



Dagestan  
Development  
Corporation



Road map for development of renewable energy  
sources in the Republic of Dagestan for a period  
2020-2025

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**Makhachkala 2020**



## Table of contents

<b>Preamble.....</b>	<b>3</b>
<b>1. Current condition of Dagestan’s electric power system.....</b>	<b>3</b>
<b>2. Potential of renewable energy sources in the Republic of Dagestan.....</b>	<b>4</b>
2.1. Hydropower .....	5
2.2. Wind energy.....	6
2.3. Solar energy .....	7
2.4. Geothermal energy.....	7
<b>3. Sectoral strategy for development of RES in the Republic of Dagestan .....</b>	<b>8</b>
3.1. Portfolio of renewable energy projects in the Republic of Dagestan .....	11
3.2. Cluster approach for development of renewable energy in the Republic of Dagestan.....	12
3.3. Wind energy general policy .....	13
3.4. Solar energy general policy.....	14
3.5. Hydropower general policy .....	17
3.6. Geothermal energy general policy .....	20
<b>4. Support measures for development of RES in Russia .....</b>	<b>22</b>
4.1. The current state of RES development in the regions of Russia .....	22
4.2. Support measures for RES development on wholesale electricity market.....	23
4.3. Support measures for RES development on retail electricity market.....	24
4.4. Support measures for RES development in the Republic of Dagestan.....	25
<b>5. Project development stages .....</b>	<b>27</b>



## **Preamble**

The road map for development of renewable energy sources (hereinafter referred to as RES) in the Republic of Dagestan was developed in accordance with General Development Strategy of Dagestan Development Corporation JSC (hereinafter referred to as Corporation) for a period until 2025 and determines main directions, order of priority and coordinated action to stimulate development of investment projects in the field of RES, harness potential of the region's renewable energy resources, attract investments in this sector, provide consumers with clean energy and develop energy construction.

The main objective of this road map is to define priorities, phasing and key areas to attract investments for development of RES in the Republic of Dagestan for a period until 2025.

### **1. Current condition of Dagestan's electric power system**

The Republic of Dagestan has an extensive electric power distribution network operating on voltage 0.4 / 6-10 / 35 kV with a total length of more than 34.000 km, as well as high voltage network of the Unified Energy System (hereinafter referred to as UES) operating on voltage 110/330 kV which passes from North to South and to main substations with a total length of 3.650 km, which ensures to deliver power from newly commissioned renewable energy facilities.<sup>1</sup>

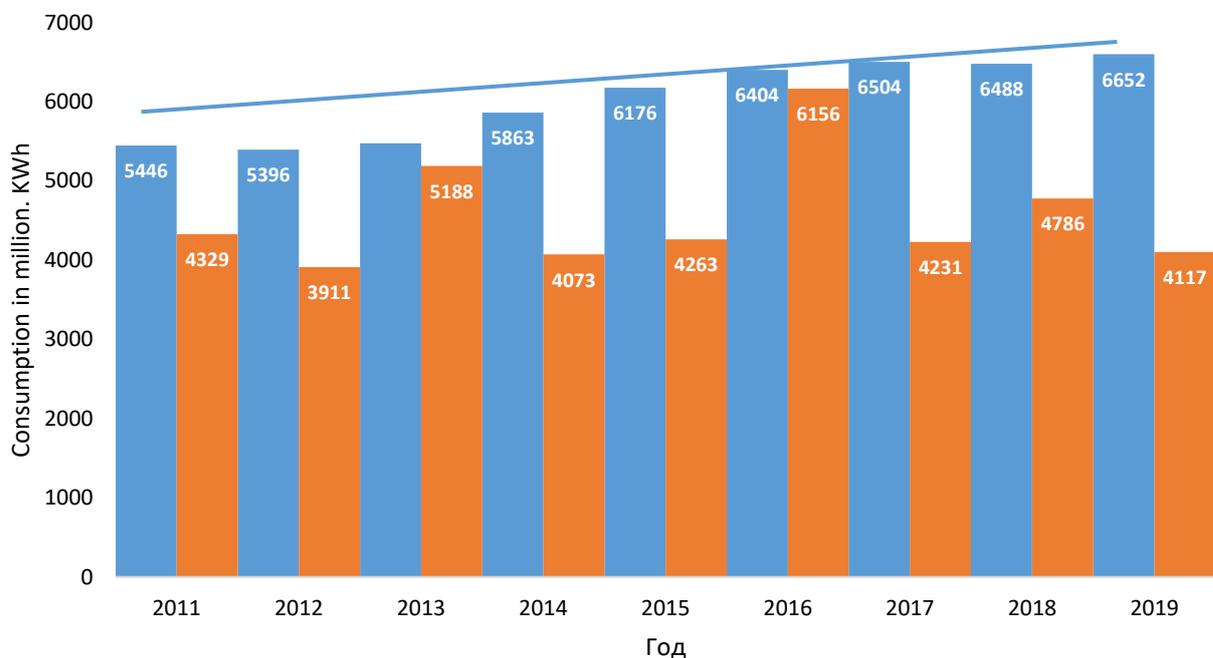
The energy system of Dagestan as of 2020 consists of 99% of renewable energy generating facilities, mainly represented by large hydroelectric power plants (hereinafter referred to as HPPs). In recent years, the growth in energy consumption has led to a shortage of generating capacities in the region. Due to sharp seasonal fluctuations in energy generation at existing HPPs, the balances of electricity are characterized by significant unevenness, which is compensated by interchange exchange from neighboring energy systems, mainly thermal power plants of the Stavropol Krai, as well as the Republic of Azerbaijan. In 2019 power plants in the region generated only 4.1 billion kWh, while consumption amounted 6.65 billion kWh. The Republic has been facing a shortage of own generation capacities for several years which has been covered by power exchange from the UES. Deterioration of the grid infrastructure has led to frequent interruptions in

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<sup>1</sup> From the materials of the Scheme and Program for the Prospective Development of the Republic of Dagestan until 2024

power supply to consumers. The balance of energy exchange in the Republic of Dagestan ranges from 1.7 to 2.5 billion kWh<sup>2</sup>.

