The Role of Energy Conservation in Georgia's Energy Supply

By Murman Margvelashvili and Badri Chkhaidze

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1. Introduction

Georgia consumes six times less energy per capita than Norway and Finland and two-and-a-half times less than Greece. However, Georgia uses 4.5 times more energy per unit of GDP production than these countries; though the Georgian economy and population consume less energy, this consumption is very inefficient.

Imports comprise 60 – 70% of Georgia's energy supply. Such a high level of dependence on energy imports brings with it significant economic and political vulnerability and is of national security concern. During the last several years the price of natural gas more than quardrupled and together with significant growth of oil prices has become a serious factor impeding Georgia's economic development. The recent events in the region impose further threat to reliability of country's energy supply. Reduction of reserves of fuel along with increasing demand and expected growth of prices for energy carriers may continue to aggravate the situation for both the country's economy as well as its citizens.

Therefore, ensuring the current and future economic and social development through energy security requires effective measures. Efficient use of existing and imported energy resources is the key to achieving this goal.

Energy efficiency in Georgia is no longer motivated only by a desire to follow modern trends or fulfill international obligations. It is one of the major conditions for sustainable development of the country and its economy, and should become one of the focal points of the country's energy policy.

What Is Energy Efficiency?

Energy efficiency is a measure of efficiency of energy resources consumption. An increase in energy efficiency means yielding the same economic or social effects by using less energy. Growth of energy efficiency can be achieved in two ways: by increasing efficiency of equipment and appliances for both power generation and end-use activities and by energy saving. The latter relates to personal and cultural behavior and requires teaching rational energy consumption or optimal production regimes.

Growth in the efficiency of energy use serves the same goal as production of additional energy and in most cases is a much cheaper option for the society. However, for years, the main focus has been placed om increasing of energy generation and energy conservation was practically neglected.

Given the network losses saving1 kWh of electric energy by user is equivalent to generating 1.2 kWh at the power station.

It should be noted that energy efficiency is a characteristic of developed communities, as it requires a high level of consumer awareness, effort on the part of government, business, and banking, an efficient, functioning society, and modern technology. Therefore, highly developed countries are able to show a higher level of energy efficiency.

The latest reforms implemented in the Georgian energy sector--privatization of power and natural gas distribution companies and the implementation of large scale rehabilitation projects—

significantly increased the reliability of Georgia's energy supply and reduced the possibility of misappropriation of power and natural gas. These successes now provide the opportunity and incentive to take further action towards creating the institutional and legal framework necessary for wide implementation of efficient use of energy resources.

It is hoped that Georgia is approaching the level of development where harnessing the potential of energy efficiency will help support the country's energy security and economic and social development.

World experience has proven that despite the explicit economic and financial advantages of energy efficiency, consumers must be provided with both the rationale for energy efficiency and the information necessary to achieving it. For this reason, growth in energy efficiency requires the state to take a leading role.

2. International Aspects of Energy Efficiency

Georgia is a participant in and signatory to several international agreements such as:

- Energy Charter Treaty and Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA)[1]
- Framework Convention on Climate Change and the Kyoto Protocol[2]
- European Neighborhood Policy[3]
- European Commission "Green Paper" [4]

These agreements can serve as roadmaps for how Georgia can increase energy efficient consumption. In addition, as a signatory Georgia is obliged to fulfill the requirements stated in these documents.

The Energy Charter Protocol requires signatories to formulate energy efficiency strategies and policy aims that establish appropriate regulatory frameworks; moreover, signatories must develop specific programs for promoting energy efficiency and reducing harmful environmental practices in the energy sector.

In May 2007, Georgia applied for an observer status in the Energy Community Treaty[5]. This is another step towards integrating into European structures, improving energy security and harmonizing legislation with European laws. The Energy Community is a significant tool for increasing energy efficiency in countries.

The Clean Development Mechanism (CDM) of the Kyoto Protocol is a key incentive and source of financing for development of energy efficiency and energy saving projects. Georgia meets the eligibility requirements to sell greenhouse gases emission quotes in the international carbon market.

[1] http://www.encharter.org/
[2] http://unfccc.int/
[3] http://ec.europa.eu/world/enp/documents_en.htm
[4] http://ec.europa.eu/energy/green-paper-energy/index_en.htm
[5] http://www.energy-community.org/

In June 2007, the CDM Council finalized new rules for Programmatic Approach, according to which programs consisting of separate small projects may be given CDM credits.

These mechanisms make it possible to generate tens of millions of dollars through growth in energy efficiency and use of renewable energy. Under current prices it is possible to receive 0.4 – 0.6 tetri for each kilowatt-hour saved. An increase in these prices is expected to take place in the future.

3. Activities to Increase Energy Efficiency

Activities of various complexity and value can increase effective energy use, from filling gaps in windows to optimizing production by equipping the energy system with complex modern technologies.

The following are examples of energy efficiency measures:

- Replacement of incandescent bulbs with energy efficient bulbs
- Weatherization of doors and windows or installation of energy efficient windows to reduce heat losses
- Improvement of thermal performance of existing buildings and implementation of modern thermal insulation standards in new buildings
- Installation of modern efficient heating systems
- Fuel switching of vehicles from benzene and diesel to to natural gas burning
- Switching from electricity to natural gas in households
- Replacement of old motors with new, variable-speed efficient motors
- Optimization of energy consuming equipment operation regimes and production processes;
- Simultaneous generation of electricity and heat (cogeneration), generation. Use of modern effective technologies including combined cycle, coal gasification, fluidized bed combustion, etc.

Undertaking economically justified energy efficient measures enables cost-saving at both the consumer and country levels and improves economic development and social conditions. Therefore, it is in the state's interest to increase energy efficiency by supporting implementation of the aforementioned measures. The state can do this by providing the population with information, developing incentive mechanisms for production and import of energy efficient equipment or other such measures.

In order to assess the energy problems that the Georgian economy and population faces and the ways in which energy conservation may alleviate those problems, it is necessary to review the peculiarities of Georiga's energy use, given below. More detailed information is available at the website www.weg.ge in their reports on energy efficiency and evaluation of renewable energy potential.

4. Georgia's Energy Characteristics in Brief

4.1. Aggregate Energy Balance

The aggregate energy balance of a country depicts the supply and consumption of various types of energy within that country. Based on the energy balance, the energy condition and economic characteristics of the country may be discussed. Sound understanding of a country's energy balances is a major precondition for developing economic strategy and action plans.

As a rule, a nation's statistics bureau compiles energy balances. Unfortunately the Statistics Department of Georgia does not prepare the country's aggregate energy balance annually. Therefore, Georgia's energy description will be based on aggregate energy balance for the year 2007 compiled by data from professionals and energy companies.

