	Commissioning date	Straight-line price (tariff) in 2023, RUB/kWh
SPP					
Verkhnyaya Burzyanskaya SPP	5.00	Republic of Bashkortostan	Hevel Regional Generation LLC	04.03.2020	**20.06**
Nizhnyaya Burzyanskaya SPP	5.00	Republic of Bashkortostan	Hevel Regional Generation LLC	04.03.2020	**20.31**
Agidelskaya SPP (No.1 and No.2)	4.99 / 4.99	Republic of Bashkortostan	Kuray Solar LLC	24.05.2022, 03.08.2022	**18.38**
Adygeyskaya SPP	4.00	Republic of Adygeya	Renewable Energy Sources LLC	01.04.2020	**16.73**
Shovgenovskaya SPP	4.90	Republic of Adygeya	Renewable Energy Sources LLC	15.10.2020	**17.46**
Naurskaya SPP	5.00	Chechen Republic	Hevel Regional Generation LLC	29.06.2021	**18.17**
SPP at Krasnodar CHPP	2.35	Krasnodar territory	LUKOIL-Kubanenergo LLC	31.05.2022	**16.08**
WPP					
Wind turbines in the village of Tamar-Utkul (No. 1, 2, 3, 4)	0.93	Orenburg region	EcoSelEnergo LLC	25.12.2013	**5.45**
Wind turbines in the village of Tamar-Utkul (No. 5,6,7)	1.80	Orenburg region	EcoSelEnergo LLC	23.12.2016	**5.45**
sHPP					
Rymäkoski sHPP	0.63	Republic of Karelia	Nord Hydro JSC	09.07.2013	**12.21**
Kalliokoski sHPP	0.98	Republic of Karelia	Nord Hydro JSC	15.12.2014	**17.52**
Kokadoy sHPP	1.30	Chechen Republic	State Unitary Enterprise "ChGK"	03.07.2015	**4.11**
Lykovskaya sHPP	1.22	Oryol region	Lykovskaya HPP LLC	22.10.2015	**5.46**
Novokarachayevskaya sHPP	1.20	Karachay-Cherkess Republic	Foton CJSC	19.02.2013	**2.91**
Uchkulanskaya sHPP	1.00	Karachay-Cherkess Republic	Foton CJSC	08.10.2018	**5.15**
BioPP					
Bely Ruchey sCHPP (biomass)	6.00	Vologda region	Bely Ruchey CHPP JSC	21.08.2007	**4.43**
Baytsury BGS (biogas)	0.53	Belgorod region	Russtroyinvest LLC	24.11.2011	**13.48**
Luchki BGS (biogas)	3.60	Belgorod region	AltEnergo LLC	25.06.2012	**8.94**
BGS Timohovo (biogas)	10.00	Moscow region	Polygon Timohovo JSC	06.12.2021	**6.66**
Torbeyevo SMW (landfill gas)	0.95	Moscow region	Enit LLC	24.09.2020	**4.98**

Source: RREDA (based on information posted on the websites of the authorized bodies of the constituent entities of the Russian Federation).

Fig. 24. Regional distribution of existing and selected RES projects operating under the retail support mechanism, MW



Source: RREDA, NP Market Council, SO UPS JSC, websites of authorized executive bodies of the constituent entities of the Russian Federation

Novy Svet-Eco solid waste landfill with a capacity of 2.4 MW in the Leningrad region, for which qualification certificates were terminated in 2022. In addition, since 2023, no tariff[49] has been imposed for the Tyup-kildy WPP with an installed capacity of 1.65 MW, the Mechetlinskaya sHPP with a capacity of 0.45 MW in the Republic of Bashkortostan and the Lyaskel sHPP with a capacity of 4.8 MW in the Republic of Karelia.

According to RREDA, in 2023, eight solar generation facilities operating in the republics of Bashkortostan, Adygeya, the Chechen Republic and the Krasnodar territory are selling electricity at a special tariff. For the first and second Agidelskaya SPP commissioned in 2022, the tariff was set for the first time. Also, the tariff for 2023 is set for two qualified wind power facilities in the Orenburg region. For small hydro generation facilities, electricity tariffs for 2023 are set for six facilities located in the Republic of Karelia, the Karachay-Cherkess and Chechen Republics, as well as the Orel region. As of 2023, the lowest straight-line electricity tariff was set at 2.91 RUB/kWh for Novokarachayevskaya sHPP **(Table 1)**. In addition, tariffs for electricity produced at qualified RES generating facilities and purchased to compensate for losses in electric grids are determined for one biomass-based facility in the Vologda region, as well as two biogas stations located in the Belgorod region, and for a qualified facility operating on the basis of landfill gas in the Moscow region.

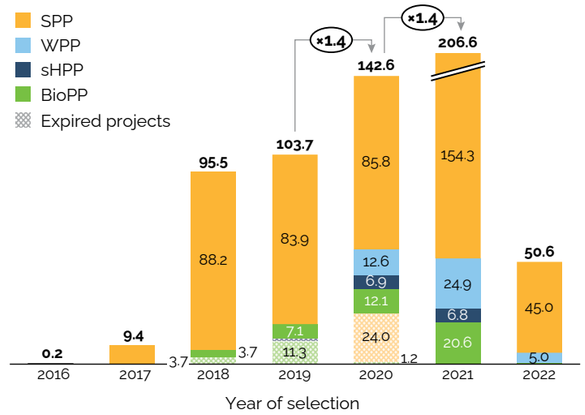
49. The reasons for the decision not to establish the tariff are unknown.

In general, the retail segment of renewable energy generation starts to attract higher interest from the potential investors. During the competitive selection of investment projects for the renewable energy facilities' construction on the retail electricity markets from 2016 to 2022, about 609 MW of renewable energy generation were selected in 23 regions of Russia. However, due to the refusal to implement a number of projects, in 2025, the installed capacity of renewable energy generation facilities operating within the framework of the mechanism for stimulating the renewable energy development in retail markets will be 576 MW (475 MW remaining for implementation)[50].

The regional distribution of existing and planned RES facilities for which the sale of electricity (capacity) is planned on the retail electricity markets is presented in **Fig. 24** (data as of July 2023). The leading regions in terms of installed capacity of renewable energy generation operating under the retail support mechanism are the Krasnodar territory (46.5 MW) and the Republic of Bashkortostan (20.0 MW). In terms of power generation technologies, solar energy is the leader. Today, it accounts for 80 MW, and in 2025, if all selected projects are implemented, solar generation will account for about 467 MW, which corresponds to 80% of the entire installed capacity of renewable energy sources operating within the framework of the support mechanism in retail markets.

In March 2022, a competitive selection of renewable energy generation investment projects on the retail electricity markets took place in the Vladimir, Omsk and Oryol regions. Based on the results of the selection, five solar, wind and biogas projects with a total installed capacity of 20.6 MW were selected in the Vladimir region. In the Omsk and Oryol regions, solar power plants with a capacity of 20.0 MW and 10.0 MW, respectively, were selected. The total selected capacity in the three regions amounted to 50.6 MW of renewable energy generation.

Fig. 25. Volumes of selected RES projects in retail electricity markets, MW



Source: RREDA, websites of authorized executive bodies of the constituent entities of the Russian Federation

In 2023, the selection of RES generation projects on the retail markets should take place by November 30, subject to the relevant decision of the executive bodies of the constituent entities of the Russian Federation.

Volumetric indicators of the results of past RES generation projects' selections on the retail electricity markets by years of competitive procedures are presented in **Fig. 25**.

In addition to 100 MW of RES generation facilities operating within the framework of the support mechanism, over 100 other RES-based power plants operate on the retail electricity markets with a total installed capacity of 746 MW (excluding facilities in isolated energy systems). This capacity includes hydro generation facilities (326 MW), solar generation (301 MW, mainly in the Republic of Crimea), wind generation facilities account for another 99 MW, of which 86 MW are located in the Crimea.

During 2022 and the first half of 2023, the increase in the total installed capacity based on RES generation on the retail electricity markets (without support measures) in the UES of Russia amounted to 5.4 MW. In May 2022, the Zelenogradskaya WPP (0.6 MW) in the Kaliningrad region and the Malaya Krasnopolyanskaya HPP (1.5 MW) in the Krasnodar territory were put into commercial operation. In March 2023, an additional 3.3 MW hydroelectric unit was commissioned at the Krasnopolyanskaya HPP in the Krasnodar territory, after which the facility's installed capacity increased to 24.9 MW.

50. According to regional authorities, another 41 MW of selected capacity will not be implemented. These retail projects are recognized as expired, the volume of capacity will be re-tendered at the next competitive selection.

RENEWABLE ENERGY DEVELOPMENT IN TITES



Photo by Artem Tsenenko

The Russian Federation is the largest state on Earth, with an area of 17.1 million square kilometers, which is almost twice the territory of the United States or China. The vast territory and large length, combined with the northern position of the country, create contradictory conditions for the development of infrastructure. On the one hand, Russia has enormous natural resources, on the other hand, huge territories and harsh climatic conditions in the northern regions complicate the development of remote areas. This feature of our country is also reflected in the structure of the energy system. A significant part of the territories of the Russian Federation is not provided with centralized electricity supply and is characterized by a large area with a very low population density (8–10% of the country's population) and, therefore, a low density of electrical loads. At the same time, these regions are of great importance for the country's economy: 76% of Russian oil, 93% of natural gas, 95% of gold and 76% of diamonds are mined in these areas.

The technologically isolated territorial energy systems — the local energy systems where for technological reasons the organization of market relations in the electric power industry is still impossible. In accordance with the Federal Law dated March 26, 2003 No. 35-FZ[51] "On Electric Power Industry", TITES include energy systems located in territories that do not have electrical connections with the UES of Russia. The list of TITES, approved by the Decree of the Government of the Russian Federation dated December 27, 2004 No. 854, includes the electric power systems of the Kamchatka territory, the Magadan and Sakhalin regions, the Chukotka and Taimyr (Dolgan-Nenets) Autonomous Districts. Also, decentralized power supply areas are located in the territories of other constituent entities of the Russian Federation, for example, the Republic of Sakha (Yakutia), the Republic of Tyva, the Murmansk, Arkhangelsk, Amur, Magadan regions, the Khanty-Mansi and Yamalo-Nenets Autonomous Districts, the Khabarovsk territory, etc.

The power systems of the Far East and the Arctic are characterized by rather low levels of power supply reliability and quality of electricity. Due to the low level of grid infrastructure development in remote and isolated areas, electricity is mainly generated using diesel fuel, which

51. Federal Law No. 35-FZ dated March 26, 2003 "On Electric Power Industry".

Fig. 26. Main documents on improving the energy efficiency of generation facilities in TITES

2009 Dec. 28

Resolution of the Government of the Russian Federation dated December 28, 2009 No. 2094-r "On approval of the Strategy for the socio-economic development of the Far East and the Baikal region for the period up to 2025"

"Given the availability of technologically isolated energy areas and decentralized energy supply areas, it is of great importance to increase the energy efficiency of electricity production, which will be achieved through the use of local fuels and renewable energy sources."

