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Basic Stages of Energy Development Program Implementation in the Chechen Republic

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ABSTRACT

The article discusses the issues of energy complex development of the Chechen Republic, which requires the creation of a stable multi-vector energy that can satisfy the growing needs of the population and economy of the region. The main emphasis is made on the development of the renewable energy sources, which need to be paid close attention, drawing on the experience of other entities and countries developing innovative technologies in this direction. The analysis of the energy development program implementation in the Chechen Republic (2011-2030) over the past 8 years has been carried out, which includes four subprograms describing the potential of resources and the prospects for the energy development in the Chechen Republic,. The estimation of power consumption indicators and maximum loads in the Chechen Republic until 2018 and for the long term ("calculated," "optimistic" and "actual" options) is given. The analysis of the state and potential for the water energy development in the Chechen Republic is carried out. The analysis of natural resources potential of the republic is carried out in order to implement effectively and develop each of the considered renewable energy sources, taking into account the development of modern innovative technologies to reduce electrical energy consumption. The state estimation of the existing integrated power grid of the Chechen Republic is given, where the initial tasks of work coordination to improve the efficiency of the republic's energy system are outlined. The results of total indicators of electric grid construction and facilities reconstruction for 2011-2019 are derived. Possible directions (calculated and optimistic options) of the electrical energy industry development are considered. In order to develop successfully the energy sector of the Chechen Republic, taking into account the electrical energy load growth, the development of modern program for the of alternative and renewable energy sources development was proposed that will allow to create additional electrical energy sources in combination with traditional ones. At the same time, the implementation of fundamental and applied research in the field of renewable energy was proposed.

Keywords: Electric Energy Industry, Power System, Power Center, Electric Energy, Power Balance, Alternative and Renewable Energy Sources
JEL Classifications: O13, P28, P48, Q42, Q43, Q47, R11

1. INTRODUCTION

The energy sector is one of the foundations for the development of the economy of both the region and the country as a whole. After a sharp decline in energy production in the early nineties, the level of energy sources production and consumption began to increase. However, there are a number of serious problems which if are not solved, the level of developed countries is impossible to reach. The irrational structure of the energy complex, where the use of gas and oil predominates, the considerable depreciation of equipment and electric transmission lines, the backwardness of technologies and low efficiency compared to today and high costs associated with this, lack of available funds for the retrofit and development of energy sector are among these problems. That's why, raising of efficiency of energy sources use, adoption of new advantageous alternative sources, the need to find new solutions that take into account regional characteristics, is one of the most important tasks in the energy sector development. The search for ways out of the described difficult situation requires a comprehensive analysis of all factors affecting the regional energy development process (Burmistrov, 2009; Al-Falahi Monaaf, 2017; Palival, 2014.).

The development of the region's energy capacities is a detailed study of the object of research on factors that affect the energetic state of the region as a whole. To perform an analysis of energy development schemes, first of all, it is necessary to identify all the base entities that affect the region's energy sector formation and development, that is, the main "global participants" in the region's energy sources production process. Those are: directly existing power system; the economy, primarily industry, which is the main consumer of energy sources and a supplier of material resources (equipment, raw materials) to the energy system; the population, which is also one of the important consumers of energy resources; personnel in the energy production system, the environment, and the state, including regional authorities. Based on the analysis of the factors, it is necessary to develop schemes of possible ways of the region's energy system formation and functioning (Guardian, 2017; Sibikin and Sibikin, 2010).

2. METHODS

In order to ensure a stable economy of the Chechen Republic with energy resources, a scientifically based state energy policy is required. First of all, the Chechen Republic Energy Development Program for 2011-2030 was developed for this in 2010, in which the principal directions and critical parameters, the list and terms of the electric power facilities planned for construction and commissioning were considered (Debiev and Popov, 2012).

This program is reviewed annually and appropriate adjustments are introduced. The program is a document that defines the goals, main objectives and directions of the longstanding program for the development of the energy complex of the Chechen Republic, taking into account emerging internal and external issues in the fuel and energy sector, as well as in the economy of both the Chechen Republic and the Russian Federation as a whole.