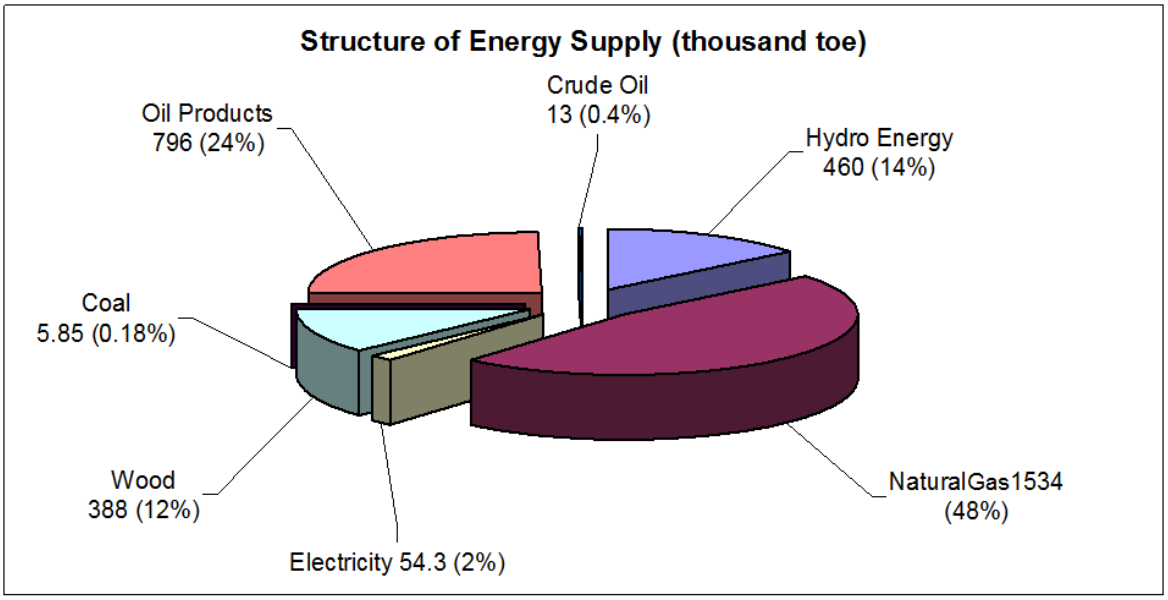

Figure 1: Structure of Energy Supply in Georgia

According to these data, Georgia's energy supply in 2007 was approximately 3,252 thousand tons of oil equivalent (TOE)[6], of which up to 70% was imported (47% natural gas and 24% oil products), at high risk to Georgia's energy and economic security. This reliance on imports represents an economic burden and significantly deteriorates the external trade balance. As a result of this dependence, Georgia's population and economy face unstable power supply and insecure prices.

Both water (through hydropower plants) and firewood are widely used local energy resources. The (official) share of firewood is high and approximates that of power generated in hydro power plants. According to professional assessment, real consumption of firewood exceeds official figures several

[6] For purposes of energy balance, in order to compare supply and consumption of the various types of energy, amount of all energy types are being converted into conditional unit, which is equivalent of 1 ton oil energy (TOE=11.6 Mega WattHr)

times over, making firewood significantly exceed hydropower in the total energy balance of the country[7];

Consumption of energy supplied to Georgia for various purposes is shown below.

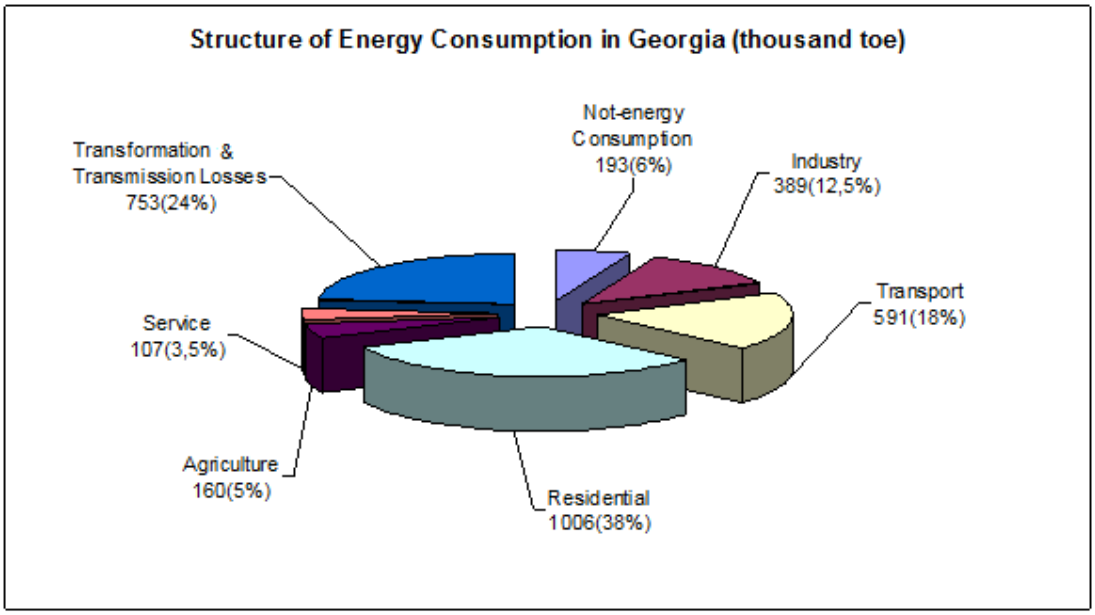

Figure 2: Structure of Energy Consumption in Georgia

Residential energy use accounts for the largest share of energy consumption. The energy used for household purposes (including personal transport) constitutes 38% of energy supply (53% of final consumption), which is 2.5 times higher than energy consumption in industry and 10 times that of the service sector. The downside of such a distribution is that the majority of energy consumption is for residential end-use and as such does not contribute to GDP production.

As depicted on the Figure 2, conversion and transmission losses are high, caused mainly by inefficient conversion of natural gas into electricity (300 thousand TOE) in thermal power plants (at 30% efficiency). It should be noted that these losses can be halved by using highly efficient technologies.

The International Energy Agency (IEA) data presented in Figure 3 show that the level of energy supply of Georgian economy and population is relatively low compared to other countries.

[7] Latest data on coal extraction and consumption are not included, however, this circumstance does not substantially affect the judgement.

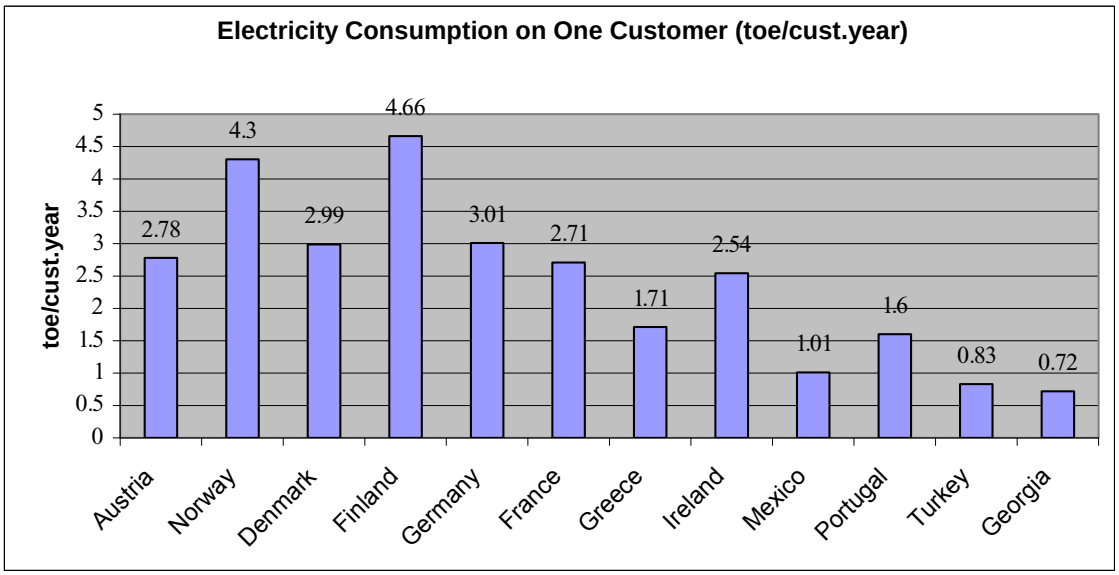

Figure 3: Consumption of Primary Energy in Various Countries

In addition, the level of use of energy resources and energy in Georgia, determined as ratio of consumed energy to unit ($1) of Gross Domestic Product (GDP) is much higher than in developed countries (See Fig. 4).