2018 May 7

Decree of the President of the Russian Federation dated May 7, 2018 No. 204 "On the national goals and strategic objectives of the development of the Russian Federation for the period up to 2024"

"Develop a plan for modernization of the backbone infrastructure, guaranteed provision of affordable electricity, including by: development of distributed generation, including using renewable energy, primarily in remote and isolated energy areas".

2019 Jan. 30

Decree of the Government of the Russian Federation dated December 29, 2011 No. 1178 "On pricing in the field of regulated prices (tariffs) in the electric power industry" (as amended by Decree of the Government of the Russian Federation dated January 30, 2019 No. 64)

The first steps have been identified to introduce a mechanism to support increased generation efficiency in isolated and hard-to-reach areas using distributed generation solutions, including through the use of renewable energy sources.

2019 Aug. 15

Action Plan for the modernization of inefficient diesel (fuel oil, coal) generation in isolated and hard-to-reach territories, approved by Deputy Prime Minister of the Russian Federation D.N. Kozak on August 15, 2019 No. 7456p-P9

Savings on fuel costs associated with the change of fuels at generating facilities, as well as with the use of renewable energy sources in each year of the long-term regulatory period, are included in the required gross revenue for 5 years.

2020 June 9

Resolution of the Government of the Russian Federation dated June 9, 2020 No. 1523-r "On approval of the Energy Strategy of the Russian Federation for the period up to 2035"

The implementation of the spatial priorities of the state energy policy involves increasing the stability and reliability of energy supply to macroregions with maximum, cost-effective use of local energy resources, renewable energy sources and distributed generation (clause 160).

2021 June 1

Resolution of the Government of the Russian Federation dated June 1, 2021 No. 1447-r (as amended on September 14, 2021) "On approval of the Action Plan for the implementation of the Energy Strategy of the Russian Federation for the period up to 2035"

More than 130 measures were approved, including:
- Creation of a mechanism for competitive projects' selection for the modernization of inefficient generation in isolated areas
- Development of a national standards' system in the field of renewable energy.

2021 June 11

Federal Law No. 261-FZ dated November 23, 2009 (as amended on June 11, 2021) "On Energy Saving and Improving Energy Efficiency, and on Amendments to Certain Legislative Acts of the Russian Federation"

The Federal Law "On Energy Saving" allows to modernize inefficient generation facilities using the mechanism of energy service contracts.

2023 planned

"Program for the modernization of local generation facilities of technologically isolated territorial electric power systems located in the Far Eastern Federal District" (under approval)

Detailed analysis of 270 inefficient diesel generation facilities with a total capacity of more than 400 MW. Identification of additional support measures.



Source: RREDA



Ininskaya SPP

is imported from other constituent entities of the Russian Federation through complicated logistics schemes. This leads to a significant increase in the cost of electricity and delivery times. Local energy is also characterized by a high level of moral and physical wear and tear and high losses at all stages of production, transportation and consumption, which leads to low energy efficiency.

An additional argument for reducing the use of traditional generation facilities is the increased risk of harm to the environment. Diesel or fuel oil generation is particularly harmful to the Arctic ecosystem, which is one of the most fragile on the planet[52].

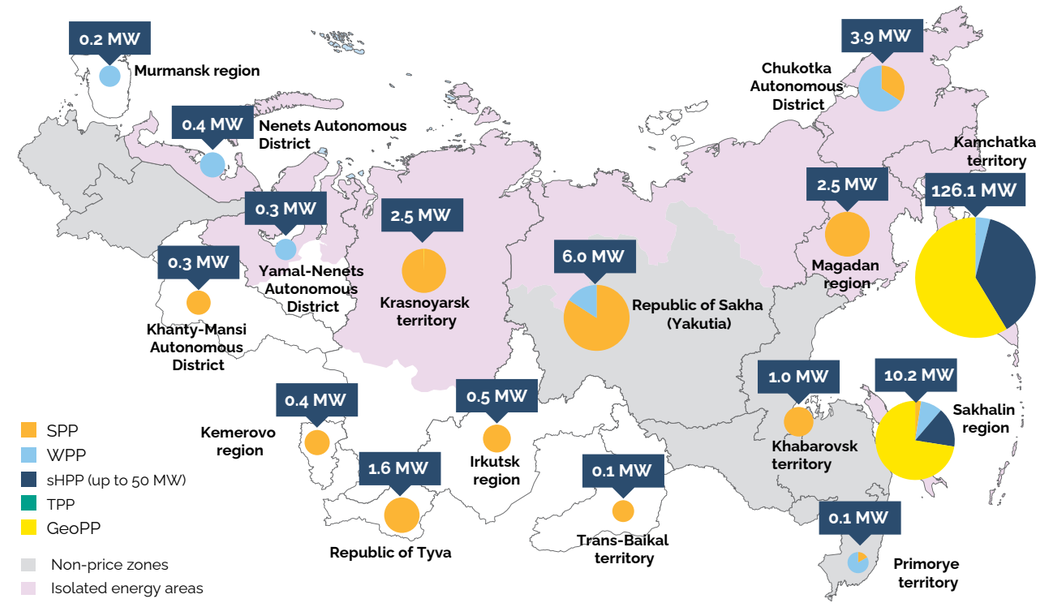
As a result of the systematic release of a large amount of CO_2 in the Arctic, environmental parameters may change — for example, the temperature of the Arctic climatic zone may increase due to a decrease in the ozone layer's density because of CO_2 emissions. For the Arctic, this problem is particularly relevant — over the past 43 years, the Arctic has been heating up almost four times faster than the rest of the world[53]. Also, when using traditional generation, man-made disasters are possible, entailing serious damage to the environment. So, on May 29, 2020, about 21 thousand tons of diesel got into the soil in Norilsk due to the rupture of the tank on the territory of the thermal power plant, as a result of which a federal emergency was declared[54].

Taking into account the existing energy problems in TITES, energy efficiency improvement and modernization of inefficient diesel generation, as well as development of grid infrastructure of isolated power supply systems based on innovative technologies are required. One of the promising areas of such development is the use of renewable energy sources in combination with traditional energy sources, the so-called autonomous hybrid power plants (hereinafter referred to as AHPP).

The renewable energy development to replace inefficient diesel generation in technologically remote and isolated energy systems is one of the priorities of the renewable energy industry in Russia, which is reflected in a number of instructions and program and strategy documents presented in **Fig. 26**. Resolution of the Government of the Russian Federation dated December 28, 2009 No. 2094-r "On approval of the Strategy for the socio-economic development of the Far East and the Baikal region for the period up to 2025"[55] indicates that the development of the Far East and the Baikal region's energy systems will be aimed at ensuring the energy security of the territory and eliminating infrastructure constraints of economic development, including with the use of renewable energy generation. Decree of the President of the Russian Federation dated May 7, 2018 No. 204 "On National Goals and Strategic Tasks for the Development of the Russian Federation for the Period until 2024" defines "guaranteed provision of affordable electricity, including through the development of distributed generation, including on the basis of renewable energy sources, primarily in remote and isolated energy areas" as one of the goals. Pursuant to the Decree, the Government of the Russian Federation, by Resolution dated August 15, 2019 No. 7456p-P9, approved a separate Plan for the modernization of inefficient diesel (fuel oil, coal) generation in isolated and remote territories, the main purpose of which is to introduce mechanisms for improvement of generation efficiency in isolated and inaccessible territories using distributed generation solutions, including through the use of renewable energy sources, autonomous hybrid power systems, liquefied natural gas, local fuels and energy storage systems. The Strategy of the Russian Federation for the period up to 2035, approved by the Resolution of the Government of the Russian Federation in 2020, states that the task of energy sector based on the use of renewable energy sources is to increase the efficiency of energy supply to remote and isolated areas. Following the results of the Eastern Economic Forum held on September 5–8, 2022, the President of Russia instructed the Cabinet of Ministers to develop a program, with the participation of the State Development Corporation VEB.RF and RusHydro PJSC, for modernization of local generation facilities of TITES located in the Far Eastern Federal District, determining the sources of its financing.[56] The Ministry of Energy of the Russian Federation has drawn up a plan for modernizing the generation in isolated power systems of the Far Eastern Federal District, which is currently undergoing approval. As part of the program, 270 objects of inefficient diesel generation with a total capacity of more than 450 MW were analyzed. The program includes two stages. As the first stage, it is proposed to prioritize 80 diesel generation facilities, primarily in the territories of Yakutia and the Kamchatka territory with a payback period of 15 years, the projects of which have a high degree of preliminary development. It is planned to attract private investment by concluding energy service contracts on the basis of competitive selection, taking into account the provision of loan financing at a subsidized rate and possible tax preferences. At the second stage, it is planned to take measures of additional support, primarily concessional lending.

Despite the existence of all the above-mentioned documents and a separate Action Plan with established targets, the modernization of local energy facilities proceeds slowly

Fig. 27. Total capacity of the commissioned renewable energy generation facilities in isolated energy systems of Russia, MW



Source: RREDA

52. Arctic Russia (2020). Crystal transparency. Arctic ecology: balance between protection and development.
53. RBC (2022). Why the Arctic is heating up four times faster than the rest of the world.
54. RBC (2020). Emergency with a diesel spill in Norilsk. What is important to know.
55. Resolution of the Government of the Russian Federation dated December 28, 2009 No. 2094-r "On approval of the Strategy for the socio-economic development of the Far East and the Baikal region for the period up to 2025".
56. List of instructions following the results of the Eastern Economic Forum.

within the framework of regulated investment programs of energy supplying companies limited by tariff sources. At the moment, less than 3% of the total installed capacity of renewable energy generation facilities in Russia falls on isolated and hard-to-reach areas, which corresponds to about 156 MW. At the same time, half of the capacity is provided by geothermal power plants, of which 74.0 MW operate in the Kamchatka Territory and 7.4 MW in the Sakhalin Region. In addition, the installed capacity of small hydro power plants is 47.11 MW in the Kamchatka territory and 1.66 MW in the Sakhalin Region. Consequently, the capacity of solar and wind power plants in TITES is only 15.5 MW and 10.2 MW, respectively. The distribution of renewable energy generation facilities by regions and technologies is presented in **Fig. 27**.

As part of the implementation of the first paragraphs of the Action Plan for the modernization of inefficient diesel generation in isolated power systems, the Analytical Center under the Government of the Russian Federation, together with the Ministry of Energy of Russia, formed the Report "Generation facilities in isolated and hard-to-reach areas"[57], which shows that in 23 regions of Russia the total number of local generation facilities potentially requiring modernization is 712 units with a total installed capacity amounting to 840.3 MW.

An important aspect of the Plan for the modernization of inefficient generation, in addition to collecting and disclosing data on generation facilities in isolated and hard-to-reach areas, is the approval of the procedure for competitive investment projects' selection to improve the efficiency of generation facilities. Currently, generation owners and potential investors in projects for the modernization of facilities in isolated power systems can use the mechanisms provided for by legislation in the field of energy saving and energy efficiency[58].



