RREDA

RUSSIA RENEWABLE ENERGY DEVELOPMENT ASSOCIATION

RUSSIAN RENEWABLE ENERGY MARKET

CURRENT STATUS AND DEVELOPMENT PROSPECTS

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INFORMATION BULLETIN



VOLODAROVKA SPP,
ASTRAKHAN REGION

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Introduction

The global renewable energy sector demonstrated record growth rates in 2024; the volume of new construction increased by 24%, 670 GW of solar and wind power plants being commissioned (according to the IEA). Renewable energy generation already accounts for 93% of the total volume of new generation commissioned worldwide.

Given the current dynamics, the goals for tripling the global installed capacity of renewable generation by 2030, set at the United Nations Climate Change Conference (COP28), held in 2023, appear achievable. Moreover, it takes place primarily not due to the support measures applied, determined by climate policy, but rather by economic prerequisites, which in most countries, renewable energy has become the cheapest solution for energy supply.

The large-scale electrification of transport is another important signal for accelerating the transition to energy and the opening of new prospects for the increase of the renewable energy share in the energy systems of countries worldwide.

Achieved through rapidly growing demand generated by the transport sector, the scale effect has opened up new prospects for the widespread use of BESS in the electric power industry, which becomes effective for solving a wide range of problems: reservation, balancing of renewable energy generation, peak load compensation, and ancillary services.

For a significant number of countries, the RES generation development was initially determined by the necessity to ensure rapidly growing energy consumption generation, namely, compensating for projected electricity shortages, while the use of BESS in the energy sector became more of a reaction to the rapidly growing share of weather-dependent generation.

Given that Russia's energy system joined the energy transition trend significantly later than global leaders in low-carbon development, it now has the opportunity to quickly «monetize» this lag. Solutions based on the use of energy transition technologies have become cheaper than any other, which has become a factor in the choice of solar and wind energy as a means of compensating for local electricity shortages in the Russian energy system.

The Integrated Energy System (IES) of East will be the first step. Construction of at least 1,700 MW of wind and solar power plants in this area will compensate for an electricity shortage at a cost that is at least twice cheaper than building thermal power plants. As a result of the additional investment projects selection, which was held in July 2025, 1044 MW of SPP and 520 MW of WPP were selected. It has become a landmark for the industry, as it opens up new prospects for scaling RES generation in our country beyond the scope of previously approved support programs.

The trend of accelerated growth in demand for electricity will increase the risk of unpredictable electrical energy and capacity shortages within conventional planning horizons. To manage these risks, system operators have three key tools, characterized by a comparable speed of achieving results: RES generation, BESS, and demand response programs. Consumers' involvement in the process of energy system's operating mode managing has become a common practice for the Russian electric power industry, but he energy supply system for the Unified Energy System of Russia (hereinafter referred to as UES), until 2025, remained a solution for the distant future. However, taking into account a sharper increase in the cost of thermal generation projects in the first half of 2025, regulators have initiated consideration of the possibility of large BESS using in the Southern IES with a total capacity of 350 MW to compensate for the risks of a peak hours power shortage.

The rapid implementation of such projects and their low- cost relative to the alternatives being considered for building gas generation ensures their high competitiveness, especially during periods of high interest rates.

The speed of adjustment of a paradigm of long-term energy system development planning increases every year. The significant developments in the Russian electric power sector described above happened just within less than two years.

For the first time, RES generation became cheaper than thermal energy according to a competitive selection of new generation construction projects that took place in 2023. Just a year later, the regulator made key decisions on submitting relevant initiatives

to the Government Commission on electric power development to cover the deficit in the IES of East by the renewable energy generation. After two years, a selection of new projects was carried out, and after three years, which means next year, the first 600 MW will be commissioned.

The speed of transformation in the industry will only increase; this quality is becoming a key competitive advantage for modern energy and the economy in general.

As of the end of the first half of 2025, the share of installed renewable energy generation capacity in the Russian energy system is 2.61%, while its share in the total volume of electricity consumption in Russia for 2024 was 1.19%.

As of July 1, 2025, the total installed capacity of RES generation facilities in Russia amounted to 6.64 GW.

Wind and solar power plants are the leaders in the structure of RES installed capacity (they account for 2.57 and 2.55 GW of capacity, respectively), and small hydro power plants with a capacity of up to 50 MW (1.31 GW).

Power plants operating on biomass, biogas, landfill gas, municipal solid waste, and geothermal energy are also in operation, with a total capacity of over 200 MW.

In 2024, 445 MW of new renewable energy capacity was commissioned, 360 MW of which was solar power, 35 MW was wind power, and 50 MW was small hydropower.

In the first half of 2025, within the framework of the CSA program, another 33 MW of small hydro power plants and 70 MW of renewable municipal waste plants were commissioned.

In 2024 and in the first half of 2025, selections of renewable energy projects were held. Based on the results of the RESPS 2024, projects for a 349 MW wind power plant and a 48 MW solar power plant were selected; based on the results of the RESPS 2025, projects for a 250 MW wind power plant, a 64.5 MW solar power plant, and a 5 MW small hydro power plant were selected.

As a result of the additional selection, organized specifically to compensate for the electric energy shortage in the IES of East in July 2025, 1044 MW of solar power plants and 520 MW of wind power plants were selected.



ADYGEISKAYA WPP,
REPUBLIC OF ADYGEA

1

STATUS AND PROSPECTS OF RENEWABLE ENERGY DEVELOPMENT IN RUSSIA



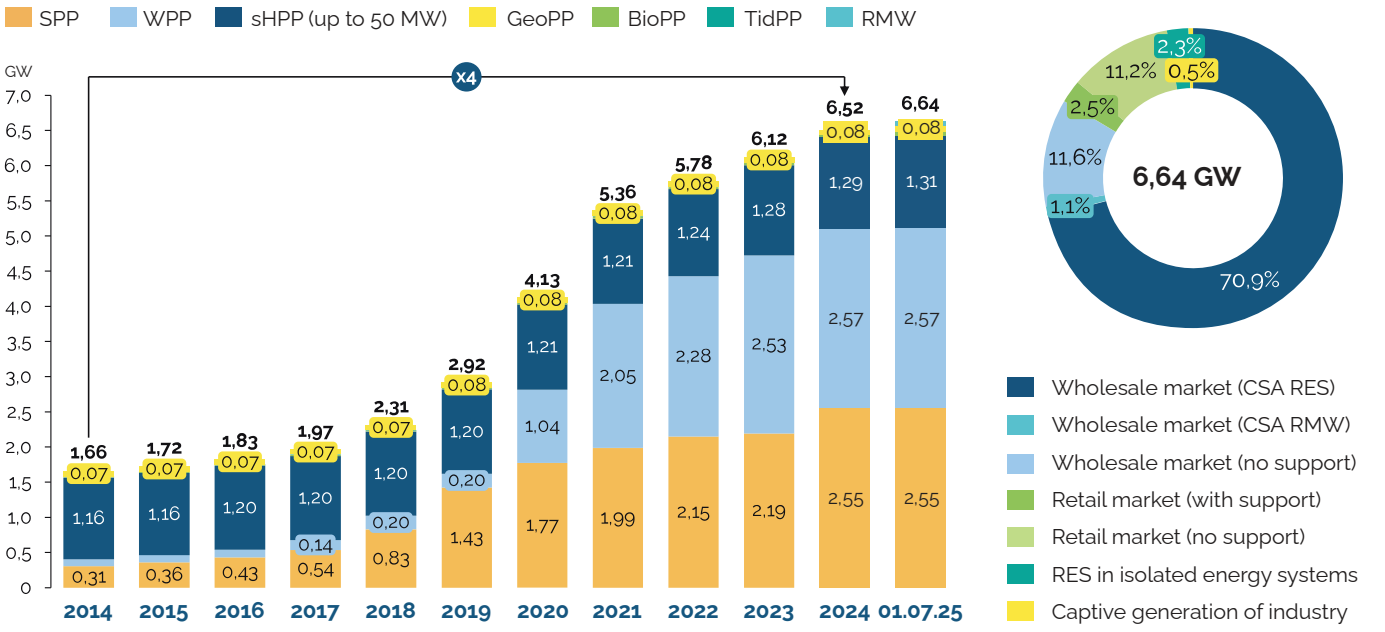
According to Article 3 of Federal Law No. 35-FZ dated March 26, 2003, «On Electric Power Industry[1]», renewable energy sources (hereinafter referred to as RES) include solar, wind, water, geothermal energy, low-grade thermal energy, biomass, biogas, landfill gas, etc. At the same time, hydro power plants with an installed capacity of over 50 MW are not included in the list of technologies for which support measures are provided. The main government policies in the sphere of improvement of the energy efficiency in the electric power industry through the use of renewable energy sources for the period up to 2035, approved by Resolution of the Government of the Russian Federation No. 1-r[2] dated January 8, 2009, the parameters of economic incentives for hydro power plants with an installed capacity of more than 50 MW have not been determined.

In accordance with above documents, RREDA takes into account solar power plants (hereinafter SPP), wind power plants (hereinafter WPP), small hydro power plants up to 50 MW (hereinafter sHPP), biofuel power plants based on biomass, biogas, landfill gas (hereinafter BioPP), geothermal power plants (hereinafter GeoPP), tidal power plants (hereinafter TidPP), to determine the indicators of the RES generation facilities installed capacity and their share in the structure of electricity generation in Russia.

As of July 2025, the total installed capacity of renewable energy facilities in Russia is 6,638 MW[3] (Fig. 1). In 2024 and the first half of 2025, the installed capacity of renewable energy power plants in the wholesale and retail markets of Russia increased by 575.2 MW, including the following reasons:

- commissioning of new power-generating equipment in the amount of 445.4 MW in 2024 and 103.7 MW from January to June 2025;
- from January 1, 2025, the Lyubertsy mini-TPP (commissioned in 2014) and the Kuryanovo mini-TPP (commissioned in 2009), with a total installed capacity of 26.1 MW, located in Moscow, began to be considered as facilities operating on biogas fuel;
- decommissioning of generating equipment — 16.5 MW;

Fig. 1. | Total installed capacity of renewable energy facilities in Russia, GW

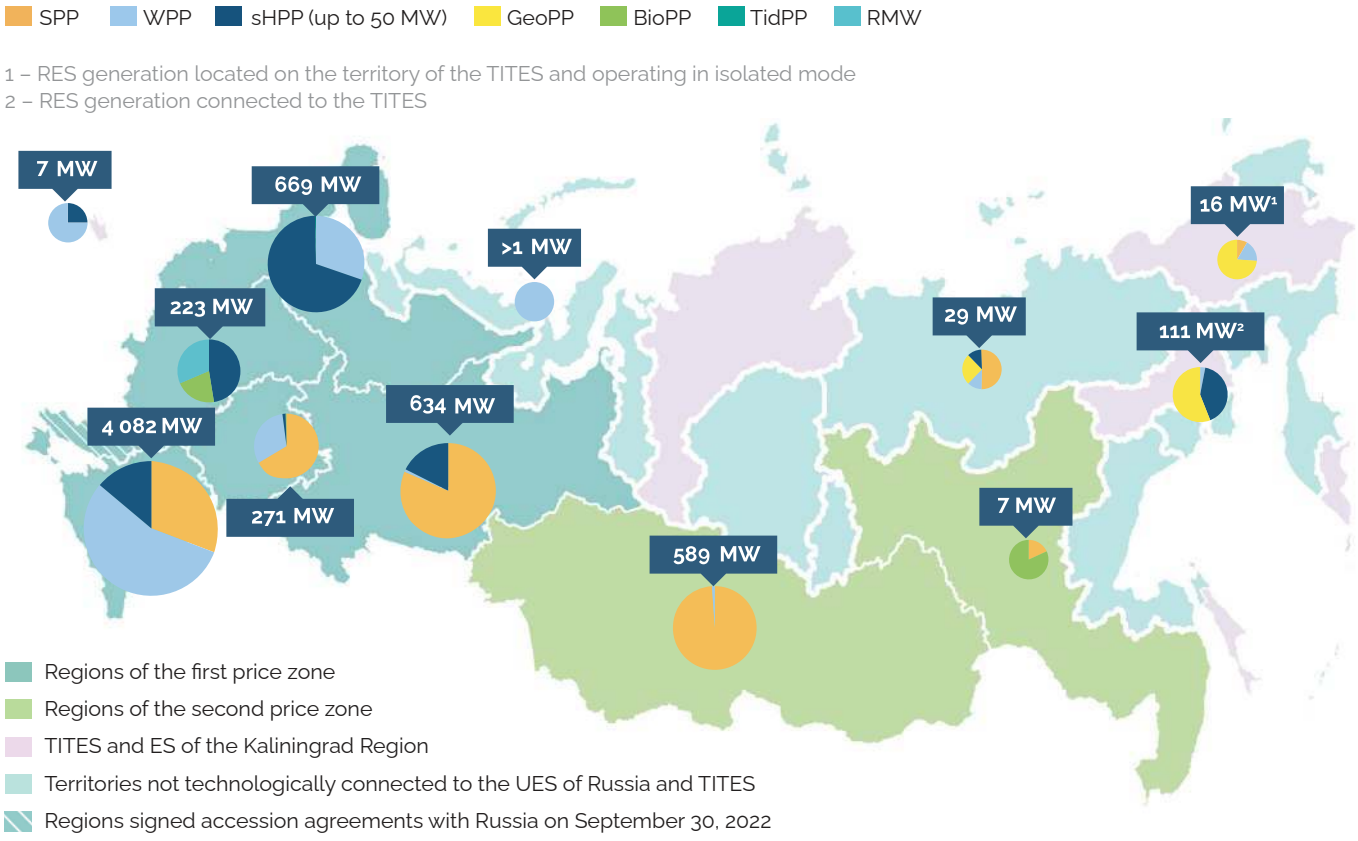


* Considering the results of operation and replacement at RES generation facilities, the equipment has exhausted its service life.
** Excluding new territories.

Source: RREDA, SO UPS JSC, NP Market Council, Association «Hydropower of Russia».

1. Federal Law No. 35-FZ of March 26, 2003 «On Electric Power Industry».
2. Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009 «On the main government policies in the sphere of improvement of the energy efficiency in the electric power industry through the use of renewable energy sources for the period up to 2035».
3. All figures below exclude data for the Donetsk and Luhansk People's Republics and the Zaporizhian and Kherson Regions. According to the Russian Ministry of Energy, the total installed capacity of solar and wind power plants in these territories as of 2024 is 1.76 GW.

Fig. 2. | Map of the RES generation distribution by price zones of the WECM, TITES, Kaliningrad Region ES, as well as territories not technologically connected to the UES of Russia and TITES, MW



*For the first and second price zones, the distribution of RES - generation capacity across the integrated energy systems (hereinafter - IES) is given.
Source: RREDA.

- transition of the Ezminskaya SHPP to the category of large hydro power plants in connection with the reconstruction and increase in the capacity of the facility from 45 MW to 60 MW[4].

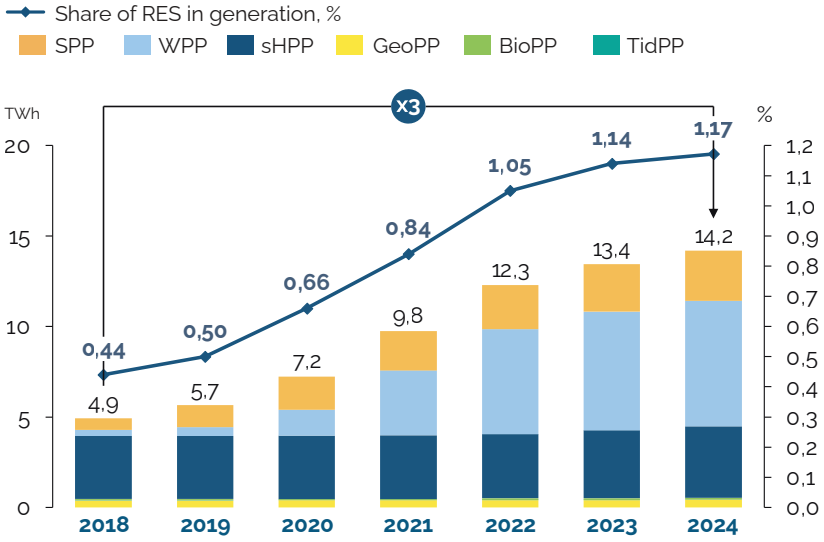
Wind and solar power plants (they account for 2.57 GW and 2.55 GW of capacity, respectively) and small hydro power plants with a capacity of up to 50 MW (1.31 GW) are the leaders in the structure of installed renewable energy capacity. In addition, power plants operating on the basis of biomass, biogas, landfill gas and geothermal energy with the total capacity of more than 200 MW are being used.

Thanks to the investment incentive mechanism (CSA RES[5]) launched in 2013 for the renewable energy development in the wholesale electricity and capacity market (hereinafter referred to as WECM), the total installed capacity of RES generation has almost quadrupled over the past decade, and thus by 2025 more than 70% of all green energy capacity is represented by objects of the wholesale market, created according to the support program.

In addition to the CSA RES program, the regulatory support package for the development of renewable energy generation in Russia includes the selection of investment projects in the retail electricity markets (hereinafter referred to as REM) to further prioritize the sale of renewable energy to compensate the losses of electric grid companies and a mechanism for «balancing» electricity generation by microgeneration facilities. 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.

4. From 01.03.2024, the facility is not included in statistics due to its transition to the category of large hydro power plants (more than 50 MW).
5. CSA RES – capacity supply agreements of renewable energy generation – a program to stimulate investments in RES generation facilities in the wholesale electricity and capacity market. Support is provided on a competitive basis to investment projects with the lowest specific capital investments (the cost of electricity production – for projects selected from 2021) through payments for capacity within 15 years.

Fig. 3 | Dynamics of electricity generation at all renewable energy facilities, TWh



Results of 2024:

14,2 TWh
Total electricity generation by all **RES generation facilities in Russia**

1,17%
RES share in the total electricity generation in the Russian Energy system

1,19%
RES share in total electricity consumption in Russia

Source: RREDA, SO UPS JSC, TSA JSC.

Fig. 4 | Key documents and projects of the federal strategic planning of the Russian Federation with regard to RES development

Resolution of the Government of the Russian Federation No. 3052-r dated 29.10.2021 «On Approval of the Strategy of socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050».

The target scenario for achieving carbon neutrality by 2060 provides for incentives for carbon-free and low-carbon technologies in the energy sector, including a significant increase in RES generation while ensuring the necessary level of equipment production localization in the Russian Federation.

Decree of the Government of the Russian Federation No. 603 dated 15.04.2023 «On approval of priorities for projects of technological sovereignty and projects of structural adaptation of the economy of the Russian Federation and Regulations on classification of projects as projects of technological sovereignty and projects of structural adaptation of the economy of the Russian Federation, on providing information about projects of technological sovereignty and projects of structural adaptation of the economy of the Russian Federation».

The priority areas included:
- construction of power plants for RES generation, including solar, wind, and geothermal;
- production of hydrogen energy equipment;
- production of electric vehicles;
- production of systems for accumulation and storage of electrical energy, including charging stations for electric vehicles, etc.

2021 **2022** **2023**

«Clean Energy» Federal Project

The objective is «to Implement a program to support the creation of a highly localized RES industry in the Russian Federation to achieve decarbonization goals in the fuel and energy sector and support innovative technological solutions in the field of electric power generation.» Target indicators for 2030:
- installed capacity of RES generating facilities exceeding 12 GW;
- renewable energy share of 2.1% of total electricity generation;
- increase in industrial production of RES equipment by 500 billion rubles;
- export deliveries of renewable energy equipment — 20 billion rubles, etc.

Decree of the President of the Russian Federation No. 81247 dated 26.10.2023 «On approval of the Climate doctrine of the Russian Federation»

Expanding the use of renewable and alternative energy sources with low greenhouse gas emissions has been identified as one of the areas for addressing the challenges of adaptation and mitigation of anthropogenic impact on climate.

Source: RREDA.

On January 1, 2025, came into force the Decree of the Russian Federation Government of December 23, 2024 No. 1868 On Amendments to Certain Acts of the Government of the Russian Federation on issues of establishing the specifics of the electric energy and capacity wholesale and retail markets functioning in certain territories of price zones that previously belonged to non-price zones of the wholesale market, according to which the non-price zones of the Komi Republic and Arkhangelsk Region became part of the 1st price zone of the wholesale electricity and capacity market (WECM), and the Far Eastern Federal District became part of the 2nd price zone of the WECM *(Fig. 2)*.

According to the results of the first half of 2025, the share of RES facilities located in the first and second price zones of the UES of Russia, relative to all RES generation facilities operating in Russia, remained at the level of 98% — 6,475 MW. Non-price zones and isolated power systems account for only 164 MW. Presently, the share of installed renewable generation capacity in the Russian energy system corresponds to 2.6% (1.8% — CSA RES). In 2024, the total electricity production by all renewable energy facilities in Russia amounted to 14.2 billion kWh, which corresponds to 1.17% of total electricity production and 1.19% of energy consumption *(Fig. 3)*.

The share of renewable energy generation in the structure of the Russian energy balance is still relatively small, however, considering the approved strategic planning documents, the renewable energy industry has the potential to grow more than threefold in the next 15 years, also due to development and increased efficiency of mechanisms for attracting investment in the fuel and energy complex of the Russian Federation *(Fig. 4)*.

2024

Federal Law No. 362-FZ of October 29, 2024 «On Amendments to Parts One and Two of the Tax Code of the Russian Federation and Certain Legislative Acts of the Russian Federation»

In terms of renewable energy, the adopted amendments to the Tax Code of the Russian Federation provide for an exemption from property tax from January 1, 2025, for organizations whose main activity is the production of electricity obtained from renewable energy sources. The tax exemption will apply to property included in solar power plants.

Ministry of Energy of Russia Order No. 2328 dated November 29, 2024 «On approval of the scheme and program for the development of electric power systems of Russia for 2025–2030»

According to the Master plan for energy systems development for 2025-2030, the total volume of generating equipment commissioning by 2030 will amount to 17.3 GW, of which 4.5 GW will come from renewable energy sources

In order to cover the deficit of electric power in the Eastern IES (equivalent to 519 MW of guaranteed generation), the IES provides for the possibility of constructing solar and wind power plants with a total installed capacity of approximately 1,700 MW on the territory of the Eastern IES.