Losses during transportation of electricity from energy generating facilities to consumers in Dagestan are caused by a high concentration of energy generation in the central part of the republic, and the complete absence of generation in the North and South. This has led to a regular power outages experienced by residents of remote settlements and affected the price of electricity for the end users. In recent years, the **inflow of water in the reservoirs of existing hydroelectric power plants has decreased**. In this regard, **the growth of electricity consumption requires a commensurate increase of new capacities** to ensure reliability of the power system.



*Picture 1: Electricity generation and consumption in the Republic of Dagestan*

## **2. Potential of renewable energy sources in the Republic of Dagestan**

Republic of Dagestan is one of the most promising regions in the Russian Federation for development and utilization of natural renewable energy resources.

The main directions for development of RES in the Republic of Dagestan are based on the most represented natural resources in the region – such as hydro, solar, wind and geothermal energy. According to scientific estimates, the hydropower potential is about 16-18 billion tons of fuel equivalent; solar energy

<sup>2</sup> According to JSC “System Operator of the Unified Energy System”

estimated at 23.6 billion tons of fuel equivalent, wind energy - 4.6 billion tons of fuel equivalent.

## 2.1. Hydropower

Dagestan is rich with water resources despite that river network is unevenly distributed over its territory. There are 6255 rivers flowing in the Republic of Dagestan, including 100 main rivers with length of more than 25 km and catchment area of more than 100 km<sup>2</sup>, 185 small and more than 5900 smallest rivers. The largest rivers are Terek, Samur and Sulak with tributaries. All rivers belong to a basin of the Caspian Sea, but only 20 rivers actually fall into the sea. Two main rivers of Dagestan source from mountains – Sulak in the North and Samur in the South, Terek river flows in the flat zone<sup>3</sup>.

The biggest mountain rivers including Sulak and Samur do not freeze in winter due to their fast flow, climatic features, high water and significant slopes.

According to research institutes technically feasibility hydropower potential of Dagestan is estimated at 38.6 billion kWh. The economically feasible hydropower potential according to expert estimates is 16 billion kWh (about 2% of consumption in the Russian Federation) and has been used by only 10-15%.

The Sulak River formed at the confluence of the rivers Avar Koisu and Andi Koisu, which originate in the mountains of the Greater Caucasus. The catchment area of the basin is 15.2 thousand km<sup>2</sup>. The Sulak river concentrate around the half of all Dagestan's hydropower resources. Almost all existing hydro power plants of the Dagestan Republic are located in the Sulak basin, including the largest: Chirkeiskaya, Irganayskaya, Miatlinskaya and Gotsatlinskaya HPPs.

The Samur River is the second largest river in Dagestan. The basin area is 7.3 thousand km<sup>2</sup>. More than 95.5% of the catchment area located in the Republic of Dagestan, and about 4.5% in Azerbaijan. The average long-term runoff is about 2 billion m<sup>3</sup>. When Samur falls into the Caspian Sea it splits into branches and forms a wide delta. Nowadays there are few small and micro hydropower facilities located in the basin on river Samur.

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<sup>3</sup> Reference book on water resources of the USSR. Volume X, North Caucasus



## 2.2. Wind energy

Wind energy potential of the Republic of Dagestan, according to the Dagestan Federal Research Center, is estimated at approximately 556 billion kWh per year, of which up to 11% (60 billion kWh / year)<sup>4</sup> is available for development, which is almost three times higher than the hydro potential of rivers in the region. However, the economically feasible part of the wind potential is limited by the capabilities of the existing energy grid infrastructure, transport infrastructure restrictions, protected bird areas and thus amounts to about 1 billion kWh per year.

The wind regime of the Republic of Dagestan is determined by the general circulation of the atmosphere (West - East transport) as well as by the nature of the underlying surface. The variety of topography and the proximity of the Caspian Sea change the overall wind flows, creating a very diverse wind regime, specific to each individual site.

Dagestan is located at junction of temperate and subtropical latitudes, characterized by high wind speeds in the coastal zone of the Caspian Sea. Observations of the wind regime in the territory of Dagestan are carried out at 24 meteorological stations which cover the coastal, plain, foothill and mountain regions of the Republic.

The wind speed, on average, ranges from 2 to 8 meters per second, depending on the geographic location. In high-mountains of Dagestan, wind speeds are minimal (Tlyarata - 1.3 m / s). In the foothill area of Dagestan the wind speed is higher (Akhty - 2.5 m / s, Buinaksk 3.5 m / s). Strong winds are typical for lowlands, on average 8.5 m/s for the coastal area between Makhachkala and the village of Sulak. Makhachkala along with Baku is one of the wind poles on the coast of the Caspian Sea is distinguished by especially increased wind weather.

In the northern low landing part of Dagestan, two main wind directions prevail throughout the year: southeast in summer and north-west in winter. From October to April, the winds of the eastern points (directions) prevail, the cause of which is the spur of the Siberian anticyclone. These winds are distinguished by their duration and relatively high speed. On the coast, the winds of the southeastern points are often called sea winds (wind blowing from the sea), which sometimes causes strong water surges on the coast.

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<sup>4</sup> According to the Geothermal institute of Russian academy of science



### 2.3. Solar energy

The Republic of Dagestan has one of the highest insolation conditions in the Russian Federation (the amount of solar radiation per m<sup>2</sup> and sunny days throughout the year) and a high level of solar potential of the territory.