Photo by Denis Belozerov

The Federal Law "On Energy Saving" allows to modernize inefficient generation facilities using the mechanism of energy service contracts. Through this mechanism, after the approval of the plan of measures for energy saving and energy efficiency in the regional program, it is possible to hold a competition by energy supplying organizations and conclude an energy service contract for the payback period of the measures. In 2022, within the framework of energy service contracts, eight AHPP based on solar generation with a total capacity of 5.0 MW were commissioned: five facilities in the Republic of Sakha (Yakutia) — 2.96 MW, one facility in the Republic of Tyva — 1.0 MW, the Chukotka Autonomous District — 0.8 MW, and the Sakhalin region — 0.25 MW. The largest solar power plant above the Arctic Circle — an autonomous hybrid power plant in Honuu with a solar power of 1.5 MW operates as part of the energy complexes introduced in the Republic of Sakha. By the end of 2024, an additional 66 solar generation facilities with a total capacity of 17.6 MW are planned to be commissioned in the Republic of Sakha under energy service contracts.

Another option for modernizing inefficient generation facilities is the mechanism for concluding concession agreements. In December 2020, Law No. 401-FZ "On Amendments to the Federal Law "On Concession Agreements" was adopted. The amendments are aimed at reducing the risks of concessionaires, attracting additional investments in the field of electricity supply by introducing legal guarantees of invariability of regulatory conditions for the concessionaire throughout the term of the agreement.

The law provides for the inclusion a provision on the amount of gross revenue received by the concessionaire as part of the implementation of the concession agreement, including for each year of its validity, in the essential terms of concession agreements. The law also provides that if the concession agreement is concluded in relation to facilities for the production, transmission and distribution of electricity owned by a state or municipal unitary enterprise on the right of economic management, such an enterprise may participate on the part of the grantor in the obligations under the concession agreement and exercise the powers of the grantor. Given that in isolated areas, 30% of the generation facilities' capacity is in municipal ownership, and 11% is in the ownership of the constituent entities of the Russian Federation, the ability to enter into concessions for generation facilities in municipal and regional ownership is an important step in attracting investors.

In addition, in these territories, renewable energy generation projects can be implemented according to the principles of the support mechanism in retail markets with a number of differences: electricity production at a new renewable energy generation facility should lead to a decrease in the cost of electricity (capacity) in the relevant territory, as well as there are no restrictions on the volume of renewable electricity production in TITES, while the local guaranteeing

Fig. 28. Competitive selection on the retail electricity markets: comparison of selection principles for UES and TITES

UES (areas united into price and non-price zones of the WECM)	TITES
Principle of selection	
▸ minimizing the growth of prices (tariffs) for electricity (capacity) for end consumers of the retail market; ▸ electricity production at renewable energy facilities should not exceed 5% of the total forecast losses in the electric grids of the region; ▸ minimization of environmental damage; ▸ publicity and openness	▸ reduction of the cost of electricity (power) in the relevant territory as a result of the investment project implementation; ▸ minimization of environmental damage; ▸ publicity and openness
Buyer of electricity (capacity)	
territorial grid organization	guaranteeing supplier
Features of a tender bid	
not exceeding the limiting maximum levels of prices (tariffs) for electricity (capacity) produced at qualified renewable generation facilities, established by the executive body of the constituent entity of the Russian Federation, responsible for state regulation of tariffs	not exceeding the limiting maximum levels of prices (tariffs) for electricity (capacity) produced at renewable generation facilities, which in turn should not exceed the weighted average of regulated prices (tariffs) for electricity producers taken into account in the forecast balance of the territory for which renewable energy projects are selected
Restrictions on the planned installed capacity of the facility	
300 kW ≤ Installed capacity < 25 MW	not established
Basic rate of return	
12% (when determining the limiting maximum levels of prices (tariffs))	according to the results of the tender
Period of return of invested capital	
15 years from the start date of the tariff (from the planned commissioning date of the facility)	based on the results of the tender, but may not exceed 30 years
Local content requirements	
for facilities commissioned since 2017	not established

Source: RREDA, NP Market Council

57. Analytical Center under the Government of the Russian Federation (2020). Generation facilities in isolated and hard-to-reach areas in Russia.

58. Federal Law dated November 23, 2009 No. 261-FZ "On Energy Saving and on Improving Energy Efficiency and on Amendments to Certain Legislative Acts of the Russian Federation" and Decree of the Government of the Russian Federation dated January 30, 2019 No. 64 "On amendments to certain decrees of the Government of the Russian Federation concerning regulation of prices (tariffs) for electric energy (capacity) supplied in technologically isolated territorial electric power systems and in territories not technologically connected with the Unified Energy System of Russia and technologically isolated territorial electric power systems, and the recognition of certain decrees of the Government of the Russian Federation as Invalid".

supplier, and not the grid organization, is obliged to purchase all electricity. As a result of the selection, long-term electricity tariffs are also established. The differences in the rules for competitive selection on the retail markets in the UES and TITES are presented in **Fig. 28**.

As of July 2023, only one region took the opportunity to conduct competitive selections in the framework of RES generation support in TITES retail markets. In 2021, AHPP with a total capacity of 5.6 MW were selected in the Tomsk region for reconstruction of power supply centers in settlements isolated from the UES.

The existing mechanisms for attracting private investment do not fully provide for comprehensive modernization of municipal energy facilities in the area of decentralized electricity supply using the potential of cogeneration, as well as energy saving and energy efficiency on the consumer side, and do not imply a decrease in total costs. In order to create organizational and financial prerequisites for the technological renewal of the energy sector of municipalities in the decentralized power supply zone, "Corporation for the Development of the Far East and the Arctic" JSC has developed a roadmap for the implementation of the "Concept for attracting private investment in the development of distributed generation, including using renewable energy sources, in remote and isolated areas of the Far East and the Arctic". The implementation of the roadmap involves, among other things, the creation of an industry institute in the form of a distributed generation development fund in remote and isolated areas of the Russian Federation in order to provide financial support for investment projects for the comprehensive modernization of the municipal energy sector and ensure guaranteed local power supply to consumers. The functioning of this structure should be provided with the necessary cross-sectoral regulatory framework, sources of financing and a professional team to conduct expertise, provide financial support and assistance for investment projects.

Results of the first regional investment rating in the field of renewable energy for regions located on the territory of non-price zones of the wholesale electricity and capacity market, and isolated energy systems of the Russian Federation



In 2022, RREDA presented a new stage of its project - the investment rating in the field of renewable energy for 15 regions of non-price zones of the WECM and isolated energy systems

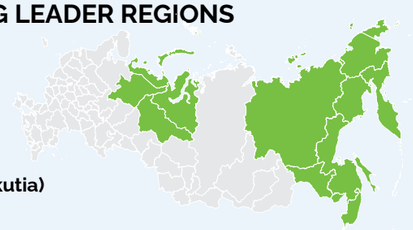
- Sakhalin region
- Kamchatka territory
- Republic of Sakha (Yakutia)
- Kaliningrad region
- Chukotka Autonomous District
- Primorye territory
- Khabarovsk territory
- Yamal-Nenets Autonomous District
- Khanty-Mansi Autonomous District - Yugra
- Arkhangelsk region
- Nenets Autonomous District
- Amur region
- Magadan region
- Republic of Komi
- Jewish Autonomous Region

RATING LEADER REGIONS

FIRST PLACE
Sakhalin region

SECOND PLACE
Kamchatka territory

THIRD PLACE
Republic of Sakha (Yakutia)



WINNERS IN NOMINATIONS

THE "GREENEST" REGION
Kamchatka territory

INVESTOR'S CHOICE
Sakhalin region

LEADER OF INDUSTRIAL DEVELOPMENT
Kaliningrad region

THE MOST OPEN RES REGION
Sakhalin region

LEADER OF SOLAR ENERGY
Amur region

LEADER OF WIND ENERGY
Chukotka Autonomous District

LEADER OF SMALL HYDRO POWER
Kamchatka territory

LEADER OF BIOENERGY
Primorye territory

LEADER OF GEOTHERMAL ENERGY
Kamchatka territory

Sakhalin region took the first place in the RREDA investment rating, and also became the winner in two nominations

RATING LEADER REGION

THE MOST OPEN RES REGION

INVESTOR'S CHOICE

SPP	WPP	sHPP	GeoPP
Actual installed renewable generation capacity in the region at the end of 2022			
0.25 MW	0.90 MW	1.66 MW	7.40 MW
Planned installed renewable generation capacity in 2025			
0.25 MW	275.70 MW*	3.56 MW	12.40 MW

*in the case of construction of WPP with a capacity of 200 MW and 67.2 MW

As of July 2023, renewable energy generation facilities with a total capacity of

10 MW

are operating in the Sakhalin Region, including diesel wind power plants in Golovnino and Novikovo, solar power plant on Iturup Island, Mendeleevskaya GeoTPP, as well as two Severokurilskaya sHPP.

- The Sakhalin region was the first of the Russian regions to start an experiment to achieve carbon neutrality. Carbon neutrality is planned to be achieved in 2025.
- The experiment will allow developing the mechanisms of carbon regulation in the context of national goals for achieving carbon neutrality and will contribute to the implementation of the goals of the Strategy for the Long-Term Development of the Russian Federation with Low Greenhouse Gas Emissions up to 2050.
- The first climate project was the construction of a SPP on Iturup Island with an installed capacity of 250 kW. According to the project's results, 96 carbon units were registered in the national register. This event launched the carbon market in the Russian Federation.
- A plant for the low-carbon hydrogen production is planned to be built in the region. The planned capacity of the first stage will be 30 thousand tons of hydrogen, the second stage — up to 100 thousand tons of hydrogen with the possibility of further expansion of production.

DEVELOPMENT OF ELECTRIC TRANSPORT AND CHARGING INFRASTRUCTURE IN RUSSIA AND THE WORLD







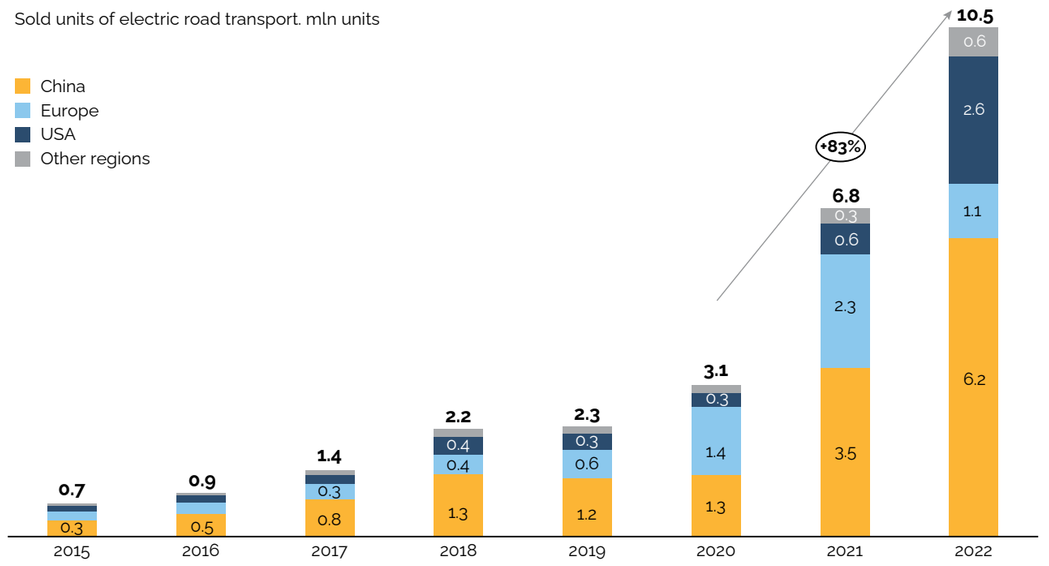
Photo by Motorinvest

STATUS AND PROSPECTS FOR THE GLOBAL DEVELOPMENT OF ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE

For the world's largest economies to achieve their stated carbon neutrality goals, adaptation of CO_2-emitting industries to reduce emissions is necessary. These industries include the transport industry, which is responsible for about 20% of global CO_2 emissions in 2022[59]. The IEA estimates that under the Net Zero Emissions by 2050 Scenario, effective decarbonization requires a reduction in emissions associated with the transport sector by about 20% by 2030[60]. Such a reduction is possible primarily due to the rapid electrification of road transport and the transition to lower-carbon fuels, for example, low-carbon hydrogen.

