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Georgia

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# **CHALLENGES IN ENERGY SECTOR OF GEORGIA AND SUSTAINABLE DEVELOPMENT**



პროექტი განხორციელდა ფრიდრიხ ებერტის ფონდის მხარდაჭერით.  
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**Editorial team:** Giorgi Maghradze, Avtandil Geladze,  
Rusudan Simonidze, Lali Gamkrelidze

**Design:** Irakli Guledani

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## FROM CONFERENCE ORGANIZERS

The presented brochure is uniting the research documents, expert assessments and recommendations that are based on analysis of realistic information and describe current situation in energy sector of Georgia, lacks and gaps existing in the system, perspectives of energy supply and possibilities of harmonization with EU standards.

Presented materials have been presented on the Conference “Challenges in Energy Sector of Georgia and Sustainable Development” that was organized with the support of Friedrich Ebert Stiftung in September, 2014.

# CONFORMITY OF NORMATIVE ENVIRONMENT AND STATE POLICY ON ENERGY EFFICIENCY AND RENEWABLE RESOURCES OF GEORGIA WITH INTERNATIONAL REQUIREMENTS

Giorgi Mukhigulishvili  
World Experience for Georgia

## **Introduction**

Georgia has big potential of renewable energy resources (hydro, solar, wind, geothermal) only small part of which has been used. At the same time, energy generation in the country is accompanied with substantial losses which in addition are aggravated by inefficient use. All this greatly damages our economics because about 60% of the used energy in the country is imported which constitutes about 16% of the whole import of the country and has big potential for the improvement of the country trade balance.

Under the different international agreements Georgia has undertaken obligation to develop renewable energy resources and promote the introduction of energy efficient measures and technologies. The given work reviews the conformity of normative environment and State policy on energy efficiency and renewable resources of Georgia with the obligations undertaken by the agreement of associated membership of Georgia-EU and Energy Charter. These two agreements as compared to others are much more insightful and comprehensive.

**Sustainable development in energy sector along with others unites two significant directions – renewable energy resources and energy efficiency.**

**Use of renewable energy resources is the precondition of the preservation of healthy environment!**

**While energy efficiency is the sign of a developed society, it is a way to comfort and wellbeing!**

## **EU-Georgia Association Agreement - conformity of normative environment and State policy on energy efficiency and renewable resources of Georgia with the Agreement requirements**

The EU-Georgia Association Agreement was initialed on November 29, 2013 in the framework of “Eastern Partnership” Vilnius Summit, and signed on June 27, 2014; it came into force on September 1.

Agreement in the field of energy sector will promote the strengthening of energy safety of the country, approximation to the European legislation and the development of cooperation in directions such as electric energy, finding natural gas and oil, their extraction and transit, **renewable energy and energy efficiency**. Also, the Agreement envisages the possibility of Georgia becoming a member of European Energy Association.

**In case Georgia joins EU Energy Association Agreement during two years after the Association Agreement comes into force, the main regulations envisaged by the Association Agreement Directives shall be implemented in the framework of Energy Association Agreement in set timeframe; in other case the Association Council will proposed new timeframe not later than three years after the Association Agreement coming into force.**

In the preamble of the document of EU-Georgia Association Agreement it is noted that parties concerned “take an obligation to strengthen energy resources provision safety, among them through the development of “southern corridor”, inter alia, through encouraging the development of relevant projects in Georgia, which will facilitate the formation of the relevant infrastructure, among them the transit through Georgia, growth of market integration and step-by-step regulatory approximation to the main elements of EU legislation (EU acquis); and also facilitate the growth of energy efficiency and the use of renewable energy resources”.

According to the Agreement “the parties acknowledge the necessity of strengthening of the cooperation in the field of energy and the obligations of the parties to **implement the Energy Charter Agreement**”. The obligations taken by Georgia under the Energy Charter Agreement is reviewed in the second part of the document and is analyzed what has been done in Georgia with regard to the introduction of energy efficiency in the country.

Cooperation under the Associated Agreement between EU and Georgia is based on partnership, common interests, transparency and prognostication principles and aims at market integration and regulatory approximation in energy field by envisaging the necessity of safe, ecological and available energy provision.

Cooperation with other fields includes the following spheres of energy:

- a) Energy strategies and policy;
- b) Promoting energy efficiency and energy saving through economically and ecologically justified way;
- c) Development and promoting renewable energy, where the main focus will be made on hydro resources and promoting bilateral and regional integration in this field;
- d) Scientific and technical cooperation and information exchange for the purpose of the development of technologies and their improvement during the process of energy production, transportation, provision and the use of final product where particular attention will be paid to energy efficiency and acceptable technologies from ecological viewpoint.

Under the Associated Agreement between EU and Georgia, Georgia takes an obligation to approximate step-by-step its legislation to the EU legislation and international legal instruments in the sector of energy within the set timeframe. The document reviews the requirement of the agreed directives on energy efficiency and renewable energy and analyses the existing state in Georgia in this regard.

European Union Parliament and Council Directive 2009/28/EC of April 23, 2009 on the Promotion of the use of energy from renewable energy resources establish the following main principles and requirements:

1. The country is obliged to define the targeted share of renewable energies in the whole energy use which will be attained by 2020.
2. The overall share of renewable resources in the use of energy in transport sector should be minimum 10% by 2020.
3. There shall be developed an Action Plan in which the targeted amount/share of renewable energies will be defined in the whole energy use for 2020, also in the energy use of transport sector and the whole production of electricity and heating. Action Plan shall also envisage energy efficiency as the significant instrument (in the final reduced use on the basis of energy efficiency the targeted share of renewable energies is more easily reached) for reaching targeted amount of renewable energy. The Action Plan shall give in details the renewable energy promotion mechanisms.
4. Energy Association member states can implement joint projects for the production of electricity and heating from renewable energy resources, provide/exchange renewable energy between each other in order to achieve national targeted amounts/share in the whole energy use.
5. The country shall ensure information accessibility on the energy origin for the generated energy for electricity and heating and cooling purposes from renewable resources. The users should have information on different sources of consumed electricity.
6. The country shall establish necessary infrastructure for promotion of renewable energy resources production. For this purpose it is necessary:
  - a) Ensure transportation and distribution system for renewable energies;
  - b) Ensure priority access to the renewable energy network.
7. The given Directive envisages promotion of bio fuel production the raw material for which can be made in the Association member states or imported from a third country. The raw material should not be produced on the territories rich in high content of biodiversity or carbon;
8. The Directive requires that Construction Code envisages the mechanisms which would promote the growth of renewable energies use in buildings. Also there should be established the minimal amount of renewable energy resources use in new buildings and already existing buildings which need renovation.

