EFFICIENT USE OF FUEL AND ENERGY RESOURCES IN GEORGIA'S ENERGY POLICY

Demur CHOMAKHIDZE

D.Sc. (Econ.), professor,
scientific consultant for
the Georgian National Energy Regulatory Commission
(Tbilisi, Georgia)

Urgency of the Problem

Energy saving is one of today's most urgent problems, and it is particularly acute in Georgia. The republic is not rich in energy resources, so in order to satisfy its economy's demand for them, a large amount of energy is imported. This includes the entire volume of natural gas consumed, most of the oil and petroleum products, and a large percentage of electricity. What is more, Georgia far from uses its energy resources rationally; in particular, there is frequently a noticeable lag in the country's energy efficiency indices behind similar parameters of developed countries.

During the years of Soviet power, an average of almost 900 million rubles in energy resources was expended in Georgia's material production per year. These expenditures were particularly high in industry—this sector accounted for 71% of all the expenditures in the material production sphere.

The expenditures of energy resources were high in the ferrous metallurgy, chemical, and petrochemical industries. Whereas an average of 15.7 kopeks per ruble of pure product was spent in industry, this index reached 16.2 kopeks in ferrous metallurgy and almost 18 kopeks in the building material sector.

These expenditures were relatively small in agriculture and construction, which shows the low level of energy supply in these industries.

Research has shown that at this stage of development, the value of Georgia's energy resources noticeably exceeded the role of labor productivity. In particular, each percent of fuel and energy resources saved in ferrous metallurgy was more significant (1.3-fold) than the percentage of increase in labor productivity. Estimates show that in 1988 an increase in labor productivity in this industry by 1% made it possible to obtain 815,000 rubles in pure product, while a drop in the energy-output ratio by 1% made it possible to save 1,069,000 rubles, or 31.2% more.[1] The importance of energy resource saving increased even more during Georgia's independence. This was promoted by the fact that the country's economy became dependent mainly on the import of energy resources. Consequently, whereas in 1988 the value of a drop in the product energy-output ratio was higher than the value of an increase in labor productivity by 31.2%, as early as 2000, this index amounted to 76.2%. This index increases even more if production is expanded. It has been proven that the value of fuel and energy resource saving as a source of the republic's economic growth increases as production expands and intensifies.

[1] See: D. Chomakhidze, *Georgia's Energy Security*, Tbilisi, 2003, p. 361 (in Georgian).

Energy resource saving makes it possible to reduce capital investments in raw material extraction and equipment manufacture for primary production, while the resources saved can be used to meet the social needs of the population.

It stands to reason that significant saving of fuel and energy resources, in the same way as their production, requires certain expenditures. So would it not be better to use the funds expended on ensuring fuel and energy resource saving to increase their production? This question does not have an affirmative answer.

- First, even if fuel and energy reserves were not limited, their increased reproduction is not justified from the economic viewpoint. Calculations have confirmed that in order to carry out large-scale energy-saving measures, 2-3-fold fewer investments are required than to produce fuel and energy resources in equivalent volumes.
- Second, practice shows that an increase in the production of fuel and energy resources aggravates the shortage of these and other resources to a certain extent. This is due to the fact that primary production is a capital- and labor-intensive industry, and its development requires large amounts of machinery, equipment, materials, and energy, as well as manpower. On the other hand, there is a rapidly growing need for these resources in the economic sphere, but meeting it only in an extensive way is not only inefficient, but also impossible.

At present, saving fuel and energy resource consumption in Georgia of 1% means saving approximately 25,000 tonnes of oil equivalent, including 80 million kWh of electricity, 15 mcm of natural gas, and so on. Most of the electric power consumed is expended in the municipal and household sector. In 2005, it amounted to almost 5 billion kWh, which is much more than the amount manufactured at Georgia's largest Inguri hydropower plant. A drop in electric energy consumption in this sector by 1% using the available reserves will make it possible to save almost 50 million kWh.