A number of countries in the world have set goals for the electrification of transport within the framework of the Paris Agreement, stimulating demand for electric vehicles both by introducing bans on the sale of cars with internal combustion engines in the future and by government subsidies for the purchase of electric vehicles. Thus, in the countries of the European Union, since 2035, a ban on the sale of new cars that emit carbon dioxide comes into force[61], which forces car manufacturers to develop electric vehicles to remain competitive in the market. China also intends to abandon the sale of traditional petrol-powered cars: in 2035, half of all cars sold in the country will be hybrids, and the rest will be battery-powered electric cars, plug-in hybrids, and hydrogen cars[62]. In terms of subsidizing the purchase of new electric vehicles, a number of European countries are leading. Such countries provide a significant amount of subsidies and incentives to stimulate the purchase of electric vehicles. So, in Germany there is a so-called environmental bonus — a grant for the purchase of a new electric

Fig. 29. Annual global sales of electric road transport



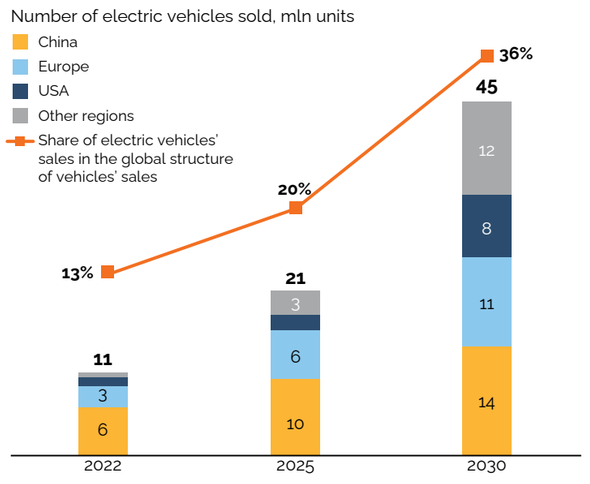
Source: IEA

59. McKinsey (2022). The net-zero challenge: Accelerating decarbonization worldwide.
60. IEA (2023). Transport: Improving the sustainability of passenger and freight transport.
61. European Parliament (2023). EU ban on the sale of new petrol and diesel cars from 2035 explained.
62. World Economic Forum (2020). China joins list of nations banning the sale of old-style fossil-fueled vehicles.



Photo by freepik.com/@frimufilms

Fig. 30. Forecast of world electric vehicles' sales according to IEA's Announced Pledges Scenario



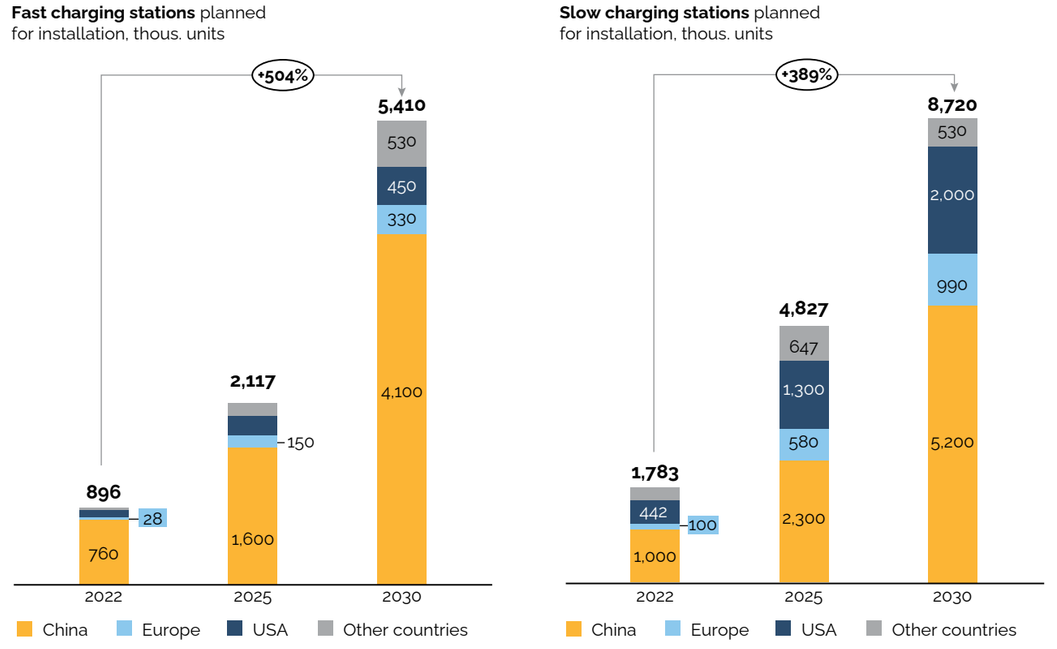
Source: IEA

car. Such a payment can be 4 thousand EURO when buying a battery-powered electric vehicle and 3 thousand EURO when buying a plug-in hybrid[63].

It is worth noting that over the past 20 years, there has been a multiple decrease in the cost of heavy-duty lithium-ion batteries — the key and most expensive structural element of an electric vehicle. Together with a significant decrease in the cost of lithium-ion batteries for electric vehicles, subsidies have become one of the reasons for the rapid development of the world market of electric road transport. In five years, from 2017 to 2022, sales of electric vehicles[64] grew from about 1 million to more than 10 million units per year. In 2020–2022, the global electric vehicle market grew at a cumulative average annual pace of 83% per year. The largest contribution to global market growth was made by China: in 2020–2022, sales in this country increased almost fivefold (from 1.3 million units in 2020 to 6.2 million units in 2022). The US market also showed significant growth — from 0.3 million units in 2020 to 2.6 million units in 2022 **(Fig. 29)**.

As a result, the total number of electric vehicles on the world's roads reached 26 million in 2022[65]. According to IEA forecasts, by the end of 2023, global annual sales of electric vehicles will amount to 14 million units. By 2030, the IEA's Announced Pledges Scenario **Fig. 30** forecasts global EV sales of around 45 million units per year, with the largest markets expected to be China (14 million units per year) and Europe (11 million units per year).

Fig. 31. Forecast of the installed charging stations according to IEA's Announced Pledges Scenario



Source: IEA

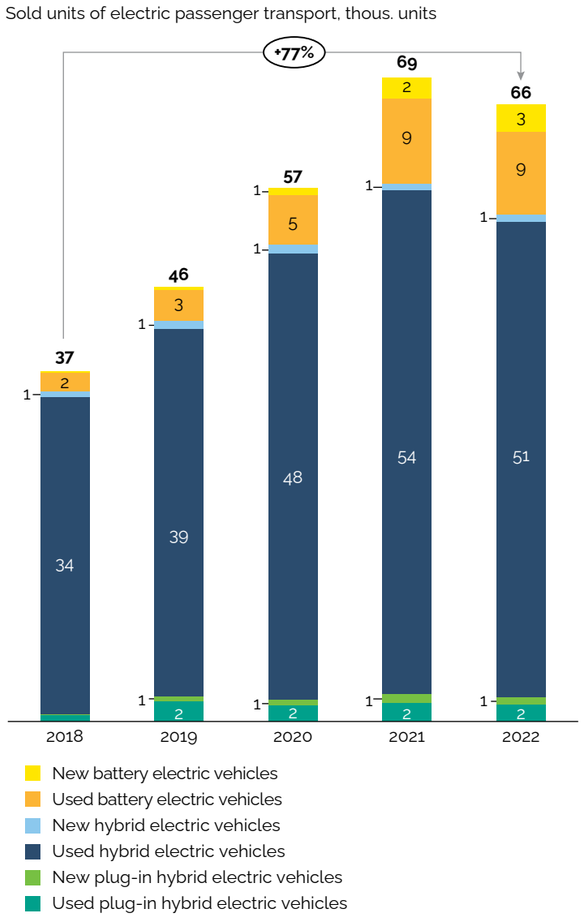
To ensure the adoption of a large number of electric vehicles, a sufficient level of development of the charging infrastructure for electric vehicles is required. Charging stations are "home"-type (an individual charging station located in a household) and "public" (a charging station for public use, usually located in a public place). The latter, in turn, are divided, based on the charging speed of the electric vehicle, into "fast" and "slow" ("slow" chargers have a rated power of less than or equal to 22 kW on average worldwide, "fast" — more than 22 kW, but not higher than 350 kW)[66]. As of the end of 2022, there are about 896 thousand "fast" "public" charging points and 1,783 thousand "slow" charging points in the world[67]. Most of them are concentrated in China — 760 thousand "fast" and 1 million "slow" points, which is 87% and 56% of the global volume of "fast" and "slow" charging points, respectively. The IEA's Announced Pledges Scenario **(Fig. 31)** predicts an increase in the number of "public" charging points introduced in the world to 14.1 million units, of which 5.4 million will be "fast" and 8.7 million will be "slow".

63. Federal Ministry for Economic Affairs and Climate Action (2023). Regulatory environment and incentives for using electric vehicles and developing a charging infrastructure.
64. Hereinafter in this section, the term "electric vehicle" includes the following categories of transport: battery-powered electric vehicle, plug-in hybrid electric vehicle.
65. IEA (2023). Global EV Outlook 2023.
66. IEA (2022). Global EV Outlook 2022.
67. IEA (2022). Global EV Data Explorer.

STATUS AND PROSPECTS FOR THE DEVELOPMENT OF AUTOMOTIVE ELECTRIC TRANSPORT AND CHARGING INFRASTRUCTURE IN RUSSIA

The automotive electric transport industry in Russia is currently actively developing. From 2018 to 2021, sales of electric vehicles and hybrids in Russia almost doubled, from 37,000 to 69,000 units sold per year **(Fig. 32)**. Used hybrid electric vehicles (77%, based on 2022 data) and used battery-powered electric vehicles (14%, based on 2022 data) account for the largest shares of sales.

Fig. 32. Annual sales of passenger automotive electric transport in Russia



Source: RREDA, Analytical Agency "Avtostat"

Most electric vehicles sold in Russia are imported. This is due to the lag in the development of the electric transport industry in Russia in comparison with the countries that are world leaders. Despite this, there are domestic manufacturers in the Russian market, such as MAZ "Moskvich", "Motorinvest", GAZ, KamAZ. The list of key Russian manufacturers of electric vehicles is presented in **Table 2**. They occupy a wide range of market segments — from passenger electric vehicles to low-tonnage electric trucks, their products also have a varying degree of local content. Domestic manufacturers plan to increase their market share and extend the local content of electric vehicle production.