Insolation indicators in the region vary, depending on local conditions and are averaged<sup>5</sup> 1670 kWh / m<sup>2</sup>, which is equal to the level of Italy or southern Germany. Moreover, high production rates were demonstrated during winter periods, which is almost uncharacteristic for other regions of the Russian Federation and is very important for the power system of the Republic of Dagestan and the UES.

The average annual rainfall in some areas is 399 mm, which is almost 2 times lower than the average annual rainfall in Central Russia. The duration of sunshine, for example, in the village of Akhty is the longest in Dagestan - 2,553 hours a year. In Central Russia, for example, the average annual number of hours of sunshine ranges from 1600 to 1800 hours.

The weather in many areas is often cloudless, the air is clean and transparent, and the air humidity is low. All these circumstances create favorable natural and technical conditions for the implementation of solar energy projects.

As of 2020, the Republic of Dagestan has a Caspian Solar Power Plant with an installed capacity of 1 MW, which was launched into operation in 2013.

### 2.4. Geothermal energy

The Republic of Dagestan also has significant potential of geothermal energy resources.

The explored reserves of geothermal hot waters amount 86.2 thousand m<sup>3</sup>/day<sup>6</sup>, which ranks Dagestan second largest geothermal energy potential in Russia after Kamchatka region<sup>7</sup>. Only 4 million m<sup>3</sup> of geothermal waters are being used annually giving up to 120 thousand Gcal of thermal energy, equivalent of 25 thousand toe. Today, not more than 15-18% of explored geothermal energy reserves are being used by consumers in the Republic of Dagestan.

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<sup>5</sup> <http://flnka.ru/aktualnoe/16176-solnechnaya-energiya-v-qorah.html>

<sup>6</sup> [http://kavpolit.com/articles/skrytaja\\_energiya\\_dagestana-26084](http://kavpolit.com/articles/skrytaja_energiya_dagestana-26084)

<sup>7</sup> Thermal waters in Kayakent district of the Dagestan Republic, Shakhbanov N.G



### 3. Sectoral strategy for development of RES in the Republic of Dagestan

The most promising fields for development of RES in the Republic of Dagestan are:

- Solar energy
- Small hydropower (<50MW)
- Wind energy
- Geothermal energy
- Production of Green Hydrogen and Oxygen

Whereas, Solar, Small Hydropower and Wind energy projects are subject to state incentives support measures (DPM) granted in form of subsidized feed-in tariffs and deserve a special emphasis in this report.

In the planning period 2020–2025, it is envisaged to provide maximum gratuitous assistance to energy companies of the RES sector for implementation of investment projects in the field of renewable energy in the Republic of Dagestan.

In order to present available potential of renewable energy sources and list potential sites for development of investment projects in the Republic of Dagestan the Corporation prepared Strategic Assessment of the potential of RES including Solar, Wind and Hydropower and submitted catalog of potential sites to interested energy companies.

The total installed capacity of promising RES facilities (SPP, WPP, SHPP) which could be placed on identified investment sites is estimated about 730 MW. Dagestan Development Corporation, as part of its work to attract investments to the Republic of Dagestan aims to work with all interested energy companies and investors to implement projects on the territory of the Republic using state incentive support mechanism DPM for stimulating renewable energy projects in the wholesale and retail electricity markets.

In 2020 a long list of promising investment sites was developed by the Corporation with a detailed description of technological, environmental, infrastructure and logistic nuances demanded by interested developers. Agreements were concluded with energy companies for development of the most promising sites using legislation for state incentive measures called Capacity Supply Agreement (Russian abbreviation DPM) for RES with timeline for a period 2021- 2025.



The main work for the planning period until 2025 is determined by legislation for stimulating renewable energy sources, laid down in the decrees of the Government of the Russian Federation dated May 28, 2013 No. 449 "On the mechanism for stimulating the use of renewable energy sources in the wholesale electricity and capacity market" and dated January 23, 2015 No. 47 "On Amendments to Certain Acts of the Government of the Russian Federation on the Promotion of the Use of RES in the Retail Electricity Markets", the Law of the Republic of Dagestan No. 55 "On the Use of RES in the Republic of Dagestan" dated October 4, 2018.

Dagestan Development Corporation is capable to provide financing, investments and co-financing for implementation of RES projects in the Republic of Dagestan. At the same time, the emphasis is made on attracting external investments, structuring of projects and helping energy companies to establish favorable conditions for implementation of projects.

The main task of the Corporation is to create favorable conditions for attracting external investments. Therefore, the key emphasis in the work is not on the provision of investment funds, but on ensuring effective project support, reducing risks for companies and creating favorable conditions for the implementation of projects with borrowed funds.

In 2020 Dagestan Development Corporation signed Cooperation Agreement with Russian Direct Investment Fund (RDIF) for joint implementation of small hydropower projects with involvement of foreign investors. For the planning period, it is planned to implement this agreement and the project.

An agreement was signed with Italian company IdroEnergia for implementation of 6 small HPPs 1 MW each, created on the basis of environmentally friendly technologies. An agreement was signed with the Hevel and Solar Systems companies to develop projects in the field of solar energy. An agreement was signed with NovaWind for development of wind energy project.

Implementation of the first phase of this road map has been completed in 2020, existing potential sites for RES development has been identified and proposed to investors and energy companies. Currently, seven projects with a total capacity of 60 MW are at design stage. For other group of projects including solar

and wind with a total capacity 160 MW owners prepare Grid Connection Scheme (hereinafter referred to as GCS).

Thus, in accordance with this road map for a period until 2025 it is planned to implement signed agreements with energy companies for projects which are at design stage or GCS stage, as well as initiate implementation of other projects included in the portfolio.



