Development of Solar Energy and Its Place in the Energy Sector of the Republic of Buryatia

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Abstract. Solar energy is one of the priority directions for the development of alternative energy. This is facilitated by climatic characteristics. Buryatia has up to 300 sunny days a year. The amount of solar radiation in Buryatia is 4-5 kWh per m²/day (Fig. 1), and the duration of sunshine is more than 2000 hours per year (Fig. 2). Three investment companies are already operating in Buryatia: LLC “Avelar Solar Technology”, LLC “Complex Industry” and LLC “Green Energy Rus” (Table 2), which in the period of 2017-2019 have already built 5 solar power plants (SPP) with a capacity of 70 MW and a total cost of 8.7 billion rubles (more than $115 mln¹). To date, the share of SPP capacity of the total capacity of Buryatia is 4.81%. Until 2022, it is planned to commission another 7 SPPs with a capacity of 155 MW, thus increasing the total capacity to 225 MW (Table 2) and the share to 14%, if the situation with CHPP-2 does not change. All SPP capacities are being introduced into the general energy system of the Southern energy district of the Republic of Buryatia, and will not be isolated energy systems.

1. Introduction

The Republic of Buryatia has developed an energy industry based mainly on thermal power plants: three thermal power plants and one Hydro-Recirculating Power Plant (HRPP) that were put into operation from 1936 to 1976 (table 1). The largest power plant is the Gusinoozorsk HRPP (79.7% of the total capacity of Buryatia), which exports part of its electricity to Mongolia. In turn, the West and North of the Republic are supplied with electricity from the Irkutsk region. In addition, there are small isolated diesel power plants (DPP) in resort villages of the North-Baikal district (Table 1; Fig. 3). The Republic would have had enough electricity if Ulan-Ude CHPP-2 had been completed. Commissioned in 1991, CHPP-2 operates as a large boiler house, although the project should have an electric capacity of 840 MW, and a thermal capacity of 1840 Gcal. All these years, the constant lack of money, severe crises in the industry and the entire economy, as well as other reasons prevented the completion of CHPP-2. In March 2019, the project to build CHPP-2 in Ulan-Ude was included in the development Strategy of Buryatia until 2035. It is planned to enter two power units with the output of the station to an electric power of 230 MW and a thermal power of 360 Gcal/hour [6].

Recently, Buryatia has been experiencing a shortage of electricity at its existing facilities. In the conditions of environmental restrictions in the zone of the Baikal Natural Territory, the republic is

¹ At the exchange rate at the end of August 2020
having trouble with the development of the economy and infrastructure, including power generation. According to the reported data for 2019, the generation of electricity by power plants in the operational zone of the Buryat Regional Dispatching Office amounted to 5,263.53 million kWh, electricity consumption – 5,549.72 million kWh [10]. The electricity deficit for the year amounted to -286.19 million kWh.

For the qualitative development of the republican economy, it is necessary, first of all, the balanced development of generating and network capacities, therefore, to solve the problem of lack of electricity without a heavy load on the environment is possible only by developing alternative energy (renewable energy sources). Buryatia has great potential for the development of alternative energy. In 2010, in Buryatia, a project was developed for the construction of 7 small hydroelectric power plants (SHPP) on the Barguzin River and its tributaries in the Kurumkan and Barguzin districts. There was even an investor – JSC “TDF Ecotech”, but the project remained on paper [5]. Along with the development of small hydroelectric power plants, it is potentially possible to develop damless hydroelectric power plants (DHPP), wind (WPP) and especially geothermal power plants (GeoPP), which can be built in the Baikal Rift Zone rich in geothermal sources from the Tunka to the Baunt district.

![Solar radiation map of Russia, kWh per m²/day [11].](image-url)
Figure 2. Map of sunshine duration in Russia, hours per year [4].