With the development of the electric transport market in Russia, the charging infrastructure is also developing — at the end of 2022, there are about 4.4 thousand charging points in Russia, of which 84% are "slow", 16% are "fast"[68]. The regions with the largest number of charging stations in Russia (as of the end of 2022) are presented in **Table 3**.

It is worth noting that in Russia the specific number of electric vehicles per charging station is lower than the world values (5.9 electric vehicles per charging station in Russia, 9.7 — in the world), which indicates a faster growth rate of the charging infrastructure relative to the electric vehicle market. The creation of a charging infrastructure should be ahead of the advent of cars, since the buyer decides to buy an electric car only if he or she clearly understands where he or she will have access to the charging infrastructure.

68. Avtostat (2022). There are more than 4 thousand charging stations in Russia.



Photo by shutterstock.com/AliaksaB

Table 2. List of key Russian manufacturers of electric vehicles and their statements on the EV production

Player	Description of the player's activities	Production plan of electric vehicles for 2023–2025
MAZ "Moskvich"	Planning to create its own platform for electric vehicles and localize a number of production processes by the end of 2025	54.7k
"Motorinvest"	Assembling Evolute electric cars in the Lipetsk region	37.2k
"Avtovaz"	Announced plans to produce an electric version of Lada Largus	7.8k
"Avtotor"	Assembling BAIC electric vehicles, planning to start production of electric vehicles of this brand in 2023	3.5k
"Electric Vehicles Manufacturing Rus"	Producing EVM Pro light electric trucks based on UAZ Profi in Moscow Technopolis	2.5k
GAZ	Producing electric buses and Gazelle low-tonnage electric vehicles	1.7k

Source: RREDA, autonews.ru

Table 3. List of regions with the largest number of "fast" and "slow" charging stations at the end of 2022

Leading region for "fast" charging stations	City of Moscow	Krasnoyarsk territory	Primorye territory
Number of "fast" charging stations	68	51	45

Leading region for "slow" charging stations	Moscow region	City of Moscow	Krasnodar territory
Number of "slow" charging stations	630	360	220

Source: "Avtostat"

CONCEPT FOR THE DEVELOPMENT OF PRODUCTION AND USE OF ELECTRIC ROAD TRANSPORT IN THE RUSSIAN FEDERATION FOR THE PERIOD UP TO 2030

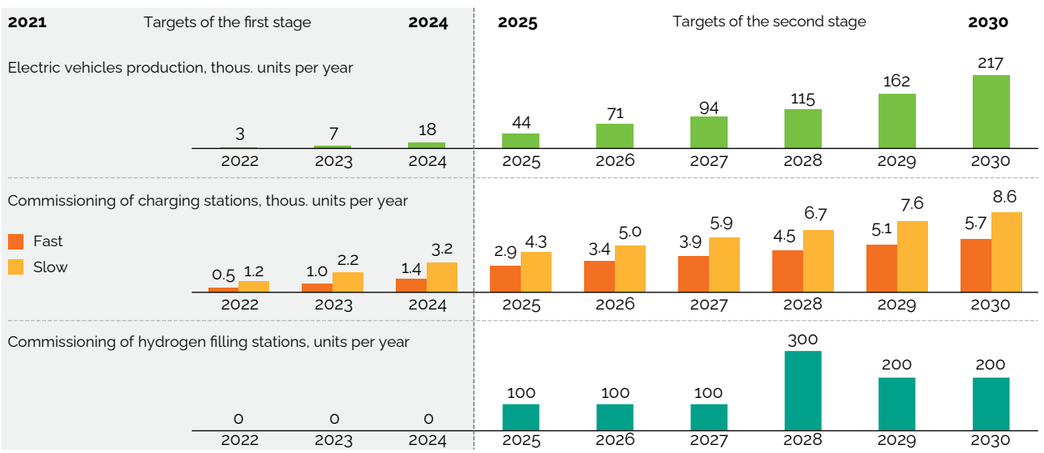
Since the end of 2017, Russia has adopted a number of regulatory documents related to the use of electric road transport and the development of charging infrastructure. Key documents are presented in **Fig. 33**.

Among these regulatory legal acts, the Concept for the development of production and use of electric road transport in the Russian Federation for the period up to 2030[69] (hereinafter referred to as the Concept), approved by the Government of the Russian Federation on August 23, 2021, occupies a special place. The concept is a key document that determines the scenario development of the electric transport industry in Russia. The document provides target indicators for the development of the industry and describes the conditions that can ensure these indicators.

Within the framework of the Concept, two key stages in the development of electric vehicles in Russia have been identified. The target of the first stage is to achieve by the end of 2024 the production volume of at least 25 thousand electric vehicles per year, as well as the commissioning of at least 9.4 thousand charging stations, of which 2.9 thousand are "fast". The targets of the second stage are the production of electric vehicles in the amount of 10% of all vehicles produced, the commissioning of at least 72 thousand charging stations, of which 28 thousand are "fast", and 1 thousand hydrogen refueling stations. The concept also envisages the launch of cells' production for heavy-duty batteries, cathode and anode materials as part of the second stage. The roadmap targets of the Concept for the production of electric vehicles and charging infrastructure are presented in **Fig. 34**.

The concept evaluates the key scenarios for the sale of electric vehicles in Russia, the prospects for the development of related technological solutions. Such solutions include the production of lithium-ion batteries, hydrogen fuel cells, cathode and anode materials. The Concept also identifies key areas of public policy to support and ensure the development of the production and use of electric vehicles in Russia, which will contribute to the targets' achievement. These areas include changes in the legislative framework, stimulating demand, launching the production of electric vehicles and heavy-duty batteries, and creating hydrogen infrastructure.

Fig. 34. Roadmap for the development of electric road transport and charging infrastructure in Russia



Source: Concept for the development of production and use of electric road transport in the Russian Federation for the period up to 2030

69. Resolution of the Government of the Russian Federation dated August 23, 2021 No. 2290-r "On approval of the Concept for the development of production and use of electric road transport in the Russian Federation for the period up to 2030".

Fig. 33. List of regulations related to electric road transport and charging infrastructure in Russia

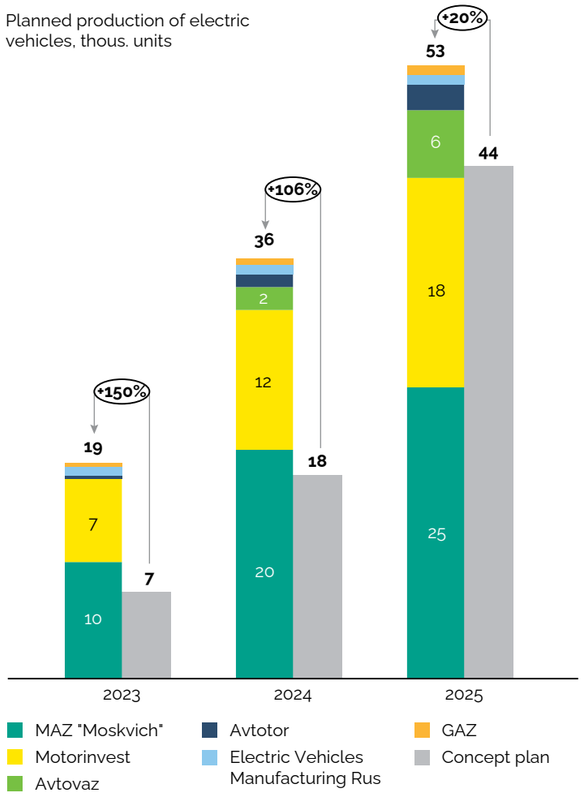


Source: RREDA

PROSPECTS FOR THE DEVELOPMENT OF ELECTRIC TRANSPORT AND CHARGING INFRASTRUCTURE IN RUSSIA

Currently, the electric road transport market in Russia has the potential for further growth. This growth is possible due to the existing measures of state support for electric vehicles, as well as the readiness of domestic manufacturers to meet the growing demand in the domestic electric transport market in the future. Thus, already now the largest manufacturers of electric vehicles in Russia have announced their intentions to produce an amount of electric vehicles exceeding the scenario conditions of the Concept. According to domestic companies, in 2025, Russian manufacturers can produce more than 53 thousand units of electric vehicles **(Fig. 35)**.

Fig. 35. Comparison of proposals of key electric vehicle manufacturers for EV production with the plans of the Concept



Source: company data, autonews.ru

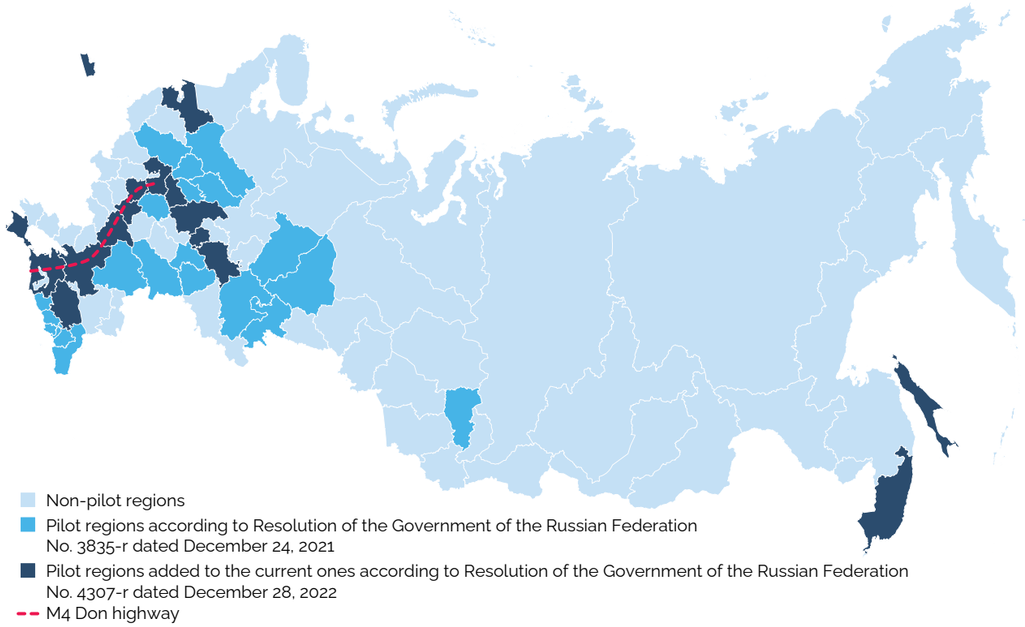
In addition, Russian companies plan to extend the local content of electric vehicles produced. Thus, MAZ "Moskvich" plans to create its own platform for electric vehicles and localize a number of production processes by the end of 2025, and Motorinvest LLC plans to achieve full localization of Evolute electric vehicles within 10 years[70]. SUE Mosgortrans plans to completely switch to electric buses by 2030. To this end, within the framework of the Moscow Energy project, the first electric buses were launched on the city's routes from September 1, 2018, and today this type of transport is an integral part of the Moscow bus fleet.

