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ANALYSIS OF THE FUEL AND ENERGY BALANCE OF THE KABARDINO-BALKARIAN REPUBLIC

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Abstract

Based on statistical data of 2019, the article analyzes the fuel and energy balance of the Kabardino-Balkarian Republic. In this constituent entity of the Russian Federation with a small territory and high population density, where in the post-perestroika period the main industrial enterprises were liquidated, natural gas, fuels and lubricants and partially electric energy are supplied from other regions. The population and small industrial enterprises became the main consumers of gas and electricity, which created certain problems. The most serious of them is the chronic debt of consumers to suppliers, which is to a certain extent associated with high (over 20 percent) losses in gas and electric networks, which are included in the calculations when setting tariffs, which cannot be fully attributed to technical. The problem associated with network losses can be solved by the widespread installation of automated control and accounting systems of electricity and gas. However, the efforts of business entities will not be able to resolve all controversial issues. In 2012, the government of the republic approved the energy efficiency and energy development program for seven years, which, in particular, was not implemented due to insufficient financing of measures aimed at energy conservation and energy efficiency.

Keywords: Gas supply, fuel and energy balance, power supply

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1. Introduction

The economy of the Kabardino-Balkarian Republic (KBR), like any constituent entity of the Russian Federation (RF), which is part of the North Caucasian Federal District, largely depends on how rationally fuel and energy re-sources are used. The republic with an area of 12,470 km^2 among the regions of the Russian Federation takes 79-th place according to this indicator. At the end of 2019, which is taken as the base year in this work, there were 868,350 permanent residents, 452,093 were urban and 416,257 - rural, the population density was 69.6 people per km2. In Kabardino-Balkaria: 8 cities with the number of inhabitants - Nalchik - 239583, Prokhladny - 58226, Baksan - 38474, Nartkala - 30634, Maisky - 26652, Tyrnyauz - 20568, Terek - 19539, Chegem - 18417; 10 municipal districts - Baksanskiy, Zolskiy, Leskenskiy, Mayskiy, Prokhladnenskiy, Terskiy, Urvanskiy, Chegemskiy Cherekskiy and Elbrusskiy; 172 villages; 112 rural settlements, in 56 of them, with a population of up to 3 thousand, 65123 people lived, in the rest, with a population of 3 to 13 thousand - 351,134 people.

Large industrial enterprises operating on the territory of the republic during the Soviet period have not survived, new ones have not been built, which had a significant impact on the operation of electric, gas and heat networks due to changes in loads and the structure of consumption of fuel and energy resources. For the modernization and transfer of networks to optimal operating modes with minimal losses, significant funds were required, which the state did not in-vest, and the new owners did not have.

In 2019, fixed assets in the economy at the full discount rate were estimated at 336.776 billion rubles, the gross regional product was calculated at 145.6 billion rubles. At the same time, the volume of goods, works and ser-vices, respectively, amounted to, billion rubles: mining - 0.242, manufacturing - 28.837, provision of electricity, gas and steam - 8.422, agricultural products - 54.133, water supply and disposal, collection and waste disposal, elimination of pollution - 1,748, construction - 22,889.

2. Problem Statement

The republics that are parts of the North Caucasian Federal District, including the KBR, are facing a dual problem that requires urgent resolution: a) when drawing up tariff proposals, network losses are up to 20% of the amount of incoming fuel and energy resources, which are in full measure cannot be attributed to technical; b) tens of billions of rubles. overdue and current debts for consumed natural gas and electricity. This division is conditional, since the first part gives rise to the second. The solution to the problem is seen in a systematic approach to it, without hushing up, taking into account all its components - technical, administrative, social.

3. Research Questions

The main questions, the answers to which can make it possible to identify the main factors affecting the consumption of fuel and energy resources in the Kabardino-Balkarian Republic should include:

- to what extent do electric, gas and heat networks meet the technical requirements for loads and wear and what are real technical losses in them, confirmed by instrumental metering?
- what is the reason of chronic debts for consumed natural gas and electricity?

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4. Purpose of the Study

The purpose of the research is to analyse the state of gas supply, electricity supply and heat supply in the Kabardino-Balkarian Republic and to formulate appropriate offers.

5. Research Methods

In this work, based on the set goal, the fuel and energy balance of the KBR is investigated, represented in mathematical expression by an equation, where on the one hand there are all supplied energy resources, on the other - their consumption, including final consumption and losses during transportation and transformation.

A significant part of the territory of the republic is classified as promising for oil and gas fields. Kabardino-Balkaria, where its own fuel resources are not used, is supplied entirely with oil products (motor fuel) and natural gas, partly with electric energy. In this paper, the supply and consumption of motor fuel is not considered.