#### **Policy and legislation of Georgia in relation to Directive 2009/28/EC:**

1. Georgia does not have yet a Law on Renewable Energy which would regulate and promoted the use of renewable energy resources.
2. In the main regulating law on energy sector “On Electric Energy and Natural Gas” renewable energy resources are defined as “not fossil, all sources of sustainable energy which are originating but not limited to bio and hydro energies, geothermal, solar, wind and sea (among them currents, waves and thermal) energies”. The

aim of the Law is to promote the primary use of local resources of hydro energy, other renewable, alternate and natural gas. The same Law defines the functions of the Ministry of Energy – to ensure the expansion of energy resources procurement, the primary use of renewable (alternate) energy resources, promotion of energy efficient measures which are connected with the effective growth of production.

3. In the Resolution of the Parliament of Georgia of 2006 on the “Main directions of the State Policy in energy sector of Georgia” it is mentioned that the study of the necessary measures for the use of renewable energy resources and their introduction is one of the priorities of the policy. In the version of preliminary project-proposal of Energy Policy developed in 2014 it is noted “use of renewable energy resources is important for overcoming the climate change problems and securing the country with clean energy. Georgia is rich in hydro resources, also it has wind, solar, biomass and geothermal waters potential, which enables the country to create additional capacities through the implementation of local and foreign investments. For this it is necessary to improve the investment conditions through the creation of stable, transparent and no discriminating legislative base; deepening of close and stable trading relations with the energy markets of neighboring countries; development of system and inter-system infrastructure; also promotion of scientific research activities in relevant direction. All above mentioned conditions decrease of the dependence on imported energy and the increase of the quality of the country energy safety”. In the document there is separately singled out the perspective of Georgia as a country of clean energy production and turning of the country into trading regional center – “the existing in Georgia rich hydro and other renewable resources, relevant infrastructure and favorable investment conditions makes it possible for the country to be formed as a regional center of clean energy production and trading. For the achievement of the noted objective it is necessary to continue the work for the perfection of legislative base, development of scientific-research work and infrastructure in order to promote the use of clean energy potential of the country and to transform the country into the regional center of trading with clean energy”.
4. Resolution N107 of the Government “State Program “Renewable Energy 2008” – on the approval of the Rule on ensuring the construction of new sources of renewable energy” adopted in 2008 in 2013 was substituted by a new Resolution N 214 “on the Approval of the Rule of interest expression on the feasibility study of electric stations construction in Georgia and their operation”. If the previous Resolution focused only on the construction of new sources of renewable energy, the new Resolution in general covers the technical rules of priority for the Government electric power stations construction.
5. With regard to the promotion of renewable energy in “Social Economic Development Strategy 2020 of Georgia” it is noted that “the government is planning to create an effective mechanism for public-private partnership, which is particularly important for attracting investments in infrastructure and hydro energy sectors”. The Strategy also mentions that “in addition to hydro resources, there is a rather high potential of wind and solar energies in the country. There are the supplies of geothermal waters which could help in the decrease of import of high cost energy bearing products. At the same time, the use of hydro resources, due to their seasonal character, requires maximal development of export markets for excess energy and regional trading”. The Strategy also envisages the protection of forest resources and introduction of the practice of their rational use.
6. Despite the definition in the Law forest is not paid due attention as an energy resource, while its share in the energy use of the country constitutes 17%.
7. Energy Development Fund of Georgia at present is working on the development of a secondary legislation on wind energy.
8. In Georgia the following governmental institutes are working on the development of renewable energy:
  - o Energy Efficiency and Alternate Energy Resources Department of the Ministry of Energy
  - o Georgian Energy Development Fund (GEDF);
  - o Georgian Co investment Fund (investment assistance for big and medium scale hydroelectric power stations development).
9. Above given legislative and State Policy documents cannot create united complex regulating frame for development and promotion of renewable energies. (9)
10. There is not any official information about the renewable energy potential in Georgia which creates problem to assess the share of renewable energies in the whole energy use of the country by 2020.
11. Georgia does not have direct terrestrial connection with the EU or Energy Association member states; consequently it is less possible to cooperate with them in renewable energies provision/exchange.

12. Vertically integrated companies (Energo-pro, Telasi) existing in the electric energy sector of Georgia, who own distribution network, as well as generation units and at the same time are also providers complicate the development of independent renewable energy generation units. All this aggravated by long-term memorandums signed between the state and these companies.
13. Relatively complicated administrative procedures of joining the energy distribution networks and high cost hinder the development of small capacity renewable generation units.
14. Adoption of the Law on renewable energy resources is the obligation of Georgia under the signed Loan Agreement between Georgia and International Financial Institutions for the construction of Black Sea transmitting line. After receiving the loan under this Agreement during three years the government of Georgia had to adopt the Law on renewable resources (the loan has been issued since 2009).

**The Directive 2006/32/EC of April 5, 2006 on the Efficiency of Final Use of Energy and Energy Service establishes the main principles and requirements:**

1. Define national target indices of energy efficiency; create institutional, legislative, financial and other stimulating mechanisms for the development of energy efficiency, which at the same time would exclude market barriers and other hindering factors.
2. Develop attractive market environment for energy serving companies, which would ensure energy saving in the different sectors of energy use with the help of relevant programs and mechanisms.
3. The country should work out National Energy Efficiency Action Plan (NEEAP) in which there would be given the indices calculated by the methodology of annex I of the Directive for long term decrease of energy consumption.
4. Establish one or more independent public services or agencies which would monitor the implementation process of the Action Plan.
5. The country should assign public service responsibility to energy distribution, system operators and retail traders who sell the electric power, natural gas and oil products to provide information to the consumers about the energy saving programs and not to hinder the accessibility to the similar programs.
6. Develop a high quality energy audit system which would help the consumers define the energy saving measures and ensure the further implementation of these measures.
7. Each consumer should be provided individual meter and delivered consumer information receipt which in addition to the ongoing consumption and tariff would reflect the difference with the previous year consumption and tariff of the same period, also contact information of the organization from which the information on energy efficiency measures could be obtained. The individual meters should be installed at competitive price everywhere where it is justified economically and technically.