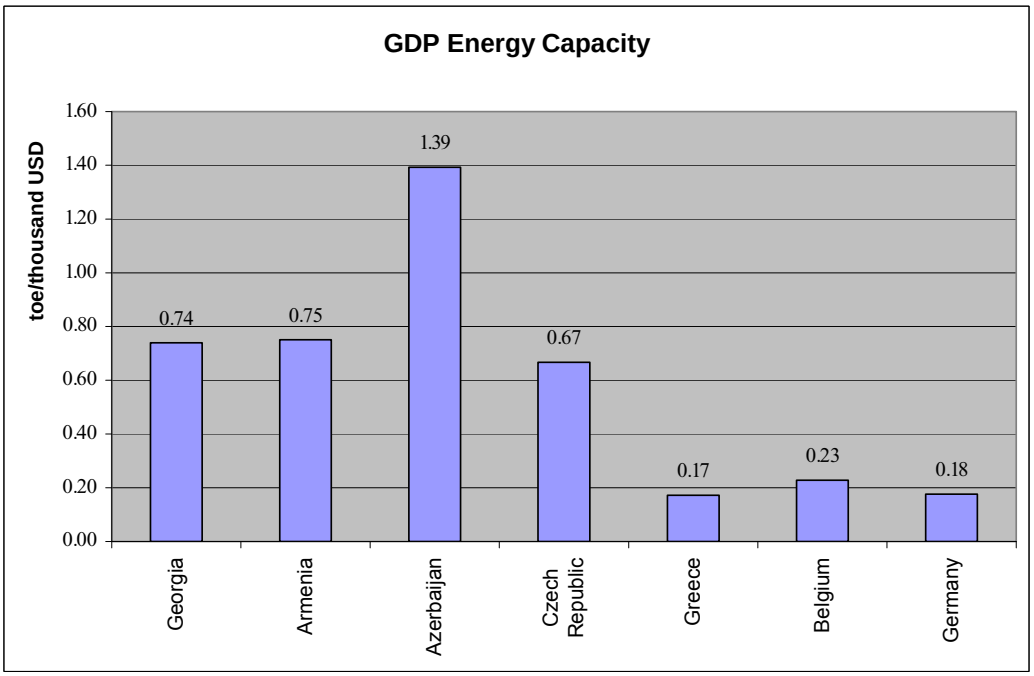

Figure 4: Energy Intensity of GDP in Various Countries

These figures show that Georgia consumes six times less energy per capita than Norway and Finland and 2.5 times less than Greece. However, in Georgia 4.5 times more energy is consumed for a unit GDP production (with the value of 1 USD) than in these countries meaning that even though the energy supplied is small, it is consumed inefficiently.

4.2 Electricity Balance

Generation and consumption of electricity in Georgia decreased approximately twice during the last 20 years, due to the economic downturn and large change in Georgia's political and economic structure. As shown in Figure 5, the total consumption of electricity remained practically unchanged for the last eight years.

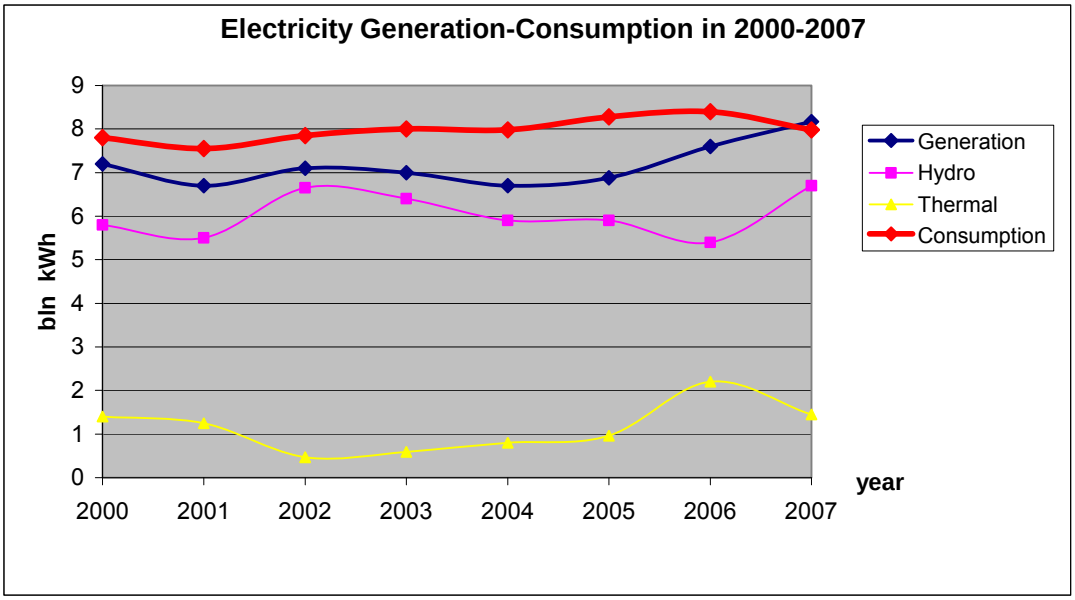

Figure 5: Generation-Consumption of Electricity in 2000 – 2007

The energy generated by hydropower plants has been increasing since 2004, due to the rehabilitation and capacity recovery of existing plants.

Figure 6 shows seasonal character of electricity generation and consumption.

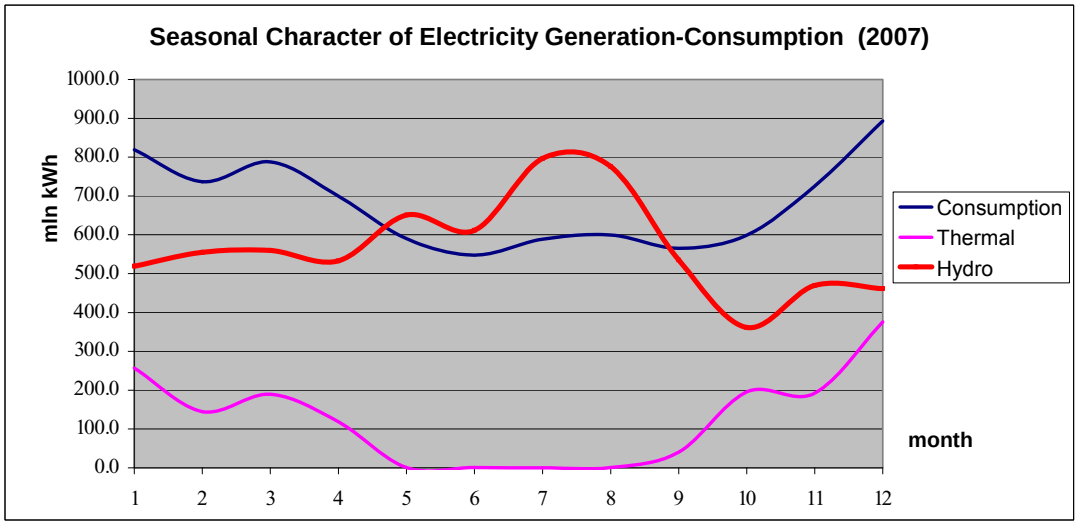

Figure 6: Seasonal Generation and Consumption of Electricity

Consumption of electricity during the fall and winter exceeds generation of local hydropower plants. This deficiency is filled by imported electricity or natural gas used at local thermal power plants to generate electricity. Conversely, during the spring and summer, hydropower plant generation exceeds the country's internal consumption.

Excessive electricity produced during the summer of 2007 permitted Georgia to export electricity and for the first time in recent years the system had the positive export-import balance (+ 192.2 million kWh). In 2006, the import-export balance was negative (- 695 kWh). However, during the fall and winter of 2007, even with fully-functioning thermal power plants, electricity imports (433.2 million. Kwthr) were necessary to meet electricity demand.

This seasonality is an impeding factor in utilizating hydro resources for further development of the energy system. New hydropower plants will have their maximum generation during the spring-summer period, when there is already an excess of electricity in the Georgian energy system. New construction without markets is not profitable. The seasonality of demand and supply equally impairs the economics of thermal plants that have to operate only in cold season.

Due to the current limited internal market, the key for development of the Georgian energy system lies in international regional cooperation in the energy sector and the creation of a regional energy market. Only stable mechanisms of electricity trade and exchange will ensure attraction of investments to the sector by yielding stable income for the investor.

There are a few large consumers that purchase electricity on a wholesale level.