In Russia, it is also planned to expand the production of a key component of electric vehicles — heavy-duty lithium-ion batteries. In October 2022, RENERA (a subsidiary of Rosatom) began construction of a battery plant in Kaliningrad, with a design capacity of 4 GWh of batteries per year. Rosatom analysts argue that the number of batteries produced by the plant in the future may not be enough to meet the growing demand[71].

As part of the implementation of the strategic initiative of socio-economic development "Electric and Hydrogen Car" and the Concept for the development of production and use of electric vehicles in Russia up to 2030, further development of the charging infrastructure is planned in the country. As part of a pilot experiment aimed at increasing the number of charging stations, in 2021, 16 regions and one federal highway became sites for the priority placement of charging stations[72].

70. RBC (2022). Batteries for the harsh winter: how electric cars are localized for Russia.
71. Strana Rosatom (2022). RENERA will expand the site for production of lithium-ion cells in Moscow.
72. Resolution of the Government of the Russian Federation dated December 24, 2021 No. 3835-r "On approval of the list of territories and roads of federal significance identified as pilot areas for creation of charging infrastructure for electric vehicles up to 2024 inclusive".

Fig. 36. Pilot regions for priority placement of charging stations



Source: Resolution of the Government of the Russian Federation dated December 24, 2021 No. 3835-r (as amended on December 28, 2022)

Subsequently, the list of pilot regions was more than doubled — it included 37 regions, three cities of federal significance and one federal highway[73] **(Fig. 36)**.

Work is also underway to increase the availability of charging infrastructure in Russia. Thus, the Government of the Russian Federation instructed the Ministry of Construction, the Ministry of Energy and Rostekhnadzor to assess the feasibility of mandatory installation of a charging station during the construction of apartment and public buildings. Residents can also be given the right to charge electric cars in underground or ground parking lots of apartment buildings without any approvals. Today it is also possible, but it is necessary to first obtain the permission of the power supply company servicing the apartment building[74].



Photo by freepik.com/@user6702303

73. Resolution of the Government of the Russian Federation dated December 28, 2022 No. 4307-r "On Amendments to Resolution of the Government of the Russian Federation dated December 24, 2021 No. 3835-r".
74. Mikhail Mishustin approved a list of additional measures to support the development of electric transport.

HYDROGEN ENERGY DEVELOPMENT IN RUSSIA



Photo by shutterstock.com/Audio und werbung

The global implementation of the circular low-carbon economy concept is a key direction to achieving carbon neutrality. Hydrogen as an energy carrier serves as an important tool for reducing greenhouse gas emissions, decarbonizing the energy, transport sector and industry. Currently, hydrogen is already widely used as an industrial raw material, primarily in the chemical industry and oil refining. According to the IEA[75], global hydrogen consumption in 2021 is estimated at 94 mln tons per year. Of these, about 40 mln tons were used in oil refining, the remaining 64 mln tons — in other industries. According to estimates of the Concept for the Development of Hydrogen Energy in the Russian Federation[76], the total average annual volume of hydrogen produced and consumed in Russia in 2021 is about 5 million tons. The main transformation of the role of hydrogen in the perspective of the current decade is its use as a promising energy carrier and tool for solving climate problems, decarbonizing economic sectors, as well as accumulating, storing and transmitting energy. Most countries have already devised strategies on hydrogen use development, and large energy and industrial companies have included it in their investment programs and allocated additional resources for this purpose.

The main hydrogen advantages include the possibility of its production in processes that avoid greenhouse gas emissions. The so-called "green" hydrogen, which is produced by electrolysis of water using renewable electricity, is considered the cleanest among the hydrogen types. This is its difference, for example, from "blue" hydrogen, which is produced from natural gas and in the production of which by-product carbon dioxide is captured and placed in special storage facilities (CCS technology — carbon capture and storage). In the long term, many countries are interested in consuming low-carbon hydrogen, which is produced using electricity from renewable energy sources. However, at the initial stages of the world economy transformation, the "blue" hydrogen is of great importance. It is estimated that in different countries, depending on the scenario of hydrocarbon prices, the price parity of "blue" and "green" hydrogen will be achieved by 2030. However, during periods of sharp spikes in hydrocarbon prices, one of which was observed during 2022 and the beginning of 2023, "green" hydrogen wins competition. In addition to the price conjuncture of the hydrocarbon market, important factors in achieving price parity of hydrogen solutions include the efficiency of renewable generation, electrolyzers and fuel cells, as well as the cost of carbon emissions. Similar to the renewable energy sector, there is a tendency in hydrogen energy to reduce the cost of technical solutions and increase their efficiency. The "green" hydrogen produced by electrolysis, with the necessary political support for the industry development, can reduce global greenhouse gas emissions by up to 34% by 2050. Meanwhile, the rapid decline in prices should contribute to the fact that hydrogen will provide 24% of the world's energy needs by 2050[77].



Photo by shutterstock.com/Scharfsinn

75. IEA (2022). Global Hydrogen Review 2022.
76. Resolution of the Government of the Russian Federation dated October 12, 2020 No. 2634-r "On approval of the action plan "Development of hydrogen energy in the Russian Federation up to 2024"".
77. Bloomberg NEF (2020). Hydrogen Economy Outlook.

REGULATORY FRAMEWORK FOR THE HYDROGEN ENERGY DEVELOPMENT IN RUSSIA

In Russia, the task of developing hydrogen energy is enshrined in the key sectoral strategic planning document "Energy Strategy of the Russian Federation for the period up to 2035", approved in June 2020[78]. According to the Energy Strategy, hydrogen, used today mainly in the chemical and petrochemical industries, has the potential to become a new universal energy carrier and form a "hydrogen economy".

The second important document that stimulates the development of hydrogen energy in Russia is the "Strategy for the socio-economic development of the Russian Federation with low greenhouse gas emissions up to 2050"[79]. To implement the target scenario of the Strategy, it is envisaged to create complexes for low-carbon hydrogen production, create an export sector for entering the international market, and increase the share of hydrogen in exported products.

To develop hydrogen energy in accordance with these two documents, at the end of 2021, the largest Russian companies formed a working group with the active participation of RREDA for creating a comprehensive national program for development of the low-carbon hydrogen energy sector of the Russian Federation. Subsequently, the Comprehensive program for development of the low-carbon hydrogen energy sector in the Russian Federation up to 2035, created under the coordination of the Russian Energy Agency of the Ministry of Energy with the participation of representatives of the Ministry of Energy, the Ministry of Industry and Trade, the Ministry of Economic Development of Russia, as well as experts from the largest Russian companies, formed the basis of the roadmap for development of the high-tech direction "Development of Hydrogen Energy" up to 2030.

In July 2022, following a meeting of the Council for Strategic Development and National Projects, Russian President Vladimir Putin instructed to work on the development of hydrogen energy. In pursuance of this instruction, the roadmap was approved by the decision of the interdepartmental working group on the hydrogen energy development in the Russian Federation. Agreements on its implementation were signed on January 16, 2023 between the Government of Russia, Gazprom PJSC and State Corporation Rosatom[80]. The new document also includes measures of the roadmap approved in 2020 by the Russian Government for the hydrogen energy development in the country up to 2024 and hydrogen energy roadmaps of Gazprom PJSC and Rosatom. At the same time, the Government invalidated the action plan "Development of Hydrogen Energy up to 2024" adopted in October 2020. See the chronology of changes in the legislation on **Fig. 37**.

The approved roadmap determines the necessary increase in the level of technology readiness, the number of results of intellectual activity and startups, and also clarifies the action plan for the development of hydrogen energy. The roadmap provides data on the amount of funding for activities in the period 2020–2030. The total amount of funds planned for the industry is about 60 bln RUB, of which more than 18 bln RUB will be allocated from the budget. One of the key targets of the roadmap is the planned low-carbon hydrogen production — by 2030, Russia plans to produce about 550 thousand tons of low-carbon hydrogen per year.

Fig. 37. Strategic documents stimulating development of the hydrogen economy in Russia



Source: RREDA



Photo by shutterstock.com/petrmalinak

78. Resolution of the Government of the Russian Federation dated June 9, 2020 No. 1523-r "On approval of the Energy Strategy of the Russian Federation for the period up to 2035".
79. Resolution of the Government of the Russian Federation dated October 29, 2021 No. 3052-r "On approval of the strategy for the socio-economic development of the Russian Federation with low greenhouse gas emissions up to 2050".
80. Resolution of the Government of the Russian Federation dated January 16, 2023 No. 40-r "On the signing of agreements of intent between the Government of the Russian Federation and interested organizations in order to develop the high-tech direction "Development of Hydrogen Energy"".

PROSPECTS FOR THE HYDROGEN ENERGY DEVELOPMENT IN THE WORLD AND RUSSIA



Photo by shutterstock.com/petrmalinak

To achieve the goals of a circular low-carbon economy, a package of high-readiness hydrogen technologies has already been formed in the world, which are undergoing stages of commercialization and scaling and, accordingly, further reduction in their cost. Technologies for hydrogen production and use in the transport and energy sectors are actively developing. However, technologies for storing and transporting large volumes of hydrogen are at an insufficient level of readiness and have relatively low economic efficiency, which is currently a barrier to creating a large-scale global hydrogen market. The formation of a sustainable hydrogen demand is also currently limited, since its use requires the widespread introduction of new technologies and the adaptation of industrial processes, such as, for example, the direct iron reduction in metallurgy.

Russia faces the task of creating a new hydrogen industry on the basis of the existing technological reserve and resource base. It is worth noting the significant prospects for the Russian Federation to produce and export hydrogen to the global market: availability of the existing resource base and potential for the renewable energy development, unused low-carbon generating capacities, geographical proximity to potential hydrogen consumers, scientific expertise in hydrogen production, transportation and storage. All this contributes to the development of the hydrogen industry in the country. With the changing global geopolitical situation and sanctions pressure on Russia, the priority areas for development of the hydrogen energy industry were updated towards the formation of in-house technological competencies for the purpose of their subsequent export to friendly countries and meeting the needs of the domestic market.

There are a number of barriers hindering the development of hydrogen energy, some of which are inherent in the global status of technological development in this industry, and others relate exclusively to Russian practice. At the current level of technology development, the cost of low-carbon hydrogen is still high, as a result of which its competitiveness in comparison with traditional energy carriers is low. The lack of infrastructure for storing and transporting hydrogen — a critical element for connecting supply and demand — is a major constraint. Restrictions on international cooperation in the production and scientific spheres associated with sanctions also have a negative impact on the pace of development of the direction.

STATUS OF HYDROGEN ENERGY DEVELOPMENT IN RUSSIA. ONGOING AND PLANNED PILOT PROJECTS

Several dozen companies are engaged in the development of hydrogen technologies in Russia, including Gazprom, Rosatom, RUSNANO, NOVATEK, InEnergy, EN+, Severstal, etc. They are working on the creation of technologies for production, storage and transportation of hydrogen, CO_2 utilization, as well as the use of hydrogen in various fields of industry, energy and transport.