Picture 2: Map of promising sites for the implementation of renewable energy projects<sup>8</sup>

<sup>8</sup> The power system diagram is taken from open sources on the Internet



Based on the results of work in 2020 as well as interaction with energy companies a map of promising sites for the implementation of renewable energy projects was created, according to which work is underway and will continue to stimulate investment in realizing the potential for the planning period until 2025.

One of the main tasks of attracting private investment in the development of renewable energy in the Republic of Dagestan is to reduce risks for companies and accelerate the passage of approval procedures, which creates favorable and competitive conditions for choosing the Republic of Dagestan as a region for the implementation of investment projects. In addition, it is important to participate in interaction with key development institutions and banks to ensure conditions for increasing confidence in the implementation of projects in the Republic of Dagestan.

To ensure favorable conditions for implementation of projects, it is advisable to sign joint agreements and work schedules between the regional government and energy companies, defining opportunities for the effective implementation of projects within the period required for energy companies.

### **3.1. Portfolio of renewable energy projects in the Republic of Dagestan**

According to this road map and explored potential of RES in the Republic of Dagestan, memorandums on cooperation were signed with project developers, energy companies and sites were defined for construction of SPP, WPP and SHPP projects.

According to incentive support measures DPM for renewable energy projects in Russia until 2035 it is planned to implement the aggregate volume of quotas for all types of renewable energy facilities equivalent to a capacity of 10 GW. The Republic of Dagestan has opportunity to accommodate new investments on its territory with a portfolio of renewable energy projects preliminary developed by the Corporation using state incentive support mechanism DPM and in cooperation with energy companies and project developers.

Based on the approved methodologies and financial models of earlier implemented RES projects in other regions, it has been concluded that full implementation of a portfolio of RES projects in Dagestan with total installed



capacity of **730 MW** can attract about **50 billion rubles** of investments, as well as add earnings to the Republican budget in amount 2,3 billion rubles annually.

### 3.2. Cluster approach for development of renewable energy in the Republic of Dagestan.

Creation of renewable energy clusters in the Republic of Dagestan is facilitated by preliminary analysis and selection of suitable sites taking into account even distribution of generation facilities throughout the entire territory of the Republic of Dagestan and technical requirements demanded by development companies. Selection of potential sites is preceded by consultations with experts and companies' representatives.

The main criteria for selection of sites are:

- Access to grid connection infrastructure;
- Availability of land resources;
- Availability of natural renewable resource;
- Access to transport infrastructure;
- Specific requirements for each type of generation;
- Environmental requirements;
- Technical requirements demanded by development companies.

Important role in creation of clusters play requirements for projects defined in the legislation.

To ensure participation in competitive selection of RES projects with location in the Republic of Dagestan, the Corporation works together with developers on each specific project before making investment decision and concluding agreement with regional government on implementation of the project. The total capacity of potential sites in the Republic of Dagestan developed for construction of renewable energy facilities is up to **730 MW**.

Implementation of renewable energy projects with support of state inventive measures does not create additional tariff burden on the population and helps to improve the quality of energy supply as well as provide employment opportunities for people and generate significant tax revenues for the regional budget.

To achieve objectives set in this road map, maximum assistance of regional authorities is required to create conditions for making positive investment



decisions by energy companies (investors) on implementation of projects in the region.

### 3.3. Wind energy general policy

In 2020 Dagestan Development Corporation completed Strategic Assessment for Development of RES potential in the Republic of Dagestan and developed a Catalogue of Investment Sites for RES projects, including wind power plants.

The most promising sites for wind energy development were identified in Kumtorkalinsky, Tarumovsky and Nogai districts of the Republic of Dagestan which met the selection criteria. Based on the results of work and modeling it has been concluded that possibilities for development of wind energy projects are significantly limited by available electricity grid infrastructure, restrictions associated with special protected natural areas, important ornithological (bird migration) zones, limited logistic access to deliver oversized cargo, restrictions to place high-rise structures within 15 km radius from the airport and other reasons.

It should be noted that biggest wind energy potential (average annual wind speed more than 8 m/s) is concentrated on the coastal area and northern part of the Republic of Dagestan. Some areas in mountainous regions also have significant wind energy potential, but delivery of oversized wind blades and generators is significantly limited in such areas.

Thus, the most promising sites for development of wind energy projects are located on the territory of Kumtorkalinsky district (100 MW), Tarumovsky district (60 MW) and Nogai district (40 MW).

In 2020 the South Sukhokumsky Electromechanical Plant started development of localized low-power wind turbines (up to 110 kW). Successful implementation of this work will allow to create a local production of wind turbines in the Republic of Dagestan, which in view of their smaller size, will allow to install also in mountainous regions. Local production of equipment and components for wind energy projects is a priority for support measures by Corporation. In 2020 development of a small Makhachkala wind farm project (12,6 MW) within the retail electricity market has started its life cycle.

Thus, the main activities in the field of wind energy development are as follows:



- Attract developers and investors for construction of wind farm projects in Kumtorkalinsky, Tarumovsky and Nogai districts, with a total installed capacity of 160 MW;
- Provide assistance for developers (investors) of wind energy projects in the Republic of Dagestan as applicable;
- Provide assistance to South Sukhokumsky Electromechanical Plant to establish production of low-power wind turbines in Yuzhno-Sukhokumsk as applicable;
- Provide assistance for development and construction of Makhachkala wind farm project (12.6 MW) as applicable;
- Define measures to stimulate development of wind energy potential in isolated and mountainous regions of the Republic of Dagestan.

Main partners for development of wind energy projects in the Republic of Dagestan may be such energy companies as **NovaWind (State Corporation Rosatom)**, **Wind Energy Development Fund (Rusnano, Fortum)**, **Enel**, **Vestas** and other interested parties. Dagestan Development Corporation intends to have active, transparent and effective cooperation with energy companies, vendors and financial institutions toward successful implementation of wind energy projects in the Republic of Dagestan.