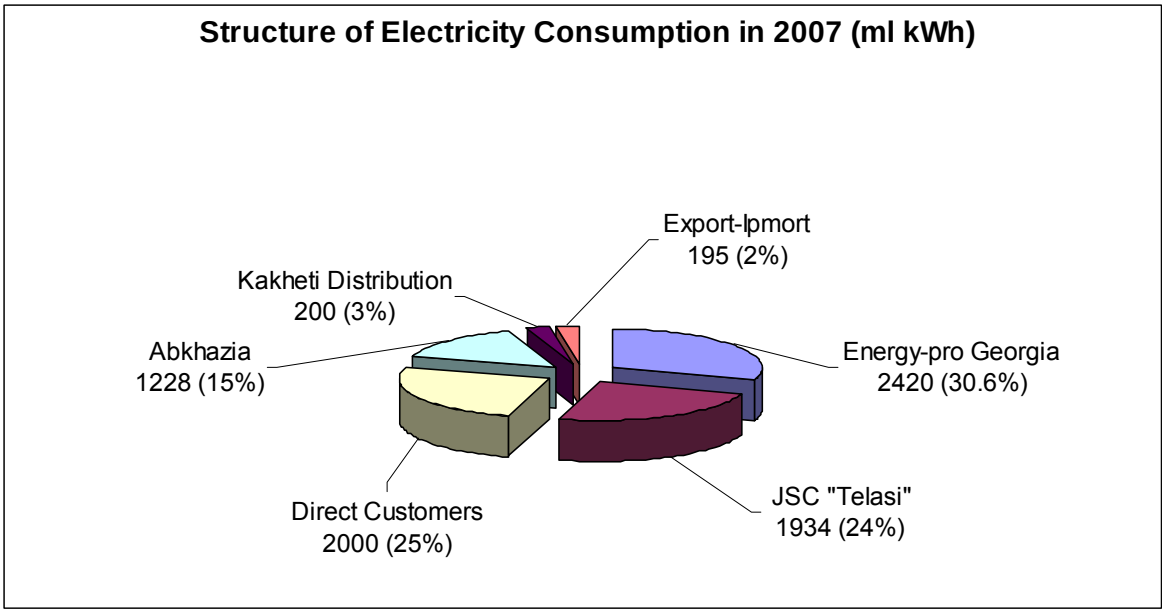

Figure 6. Major Electricity Consumers in 2007

As shown above, the large wholesale consumers are Energo Pro Georgia (30%), Telasi (23%) and large (Qualified) industrial enterprises or direct consumers (23%).

Figure 7 presents the structure of electricity consumption by direct consumers. They consume a significant part of electricity supply and therefore can make significant contribution to energy saving. Given the fact that these companies operate with old Soviet technologies and technical facilities, it can be presumed that there is potential for energy saving in these enterprises.

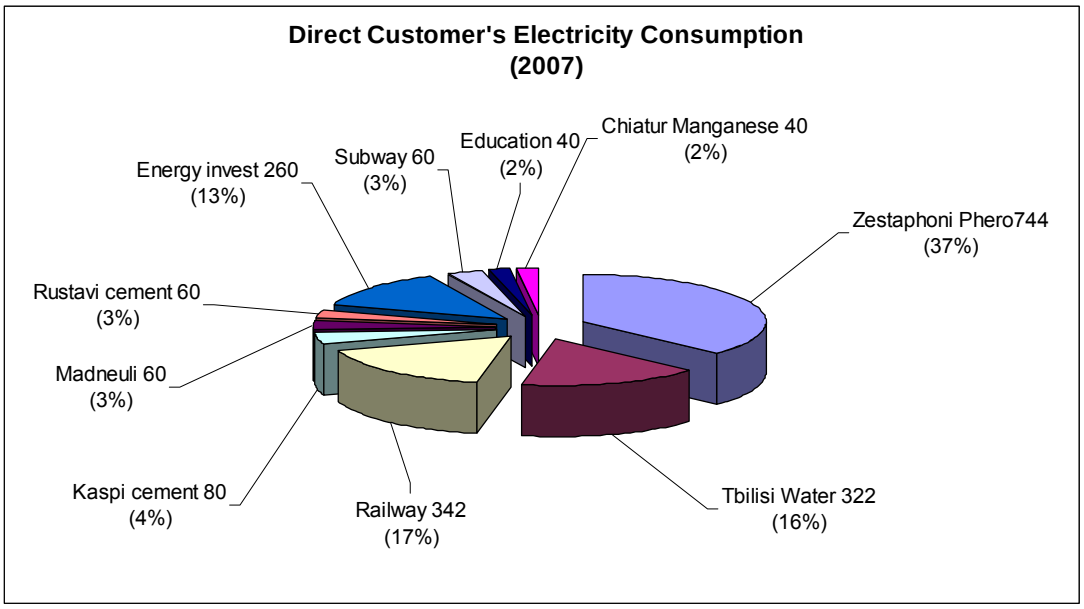

Figure. 7. Electricity Consumption by Direct Consumers (million kWh)

Ascertaining the energy efficiency potential of these enterprises requires an energy audit.

4.3 Consumption of Natural Gas

Annual consumption of natural gas in 2007 equaled 1,683.8 million m^3, which constituted 89% of the previous year's consumption. The reduction in natural gas consumption was caused by the fact that in 2007 natural gas was not used for electricity generation in thermal power plants.

Natural gas consumption, as well as energy consumption during the year is seasonal, as depicted in Figure 8.

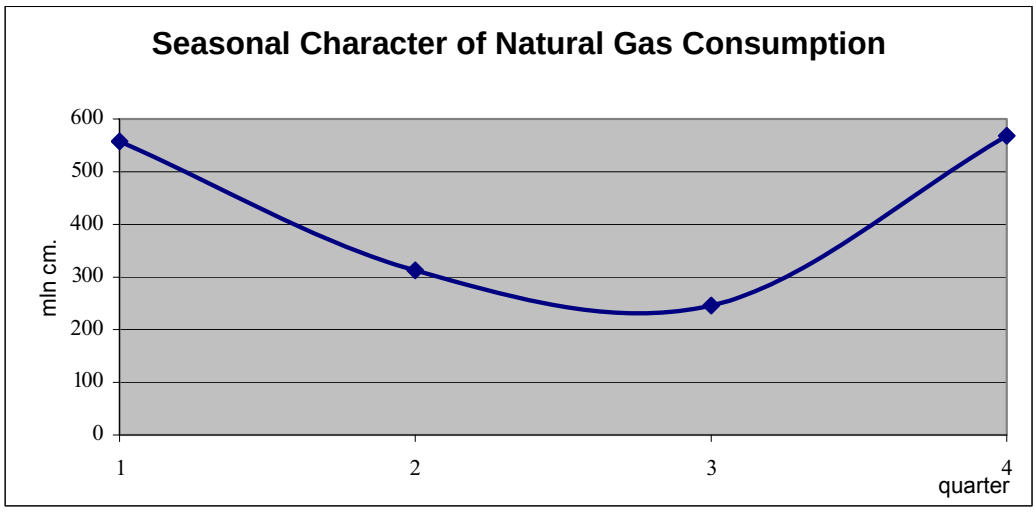

Figure 8: Natural Gas Consumption in 2007

The residential sector is one of the largest consumers of natural gas. Both transmission losses and energy conversion losses from thermal power plants are included.

Figure 9 shows the structure of natural gas consumption by wholesale consumers.

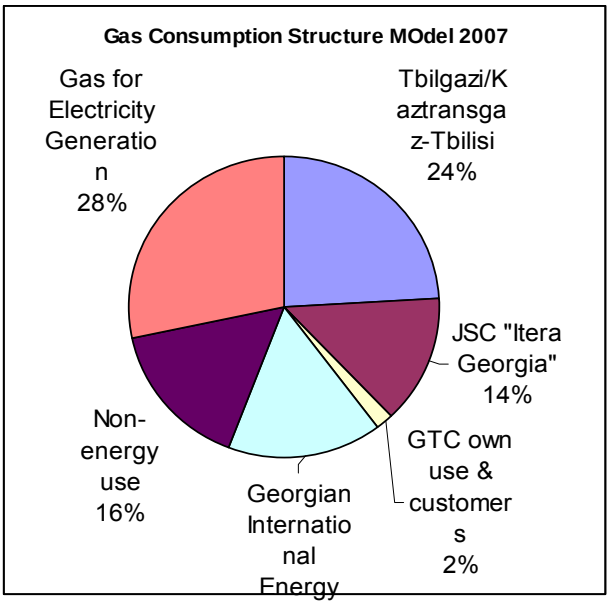

Figure 9. Natural Gas Consumption by Wholesale Consumers

According to the above data, TPPs (Mtkvari, Tbilsresi and Energy Invest Air Turbine) account for the largest share of natural gas consumption. The average efficiency of these TPPs does not exceed 30%. In contrast, use of modern, combined cycle equipment can increase the fuel efficiency to 55-60%.