Due to the fact that the Energy Efficiency Directive of 2006 did not achieve the objective to reduce the energy consumption in EU countries by the preliminarily defined index by 2020, in 2012 there was adopted a new Directive on Energy Efficiency which includes other additional mechanisms.

The Directive 2012/27/EU of October 25, 2012 of European Parliament and Council on Energy Efficiency establishes the following main principles and requirements:

8. The new Directive gives possibility to define the national energy efficiency target indices by 2020 choicely either with regard to the primary energy consumption or the final energy consumption indices.
9. The countries through the implementation of obligatory measures of energy efficiency and the use of targeted policy mechanisms shall reduce the energy consumption in domestic, industrial and transport sectors during the period 2014-2020.
10. Ensure free access to the historical data for the consumers on the energy consumption.
11. The new Directive attaches even more importance to the existence of energy audit system, strengthening of stimulating mechanisms for carrying out energy audit in domestic, small and medium enterprises. There should be developed consultative programs for identifying the benefits of energy audits in family households and carrying out the relevant services. There shall be developed programs for the preparation of qualified energy auditors.
12. Big enterprises shall be obligated to carry out energy audit once every four years.



13. For clearness, the buildings owned by the central government shall undergo the rehabilitation works, at the same time, in the state purchases rules there should be envisaged the criteria of energy efficiency.
14. For the purpose of defining the level of efficiency there shall be conducted the monitoring of the new units of energy generation. For thermal stations whose capacity exceeds 20 MW, there shall be defined the possibility of installation of high effective co-generating mechanisms on the basis of the expenditure-benefit analysis. The potential of co-generation and regional heating systems shall be assessed as well.

**Georgian policy and legislation in relation to Directives 2006/32/EC-2012/27/EU:**

1. There is no law in Georgia on energy efficiency which would comprehensively regulate this direction and promote energy saving measures and introduction of energy efficiency technologies. The draft law on Energy Efficiency developed in 2008 was not adopted by the Government.
2. There is no explanation of the significance of energy efficiency in the main regulating Law on “Electric energy and Natural Gas” of energy sector although the main task of the Law is: “promote the efficiency growth of electricity production, transit, production control, distribution, import, export and consumption, also the provision, import, export, transportation, distribution and consumption of natural gas”. Under the same Law the function of the Ministry of Energy is – “Coordination of the development of united State program for efficiency growth measures and implementation of electricity production, transition, production control, distribution, import, export and consumption, also the provision, import, export, transportation, distribution and consumption of natural gas”.
3. The Resolution of the Parliament adopted in 2006 on the main directions of the State policy in the energy sector of Georgia says that “formation of legislative and institutional frames for the growth of energy efficiency in industrial and domestic spheres” is one of the directions of the policy.
4. According to the preliminary/draft energy policy document developed in 2014 “development of united approach of the energy efficiency in Georgia and its implementation” is one of the main directions of the policy in which it is noted that “the capacity of the generated product is one of the significant indicators of economic strength and competitiveness of the product. The noted index in Georgia is higher than the indices not only of the EU member states but also of other developed countries. Intelligible management policy of energy consumption is the precondition of economic growth and further development. Correct management of energy production, transportation and distribution and use, also energy efficiency programs play significant role for the optimization of the energy consumption in the country. In order to promote the above noted there should be created relevant legal base; there should be planned and implemented the measures oriented at the development and introduction of energy efficiency facilities and technologies; there should be created and established encouraging regulation for energy enterprises and consumers for energy efficiency programs implementation”.
5. With regard to the promotion of energy efficiency in “Social and Economic Development Strategy 2020 of Georgia” it is noted that “for the purpose of saving energy resources for the country the energy efficiency growth will be promoted and there will be developed relevant legislative mechanisms in accordance with the international and European norms for its securing. In its turn, effective use of energy is significant both for the growth of independence in energy sector and rational use of the resources, and for the decrease of costs carried out in this sector in the future”. The same strategy document states – “for the purpose of institutional arrangement and introduction of energy efficiency standards in accordance with the modern European standards in energy sphere there will be sequential implementation of the obligations envisaged by the Associated Membership Agreement with EU”.
6. The extracts from laws and State policy documents given above are only formality as yet, for their practical implementation it is necessary to develop complex programs and actions plans envisaged by the Directive.
7. In Georgia there are the following governmental institutes working on the development of energy efficiency:
  - a. Department of Energy Efficiency and Alternate Energy Resources of the Ministry of Energy
  - b. Department of Sustainable Development of the Ministry of Economic and Sustainable Development (is responsible for the implementation of three main directives on energy efficiency)
8. Georgia has not developed until now national target indices of energy efficiency and Action Plan. Although, eight big cities, Tbilisi among them, became the signatories of Mayors Agreement. Under the Mayors Ag-

reement the mayor's office undertakes the obligation of reducing CO<sub>2</sub> emissions with the use of energy efficient and renewable energy for the purpose of which it develops sustainable energy action plan (SEAP). Only four cities (Tbilisi, Batumi, Gori, Rustavi) until now have developed such plans.