2025

Russian Government Order No. 4153-r of December 30, 2024, «On the General Plan for the Placement of Electric Power Facilities until 2042»

The general plan for the placement of electric power facilities until 2042 provides for:

- 17.2 GW of new solar and wind generation, which corresponds to about 19% of the total projected volume of new generation inputs by 2042;
- 4.6 GW of new hydro power plant commissioning

In the structure of installed capacity, the share of solar and wind power plants is planned to increase from 1.9% in 2023 to 5.8% by 2036 and to 7.3% by 2042.

Russian Government Order No. 908-r of April 12, 2025 «On approval of the Energy Strategy of the Russian Federation until 2050»

In accordance with the accelerated energy transition scenario of the Energy Strategy of the Russian Federation until 2050, the consumption of primary energy from RES (excluding hydro power plants) will increase more than 6-fold by 2050, from 3.1 to 19 million tons of equivalent fuel.

In the Forecast Fuel and Energy Balance of the Russian Federation, which is an application to the Energy Strategy of the Russian Federation for the period up to 2050, renewable energy sources will account for 19 million tons of fuel equivalent by 2050 (in the target scenario), which is 6 times more than in the base year of 2023 (3.1 million tons of fuel equivalent).

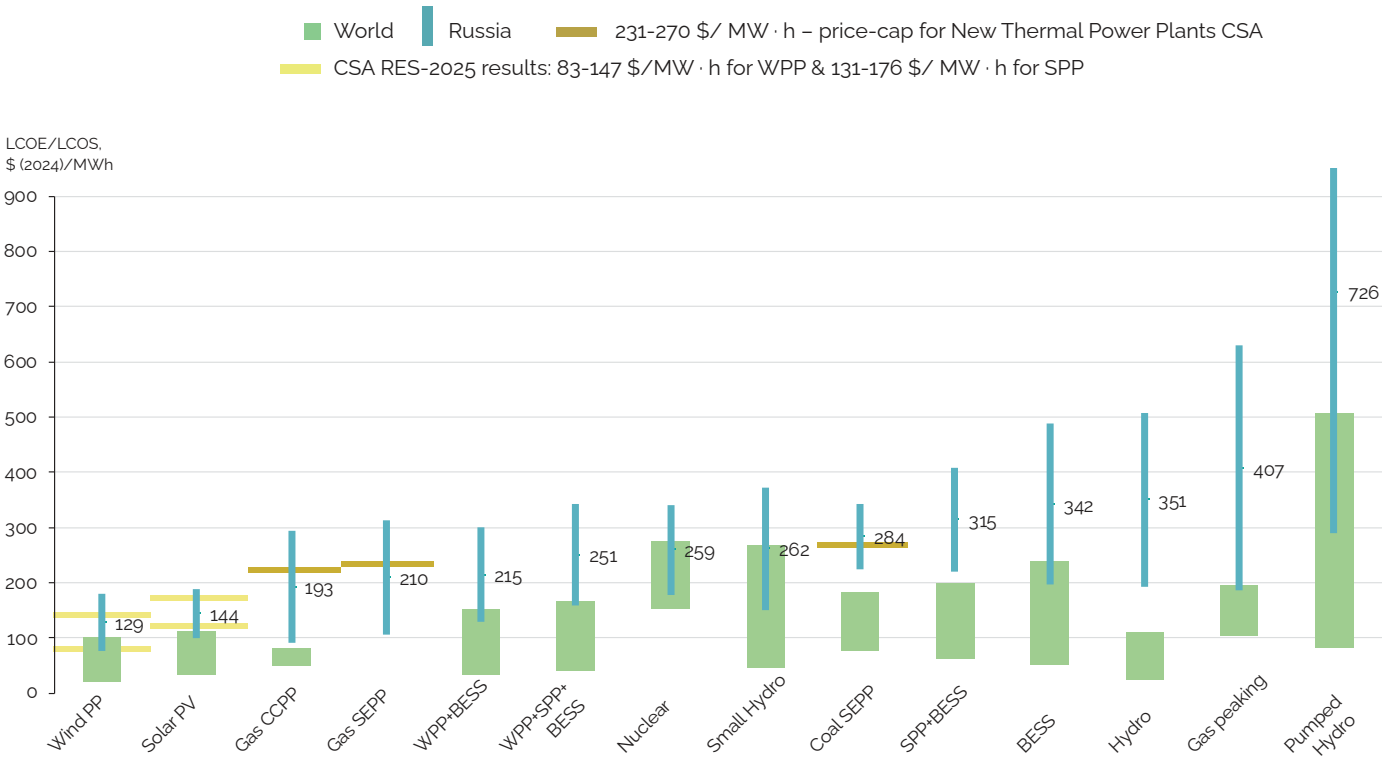
The adopted Energy Strategy of the Russian Federation for the period up to 2050 (Energy Strategy-2050)[6] identified priority measures to improve the renewable energy generation efficiency, including:

- improving mechanisms for the renewable energy development in the medium- and long-term perspective;
- creation of incentives to support the export of equipment and provision of services for the design, construction, operation, and maintenance of generating facilities based on renewable energy sources abroad;
- improving the system of voluntary demand for renewable energy;
- developing electrical energy storage systems, etc.

In 2024, the G20 summit was held in Rio de Janeiro, where a delegation from Russia, headed by Foreign Minister Sergey Lavrov, participated. Following the summit, a declaration was published in which the participants supported the idea of tripling global renewable energy capacity, doubling the average annual rate of improvement in energy efficiency by 2030, and supporting the adoption of low- and zero-carbon technologies in accordance with national circumstances. The declaration also highlights the importance of scaling up investments in energy transition financing instruments.

New opportunities for the development of renewable energy generation, as well as other energy transition technologies in Russia, may appear as part of the wholesale market mechanisms optimization planned in the Energy Strategy, including the implementation of technology-neutral selections of projects for the generating capacities construction. The said measure

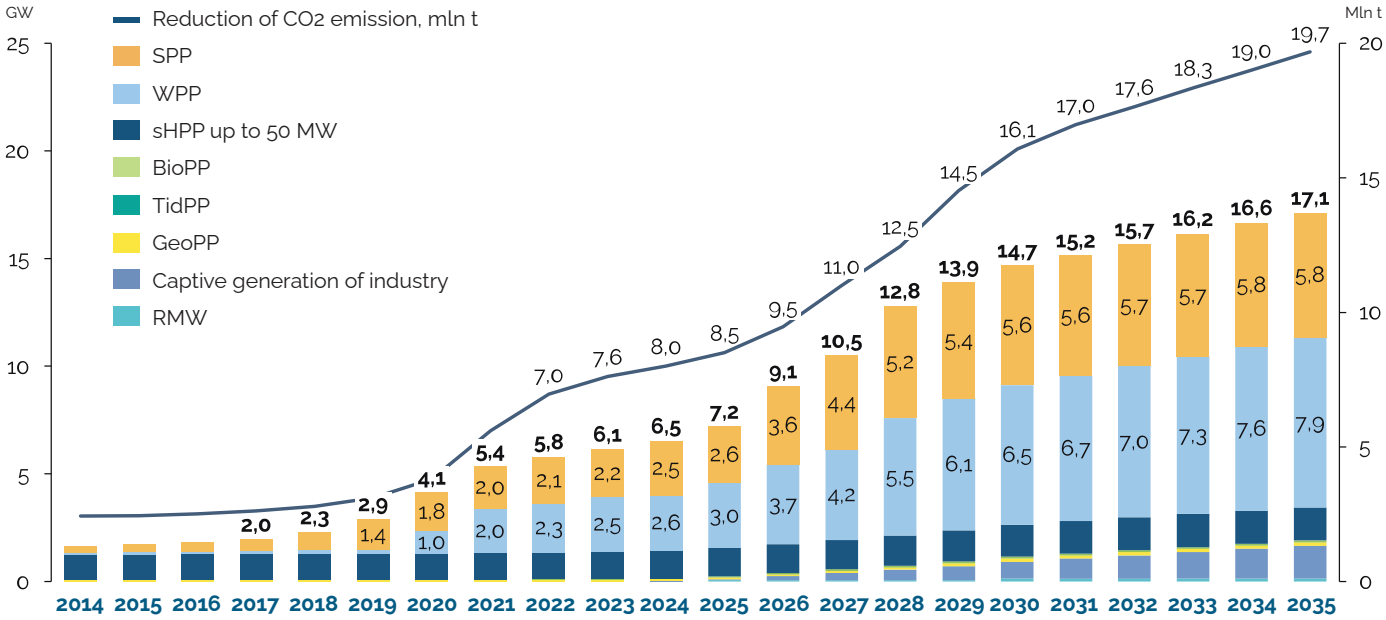
Fig. 5 | Structure of RES- based technical solutions and comparison with alternatives based on LCOE/LCOS, $/MWh



Source: IRENA, RREDA, Lazard.

6. Resolution of the Government of the Russian Federation No. 908-r dated 12.04.2025 «On Approval of the Energy Strategy of the Russian Federation up to 2050»

Fig. 6 | Forecast of the total renewable energy generation capacity and reduction of CO2 emissions



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

is included in a set of priority measures of enhancing the effectiveness of the electric power industry efficiency and, given the constant reduction in the new technologies cost, will make renewable energy generation an effective solution to cover emerging electricity shortages.

A comparative analysis[7] by RREDA of the levelized cost of production and/or storage of electrical energy (LCOE and LCOS, respectively) using various technologies for new construction projects demonstrates that wind power plants and solar power plants are the cheapest sources of electrical energy *(Fig. 5.)*, and BESS wins over the pumped storage power plant (PSPP) and is competitive in comparison with peak generation.

In addition, combined solutions based on RES and BESS (in proportions that allow the most effective typical profile compensation of the predicted electrical energy and power deficit[8]) also competitive in terms of LCOE compared to the most efficient types of thermal generation.

The maximum straight-line rate for the CMA NGF TPPs in the IES of the East, announced in accordance with the Russian Government Decree No. 1858-r of July 10, 2025, makes it possible to cover the cost of such solutions, among other things.

The diagram also demonstrates that new projects in Russia are characterized by higher LCOE values. This is primarily due to the higher cost of capital (20.5% versus the global average of 8% as of July 2025), as well as current requirements for the main equipment localization of new power plants.

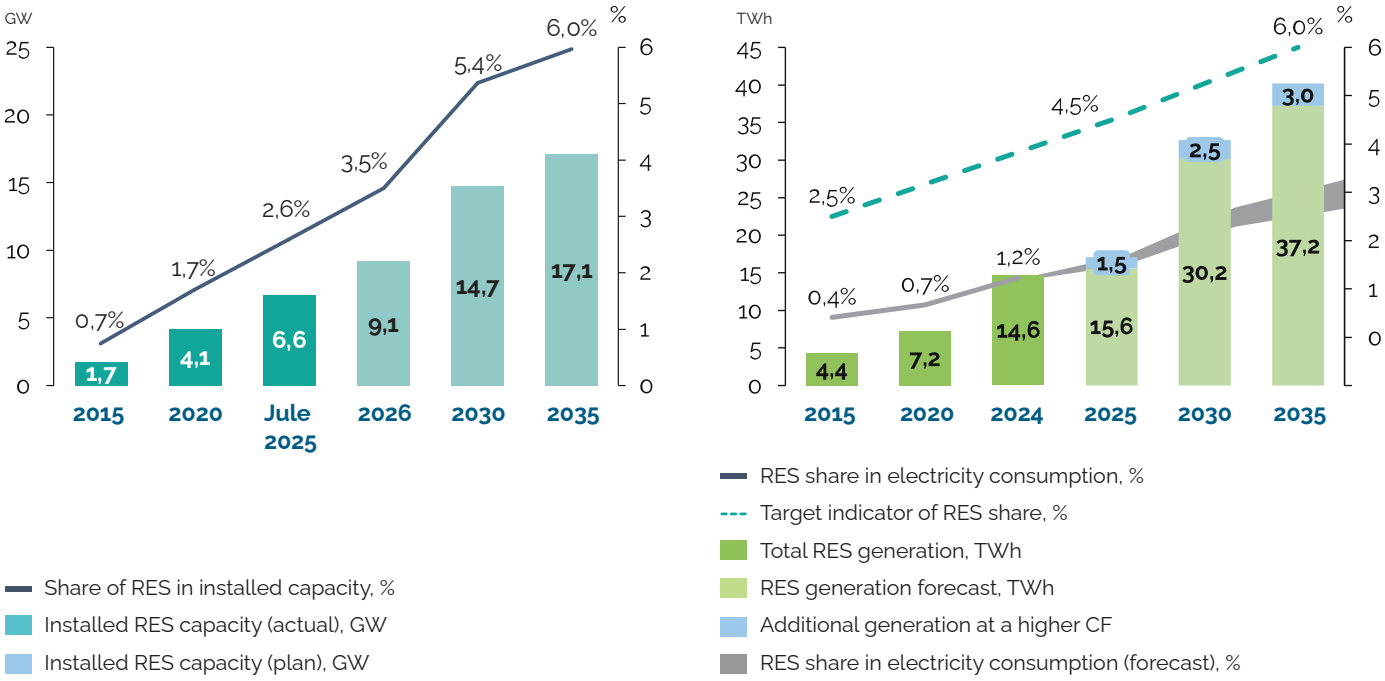
At the same time, the higher cost of capital increases the gap in LCOE between projects with different construction periods. Generating facilities that are faster to construct receive an additional advantage due to the lower first-year conversion factor (based on the cost of capital). First of all, such projects include WPP, SPP, and BESS.

Thus, the growth of the RES and BESS share in the balance of electrical energy and capacity in the long term is becoming an increasingly significant factor in optimizing the final cost of these goods.

With implementation of all projects selected to date and further facilities commissioning under the sec-

7. The assumptions and input data used for the calculation are given in the tables in Annex 1.
8. In which the power grid capacity is approximately 50% of the total wind and solar power plants capacity, and the maximum duration of output at maximum capacity is 6 hours.

Fig. 7 | Current and forecast RES share in installed capacity and in electricity consumption in Russia



* The forecast data are the result of RREDA expert assessments 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.

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.

ond stage of the renewable energy support program CSA RES 2.0 in accordance with the planned indicators, approved by the Government of the Russian Federation for the wholesale electricity and capacity market, as well as the RES development in retail markets, the total installed capacity of all RES facilities will approach 17 GW until 2035 (Fig. 6), which will provide about 6% of the total capacity of the Russian energy system. The reduction of annual CO2 emissions by 2035 will amount to about 20 million tons.

At the same time, according to Resolution of the Government of the Russian Federation No. 1-r[9] dated January 8, 2009, the target share of RES production (except small hydro power plants with a capacity of over 25 MW) and its consumption in the total volume of electricity production and consumption in the Russian Federation should reach 6% by 2035. Currently, the adopted support programs and, accordingly, investment plans of generating companies will not be able to achieve this indicator.

Figure 7 shows the dynamics of the actual and estimated share of RES generation in the energy system power balance of the Russian Federation and in total electricity consumption in Russia until 2035.

Among the most promising mechanisms for attracting additional investment in renewable energy are the following:

- conducting additional selections of renewable energy projects or technologically neutral capacity selections to compensate for the risks of local electrical energy and/or capacity shortages over a shorter horizon than the «delayed» compensatory measures for the UES development, envisaged in previously approved long-term planning documents, can be implemented;
- identification and early addition of electric power generation, integrated RES facilities, and high-power BESS, the sites for which placement are optimized for a phased increase in the ca-

9. Resolution of the Government of the Russian Federation No. 1-r dated 08.01.2009 «On the main government policies in the sphere of improvement of the energy efficiency in the electric power industry through the use of renewable energy sources for the period up to 2035»

pacity of such facilities, with the subsequent addition of measures to create the appropriate grid infrastructure to the Development Program and Scheme of the Electric Power Systems and the investment programs of power grid organizations.

An example of the implementation of the first approach is the additional, completed selection of renewable energy projects in 2025, aimed to electricity shortages risks compensating in the territories of the Far Eastern Federal District.

There are currently no examples of the implementation of the second approach in Russia. Power grid infrastructure development for the RES placement begins only after competitive procedures have been completed and relevant proposals have been received from project initiators. Given the short construction timeframes for such facilities, this does not allow for the full realization of such advantages of RES and BESS, due to the speed of construction.

At the same time, the combination of these approaches is a global trend. The inclusion of RES zones in the General Scheme for Power Facility Locations may become a significant factor in optimizing the amount of total capital investments required to implement projects included in the General Scheme, as well as create expanded opportunities for conducting technology-neutral tenders for the RES and BESS construction to compensate for the risks of projected electricity and capacity shortages over the shortest possible horizon (from 1 year).



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Republic of Kalmykia

Development of the RES industry in the world by the end of 2024

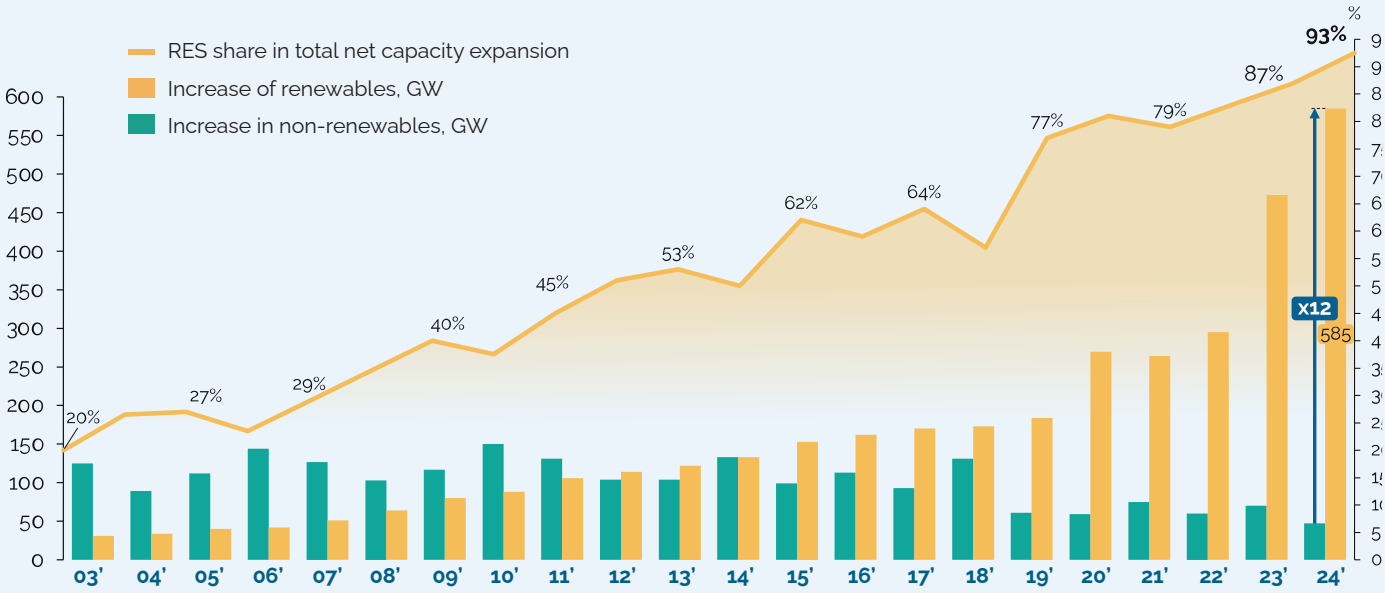
Over the past decade, global commissioning of RES generation facilities has been outpacing the growth of traditional power generation capacities every year and demonstrating record growth rates. According to the International Renewable Energy Agency IRENA, by the end of 2024, the total installed capacity of renewable energy generation in the world amounted to 4.448 GW, showing a record increase of 585 GW[10], which exceeds the net growth in 2023 by 24%.

Commissioning of new solar and wind generation facilities alone amounted to almost 565 GW[11] in 2024, increasing by 25%.

The share of renewable energy in the global construction of all new generation facilities has already reached 93% (Fig. 8).

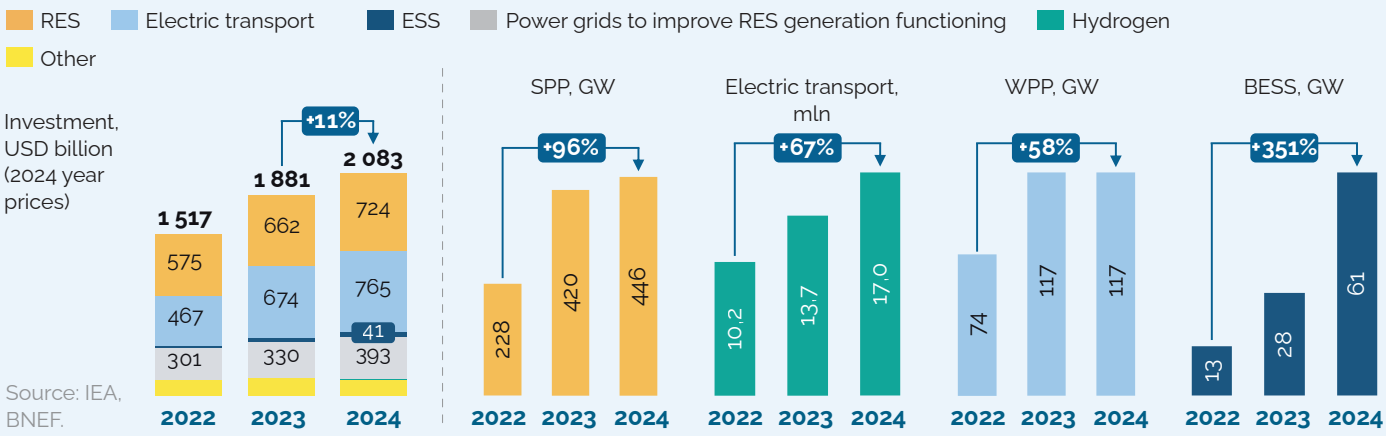
In 2024, global investments in energy transition technologies amounted to about 2.1 trillion US dollars, which is 37% more than in 2022 and 11% more than in 2024 (Fig. 9). In 2024, the trend of exceeding investments in electric transport compared to investments in renewable energy generation continued — 765 billion US dollars (674 billion US dollars in 2023). Together, these areas cover 3/4 of all investments in energy transition[12].

Fig. 8 | Global annual capacity growth, GW



Source: IRENA.