The energy development program of the Chechen Republic, taking into account the development of the electrical energy complex for the period until 2030, includes 4 subprograms:

- Subprogram "Electrical energy."
- Subprogram "Water energy."
- Subprogram "Use of alternative and renewable energy sources."
- Subprogram "Use of geothermal waters."
- Moreover, two programs have been developed additionally to increase the reliability of the functioning of the integrated power grid of the Chechen Republic:
    - The Chechen Republic electric grid complex modernization and reliability improvement program for 2020-2024 (long-term), which covers modernization, technical re-equipment, renovation and new construction of power lines with a length of 5,188 km and the transformer fleet with capacity of 577 MVA;
    - The program to reduce electrical energy losses for 2019-2023, for the retrofitting and reconstruction of 10-6/0.4 kV transformer substations with outgoing 0.4 kV overhead lines, as well as with the construction of 6.10 kV branch lines from overhead lines.

2.1. Subprogram "Electrical Energy"

Currently, the management and operation of the energy complex of the Chechen Republic is carried out by the distribution company - JSC Chechenenergo. This complex territorially includes electric power systems with voltage of 330 kV, as well as electric power systems with voltage of 0.4; 6; 10; 35; 110 kV (Kerimov and Debiev, 2012). Today the most important and primary main substation for the 110 kV electric power system on the territory of the Chechen energy system is the substation "Substation 330 kV Grozny." In 2011, the third autotransformer - "AT-3 330/110 kV" was installed on the substation "PS 330 kV Grozny" with subsequent commissioning with a total capacity of 125 MVA and the total power of the substation is 375 MVA. The electric power systems with voltage of 330 kV are owned by JSC "FGC UES" and are serviced by its regional branch - Main Power Transmission Lines of the South. The electric power systems with voltage of 0.4; 10; 35 and 110 kV are mainly owned and operated by JSC "Chechenenergo."

JSC "Chechenenergo" is the electricity wholesale market entity, as well as a guaranteeing electrical energy supplier serving consumers in six cities (Grozny, Gudermes, Kurchaloy, Argun, Shali, Urus-Martan) and 16 rural areas of the Chechen Republic. JSC "Chechenenergo" serves 200 thousand individuals and 16 thousand legal entities.

JSC "Chechenenergo" has the following technical potential on the books - the number of substations is 4928 pcs., including:

- 30 substations of 110 kV;
- 59 substations of 35 kV;
- 4842 substations of 6-10 kV.

The total transformer capacity of all substations is 2258.96 MVA.

The length of electric transmission lines is 14678.31 km, including:

- Overhead line 110 kV - 52 pcs. (1,150.54 km);
- Overhead line 35 kV - 88 pcs. (980.65 km);
- Overhead line 6-20 - 355 pcs. (4,798.85 km);
- Overhead line 0.4 - 7408 pcs. (7,748.27 km);
- Cable line 6-20 kV - 441 pcs. (459.62 km);
- Cable line 0.4 kV - 449 pcs. (644.95 km).

JSC Chechenenergo pursues a uniform technological policy aimed at technical development, improving the reliability and efficiency of permanent assets.

For the successful development of the electrical energy industry in the Chechen Republic, the following tasks are primary (Ellabban et al., 2014; Farkhutdinov and Cherkasov, 2017; Palival, 2014):

- Ensuring a reliable supply of electrical and thermal energy to consumers in the Chechen Republic;
- Maintaining full process management of the energy system in conjunction with the unified energy system of the Russian Federation in accordance with market conditions;
- Coordination of work to increase the efficiency of functioning and ensure stable development of the energy industry based on modern innovative technologies;
- Reduction of the level of negative impact on the environment.

3. RESULTS AND DISCUSSIONS

The evaluation of energy consumption indicators and maximum loads in the Chechen Republic until 2019 and for the long term is shown in 2 diagrams (Figures 1 and 2).