9. In Georgia there do not function energy service companies, there are no financial or other mechanisms for their assistance.
10. It is difficult to impose public service responsibility on vertically integrated energy companies existing in Georgia whose interests come in contradiction with similar programs. All this is aggravated by long-term memorandums signed between the state and these companies.
11. There is no energy audit system in Georgia. There is no an official document which would regulate energy audit procedures in buildings. Only in the frames of separate donor financed grants there is carried out energy audit in a small number of buildings which frequently are not followed up by the implemented measures recommended by the audit. There should be worked out the programs for the training of qualified auditors.
12. There have been installed individual meters for electricity consumers for years now. According to the 2013 Report of the Georgian Energy and Water Supply Regulating National Commission the statistics of the subscribers not having individual meters is the following: JSC "Telasi" – 1,3%, "Energo-pro Georgia" – 15%, JSC "Kakheti Energy Distribution" – 10,7%;
13. Tariff which is established with the help of correct economic methodology might be the best stimulator for the introduction of energy efficiency measures. In Georgia electricity and gas tariffs are subsidized and are much lower than in our neighboring countries. Although the existing step-up tariff promotes electricity saving in domestic sector to some extent. One of the significant financial instruments for energy efficient and renewable energy projects promotion is the energy credit which is carried out through 100 million US dollars credit in the Caucasus. The local enterprises and individual persons in the rank of sub-borrower can receive relevant finances from local partner banks. When implementing energy efficiency projects sub-borrowers can receive 10-15% of loan money in the form of investment subsidy which is available from the European Reconstruction and Development Bank and its donors. Line of credit represents the part of the Caucasus Energy Efficiency Program (CEEP).

40% of the whole energy consumption of the European Union and 36% of CO<sub>2</sub> emissions fall on buildings. Because of this the reduction of energy consumption and the use of renewable energy resources in the buildings is the main priority for the purpose of energy independence and green house emissions reduction. In Georgia the situation is much worse. In old and new buildings the loss of energy is three times higher than in the European buildings with the same climatic conditions.

Directive 2010/31/EU of 19 May 2010 of the European Parliament and Council on the Energy Efficiency of Buildings establishes the following principles and requirements:

1. Develop the methodology of defining energy indices of buildings according to which for different category of buildings there will be developed minimal requirements of energy system. These requirements shall be revised and renewed every five years. According to the requirement of paragraph 10 of the Directive countries shall make a list of existing and potential instruments for the promotion of energy indices which will be renewed every three years.
2. New buildings shall meet the established requirements and before starting construction there shall be studied the possibility of the installation of renewable energy provision system. During the full value reconstruction of the existing buildings the energetic characteristics shall be improved for meeting the minimal requirements. The requirements of the Directive do not cover officially protected buildings (for example historical buildings), buildings of religious purposes, temporary buildings, the living buildings designed for the use during the limited time, autonomous buildings whose living space is less than 50 square meters.
3. Technical systems in the buildings such as heating, water supply, cooling and aeration systems shall meet the preliminarily established minimal requirements. Also there shall be ensured the system of their regular checking.
4. The part of a building (for example window-frame) which significantly influences the building energy index shall meet the preliminarily defined minimal requirements when being changed or renewed.
5. Installation of intellectual consumer meters shall be promoted during the reconstruction of a building. This would also satisfy the Directive requirements on the general rules of internal energy market of electric power.

6. By December 31, 2020 all new buildings shall satisfy the almost zero energy consuming conditions by the buildings. While the building used by the public sector shall meet these requirements by December 31, 2018 already.
7. Buildings certifying system shall be created which would include the information on the energetic indices of the building, the ways of their improvement and recommendations.
8. When selling or renting the part of the building the energy indices certificate should be submitted to the renter/buyer and in advertisement.
9. In public and society gathering buildings whose space is more than 500 square meters their energy indices certificate must be placed at a visible location (this threshold will be reduced to 250 square meters from 9 July 2015).

**Georgian policy and legislation in relation to the Directive 2010/31/EU:**

1. The requirements of the mentioned Directive in Georgia should be regulated by the Law on the Construction Activities although there is nothing said in it about energy efficiency. At present the Ministry of Economics is working on the draft Code on Spatial Arrangement and Construction in Georgia which according to the officials' statements is based on the best European experience and will facilitate the approximation of the legislation on spatial arrangement, urban construction planning and construction sphere to the European and international standards.
2. In the preliminary version of the draft Code on Spatial Arrangement and Construction in Georgia article 108 and 109 are dedicated to the thermal isolation and energy efficiency of the buildings and constructions and the use of renewable energy resources (see below).
3. In Georgia there does not exist an official requirement for buildings certification, standard and institute which would work in this direction. With the assistance of German International Cooperation Agency (GIZ) the Ministry of Economics works on bringing of Euro codes on buildings' structural design although it is only at the stage of translating.

***Article 108. Heat isolation of buildings and constructions and energy efficiency***

1. Circumscriptive constructions of buildings and constructions and its orientation, also equipment and installations located there for heating, conditioning, lightning, aeration and heat isolation must have characteristics ensuring maximally less energy in whole.
2. Reconstruction of buildings and constructions shall be carried out under the condition of minimal correspondence to energy efficiency according to the set rules by the legislation.
3. Energy efficiency norms of buildings and constructions are established under the resolution of the government on "Heat stability norms".
4. The unit issuing a permit on construction is obliged to issue energy efficiency confirming passport for those buildings and constructions which satisfy the requirements under this Article.
5. When developing energy efficiency regularizing legislation there should be envisaged the requirements of European Union 2010/31/EU regulations.

***Article 109. Use of renewable energy***

1. When designing and constructing buildings and constructions there should be taken into account the possibilities of the use of renewable energy resources.
2. Use of renewable energy in buildings and constructions may include the following technical means:
  - a) Passive systems of the sun, water heating installations functioning on solar energy, also combined systems of hot water supply;
  - b) Heating/cooling and hot water supply systems functioning in combination with geothermal water or other energy resources;
  - c) Other systems which give the possibility of efficient use of renewable energy.

European Parliament and Council Directive 2010/30/EU of May 19, 2010 on Labeling and Products sets the following main principles and requirements about the use of energy by the energy using products and other sources of use:

1. The purpose of the Directive is to form harmonized frames on labeling of all energy using products which will provide the consumer enough information with regard to choosing energy efficient product. At the same time, it should be accompanied the information/educational and stimulating campaign on energy efficiency.
2. The Directive established obligations for all energy using products producing/supplying participating parties; also establishes state purchase rules criteria and penalty provisions.