Fig. 9 | Annual volume of various energy transition technologies commissioning and energy transition investments in 2022, 2023 and 2024



Source: IEA, BNEF.

10. IRENA (2024). Renewable Capacity Statistics 2024
11. IEA (2024). Clean Energy Market Monitor.
12. BloombergNEF (2024). Energy Transition Investment Trends.

COP29 results

At the Conference of the Parties to the United Nations Framework Convention on Climate Change (hereinafter — COP29), held in 2024 in Azerbaijan, concrete steps were identified to implement the goals set at COP28, including a goal to triple the global renewable energy installed capacity to 11 thousand GW[13] by 2030. *(Fig. 10).* Although COP29 participants confirmed their intention to achieve this goal, current growth rates are still insufficient, and the global community is focusing on significantly increasing investment and accelerating project implementation.

In addition, a commitment was made to increase the installed capacity of energy storage systems to 650–1,500 GW by 2030 and to build or modernize 25 million kilometers of electrical grids[14]. These measures are aimed at increasing the efficiency and reliability of energy systems with significant volumes of carbon-free generation.

At COP29, to accelerate the RES development, participating countries considered promoting the concept of creating green energy zones (RES zones) in various regions of the world.

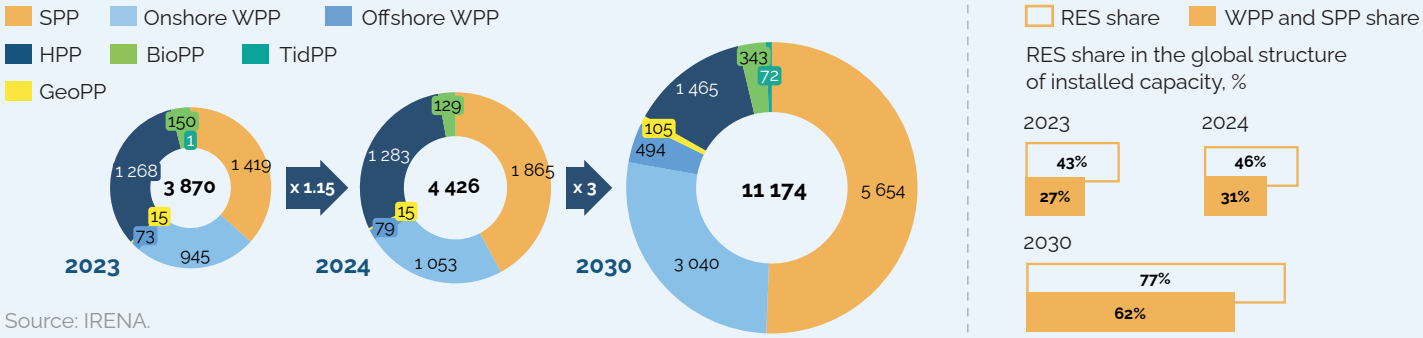
A renewable energy zone is a designated geographic area with a high concentration of renewable energy sources, where large energy generation, storage, and transmission facilities are located.

RES zones creation is ensured by the presence of a consumption center and the readiness to provide investment incentives for the subsequent expansion of the RES projects construction *(Fig. 11).*

Thus, thanks to the ability to accelerate construction of facilities on prepared zones and the economies of scale from the large generation volumes commissioning (which reduces specific capital costs), the development of renewable energy zones will enable the cost-effective expansion of renewable energy capacity — both locally and globally.

Another significant advantage of renewable energy zones is that they act as a major technology hub, facilitating economic growth and investment in specific areas. The creation of such projects contributes to a significant acceleration of the energy transition through the widespread introduction of advanced low-carbon technologies[15].

Fig. 10 | Structure of installed RES generation capacity in the world according to the IRENA – 1.5°C Scenario, GW



Source: IRENA.

Fig. 11 | Factors for the effective implementation of green energy zones

ECONOMY

MARKET MECHANISMS

Effective mechanisms for the return on investment in generation facilities must be provided

FORECASTING QUALITY

Consumption forecasts in the area, for the energy supply of which the RES zone is being built, must be confirmed by documents on the prospective development of the electric power industry

LOCATION SELECTION

NATURAL POTENTIAL

The location must have high natural potential for the placement of systemically important RES generation facilities

ADVANCED DEVELOPMENT OF INFRASTRUCTURE

Grid construction (Grid connection scheme and transmission to the consumption center) is carried out «with a reserve» for future stages of commissioning.

Source: RREDA.

13. COP28, IRENA, GRA (2023). Tripling renewable power and doubling energy efficiency by 2030: Crucial steps towards 1.5°C.
14. COP29 (2024). COP29 Global Energy Storage and Grids Pledge.
15. COP29 (2024). Green Energy Pledge: Green Energy Zones and Corridors.



ARSHANSKAYA SPP,
REPUBLIC OF KALMYKIA

2

RENEWABLE ENERGY DEVELOPMENT IN THE WHOLESALE ELECTRICITY AND CAPACITY MARKET

in 2024 and the first half of 2025



Implemented renewable energy investment projects in the wholesale electricity and capacity market

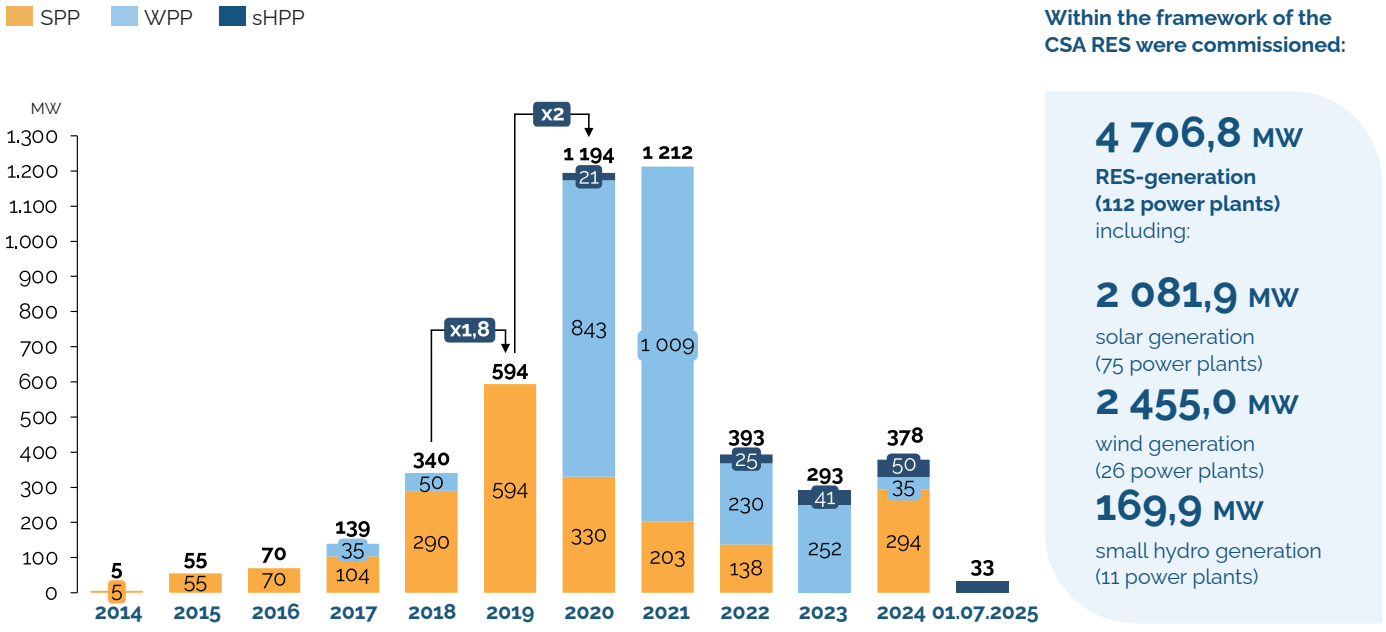
Since the beginning of the RES program support in the wholesale electricity and capacity market in Russia (CSA RES), as of July 2025, 112 renewable energy-based power plants have been commissioned and started the power supply, including: 75 solar power plants — 2,081.9 MW, 26 wind power plants — 2,455.0 MW, 11 small hydro power plants — 169.9 MW.

In 2024 and the first half of 2025, the commissioning volume of facilities operating based on renewable energy sources and built within the framework of the support mechanism for renewable energy sources — CSA RES amounted to 411.8 MW. As a result of this, the total installed capacity of CSA RES facilities reached 4,706.8 MW *(Fig. 12)*.

In accordance with the right of investors to postpone the commissioning of facilities in 2022, as well as the refusal to implement projects without appropriate penalties[16], the launch of 1,852.1 MW of RES generation was planned for 2025, including WPP of 976.5 MW and sHPP of 41.5 MW as part of the first stage of the support program (CSA RES 1.0), as well as SPP of 650.1 MW and WPP of 184.0 MW, already selected according to the rules of the second stage of the support program (CSA RES 2.0)[17].

Amid sanctions pressure and the persistence of high lending rates, the risk of commissioning delay within the framework of CSA RES remains. In 2024, RREDA initiated an appeal to the Russian Ministry of Energy regarding the provision of additional anti-crisis deferments for several projects. Later, in February 2025, the Government Commission on Electric Power Development decided to grant the right to postpone the start dates of power supply for 54 projects for a period of up to 24 months. This means that the commissioning dates for a significant portion of projects will be shifted to 2027-2028. Moreover, given that an additional competitive selection of solar and wind power plant projects to cover the electricity deficit in the IES of the East will take place in July 2025, a significant volume of solar power plant commissioning may occur in 2026. In total, based on competitive RES

Fig. 12 | Dynamics of RES generation facilities commissioning within the framework of the CSA RES, MW



Within the framework of the CSA RES were commissioned:

4 706,8 MW
RES-generation (112 power plants)
including:

2 081,9 MW
solar generation (75 power plants)

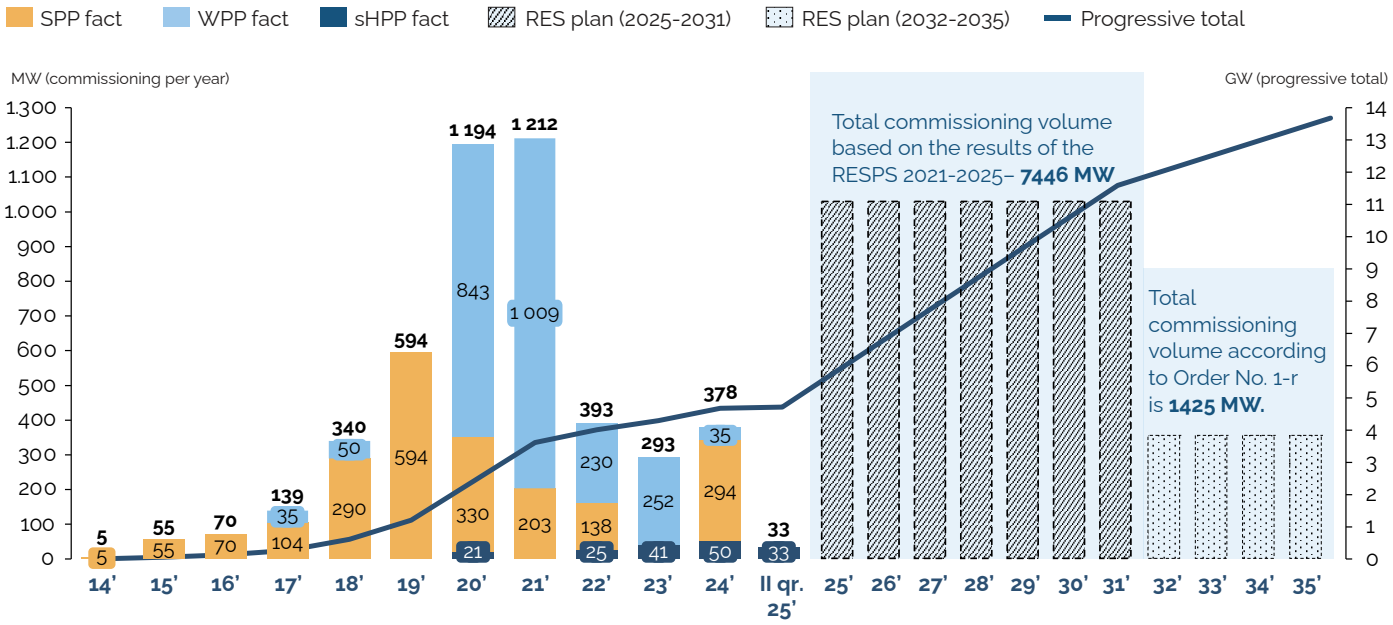
2 455,0 MW
wind generation (26 power plants)

169,9 MW
small hydro generation (11 power plants)

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

16. In May 2022, as anti-crisis measures, the decision of the Government of the Russian Federation approved the right of investors to postpone the commissioning of facilities, as well as the refusal to implement projects (Decree of the Government of the Russian Federation No. 912 dated 20.05.2022).
17. Between July 1, 2024, and July 1, 2025, changes were made to the installed capacity of two RES facilities, increasing the commissioning plan by 13.3 MW. The planned commissioning targets for 2025 also included projects that were not implemented in 2024 (258.1 MW) and new projects that passed the competitive RES projects selection under the CSA in 2024 (11.5 MW).

Fig. 13 | 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, with regard to approved postponement



Source: RREDA, NP Market Council, TSA JSC, Resolution of the Government No. 1-r dated January 08, 2009

project selections (CSA RES), conducted from 2013 to 2025, at the moment, CSA RES has been concluded for 398 facilities with the start date of power supply in 2014-2031. The total planned installed capacity of the selected projects is 11,852 MW *(Fig. 13)*, including: SPP — 4,828 MW, WPP — 6,728 MW, SHPP — 296 MW.

As the total capacity of RES generation facilities in Russia grows, the generation of green electricity is also increasing. By the end of 2024, electricity generation by facilities built within the framework of the CSA RES amounted to 9.3 billion TWh (an annual increase of 6%). This volume corresponds to 0.79% of the total electricity generation in the UES of Russia *(Fig. 14)*. According to the results of the first half of 2025, the share of solar, wind, and small hydro generation within the framework of CSA RES in the electricity consumption in the UES of Russia amounted to 0.76%.

The installed capacity utilization factor (hereinafter referred to as CF) of RES generation facilities is demonstrated at a level above the standard values provided by the Government of the Russian Federation within the framework of the CSA RES support program.

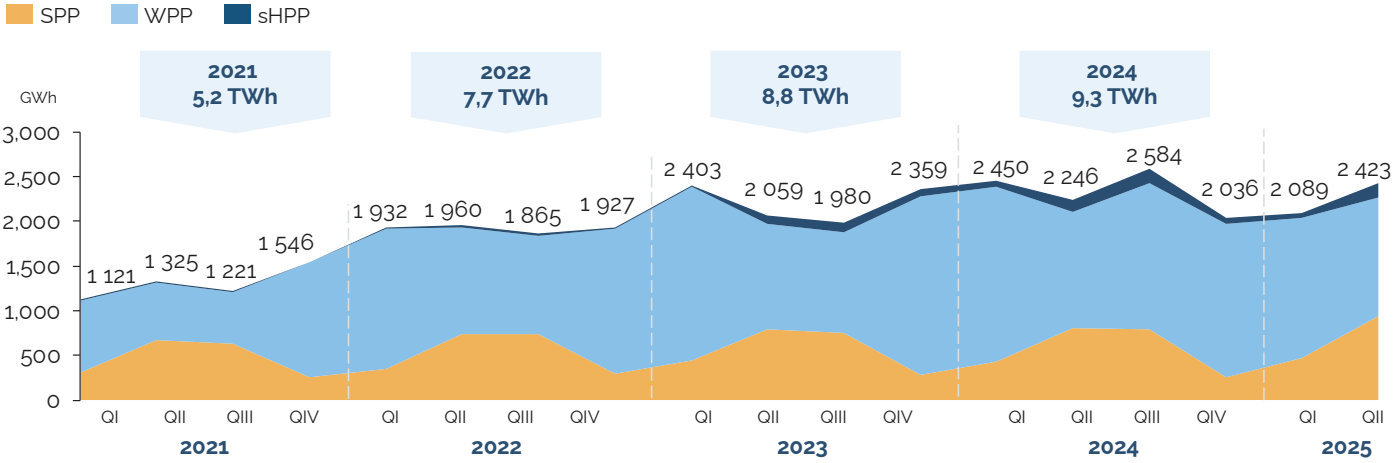
The average CF of power plants in 2024 was: for SPP — 14.5%, WPP — 30.9%, sHPP — 39.5% *(Fig. 15)*. At the same time, for solar power plants and small hydro power plants, the highest CF values were achieved in the summer months: from May to August the CF of SPP was in the range of 19.4% — 21.5%, CF of sHPP — 49.7% — 70.1%. For wind power plants, the highest CF values were recorded in February and September: 44.7% and 46.8%.

The distribution of the average annual CF by technologies and regions of the Russian Federation is shown in *Fig.16*. The highest average annual CF within the framework of CSA RES is recorded: for solar generation facilities — in the Stavropol Krai, Volgograd Region and Zabaikalsky Krai (more than 15.5% in each of these regions), for wind generation — in Rostov (32.6%), Volgograd (31.9%) and Astrakhan (31.8%) Regions, for small hydropower generation — in the Kabardino-Balkarian Republic (50.8%).

The practice of limiting the load on renewable energy generation facilities by the System Operator (hereinafter referred to as the SO) has significantly increased in scale in 2024.

Thus, the duration of restrictions for wind power plants operating under CSA RES has increased almost fourfold at the dispatcher's command — 396 hours in 2024 versus 96 hours in 2023, including 334 hours — these are loading restrictions in relation to facili-

Fig. 14 | Electricity generation at qualified CSA RES facilities, GWh



Results of 2024:

9,3 TWh
RES generation within the framework of the **CSA RES**

+6%
Increase in RES generation year-on-year

0,79%
Share of RES generation **(CSA RES)** in the total electricity consumption in the UES of Russia

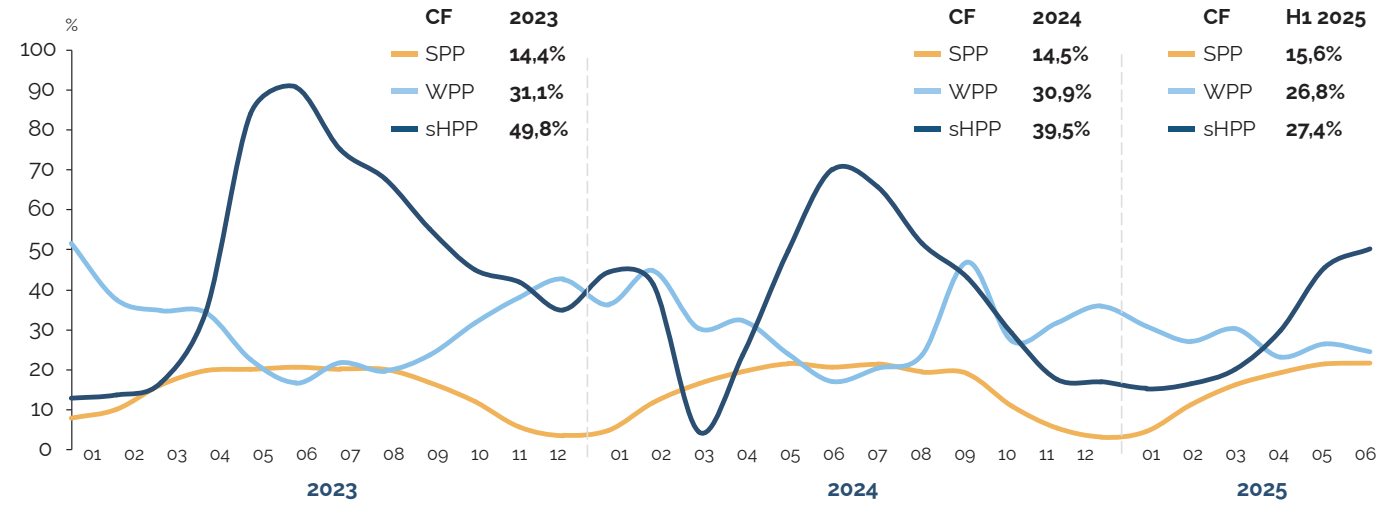
Results of H1 2025:

4,5 TWh
RES generation within the framework of the **CSA RES**

0,76%
Share of RES generation (**CSA RES)** in the total electricity consumption in the UES of Russia

Source: RREDA, SO UPS JSC, TSA JSC

Fig. 15 | Capacity factors of CSA RES projects by months of 2023–2025, %

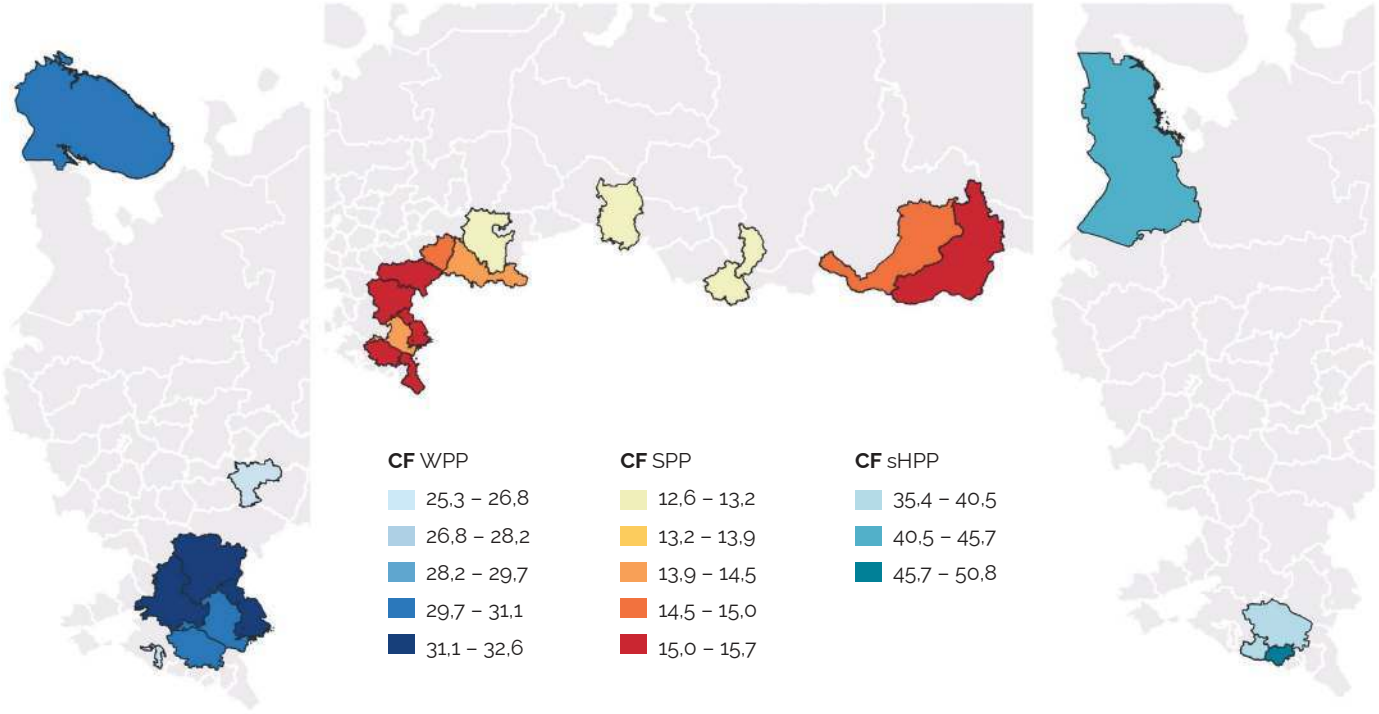


Source: RREDA, SO UPS JSC, TSA JSC

ties located in the IES of South (Astrakhan, Volgograd and Rostov Regions, Stavropol Krai, the Republics of Adygea and Kalmykia), 62 hours — for wind power plants in the IES of North-West (Murmansk Region).