Table 1. Power generation facilities of the Republic of Buryatia (2020).

| Company name | Power generating facility name | Power volume, MW | Share, % | Location (district, city or settlement) | Commissioning year(s) |
|--------------|-------------------------------|------------------|----------|----------------------------------------|-----------------------|
| OJSC “TGK-14” | Ulan-Ude CHPP-1 [2] | 148.77 | 10.02 | City of Ulan-Ude | 1936 |
| | Timlyui CHPP [12] | 22 | 1.48 | Kabansk district, Kamensk settlement | 1953 |
| OJSC “Selenginsk pulp and cardboard mill” | CHPP OJSC “Selenginsk pulp and cardboard mill” | 36 | 2.42 | Kabansk district, Selenginsk settlement | 1971 |
| JSC “InterRAO – Electrogeneratsia” HRPP [13] | | 1190 | 80.12 | Selenga district, Gusinooyorsk town | 1976 |
| PJSC "MRSK Sibiri" - "Buryatenergo" | Diesel Power Stations (DPS) [2] | 18.62 | 1.25 | North-Baikal district: Davsha settlement, Khakusy and Kotelnikovsky recreation areas [1] | |

Alternative energy sources

| Investment companies | Solar power plants (SPP) (Solar parks) | Total: | Share, % | Location districts of Buryatia | 2017-2019 |
|----------------------|--------------------------------------|--------|----------|-------------------------------|-----------|
| | 70 | 1485.39 | 100 | South and Central | 2017-2019 |
Despite the high costs of their creation, the contribution to alternative energy is a long-term and profitable investment in the infrastructure of the republic. At least investors who are investing in a seemingly low-profit project look far into the future.

Smart investors do not run after "quick money", realizing that the constructed power plants will pay off for a long time, since at the moment of development they have a relatively low efficiency. Despite criticism from some [3], they are investing in green energy, modern infrastructure and a future without emissions (CO2, NO2, SO2 and other gases) from burning coal, fuel oil and firewood. Other experts see great potential in the development of SPP, refuting the arguments of critics about the high cost of electricity and other erroneous opinions [7].

Table 2. Solar (Photovoltaic) power plants of the Republic of Buryatia (2020).

| The name of the company implementing the investment project | Generating facility name | The investments in the project, million rubles | Installed capacity, MW | Location (district and settlement) | Year (date) commissioning |
|-----------------------------------------------------------|--------------------------|-----------------------------------------------|------------------------|-------------------------------------|--------------------------|
| JSC "Avelar Solar Technology"                             | Bichura SPP [14]         | 1,200                                         | 10                     | Bichura district, Bichura village   | 13.11.17.                |
| JSC "Complex Industry"                                    | Kabansk SPP [8]          | 2,000                                         | 15                     | Kabansk district                    | 29.10.19.                |
|                                                           | Tarbagatai SPP [8]       | 2,000                                         | 15                     | Tarbagatai district, Tarbagatai village | 29.10.19.                |
|                                                           | “BVS” SPP [8]            | 2,000                                         | 15                     | Kyakhta district, Kyakhta town      | 29.10.19.                |
| JSC "Avelar Solar Technology"                             | Khorinsk SPP [9]         | 1,500                                         | 15                     | Khorinsk district, Khorinsk village | 08.12.19.                |
| Planned and under construction                             |                          |                                               |                        |                                     |                          |
| JSC "Avelar Solar Technology"                             | Torey SPP [15]           | -                                             | 45                     | Jida district, Torey village        | 2020                     |
|                                                           | Gusinoozyorsk SPP        | -                                             | 15                     | Selenga district, Gusinoozyorsk town | 2020                     |
| JSC "Complex Industry"                                    | Mukhorshibir SPP         | -                                             | 15                     | Mukhorshibir district, Mukhorshibir village | 2020                     |
| JSC "Green Energy Rus"                                    | Okino-Klyuchi SPP        | -                                             | 20                     | Bichura district, Okino-Klyuchi village | 01.12.20.               |
|                                                           | Uda-1 SPP                | -                                             | 15                     | Khorinsk district                   | 01.12.21.               |
|                                                           | Uda-2 SPP                | -                                             | 15                     | Khorinsk district                   | 01.12.21.               |
| JSC "Avelar Solar Technology"                             | Jida SPP                 | -                                             | 30                     | Jida district, Dyrestui village     | 2022                     |
| Total:                                                     |                          |                                               |                        |                                     | 8,700                    |

Entering the position of investors, we believe that the desire to quickly recoup investments prompted them to place SPP in relatively densely populated areas of the south and center of Buryatia, which is shown in Fig. 3. Private investment is good, but at the same time, we consider it necessary to
develop energy in the remote districts of the north, west and east of Buryatia. The state should help ensure that the population of sparsely populated areas is provided with uninterrupted and high-quality electricity through the construction of solar power plants and other types of power plants. The development of clean energy is especially necessary in the Central Ecological Zone of the Baikal Natural Territory (CEZ BNT), where there are still no relatively large or medium-sized power generation facilities, and the tourist load on the network is increasing every year [1].