Figure 1: Maximum power diagram

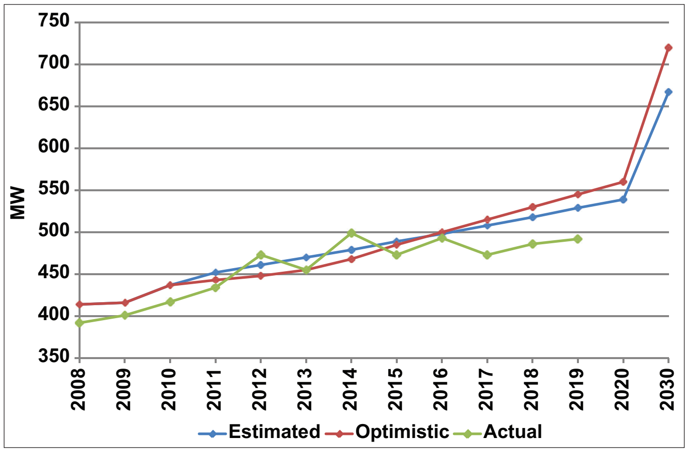
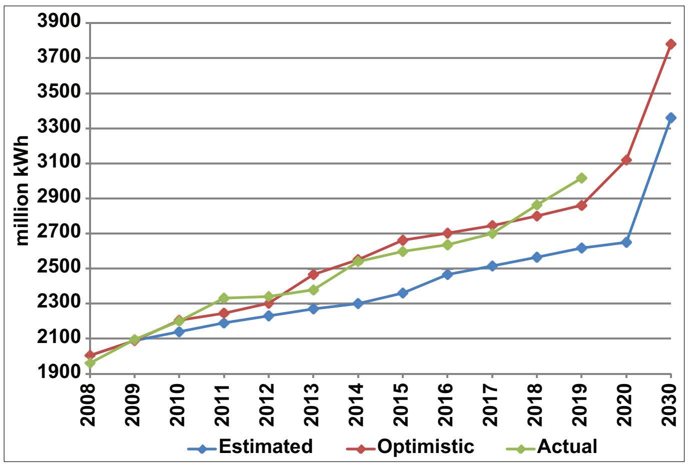


Figure 2: Electrical energy consumption diagram



In 2019, the Chechen energy system's own maximum load amounted to 492 MW (Figure 1), as a result the rate of electricity consumption has a dynamic of a certain growth in electricity consumption. In the Chechen Republic, as a result of infrastructure development, as well as continued construction and repairing works, compared to 2018, the level of energy consumption increased by 5% and reached the value of 3015.9 million kW/h. (Figure 2). At the same time, due to the fact that the existing electric networks are overage and have not undergone renewal, the losses of electrical energy occur, which must be minimized by renewal of the electric power systems. The main goal of electricity losses reduction is the implementation in the territory of the Chechen Republic of the Comprehensive program to reduce excess losses. Moreover, the active work of energy supplying enterprises in relation to consumers is required to obtain the effect of electricity losses reduction and increasing the level of payments for electricity consumed.

3.1. Development of Power-supply Sources, Capacity and Electrical Energy

The shortage of capacity and electrical energy will increase in the coming years and may amount to 500-510 MW in capacity and 3120-3210 million kW/h in electrical energy in 2020. To achieve the goals of power-supply sources development in the energy system of the Chechen Republic, the creation of new generating capacities and the corresponding modernization of fixed assets of the energy system are a prime consideration (Kerimov and Debiev, 2012).

The development of generating sources in the Chechen Republic was provided by enhancement of the Argun TPP to 50 MW and the construction of the Grozny TPP with a capacity of 400 MW. The commissioning of the Argun TPP capacity was planned in 2019, but due to the construction of the Grozny TPP with a capacity of 358 MW, implementation of measures for the restoration of the Argun TPP was completely stopped due to the lack of an investor and the advisability of restoring the station in its current form. In 2018, the Grozny TPP (GTP-1 and GTP-2, with a capacity of 176 MW each) was commissioned in the Chechen Republic with a total capacity of 352 MW.

Taking into account the commissioning of the second 200 MW block at the Grozny TPP and the hydroelectric power chain on the Argun river the Chechen energy system can self-balance (deficit in capacity is 50-60 MW, in electrical energy - 140-150 million kW/h). With the commissioning of the 1st and 2nd stage of the hydroelectric power chain of Argun HPPs, electrical energy excesses increase to 400 million kWh. In the period 2021-2030 taking into account the commissioning of the third stage of the Argun cascade of hydroelectric power stations in the energy system of the Chechen Republic, there will be insignificant surpluses in both capacity and electricity (up to 130 MW and 470-480 million kW/h, respectively).