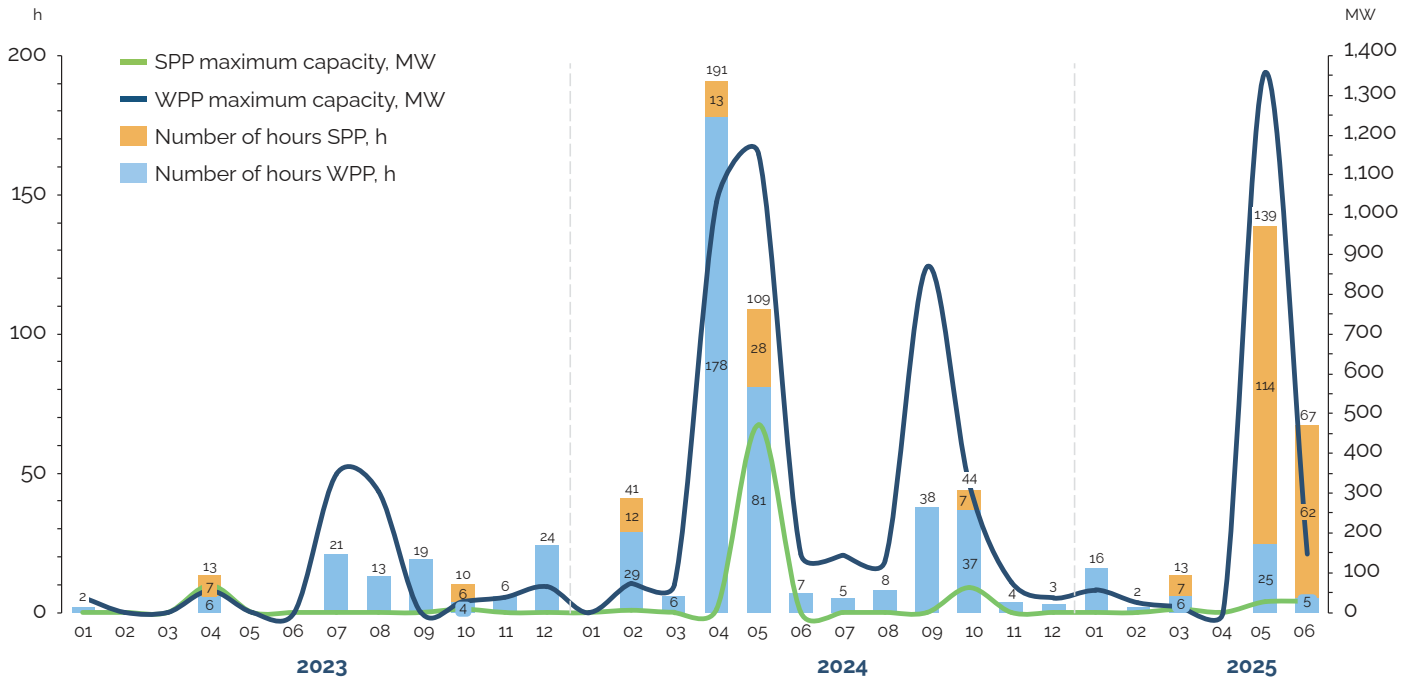
In the first half of 2025, the total duration of restrictions was 49 hours, which is six times less than the same period last year. Moreover, the maximum capacity of restrictions exceeded the previous year's

Fig. 16 | Distribution of the average annual CF projects of CSA RES by subjects of RF in 2024, %



Source: RREDA, SO UPS JSC, TSA JSC

Fig. 17 | The distribution of restrictions on the number of hours for power supply and maximum power restrictions to the grid by the command of the SO



Source: RREDA, JSC «SO UPS»

figure: 1,384 MW (in May 2025) versus 1,151 MW (in May 2024).

The duration of restrictions on the power supply to the solar power plant network by the SO commands has also increased fourfold, 60 hours in 2024 versus 15 hours in 2023, including 12 hours for solar power plants in the IES of Middle Volga (Saratov Region), 48 hours for SPP in the IES of South (Astrakhan and Volgograd Regions, the Republic of Kalmykia, the Republic of Dagestan and Stavropol Krai).

The maximum limit on the SPP power supply within the framework of CSA RES was 472 MW (in May).

In the first half of 2025, the total duration of restrictions reached 121 hours, double the amount for the same period last year. This increase is due to new solar power plant facilities being commissioned in the Republic of Buryatia and the Zabaikalsky Krai.

The distribution of restrictions on the number of hours for power supply and maximum power restrictions to the grid by the command of the SO for SPP and WPP within the framework of CSA RES is presented in *Fig. 17*

The application of these restrictions is a largely forced measure, because at the moment there is no centralized system for forecasting the RES production and, accordingly, not taking it into account when selecting the composition of generating equipment on the wholesale electricity market. However, this issue is currently being worked out by RREDA together with SO within the framework of the National Working Group in the direction of NRC C1 RNC CIGRE «Assessment of existing and development of new proposals for changing approaches to forecasting the generation of electricity and the available capacity of RES generation facilities for a period of one month or more.»



Azovskaya WPP, Rostov Region

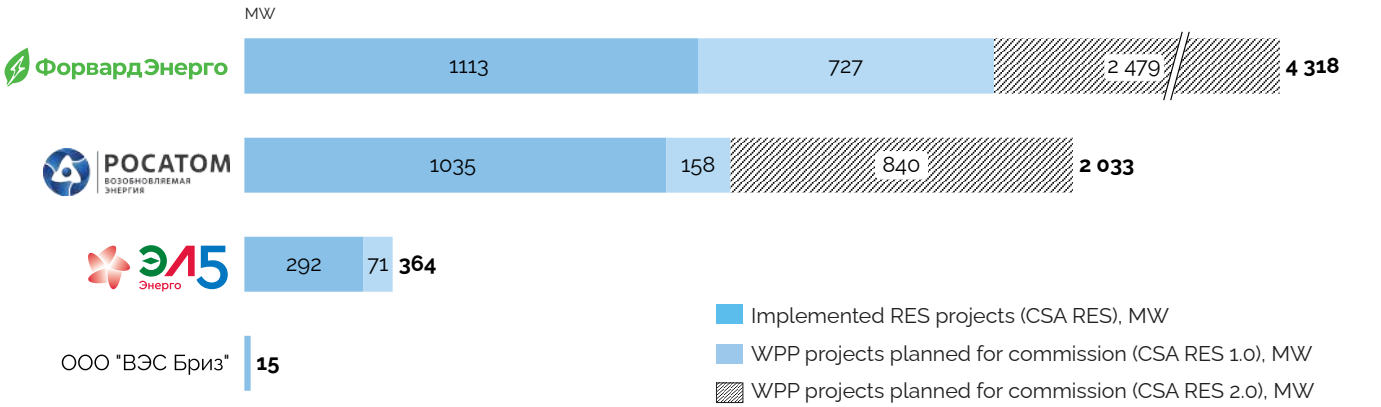
Wind power plants

In the wind energy sector, in February 2024, Rosatom completed the construction of the Trunovskaya Wind Power Plant with an installed capacity of 95 MW, the first stage of which was commissioned in August 2023 (60 MW).

The Trunovskaya WPP project has already been implemented concerning the reconfigured supply chains of key equipment components and the replacement of foreign suppliers, who left the Russian market, with domestic ones. According to the results of the first half of 2025, the total installed capacity of 26 wind power plants operating within the framework of CSA RES in the wholesale market is 2,455 MW. The facilities of Forward Energo PJSC (1,112.6 MW) and the wind energy division of Rosatom (1,035.0 MW) have shown the largest capacity volume of implemented projects. EL5-Energo PJSC has built facilities with a total capacity of 292.4 MW.

Another 955 MW of WPP are to be commissioned under the CSA RES 1.0 program, including 726.6 MW —

Fig. 18 | Distribution of wind investment projects (CSA RES 1.0 and 2.0), MW



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

projects of Forward Energo PJSC, 157.5 MW — projects of Rosatom, 71.3 MW — projects of EL5-Energo PJSC. In addition, the implementation of projects selected under the second stage of the CSA RES 2.0 support program will begin in the second half of 2025. The total volume of selected projects based on the results of competitive selections in 2021 and 2023, 2024, and 2025 is 3,319 MW. The distribution of implemented and planned WPP projects by investors is shown in *Fig.18*.

The WPP facilities operating within the framework of the CSA RES program are currently located in eight regions of Russia. The largest amount of wind generation facilities is located on the territory of the IES of the South — mainly in the Stavropol Krai (765.0 MW), Rostov Region (607.3 MW),and Astrakhan Region (340.2 MW). In total, these three regions provide 70% of the total installed capacity of WPP in the UES of Russia.

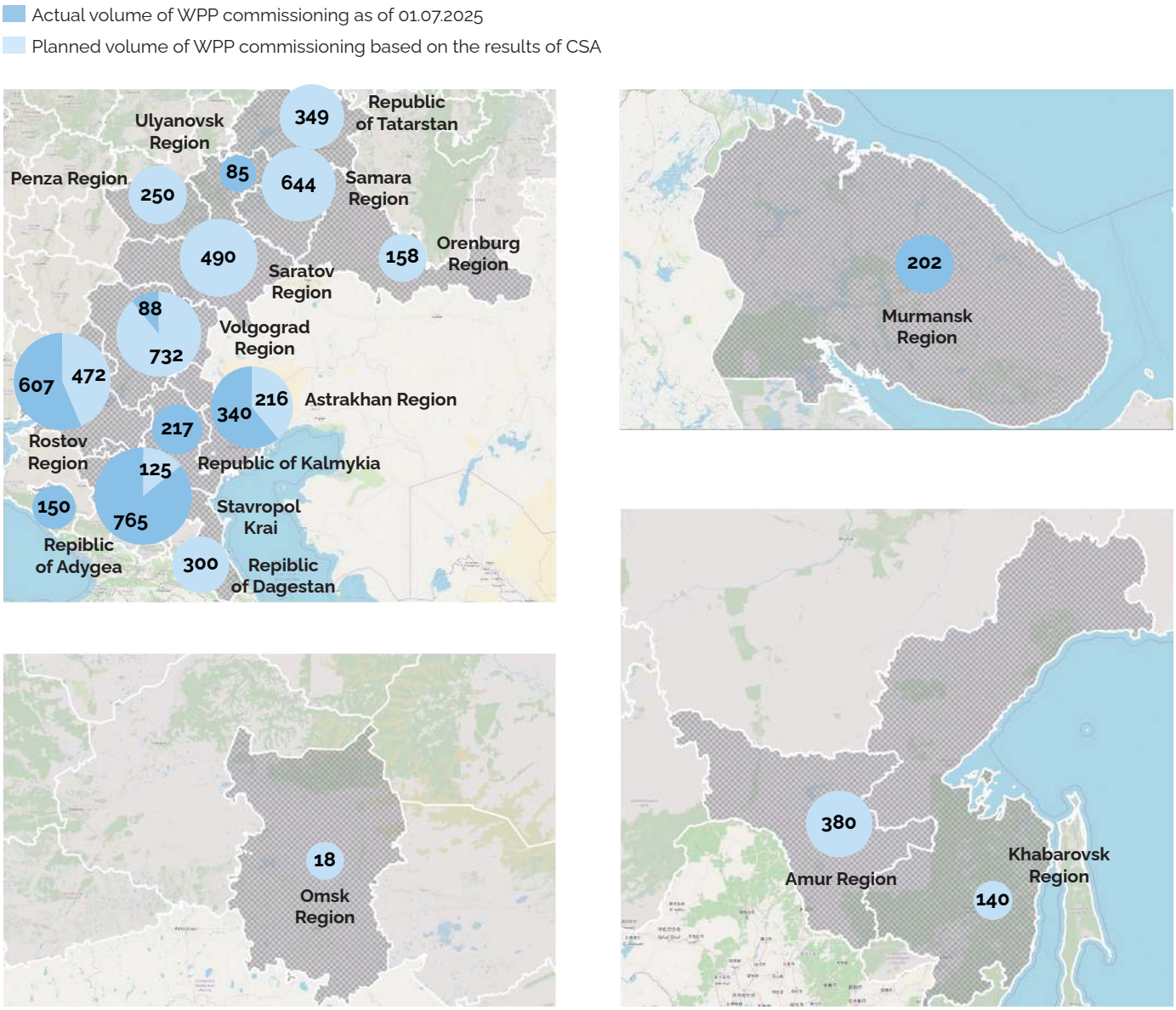
On the horizon of 2031, the construction of WPP based on the results of the past competitive selections is planned in seven more new regions, including 644 MW in the Samara Region, 349 MW in the Republic of Tatarstan, 300 MW in the Republic of Dagestan, 490 MW in the Saratov Region, 18 MW in Omsk Region, 157.5 MW in Orenburg Region, 249.8 MW in the Penza Region, 380 MW in the Amur Region and 140 MW in the Khabarovsk Region, as well as in other regions of the Russian Federation, where previously built WPP are successfully operating. The Volgograd Region is the leader in terms of the volume of projects planned for implementation, 732 MW of WPP are planned until 2031 *(Fig.19)*.

As of 2024, the production of wind turbines using gearless technology with a single capacity of 2.5 MW (Rosatom Renewable Energy JSC), as well as wind turbine towers (VetroStroyDetal LLC), laminated rotor and stator plates of wind turbines, large-sized generator parts, composite wind blades, and permanent magnets has been localized in the wind energy sector in Russia. The plant for the production of generators, nacelles, hubs, cooling systems, and tower base platforms for wind turbines, and the tower production plant are located in Volgodonsk, Rostov Region. The annual production of equipment sets (generator + nacelle + hub) by Rosatom Renewable Energy JSC reaches up to 120 pcs.

Rosatom State Corporation, represented by Rusatom Vetrolopasti JSC (part of Rosatom State Corporation composite division — Yumatex JSC), is also implementing a project to create domestic production of blades for wind turbines in the Ulyanovsk Region. The grand opening of the plant took place on December 26, 2024. The plant's design capacity is 450 blades per year. Construction of the Novolakskaya Wind Farm in the Republic of Dagestan this year will require approximately 400 blades. Rosatom's wind energy division will need an average of 360 blades per year.

Additionally, the Rosatom State Corporation is implementing the Rusatom Metalltech project to build a plant for the full-cycle production of neodymium magnets. Permanent magnets are an essential component in the manufacture of electric motors and generators of wind power plants. The first large–scale production of permanent rare-earth magnets in Russia (a special investment contract (hereinafter

Fig. 19 | Distribution of wind investment projects (CSA RES 1.0 and 2.0) by regions of the Russian Federation, MW



Source: RREDA.

referred to as the SPIC) was signed in February 2024) will be established in the city of Glazov, Udmurt Republic. The planned production capacity of the future facility is 1 thousand tons per year.

The production technology of sovereign high-capacity wind turbines is included in the List of technologies recognized as modern technologies for conclusion of SPIC by the Resolution of the Government of the Russian Federation No. 3143-r[18] dated November 28, 2020 «On approval of the list of technologies recognized as modern technologies for conclusion of special investment contracts» (as amended by Resolution of the Government of the Russian Federation No. 3133-r dated November 9, 2023). The following key components of wind turbines are classified as industrial products, for which mass manufacturing should be mastered as a result of the introduction of technology: nacelle, blade, hub, generator, automated and automatic control systems for wind turbine equipment. The main requirements within the framework of the SPIC:

- the unit power of the wind turbine should be at least 4.5 MW in the first 3 years from the date of conclusion of the SPIC, and at least 5 MW, not later than 3 years after that;

18. In some regions, the installed capacity indicators have been adjusted compared to last year's data due to changes in the planned installed capacity indicators for a number of selected facilities.

- key components of wind turbines must be produced in the territory of the Russian Federation not later than 3 years from the date of conclusion of the SPIC;
- at least 3 key components must be mastered by the investors on their own (except for wind turbine towers);
- rights to design and technical documentation in an amount sufficient for the production, modernization, and development of relevant products should be available.

In June 2024, Forward Energo PJSC, the Ministry of Industry and Trade of Russia, and the Samara Region signed the SPIC 2.0 project, which involves the creation of high-capacity sovereign wind turbines in the region and will allow the localization of 6.25 MW turbine production in Russia. Within the framework of the SPIC, Forward Energo will provide production localization of the main components of wind turbines — blades, hubs, nacelles, generators, towers, and automated control systems.

The launch of the production site is scheduled for 2027 in the special economic zone of Togliatti. Investments will amount to at least 4.5 billion rubles.



Mikhailovskaya SPP,
Volgograd Region

Solar power plants

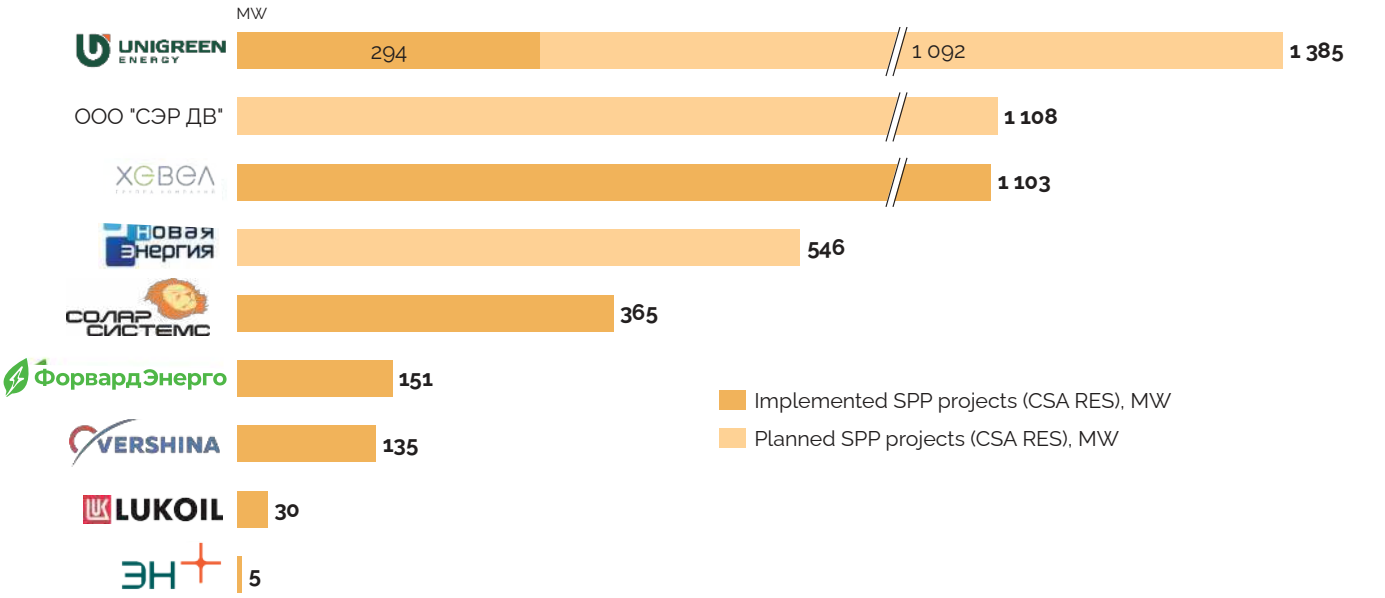
In the solar energy sector, the commissioning of SPP projects planned for the first stage of the CSA RES 1.0 support program was completed by July 1, 2022. In total, 70 solar power plant construction projects with a total capacity of 1,788.3 MW were implemented in 14 regions of Russia during the period from 2014 to 2022. Almost 2/3 of all functioning generation facilities belong to Hevel Group (1,102.5 MW). Another 365.0 MW belongs to Solar Systems LLC, 150.6 MW to Forward Energo PJSC.

Beginning from July 2024, SPP projects have already been implemented according to the rules of the second stage of the CSA RES 2.0 support program. In December 2024 года 5 solar power plants with a total installed capacity of 293.6 MW were commissioned in four regions of Russia (all projects of Unigrin Energy LLC): in the Republic of Buryatia, the Dzhidinskaya SPP (50 MW) and the Novobichurskaya SPP (52 MW), in the Zabaikalsky Krai, the Borzinskaya SPP (60 MW), in the Republic of Kalmykia, the Krasinskaya SPP (63 MW), and in the Astrakhan Region, the Bogdinskaya SPP (68.6 MW). In total, SPPs of 2,746 MW are planned for construction by the end of 2031. The distribution of implemented and planned SPP projects by investors is shown in *Fig. 20*.