Thus, general policy for development of wind energy projects envisages commissioning of 12.6 MW WPP by 2025 as well as design and construction of wind power plants with a total installed capacity up to 160 MW.

### **3.4. Solar energy general policy**

Solar energy potential in the Republic of Dagestan is quite extensive and distributed evenly throughout the region. Main priorities for development of solar energy generation include support for implementation of projects via state incentive support mechanism DPM, incentives via retail energy market as well as development of distributed solar generation.

In 2020 the most promising sites for development of large solar power plants in the Republic of Dagestan were defined. It should be noted that industrial solar energy facilities occupy fairly large area in comparison with similar capacities of wind and small hydropower plants. At the same time, the sites for construction of



solar power plants are quite demanding in terms of landscape conditions, non-shading and other parameters that directly affect production and operation. Taking into account set of criteria for selection of projects demanded by potential developers, the most promising sites were defined as follows: Kumtorkalinsky district (140 MW), Buinaksky district (60 MW), Nogai district (300 MW), Yuzhno-Sukhokumsk (20 MW), Derbent district (120 MW). **Due confidentiality restrictions this document does not provide exact names and locations of future SPPs facilities.**

In 2020 Dagestan Development Corporation signed agreements on cooperation with developers which started design and preparation of Grid Connection Schemes for their projects. Projects will be implement with state incentive measures DPM.

In addition, in 2020 within the framework of the mechanism for stimulating renewable energy sources in the retail market of electrical energy, the design of SPPs in the Kizlyar region and in the city of Kaspiysk began. A phased commissioning of up to 25 MW of solar generation is planned from 2021 to 2024.

Also, in 2020 a pilot floating solar power plant (FSPP) was commissioned on Lake Ak-Gel in Makhachkala. The developers of this project are the following companies: HelioREK, EcoEnergy and Solar Systems. This FSPP is one of the first in Russia and the first of its kind solar aeration system which feeds aeration units located underneath the floating structure with electricity from solar energy panels. The companies implemented this project as part of environmental responsibility measures and scientific research (R&D) to determine the optimal parameters of floating solar power plants and establish local production of pontoon structures in the Russian Federation.

The development of technologies for floating solar power plants has significant potential in the horizon of 2025 and will reduce the dependence of solar power plants on land resources. In addition, FSPP technologies provide a number of other benefits, including reduced evaporation from the water body and increased production through the effect of cooling solar modules from the water surface. In this regard, one of the promising directions for development of solar energy is assistance to establish local production of components for floating solar power plants in the territory of the Republic of Dagestan which can be placed on



surface of reservoirs for irrigation, hydroelectric power plants and other water bodies.

Another important area for development of solar energy in the Republic of Dagestan for the planning period until 2025 is to stimulate development of distributed solar generation for households and industrial or warehouse facilities. As of 2020, the Republic of Dagestan has poorly developed provision of the population and business with solar generation technologies for household use. At the same time, the existing electricity tariffs for commercial enterprises stimulate the growth of demand for providing their own environmentally friendly sources of generation based on RES.

In addition, one of the most important global trends is agrovoltaics, i.e. integration of solar generation technologies in agriculture. This area also covers animal husbandry, i.e. ensuring the possibility of grazing livestock at industrial solar power plants, which allows SPP developers not to carry out mechanical cleaning of grass, and Dagestan livestock breeders can get access to dedicated areas for grazing by small ruminants. Agrovoltaic also covers crop production, in terms of partial shading of plantations for growing certain crops that require minimizing direct sunlight. The appearance in the Republic of Dagestan of regional engineering companies in the field of solar energy will ensure, among other things, the implementation of solar projects.

Thus, the main areas of activity in the development of solar energy are:

- Provide assistance to energy companies and investors for development of solar power plant projects as applicable;
- Provide assistance for implementation of large projects for the construction of industrial solar power plants in Kumtorkalinsky, Buinaksky, Nogai, Derbent districts, as well as in the city of Yuzhno-Sukhokumsk as applicable;
- Provide assistance for implementation of small projects for construction of solar power plants in the Kizlyar region and the city of Kaspiysk, as well as other regions of the Republic of Dagestan, initiated by regional developers as applicable;
- Promote local production of equipment for solar power plants, including technologies of floating solar power plants as applicable;

- Support engineering companies in the field of solar energy for implementation of projects for household and commercial applications of technologies.

The main partners for development of solar potential of the Republic of Dagestan can be such energy companies as **Hevel, Solar Systems, NeoSun, Electron, HelioREK** and other interested parties. Dagestan Development Corporation intends to have active, transparent and effective cooperation with energy companies, vendors, developers and financial organizations toward successful implementation of solar energy projects in the Republic of Dagestan.

Thus, in the direction of stimulating the development of solar generation, this road map and existing projects at the development stage envisage the commissioning of at least 20 MW by 2025, as well as the design and construction of solar power plants with an installed capacity of up to 300 MW.

### 3.5. Hydropower general policy

The main priority for development of hydropower is to develop small projects which meet up-to-date environmental standards for sustainable development and are eligible for state support incentive measures for renewable energy projects.

According to current legislation for RES support measures adopted in the Russian Federation small hydropower projects are the generating facilities which produce electricity from energy of water flows (except pumped storage power plants) with an installed capacity up to 50 MW.

Considering eligibility requirements for obtaining state support incentives potential sites for development of small hydropower projects have been identified in basins of rivers Samur and Sulak. One of the most promising and advanced in development is Samur Energy Cluster Project which includes utilization of hydropower potential in the basin of river Samur using small hydropower facilities.

Samur Energy Cluster Project foresee integration of solar, wind and geothermal energy sources located in the southern part of the Republic of Dagestan, mainly in the valley of river Samur. Operation of the cluster project is based on principle of combined operation of all renewable energy sources included in the project, whereas small hydropower facilities to play a key role in stabilizing



production, taking into account the unevenness of wind and solar generation sources.