#### **Policy and legislation of Georgia with regard to 2010/30/EU Directive:**

1. Georgian Law on “Safety of products and Free Circulation” regulates the safety of products that are at Georgian market and their technical norms. According to the Law when assessing the product safety along with other factors there is taken into consideration the labeling of the product. There is nothing said in the Law about the obligatory labeling of the products using energy.
2. One of the objectives of the noted Law is the reduction of non-tariff barriers in trading.
3. At the first stage of the implementation of above mentioned energy credit program there was a big problem of a very low awareness of the consultants working in energy efficiency and renewable energy technologies supplying companies which in its turn made difficult for the consumers make a right choice.

The aim of Directive 2009/33/EC of the European Parliament and Council of April 23, 2009 on the Promotion of Clean and Energy Efficient Road Transport Facilities that the contractors who are going to purchase transport facilities envisage the total amounts of energy use during all their life span and CO<sub>2</sub> emissions for the purpose of supporting and development of clean and energy efficient transport market.

Georgian Law ‘On State Purchase’ does not envisage the requirements of given Directive during the purchase of transport facilities or other products to envisage the total amounts of energy use during the life span of transport facilities and CO<sub>2</sub> emissions.

During the purchase of transport facilities in public sector the main focus is made on safety and comfort and do not take into consideration clean and energy efficient road transport facilities requirements. Because of this purchased transport facilities frequently are sizable, high power and not energy efficient.

The government is planning to introduce obligatory technical inspection of transport facilities from 2015 which in normal, not corrupt conditions will bring positive results.

#### **“Protocol of Energy Charter about the aspects connected with energy efficiency and environment” and conformity of Georgian normative and state policy with the Protocol requirements.**

Energy Charter Agreement on the grounds of free, market and sustainable development principles creates international legal environment for securing the energy safety. Relevantly, the Agreement represents a legal obligatory multiple instrument.

The Energy Charter Agreement Georgia signed in 1994 and came into force in 1998, while Energy Charter Protocol on the Aspects of Energy Efficiency and Environment was signed in 1994 which was ratified in 2004 by the Parliament of Georgia.

“Energy Charter Protocol on the Aspects of Energy Efficiency and Environment” defines the policy principles connected with the promotion of energy efficiency and the reduction of energy systems harmful impact on the environment. It also includes the guiding provisions for the purpose of the development of energy efficiency programs, defines the spheres of cooperation and frames for the development of joint and coordinated activities.

Contracting parties define the strategy and the tasks of energy policy for the improvement of energy efficiency and reduction of environmental impact during the energy cycle with taking into consideration the existing conditions in the field of energy. This strategy and tasks will be transparent for all stakeholders.

For the achievement of energy policy objectives each contracting party will develop, implement and regularly update energy efficiency programs which are more relevant to the specific conditions.

***These programs can include the measures such as:***

- a) Defining the long term demand on energy and energy provision plan for the purpose of correct direction of decision making process;
- b) Assessment of implemented measures with regard to energy, environment protection and economics;
- c) Defining necessary standards for the improvement of efficiency of energy consuming facilities and their harmonization at the international level for the purpose of avoiding trading infringements;
- d) Development and encouragement of private initiatives and industrial cooperation, including joint enterprises;
- e) Promotion of energetically most effective, economically viable and from environmental point of view safe technologies;
- f) Promotion of innovative approaches in the sphere of investments for the purpose of energy efficiency improvement, namely, participation of third parties in financing and joint financing;
- g) Creation of energy balances and data base. In data there should be reflected in details the existing demand on energy and the energy efficiency improving technologies;
- h) Promotion of the creation of consultative and advisory service which could work in state and private industry or enterprises and ensure information provision on existing programs and technologies in the sphere of energy efficiency and could assist both consumers and enterprises;
- i) Promotion of measures for joint generation of energy, at regional level thermo production efficiency growth and ensuring distribution systems of buildings and enterprises;
- j) Establishment of specialized bodies functioning in the energy efficiency field which would be secured with enough finances and personnel for the development and implementation of energy policy directions;
- k) During the implementation of energy efficiency programs, the contracting parties shall ensure the existence of relevant institutional and juridical infrastructure.

European Energy Charter Agreement also appeals to the member states to develop renewable energy resources and alternate technologies for the reduction of negative impact to the environment.

It should be noted that other chapters (trade, investments, transit) of the Energy Charter Agreement is legally binding in difference from the energy efficiency chapter because the latter is free from possible conflict risks.

Georgian energy policy in relation to the European Energy Charter Agreement requirements – namely energy efficiency:

1. In the Resolution of the Georgian Parliament of 2006 on the Main Directions of State Policy in Energy Sector of Georgia it is said that for the increase of energy efficiency in the country there should be created legislative and institutional frames, although it is just formality without relevant legislative initiatives and the development of programs and Action Plan;
2. Georgia does not have not only the energy efficiency strategy but even energy sector development strategy;
3. Energy efficiency projects are implemented only in the framework of donor programs and the scale is very small;
4. After 2001 in Georgia there have not been made united energy balance, which would enable us to analyze the sector and plan relevant programs. There were made only electric power and gas balances.
5. Positively could be assessed:
  - o Rehabilitation of hydro energy power stations for energy efficiency which has been carried out during the last years.
  - o The dynamic of reduction of losses in electric energy system network;
  - o Simplification of taxpaying system for the purpose of the promotion of technologies introduction, liberalization of customs regime.

## **Conclusion**

The normative and institutional conditions of Georgia mainly do not correspond to the requirements of international agreements in terms of energy efficiency and renewable energies. For Georgia which is on its way to Europe it is important to meet these requirements and implementation in practice which, in the first place, will be beneficial for the country energy system safety. The weak economics of Georgia inefficient use of energy makes ever weaker and increases the energy safety risks. There is not enough efforts taken by the state institutions to promote introduction and development of energy efficiency and renewable energies; in this direction NGOs are more active within the donor programs framework.