More than 50% of the total SPP installed capacity operating in the UEPS of Russia on the wholesale electricity and capacity market is concentrated in three federal subjects of the Russian Federation: 370 MW in the Orenburg Region (there were no additional commissionings in 2024), 353.6 MW in the Astrakhan Region (+68.6 MW by 2023), and 297.1 MW in the Republic of Kalmykia (+63 MW by 2023).

In accordance with the results of the competitions held within the framework of the CSA RES 2.0 program in 2021, 2023, 2024 and 2025, SPP projects will be implemented in eighteen regions of Russia, including the Amur Region, the Jewish Autonomous Region, as well as the Republic of Tyva and the Republic of Chechnya, where SPP projects were not previously presented on the wholesale market. Significant volumes of solar generation are planned in the Zabaikalsky Krai (1,001 MW) and the Astrakhan Region (270 MW). The distribution of the commissioned and planned[19] solar capacities is shown in *Fig. 21.*

Fig. 20 | Distribution of solar investment projects (CSA RES 1.0 and 2.0), MW

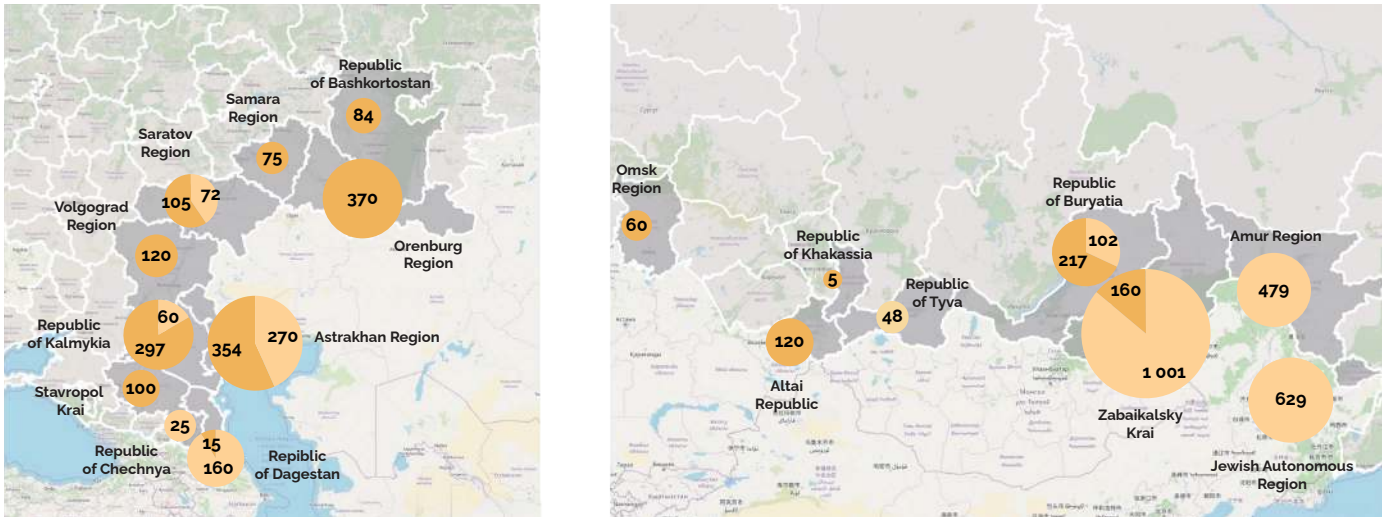


Sources: RREDA, TSA JSC, NP Market Council (Register of qualified facilities).

Fig. 21 | Distribution of solar investment projects (CSA RES 1.0 and 2.0) by regions of the Russian Federation, MW

Actual volume of SPP commissioning as of 01.07.2025

Planned volume of SPP commissioning based on the results of CSA



Source: RREDA.

19. In some regions, the installed capacity indicators have been adjusted compared to last year's data due to changes in the planned installed capacity indicators for a number of selected facilities.

As of 2025, the country's technological sovereignty in the solar energy sector is ensured by two main enterprises. The Hevel LLC plant in Novocheboksarsk, after completing the fifth stage of production modernization, produces 669 MW of photovoltaic cells and modules per year. The EnCOR Group LLC plant, located on the territory of the Chernyakhovsk Industrial Park in the Kaliningrad Region, produces silicon wafers and photovoltaic cells with a capacity of 1.3 GW per year and 1 GW per year, respectively.

During the first year of the EnCOR Group LLC plant operation, a new raw material preparation section was launched, which ensured the achievement of planned indicators for the use of recycled silicon. The use of recycled materials has allowed to reduce production costs, while maintaining its high quality. Thus, based on the industrial complex, EnCOR formed a base for the development of alternative energy and localized production of key components of solar generation.

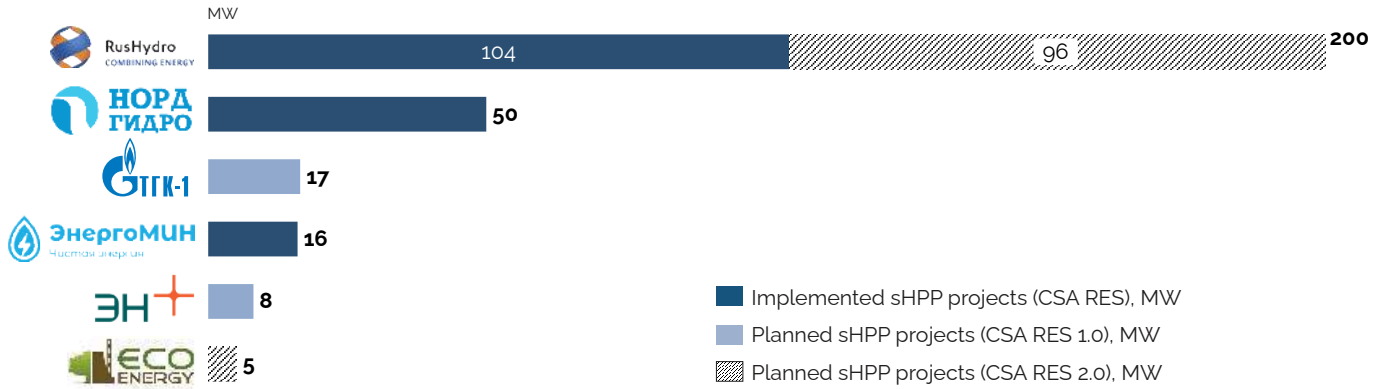
Small hydro power plants

The sector of small hydropower in Russia in 2024 showed moderate growth due to the launch by Nord Hydro JSC of Beloporozhsky small hydropower plants in the Republic of Karelia, with a total installed capacity of 49.8 MW. At the moment, a cascade of two Beloporozhsky small hydropower plants is one of the largest sHPP projects in the country. In the first half of 2025, two other sHPPs located in the IES of South were commissioned: Bashennaya sHPP in the Republic of Chechnya, installed capacity of 10 MW, and Cherek sHPP in the Kabardino-Balkar Republic, installed capacity of 23.4 MW. Both projects were implemented by RusHydro PJSC.

The significant event of the past period was that, after a three-year lull of investors' activity in the segment of hydropower generation, for the competitive selection of investment projects of 2025, finally, one bid for the construction of an sHPP in the Republic of Dagestan with a capacity of 5.1 MW by HydroEnergy-Ossetia LLC (EcoEnergy Group) was finally submitted. Currently, 125.6 MW of small hydro power plants are planned for construction, including the 8.1 MW project by En+ Generation JSC Generation in the Republic of Karelia and a 16.5 MW project by TGC-1 PJSC in the Murmansk Region (CSA RES 1.0), 96 MW projects by RusHydro PJSC in the Republics of Dagestan, Kabardino-Balkaria and Chechnya, and a 5.1 MW project by HydroEnergy- Ossetia LLC. As of July 2025, the total installed capacity of the eleven sHPPs operating under the CSA RES amounts to 169.9 MW. Investors in small hydropower generation projects on the wholesale market include PJSC RusHydro, NordHydro JSC, TGC-1 PJSC, EnergoMIN LLC, En+ Generation JSC, and EcoEnergy Group *(Fig. 22)*.

As of the first half of 2025, sHPPs (under the CSA RES) are in operation or planned for commissioning in 5 regions of the IES of South (the Karachay-Cherkess Republic, the Kabardino-Balkarian Republic, the Chechen Re-

Fig. 22 | Distribution of small hydropower investment projects (CSA RES 1.0 and 2.0), MW

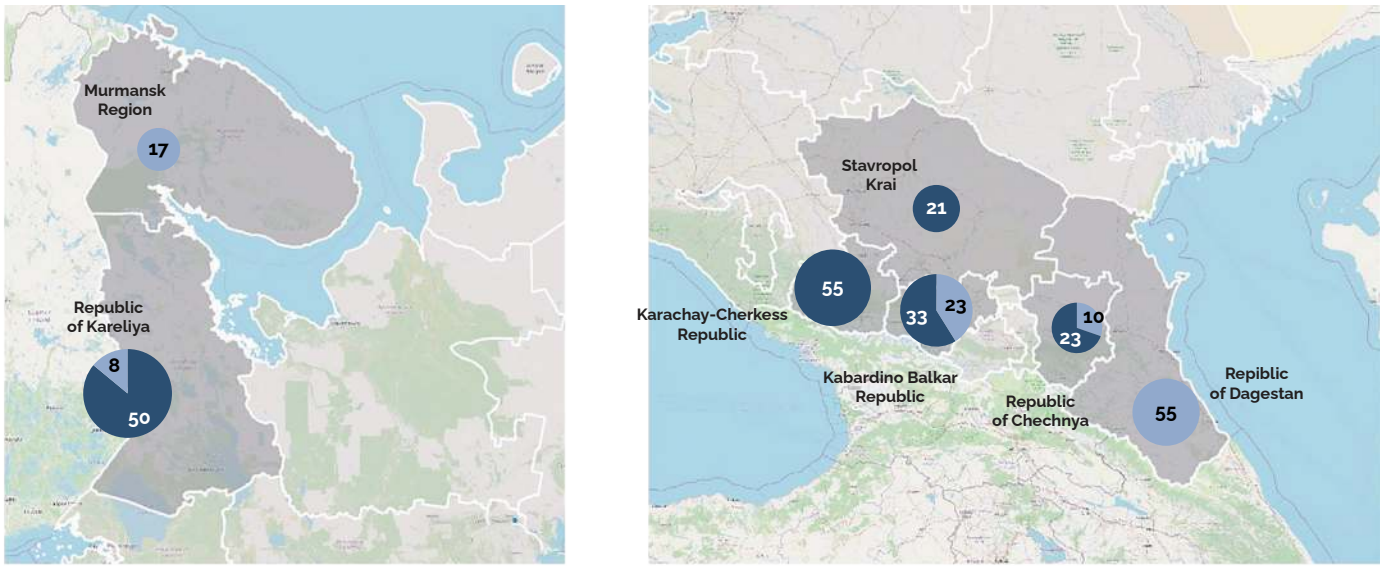


Sources: RREDA, TSA JSC, NP Market Council (Register of qualified facilities)

public, Stavropol Krai, and the Republic of Dagestan) and 2 regions of the IES of North-West (the Republic of Karelia and the Murmansk Region). The territorial distribution of the sHPP projects selected within the framework of the CSA RES program is shown in *Fig. 23*.

The revival of the small hydropower generation sector was facilitated by the fact that at the beginning of 2024 the Russian Ministry of Energy prepared and submitted for consideration to the Government of the Russian Federation a draft **Resolution on amendments to the Order of the Government of the Russian Federation No. 1-r of January 8, 2009[20],** which assumes an increase in the volume of support for small hydropower generation facilities, as well as the basic marginal efficiency values for the period 2027-2035, based on the need for additional indexing of the capital expenditures in their structure. Later, this Order was adopted by the Government **(Order of the Government of the Russian Federation No. 2414-r dated September 3, 2024[21]).** On this basis, the volume of support for sHPP within the framework of the second stage of the support program CSA RES 2.0 was increased by 60% (from 30 to 48 billion rubles in 2021 prices until 2035), which, according to maximum estimates, could ensure the commissioning of more than 220 MW of small hydropower generation facilities, considering previously selected projects for the 2021 and 2025 at RESPS. In addition, the Government decree increased the maximum levels of efficiency indicators (single-rate price for electricity and capacity) by more than 20%. An additional incentive for the sector was the adoption at the end of the year of Russian Government Resolution No. 1472 dated November 1, 2024, according to which the minimum financial security for the fulfillment of obligations for participants in the RES projects selection was reduced from 22% to 16%. The said Government Resolution also extended the period for which competitive sHPP selections are conducted: now the sHPP projects selection is carried out for each year out of the 7 years following the year in which such selection is carried out. All regulatory changes implemented in 2024 have become an additional driver to increase the segment's investment activity.

Fig. 23 | Regional distribution of sHPP projects (CSA RES 1.0 and 2.0), MW



Source: RREDA

20. Resolution of the Goverment of the Russian Federation N 1r dated January 8, 2009 «On the main directions of state policy in the field of increasing the energy efficiency of the electric power industry based on the RES use for the period up to 2035».
21. On Amendments to the Resolution of the Government of the Russian Federation N 1-r dated January 8, 2009.

Competitive selection of CSA RES projects in 2024 and 2025 (RESPS 2024 and 2025)

In December 2024, another renewable energy sources project selection (hereinafter — RESPS) took place within the framework of the CSA RES 2.0 program in the wholesale electricity and capacity market. According to its results, the total capacity of the selected projects amounted to 474.7 MW, including WPP — 427.1 MW, SPP — 47.6 MW.

Eleven bids in the wind generation sector and one bid in the solar generation sector were accepted for the competitive selection process. Bids for small hydropower generation projects have not been received.

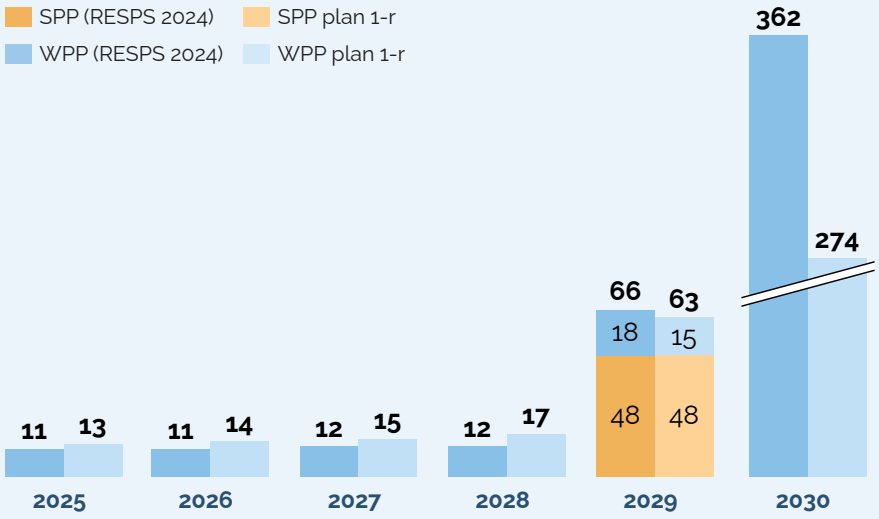
In total, 12 RES generation facilities were selected, with the start of power supply in 2025–2030, with a required annual revenue from 0.3 to 4.2 billion rubles (in 2021 prices) cumulatively from 2025 to 2030, respectively. The total amount of support considered at RESPS 2024 until 2035 amounted to about 20 billion rubles (in 2021 prices). Capacity supply agreements have been concluded with the winners of the selections in accordance with the established procedure *(Fig. 24)*.

The selected SPP project will be implemented by Unigreen Power LLC (Unigreen Energy LLC) in the Republic of Tyva. Forward Energo PJSC accounted for 95% (408.7 MW) of the total capacity selected in the wind power generation sector for construction in Samara and Rostov Regions. The project of VetroSPK JSC (Rosatom Renewable Energy JSC) with a capacity of 18.4 MW will be the first wind power plant project to be implemented within the framework of the CSA RES in Western Siberia. The Omsk Region has been identified as a construction area.

The next RES generation projects selection under the CSA RES 2.0 support mechanism took place in June 2025, and as a result, the total capacity of the selected projects was 319.3 MW: wind power plants — 249.8 MW, solar power plants — 64.4 MW, and small hydro power plants — 5.1 MW. For the RESPS 2025, 4 applications for wind power generation projects, 5 for solar power generation projects, and 1 for a small hydro power plant were accepted for participation in the competitive selection. A total of 10 RES generation facilities were selected, with capacity delivery expected to commence in 2025–2031 and with a total required annual revenue of 0.1 to 3.4 billion rubles (in 2021 prices) cumulatively from 2026 to 2031, respectively. The total amount of support awarded under the 2025 until 2035 period amounted to approximately 14 billion rubles (in 2021 prices) *(Fig. 25)*.

The SPP projects will be implemented by SER DV LLC in the Jewish Autonomous and Amur Regions — these are the first solar power generation facilities announced under the CSA RES in the IES of East. This became possible after this territory joined the wholesale electricity and capacity market pricing zone on January 1, 2025.

Fig. 24 | Capacity of the projects selected at RESPS 2025 and minimum capacity planned for selection according to the Resolution of the Government № 1-r of 08.01.2009, MW



SPP

RES CS 2024	Plan 1-r	Surplus over plan
1 project 48MW	48 MW	–

WPP

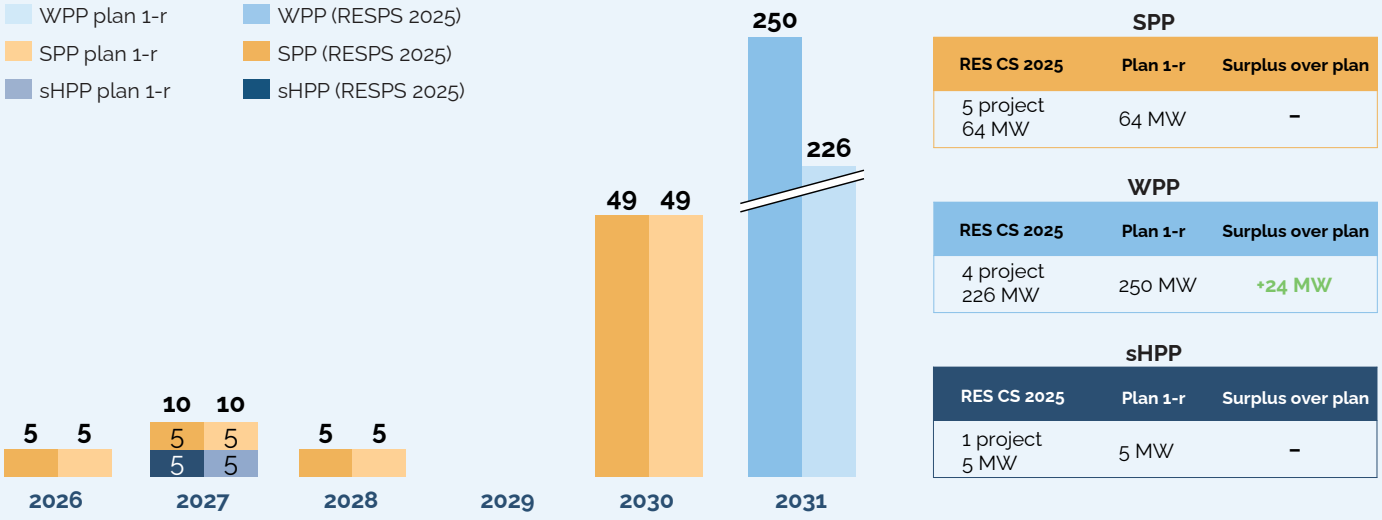
RES CS 2024	Plan 1-r	Surplus over plan
11 project 427MW	349 MW	+78 MW

sHPP

RES CS 2024	Plan 1-r	Surplus over plan
No bids provided	110 MW	–

Source: RREDA, JSC «ATS», the Resolution of the Government № 1-r 08.01.2009

Fig. 25 | Capacity of the projects selected at RESPS 2025 and minimum capacity planned for selection according to the Resolution of the Government № 1-r of 08.01.2009, MW



SPP

RES CS 2025	Plan 1-r	Surplus over plan
5 project 64 MW	64 MW	–

WPP

RES CS 2025	Plan 1-r	Surplus over plan
4 project 226 MW	250 MW	+24 MW

sHPP

RES CS 2025	Plan 1-r	Surplus over plan
1 project 5 MW	5 MW	–

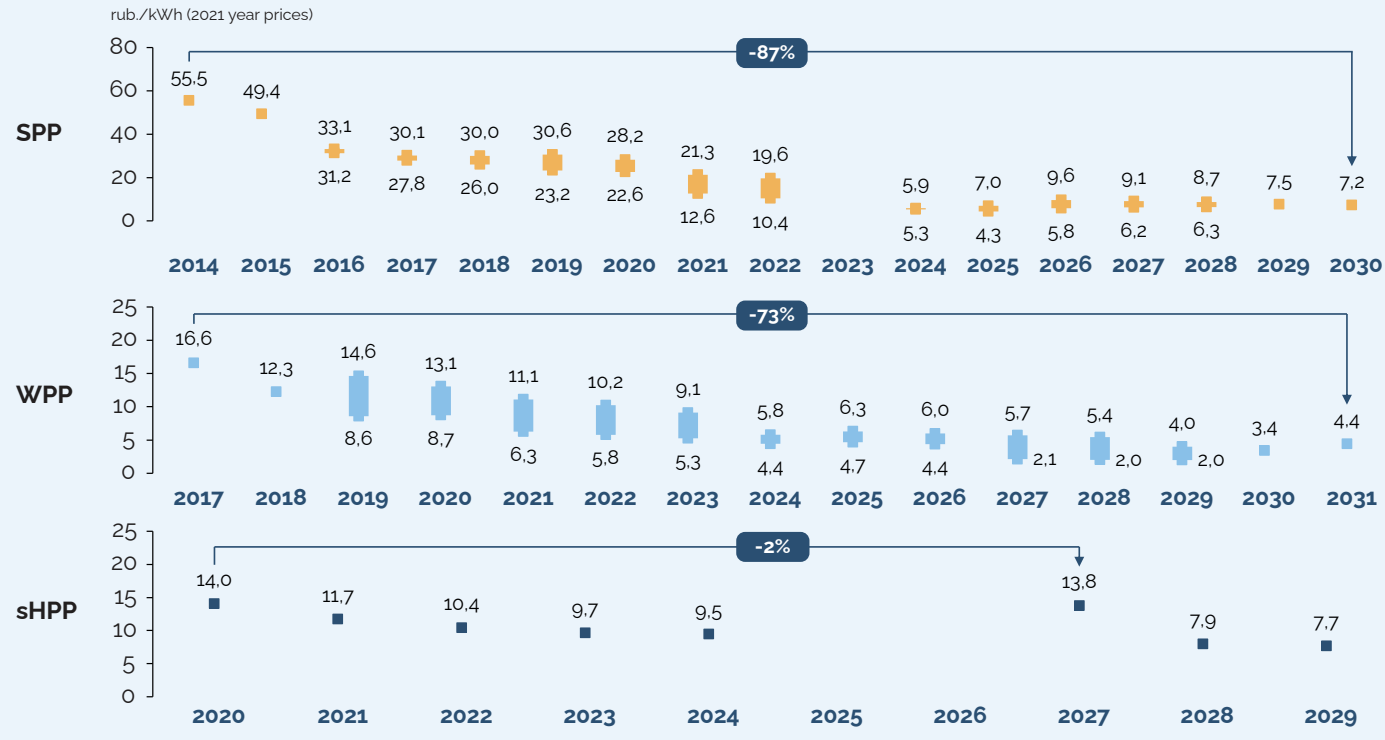
Source: RREDA, JSC «ATS», the Resolution of the Government 08.01.2009 № 1-r

The selected wind power facilities were announced by Forward Energy PJSC; new wind power plants will be commissioned in the Penza Region.