In 2015 a small HPP on the Argun River (SHPP Kokadoy) with a capacity of 1.3 MW was commissioned. The construction of a small HPP on the Sunzha river with a capacity of 0.5 MW (Kirov SHPP) is being completed. Projects for the construction of small HPPs on the Argun river have been developed: SHPP "Satellite" – 1.2 MW; SHPP "Gukhoi" – 2.1 MW; SHPP "Ushkaloy" – 4.9 MW. LLC "Yug-Stroy" began investing in construction project of SHPP with capacity of 1 MW on the Aksay River with a preliminary cost of 294 million rubles.

Preliminary surveys of the LLC "Stroyproject-TM" on the construction of the Bashennaya SHPP in the Itum-Kali district of the Chechen Republic with an installed capacity of 8 MW and an estimated value of 1.3 billion rubles have begun.

According to the Energy Development Program of the Chechen Republic for 2011-2030 on the Terek ridge of the republic, it was planned to build a wind farm consisting of 24 WDPPs with an installed capacity of 1.5 MW each, with the total installed capacity of 36 MW.

Unfortunately, this project is currently not taken into account in the program (Debiev and Popov, 2012). The Government of the Chechen Republic signed an agreement with LLC "Avelar Solar Technology" on the construction of a solar power plant in the Chechen Republic with a capacity of up to 5 MW with an estimated construction cost of 525 million rubles.

3.2. Electrical Power Systems Development

Analyzing the state of the energy complex of the Chechen Republic, it is necessary to outline the following initial tasks for the development of electrical power systems:

- Increasing the stability of electrical connections of the energy system of the Chechen Republic with energy systems of other regions and constituent entities of the Russian Federation;
- The formation and strengthening of the internal electric network of the energy system, if necessary, with the possibility of electric grid facilities redundancy, the purpose of which is to increase the reliability and uninterruptedness of power supply to consumers;
- Deloading of the 35 kV electric network, which has been significantly loaded in recent years and has led to an increase in the loss of electric energy in the electric network, additionally ensuring the maximum redundancy level with the minimum total length of electrical energy transmission lines;
- Increase in the transformers' rated capacitance at some substations with a voltage of 35 and 110 kV, the load of which in recent years has increased and reached 70-90% of their rated capacitance, as a result they are overloaded at load-peaks;
- Making decisions on the construction, reconstruction and retrofitting of some overhead transmission lines and substations that have exhausted performance potential;
- Improving the flexibility of substation circuits and overhead transmission lines, replacing primary switching equipment in order to increase the reliability of both the energy system itself and the electric power supply to consumers.

Over the past 4 years, six new substations with voltage of 110 kV and total capacity of 285 MVA have been constructed and commissioned on the territory of the republic. The "110 kV City" substation, built in the center of Grozny and put into operation in 2019, with two transformers of 40 MVA each, with a total capacity of 80 MVA, is one of the first digital substations in the North Caucasus. This substation will allow removing electrical loads from overloaded substations in the city of Grozny and thereby will act to raise the uninterruptibility, reliability and quality of electric power supply to the population and infrastructure of the capital of the Chechen Republic. Replacement of one of the two transformers from 16 MVA to 40 MVA was performed at the substation "110 kV Shali" substation, which also contributes to the uninterrupted operation, reliability and quality of electric power supply to the population and infrastructure completely of the Shali and Vedeno regions of the republic. The block transformers with a capacity of 250 MVA (total - 500 MVA) are installed at the commissioned Grozny TPP. An increase in the capacity of the transformer fleet of the existing substations of the Chechen energy system by 245 MVA was performed. Five overhead transmission lines with a voltage of 110 kV were commissioned, the total length of which is about 120 km. The reconstruction and retrofit of some substations of JSC "Chechenenergo" was carried out, with the replacement of switching equipment, as well as the installation and commissioning of relay protection and automation devices on a modern elemental base.

