



Electrification and Gasification in Georgian Agriculture Sector

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ABSTRACT

The article provides a brief retrospective analysis of the level and dynamics of Georgia's electrification and gasification from the beginning of the process up to today. It is said that the production and consumption of electricity per inhabitant throughout the country reached its maximum in 1989. It is almost the same about gasification. As for these indicators in agriculture, it is far worse. However, it is noteworthy that in the last years of the country's independence the situation has been improved. The research has been provided throughout the country as well as in agriculture. The article provides suggestions for improvement of the situation. Namely to increase the level of electric power and gasification..

Keywords: Agriculture, Electrification, Gasification, Energy Balance, Energy Resources, Electricity Balance.

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Introduction

Power engineering is the most important basic for developing of any country whereas the level and dynamics of energy consumption and production per inhabitant is as objective and adequate parameter to characterize economic development as the Gross National Product.

Power engineering plays a leading role in economics because any process of manufacturing in all subfields of industry, agriculture, transport, all areas of population service and so on, is related to using more and more energy. Energy equipment is a fundamental material basis for the growth of productivity of social work. The development level of power engineering greatly influences the progress of dynamics and arrangement of industrial production across the country. It creates essential preconditions for raising living standards and improving labor conditions. Also, it is a ground for developing of all fields, including agriculture as well.

2. Electrification

It is well-known that electrification represents the most important indicator of energy security means; it implies the introduction of electricity in national farming and residential areas throughout the country. The integral indicator of electrification is electricity generation and consumption per capita. It is concentrated on the development of production forces in a particular country, the use of its ability and power. The level of production of electricity - consumption level, at the same time, is an indicator of the level of the people's life's quality, the socio-economic development and security of the whole country [1, 2].

The first power plant in Georgia was built in 1887 by Ilia Chavchavadze (an outstanding Georgian writer and public figure) in Tbilisi. The power generation was gradually rising, and in 1913 it reached 20 million kWh. This indicator reached its highest rate in the history of Georgia in 1989, while in the transition period of the market economy it was halved. There has been some growth since 2010 [3]. Consequently, the country's electrification indicator - electricity generation - consuming per person was changing (Table 1).

Table 1. *Electrification level and dynamics in Georgia in 1913-2016 [4]*

| Years | Electricity production, mln kWh | Consumption of electricity per person kW |
|-------|---------------------------------|--|
| 1913 | 20 | 10,0 |
| 1940 | 7417 | 205,3 |
| 1960 | 3916 | 948,4 |
| 1980 | 13984 | 2765,5 |
| 1989 | 15825 | 3330,0 |
| 2000 | 7446 | 1769,2 |
| 2010 | 9919 | 1902,9 |
| 2015 | 10593 | 2790,5 |
| 2016 | 11365 | 2966,5 |

Electricity consumption exceeded three thousands per person in 1989, and by the end of the century fell to 1769.2 kWh. By 2016, this figure made up 2966.5 kWh [4].

The image of rural electrification is the same throughout the country. It allowed us to utilize more fully the rural natural resources, the production forces, and to implement the achievements of scien-

tific and technological progress, to provide effective socio-economic development and better living conditions for the population.

In the second half of the last century, the rural electrification was successful. In particular, consumption of electricity per person in rural population was as follows [5]:

Table 2. *Indicators of Electrification for agriculture 1960-1990*

| Indicator | 1960 | 1970 | 1980 | 1990 |
|-----------|------|-------|-------|-------|
| kWh | 73,2 | 178,7 | 459,3 | 871,5 |

Therefore, in 1990 the inhabitants of rural areas used on average 871.5 kWh electricity, which was 11,9 times higher than the 1960 indicator. The same picture of electrification was in agricultural work and living. In the process of increasing the level of electrification made a significant contribution activation of scientific-research works. The reasoning

and importance of electrification were given in them, and necessity of introduction and measures.

In particular, in the beginning of 1980, labor force in Georgia's Soviet farming calculation of one worker was 910 kWh, and in the farmers - 415 kWh. Electricity consumption in the household and service sphere per capita on average was 115.2 kWh.

Table 3. *Final use of total energy resources in Georgian agriculture, forestry and fishing in 2013-2016. Equivalent to 1000 tons of oil [6].*

| Year | Final consumption in the country, total | agriculture, forestry and fishing | % for total consumption |
|------|---|-----------------------------------|-------------------------|
| 2013 | 3726,3 | 13,7 | 0,367 |
| 2014 | 4022,8 | 12,1 | 0,301 |
| 2015 | 4174,6 | 18,7 | 0,448 |
| 2016 | 4330,5 | 29,6 | 0,683 |

Thus, the labor power equipment of Soviet industries was twice as high as in the farms. Both of them were characterized by growing tendency. The indicator of electricity consumption per capita in household and services were improving. However, all the above parameters were lower than in the industry and the city. For example, labor power gen-

eration in the industry was at 20242 kWh, or 22.2 times higher than in Soviet farms and 48.7 times more than in farms, while consumption of electricity in household and service sphere per capita was 636,2 kW. H, i.e. 5.5 times more than in the village [7]. It is noteworthy that the same indicators of the electrification of Georgia were even noticeably

lower, in comparison with average unionists [8, 9].