Level and Dynamics of Energy Efficiency Indices

Georgia is a major consumer of fuel and energy. At present, the country consumes an average of 2.5 million tonnes of oil equivalent a year. In recent years, consumption has risen even more. In 2006, approximately 8 billion kWh were expended, which is higher than the corresponding index for 2000. During this period, fuel consumption has increased, while in general the expenditure of fuel and energy resources for 2000-2006 rose by 34.9%.

In 2006, fuel accounted for about 74.7% of the total consumption of fuel and energy resources in Georgia, electric energy for 24%, and thermal energy for 1.3%.

Until the 1990s, the rational use of fuel and energy resources was solved by primary use of more economic types of energy, such as oil and gas, and the percentage of hydropower increased in electric energy production. As a result, over a span of 20 years (1961-1980), the percentage of oil production in the republic's fuel and energy resources increased from 0.4% to 20.8%, while the percentage of electric power manufactured at hydropower plants increased from 2.5% to 3.6%. Meanwhile, during this period, the percentage of natural gas in the structure of fuel consumption rose from 11.1% to 38.5%, and the percentage of coal dropped from 53.9% to 15.8%.

In 2006 the total consumption of fuel and energy resources in Georgia amounted to 2,499,000 tonnes of oil equivalent, which was 60.2% higher than the same index for 1995. The per capita consumption of fuel and energy resources is also growing: in 1995, it was equal to 0.32 tons, in 2002 to 0.42 tons, and in 2006 to 0.56 tons, that is, 75% higher than in 1995. As for the energy-output ratio of the gross

domestic product (GDP), during the period under review, it was characterized by a downward trend. In 2000, 2,566 kWh of energy was expended on the "production" of every thousand dollars of the GDP, which was 2.4-fold more than the index for 2006. A similar trend has also been developing in industry. In particular, the energy-output ratio of industrial production for the same period dropped by 36.5%.

This is the result of those measures implemented in the country in recent years. It should be noted in particular that in a market economy the consumer uses fuel and energy resources more rationally and looks for new ways to economize on them. In addition, energy accounting and other things improved. A Center of Energy Efficiency has also long been functioning in the republic, and various energy projects are being carried out with the help of USAID. In order to study the potential of energy efficiency and the use of renewable energy sources, a Winrock International project is being drawn up, along with the World Experience for Georgia Foundation, called Development of the Energy Industry in the Village, among other things.

Within the framework of this project, there are plans to rehabilitate four small hydropower stations. They can produce 17.3 million kWh a year and meet the energy demands of 4,000 rural families. The largest of these hydropower plants, Kabali, went into operation in October 2007. Projects are also being implemented to raise energy efficiency. In particular, a biogas installation is being built in the village of Sadmeli (mountainous Racha Region) for heating the school, kindergarten, hospital, and territorial authority building, as a result of which farmers will be able to acquire gas and fertilizers for their farms.

One of the measures designed to raise energy efficiency is replacing incandescent lamps with more efficient fluorescent ones, which consume 4-fold less electricity. This will allow the country to save 350 GWh of electric power. Whereby it should be kept in mind that implementing this measure will lower the demand for electricity in the winter, which is the most difficult time for Georgia in energy terms. Calculations have shown that this will make it possible to save approximately 310 GWh of the electricity produced at thermal power stations per year, which in turn will decrease the import of natural gas by 100 mcm.[2]

The level and dynamics of the product energy-output ratio in Georgia for 2000-2006 are presented in Table 1, from which it follows that the product energy-output ratio and electric capacity are decreasing every year (only 2002 was an exception in this respect). Despite the fact that the republic is experiencing a shortage of fuel and energy resources, this year the energy-output ratio of the GDP increased by 0.7%, and the industrial product electric capacity by 0.9%. In both cases, the growth rate of fuel and energy resource consumption was higher than product production, which caused an increase in the energy-output ratio and electric capacity.