Frequent changes in the legislation on energy, long-term memorandums signed with vertically integrated companies, uncompetitive environment, low level of awareness of the society makes even more difficult the development of energy efficiency and renewable energies.

## **Recommendations**

- For the promotion of energy efficiency measures and renewable energies development the state shall complexly plan and implement obligatory programs under the international agreements: develop laws, functional institutions, financial mechanisms, action plan and its monitoring system, ensure free market environment;
- There is necessity of assessment of energy efficiency and renewable energy potential at professional level, systemization of energy data (balances) and analysis for energy safety risks reduction;
- The State shall promote development of renewable energies not in the supply sector and only through the concentration on hydro resources, but also by taking into account other resources, including the consumption sector;
- The tariff which is a good instrument for energy efficiency growth should not become the means for political scoring, neither it is the means of social problems settling; tariff shall be defined through the economically justified methodology;
- In the energy regulating bodies of the developed countries the successful practice is the existence of separate division/department/specialists group working in relation to energy efficiency and renewable energies; it will be good if Georgian National Energy and Water Supply Regulatory Commission takes into account the similar practice;
- Buildings represent a long term investment and are connected with the human safety, the State should seek finances for the stimulation of energy efficient constructions, in addition it should promote the creation of institution of energy service companies;
- There shall be envisaged in the Law on Purchases and carried out in practice the requirements of Directives 2009/33/EC, 2012/27/EU which would be a good example for ordinary citizens.

# REVIEW OF THE SITUATION IN ENERGY SECTOR OF GEORGIA, EVALUATION OF EXISTING PROBLEMS AND THE WAYS OF THEIR MODERNIZATION

Anzor Dundua, Nugzar Uplisashvili  
Georgian energy-resources effectively using association

## PRESENT SITUATION OF ENERGY SECTOR OF GEORGIA

### *General review*

During the assessment of economic potential of Georgia, great importance is attributed to the quality of development of heat-and-power engineering complex, with generating, processing, and converting enterprises, natural conditions, and country's geographic location. Special place is occupied by the potential of hydro-energy resources and renewable energy sources, to which apart from hydrological resources geothermal, wind, and solar energy belongs. Sustainable ecologic development means creation of such economic mechanisms, which stipulates growth and improvement of macroeconomic indicators, formation of ecological-economic and economic influence system of innovation activities, without adequate growth of primary energy resources. Highly developed industry represents important sector of economic strength and national economy, and achieving this is possible against the background of energy development and energy safety.

Strategic plan of sustainable economic development should be based on the principles of sustainable development, and should ensure development of economy with protection of these principles. Each economic project should be evaluated in advance with consideration of its economic profit and the damage imposed on nature, only within the framework of observation of the essence and principles of sustainable development. The strategic plan should envisage the marking of main priorities, its economic and ecological justification and seeking optimal ways of the result-oriented implementation. Maximal use of renewable energy resources (water, solar, wind, marine waves, geothermal waters, biomass, etc.) is considered as one of the effective priorities in this direction. This is of especial priority for our country, since the coefficient of use of existing potential of hydrological resources is quite modest at present, while there is no basis of primary mineral fossil resources. This issue becomes especially topical at present proceeding from grandiose scales of the building of the country.

### **Electric energy sector (description):**

#### ***Transmission***

Georgia's electric energy transmission network operates at the voltage of 500/330/220/110/35/10/6 KV.

Energy system of Georgia connects the energy systems of neighboring countries by means of transmission network of 500 KV:

500-KV main electric transmission line "Kartli 1" – "Kartli 2" – "Imereti" – "Kavkasioni", which by passing the 500 KV substations "Gardabani-500", "Zestaphoni-500" and "Ksani-500" connects Georgia's energy system with Russia and large generation objects located in the North-East of Georgia (including "Enguri HPS")

GSE's subsidiary company "Energotrans" has constructed the 500 KV main electric transmission line "Vardzia" – "Zekari" – "Meskheti", which by passing the 500 KV substations "Gardabani-500", "Zestaphoni-500" and "Akhaltzikhe-500" connects Georgia's energy system with Turkey.

The 500 KV electric transmission line "Georgia-Azerbaijan" and 330-KV transmission line "Gardabani-330" connecting the energy system of Azerbaijan goes from the 500 KV substation "Gardabani-500".

Also, a wide 220 KV transmission network functions, which is connected with other generation objects and central regions of demand-and-consumption. Georgia's energy system is connected with Russia, Armenia, and Turkey by the 220 KV transmission lines. There are isolated 110 KV connecting electric transmission lines with Armenia and Russia. The budget of "Georgian State Electrosystem" and its subsidiary company "Energotrans" consists of:

500-220-110-35 KiloVolt 130 units of electric transmission line of total length of 3221.97 km. It includes: 500 KV line length – 289 km; 220 KV line length – 1584.41 km; 110 KV line length – 856.79 km; 35 KV line length – 491.77 km.

500-220-110-35 KiloVolt 92 units of substations with total capacity – 10212.6 MWt. It includes: 500 KiloVolt substations – 4 (total capacity – 5228.2 MWt); 220 KiloVolt substation – 17 (with capacity – 4396.5 MWt); 110 KiloVolt substations – 25 (capacity 421.4 MWt); 35 KiloVolt substation – 46 (with capacity – 166.5 MWt).

### ***Process Control***

National Process Control Center of Georgian Energy System is located in the building of GSE, in the center of Tbilisi. It is responsible for efficient management of Georgian energy system, right working of the 500/220/110/35 KV transmission objects and sustainability of the energy system. National Process Control ensures the working of the energy system as a single object in normal and emergency modes. The Center is equipped with newest technologies, which enables of obtaining the information about the system in electronic mode, distance-control of the system, and efficient management of emergency situations. In particular, National Process Control obtains full information from substations and stations, and on the basis of constantly updated database promptly reacts on emergency situations.

### ***“Sakrusenergo”***

JSC United Energy System “Sakrusenergo” was established on 27 May 1996 by the Government of Georgia and “Russia’s United Energy System”. The article capital of the joint stock company is distributed between the founders as 50%-50%.

