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Assessment of solar energy resources of the Far Eastern Federal District

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The main feature of the Far East energy sector is the isolation of territories. Alternative energy sources (wind, solar, biomass, geothermal and local fuels) allow solving the problem of decentralized power supply zones, which account for more than 75% of the Far East's territory.

The solar radiation is the key renewable resource of the region, with a gross potential of 813 200 million t.c.e./year, technical potential – 3224,4 million t.c.e./year, economic potential - 0,132 million t.c.e./year. However, this potential is not actively realized in all regions of the district.

According to the zoning of Russian territory by natural potential of solar energy resources, the southern areas of the Far Eastern Federal District belong to the highest priority area. In the western areas of Primorsky Krai, the annual amount of total radiation reaching the Earth's surface is 1450 kW•h/m^2, which is the maximum for the Russian territory and accounts for 70-75% of the possible radiation. The duration of sunshine is up to 2850 hours per year. The amount of energy that can be produced by a photovoltaic battery with a photogenerator efficiency of 15% is 250-290 kWh/m^2, with the use of solar tracking systems, the specific power production increases to 350-380 kWh/m^2.

Currently, the Borzinskaya solar power plant (SPP) with a capacity of 60 MW has been put into operation in Transbaikalia, which increased the share of renewable energy in the region to 9%.

Intensive development of solar energy is taking place in Buryatia, where the Novobichurskaya (52 MW) and Dzhidinskaya (50 MW) SPPs were put into operation at the end of 2024. The share of total installed capacity in the region's energy system was increased to 13%.

The leader in the use of solar energy in the Far East is Yakutia, where in the spring-summer period, especially in April and May, the monthly sums of total radiation in its northern regions are as high as in the northern Caucasus and Astrakhan region - more than 165 kWh/m^2. There are 32 solar power stations operating here. In 2015, a SPP with an installed capacity of 1 MW was put into operation in Batagai settlement - one of the largest in the Far East and the only one of such capacity above the Arctic Circle. The Batagayskaya SPP was included in the Book of Records as the northernmost SPP.

An assessment of climate change impact on SPP heat generation using CMIP6 global climate models has shown that during the 21st century, the Far Eastern Federal District is expected to experience extensive summer positive solar radiation anomalies, which is favourable for the operation of solar plants.

At present and in the near future the most realistic direction of practical use of solar energy is heat supply. The influence of changes in solar radiation and air temperature regime will positively affect the heat generation by flat-plate solar collectors. The tendency to increase heat generation is confirmed by the refined calculations of solar radiation input and air temperature in accordance with CMIP6. In the northern and northeastern regions of the Far Eastern Federal District, the temperature increase will override the projected decrease in solar radiation, and the use of solar collectors in hot water supply may become profitable.