One significant user of natural gas is KazTransGasTbilisi (21%), which serves Tbilisi consumers. Annual natural gas consumption patterns during the year are similar to those of electricity consumption. Consumption during the winter period is 2.5-3 times higher than summer consumption due to the use of natural gas for heating (280-330 million m^3). Consumption of KazTransGasTbilisi equals 399.3 million m^3. It should be noted that the volume of natural gas used

for this purpose is much less than the volume required for normal living conditions. In Tbilisi, residential and public buildings require approximately 750-800 million m^3 natural gas for heating.

4.4 Use of Firewood

Like electricity and natural gas, firewood is a significant source of energy though mainly in villages. According to official data its share in the total energy supply equals 11-12%, which is equivalent to the total electricity generated by all hydropower plants. Experts assert that the real volume of firewood consumption may be 2-3 times higher.

People use firewood for cooking during the year and for heating in winter. Handicraft ovens, designed for cooking as well as for heating are used for burning the firewood. Efficiency of these ovens especially when used only for cooking, which is the case for 6-7 months out of the year, is low and consumes only 10-15% of the firewood's energy.

The large share of firewood use in energy balance would be a positive trend, if not the following factors:

- Logging and consumption of firewood is four times greater than the norms permitted for Georgian forests, negatively impacting the environment
- Firewood is used in ovens with low efficiency, resulting in the loss of most of the generated energy

5. Energy Efficiency in Georgia and Other Countries

As noted above, increasing energy efficiency is of vital importance for Georgia both at the individual consumer level and for the state.

Due to subsidized price on electricity in the Soviet Union, the population, as well as institutions and organizations developed wasteful attitude towards energy consumption. Despite the current high tariffs, this attitude is still prevalent in Georgia. Society is not adequately informed about the profitability and technical opportunities of energy conservation.

Global experience shows that buildings account for 40% of general energy consumption. Energy consumption in buildings is determined by their thermal characteristics in addition to their ability to use the solar energy. Many buildings in Georgia were constructed during the Soviet period and according to the standards of that time, where heating 1 m^2 required 250-300 kWh per annum (28-33 m^3 of natural gas). In comparison, based on the thermal classification of European buildings, this figure is equal to 30 kWh per annum for the highest class and 160 kWh per annum for buildings of the lowest class. The difference in energy efficiency between the Georgian and European buildings is significant. Thus, the issue of energy efficiency for existing and newly constructed buildings requires special attention.

Currently modern energy efficiency norms are not used in the country and even the old Soviet standards are often neglected. Therefore:

Many buildings currently under construction will become future sources of unnecessary energy losses, thus complicating the country's energy supply.

Results of a World Bank survey on 625 large enterprises of Russia deserve attention. According to the report, the energy intensity of GDP in Russia is eleven times higher than in Germany, six times higher than in Canada and four times higher than in Poland[8]. The headline *Energy Saving in Russia – In Time to Survive* - is telling. If energy saving is important for the energy giant Russia, then for Georgia it should even more significant.

Alhough similar surveys have not been done in Georgia, it can be concluded that the situation is not very different. The same conclusion can be made by comparing figures with other countries (Figure 4). The energy intensity of Georgian GDP (0.72 TOE/thousand USD) significantly exceeds figures for Germany (0.18 TOE/thousand USD), and Greece (0.17 TOE/thousand USD). The economies of these two countries completely differ from each other: the German economy is oriented towards heavy industry while the Greek economy towards light and agrarian industries. Therefore, it can be concluded that:

Regardless of the direction of Georgia's economic development, by undertaking energy efficiency measures it is possible to decrease energy expenditure per unit of GDP by at least four times.

Reaching this potential requires action on the part of both industries and households.

The support of international organizations (IBRD, EBRD, United Nations, USAID) and various countries (Netherlands, Norway, Great Britain, etc.) helped to facilitate the implemenation of several pilot projects in Georgia. Projects implemented with assistance of the USAID, PA Consulting and Winrock International, including the project *Program in Rural Energy* should be emphasized. These projects explicitly identified enormous energy efficiency potential in Georgia's residential and industrial sectors. The findings were widely distributed, though the results did not go beyond the ranges of the pilot project. This examples show that despite the profitability for each consumer and the whole community, energy conservation requires state involvement and the removal of existing barriers.

The level of energy efficiency and energy conservation is high in countries where these issues are included as a priority in energy policy, with supporting laws and state support measures in place. Georgian Energy Policy also acknowledges the importance of energy conservation, however in practice this has not gone much beyond the mere declaration.

In order to develop practical measures for improvement of energy efficiency, local impediments need to be taken into account. Interviews with citizens and enterprise and organization managers revealed the following main barriers to energy conservation:

[8] ИТАР-ТАСС 2007

- Low social awareness about the importance of, benefit from and opportunities for energy efficiency
- Lack of energy saving culture and habits
- Limited financial resources for initial investment
- Obsolete technology and appliances
- Lack of incentives for undertaking energy efficiency measures,
- Lack of low interest loans
- Lack of legislation and institutions promoting energy conservation

Overcoming of these barriers requires concentrated action otherwise it will take many decades. In order to expedite the benefits from improvement of energy efficiency, timely development and implementation of energy efficiency legislation is required.

The following are the most important measures the state can undertake:

Tax allowances, cheap loans, and grants – consumers with limited financial resources are unable to undertake certain energy efficiency measures while other measures are simply not profitable even though they bring financial benefits to the society as a whole. In such cases, financial and fiscal incentives are required.

Specialized organizations and agencies – by handling the distribution of consumer information, expert consulting services, and financial incentives, energy service companies, specialized agencies and funds create that institutional evironment, effectively enable the adoption of energy efficiency measures.

Energy audits – of large enterprises an energy audit identifites specific energy efficiency measures such as implementation of new technologies, replacement of old equipment, and regime optimization. By reducing expenditure on energy, a company's product becomes more competitive. Future law should encourage energy audits of large enterprises.

Construction norms and standards - new construction results in increase of natural gas consumption for heating. For the most part the issue of thermal insulation in buildings is not addressed and efficient standards and norms have yet to be adopted. This shortcoming results in increased energy demand, and furthers Georgia's dependence on foreign energy imports. Avoiding this cycle requires the adoption of modern construction standards that would account for the thermal characteristics of buildings.

Information campaign –Information campaigns are the cheap highly effective way to promote simple and inexpensive energy efficiency measures (such as light bulb replacement) that require only basic consumer awareness for energy conservation.

Energy labeling – Energy labels and certification for buildings are informative instruments that give consumers information about the energy characteristics of equipment or buildings. Providing ready access to this information facilitates the sales of energy efficient goods.

Unfortunately, Georgia is significantly behind both developed and developing countries in this regard. Legal measures, dedicated state agencies, financial incentives, information campaigns, and standards, certification and energy labeling need to be created. The only energy-saving measure taken to date is the introduction of stepped tariff, which provides an incentive to save electricity.

Figure 10 compares the implementation of state energy efficiency programs in Georgia and Eastern European countries.