Electricity losses in Georgia's power transmission lines have always been high—some years they amounted to 20-30%. This index sharply dropped recently due to the implementation of the necessary measures. In 2002, losses amounted to 15.7%, while by 2006 they had decreased to 2.8%. The situation began to change after 2003. At that time, a foreign company (Ireland's ESBI) began to participate in power transmission in Georgia. In 2006, the exclusion of a large part of power transmission lines with a voltage of 110-35 kV and substations transferred to the Joint Distributor Joint-Stock Energy Company from the authorized capital of State Electricity System of Georgia, Ltd. at the end of 2005 led to a sharp drop in electricity loss (from 6.3% to 2.8%).

Georgia's thermal power stations are characterized by low technical and economic indices. They expend much more fuel to produce 1 kWh of electricity than in the developed countries of the world. In the past, the specific expenditure of fuel on the production of 1 kWh of electricity was equal to

[2] See: USAID WINROCK INTERNATIONAL. Quarterly Information Bulletin. Fall 2007.

Table 1

Level and Dynamics of Georgia's Energy Efficiency Indices in 2000-2006[3]

Indices	Unit of Measure-ment	Years							2006 % of 2000
		2000	2001	2002	2003	2004	2005	2006	
Energy-output ratio of the country's GDP	kg of oil equivalent / $1,000	605.7	602.5	606.6	576.2	471.9	380.6	334.8	55.3
including: electric capacity	kWh/ $1,000	2,566.3	2,265.7	2,274.6	1,978.0	1,544.8	1,305.0	1,055.7	41.1
industrial production energy-output ratio	kWh/ $1,000	434.8	472.6	474.2	424.8	368.0	289.6	242.5	55.8
including: electric capacity	kWh/ $1,000	1,474.3	1,836.6	1,853.0	1,562.0	1,257.3	1,003.0	936.8	63.5
electricity losses in power transmission lines	million kWh	828.1	1,063.0	1,216.0	1,150.0	500.0	530.0	221.9	3.7-fold
in % of consumption	%	10.6	14.9	15.7	14.6	6.3	6.3	2.8	–7.8

400-500 g, and some years it was as high as 1 kg. The situation has slightly improved recently in this respect, but it cannot be said to be satisfactory (see Table 2).

At present, Georgia's power stations (Mtkvari-energetika, Ltd., TbilGRES Joint-Stock Company, and Energy-investi Joint-Stock Company) are experiencing significant problems.

Mtkvari-energetika, Ltd. and TbilGRES Joint-Stock Company are equipped with old energy units. They were manufactured when symbolic prices for primary energy resources were in effect and are characterized by low efficiency indices. The situation is also aggravated by the fact that market prices for primary energy resources rose almost seven-fold, and this makes it dubious that these energy units are capable of functioning at all. But it must be taken into account that under present-day conditions it is impossible to satisfy the peak demand for electric and thermal power in the fall-winter period without thermal power stations.

[3] The table was compiled on the basis of the data of the Department of Statistics of the Georgian Ministry of Economic Development.

Table 2

Specific Expenditure of Fuel on the Production of Electricity at Georgia's Thermal Power Stations[4] (*grams/kWh*)

Years	TbilGRES Joint-Stock Company	Mtkvari-energetika, Ltd.	Energy-investi Joint-Stock Company
2001	286.6	229.4	—
2002	304.3	219.7	—
2003	322.0	229.4	—
2004	346.2	231.8	—
2005	284.2	216.5	—
2006	256.8	233.5	248.7

The shortage of primary energy and the seasonal nature of Georgia's power-generating rivers require that thermal power stations operate under seasonal conditions. For this reason, the three thermal power stations with a capacity of 620 MW produced only 2 billion kWh of electricity in 2006. And this shows the low level of use of the capacities of the mentioned thermal power stations—during the year they were in operation for a total of 3,200 hours. This is a low index for such stations (the standard time is 6,000-6,500 hours).