The supreme objective of “Sakrusenergo” is working in simultaneous mode with all neighboring energy systems. Its main function is transmission of electric energy by means of inner system 500 KV electric transmission lines and technical service of the lines connections with neighboring countries.

The total length of transmission lines available in the article budget of “Sakrusenergo” is 908 km. It includes electric transmission lines of 603 km in length passing the territory of Georgia, and of 305 km in length passing the territory of Russia.

### **Allocation and Distribution**

#### ***Energo-Pro Georgia***

JSC Energo-Pro Georgia is a company existing in the ownership of Czech Energo-Pro A.S.E. Czech company JSC “Energo-Pro Georgia” bought the assets of “Georgian United Distribution Energy Company” and “Adjara Energy Company” in June, 2007. Together with the assets of distribution companies, seven hydro-power stations were passed in the ownership of “Energo-Pro Georgia”. These, in particular, were: “Rionihesi”, “Gumathesebiskaskadi”, “Dzevrihesi”, “Shaorihesi”, “Ladjanurhesi”, “Zahesi”, “Ortachahesi” and “Atshesi”. Their total capacity exceeds 368 MWt. Considering the number of consumers and the territory of service, JSC Energo-Pro Georgia represents one of the largest companies in the region of Transcaucasus. JSC Energo-Pro Georgia is a member of Energo-Pro group; Energo-Pro group, in its turn, owns energy objects in Czech Republic, Bulgaria, Turkey, and Armenia. The market value of the assets of the Group constitutes today 650 million Euro.

JSC “Energo-Pro Georgia” is one of the largest distribution companies on Georgian energy market, which, apart from Tbilisi and part of Kakheti, owns network of high (110 KV), medium (35-10 KV) and low (6-0.4 KV) voltage on the whole territory of Georgia.

#### ***The main types of the company’s activities are:***

- allocation of electric energy;
- generation of electric energy;
- transit service of electric energy;
- technical service of consumers.

Serving the consumers and operating the electric networks is carried out by means of 7 regional branches and 55 service-centers of consumer service.

“Energo-Pro Georgia” annually provides 850 000 consumers with 2,150 billion KWt/hour of electric energy. The sales of electric energy by the Company is equal to 40% of total consumption of electric energy in the country;

#### ***The main directions of the Company’s operations are:***

- Reliability of energy supply;
- Improvement of consumer service;



- Introduction of new technologies;
- Total modernization of the network.

Czech company “Energo-Pro” was established in 1994 in Czech Republic, the city of Svitav. It represents a company established by the private persons of Czech Republic, for which generatio of electric energy is continuati-on of their past activities. Initially, the Company was occupied with production of water turbines and HPS-s.

At present, “Energo-Pro” owns and operates 11 hydro-power stations in Czech Republic. It also owns hydro-power stations in Bulgaria and Turkey.

In Georgia, “Energo-Pro Georgia” group project has been implemented by support of Czech “Export-Import Bank”, which is the state property. It is specialized in financial provision of the export and foreign investments of Czech companies. Since 2002, Czech “Export-Import Bank” provides financial support of international activities of the “Energo-Pro” group. The support of “Energo-Pro” investment activities is provided by Export Guarantee and Insurance Company of Czech Republic (EGAPP), which provides the insurance of the risk of investments in Georgia of “Energo-Pro” and Czech Export Bank.

### **“Telasi”**

JSC “Telasi” is the second distribution company by size at Georgian energy market, which owns the network of high (110 KV), medium (35-10 KV) and low (6-0.4 KV) voltage in the city of Tbilisi and its adjacent territories.

The main type of the activity of the company is distribution of electric energy. At the same time, the company renders the following services:

- electric energy transit service;
- technical service of consumers;
- service of billing and payment collection for external service organizations.

The service of consumers and operation of electric networks is carried out in consumer service centers and operation areas, which are located in all administrative regions of the city.

JSC “Telasi” provides annually electric energy of 2 billion KWt/h to 416 500 consumers. In contrast to critical days of the last year, the number of electric energy limitations and accidents in the capital city has reduced significantly, the quality of reliability of energy supply has increased, and the indicator of getting back of the price of consumed electric energy also has. In two years, the Company has paid the sum of more than 200 million GEL in form of budget duty.

### ***The allocation network of the JSC “Telasi” includes:***

- 110 KV substations – 23 substations, 45 transformers;
- 35 KV substations – 12 substations, 23 transformers;
- 6-10/0.4 KV substations – 1570 substations, 2032 transformers;
- 110 KV air electric transmission lines – 33 lines, 284 km in length;
- 35 KV air electric transmission lines – 14 lines, 85 km in length;
- 35 KV cable lines – 10 lines, 17 km in length;
- 6/10 KV air electric transmission lines – 37 lines, 36 km in length;
- 6/10 KV cable lines – 2098 lines, 1587 km in length;
- 0.4 KV air electric transmission lines – 1206 lines, 502 km in length;
- 0.4 KV cable lines – 6569 lines, 739 km in length.

The main directions of the company’s activities are: reliability of energy supply, improvement of consumer service, introduction of new technologies, and total modernization of the network.

75% of “Telasi” stocks have been owned since 2003 by Russia’s united energy system, which bought “Telasi” from American company “A.E.S.”. JSC “AES Russia” was created in 1992. The company’s initial capital included thermal and hydraulic power stations, main electric transmission lines and energy objects, also shareholding of construction and R&D (research-and-development) organizations.

### ***Kakheti Energy Distribution***

JSC “Kakheti Energy Distribution” is a distribution company in Kakheti region, which was created on 15 April 2003 on the basis of JSC “Sinatle”. The main type of the company’s activities is distribution of electric energy.

Consumer service and collection of monetary funds is carried out in 8 service centers of JSC “Kakheti Energy Distribution”, which are located in all administrative districts of Kakheti region. JSC “Kakheti Energy Distribution” is served by 117 058 consumers. Its average annual consumption is 200 million KWh/hour.