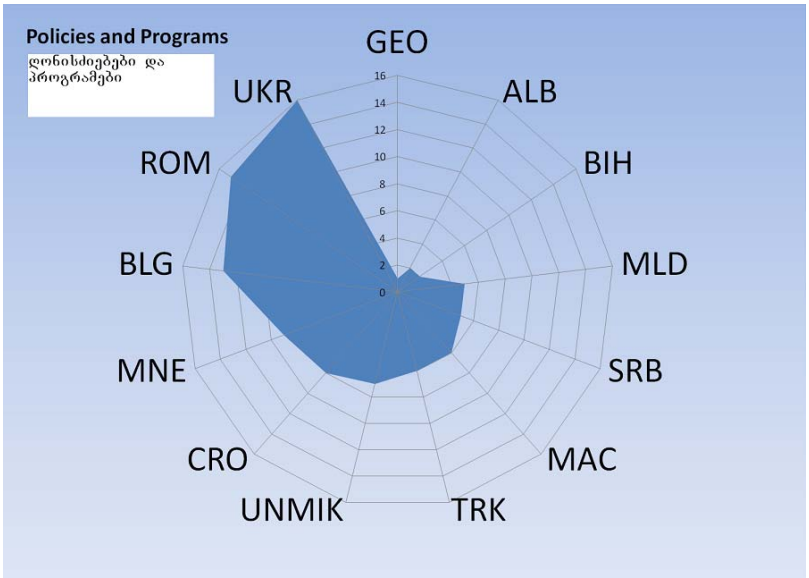

Figure 10. Comparison of State Measures and Programs in Various Countries (The Alliance to Save Energy, USAID, 2008)

One of the main priorities of the *Main Directions of the State Policy in Energy Sector* approved in June 2006 by Georgian Parliament is the development of a legal and institutional environment and improvement of energy efficiency both in industrial and residential sectors. Currently, the implementation of specific legislative and institutional changes is on the agenda.

6. Energy Efficiency in Developed Countries

6.1. Mechanisms of State Support for Energy Conservation

Energy efficiency policy in developed countries is determined by a country's social, economic and political readiness. The existence of strong civil society and effective community administration is also necessary for implementation of policy.

There are various barriers to improving energy efficiency such as:

- Psychological – The illusion of limitless energy availability and emphasis on energy supply instead of its rational use
- Informational – Insufficient awareness among CEOs and the population at large about importance and economic benefits of energy efficiency

- Economic – Lack of investments and financial incentives and low solvency of population;
- Technical – Obsolete and low level energy efficient equipment;
- Legislative – Lack of legistlation and governmental resoluations facilitating development of energy efficiency.

These barriers exist in all countries. Yet, international experience shows that by usings a system approach with a wide range of state actions, these barriers can be overcome. The law on energy efficiency is the main instrument that should ensure the gradual removal of these barriers.

Economic instruments for facilitating energy efficiency are divided into two groups – prices (regulation of tariffs) and subsidies.

Setting economically realistic costa based tariffs for electricity and natural gas is a requirement for increasing energy efficiency. Only by receiving a proper market signal will consumers think about saving energy.

Tariffs should not be used as a social security mechanism. Instead special, targeted programs should be developed for those in need.

When setting tariffs, regulatory authorities are often unable to make sound decisions as they fear both community resistance and the impact on the consumer prices, which would have a negative Only correct pricing enables the economy to adjust to the new reality. This becomes increasingly important in the face of rising energy import prices. If the state deems it necessary to subsidize the vulnerable population, this should be done in a transparent and targeted way through direct subsidization of people – not tariffs.

Metering and payment collection of both electricity and natural gas are the most important issues in facilitating energy efficiency. Without them, consumers are indifferent to energy efficiency, as reliable records and payment give a clear cost to the energy being consumed.

One major tool for facilitating investments in energy efficiency improvement is the use of economic and financial incentives. These mechanisms, which can be used for both consumers and producers fall into two categories – investment subsidies and preferential loans.

Investment subsidies and grants – are used for co-financing energy efficiency projects.
Preferential loans or loan guarantees – below market-rate loans on investments made for improvement of energy efficiency.
Fiscal stimulation – tax reduction, tax allowances and use of accelerated amortization.
Tax credits – offsetting taxes by a portion of the energy efficiency investment .

These measures can be used to promote energy efficiency activities that have a collective social benefit, but which are financially unattractive to individual investors. Fiscal incentives deserve preference over economic ones as they require less government outlay.

6.2. Energy Efficiency in European Union Energy Policy

The European Community, together with its Member States, is working to improve energy efficiency in all sectors as well as to increase the use of renewable energy. In early March of 2007 the EU Prime Ministers agreed on an Energy Policy for Europe (EU-27), including a firm commitment to increase renewable energy to 20% of primary energy supply and the share of biofuels to 10% by 2020.

The Intelligent Energy Program is a leading EU program in energy efficiency with an annual budget of €91 million. In 2008, approximately €50 million will be allocated for co-financing energy efficiency and renewable energy projects and for establishing local and regional energy efficiency agencies. 75% of expenses may be covered by grants.

The Intelligent Energy Program will support more rational, efficient, and sustainable patterns in energy use by identifying and removing administrative, communication, and other non-technological barriers to the implementation of the following projects:

- Strategic studies on energy trends for the preparation of future legislative measures as well as the development of standards, labeling and certification systems
- Creation, enlargement or reorganization of structures and instruments for sustainable energy development. This includes local and regional energy management, and the development of adequate financial products and market instruments
- Promotion of sustainable energy systems and equipment in order to accelerate their penetration to the market and to stimulate investment
- Development of information, education and training capacity

Directives and normative acts approved by the European Parliament regulate energy efficiency improvement, such as the regulation of energy efficiency in buildings and mandatory energy audits of large consumers. Other measures include mandatory energy labeling for household appliances, which can either allow consumers to compare the levels of energy efficiency among all products or simply designate the most energy efficient appliance. The use of these labels is mandatory for the EU and many other developed countries (USA, Canada, Mexico, Norway, South Korea).

6.3 Energy Efficiency in the United States

Energy efficiency in the US is regulated by the Special Energy Efficiency and Renewable Energy Office of the Department of Energy (Ministry). This office supervises federal programs such as a multi-year program to implement energy efficient building technologies, a program for improvement of thermal insulation, and the promotion of renewable energy use and energy efficiency in schools and federal buildings. Energy efficiency in the US is regulated both on the federal and state level through a number of legislative acts.

The most recent Energy Policy Act of 2005 should be noted as it represents an attempt to resolve problems caused by increasing demand for energy. It provides tax incentives and loan guarantees for energy efficiency, energy production of various types and energy services. It also provides tax breaks for households investing in energy efficient improvements.

Consumer awareness is achieved through special websites (e.g. http://www1.eere.energy.gov/consumer/tips/index.html) that provide information about use and profitability of energy saving methods, new technologies, construction materials, and household appliances. In addition, the websites contain information on the use of renewable energy sources and recommendations for overcoming problems caused by increasing fuel prices.

6.4. Energy Efficiency in Bulgaria

Bulgaria is a good example of development of a comprehensive legal framework for energy efficiency policy among former socialist countries. It should be noted that this process here was catalyzed and to a large extent enforced by the EU, as the EU included energy efficiency measures in the list of accession demands for Bulgaria. Thus energy efficiency measures received more attention here than in other post-socialist or post-Soviet countries that are not on the EU "waiting list."

Energy efficiency measures in the country are regulated through **The Energy Efficiency Act** adopted in 2004, and amended in 2006 and 2007.

The principal purposes of this act are:

- Energy sector development and increasing energy security through efficient use of energy
- Development and submission of energy efficiency program to the Council of Ministers
- Adoption of recommended national targets for consumption of electricity produced from renewable energy sources by the Council of Ministers
- Preparation of annual reports that include progress towards the adopted targets and compliance with obligatory measures to prevent climate change.

In Bulgaria, the Ministry of Economy and Energy is responsible for both economic and energy policy. Its aim is to increase the competitiveness of the national economy by encouraging investments, innovation, entrepreneurship, exports, and modernization of the industrial base. It is also charged with developing measures to promote both industrial energy efficiency and the use of renewable energy resources. The Ministry works through the Energy Efficiency Agency, which is supported by the budget and has the status of a ministerial executive agency. The Agency develops programs and projects for improvement of energy efficiency and electric and heat power generation by renewable power sources. It coordinates energy efficiency programs.