In view of the fact that the limited possibilities for innovative development of the energy complex are observed in the regions, it is necessary to analyze the effectiveness of the introduction and development of renewable energy sources, taking into account the development of modern innovative technologies that reduce energy consumption (Burmistrov, 2009; Ellabban et al., 2014; Palival, 2014).

4. SUBPROGRAM "WATER ENERGY"

Today the state of Russia's water energy complex consists of over 80 hydropower plants with a total installed capacity of about 46 thousand MW. The long-term annual average generation reaches 180 billion kW/h/year, which is 22% and 18.6% respectively, of capacity and generation from all the existing power plants of the Russian energy system. This list does not include small hydropower plants (HPPs). The advisability of using the water energy resources of mountain rivers has been justified repeatedly on the practical activities of the energy development in the republics of the North Caucasus, where 36 hydropower plants are operating currently. Works on the design and construction of about 30 more hydroelectric power stations are under way (Guardian, 2017; Kerimov and Debiev, 2012).

In the "Layout of hydroelectric power chain and social sphere facilities" presented by "RIKO Group," the construction of a hydroelectric power chain on the Argun river which plans to ensure in the Chechen Republic: the further development of the economy, agricultural facilities, the production of ecologically-green electrical energy, the improvement of services and recreation, reduce losses in electric networks, improve the social situation. In August 2015 a small hydroelectric power station with capacity of 1.3 MW was commissioned on the river Argun. The Government of the Chechen Republic and RAO "UES of Russia" earlier came to a mutual decision on the necessity to develop water energy. By the Resolution of the Chechen Republic Government in 2009, the construction project of hydroelectric power chain on the Argun river was included in the List of priority investment projects and proposals of the Chechen Republic. In general, the investment project of the Argun hydroelectric power chain is also of great social importance, associated with the creation of more than 20,000 new jobs during construction (12-15 years).

The territory of the Chechen Republic is characterized by a high supply of water resources (both surface and underground), concentrated in rivers, lakes, water storage reservoirs, glaciers and in the earth interior. The whole territory of the republic is characterized by an arterial drainage. The number of all rivers is about 3198, the total length of which is 6508.8 km. Heavy autumn rains in the mountains also contribute to water level rise in the rivers of the republic. The value of the water level in mountain rivers is minimum in winter. The flow of mountain rivers by the seasons of the year is characterized by approximately the following distribution coefficient: 55% for the summer period (June-August), 35% for the spring and autumn, and 10% for the winter (December-February). The hydrological regime of rivers of this nature contributes to favorable conditions for irrigation of the soil, but is adverse for the regular operation of hydroelectric power plants. It should be noted that the hydrological regime of the rivers of the republic has changed significantly in recent decades, and therefore it is necessary to conduct regular hydrological observations on the most of rivers of the republic (Kougias and Patsialis, 2014; Morales and Corredor, 2014).

5. SUBPROGRAM "ALTERNATIVES AND RES"

5.1. Wind Energy

Wind power continues to be the largest segment of the renewable energy market over the past few years. The total capacity of all wind turbines in the world amounted to about 530 GW at the end of 2017, which was almost one and a half times higher than the total capacity of 439 nuclear power reactors registered in 32 countries of the world with a total capacity of 340 GW. So, in 2017, 52 GW capacity from wind turbines was commissioned in the world, which was absolutely unprecedented (Al-Falahi, 2017; Barinova and Lanshina, 2017).

Concrete calculations for the research and study of wind energy resources in the Chechen Republic were not carried out. The Chechen Republic belongs to the region, where the territory is characterized by the medium speed of wind energy. A certain feature of the republic's wind potential is the irregularity in the distribution of wind speed over different districts and intensity in different periods of the year. One of the most common types of winds in the territory of the Chechen Republic are mountain and valley breezes arising due to different air temperatures of particular areas of valleys or hollows, as well as flanks. The directions of the mountain and valley breezes are characterized by a day shift. Also, the mountain and valley circulation is expressed especially strong and reaches its maximum value in the summer season (Farkhutdinov and Cherkasov, 2017; Kerimov and Debiev, 2012).