5.1. Primary deliveries

Natural gas. According to the official data of the Limited Liability Company Gazprom Mezhregiongaz Nalchik, about 1,500 million m3 of natural gas was supplied to the republic in the base year, which was supplied to 5,426 legal entities and 235 natural entities, with a consumption share of 30 and 70 percent, or 450 and 1,050 million m3 respectively. The average annual gas consumption per person permanently residing in a gasified house was 1249 m^3.

Electric Energy. In total, 1579.8 GWh were received from electricity suppliers in the base year, losses of which were 404.8 (25.6%), productive supply - 1175. At the end of 2019, there were 7 hydroelectric power plants in the KBR with a total installed capacity of 188.2 MW, including Akbashskaya HPP - 1.1, Baksanskaya HPP - 27, Mukholskaya HPP - 0.9, Kashkhatau HPP - 65.1, Aushigerskaya HPP - 60, Zaragizhskaya HPP - 30.6, HPP-3 - 3.5. Their total annual output and productive supply amounted to 408.9 and 401.2 million kWh, respectively. In fact, all hydroelectric power plants located on the territory of the republic worked during the year to replenish grid losses, covering them by 99.1%.

5.2. Loss and consumption

Gas supply. Since 1994, the population has become the main consumer of natural gas in the KBR. In 2016, 1467.1 million m^3 were distributed, including: to the population - 45.0%, to other consumers - 32.9%, the imbalance (losses) in gas networks - 22.1%. From the documents of the Joint Stock Company Gazprom Gazoraspredelenie Nalchik it follows that in 2017, the population was supplied with 1,003.7 million m3 of gas, including 517.8 to cities and 485.9 to rural settlements. During the year, gas consumption by the population increased by 343.2 million m^3, but only network losses were taken into account, which amounted to 0.58%, the imbalance was removed from the calculations. A significant increase in gas consumption by the population is due only to the fact that the calculated volume included commercial losses.

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In the KBR, the level of gasification is significantly higher - 96.8% (cities - 98%, rural areas - 95.2%) than the national average - 70.1%. In the republic, 17513153 m^2 of the total area of the housing stock has been supplied with gas, that is, on average, one subscriber input of the gas pipeline falls on 74.5 m^2.

Gas consumption in 2019: population - 27.3%, losses - 25.6%, industrial enterprises - 14.9%, other consumers - 14.7%, housing and communal services - 10.2%, budget consumers - 6.9%, own needs - 0.4%.

Electricity consumption. Supplies amounted to 1579.8 GW h, of which productive supply - 1175 (74.6%), including budget consumers - 109 (6.9%), housing and communal services - 161.2 (10.2%), industrial enterprises - 235.3 (14.9%), population - 431.1 (27.3%), other consumers - 232.6 (14.7%), own needs - 5.8 (0.4%).

The peculiarity of household consumers is that their daily load schedules with an evening maximum have low fill factors. The base part of the load is also insignificant. All this creates certain problems for the electricity supplier.

In the KBR, the twenty-four largest consumers of electricity consumed 205.3 GW h in total for the year. The top five (Joint Stock Company TEK, Municipal Unitary Enterprise Management Company Vodokanal, Limited Liability Company Nalchik Dairy Plant, Municipal Unitary Enterprise "Vodokonal", Closed Joint Stock Company "Erpak") consumed 124.6 in total, the second five - 33, the third five - 24.4, the fourth five - 17, the rest - 6.3.

The population, which uses natural gas and electricity for household needs is. the main consumer.

The total area of the housing stock of the republic is 18092.1 thousand m2, including urban - 10361.9 and rural - 7730.2. On average, there was 20.8 m2 per inhabitant, in urban and rural areas 22.2 and 19.3 respectively.

As of the base year, 648 construction organizations were registered in the KBR, including one state-owned and private. They had about 200 basic construction machines, half of which had expired by that time. The number of employees in organizations, with the exception of one, is up to 100. In the field of construction in 2019, at current prices, work was performed for 22.889 billion rubles. Residential buildings with a total area of 474.1 m2 were commissioned, of which 324.0 are individual housing construction.

For regions where the main consumer of electricity is the population, foreign experience in reducing the peak load will be very interesting. In the past decade, the concept of demand response (demand response) has been introduced in the electricity markets, the main goals of which are to reduce the peak load in the power system.