The Energy Efficiency Agency's priorities include:
• Improving energy efficiency
• Using natural gas for public supply
• Regulation of the Energy Efficiency Fund
• Harmonizing Bulgarian legislation with EU energy legislation
• Ensuring financial support for development of energy efficiency in Bulgaria

The Bulgarian Energy Efficiency Fund (BgEEF) was established through the Energy Efficiency Act of 2003, which was adopted by the Bulgarian Parliament in 2004. The initial capitalization of BgEEF

was entirely with grant funds from the following major donors: the Global Environment Facility through the International Bank for Reconstruction and Development (the World Bank) - USD 10 million; the Government of Austria - € 1.5 million; the Government of Bulgaria - € 1.5 million and several private Bulgarian companies. BgEEF has the combined capacity of a lending institution, a credit guarantee facility and a consulting company. It provides technical assistance to Bulgarian enterprises, municipalities and private individuals in developing energy efficiency investment projects and then assists in the financing or co-financing. It can also serve as a guarantor for other these projects with other financing institutions.
The underlying principle of BgEEF's operations is a public-private partnership. The Fund is fully supported by the Government of Bulgaria, but it is structured as an independent legal entity, separate from any governmental, municipal and private agency or institution. The Fund finances various energy efficiency projects and also regularly conducts related seminars. All projects are conducted by energy service companies selected by tender.

In recent years, a number of Eastern European and former Soviet countries have passed laws supporting energy efficiency (Czech Republic, Romania, Slovenia Russia, Ukraine, the Baltic States, Belarus, Armenia, Moldova).

A comparison of legislative and normative environmental and institutional frameworks, plans, programs and measures between Georgia and some of the Eastern European Countries is presented in the Annex (data from the Alliance to Save Energy/USAID-2008).

7. The Energy Efficiency Potential of Georgia

As it was noted above, there is significant untapped potential for energy saving in Georgia, which, with the proper attention and use, can provide benefits akin to a new source of cheap energy.

In June-September of 2007, within the framework of the Rural Energy Program financed by the USAID, Winrock International in cooperation with World Experience for Georgia conducted a primary assessment of the energy efficiency potential in Georgia.

The assessement identified the following main measures for improving of energy efficiency and energy saving:

- **Reduction of Electricity and Natural Gas Distribution Losses**

Improving energy distribution is the most effective energy efficiency measure that Georgia can implement. Distribution systems are owned by private companies and are still subject to high levels of loss; these losses can be reduced significantly through cost effective measures. By improving the technology and organization of distribution companies, it is possible to reduce losses and save approximately 400 million kWh electricity and 130 million m^3 of natural gas in Georgia.

- **Replacement of incandescent light bulbs with fluorescent bulbs**

Efficient lighting is the highest priority measure for addressing economic and supply security issues at a low cost. Large scale replacement of incandescent bulbs with fluorescent bulbs is a profitable and easy to implement energy efficiency measure. As seen in Figure 1.1, this measure provides a high return on investment to energy consumers.

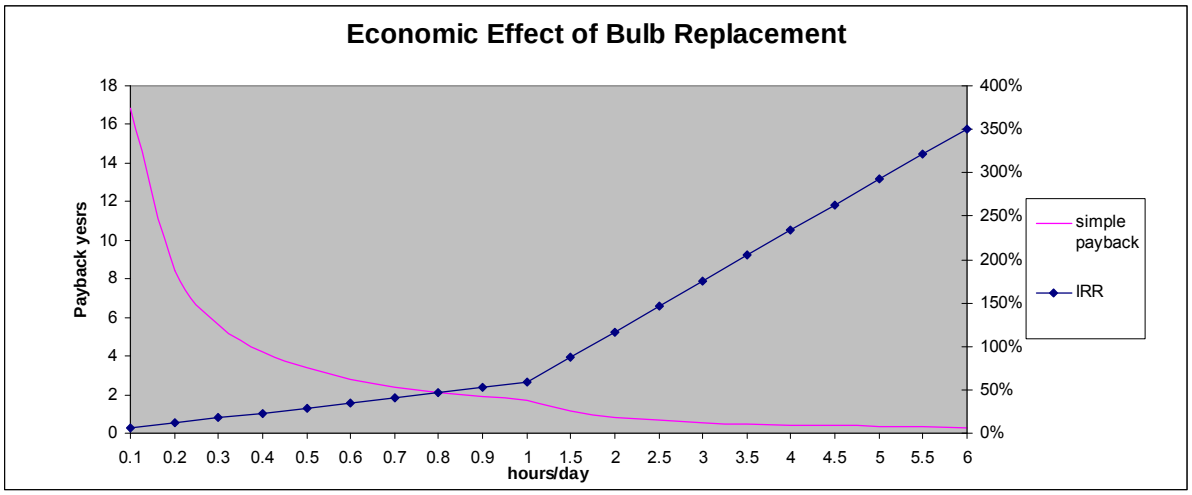

Figure 11. Simple payback and Internal Rate of Return (IRR), indicators of the financial merits of fluorescent bulb replacement

Increasing energy efficiency brings positive macroeconomic benefits to the country:

- **Efficient lighting has the potential to yield energy tariff reductions.** Effective tariff reductions vary from 0.009 tetri per kilowatt hour (t/kWh) in the summer to as much as 0.48 t/kWh in winter months.
- **The cost of a saved kilowatt hour through bulb replacement is 0.8 tetri/kWh**. In comparison, the cost of generating energy in Georgia through hydropower is estimated to be between 7-9 tetri/kWh. **Thus, the cost of saving energy through light bulb replacement is about 10 times less than the cost of generating that same amount of energy from a new hydropower plant.**
- **Replacing six million bulbs contributes 86 million USD to Georgia's external trade balance over a 5 year period**, with a discounted present value of 54 million USD.
- **Full implementation of efficient lighting has the potential to reduce the need for budget subsidization in the energy sector by $26 million annually.**

> ***Replacement of incandescent bulbs with efficient bulbs will save approximately 350 million kilowatt hours of electricity. This is equal to the power generation of a large hydro power plant such as Zhinvalhesi .***

- **Promotion of efficient wood stoves**

According to simple estimates, the widespread introduction of energy efficient stoves can reduce current firewood consumption by as much as 30-40%. This is equivalent to roughly 1 million cubic meters of firewood. A reduction in wood consumption of this magnitude would significantly mitigate the environmental impact from wood-felling and reduce Georgia's greenhouse gas

emissions. In the case of Georgia, where wood is consumed at an estimated four times the official amount, the promotion of efficient wood stoves has tremendous significance for both energy use and the environment.

- Efficient Use of Natural Gas

Transitioning from electricity to natural gas use for hot water and heating supply is an effective energy saving measure. In Tbilisi, natural gas can replace approximately 50-100 million kWh of electricity. This saving is particularly important during the fall and winter when electricity is being produced in thermal power plants. 1 m^3 of natural gas can replace 3.5 m^3 natural gas used in TPPs.

Switching of transport from liquid fuel to gas is one of the important energy conservation measures This can save up to hundred millions of dollars annually in energy cost for country and at the same time significantly reduce the air pollution.

Use of cogeneration systems, where electricity and heat are simultaneously produced, can increase efficiency of gas consumption in the energy sector. The largest consumers of natural gas are Gardabani TPPs: Sresi, Mtkvari and Energy Invest Air Turbine[9]. In total, these plants consume 400-500 million m^3 of natural gas. These plants are currently only about 30% efficient. By switching to modern combined cycle technology, efficiency can reach 55-60%, saving 200 m^3 annually. In addition to improving energy efficiency, this measure has the added benefit of increasing the capacity of the equipment. However, before proceeding with this or any measure, it is important that studies be conducted.

- Energy Saving in Buildings

Estimates show that approximately 40% of Georgia's energy consumption is used for heating and lighting buildings. The cheapest and the most effective way to reduce losses of energy used for apartment heating weatherization, which can be achieved through simple weatherization of doors and windows. According to various assessments, these losses comprise 20-35% of total heating losses. Evaluation shows that weatherization that can save 25-30 million m^3 of natural gas, equivalent to 230-289 million kWh.

Centralized heating and ventilation of buildings as well as centralized heating systems for a group of buildings can also be an important source of energy saving.

A weatherization measure will result in electricity saving for the segment of the population that uses electric heaters. According to estimates, 40 million kWh electricity can be saved through this measure per year.

The majority of Georgian households heat only part (30-50%) of their residence. Therefore, in most cases weatherization will improve living conditions, which is also an important benefit.

- Increasing the Culture of Energy Consumption and Energy Saving

[9] Company "Azoti" uses natural gas as abasic raw material and thus isnot reviewed in this paper.