The most complete picture of promising hydrogen projects can be seen in the Atlas of Russian projects for production of low-carbon and carbon-free hydrogen and ammonia prepared by the Ministry of Industry and Trade of the Russian Federation[81]. This atlas contains 33 pilot projects in 18 regions of Russia (including 25 projects for "green" hydrogen production), the implementation of which will contribute to the creation of a full-fledged hydrogen industry in Russia.

Among the significant projects being implemented, it is worth noting the creation of a hydrogen cluster on Sakhalin, within the framework of which it is planned to organize the production, export and development of domestic hydrogen consumption. The region has sufficient resources for hydrogen production — both raw materials (natural gas) and energy (developed and prospective generation, including through the use of renewable sources). It is planned to build a plant for hydrogen production from natural gas by steam conversion of methane, a pilot project on the use of hydrogen in railway transport is being implemented, and there are plans to create a railway line that will be used only by hydrogen trains. The authorities of the region also consider the production of "green" hydrogen as a promising direction and intend to establish its production in the amount of up to 100 thousand tons per year by 2030. Construction of the plant is planned to begin in 2023, commissioning is expected in 2025[82]. Rosatom sees Sakhalin as a key site for large-scale hydrogen production.

Already this year, the construction of the "Snezhinka" Arctic Station can begin — a year-round and fully autonomous complex created on the basis of renewable and hydrogen energy[83]. The purpose of the project is to test and demonstrate nature-saving life support technologies, as well as smart home / settlement systems, robotics, telecommunications, medicine, biotechnology, new materials, artificial intelligence solutions. The site of the "Snezhinka" Station is located in the Priuralsky district of the Yamal-Nenets Autonomous District, 70 km from Salekhard. At the beginning of 2023, the Main Department of State Expertise of Russia issued a positive opinion on the project to create an Arctic station, the developer of the facility is the non-profit organization Regional Innovation and Investment Fund Yamal, the general designer is the Autonomous Energy Engineering Center LLC.

Two major projects have been announced in the Murmansk region: a pilot project for production of low-carbon hydrogen (Rosatom) at the Kola NPP, as well as the first Russian project for production of "green" hydrogen based on the Kola WPP with a capacity of 201 MW with a projected hydrogen production of 12 thousand tons per year. It is worth noting the successes achieved — in December 2022, the first hydrogen was produced at a domestic electrolyzer at the Kola NPP[84]. In the Arkhangelsk region and in Kamchatka, the possibilities of producing "green" hydrogen using electricity from tidal power plants at the Mezenskaya and Penzhinskaya TPP, respectively, are being explored.

Russia is also working on projects aimed at the use of hydrogen in transport. In 2021, KamAZ and GAZ presented samples of hydrogen buses, i.e. buses that use hydrogen fuel for movement. Production of such vehicles is scheduled for 2023[85].

81. Ministry of Industry and Trade (2021). Atlas of Russian projects for production of low-carbon and carbon-free hydrogen and ammonia.
82. Strana Rosatom (2023). The first Sakhalin element: Rosatom has signed five agreements on hydrogen energy at the WEF.
83. "Snezhinka" International Arctic Station (2023). The official website of the project.
84. Rosatom (2022). The first hydrogen was produced at the Kola NPP using a new domestic electrolyzer.
85. Avtostat (2021). Production of hydrogen buses in Russia will begin in 2023.

COUNTRIES WITH THE LARGEST EXPECTED VOLUMES OF “GREEN” HYDROGEN PRODUCTION BY 2030

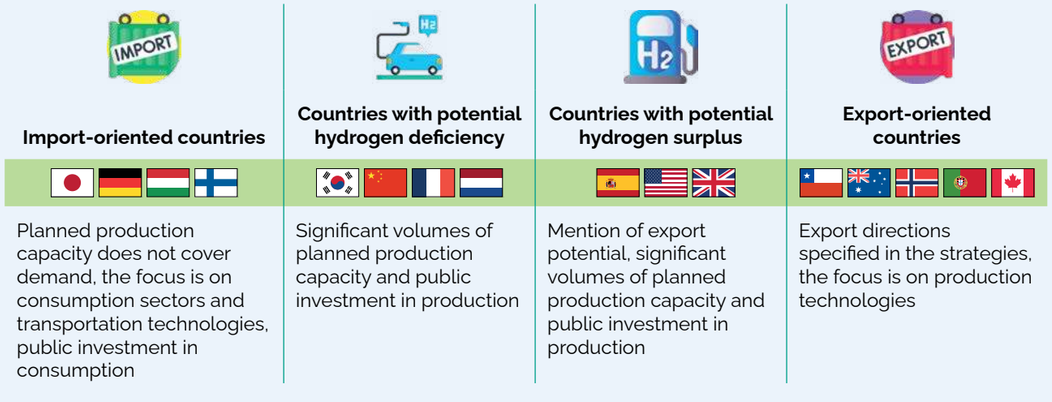


Photo by freepik.com/@rawpixel.com

More than 25 countries around the world have already developed strategies or roadmaps for the hydrogen use. Within the framework of the energy transition, the strategic prospects of hydrogen for almost all countries are associated primarily with low-carbon hydrogen energy, since it can potentially make a great contribution to reducing greenhouse gas emissions. Countries are also relying on hydrogen in connection with the diversification of fuel and energy balances and the reduction of dependence on large energy suppliers. Hydrogen strategies of countries can be divided into four groups: import-oriented countries; export-oriented countries; countries with potential hydrogen deficiency; countries with potential hydrogen surplus **(Fig. 38)**.

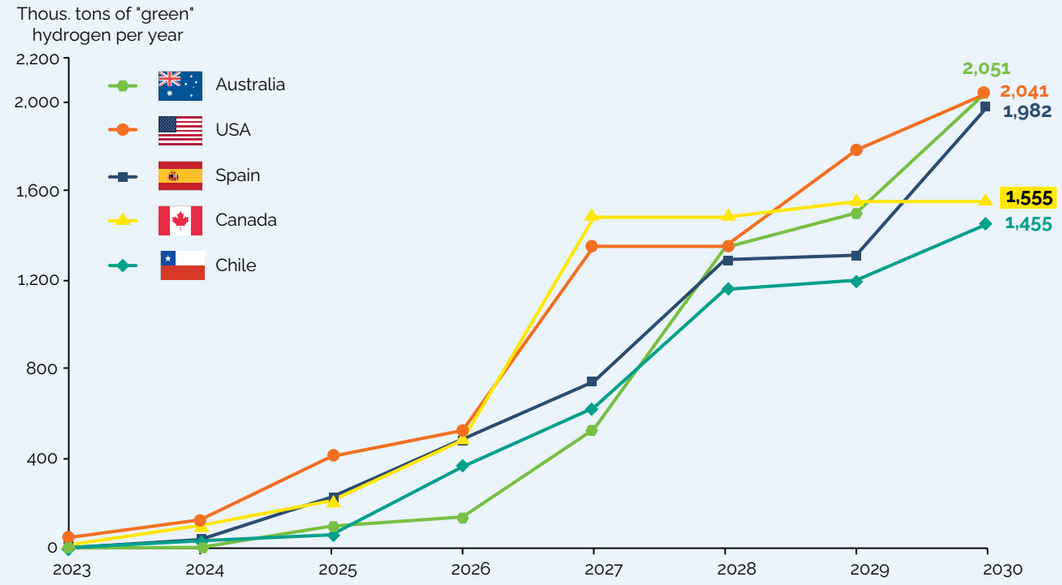
1. In import-oriented countries, planned production capacity does not cover demand, the focus is on consumption sectors and transportation technologies, as well as active public investment in consumption. Such states, in particular, include Japan, Germany, Finland and Hungary.

Fig. 38. Groups of countries by their role in the global hydrogen market



Source: RREDA

Fig. 39. Planned annual production of “green” hydrogen by countries, thous. tons/year



Source: Hydrogen Insight

2. In export-oriented countries, the strategies indicate export directions, and the main focus is on production technologies. These include the Republic of Chile, Australia, Norway, Portugal and Canada.
3. Strategies in countries with potential hydrogen deficiency, such as South Korea, China, France and the Netherlands, mention substantial planned production capacity and government financing of production.
4. Countries with potential hydrogen surplus, such as Spain, the United States and the United Kingdom, mention in their strategies the potential for exports, significant volumes of planned production capacity and public investment in production.

Since one of the key goals of integrating hydrogen into the fuel structure is to reduce greenhouse gas emissions, countries intend to develop green hydrogen technologies as a clean energy source in the long term. According to the EU Regulations[86], “green” hydrogen can be defined as hydrogen derived from electricity from RES or biomass. **Fig. 39** shows the top ten countries with the largest plans for “green” hydrogen production by 2030. According to Hydrogen Insight, Australia, the United States and Spain will take the lead thanks to subsidies and mega-projects[87].

Australia is leading the way thanks to the Australia Renewable Energy Hub project, which could start in 2030. Ten major projects are planned in Spain, including the “green” hydrogen production complexes Fertiberia and Iberdrola’s Puertollano[88]. The latter was commissioned last year and is expected to produce 200 thousand tons of “green” hydrogen annually. In the United States, more than 10 projects for “green” hydrogen production will be implemented by 2030[89], which can provide the country with a leading position in the production of this energy source.

86. EU Directive (2023). Commission delegated regulation.
87. Hydrogen Insight (2023). Which ten countries will be the biggest producers of green hydrogen in 2030?
88. S&P Global (2021). Iberdrola gets approval for Puertollano hydrogen project PV plant.
89. Clean Energy Group (2023). Hydrogen Projects in the US.



Berestovskaya WPP

CONCLUSION

The pace at which the Russian renewable energy industry has adapted to the new conditions of work under the sanctions regime inspires confidence that, despite its youth, the new industry has a stable foundation and can confidently withstand the most serious threats.

Investors managed to resolve a large number of complex problems over the past year, thanks to which the industrial potential of the national renewable energy industry is expected to expand significantly within the next year. The construction of a new plant of EnKOR Group LLC in the Kaliningrad region is being completed with the planned production of 1.3 GW of silicon wafers and more than 1 GW of photovoltaic cells for solar modules. The capacity for the photovoltaic modules' manufacturing will also increase to more than 1 GW per year due to the expansion of production at the Hevel LLC plant and the construction of a new plant by Solar Systems LLC. In the wind generation sector, Rosatom announced its intention to launch the production of blades for the wind turbines based on the manufacturing facilities of Vestas, a company that has withdrawn from the Russian market, in Ulyanovsk. The release of the first batch of domestic blades is expected by December 2024. The Ministry of Industry and Trade of Russia is actively working towards further extending the local content in production of multimegawatt-class wind turbines and creating a production base in Russia to ensure technological sovereignty. In the second half of 2023, a competition will be organized for conclusion of a special investment contract, in which several technology companies have already shown interest.

The implementation of renewable energy generation projects to meet the needs of industrial and commercial facilities is actively developing, due to which, according to various estimates, until 2035, about 2 GW will be commissioned above the capacity planned within the wholesale electricity market renewable energy support program. There is still a lot of work to be done for increasing the efficiency of the renewable energy support mechanism on the retail electricity markets: its harmonization with the approaches implemented within the framework of the wholesale market support program (CSA RES), and wide dissemination of the practice of organizing competitive selection of renewable energy generation investment projects at the regional level. The so far undervalued segment of the retail market has significant potential and, with proper support, will provide an additional 3 GW within the next 10 years. In total, the cumulative capacity of the entire RES generation in Russia may increase by more than 12 GW by 2035.