The certain calculations of the wind potential have been performed for some different climatic zones of the republic, namely, the mountainous terrain, the midland and the Zaterechny plain, with the recalculation of wind speeds and frequencies and intensities from the height of weather vanes to a height of 75 m (the level of the upper point of a wind power plant with a capacity of 500-750 kW). From the analysis of the calculations, it follows that the wind energy gross potential of the above territories is 1406.0 billion kWh/year, and the technological capacity, in turn, reaches ≈ 14.0 billion kWh/year. Therefore, in some areas of the republic where the wind speed is quite high, the use of wind energy is an innovative solution. The use of modern wind-driven power plants (WDPPs) is economically feasible and profitable with an average annual wind speed of 5 m/s (Kerimov and Gaisumov, 2011; Morales and Corredor, 2014).

Data on wind speeds testify to the development of wind energy in the north of the republic. It seems optimal to create a wind power plant on the Terek ridge with altitudes of 400-600 m above sea level (Kerimov and Debiev, 2012). According to the studies on windpower engineering, wind energy at such altitudes is 5-10% higher than wind energy at altitudes of 0-100 m. Nevertheless, wind measurements are necessary for this region. It is necessary to install masts for a wind speed measurement cycle at the site of the future WDPP.

In recent years, the construction of WDPPs, in particular in the Rostov Region, has been actively conducted in several regions of southern Russia. Within design basis 78 wind turbines of the Danish company Vestas with a capacity of 3.8 MW each will be placed in total (Kerimov and Debiev, 2012).

5.2. Solar Energy

Geographically, the Chechen Republic is located between 42° and 46° north latitude, causing the heavy influx of solar radiation. The capacity of solar energy, expressed by the value of the radiation balance, in the plain and submontane districts amounts for 50-55 kcal/cm^2/year. The higher the terrain elevation, the lower the radiation balance and at an altitude of 2500 m its values do not exceed 30-35 kcal/cm^2, and in the high mountain zone it decreases to negative values and at an altitude of more than 3000 m is –3 ÷ 4 kcal/cm^2 on average. On the plain part of the territory of the Chechen Republic, the radiation balance is positive for almost the entire year. With territory height increase in the winter season, the expenditure side of the balance begins to exceed the incoming one. The wide scale of the physical and geographical states variety of the republic determines the vast diversity in the distribution of the sunshine duration (Kerimov and Debiev, 2012).

The sunshine duration averages 330 days a year and the density of solar radiation reaches about 0.33 kW/m^2 in the entire territory of the Chechen Republic, and reaches 0.46 kW/m^2 on the plain and in mountainous districts. At the same time, there are sunless days, which range from 34 to 40 days in the valley and submontane districts of the republic and from 10 to 12 days in the mountainous areas. The largest number of sunless days is observed on the flat part of the territory of the republic and is 61 days. The least of "sunless" days in the annual cycle can be seen in the winter, from 6 to 12 days. From 1 to 5 "sunless" days are observed from the end of May to the end of September. In general, over the year cloudy weather decreases direct beam radiation by 20 ÷ 25% of the potentially probable.

The value of the total solar radiation is determined by the total influx of direct and diffuse radiation to the horizontal surface of the entire territory of the Chechen Republic. The total solar radiation on the republic territory reaches the maximum intensity in May-July, varies from 280 to 300 mJ/m^2 for submontane districts, and ranges from 360 to 400 mJ/m^2 in high-mountain districts.

The total volume for the entire territory of the Chechen Republic is estimated at 1.365 kWh/(m^2·year). Recently, in view of technological upgrade, the efficiency factor of solar panels is becoming higher and the energy conversion efficiency of silicon photovoltaic sources series-produced by the industry is 12-17%.

It can be said that given the current level of technology development and the lack of state support, it is economically feasible to install solar stations only in areas where technical means do not allow this to be done with the help of other power plants (Barinova, 2017; Kerimov and Gaisumov, 2011).

5.3. Expander-generator Sets

For the purposes of energy saving during the production of electrical energy, in addition to the recovery of waste-heat from gas turbine engines, the utilization of the excess pressure of natural gas supplied through gas pipelines to the gas distribution station or gas distribution point of compressor stations and large enterprises has recently become very relevant. as well as a thermal power plant and combined heat and power plant.