The sHPP project of HydroEnergy-Ossetia LLC (Eco-Energy Group) in the Republic of Dagestan has become the first SHPP project selected under the CSA RES in the last four years.

According to the RESPS results in 2024, the minimum cost of electricity (efficiency indicator) for wind power plants decreased by 30% relative to the maximum val-

Fig. 26 | Dynamics of SPP, WPP and sHPP electricity prices determined at competitive selections of CSA RES projects (RESPS of 2024 and 2025 are considered)



Source: RREDA, TSA JSC

ues; in 2025, the indicator decreased by 6%. For the 2024 and 2025 RESPS, applications for solar power plants and small hydro power plants were accepted based on the maximum values of the efficiency indicator.

Based on the results of the RESPS in 2024 and 2025, the single-rate prices in the wind generation segment was set in the range of 3.426–4.444 rubles/kWh in 2021 (5.171–6.636 rubles/kWh in 2025 prices) for power facilities planned for 2030 and 2031, in the solar energy segment — 7.205–7.546 rubles/kWh (10.464–10.959 rubles/kWh) for 2030 and 2029, in the small hydropower segment — 13.764 rubles/kWh (20.602 rubles/kWh) for 2027 *(Fig. 26)*.

In total, 22 renewable energy facilities with a total capacity of 794 MW, including wind farms, solar power plants, and small hydro power plants, were selected based on the RESPS 2024 and 2025 results under the CSA RES 2.0, with a total support volume of approximately 50 billion rubles until 2035. The increase in the RES projects' economic efficiency was reflected in the reduction of single-rate prices following the RESPS. This became the prerequisite to organize the first additional RESPS to prevent electricity shortages in the territory of the Far Eastern Federal District, in particular, the Amur, Jewish Autonomous, and Khabarovsk Regions (hereinafter referred to as RESPS in Far East).



Kolskaya WPP,
Murmansk Region

Photo: Artyom Zenko

Additional RESPS in Far East, 2025

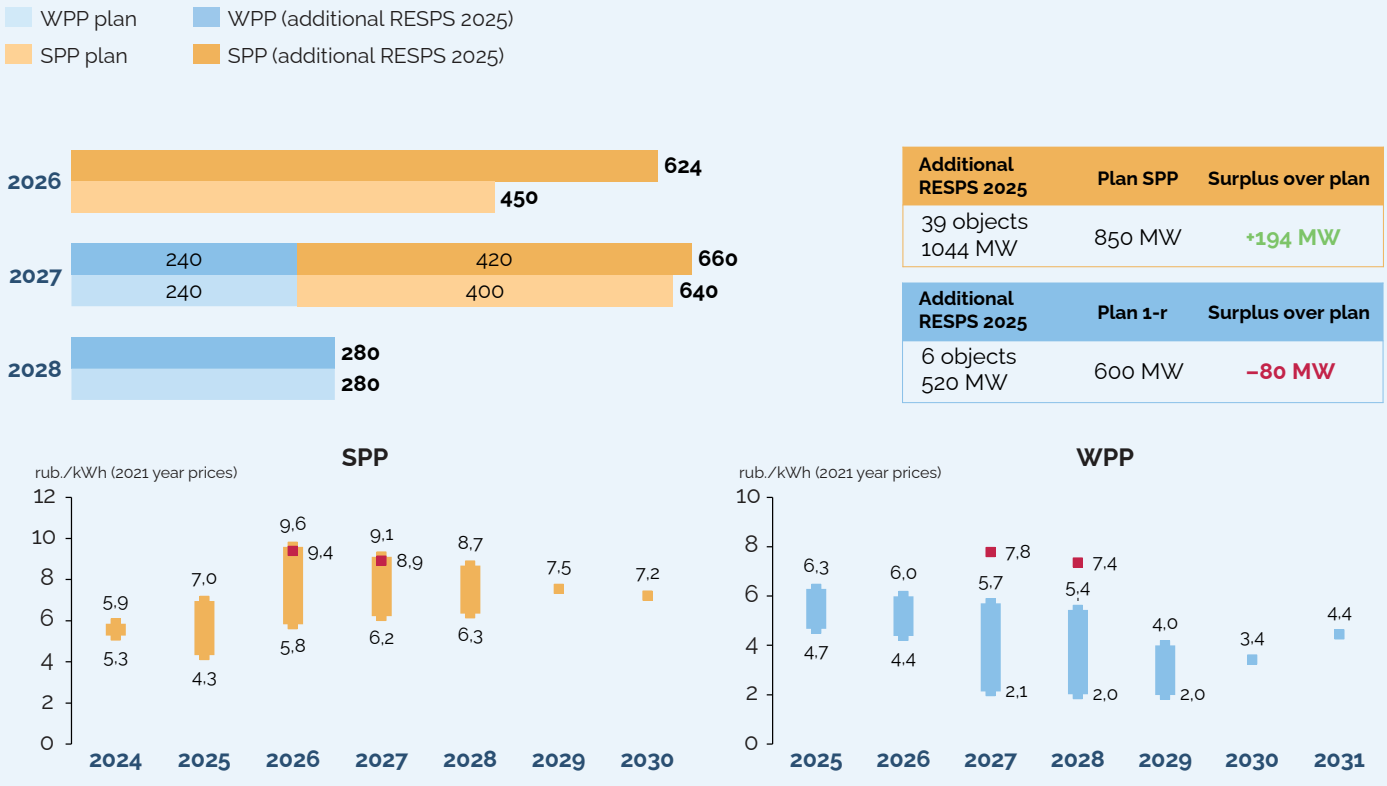
The additional RESPS were held to compensate for electricity shortages in the Far East in the period from July 28 to 30, 2025. The selection was carried out in relation to a part of the territories of the Amur, Jewish Autonomous, and Khabarovsk Regions, separately for solar and wind power-generating facilities. The RES facilities commissioning is planned for the period from 2026 to 2027 for SPP and from 2027 to 2028 for WPP. The total amount of support following the RESPS in Far East amounted to 29 billion rubles in 2021 prices.

Following the additional RESPS, the total capacity of the selected projects amounted to 1,564 MW, including 520 MW of WPP and 1,044 MW of SPP. Seventeen bids in the wind generation sector and 39 bids in the solar generation sector were accepted for the competitive selection. A total of 45 RES facilities with required revenues ranging from 0.2 to 4.1 billion rubles were selected *(Fig. 27)*.

The selected SPP projects will be implemented by SER DV LLC. The facilities planned for 2026 will be commissioned in the Jewish Autonomous Region, and for 2027, in the Amur Region. Rosatom Renewable Energy JSC accounted for 370 MW of the total capacity selected in the wind power sector, with construction planned in the Amur and Khabarovsk Regions. The remaining 150 MW will be implemented by Forward Energy PJSC in the Amur Region in 2027.

Considering the RESPS carried out in 2025 (main and additional), the range of single-rate prices for electricity from SPP amounted to 10.5-14.1 rubles/kWh, for WPP — 6.6-11.7 rubles/kWh in 2025 prices.

Fig. 27 | Capacity and electricity prices of WPP and SPP selected at additional RESPS in year 2025 (in comparison with price indicators of other projects selected at RESPS in 2021-2025)



Source: RREDA, TSA JSC

Changes in RES regulation in the wholesale electricity and capacity market

In 2024, **Decree of the Government of the Russian Federation No. 561[22] dated May 3, 2024,** was adopted, and it approved additional indexing of the capacity price relating to solar investment projects distributed at the competitive selection in 2021. These changes were considered by the federal executive authorities (hereinafter referred to as FEA) and the Government of the Russian Federation on the initiative of the Association. The Decree, together with **Resolution of the Government of the Russian Federation No. 1088-r[23] dated May 3, 2024 «On amendments to Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009»,** is a compromise solution formed as a result of a long discussion with market participants and FEA, and allows to implement 18 SPP investment projects with a total installed capacity of 775 MW under the background of significant increased capital investments in their construction. To compensate for the effect of the increase in capacity payments, amendments to Resolution of the Government of the Russian Federation No. 1-r dated January 8, 2009, provide for a proportionate reduction in the amount of support for the use of renewable energy sources, which will be bid at the upcoming competitive selections for solar generation construction projects.

The second change for RES generation facilities of the wholesale market, implemented by **Decree of the Government of the Russian Federation No. 561[24] dated May 3, 2024,** is related to the procedure for coordination of the location of wholesale RES generation facilities with the System Operator. The coordination becomes one of the conditions for the start of the power supply for generating facilities, which will be selected beginning from 2024. In addition, coordination with the System Operator will be required in case of changing locations under already concluded RESPS from July 1, 2025. Within the framework of the introduced procedure, the System Operator will:

- determine the presence/absence of restrictions for the location of RES generation facilities in a certain territory (energy district, part of the territorial energy system) and the installed capacity limits for location in the specified territory;


Azovskaya WPP,
Rostov Region

22. Decree of the Government of the Russian Federation No. 561 dated May 3, 2024 «On amendments to certain acts of the Government of the Russian Federation on stimulating the use of renewable energy sources».
23. Resolution of the Government of the Russian Federation No. 1088-r dated May 3, 2024 «On amendments to Resolution of the Government of the Russian Federation No. 1-r dated 08.01.2009».
24. Decree of the Government of the Russian Federation No. 561 dated May 3, 2024 «On amendments to certain acts of the Government of the Russian Federation on stimulating the use of renewable energy sources».

- form a list of renewable energy generation facilities that meet the requirements of the agreed planned location.

The procedure for coordination of the RES generation facilities location with the System Operator, added into the CSA RES mechanism at this stage of the implementation of the support program, will allow for minimizing cases of limitation of electricity generation at RES generation facilities in the future, which may arise due to high concentration of RES capacities in certain parts of the energy system.

In the second half of 2024, several important changes were adopted to the rules for competitive selection of investment projects for the construction of renewable energy generation facilities in the wholesale electricity and capacity market.

In accordance with Federal Law No. 309-FZ[25] of August 8, 2024, «On Amendments to the Federal Law 'On Electric Power Industry'» a special territorial category of the wholesale electricity and capacity market (WECM) was introduced: «separate territories of price zones, previously classified as non-price zones of the wholesale market», where a gradual transition to market pricing will take place.

The powers of the Government of the Russian Federation were assigned to define the list of certain territories of wholesale market price zones, previously referred to as non-price wholesale market zones, for which the specifics of wholesale and retail electricity markets (capacity) operation were established by the Government.

Decree of the Government of the Russian Federation No. 1868[26] dated December 23, 2024 «On amendments to certain acts of the Government of the Russian Federation on the establishment the specifics of wholesale and retail electricity markets and capacity operation in certain areas of price zones previously referred to non-price zones of wholesale market», adopted pursuant to the Federal Law 309FL[27] of 08.08.2024, defines the List of selected wholesale market price zones that were



25. Federal Law No. 309-FZ of August 8, 2024 «On Amendments to the Federal Law «On Electric Power Industry».
26. «On amendments to certain acts of the Government of the Russian Federation concerning the establishment of wholesale and retail electricity markets and capacity functioning in certain territories of price zones, previously referred to non-price zones of wholesale market».
27. Federal Law No. 309-FZ of August 8, 2024 «On Amendments to the Federal Law «On Electric Power Industry».

previously classified as non-priced wholesale market zones. The specified List includes the Komi Republic, Arkhangelsk Region, Sakha Republic (Yakutia), Primorsky Krai, Khabarovsk Krai, Amur Region, and the Jewish Autonomous Region (except for territories not technologically connected to the UES of Russia and the TITES).

The integration of the Far East territories in the second price zone for renewable energy generation will allow for the investment projects geography expansion due to the possibility of transferring already selected facilities for which CSA RES have been concluded, as well as new construction within the framework of RESPS, including additional competitive selections to cover the projected electricity deficit in the territory of the IES of East.

Decree of the Government of the Russian Federation No. 99[28] of 04.02.2025 established the possibility of conducting an additional RESPS. The rules of the wholesale electricity and capacity market, approved by Decree of the Government of the Russian Federation No. 1172 of December 27, 2010, have been supplemented by provisions providing for:

- the possibility of conducting an additional RESPS in relation to territories of technologically necessary generation in accordance with the latest approved Development Program and Scheme of the Russian Electric Power Systems (DPSREPS);
- the decision to conduct an additional selection shall be taken by the Government of the Russian Federation based on proposals from the Governmental Commission for the Development of the Electricity Industry;
- the specifics of conducting an additional competitive selection.

By Resolution of the Government of the Russian Federation N1381[29]r of May 29, 2025, the Government determined the timing of the additional selection, territories, calendar years, types of generating facilities, as well as the maximum values of the efficiency indicator and the maximum values of the annual volume of support for the use of renewable energy sources for each type of generating facility. According to the above-mentioned Resolution of the Government of the Russian Federation, it was decided to conduct in 2025 an additional competitive selection of investment projects for the construction of WPP and SPP to cover the projected electricity deficit in the IES of East with the planned years of commissioning of generating facilities in 2026-2028. The WPP and SPP locations have been identified on the territories of the Amur Region, the Jewish Autonomous Region, and the Khabarovsk Region. The approved economic parameters of the additional selection allow for the selection of at least 1,450 MW of RES generation (850 MW of SPP and 600 MW of WPP).

Russian Government Resolution No. 4153-r[30] of December 30, 2024, «On the General Scheme for the Layout of Electric Power Facilities until 2042», approved the key document for the long-term development of the electric power industry (approved by the Russian Government every six years; a one-time update is possible). The General Scheme for Power Facility Locations until 2042 provides for the development of renewable energy:

- 17.2 GW of new solar and wind generation commissioning, which corresponds to about 19% of the total projected volume of new generation commissioning by 2042;
- 4.6 GW of new hydropower plant.

In the structure of installed capacity, the share of solar and wind power plants is planned to increase from 1.9% in 2023 to 5.8% by 2036 and to 7.3% by 2042. The share of hydropower plants in the rational structure of generating capacity will decrease from 20.3% in 2023 to 19.2% by 2036 and to 18.8% by 2042.

The General Scheme includes approved Lists of solar and wind power plants planned for commissioning, the installed generating capacity of which is 100 MW or more (Annexes No. 16 and 18), and Lists of hydropower plants planned for commissioning, the installed generating capacity of which is 100 MW or more (Annexes No. 15, 17, and 19).

28. Decree of the Government of the Russian Federation N99 of 04.02.2025 «On amendments to certain acts of the Government of the Russian Federation».
29. Resolution of the Government of the Russian Federation No1381r of May 29, 2025 «On Amendments to the Resolution of the Government of the Russian Federation N1-r of 08.01.2009».
30. Russian Government Resolution No. 4153-r of December 30, 2024 «On the General Scheme for Power Facility Locations until 2042».



SPP ON THE TERRITORY OF THE OMSK OIL REFINERY,
OMSK REGION



3

RENEWABLE ENERGY DEVELOPMENT IN RETAIL ELECTRICITY MARKETS

in 2024 and the first half of 2025

Implemented investment projects of renewable energy generation in retail markets

In June 2024, as part of a mechanism to support RES generation in retail electricity markets, a 9.2 MW solar power plant was commissioned in the Achkhoy-Martan district of the Chechen Republic — the first power plant in Russia to use tracking systems. Also, in September, a complex of three solar power plants with a total capacity of 37.9 MW was commissioned in the Artinsky urban district of the Sverdlovsk Region. The owner of these solar power facilities is Hevel Regional Generation LLC.

As of 01.07.2025, the installed capacity of RES generation facilities that operate within the framework of the support mechanism in the retail electricity markets, and for which a tariff for electricity purchased to compensate for losses in the grids amounts to 162.6 MW, where 137.4 MW — are facilities commissioned according to the results of competitive selections, 25.2 MW — facilities built without competitive procedures, qualified and selling electricity to the grid at a special tariff.

The support mechanism in retail markets ensures the project's payback through a tariff for priority purchase of renewable electricity to compensate for losses of electric grid companies. According to RREDA, in 2025, a special tariff for the sale of electricity is set for 34 RES generation facilities.

In October 2024, a decision was made to terminate the qualification of one power plant from the list of qualified generating facilities receiving a tariff for electricity purchased to compensate for losses in the grids. The tariff for 2025 has not been set for the Novokarachaevskaya sHPP, located in the Karachay-Cherkess Republic.

21 solar generation facilities, operating in the Republics of Bashkortostan, Adygea, the Chechen Republic, Sverdlovsk Region, the Krasnodar Krai, and owned by Hevel RG LLC, VIE LLC, Kurai Solar LLC, LUKOIL-Kubanenergo LLC, sell electricity at a special tariff. In the first half of 2025, tariffs are in the range of 10.5 — 18.8 rubles/kWh.

For wind power generation projects, tariffs have been set for two qualified facilities in the Orenburg Region at the level of 5.2 rubles/kWh (EcoSelEnergo LLC).

Also, the tariff for 2025 is set for six small hydro generation facilities located in the Republic of Karelia, the Karachay-Cherkess and Chechen Republics, as well as the Oryol Region. Tariffs are set at 3.69–15.92 rubles/kWh. The lowest ssingle-rate prices (up to 5 rubles/kWh) are determined for Uchkulanskaya and Lyaskelya sHPP, located in the Republic of Karachay-Cherkessia and the Republic of Karelia, respectively.

In the bioenergy sector, in 2025, electricity tariffs are set for five qualified facilities, including three biogas plants located in the Belgorod and Moscow Regions, one biomass-based facility in the Vologda Region, and one landfill gas-based facility in the Moscow Region. Tariffs for biofuel power plants are 5.07–13.37 rubles/kWh.

Competitive selection of RES generation projects in retail electricity markets, which took place in November 2024, in Moscow, Amur, and the Jewish Autonomous Region, was declared invalid. In the Amur and the Jewish Autonomous Region, no applications were submitted for the competitive selection, and in the Moscow Region, the applications received were deemed ineligible due to the requirements specified in paragraph 270(1) of the Basic Provisions for the Functioning of Retail Electricity Markets, Decree of the Government of the Russian Federation No. 442 dated May 4, 2012 «On functioning of retail electricity markets, full and/or partial restriction of the electricity consumption».

In August 2024, a competitive selection was also held in the Novgorod Region. It should be noted that the competitive selection was carried out ahead of the deadline stipulated by the Basic Provisions for the Functioning of Retail Electricity Markets, approved by Russian Government Decree No. 442[31] of 04.05.2012 «On functioning of retail electricity markets, full and/

31. Decree of the Government of the Russian Federation No. 442 dated May 4, 2012 «On functioning of retail electricity markets, full and (or) partial restriction of the electric energy consumption».

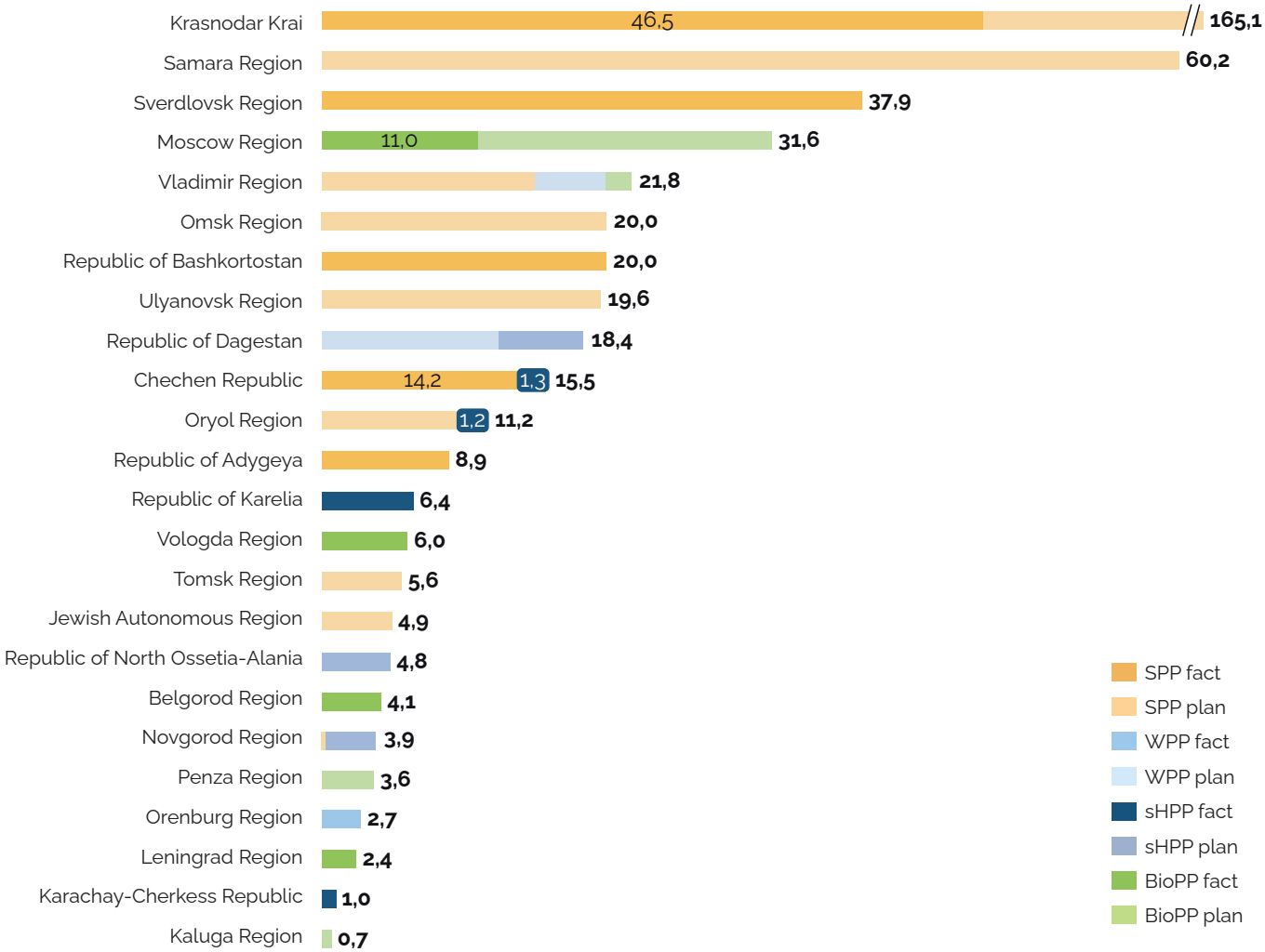
or partial restriction of the electricity consumption», however, no decision to cancel the competition was made. NovHydroEnergo JSC won the competitive selection process with its 0.55 MW Paper Factory sHPP project. The planned electricity generation cost for the projects is 24,180 rubles/MWh.