The fact that the Russian renewable energy industry coped with the unprecedented challenges met in 2022 is confirmed by the extremely successful results of the competitive selection held in April 2023 after a long pause. Contrary to all the negative forecasts of the energy transition skeptics and, in particular, of the renewable energy development, who called for postponing the selection for at least another year under the pretext of the investment community's unwillingness to new projects, the competition on the tender was high. The prices in the bids fall by 25-30% in the solar and wind segments, thanks to that 1,825 MW were selected, which is 300 MW higher than planned according to the support program. The only segment where no bids were received at all was small hydro power plants, which again signals that conceptual changes are required in the support mechanism. Current parameters do not create incentives and are not able to provide the necessary conditions for the integrated development of small hydro power. It is extremely important to make every effort to remove all restrictions and risks based on the lessons learned from the implementation of the CSA RES program.

Despite the fact that the number of initiatives in the low-carbon hydrogen energy sector has clearly decreased over the past 12 months due to the target market loss associated with sanctions pressure, the development continues. The result of the systematic work of the market players towards the formation of a comprehensive program for development of low-carbon hydrogen energy was the approval of a special roadmap. Particular emphasis in the document is placed on measures to ensure technological development and implementation of pilot projects, which, among other things, will bring the annual production of low-carbon hydrogen in Russia to 550 thousand tons.

Active development is observed in electrification of the transport sector. Sales of electric vehicles have increased by 100% over the past two years, and the introduction of electric vehicles into urban infrastructure continues. If all the announced plans are fulfilled by 2030, Russian production of electric cars and electric buses will generate demand for heavy-duty batteries in the amount of more than 13 GWh per year. These are quite serious figures for attracting additional investment resources to this segment in order to form an integrated technological base, including export-oriented base in the future. The development of electric transportation should go hand in hand with renewable energy. After all, by 2030, transport electrification will lead to the formation of additional demand for electricity in the amount of 2.5-4 billion kWh. The target concept of a circular low-carbon economy should follow the rule that every new kilowatt-hour of electric transport consumption should be matched by additional carbon-free generation, primarily based on renewable energy sources.

For 2023–2024 a comprehensive work is planned for finalizing the most important strategic documents of the Russian Federation, which form the basis for making significant investment decisions in the future up to 2050. These are the Energy Strategy and the Comprehensive Action Plan for implementation of the Strategy for Socio-Economic Development of Russia with Low Greenhouse Gas Emissions. When determining goals and objectives for such a long-term perspective, it is especially important to be based on reliable information about current technological, market and regulatory trends. Given the speed with which the entire world is making the energy transition and the prospects for the transformation of the global energy market, the renewable and hydrogen energy sectors should play a special role in these documents. Initiatives to reduce the carbon intensity of the national economy should be harmonized and complementary and definitely not lead to disparate effects.

LIST OF ABBREVIATIONS



Arshanskaya SPP

AHPP	Autonomous hybrid power plant
APCS	Automated process control system
BGS	Biogas station
BioPP	Biofuel power plant
CCS	Carbon Capture and Storage
CF	Capacity factor
CHPP	Combined heat and power plant
CSA RES	Capacity Supply Agreements for Renewable Energy Sources
CSA SMW	Capacity Supply Agreements for Solid Municipal Waste
EU	European Union
EV	Electric vehicle
FAS	Federal Anti-Monopoly Service
FSC	Financial Settling Center
FZ	Federal Law
GeoPP	Geothermal power plant
GW	Gigawatt
GWh	Gigawatt-hour
HPP	Hydro power plant
IEA	International Energy Agency
IES	Integrated energy system
kW	Kilowatt
kWh	Kilowatt-hour
MW	Megawatt
MWh	Megawatt-hour
NPP	Nuclear power plant
PDPS of a region of the Russian Federation	Regional prospective development program and scheme
PDPS of EPS	Prospective development program and scheme of electric power systems
PERC	Passivated emitter and rear cell
PSPP	Pumped storage power plant
REM	Retail electricity market
RES	Renewable energy sources
RESPS	Competitive RES projects' selection
RREDA	Russia Renewable Energy Development Association
sCHPP	Small-scale combined heat and power plant
sHPP	Small hydro power plant (up to 50 MW)
SMW	Solid municipal waste
SO UPS	System operator of the Unified Power System
SPP	Solar power plant
TGO	Territorial grid organization
TITES	Technologically isolated territorial energy systems
TopCon	Tunnel oxide passivated contact
TPP	Tidal power plant
TSA	Trading System Administrator of wholesale electricity and capacity market
UES	Unified Energy System of Russia
WECM	Wholesale electricity and capacity market
WPP	Wind power plant

ABOUT ASSOCIATION

RRREDA
RUSSIA RENEWABLE ENERGY DEVELOPMENT ASSOCIATION

Russia Renewable Energy Development Association (RREDA) is leading expert platform in Russia in the field of renewable energy, representing the interests of the largest and most active players in the Russian renewable energy and low-carbon hydrogen sector, a growing high-tech market with over 600 bln RUB already invested.

The Association unites generating companies, investors and developers of renewable energy generation projects, manufacturers and suppliers of equipment, technology companies, research and financial institutions in order to create a favorable investment climate, transparent legal regulation and promote energy transition technologies to achieve the goals of low-carbon development of Russia.

Areas of activity:

ANALYTICS AND EXPERTISE
Comprehensive analysis of trends in the development of renewable and hydrogen energy in Russia and abroad. Development and regular release of analytical materials and industry statistics (market reviews, investment ratings, forecasts, registers, etc.).

INTERACTION WITH GOVERNMENT BODIES
Developing policy initiatives to facilitate the rapid and harmonious growth of the renewable and hydrogen energy industries, contributing to the drafting of legislation and regulations, and advising government agencies in strategic decision-making. Participating in key industry working groups under federal and regional government executive and legislative bodies, infrastructure organizations, and international organizations to help shape a stable regulatory framework and institutional environment.

PUBLIC RELATIONS
Popularization of energy transition in the public domain. Boosting market players' competitive position in the media arena and cultivating a positive image of the industry. Organizing and hosting industry events, providing informational support for Association members' activities and representing their interests to the media.

INTERNATIONAL COOPERATION
Facilitating engagement and exchange of expertise with foreign industry groups, associations and international organizations, assisting in the promotion of Russian technologies and capabilities in foreign markets, and supporting the international projects of Association member companies.

EDUCATION AND SCIENCE
Support in the development of a professional training system, including support for educational institutions to create specialized advanced training programs, assisting in the development of government sectoral programs to stimulate research and development in the field of renewable and hydrogen energy.

Our mission

Promoting an efficient and harmonious energy transition through comprehensive support for the development of renewable and low-carbon hydrogen energy

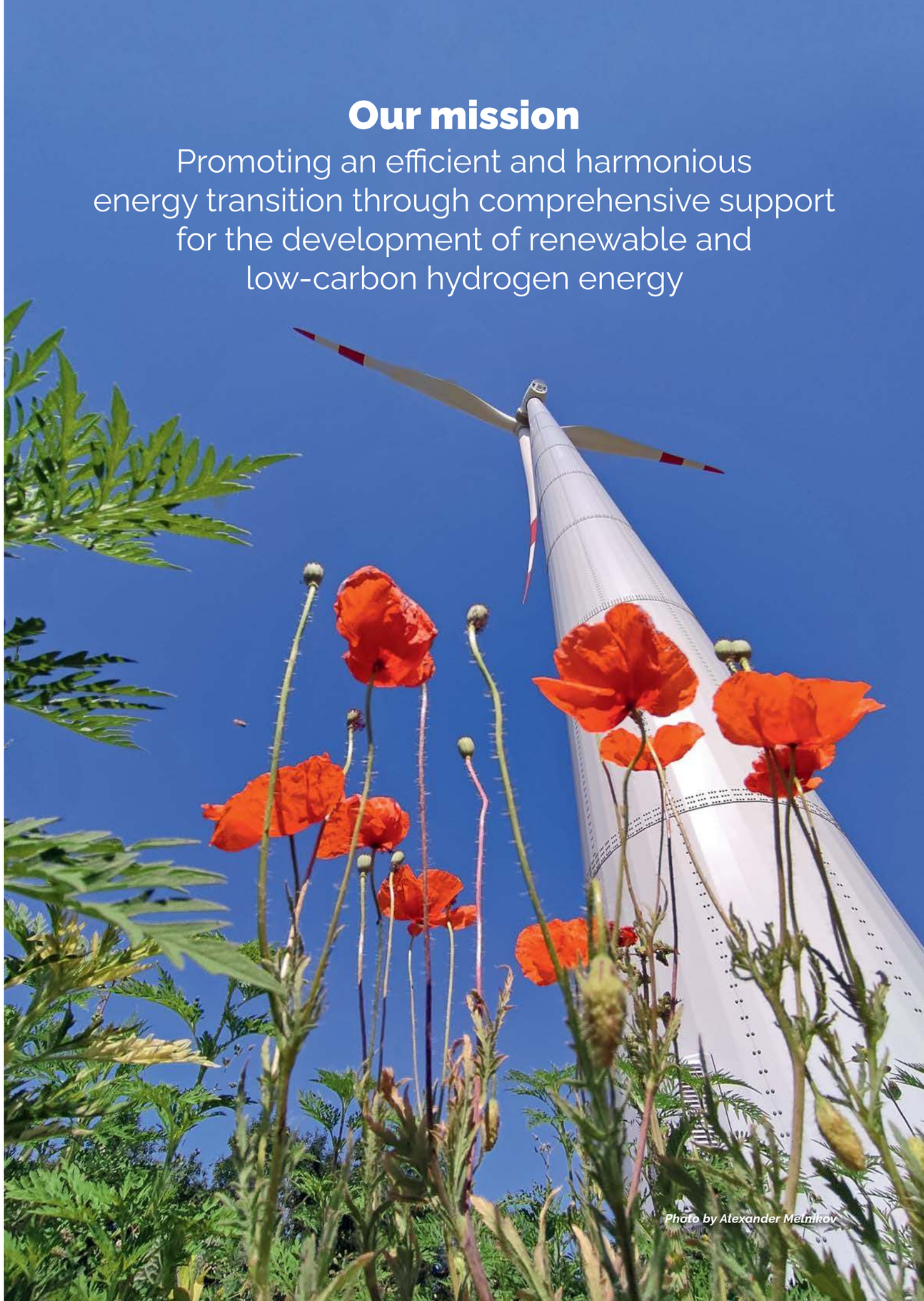


Photo by Alexander Melnikov

RRE D A

RUSSIA RENEWABLE ENERGY
DEVELOPMENT ASSOCIATION

Russia Renewable Energy Development Association

Russia, Moscow, 123610, Krasnopresnenskaya emb., 12,
entrance 6, office 1002

tel.: +7 495 115 1034

e-mail: info@rreda.org
web site: https://rreda.ru/