Developing technologies for small energy, as well as the creation of own generating, autonomous energy sources on the basis of high-performance turbo-expander units with electric capacity of 0.5-10 MW, in different districts, human settlements and industrial facilities contribute to the economically sound and prospective development of the energy complex (Aldo and Hansen, 2020; Kaja and Slabe-Erker, 2020).

Gas is supplied and distributed in the Chechen Republic by the gas supplying organization - OAO Chechengazprom. The total length of high-pressure gas pipelines is currently 698 km. From 2000 to 2008, more than thirty gas control stations (GDS) were restored and built. Gas consumption in 2009 amounted to 3.1 billion m^3.

The energy resource potential of pressurized gas consists of the following parameters: gas pressure at the inlet and outlet of the pipeline; efficiency factor of a turbo-expander; value of gas flow rate and thermodynamic characteristics. The total value of the potential of the available gas capacity at the gas distribution station of the Chechen Republic is estimated at 27.2 MW. With this value of gas it becomes possible to generate electrical energy in the amount of 220 to 250 million kWh/year and will largely depend on the mode and specific character of design of the applied diagrams and operation algorithm.

The employees of the company ZAO "Ion Exchange Technologies" (Moscow) performed an analysis of the possibilities of introducing an energy-saving complex based on an ETDA expander-generator set of Russian production.

Studies have determined that expander-generator sets can be effectively used at 11 gas distribution stations of the Chechen Republic. In 2011-2018 It was planned to introduce the technology of expander-generator sets at five gas-regulating stations, which would affect the use of irretrievably lost energy of compressed gas, with an installed total capacity of 11.3 MW and generation of electrical energy up to 100 million kW/h in year. Estimated project cost - 500 million rubles. The first project was supposed to be implemented in 2011-2012 at GDS-1, with a rated capacity of 1.5 MW and electrical energy generation up to 13.1 million kW/h/year. The estimated cost of the project is 62.1 million rubles.

Currently, the team of the scientific and technical center (STC) "Green Energy" has developed proposals for the introduction of expander-generator set at the Chir-Yurt cement plant, which will significantly increase the energy supply of technological production.

5.4. Bioenergy

The issues of solid municipal waste (SMW) utilisation in bioenergy in the Chechen Republic have not been raised before, however, it is known from international experience that the level of profitability of biogas production increases significantly when waste utilisation from cities with a population of more than 100 thousand people and preparation for production is carried out in advance at the stage of filling of the Municipal solid waste landfills. The implementation of such production is possible in some cities of the Chechen Republic; Grozny, Gudermes, Argun, Shali, Urus-Martan, etc. (Kerimov and Debiev, 2012; Morales and Corredor, 2014).

The evaluation of initial biogas utilization, at the Municipal solid waste landfill of Grozny, is given below.

5.4.1. Engineering factors

- The value of biogas obtained is 13-15, 0 thousand m^3/day. (5.0 million m^3/year);
- Reduction of GHG emissions: about 40 thousand tons of CO_2 - equivalent/year;
- The design capacity of the engine generator, which can be used to generate electrical energy from biogas is 1000 kW;
- Tariff of electricity sold - 1.74 rubles./kWh;
- Discount rate - 10%;
- The cost of a unified social tax (UST) is 8 euro/t CO_2 - eq.

The cost of construction of the biogas collection and utilization system in developed countries is usually in the range of $ 1,550-2,250/1 kW of installed electric capacity. In accordance with the Kyoto Protocol, as a result of biogas collection and utilization, the so-called "carbon credits" or "emission reduction units" can be carried out as part of joint implementation projects. As a result, one can get additional investment of approximately $ 0.02/kWh (0.62 rubles KWh). This possibility increases significantly the attractiveness of biogas utilization even at the landfills that were previously considered prospect less. The average payback period of the project for landfill gas utilization for electricity production without taking into account the sale of Emission Reduction Units is 7-8 years, and taking into account the sale of Emission Reduction Units is <3 years. For the domestic waste recovery with biogas production at existing landfills in large cities and the human settlements of the Chechen Republic, it is necessary to conduct research on the domestic waste potential assessment, determine the direction of utilization and develop the project feasibility study for the implementation of technology. To solve these problems, in 2011 it was planned to allocate 10.0 million rubles for the research works.