Expert evaluations show that 5-10% of the energy that is consumed could be saved by inculcating a culture of rational energy use, changing energy consumption skills and optimizing operational processes of different enterprises.

- **Energy Efficiency in the Non-Residential Sector**

Industry (such as the Zestaphoni alloy plant, Rustavi Metallurgy Plant, Chiaturmanganumi, Saktsementi), large consumers (Metropoliteni, Tbilisis Tskali, Railway) and various medium or small enterprises consume approximately 3 billion kWh electricity. The majority of large enterprises use obsolete technologies and equipment.

To date, there have been no recent energy audits from which to draw reasonable conclusions about efficiency. Therefore, previous analyses and energy audit results were used to assess the energy saving potential. The experience of numerous pilot projects implemented in Georgia with assistance of international organizations show that reduction of energy consumption by 10-15% does not require large initial investments. According to this estimate the energy efficiency potential in this sector is approximately equal to 450 million kWh[10].

Estimated Energy Efficiency Potential of Georgia is depicted below in Table 1:

Energy Efficiency Measure	Energy saving	
	Electricity (GWT*hr/annum)	Natural gas Million cubic m./annum
Reduction of losses in electricity and natural gas supply	400	150
Energy efficient lighting	350	-
Weatherization of buildings	50	25-33
Energy saving (changing consumption skills of consumers)	150	20-30
Implementing effective power generation technologies		200
Energy saving in the non-residential sector	450	
Effective use of firewood	1 mln m^3 firewood/year	

Table1. Energy saving possibilities through energy efficient measures

In total, the estimation of potential savings equals 670 thousand TOE, which is 27% of energy consumption.

[10] The assessment does not include enterprises such as cement, construction materials and bread producing plants, which requires additional research.

8. Conclusions and Recommendations

For Georgia, as for all energy importing countries, energy conservation is one of the main priorities in resolving energy supply problems. By increasing energy efficiency and energy saving it is possible to make a significant contribution to the country's energy supply.

In order to achieve a high level of energy efficiency, state should support it through special legislation, dedicated institutions and economic incentives. These measure will yield a number of positive results, including:

- Strengthening the country's national security by reducing energy and economic vulnerability
- Improvement of Georgia's economic competitiveness and living conditions of population
- Budgetary savings and improvement in country's external trade balance
- Increase in economic activity
- Use of existing energy generation facilities with maximum efficiency and reduction of demand for new capacities
- Reduction of negative environmental impacts
- Bolstering membership progress in European and Euro-Atlantic structures

Achieving these goals requires carrying out organizational and legislative measures in a timely manner with active support of the state, including:

- Expediting the drafting and adopting of the Law on Energy Efficiency
- Establishing a specialized authority responsible for coordinating energy efficiency measures
- Designing state strategy with explicit objectives for increasing energy efficiency
- Developing financial incentives including subsidies and allowance programs
- Introducing standards on thermal features of buildings to the Construction Code and mandatory energy efficiency certification of buildings
- Facilitating scientific research in the field of energy efficiency
- Introducing an information campaign to popularize energy efficiency with wide dissemination
- Developing effective mechanisms for financing energy efficiency projects
- Developing and operating specialized organizations working on improving energy efficiency
- Facilitating the practical use of the Clean Development Mechanism in Energy Efficiency Improvement Projects
- Developing and implementing training and informative programs in energy efficiency
- Requiring large consumers to study their energy consumption and possible ways for reduction

Prior to adoption of an energy efficiency law, short-term and low-cost measures can be undertaken that do not require significant organizational efforts, such as conducting an informational campaign promoting the simple and inexpensive measure of replacing incandescent bulbs with energy efficient bulbs or weatherization of doors and windows in apartments.

Energy saving is the least expensive and most environmentally-clean measure. With energy supply 70% dependent on imports, energy efficiency should be Georgia's first priority.

APPENDIX. Comparison of EE Legal, Policy and Institutional Framework in Different Countries

Table 1: Legal Framework

Country / Question	ROM	BLG	UKR	CRO	TRK	MCD	ALB	MLD	BIH	GEO	SRB	UNMIK	MNE
Legislation	++	++	++	-	+	+	+	-	-	-	+	+	++
High-efficiency power generation.	++	+	++	++	++	++	-	+	-	-	+	++	+~
EE standards, certification and labeling	++	++	++	++	++	+	+	~	-	-	+	+	+~
Heat metering and consumption-based billing.	+	++	+	++	+~	+	-	+~	~	-	+	+	++
Sanctions for wasteful energy practices.	+	++	++	-	+~	-	-	~	-	-	-	-	-
Energy auditing	++	++	+	+	+~	+	+~	+	-	-	~	+~	+~
Social safety mechanisms	++	++	-	+	+	-	-	++	+	-	++	++	+
Energy taxes	+	-	+	++	-	-	-	++	-	-	-	-	-
Procedures for HOAs	++	++	+	++	+	-	~	++	~	+	++	+~	+~
Municipal energy planning	++	+	~	+	-	+	-	~	-	+~	+	+~	+
Municipal borrowing	-	++	+~	-	++	-	-	+	+	-	++	-	+
Private sector participation	-	++	+	+	-	+	-	-	~	-	+	+	~
ESCOs / performance contracting.	+~	+	-	+~	+~	+~	-	-	~	-	+	+~	+~

++ **Fully Implemented**: Development in this area is advanced and necessary capacities
+ **Partially Implemented**: Development has started, legislation and some capacity is in place, further legal and capacity advancement still necessary
+~ **Planned but not implemented:** Legislation is in place, is fairly recent, implementation is pending
- **Nothing:** No legislation and/or capacity is in place, need for both legal and capacity development
~ Legislation has been in place for substantive amount of time but implementation failed

Table 2: Policies and Programs

Country / Question	ROM	BLG	MAC	ALB	BIH	CRO	UKR	MLD	TRK	GEO	SRB	UNMIK	MNE
EE Policies, programs, strategies	++	++	+	+	+	++	++	++	++	-	+	+	++
EE action plans	++	++	++	+	-	~	+	-	-	-	~	+~	++
EE funds	+	+	~	-	-	-	++	+	+~	-	+	-	+~
Economic&financial incentives	++	++	+~	~	~	+	++	+~	+	+~	~	+~	+
Voluntary agreements	+	-	-	-	-	-	++	-	-	-	-	-	-
EE equipment import & manufacturing	+	-	-	-	-	-	-	-	-	-	~	+~	+~
Incentives for EE services	+	-	-	-	-	-	++	-	-	-	~	+~	-
National programs for public EE	+	++	+~	-	-	+	++	-	+~	-	+	+~	+~
Municipal programs for public EE	++	++	-	-	+	++	+	~	+~	-	+	+~	-
EE information campaigns	++	++	+	-	-	++	++	+	-	-	+	+	+~

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Table 3: Institutions

Country / Question	ROM	BLG	MAC	ALB	BIH	CRO	UKR	MLD	TRK	GEO	SRB	UNMIK	MNE
Government entities	++	++	++	+	+	+	++	++	++	+	+	+	+
• **Ministries with EE staff**	++	++	++	+	+	+	++	++	++	+	+	+	+
• **EE Agency**	++	++	+	+	-	+	++	++	-	-	++	-	-
• **Energy institutes**	++	++	-	-	-	+	+	+	-	+	+	-	-
• **Regional/local EE agencies/institutes**	+~	-	-	-	+	-	-	-	-	-	+	-	-
• **Donor and IFI PIUs**	+	-	+	-	+	-	-	+	-	+	+	-	-
NGOs	++	++	+	+	+	++	++	+	+	+	+	+	+
• **Municipal associations**	+	-	+	+	-	-	++	-	-	-	+	+	+
• **EE centers**	++	++	++	++	+	++	++	+	+	++	++	+	-
• **Environmental groups**	+	-	-	-	-	++	+	+	+	+	-	-	+
• **Business associations**	+	-	-	-	-	-	+	-	-	-	-	-	+
• **Energy consumers' organizations**	++	-	+	-	-	-	-	-	-	-	-	-	-

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