The project envisages construction of small hydropower facilities with installed capacity up to 160 MW by 2035. It should be noted that earlier schemes for harnessing hydropower potential of river Samur considered creating large hydroelectric power plants with total installed capacity up to 800 MW. Meanwhile, Samur Energy Cluster Project considers environmental and social aspects without affecting agricultural lands, resettlement of people or significant impacts to the environment. The project will apply best practice of hydropower development considering significant reduction of flood zones and their preservation within the channel boundaries and the possibility of flow regulation by a cascade method. Currently, the project is structured into separate investment projects, the implementation of which carried out with the attraction of funds from private investors.

Another hydropower development project foresee construction of 6 small HPPs with installed capacity 1 MW each by Italian developers. These projects have been included in the Scheme and Program for Development of Electric Power Industry in the Republic of Dagestan until 2025. Also, preliminary design study is underway for construction of 2 facilities in basin of river Samur with an installed capacity of 21 MW each.

Additionally, it is planned to attract investments for development of small hydropower projects in basin of river Sulak. Currently, up to 30 potential sites have been explored. The most promising projects are Kurminskaya SHPP (10 MW), Cascade of 8 HPPs on river Avarskoe Koisu (21 MW each), Mogokhskaya SHPP (49 MW), Tsudakharskaya SHPP (3 MW). Until 2025 it is planned to attract developers (investors ) for at least 15 MW of installed capacity to ensure implementation of the most promising projects in basin of river Sulak.

Existing support measures of state incentives for renewable energy sources do not foresee support for large hydroelectric power plants or pumped storage power plants.

In accordance with modern trends in development of small hydropower, the development of combined and distributed small hydropower can be identified as a promising direction, where individual enterprises can act as a consumer of



electricity, such as: plants for production (electrolysis) of hydrogen, production of oxygen (medical), data center and other direct consumers. The direction of converting electrical energy into a gaseous state of oxygen or hydrogen is one of the stages of transformation of natural kinetic energy into a "green gas" hydrogen and / or oxygen.

Meanwhile, this direction is currently actively developing in the world, and the possibilities of the hydro potential of the Republic of Dagestan contribute to the implementation of projects in the field of "Power to Gas". In addition, in the future until 2025 it is possible to intensify the development of electric transport operating on environmentally friendly energy sources through the mechanism of direct contracts. According these trends, one cannot exclude the possibility and prospects of the development of small hydropower for selected consumers, and not only for the supply of energy to the UES. Support for projects of own distributed generation is also one of the most promising areas, taking into account global trends. At the same time, the existing explored sections for small hydropower facilities may be in demand for direct consumers.

Thus, main areas of activity in the development of small hydropower are:

- Provide assistance to increase volume of quotas for development of small hydropower projects according to state incentive support mechanism DPM;
- Provide assistance to attract investments for development of small hydropower projects in the wholesale and retail electricity markets for promising sites in the Republic of Dagestan;
- Attract development companies and investors to utilize hydropower potential of in the basin of river Samur;
- Provide assistance for implementation of small hydropower projects with distributed generation, "Power to Gas" and direct contracts;
- Provide assistance for implementation of small hydro generation projects in the basin of river Samur within framework of Samur Energy Cluster Project as applicable
- Encourage local production of equipment and components for hydropower projects in the Republic of Dagestan to support industrial development.

The main partners for development of hydropower projects in the Republic of Dagestan can be such energy companies as: **RusHydro, En+Group, Nord Hydro,**



**IdroEnergia, Scotta, EcoEnergy, EnergoMIN, Verkis, Landsvirkjun Power** and other interested parties. Dagestan Development Corporation intends to have active, transparent and effective cooperation with energy companies, vendors and financial institutions toward successful development of hydropower projects in the Republic of Dagestan.

Thus, general policy for development of small hydropower envisages commissioning of 6 MW SHPPs until 2025 as well as design and construction of new hydropower projects with a total installed capacity of 106 MW.

### **3.6. Geothermal energy general policy**

For the planning period, it makes sense to consider possibility for development of geothermal energy projects and their implementation in form of balneotherapy centers in the Republic of Dagestan in places of natural outlet of thermal waters, as well as the use of water for heat supply, in particular for greenhouses and industrial facilities.

Assuming explored and proven geothermal energy potential on the territory of the Republic it is advised to attract specialized development companies and investors for development of geothermal energy projects in line with development of touristic sector.

Geothermal energy is not included in the state support incentive measures to stimulate development of RES. Taking into account significant natural potential of geothermal resources in the Republic of Dagestan, it seems expedient in the planning period until 2025 to initiate inclusion of geothermal energy into legislation for state incentive measures for RES. The implementation of this task will require involvement of specialized development companies to determine specific promising projects, market capacity and the possibility of localizing equipment for the implementation of geothermal energy potential. When developing projects in the field of geothermal energy, one should take into account their significant difference from other types of renewable energy sources, both in terms of the specifics of generation and consumption, taking into account thermal generation, and the practice of implementing balneotherapy centers in conjunction with a generating facility.



At present, Iceland has the greatest experience in the development of geothermal natural resources, which has made significant progress in the use of geothermal resources for both the generation of electric and thermal energy in conjunction with creation of tourist-attractive projects. Interaction with Icelandic engineering and consulting companies as well as the Icelandic Embassy in Moscow and financial institutions allows initiating joint work to develop the geothermal potential of the Republic of Dagestan, attracting investments and technologies from Icelandic companies with significant experience in the development of geothermal energy.