It stands to reason that the operation of thermal power stations under such conditions significantly lowers energy efficiency. In the final analysis, all measures that envisage high energy efficiency are related to a decrease in specific fuel expenditure on the production of electric and thermal energy. According to experts' estimates, 70-80 million lari (40-45 million dollars) for natural gas can be saved a year by raising the energy efficiency at Georgia's thermal power plants. And this, in addition to the economic benefits, will help to improve the environmental situation.

Unfortunately, not only old energy units, but also new generation gas-turbine installations (Energy-investi Joint-Stock Company) require raising energy efficiency. A gas-turbine installation was put into operation in March 2006. It was set up in an area with insufficient potential to realize the advantage of this type of station. Nor was a unit built for utilizing the products of high-temperature combustion, which could additionally raise the capacity by 40 MW.

So the level of energy efficiency of the gas-turbine unit is rather low and specific fuel expenditure electricity production here is almost 7-fold higher than at the ninth energy unit of Mtkvari-energetika, Ltd. This significantly raises the price of electricity produced at this facility.

Consequently, not one of Georgia's thermal power stations meets the standards of specific fuel expenditure on electricity production.

In addition, at enterprises of material production—industry, construction, agriculture, and transportation—the specific expenditures of fuel and energy resources are still high, there are great fuel and energy losses, secondary resources and non-traditional types of energy are not fully used, energy-saving technology is being slowly introduced, and so on.

[4] The table was compiled on the basis of data of the indicated thermal power stations.

The Main Ways to Raise Energy Efficiency

Raising energy efficiency is a fundamental part of the strategic development of Georgia's energy industry. From the viewpoint of efficient energy use, the Main Vectors of State Policy in Georgia's Energy Sector envisage "the formation and improvement of legislative and institutional acts, as well as the implementation of the necessary measures to improve the use of renewable types of energy, as well as of thermal supply facilities and co-generating systems."[5]

The fact that according to U.N. data in recent years the beneficial use of the fuel produced amounts to 20% in the world while the other 80% is lost in the production, enrichment, and transportation of energy resources, as well as during the transformation and use of energy, indicates man's great potential for resolving this problem.

Energy efficiency can be raised by reducing losses using resource-saving technology and high labor organization, which in turn can be ensured both during the production of energy resources and during their transportation and consumption. Due to the limited resources, it stands to reason that society will not be able to manage without economizing. Raising energy efficiency will ensure reliable long-term prospects both for the energy industry and for the country's economy as a whole. The orientation toward energy-saving technology means not only raising the competitiveness of the economy, but also requires significant potential in meeting the republic's need for energy resources. So raising energy efficiency will continue to be one of the priority tasks of the country's energy strategy for a long time to come.

During the transition period, Georgia will not be able to carry out new important and large-scale building programs. At this time, the restoration of existing facilities, the technical refurbishing of the basic funds, and the efficient use of fuel and energy resources should be the priority areas. It is clear that in a market economy Georgia should not allow itself to make irrational use of energy resources. The need to save energy resources is increasing over time; a widespread complex of saving measures must be drawn up and put into practice.

In the mid-1970s, mankind began to intensively incorporate "easily accessible" energy resources, mainly of organic origin, into economic circulation. As research has shown, world oil supplies will be exhausted in about 50 years, natural gas in 60 years, and coal in 200-400 years.[6]

It stands to reason that ensuring the rational use of fuel and energy resources has its own specifics both in quantitative and qualitative terms in every country. In Georgia, the key vectors in energy saving are the following: acceleration of scientific and technological progress in the production and consumption of energy resources; improving the sectoral, technological, and territorial structures of the economy; increasing the use of non-traditional types of energy (sun, wind, thermal waters, biomass, secondary energy resources, and so on) and the energy of small rivers; and improving the economic mechanism of energy saving.