During the transition to the market economy, the indicators of electrification were significantly worsened throughout the country as well as rural areas. In particular, according to Geostat data, in 2015, only 42 kWh energy was spent on village agriculture,

forestry and fishery in Georgia, which is much (70.6) lower than the country's similar index [10].

According to the main indicator of electrification – by consumption of electricity per 1 person of population, Georgia still far behind the similar indicators of most of European countries and the world (Table 4):

Table 4. *Electricity consumption per 1 person in different countries of the world, 2014 [11]*

| Names of countries | kWh | % Compared to Georgia |
|------------------------------------|---------|-----------------------|
| The world on average, between them | 3029,3 | 136,0 |
| Asia | 946,8 | 42,5 |
| Africa | 568,3 | 25,5 |
| USA | 12962,0 | more than 5,8 |
| Russia | 6602,6 | 296,5 |
| Germany | 7035,7 | 316,0 |
| Japan | 7829,3 | 351,6 |
| Georgia | 2226,6 | 100,0 |
| Azerbaijan | 2201,0 | 98,8 |
| Armenia | 1897,0 | 85,2 |
| France | 6954,8 | 312,3 |
| Latvia | 3460,0 | 155,4 |
| Lithuania | 3820,0 | 171,5 |
| The Ukraine | 3410,0 | 153,1 |

3. Gasification

Gasification means the unity of maintenance and technical and design solutions implementation, construction and repair works and organizational activities that are aimed at moving the housing and communal facilities to the consumption of gas as the fuel and energy resource all over the country.

Gasification works in Georgia commenced in 1956. At the end of 1959, Tbilisi was supplied gas from the Republic of Azerbaijan. Annual capacity of the main gas pipeline was 1,8 billion m³ which, as a result of the reconstruction, achieved 4,6 m³. From the very beginning, gasification of the country developed very rapidly due to which the capacity of the existing gas pipeline as well as the gas resources became insufficient. It was necessary to find new sources. Vladikavkaz-Tbilisi gas pipeline was constructed and put into the operation from 1963. Over 1970-1978 Georgia was supplied gas from Iran too [10]. From November 1978, gas supply of Georgia from Iran was seized due to political developments in this country, and it was necessary to reconstruct Vladikavkaz-Tbilisi gas pipeline which commenced in 1985 and terminated in 1991. Annual capacity of the gas pipeline achieved 20 billion m³ due to which South Caucasus countries including Georgia moved to receiving the Turkmenistan gas.

Within this period, Georgia was one of the leading countries according to the gasification level. 48 cities and 230 villages, up to 600 thousand flats, up to 800 industrial and agricultural plants, 1500 thermal power supply boilers, 2 thousand housing and communal facilities were gasified [3]. 10 thousand km gas pipeline including 2 thousand km main gas pipeline and 8 thousand km distribution network were constructed [11].

In 1989 gas consumption in Georgia exceeded 6,0 billion m³, and made 60% of the country's fuel balance. Natural gas was made available to almost every region of the country (except for the mountainous Svaneti and Adjara). In 1990, the consumption of natural gas in Georgia reached its maximum – 6046 million m³ [12]. By this time, there were 576,5 thousand flats gasified in the country and the length of the gas pipelines was 4802,8 km. In 1990, the country's gas consumption gradually reduced and by the year 2000 it dropped down to 1094 million m³, i.e. it reduced 5,5 times compared to the year 1990 [13] (please see Table 5 below).

In the process of increasing the level of gasification and electrification made a significant contribution activation of scientific-research works. The reasoning and importance of electrification and gasification were given in them, and necessity of introduction and measures [14-21].