6. SUBPROGRAM "MULTIPLE USE OF GEOTHERMAL WATERS"

More than 70% of the geothermal water reserves of the Russian Federation are located on the territory of the North-Caucasian Federal District. Among the constituent entities of the Russian Federation the Chechen Republic ranks third in terms of explored geothermal water reserves, trailing only to Dagestan and the Kamchatka region. On the territory of the Chechen Republic there are the most favorable conditions for the creation of geothermal circulation systems, which is confirmed by the long-term operation of the first geothermal circulation system in the USSR created in the Khankala Valley in 1985 (Kerimov and Gaisumov, 2017, April 7). On the territory of the Chechen Republic there are 14 thermal intakes, according to which the total explored reserves amount to 64,680 m^3/day in spouting mode. The reserves for commercial categories in the amount of 10,650 m^3/day are approved for two thermal water intakes (Khankala, Goity).

In explored fields, the commercial reserves of geothermal waters cannot satisfy the ever increasing demand for heat. For example, in 1985 only in Grozny the declared demand for thermal water amounted to 78 thousand m^3/day. That's why to satisfy the needs of the republic in thermal water, an increase in the raw material base is required due to the construction of new thermal intakes and expansion of old ones. At present, the main consumer of thermal water is municipal infrastructure - 12.8 thousand m^3/day (48%) and agriculture - 11.4 thousand m^3/day (43%). According to calculations, the creation of a geothermal heat supply system in the territory of Grozny city on the basis of explored resources of the fields will ensure annual savings of fossil fuel at 150 thousand tonns of fuel oil equivalent and reducing the harmful substances emissions into the atmosphere in the amount of 250 thousand tons.

From the available 14 geothermal water deposits, the Khankala field is the largest and most promising in terms of commercial development, which is characterized by a shallow bedding of deposits, large flow rates, high enthalpy, low salinity, and high content of valuable components.

Within the Decree of the Government of the Russian Federation No. 218 of April 9, 2010, by efforts of GSOTU named after Acad. M.D. Millionschikov the comprehensive project was implemented to create a experimental-industrial geothermal station based on the implementation of the circulation scheme for using the deep heat of the Earth (Kerimov and Gaisumov, 2017, April 7). This field has several advantages over others:

- Bedding of deposits at shallow depths (up to 1000 m);
- Large flow rates (up to 1 l/cm);
- High temperatures (up to 100^0C and more);
- The waters of the XIII bed are practically fresh, with salinity of 0.81-1.7 g/l, which conditions their low corrosion activity;
- The ability to extract valuable components.

The area assigned for the Khankala geothermal station is 4900 m^2, while the area of the station itself, including the wells, is 406 m^2. At the same time, the heat survey of the village. Gikalo and the adjacent territory of the Khankala deposit revealed 13 abnormalities with various sources (bonfires, heating systems, etc.). To reduce the formation of solid deposits in the form of carbonates, corrosion inhibitors (5 g/ton of treated water) are used in the field (Kerimov and Mintsaev, 2019).

7. CONCLUSION

The development of the energy complex of the Chechen Republic requires the creation of a stable multi-vector energy that can satisfy the growing needs of the population and the economy of the region, and renewable energy sources need to be given close attention, drawing on the experience of other entities and countries developing innovative technologies in this direction. The primary tasks of the development of the republic's energy sector are as follows:

1. Development of the modern program for the development of alternative and renewable energy sources in the Chechen Republic.
2. Organization of hydrological monitoring on the mountain rivers of the republic in order to select the optimal locations for SHPP.
3. Organization of integrated meteorological observations (solar radiation, wind speed and direction at different heights, etc.) in various districts of the republic in order to select the optimal locations for solar and wind power plants.
4. Implementation of fundamental and applied research and development in the field of renewable energy.
5. Development of recommendations and investment proposals for industrial enterprises and housing and communal services of the republic.

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