In Georgia, as in all the former socialistic republics, energy efficiency is still low. But, as was mentioned above, trends have been developing in recent years in the country toward a drop in the energy-output ratio and electric capacity, as well as toward an improvement in several other indices of energy efficiency. These trends will continue as new forms of ownership in production relations and the privatization of state facilities are introduced.

---

[5] *Resolution of the Georgian Parliament on the Main Vectors of State Policy in Georgia's Energy Sector*, Tbilisi, 7 June, 2006 (in Georgian).

[6] See: A.P. Fedotov, *Globalistika: Nachala nauki o sovremennom mire*, Moscow, 2002, p. 140.

It was established that industry accounts for 70% of the total amount of fuel and energy saved in the republic, transportation for 15-18%, and the municipal sector for 10-14%.

The following should be singled out from among the main vectors of energy saving in Georgia:

— replacing existing production equipment with up-to-date economic machinery and mechanisms;

— introducing progressive technology;

— developing and introducing optimal conditions for the use of power-generating technological equipment;

— raising the technical level of operation of boiler and furnace equipment;

— lowering the loss of fuel and thermal and electric power during transportation;

— improving the system of fuel and energy accounting in production and consumption;

— introducing the secondary use of energy resources and thermal residues of industrial enterprises;

— using natural sources of heat (thermal waters, solar energy, heat from the environment, sea water, and others);

— developing and introducing progressive projects for building housing and public facilities.

Further improvement of the structure of the heat and energy balance should also be included among the important measures aimed at the rational use of fuel and energy resources in order to identify types of deficit fuel and replace them with more accessible resources.

At present, some of the basic funds used in Georgia's energy industry are already outmoded and characterized by low technical-economic indices. Their efficiency factor can be increased by 5-6%, which is equivalent to 0.35 GWh a year. Moreover, idle periods in the operation of units lead to water losses (particularly in the derivation system), which on average amounts to 0.4 GWh in electricity loss a year.

Even higher electricity losses of 0.43 GWh a year occur at regulating hydropower plants, which is due to disruptions of the water "development" conditions. A total of 1.18 GWh of electricity a year is lost at hydropower plants (approximately 17% of production).

There is great potential for energy saving in the transportation, delivery, and distribution of natural gas. For example, the losses in gas pipelines, etc. are enormous. In order to intensify energy supply in this sphere, it is necessary to:[7]

— improve the regulations of energy accounting and control over its consumption;

— establish standards of energy use and the maximum values of energy loss; ensure mandatory certification of mass use energy-consuming instruments and equipment and bring them into harmony with the standard energy expenditures;

— carry out regular audits of enterprises;

— introduce additional economic stimulation of energy saving and encourage its introduction into business;

— ensure ubiquitous state propaganda of the importance of energy saving, mass training of personal, openness of the results obtained, and availability of information on energy-saving measures, technology, equipment, and regulatory-technical documents;

[7] See: *Georgia's Energy Strategy* (group of authors), Tbilisi, 2004, p. 133 (in Georgian, Russian, and English).

— assist goal-oriented business in the energy-saving sphere aimed at developing optimal scientific, engineering-design, and production decisions that will be used to decrease the energy-output ratio.

Additional tools for stimulating energy saving include the mechanisms envisaged in the Kyoto Protocol, including joint projects.

Measures aimed at saving and efficiently using energy should become a mandatory component of regional and municipal programs.

Within the framework of the latter, it is expedient to institute the acquisition of honorable title of Power-Generating City. This title can be acquired by a city that carries out an energy policy oriented toward the use of alternative energy technology. This Swiss idea has already become an international asset.[8]

Implementation of the designated measures will help to raise the reliability of the country's energy supply, improve the population's standard of living, and resolve environmental problems.

[8] See: "Ekonomiia energii," in: *Informatsionnyi referativnyi sbornik Vserossiiskogo instituta nauchnoi i tekhnicheskoi informatsii* (VINITI, Moscow), No. 8, 2004, p. 3.