Thus, main activities in the field of geothermal energy development are:

- Initiate study of geothermal energy potential in the Republic of Dagestan together with scientific and expert community;
- Initiate cooperation with Icelandic energy and consulting companies with experience in development of geothermal projects to attract modern technologies, experience and investments;
- Cooperation with Icelandic Embassy in Moscow to stimulate joint work on development of geothermal energy potential with Icelandic companies;
- Initiate amendments to legislation on state support incentive mechanism DPM for RES in order to include in it geothermal energy;
- Development of feasibility studies for projects on the use of geothermal waters for the production of electricity, heat and creation of a balneological resort;
- Stimulate local production of equipment and components for geothermal energy projects in the Republic of Dagestan.

The main partners for development of geothermal energy potential in the Republic of Dagestan can be such organizations as: **Verkis hf., ISOR, Landsvirkjun Power ehf., Embassy of Iceland in Moscow** and other interested parties. Dagestan Development Corporation intends to have active, transparent and effective cooperation with partners toward successful implementation of geothermal energy projects in the Republic of Dagestan.

Thus, in the direction of stimulating the development of geothermal energy, this plan envisage work to study possibility to include geothermal energy in the legislation for state incentives measures DPM for RES as well as development of

feasibility studies for comprehensive use of geothermal energy potential in cooperation with Icelandic partners for joint and mutually beneficial implementation in the Republic of Dagestan.

## **4. Support measures for development of RES in Russia**

### **4.1. The current state of RES development in the regions of Russia**

Renewable energy projects are being developed in different regions of Russia within the framework of legislation for state incentives support measures mainly in regions which have greater potential of RES. This allows investors to maximize generation of electricity and comply with requirements of electricity market regulator to achieve required energy production indicators. It is important to note about growing competition between regions to attract investments as such projects do not require investments from regional budget, create jobs and generate significant revenues for the regional budget.

As of today, investment projects have been implemented in 21 regions of Russia through DPM incentive support legislation measures. Among leaders are the southern regions, such as: Stavropol Krai (867 MW), Rostov oblast' (717 MW), Astrakhan oblast' (680 MW), Republic of Kalmykia (364 MW), etc. However, Republic of Dagestan regardless of its highest RES potential does not have a single project implemented with DPM incentive support measures.

One of the factors that previously limited implementation of renewable energy projects in Dagestan with use of government incentive measures was lack of integrated approach to assist energy companies (investors) in development of projects in the region.

Energy companies (investors) operating in the Russian renewable energy sector are seeking for investment projects with well-prepared preliminary study of the potential sites. It is determined by risk of penalties which company may face after granting feed-in tariff for delays and not fulfillment of design parameters.

In order to attract investors for implementation of renewable energy projects in the Republic of Dagestan it is important to ensure effective support for energy companies (investors), including selection of potential sites, preparations, assistance to obtain land rights, information support, etc.



Picture 3: Distribution of capacities quotas through competitive selection of projects with DPM by regions of the Russian Federation<sup>9</sup>

## 4.2. Support measures for RES development on wholesale electricity market

Since 2013, within the framework of Russian Government Decree No. 449, a mechanism has been in place to stimulate investments in the generation of renewable energy sources on the wholesale electricity and capacity market by paying for the capacity of such facilities under the Capacity Supply Agreement (Russian abbreviation DPM), which is regulated by a package of laws and Resolutions of the Government of the Russian Federation. On the basis of a competitive selection of projects at federal level, investors are given the right to

<sup>9</sup> According to data from the REDA report "The Russian Renewable Energy Market: Current Status and Development Prospects", May 2020.

conclude CSA (DPM) for RES which guarantees a special tariff for capacity for the return of invested capital and a rate of return of 12% for 15 years, which provides opportunities for attracting direct and credit investments for developers.

This mechanism allows investors to implement projects without a burden on regional consumers. CSA (DPM) RES projects supply electricity to the grid and receive payment for capacity without increasing tariffs in the region of sale. Moreover, investors are compensated for invested capital and operating costs over 15 years of operation, which creates conditions for investment attractiveness and guarantees the economic efficiency of these projects.

When submitting documents for participation in the competitive selection of renewable energy projects, investors fix the connection to grid point of the facility in a specific region of implementation and provide a bank guarantee or letter of credit for 5% of the total project cost. For non-fulfillment of the conditions of the CSA (DPM), the investor bears fines from the provided guarantee, which guarantees the construction of the facility, but requires a detailed study of the site in the region at the stage of making decisions on filing an application for the selection of renewable energy projects according the CSA (DPM).

Incentive measures for renewable energy sources in the Russian Federation determines the possibility of implementing projects under the mechanism of CSA (DPM) for renewable energy sources at the expense of private investments from energy companies operating in this sector without attracting funds from regional government. Energy companies in the renewable energy sector are implementing cost-effective projects with the attraction of private and credit investments, creating significant tax revenues to the regional budgets of the regions.

#### **4.3. Support measures for RES development on retail electricity market**

The basis of the mechanism for supporting renewable energy sources in retail markets laid down in the Federal Law "On the Electricity Industry", which fixes the possibility of stimulating the development of renewable energy sources in the retail market in order to compensate for losses in networks.

The mechanism came into force in 2015 with the adoption of the Russian Government Decree No. 47, which defined the main conditions and rules for the inclusion of renewable energy generating facilities in regional schemes and

programs for the development of the electric power industry. This tool is the basis for the implementation of small RES facilities operating in retail markets in order to compensate for network losses. Thus, a legal basis formed for the implementation of a mechanism to stimulate the use of renewable energy sources in retail markets.

This incentive mechanism in the retail market also creates an opportunity to attract private investment in the implementation of renewable energy projects in the Republic of Dagestan. This mechanism of state stimulation of development is also promising for ensuring the implementation of renewable energy projects and contributes to the development of natural potential and the creation of additional jobs.