Rationalization of demand (Demand-Side Management) consists of two components - demand management and energy efficiency (AEIC, 2009). The admission of consumers to the provision of ancillary services is advisable because it can reduce the total cost of their provision (Brattle Group «International Review of Demand Response Mechanisms», 2015). When assessing the coverage of consumers by demand management programs, determining the share of different segments of consumers, classifications are used that subdivide consumers into industrial, commercial, agricultural and household (DREAM-GO, 2017). It is believed that demand management provides some reduction in total consumption (Goldman et al., 2010). The use of demand management resources for frequency regulation in power systems has already gained some distribution and continues to develop (Hledik et al., 2016). In Europe, it is planned to use up to 160 GW of managed demand by 2030 (International Energy Agency, 2017). The potential for reducing the peak

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load in the power system through the use of demand management programs is estimated at 10-15% of the peak load (Nadel, 2017). Since the bulk of the potential for demand management is concentrated in buildings, large commercial buildings, as well as industrial plants and electric transport also play a significant role in demand management (Smart Energy Demand Coalition, 2017).

6. Findings

The Government of the KBR, taking 2012 as the estimated year, approved the state program "Energy Efficiency and Development of Energy in the Kabardino-Balkarian Republic" for 2013 - 2020. It planned to create conditions for energy saving and increasing production efficiency. Control figures were adopted by year, in particular, at the end of 2019, electricity consumption was 1517 GWh, of which the volume of losses was 273.1 (18%), productive supply was 1243.9, including to the population - 391.5, industry - 440.2, housing and communal services - 121.2. The government believed that the production of electrical energy at hydroelectric power plants located in the republic, with their total installed capacity of 428.9 MW, would reach 682.2 kWh.

Compared to the planned indicators: the total installed capacity of hydroelectric power plants is 240.7 MW less than envisaged by the program, since the construction of some hydroelectric power plants was not started, electricity consumption increased by 4.14% or 62.8 GWh, losses increased by 48.22% or 131.7 GW h, useful vacation decreased by 5.54% or 68.9 GW h.

The construction of hydroelectric power plants on the territory of the KBR was carried out by the Public Joint Stock Company "RusHydro", the corresponding structures of which were busy with the commissioning of the Verkhnebalkarskaya HPP. The government of the KBR, setting such control figures into the program, believed that more new hydroelectric power plants would be built.

The most significant deviation from the program's benchmarks is an increase in losses by one and a half times, which is rather difficult to explain only by technical problems. To write off more than a quarter of the consumed electricity as losses, that is, under one item, apparently, it is not advisable. To separate technical losses from the so-called "commercial" losses, it is necessary to introduce everywhere automated systems for monitoring and metering electricity. Installation of automated systems everywhere will take a lot of time and money.

6.1. Energy saving

The ratio of some indicators of the KBR in relation to the leaders among the constituent entities of the Russian Federation at the beginning of 2019:

The ratio of the volume of attracted investments in measures aimed at energy conservation and energy efficiency improvement to the gross regional product in the Kaluga region was 2.8, in the KBR - 0.1; the share of LED lamps in outdoor lighting in the Republic of Karelia was 61%, in the KBR - 30%.

The KBR, being a subsidized entity, receiving natural gas and electricity from other regions, uses them rather irrationally. Energy saving measures in the republic are carried out poorly, there are no energy service companies capable of carrying out the corresponding work. To reduce losses of electric energy and

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natural gas, it is necessary to connect all electric and gas meters to automated control and accounting systems.

7. Conclusion

The analysis of the fuel and energy balance of the KBR shows that its structure is very typical for many regions that have lost their enterprises in the post-Soviet period. It is rather one-sided with a weak industrial consumer. Electric networks were not modernized, but the loads have changed radically, since the first place was taken by the household consumer, which has a very specific load schedule. Due to the deterioration of the equipment of gas, electric and heating networks, sometimes the commissioning of new capacities leads to an increase in losses.

The Government of the KBR allocated 3.88 million rubles from the budget for measures under the energy saving and energy efficiency program, there were no other sources of funding.

The State Report on the State of Energy Saving and Increasing the Energy Industry of the Russian Federation shows that in 2019 the average specific annual consumption of: heat energy for heating 1 m2 of residential premises was 0.107 Gcal (0.448 gigajoule); electricity for 1 person - 1070 kW h; hot and cold water for one person 43.6 m^3.

Energy intensity of the gross regional product, kg of FOE per 10,000 rubles, in 2012 prices: average for the Russian Federation from 129 to 221; the best indicator in Moscow is 37.04; the worst in the Lipetsk region - 553.21; there is no exact data on the KBR in the report, it should be in the range from 197.4 to 241.4.

To all this, it should be added that a lot of schemes for the use of natural gas, electric and thermal energy have been developed and are used, bypassing legislative acts and standards, that is, stealing. Losses of suppliers are offset by higher tariffs, which arouses public outrage.

The declared energy saving measures are of an unsystematic nature, mainly due to the lack of attracted investments, and do not give a significant effect.

In the republic, renewable energy sources are not used at all, in particular solar energy, for heating and hot water supply of residential buildings in cities and rural settlements. This is especially true for areas where the number of sunny days per year is more than two hundred.

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