Table 5. *Gasification Values of Georgia over 1990-2000 (by the year end)*

| Year | Amount of gasified flats (thousand) | Gas pipeline length (km) | Consumption of natural gas (mln m ³) | Including agriculture |
|------|-------------------------------------|--------------------------|--|-----------------------|
| 1990 | 576,5 | 4802,8 | 6046,0 | 180 |
| 1991 | 579,8 | 4937,8 | 4577,1 | 176 |
| 1992 | 587,2 | 4962,1 | 4633,7 | 49,6 |
| 1993 | 587,2 | 5158,4 | 3343,7 | - |
| 1994 | 587,4 | 5158,4 | 2595,2 | - |
| 1995 | 587,4 | 5158,4 | 910,5 | - |
| 1996 | 587,4 | 5151,9 | 947,0 | 12,4 |
| 1997 | 587,4 | 5151,9 | 830,0 | 13,6 |
| 1998 | 587,4 | 5151,9 | 846,0 | 14,9 |
| 1999 | 587,4 | 5151,9 | 1022,0 | 23,5 |
| 2000 | 587,4 | 5151,9 | 1094,0 | 26 |

The well-known developments of the past years had very negative impact on the gas plants. The country's gas supply stopped for a long time, gas was not supplied to Tbilisi as well as the entire Georgia (except Rustavi and Kazbegi region) during the entire 1995 and first half of 1996.

Within this period, Georgia's gasification level could not be improved due to the following issues:

1. Hard financial situation. No industrial enterprises were operating due to which the natural gas farms, in the environment of non-payment and low consumption, had very low revenues. There was not a single gas farm that had no debts (from several thousands to millions of GEL); Due to little volume of sold gas, gas cost was

high as only small part of the network was functioning; however, depreciation and other taxes were fully charged;

2. Physical losses of gas were high and its percentage rate was high. Gas overconsumption by the residents (commercial losses) was added to the losses caused by the technical issues during the non-meter period, especially in winter;
3. Certain part of the residents had no money to install gas meters (approximately 100 USD);
4. Business plans could not be drafted and this made it difficult to attract investors.

Georgian gas supply was unstable over the following years too. It would even reduce during several years (Table 6).

Table 6. *Natural Gas Supply in Georgia over 2000-2016*

| Year | Million m ³ | Year | Million m ³ | Year | Million m ³ |
|------|------------------------|------|------------------------|------|------------------------|
| 2000 | 1094 | 2006 | 1860 | 2012 | 1933 |
| 2001 | 880 | 2007 | 1684 | 2013 | 1907 |
| 2002 | 700 | 2008 | 1450 | 2014 | 2197 |
| 2003 | 1011 | 2009 | 1200 | 2015 | 2416 |
| 2004 | 1231 | 2010 | 1094 | 2016 | 2261 |
| 2005 | 1440 | 2011 | 1750 | | |

Until recently, the gasification of the villages in the country was conducted slowly. At present, this process is rather intensive. Major source of natural gas for Georgia now is Azerbaijan. So far the local production is still insignificant – only 0.3% of the total consumption. Both in villages and cities the consumption of the natural gas increases in the household sector. At the end of 2016, the amount of the consumers of this energy source exceeded a million (1055600) out of which 96.7% comes on the household [10]. Significant share in this number comes on villagers. In 2016, the average amount of natural gas consumed by one household consumer

was 773 m³. This value is 4.5% more than the value recorded in 2014. The increase is observed in Tbilisi too, and for the household consumers of the rest of Georgia, constant increase of the volume of the natural gas consumed by an individual subscriber indicates the increase of the role of the natural gas in the household sector. In the environment when it is more and more difficult to obtain wood in the country and its price increases respectively, natural gas is the most accessible (financially and in terms of the access to the energy) energy source in the environment of mass gasification of Georgian villages.

According to the aggregated energy balance of Georgia, natural gas consumption in agriculture, forestry and fishing amounted to 8,8 thousand tons of conventional fuels in 2016 which is 2,5 times higher than the same index in 2015. Now in this field the total cost of natural gas in the country is 0.656% (in 2015 – 0,256%) [20].

4. Conclusion

Energy development in Georgia is characterized by unsteady successes. Over the last 100 years (1913-2016) the manufacture of electricity has increased 568,3 times and the natural gas consumption has increased 5,0 times since the assimilation of it up to today (1960-2016). It is noteworthy that the maximum for both of them were achieved in 1989. Comparing the level of 2016, it was more than 39,2% in electricity manufacture and 2,7 times more in natural gas consumption. There is approximately the same trend in separate sectors in the use of these energy sources, including agriculture, which is traditionally characterized by low power equipment.

Analysis shows that in order to improve the situation in the future, it is necessary to take into account the characteristic specificity of both fields (energy and agriculture). For energy to work out successfully, the intensive and continuous funding is necessary in order to maintain the functioning capacity and at the same time to achieve progress in accordance with the Macroeconomic Environmental Requirements. It is necessary to attract a significant number of additional investments. This as a result of joint influence of other objective factors (ecological requirements, the need for more expensive energy resources, etc.), in the first place the capitalization of the sector and overall significance increase.

Also the peculiarities of Georgian agriculture electrification and gasification should be taken into consideration. First of all, here we assumed the country's mountainous relief, climate, seasonality, the existence of small settlements far away from the center, still high-handed labor, still remaining high share of manual labor and so on.

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