In total, as part of the stimulation of the segment of retail renewable energy markets, projects for 618 MW were selected in 24 regions of Russia, based on the results of competitive selections of investment projects for the construction of renewable energy facilities from 2016 to 2024. Later, for projects with a total capacity of 89 MW, the contracts were terminated due to refusal to implement them as scheduled or because the selection results were considered invalid. Presently, renewable energy generation facilities of 356 MW are considered relevant for construction. Regional distribution of existing and planned renewable energy facilities, when electricity is sold in retail markets, is shown in *Fig. 28* (as of July 2025). The largest portfolio of renewable energy generation in terms of installed capacity currently operates in the Krasnodar Krai (46.5 MW), in the Sverdlovsk Region (37.9 MW), and the Republic of Bashkortostan (20.0 MW).

Volumetric indicators of the results of the past RES generation project selections in the retail electricity markets by years of competitive procedures are presented in *Fig. 29*.

At the beginning of 2025, the power plants operating in Moscow that use biogas generated from sewage sludge as fuel, the Lyubertsy mini-TPP with

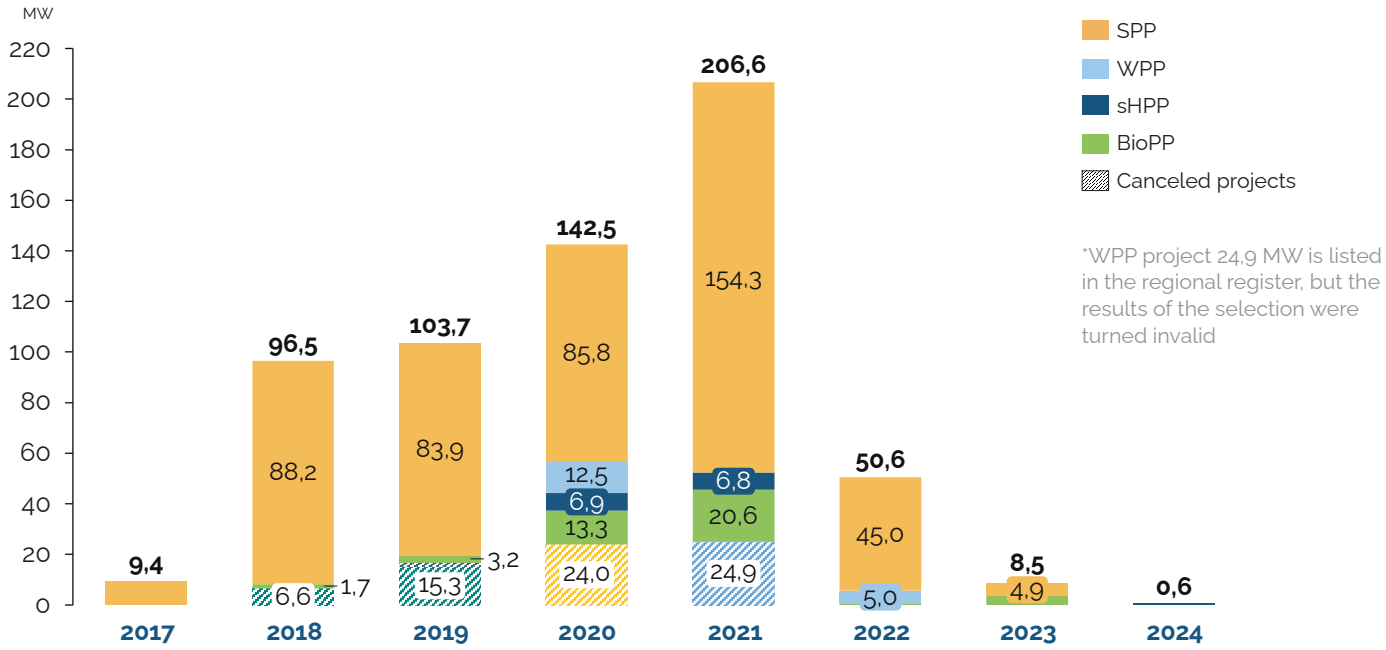
Fig. 28 | Regional distribution of existing and selected renewable energy projects operating under the retail support mechanism, MW



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

a capacity of 13.69 MW (commissioned in 2014) and the Kuryanovo mini-TPP with a capacity of 12.46 MW (commissioned in 2009), began to be counted as RES generation facilities operating in retail electricity markets outside the support mechanism.

Fig. 29 | Volumes of selected RES projects in retail electricity markets, MW



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

Changes in renewable energy legislation in the retail electricity markets

In accordance with Decree of the Government of the Russian Federation No. 562[32] dated May 3, 2024, investors implementing projects in the field of renewable energy in retail markets have the right to postpone the planned date of commissioning of the facility within 24 months or abandon the implementation of the investment project. This right can be used until July 1, 2024, if the project was selected according to the results of regional competitive selections held before April 1, 2022. Information about the changed planned date of commissioning of the generating facility or its exclusion is entered into the regional register[33] of renewable energy generation facilities by the executive body of the region authorized to conduct project selections.

The Decree also synchronizes the local-content requirements in retail markets with the requirements currently in force in the wholesale market: starting from the 2024 competitive selection, the level of localization for the project will correspond to the target set for the planned year of commissioning of the generating facility. For projects whose planned commissioning date will be postponed according to the provided right, along with the possibility to apply a new approach to meeting local content requirements, there is the possibility to use the current procedure applied for already selected projects, i.e., according to the target set for the year of the actual commissioning.

In September 2024, **the Decree of the Government of the Russian Federation No. 1227[34] of 07.09.2024 «On Amendments to the Decree of the Government of the Russian Federation No. 442 of May 4, 2012»**,

32. Decree of the Government of the Russian Federation No. 562 dated May 3, 2024 «On Amendments to certain acts of the Government of the Russian Federation on functioning of the wholesale electricity and capacity market and retail electricity markets».
33. In connection with the transition from regional development schemes to a unified prospective Development Program and Scheme of the Russian Electric Power Systems (hereinafter referred to as DPSREPS), information on selected projects for the construction of renewable energy facilities in retail markets from 2023 should be put in regional registers of RES generation facilities.
34. Decree of the Government of the Russian Federation No. 1227 of 07.09.2024 «On Amendments to the Decree of the Government of the Russian Federation No. 442 of May 4, 2012».

stated requirements for the provision of financial guarantees for participants in RES generation retail competitive selection.

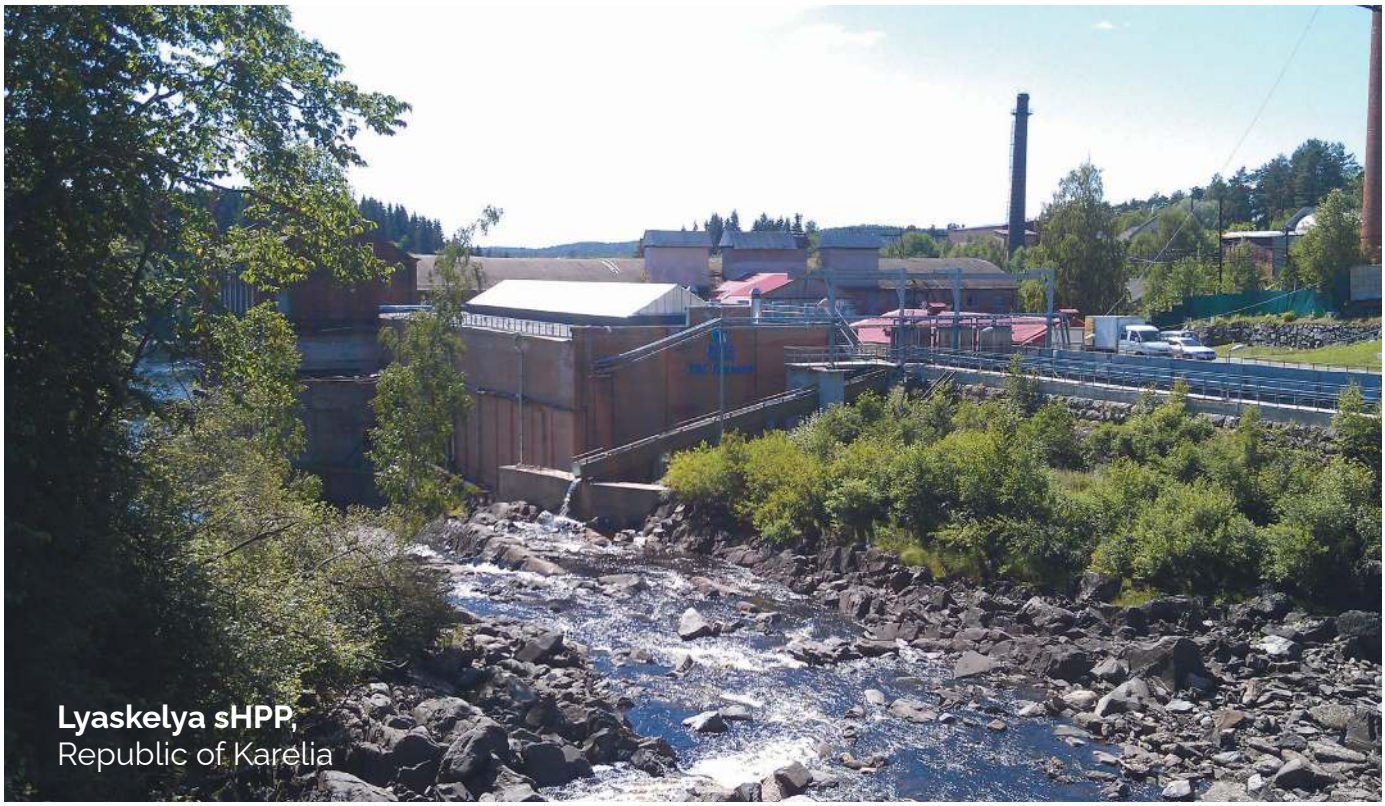
Since 2024, participants who have provided a bank guarantee separately for each project for which an application for participation in the selection of projects has been submitted are eligible to participate in the selection. Proper performance of the obligations upon commencement of electrical energy production by the Decree is determined by the submission of documents no later than 18 months from the scheduled date of generating facility commissioning, confirming at least 70% of the planned installed capacity of the generating facility specified in the tender bid.

The amount of money payable under the bank guarantee must be at least 10% of the production of the maximum price (tariff) limit for electrical energy (capacity) produced at the qualified generating facility, and planned annual electricity production (capacity).

The implementation of financial guarantees in retail markets will significantly reduce the risks of bidding at unreasonably low prices without participants' intention to subsequently fulfil obligations. Taking into account the existing quota in retail markets for the construction of renewable energy projects, financial guarantees are a necessary condition for the investment attractiveness of retail projects.

In November 2024, a change of approach to the regulation of prices (tariffs) for electrical energy (capacity) produced at qualified generating facilities and acquired to compensate for losses in electricity grids was implemented. According to **the Government of the Russian Federation Decree of N1611 dated November 23, 2024[35],** for generating facilities commissioned following retail competitive selection, the tariff will be approved in the form of a formula that provides for indexation using the consumer price index. Previously, the tariff was set at a single value for 15 years at the level of the single-rate price declared during the competitive selection.

Indexation of the planned cost of producing 1 MWh of electrical energy (capacity) declared by the investor for selection will reduce investment risks for market participants. The Resolution also adjusted the specifics of postponing the competitive selections date in the event of the entry into force of Russian Government acts affecting the conditions for conducting



Lyaskelya sHPP,
Republic of Karelia

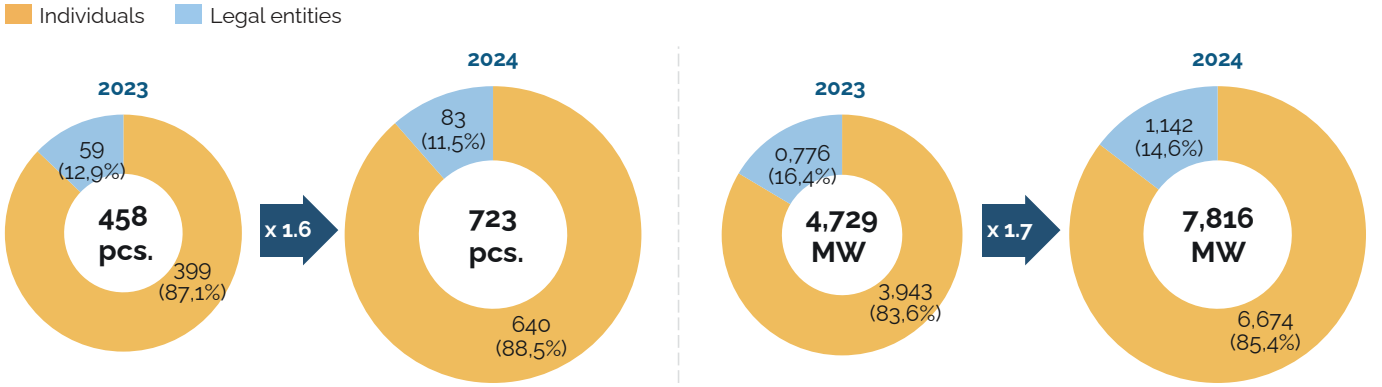
35. Decree of the Government of the Russian Federation No. 1611 of November 23, 2024 «On Amendments to Certain Acts of the Government of the Russian Federation».

competitive selections less than 45 days before the deadline for submitting applications for participation in the selection:

- the minimum period for determining a new deadline for submitting applications has been reduced from 50 to 30 days from the date of entry into force of the specified acts of the Government of the Russian Federation;
- the latest date for postponing the deadline for submitting applications has been set as December 20 of the calendar year in which the decision to conduct a selection of projects was made.

Development of the renewable energy microgeneration market in Russia

Fig. 30 | Number of contracts for electricity sale and a total capacity of the microgeneration RES facilities



Source: Minenergo of Russia, Association of default retail suppliers and energy supply companies

At year-end 2024, the number of sales contracts for the electricity produced at microgeneration facilities, concluded with guaranteed electricity suppliers, is 723, including 640 contracts concluded with individuals, 83 — with legal entities. The total installed capacity of renewable energy microgeneration facilities in Russia is 7.8 MW. At the same time, compared to 2023, the number of contracts has increased 1,6 times *(Fig. 30).*

Facilities that sell excess electricity to the grid in amounts not exceeding 15 kW are located in the territory of 48 regions. The largest volume of capacity and number of contracts are registered in the Krasnodar Krai, Rostov, Moscow, Volgograd Regions, and the Republic of Tatarstan.

Renewable energy development in isolated energy systems

Isolated territories are subdivided into technologically isolated territorial energy systems (TITES)[36] and other territories that are not technologically connected to the UES. The TITES include isolated power systems, comprising large generating facilities, connected by high-voltage electrical grids, in the regions of the Far East and the Arctic zone of the Russian Federation: Chukotka Autonomous Area, Magadan, Sakhalin, Krasnoyarsk, and Kamchatka Regions. Other (non-TITES) territories that are not technologically connected to the UES of Russia include the eastern part of the Murmansk and the north-eastern part of the Arkhangelsk Regions, most of the territory of the Nenets Autonomous Area and Yamalo-Nenets Autonomous Region, the north-eastern part of Krasnoyarsk and the northern part of Irkutsk and Khabarovsk Regions, the northern part of the Sakha Republic (Yakutia), as well as other remote and (or) hard-to-reach territories, for which energy supply is carried out from local energy complexes.

36. In accordance with Decree of the Government of the Russian Federation No. 84 dated January 31, 2024 «On amendments to Decree of the Government of the Russian Federation No. 937 dated August 13, 2018», the list of TITES presented in the Annex to the Rules of technological functioning of electric power systems is given in a new edition.

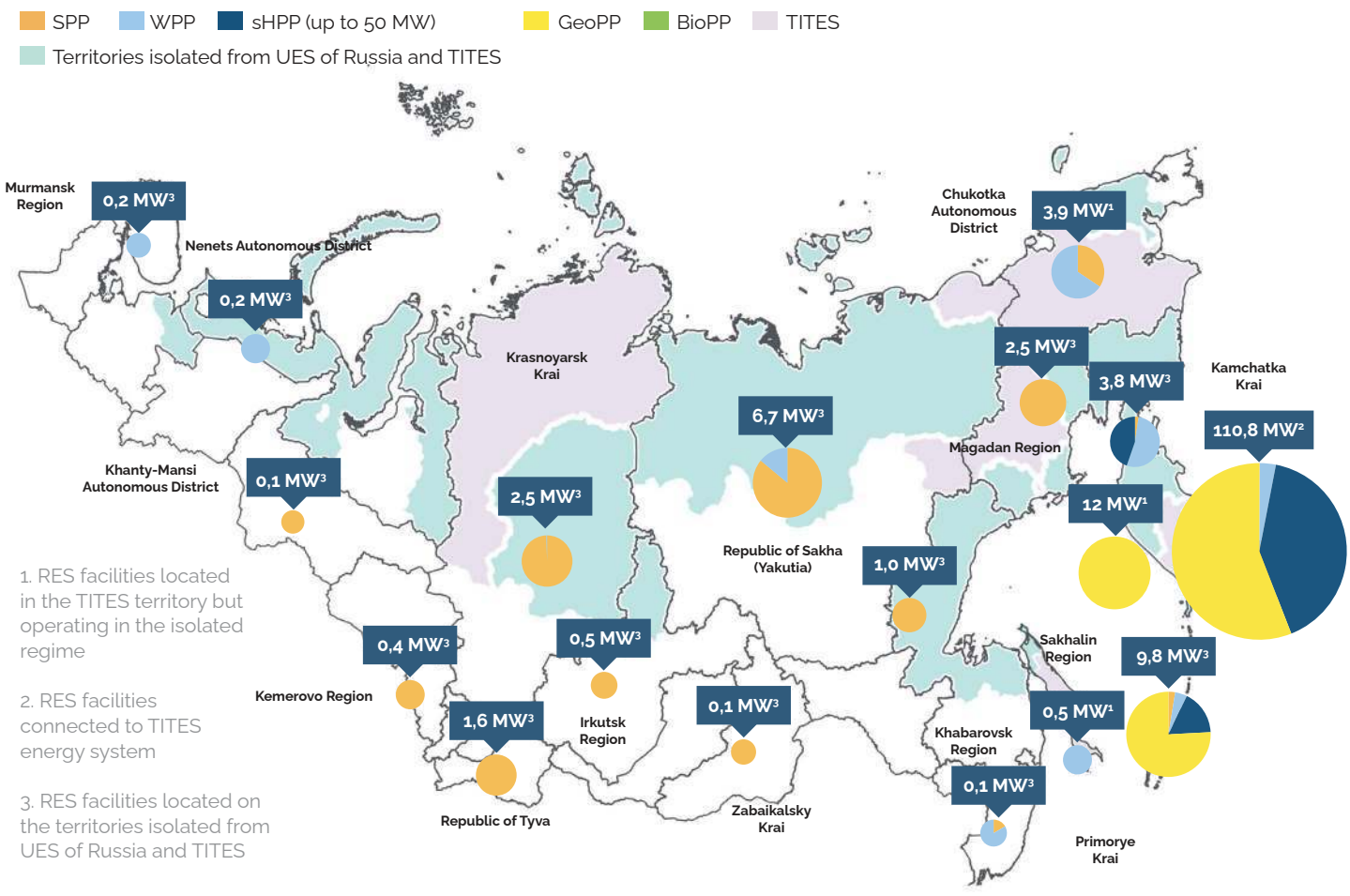
In 2024, new RES generation facilities in isolated areas were primarily commissioned in remote communities with difficult logistics and high costs of electricity from traditional sources. Thus, in the Kamchatka Region, from January 1, 2024, the fourth WPP with a capacity of 0.3 MW was commissioned at «VES-23» in Ust-Kamchatsk (total capacity of 1.475 MW), as well as the SPP 0.09 MW at the diesel power plant «DPP-19» to reduce the use of diesel fuel.

From October 2024 to January 2025, 6 solar energy facilities with a total capacity of 0.79 MW were commissioned in 6 villages in isolated areas of the Republic of Sakha (Yakutia): Oymyakon, Topolinoye, Orto-Balagan, Sanyyakhtakh, Daban, and Uritskoye.

Presently, 2.5% of the total installed capacity of renewable energy generation facilities in Russia is in isolated and hard-to-reach territories, which corresponds to about 156 MW. At the same time, half of the capacity is provided by geothermal power plants. Solar and wind power plants in the TITES account for 15 MW and 10 MW, respectively. A map of the distribution of existing renewable energy capacities by regions and technologies is shown in *Fig. 31.*

For the period up to the end of 2026, additional renewable energy generation facilities of 31 MW are planned to be built in isolated energy districts. By the end of 2029, another 95 MW are planned to be commissioned[37]. The largest amount of commissioning of RES generation facilities is expected in the Kamchatka Krai, the Sakhalin Region and the Republic of Sakha (Yakutia), and the Chukchi Autonomous Region.