#### **4.4. Support measures for RES development in the Republic of Dagestan**

To support implementation of renewable energy projects on the territory of the Republic of Dagestan and interact with development companies, initiators and financial investors, the Dagestan Development Corporation has established a Directorate for Renewable Energy Projects.

The Directorate provides assistance in the development of potential projects together with energy companies accompanies the implementation of projects at the primary stages of the life cycle and performs the following tasks:

**- Accelerated primary collection of information about the site:**

1. Initial visit to the site to assess the existing infrastructure and conduct aerial photography;
2. Requests to the executive authorities and municipalities, if possible, to agree on the site for the implementation of the RES investment project;
3. Determination of possible legal restrictions and encumbrances on the selected cadastral site;
4. Obtaining confirmation of the absence of burial objects and / or cultural heritage, as well as other possible restrictions for the economic development of the territory;
5. Assistance in the development of a power distribution scheme;

**- Approval of the site as the location of the RES facility:**



1. Initiation of the creation of a regional working group at the level of the Government of the Republic of Dagestan with the involvement of all stakeholders to ensure the acceleration of decision-making;
  2. Assistance in obtaining approvals and permits for the construction and commissioning of renewable energy facilities;
  3. Agreements and discussions with the population and the scientific community of the Republic of Dagestan;
- Preparation of the site for participation in the competitive selection of RES**
1. Assistance in removing encumbrances on the land plot, if any (negotiations with existing tenants and the local population for the transfer of the land plot);
  2. Assistance in granting an investment project a large-scale or priority status (if necessary);
  3. Assistance in the formation of a land plot and transfer of the category to industrial and energy lands for the placement of a RES facility;
  4. Inclusion of the site in the STF of the Republic of Dagestan;
- Preparation of a site for the implementation of a RES project based on the results of a competitive selection;**
1. Assistance in the inclusion of the selected project in the SIPR (Scheme and Program for Development of Electric Power Industry) of the Republic of Dagestan;
  2. Working out the issue of providing the construction site with the necessary infrastructure (working out the logistics for the import of equipment, laying the road, laying the water supply and other necessary communications at the construction stage);
  3. Assistance in coordinating technical connection and including this territory in the program for the development of the power grid.

At the same time, in order to improve the investment attractiveness of the region and attract investment funds, the Corporation can assist in:

- **attracting investment financing for projects;**
- **participation in negotiations with banks and development institutions;**
- **participation in the promotion and structuring of projects.**



## **5. Project development stages**

### **STAGE 1 - INITIALIZATION AND PREPARATIONS FOR THE PROJECTS (2020)**

- DEVELOP A MAP FOR IMPLEMENTATION OF RES PROJECTS IN DAGESTAN;
- DEFINE SELECTION CRITERIA FOR RES PROJECTS ;
- SELECTION OF SITES FOR IMPLEMENTATION OF RES PROJECTS AND THEIR FOLLOWING INCLUSION IN THE PORTFOLIO;
- DISTRIBUTION OF RES PORTFOLIO WITH SELECTED INVESTMENT SITES TO INVESTORS AND ENERGY COMPANIES;
- CONCLUSION OF AGREEMENTS ON SUPPORT OF PROJECTS BETWEEN DAGESTAN DEVELOPMENT CORPORATION JSC AND DEVELOPERS OF RES PROJECTS FOR THE DEVELOPMENT OF PROJECTS IN THE REPUBLIC OF DAGESTAN;

### **STAGE 2 - PROVIDING SITES FOR IMPLEMENTATION OF RES PROJECTS (2021-2023)**

- PROJECT DEVELOPMENT INDIVIDUALLY WITH EACH DEVELOPER, TAKING INTO ACCOUNT DEFINED REQUIREMENTS AND CRITERIA;
- APPROVAL OF SITES FOR IMPLEMENTATION OF PROJECTS WITH THE EXECUTIVE BODIES OF THE REPUBLIC OF DAGESTAN AND MUNICIPALITIES;
- AGREEMENT OF SITES FOR IMPLEMENTATION OF PROJECTS WITH THE SCIENTIFIC COMMUNITY, POPULATION AND ECOLOGISTS IN THE FRAMEWORK OF THE OPEN DIALOGUE;
- ALLOCATION OF LAND PLOTS FOR IMPLEMENTATION OF PROJECTS WHICH PASSED COMPETITIVE SELECTION;

### **STAGE 3 - LAUNCHING OF RES GENERATION FACILITIES AND FURTHER SCALING (2022 - 2025)**

- SUPPORT OF PROJECT DEVELOPERS DURING CONSTRUCTION OF RES PROJECTS;
- STARTING THE POWER PLANT INTO OPERATION;
- FURTHER DEVELOPMENT OF SITES FOR SCALING OF IMPLEMENTED PROJECTS AND ATTRACTING INVESTORS;
- IMPROVING THE INVESTMENT ATTRACTIVENESS OF THE REPUBLIC OF DAGESTAN THANKS TO DEMONSTRATION OF SUCCESSFULLY IMPLEMENTED PROJECTS, ATTRACTING NEW INVESTORS

Estimated volumes of development and potential participants in the implementation of RES projects in the Republic of Dagestan for the period 2021-2025.



Figure 4: Benefits from implementation of RES projects in Dagestan

RES / Company type					Total	Regional budget taxes per year	Investment volume
Solar PP	205 MW	300 MW	-	-	505 MW	1010,5 mill. rub	32 825 mill. rub
Wind PP	-	-	160 MW		160 MW	914,8 mill. rub	12 082 mill. rub
Small Hydro PP	-	-	-	48 MW	48 MW	432 mill. rub	9 360 mill. rub
<b>Total</b>	<b>225 MW</b>	<b>300 MW</b>	<b>160 MW</b>	<b>60,6 MW</b>	<b>725,6 MW</b>	<b>2350,3 mill. rub</b>	<b>54 267 mill. rub</b>