![Figure 3. Power generation facilities (compiled by the author).](image)

In Ulan-Ude, the air in winter becomes more and more smoky every year. On other days, smog that does not dissipate over the city and its suburbs is observed, and it would be just right to introduce a "black sky regime" or an emergency. Residents burn all types of fuel due to the long-rooted habit of heating with coal and wood, and houses equipped only with solid fuel boilers or wood stoves. Many even have no idea that electricity can be used as heating.

The high price of electricity, the absence of night and winter tariffs, the absence of any environmental preferences and other socio-economic instruments to maintain clean air pushes people to warm themselves with dirty fuels. Ultimately, dirty air increases the number of diseases in the population, primarily of the respiratory system. Treatment of a huge number of sick people will cost many times more than the money that is saved with traditional heating. Most of the costs for medical treatment of the population will fall on the state and municipalities, which make almost no efforts to reduce the cost of electricity and, as a result, improve the situation with winter smog.

2. References

[1] Badmaev A G 2019 Energy infrastructure characteristics of the Central ecological zone of the Baikal natural territory of the Buryatia Republic Bulletin of Eurasian Science 1(11) pp 1-15

[2] Kozlov S Yu 2015 Scheme and program of electric power industry development of the Buryatia Republic 2016-2020 (Ulan-Ude)
[3] Uskeev B Solar power plants "Hevel" in Buryatia – a targeted economic sabotage MK.RU [Electronic resource] URL: https://ulan.mk.ru/economics/2019/10/06/boris-uskeev-solnechnye-elektrostanitsii-khevel-v-buryatii-celenapravlenaya-ekonomicheskaya-diversiya.html (date accessed: 03/30/2020)

[4] The amount of solar energy in the regions of Russia rearsolar.ru [Electronic resource] URL: https://realsolar.ru/article/solnechnye-batareii/kolichestvo-solnechnoy-energii-v-regionah-rossii/ (date of access: 04/02/2020)

[5] Buryatia will build small hydroelectric power plants egov-buryatia.ru [Electronic resource] URL: http://oldegov-buryatia.ru/index.php?id=5330&tx_ttnews[tt_news]=19121

[6] CHP-2: the future promises to rise in the East Nomer odin (Number one) [Electronic resource] URL: https://gazeta-n1.ru/news/society/78389/ (date accessed: 04/02/2020)

[7] Forbes author answered Boris Uskeev why Buryatia is developing solar energy New Buryatia [Electronic resource] URL: https://newbur.ru/n/47834/ (date of access: 03/30/2020)

[8] Three solar power plants with a total capacity of 45 MW were put into operation in Buryatia energybase.ru [Electronic resource] URL: https://energybase.ru/news/industry/three-solar-power-plants-with-total-capacity-45-mw-commissioned-in-buryatia-2019-10-29 (date accessed: 03/30/2020)

[9] The fifth solar power plant was commissioned in Buryatia egov-buryatia.ru [Electronic resource] URL: https://egov-buryatia.ru/press_center/news/detail.php?ID=55548 (date accessed: 03/30/2020)

[10] Branch of JSC "Systemic operator of a unified energy system" Buryat regional dispatch office Branch of JSC " Systemic operator of a unified energy system " joint dispatch control of Siberia [Electronic resource] URL: https://so-ups.ru/index.php?id=rdu_buryatia (date accessed: 04/02/2020)

[11] Plug in the sun ulan-ude.me [Electronic resource] URL: http://ulan-ude.me (date of access: 02.04.2020)

[12] Portal "RosTepl.ru" – everything about heat supply in Russia RosTepl.ro [Electronic resource] URL: https://www.rosteplo.ru/w/Timlyuiskaya CHPP (date of access: 01.04.2020).

[13] Gusinoozyorsk HRPP Inter-RAO Electric Power Plants [Electronic resource] URL: http://irao-generation.ru/stations/gusozor/ (date accessed: 04/08/2020)

[14] Bichura SPP energybase.ru [Electronic resource] URL: https://energybase.ru/power-plant/bichurinskaya-solar-power-plant (date accessed: 03/30/2020)

[15] Torey SPP energybase.ru [Electronic resource] URL: https://energybase.ru/power-plant/toreiskaya-solar-power-plant (date of access: 03/30/2020)

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