Fig. 31 | The total installed capacity of renewable energy generation facilities in isolated energy systems of Russia, MW



1. RES facilities located in the TITES territory but operating in the isolated regime

2. RES facilities connected to TITES energy system

3. RES facilities located on the territories isolated from UES of Russia and TITES

Sources: RREDA.

37. The information is provided in the Program for the Modernization of Local Generation Facilities in the Far Eastern Federal District, approved by the Ministry of Energy of Russia on June 10, 2024.

Presently, the Kamchatka Krai is conducting comprehensive work aimed at the construction of RES generation facilities. In the central energy hub of the Kamchatka TITES, 66.5 MW of GeoPP (Mutnovskaya GeoPP-1, Mutnovskaya GeoPP-2) and a 6 MW HPP (Tolmachevskaya HPP-4) are planned for commissioning.

The region plans to modernize and build renewable energy facilities (WPP, SPP) in 41 localities and a production facility in isolated power hubs of Kamchatka Krai with a total capacity of 42.5 MW.

RES generation facilities of 58 MW are planned to be built in the Sakhalin Region, including several WPPs with a total installed capacity of 31 MW on the islands of Kunashir, Shikotan, and Sakhalin. Also, in terms of the renewable energy development, it is planned to build a 5 MW Oceanic geothermal power plant on Iturup Island.

Active promotion of diesel generation modernization projects based on hybrid energy complexes, including diesel and solar generation with energy storage, is underway in the Republic of Sakha (Yakutia). The projects are implemented within the framework of cooperation between the Government of Yakutia and RusHydro PJSC based on energy service contracts. Between the beginning of 2021 and July 2025, 12 projects were commissioned, and an additional 129 projects with a total solar generation capacity of 30.5 MW are planned for implementation.

The RES facilities with a total installed capacity of 11.4 MW operate in isolated areas of the Arctic zone of the Russian Federation. By 2030, approximately 23.5 MW of additional capacity is planned for commissioning. The largest facilities are planned for the Republic of Sakha (Yakutia): SPP as part of the Autonomous hybrid energy unit in Zyryanka (1.5 MW), Batagay (1.51 MW), and Srednekolymsk (1.35 MW). In the context of the global transition to sustainable energy and the growing interest in renewable energy sources, the implementation of RES generation in isolated territories of the Russian Federation represents a promising direction for ensuring reliable, environmentally friendly, and economically efficient energy supply.


Photo:
Dmitry Lebedev

Results of a comprehensive investment RES-field rating for the regions located in the territory of non-price zones of the wholesale electricity and capacity market and isolated power systems of the Russian Federation

LEADING REGIONS

THE FIRST PLACE
Kamchatka Region

THE SECOND PLACE
Sakhalin Region

THE THIRD PLACE
Republic of Sakha (Yakutia)

WINNERS IN THE NOMINATIONS

«THE GREENEST» REGION
Kamchatka Krai

INVESTOR'S CHOICE
Amur Region

THE MOST INDUSTRIAL RENEWABLE ENERGY REGION
Kaliningrad Region

THE MOST OPEN RENEWABLE ENERGY REGION
Republic of Sakha (Yakutia)

SOLAR ENERGY LEADER
Amur Region

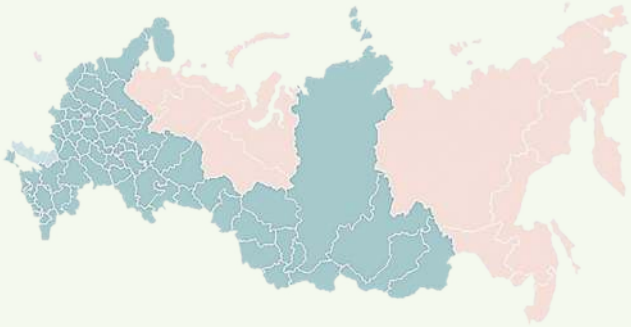
WIND ENERGY LEADER
Sakhalin Region

LEADER OF SMALL HYDROPOWER
Kamchatka Krai

LEADER IN BIOENERGY
Arkhangelsk Region

GEOTHERMAL ENERGY LEADER
Kamchatka Krai

In 2024 RREDA presented the results of a comprehensive investment rating for 15 regions based on the results of 2023.



in 11 regions
there are and/or will be projects for the RES facilities construction within the framework of the regions' own initiatives or based on the results of competitive selections

in 6 regions
there are prepared areas and/or ready-made investment proposals for the RES generation facilities placement

in 9 regions
goals, results and activities in the RES development field are formalized in strategic regional documents

in 4 regions
working groups (or other working bodies) are functioning on issues of renewable and low-carbon energy/electric transport development

in 7 regions
representatives of executive authorities took part in public events at the regional/federal/international level in 2022 and 2023

in 8 regions
environmental events, organized by the regional government, were held in 2022–2023

Kamchatka Region

- **1st place** in the comprehensive investment rating for 2023
- **Winner** in the «Greenest Region» category
- **Winner** in the «Small Hydropower Leader» category
- **Winner** in the «Geothermal Energy Leader» category

SPP	WPP	sHPP	GeoPP	Total RES
Actual installed RES generation capacity in the region by the end of 2023				
0,1 MW	5,0 MW	47,1 MW	74,0 MW	**126,2 MW**
Planned installed capacity indicators in 2029				
10,5 MW	6,9 MW	53,1 MW	140,5 MW	**211,1 MW**

Results of a comprehensive investment RES-field rating for regions of the first and second price zones of the wholesale electricity and capacity market

LEADING REGIONS

THE FIRST PLACE
Rostov Region

THE SECOND PLACE
Stavropol Krai

THE THIRD PLACE
Volgograd Region

WINNERS IN THE NOMINATIONS

THE MOST ACTIVE RENEWABLE REGION
Stavropol Krai

«THE GREENEST» REGION
Republic of Kalmykia

INVESTOR'S CHOICE
Astrakhan Region

THE MOST INDUSTRIAL RENEWABLE ENERGY REGION
Chuvash Republic

LIDER IN LEGAL REGULATION
Republic of Daghestan

THE MOST OPEN RENEWABLE ENERGY REGION
Republic of Tatarstan

SOLAR ENERGY LEADER
Zabaikalsky Krai

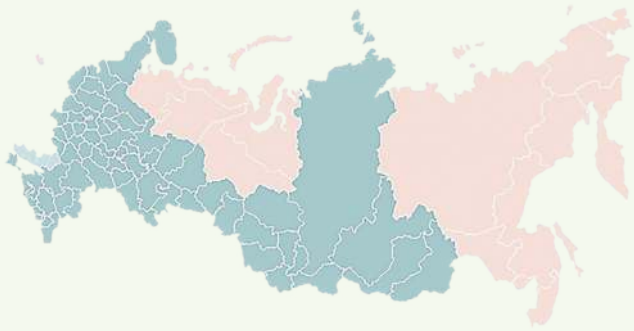
WIND ENERGY LEADER
Rostov Region

LEADER OF SMALL HYDROPOWER
Republic of Karelia

LEADER IN BIOENERGY
Moscow Region

LEADER IN THE ELECTRIC TRANSPORT SECTOR
Moscow city

In 2025 RREDA updated the comprehensive investment rating results for 67 regions in price zones based on the results of 2024



in 38 regions

investment projects for the RES generation facilities construction have been implemented and/or are planned for implementation within the framework of the first and second stages of the CSA RES, as well as support in the retail electricity markets

in 16 regions

there are permanent working groups on the development of renewable and hydrogen energy, the development of electric transport, as well as on climate policy and decarbonization issues

in 43 regions

specific activities and goals are planned in the socio-economic development strategy or other documents aimed at the implementation and support of RES sources/there is a special program for the RES generation development

in 8 regions

roadmaps for the RES development have been approved/laws on the RES use have been adopted/strategies in the field of sustainable development and the RES development have been approved

in 23 regions

more than 70 agreements/memoranda on cooperation in the RES development field and within the framework of individual RES investment projects have been concluded between regional governments and investment companies

Rostov Region

- **1st place** in the comprehensive investment rating for 2024
- Winner in the «Wind Energy Leader» category
- **2nd place** in the «Most Industrialized Renewable Energy Region» category
- **3rd place** in the «Most Active Renewable Energy Region» category
- **4th place** in the «Investor's Choice» category
- **5th place** in the «Leader of Legal Regulation» category

SPP	WPP	sHPP	Total RES
Actual installed capacity of renewable energy generation in the region by the end of 2024			
0,5 MW	607,3 MW	–	**607,8 MW**
Planned installed capacity indicators in 2030			
0,5 MW	981,6 MW	–	**982,2 MW**

Conclusion

The energy transition continues to accelerate all over the world, including Russia. In the context of forecasting local electricity and capacity shortages against the background of outrunning growth of energy consumption and disposal of used-up thermal generation capacities, not only do more affordable and cheap technical solutions become relevant, but also faster in implementation.

Speed is a factor that becomes key-note in our high-tech world. Economic transformations that would have taken decades half a century ago can now occur in literally a year. Solutions that can be implemented quickly are now more relevant. The constant increase in the cost of financing also contributes to a revaluation of values. Long-term projects that take five to ten years to implement become the most risky or unprofitable.

The acceleration that rapidly developing new energy technologies have given to the global energy transition truly impresses and once again proves that in the modern world, even the most incredible predictions come true. Even the most optimistic experts did not predict a fivefold increase in global energy transition investment ten years ago, nor that the total global RES generation capacity would grow threefold. The fourfold increase in installed capacity of Russian RES between 2015 and 2025 is, of course, primarily explained by the low base effect, but if we make a forecast today, it is clear that high rates will continue over the next decade, with this figure increasing by another threefold.

The pace of structural change in the electric power industry is accelerating. Within just one 2024 year, project economics have changed fundamentally. The gap in final electricity prices for different technologies reaches 50–70%. For the first time in the history of the UES of Russia, a competitive selection of energy transition projects was planned to prevent local electricity shortages, opening up new prospects for this market. By 2025, in addition to the previously approved support programs, approximately 2,000 MW of RES generation and BESS were planned to promptly respond to the risks of energy shortages. In the future, a combination of such solutions could become an important component of the long-term planning system for energy system development.

Initiatives implemented over the past year in the electricity and capacity market have formed a fundamental base for the sustainable long-term development of the national energy transition sector. The General Scheme until 2042, adopted at the end of 2024, envisages the construction of approximately 10 GW of RES generation capacity over the next ten years. The updated Energy Strategy-2050, in addition to a Target Scenario that assumes a 40% increase in RES generation capacity in Russia by 2050, also considers an Accelerated Energy Transition Scenario that envisages higher rates of RES-based energy sector decarbonization. The set of priority measures of the Energy Strategy-2050 for increasing the electric power industry efficiency includes the optimization of the wholesale electricity and capacity market mechanisms to increase the level of competition, and the important one is technology-neutral tenders of power generation projects. This direction will be crucial in terms of improving mechanisms for attracting investment into the industry, aimed at compensating for the risks of electricity and capacity shortages.

Accounting of certain RES facilities in the electrical energy and capacity balances based on more advanced methods will optimize the power plants' operating mode, effectively adjust the system of incentives to improve the quality of forecasting the generation of electrical energy by RES facilities, and also become the basis for further adaptation of the wholesale power market to actual global trends. Systematization of the regular additional selections of RES generation or technology-neutral selections in the territories of high risks of electricity and capacity shortages will become a crucial factor for further increase of RES and BESS projects efficiency.

List of abbreviations

BioPP	Biofuel power plant
BNEF	Bloomberg New Energy Finance
CCPP	Combined cycle power plant
CMA NGF	Capacity Market Auction of New Generating Facilities
CCUS	Carbon capture, utilization, and storage technology
CF	Capacity factor
CIS EPC	Electric Power Council of the Commonwealth of Independent States
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change
CSA RES	Capacity Supply Agreements for Renewable Energy Sources
DPP	Diesel power plant
DPSREPS	Development Program and Scheme of the Russian Electric Power Systems
EAEU	The Eurasian Economic Union
FBA RES	Free bilateral agreement with a qualified RES generation facility
FEA	Federal executive authorities
FID	Final investment decision
GDP	Gross domestic product
GeoPP	Geothermal power plant
GHG	Greenhouse gas
GW	Gigawatt
GWh	Gigawatt-hour
HPP	Hydro power plant
IEA	International Energy Agency
IES	Integrated Energy System
IRENA	International Renewable Energy Agency
kW	Kilowatt
kWh	Kilowatt-hour
MW	Megawatt
MWh	Megawatt-hour
NPP	Nuclear power plant
NZE	The IEA scenario for achieving carbon neutrality (Net Zero Emissions)
R&D	Research and development
REM	Retail electricity market
RES	Renewable energy sources
RESPS	Competitive selection of investment projects for the construction of renewable energy generation facilities
RREDA	Russia Renewable Energy Development Association
SCO	Shanghai Cooperation Organization
sHPP	Small hydro power plant (up to 50 MW)
SO UPS	System operator of the Unified Power System
SPIC	Special investment contract
SPP	Solar power plant
SEPP	Steam electic power plant
TITES	Technologically isolated territorial energy systems
TidPP	Tidal power plant
TSA	Trading System Administrator (wholesale electricity and capacity market)
TWh	Terawatt-hour
UES	Unified Energy System of Russia
WECM	Wholesale Electricity and Capacity Market

А Р В Э
АССОЦИАЦИЯ РАЗВИТИЯ
ВОЗОБНОВЛЯЕМОЙ ЭНЕРГЕТИКИ

About the Association

Russia Renewable Energy Development Association (RREDA) is the leading expert platform in Russia in the field of renewable energy, representing the interests of the largest and most active participants in the Russian renewable energy sector and low-carbon hydrogen sector — a growing high-tech market with investments already made in the amount exceeding 600-700 billion rubles.

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



Adygeiskaya WPP,
Republic of Adygea

Our mission

PROMOTION OF EFFICIENT AND HARMONIOUS ENERGY TRANSITION THROUGH COMPREHENSIVE SUPPORT FOR THE RENEWABLE AND HYDROGEN ENERGY DEVELOPMENT.

Activities:

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 sectoral statistics (market reviews, investment ratings, forecasts, registers, etc.).

International cooperation

Organization of interaction and exchange of experience with foreign sectoral communities, associations, and international organizations, support for the promotion of Russian technologies and competencies in foreign markets, and support and monitoring of international projects of the Association member companies.

Public relations

Popularization of the energy transition topic in public space. Promotion of the consolidated position of market participants in the information field and the formation of a positive image of the industry. Organizing and conducting sectoral events, providing information support for the activities of Association members, and representing their interests in the mass media.

Education and science

Assistance in the formation of a professional training system, including support to educational institutions for the development of specialized professional development programs, assistance in the development of governmental sectoral programs to stimulate research and development in the field of renewable and hydrogen energy..

Interaction with government bodies

Development of policy initiatives to ensure the accelerated and harmonious development of renewable and hydrogen energy industries, participation in the development and preparation of draft legislative and regulatory documents, and expert support to public authorities in making strategic decisions. Participation in key sectoral working groups of federal and regional executive and legislative authorities, infrastructure, and international organizations to form a stable regulatory framework and institutional environment.



Kaliningrad Region
Photo: Sergei Shalatov

Annex 1.
Input data for estimating the range of LCOE/LCOS indicator values.

For global average data,
the following macroparameter values were used:
weighted average cost of capital (WACC) — 8%,
CPI — 2%,
income tax — 21%.

For the Russian data,
the following macroeconomic parameters were used:
WACC — 20,5%,
CPI — 4%,
income tax rate — 25%,
dollar exchange rate — 80 rub/$.

Table 1.1. Traditional basic generation (world)

		TPP CCPP		TPP SEPP (coal)		NPP		HPP	
		min	max	min	max	min	max	min	max
Commissioning period	year	15	30		40	40	70	50	70
Construction period	year	2	5	3	6	7	10	7	10
CAPEX	$/kW	1,200	1 600	3 405	7 210	9 020	14 820	824	2 433
OPEX	$/kW per year	32	39	64	127	171	198	16	49
Fuel cost	$/MWh		23		14		5		–
CF	%	60	90	65	85	89	92	35	50
Power plant consumption	%		3.3	6.9	8.1	6	7.5		0.5
LCOE	$/MWh	48	80	77	182	53	276	23	109

Table 1.2.1. Traditional generation (Russia)

		TPP SEPP (gas)		TPP SEPP (coal)		NPP		HPP	
		min	max	min	max	min	max	min	max
Commissioning period	year		40		40	40	70	50	70
Construction period	year	3	5		5	7	10	7	10
CAPEX	$/kW	2 263	4 901	4 375	4 901	3 225	5 161	2 500	4 000
OPEX	$/kW per year	30	60	38	51	61	65	23	38
Fuel cost	$/MWh	13	23	17	39		5		–
CF	%	60	75	60	75	80	85	35	50
Power plant consumption	%		5.8	6.9	8.1	6	7.5		0.5
LCOE	$/MWh	106	314	224	343	177	341	194	508

Table 1.2.2. Traditional generation (Russia) — CCPP considering regional differentiation based on the results of the competitive selection of capacity for new generating facilities

		TPP CCPP		TPP CCPP (South)		TPP CCPP (Siberia)		TPP CCPP (East)	
		min	max	min	max	min	max	min	max
Commissioning period	year	15	30	25		25		25	
Construction period	year	4	5	5		5		5	
CAPEX	$/kW	1 931	4 901	1 931		4 273		4 901	
OPEX	$/kW per year	30	60	30.7		50.9		60	
Fuel cost	$/MWh	9.9	17.4	16		9.9		17.4	
CF	%	60	80	80		80		80	
Power plant consumption	%		3.3	3.3		3.3		3.3	
LCOE	$/MWh	92	293	106		200		237	

Table 2.1. RES-based generation (world)

		SPP		WPP	
		min	max	min	max
Commissioning period	year	15	25	25	30
Construction period	year	1	1.5	1.5	2
CAPEX	$/kW	591	1 058	856	1 670
OPEX	$/kW per year	11	14	25	93
Fuel cost	$/MWh	–		–	
CF	%	14	23	30	55
Power plant consumption	%		0.5	0.5	0.5
LCOE	$/MWh	34	112	22	102

Table 2.2. RES-based generation (Russia)

		SPP		WPP	
		min	max	min	max
Commissioning period	year	15	25	25	30
Construction period	year	1	1.5	1.5	2
CAPEX	$/kW	813	1 000	1 375	1 875
OPEX	$/kW per year	9	19	25	44
Fuel cost	$/MWh	–		–	
CF	%	14	19	28	38
Power plant consumption	%		0.5		0.5
LCOE	$/MWh	99	189	70	181

Table 3.1. Peak generation (world)

		TPP Gas peaking		PSPP		BESS (6h)	
		min	max	min	max	min	max
Commissioning period	year	15	30	50	70		25
Construction period	year	2	5	7	10	0.5	1
CAPEX	$/kW	1 150	1 450	1 000	3 000	835	2 155
OPEX	$/kW per year	15	21	40	120	18	48
Fuel cost	$/MWh		36	–		–	
CF	%	13	23	13	23	13	23
Power plant consumption	%		3.3	8	15		8
LCOE	$/MWh	105	195	82	508	51	240

Table 3.1. Peak generation (Russia)

		TPP Gas peaking		PSPP		BESS (6h)	
		min	max	min	max	min	max
Commissioning period	year	15	30	50	70		25
Construction period	year	3	5	7	10	0.5	1
CAPEX	$/kW	1 275	2 040	1 563	2 500	1 900	2 588
OPEX	$/kW per year	31	60	23	38		19
Fuel cost	$/MWh	14	25		–		–
CF	%	13	23	13	23	13	23
Power plant consumption	%		3.3	8	15		8
LCOE	$/MWh	185	629	290	1 162	197	487

Table 4.1. Hybrid RES generation systems and BESS (world)

		SPP + BESS (50%, 6 h)		WPP + BESS (50%, 6 h)		SPP (50%) + WPP(50%) + BESS (50%, 6 h)	
		min	max	min	max	min	max
Commissioning period	year		25		25		25
Construction period	year	1	1.5	1.5	1.5	1.5	1.5
CAPEX	$/kW	1 009	2 136	1 274	2 748	1 141	2 442
OPEX	$/kW per year	20	38	34	117	27	78
Fuel cost	$/MWh	–		–		–	
CF	%	14	23	30	55	22	39
Power plant consumption	%	2.9	3		1.8		1.5
LCOE	$/MWh	61	200	34	152	41	167

Table 4.2. Hybrid RES generation systems and BESS (Russia)

		SPP + BESS (50%, 6 h)		WPP + BESS (50%, 6 h)		SPP (50%) + WPP(50%) + BESS (50%, 6 h)	
		min	max	min	max	min	max
Commissioning period	year		25		25		25
Construction period	year	1	1.5	1.5	2	1.5	2
CAPEX	$/kW	1 763	2 294	2 325	3 169	2 044	2 731
OPEX	$/kW per year	18	28	35	53	26	41
Fuel cost	$/MWh	–		–		–	
CF	%	14	19	28	45	21	32
Power plant consumption	%	2.9	3.3	1.9	2	2.3	2.5
LCOE	$/MWh	220	409	130	299	159	342

Table 5. Small generation.

		World		Russia	
		sHPP		sHPP	
		min	max	min	max
Commissioning period	year	30	50	30	50
Construction period	year	2	5	2	5
CAPEX	$/kW	1 500	5 500	2 750	4 000
OPEX	$/kW per year	60	220	33	41
Fuel cost	$/MWh	–		–	
CF	%	35	50	35	50
Power plant consumption	%		0.5		0.5
LCOE	$/MWh	46	268	151	373

* Designation: for hybrid systems, the contribution of WPP and SPP to the installed capacity of the system (in case of their combination) is indicated in brackets, as well as the availability of such BESS systems (in % of installed capacity) with a specified capacity (in h). For other types of generation, designations adopted in accordance with the regulations of the Ministry of Energy of the Russian Federation and the Government of the Russian Federation are used.

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