#### ***The distribution network of JSC “Kakheti Energy Distribution” includes:***

- 10-6 KV electric transmission lines – 4 990 km;
- 0.4 KV electric transmission lines – 11 359 km;
- 10 KV. feeder - 192;
- 10-6/0.4 substations;
- 1 669 transformation points.

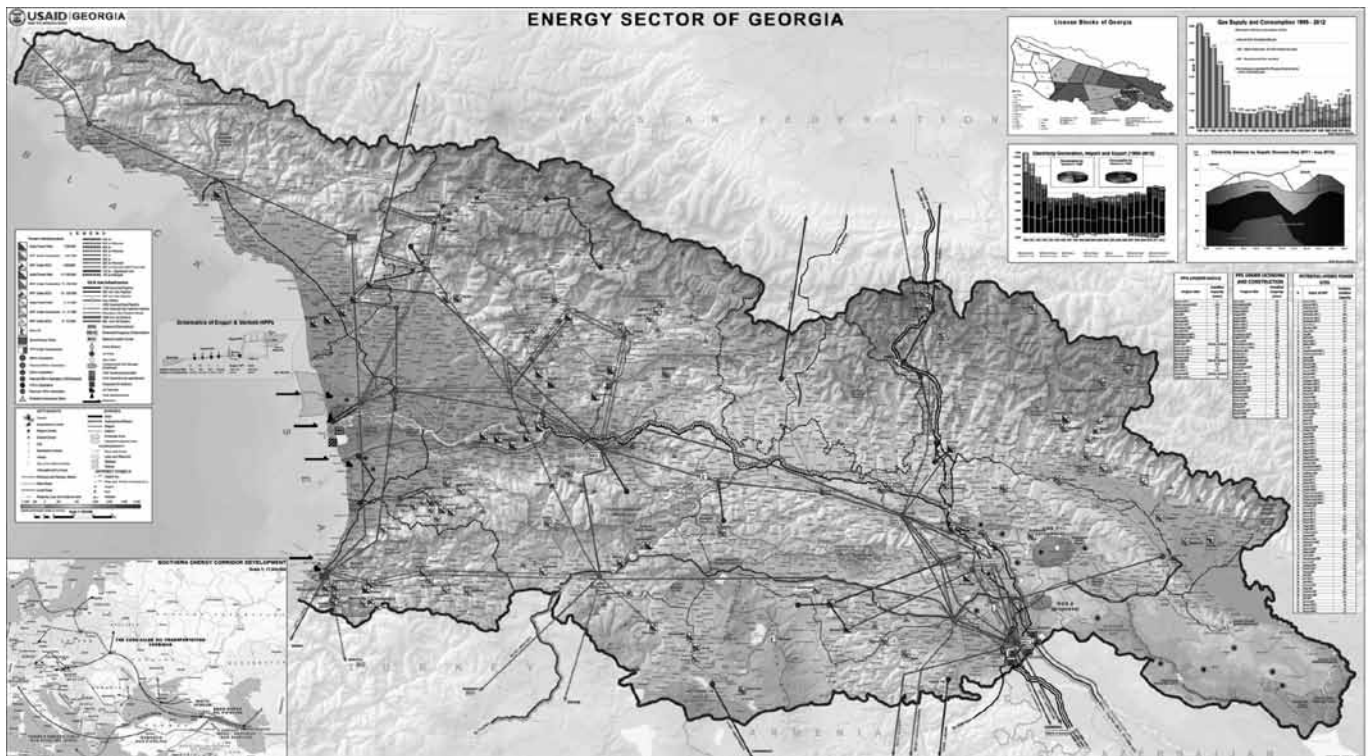
### ***Production***

Energy sector of Georgia is represented by small, medium, and high power HPS’s, condensation thermal power stations, and air-turbine plants.

#### **Electric energy generated by electric stations (feeding the circuit) in 2013**

<b>No</b>	<b>Title of the electric station</b>	<b>Electric energy (million KWh/hour)</b>	<b>Electric station capacity (megawatt) (MWt)</b>
1	Engurhesi	3577.4	1300
2	Vardniliesi	648.8	220
3	Khramhesi 1	184.1	112.8
4	Khramhesi 2	295.4	114.4
5	Zhinvalhesi	389.9	130
6	Vartsikhehesebiskaskadi	847.6	184
7	Rionhesi	303.2	48
8	Gumathesi	343.5	68.8
9	Ladjanurhesi	444.7	112.5
10	Dzevrulhesi	120.5	80
11	Shaorhesi	107.2	38.4
12	Zahesi	166.3	36.8
13	Ortachalhesi	83.9	18
14	Atshesi	79.3	16
15	Chitakhevhesi	90.8	21
16	Satskhenhesi	17.6	14
17	Khadorhesi	142.5	24
18	Other HPS’s	321.7	118.41
	Hydro-stations total	8163.5	2657.11
19	Mtkvari	854.5	300
20	Tbilsresi	816.8	272
21	Gepower	25.9	110
	Thermal power stations total	1697.1	682
	Total generation	9860.6	3339.11

According to available information, the main and supportive equipment of electric stations is obsolete and because of this their efficiency is significantly reduced. This means that the installations are not able to receive (cannot reach) project parameters, as a result there is reduced generation, diminished energy safety, and increased damage to the environment.



### **Commercial operator of the electric energy system**

“Electric energy Sector Commercial Operator” (ESCO) was established on 7 August, 2006 in accordance with the Law on Electric Energy and Natural Gas. The company started functioning on the 1st September, 2006.

On the basis of the Decree No.142 of the Minister of Energy and Natural Resources of 10 August, 2011, “Electric energy Sector Commercial Operator” was transformed into a joint-stock company. 100% of its shares are owned by the state.

#### ***ESCO’s functions are:***

- Buying and selling of balance electric energy (capacity) (including through drawing the medium- and long-term agreements on import and export);
- trading with guaranteed capacity in correspondence with the Law of Georgia on Electric Energy and Natural Gas, and the Regulations of the Market of Electric Energy (Capacity);
- Creation and management of a single basis for wholesale buying and selling, including the single register of accounting;
- presenting relevant information for the licensee of process control with the purpose of supplying and consuming of electric energy and capacity in the single electric energy system of Georgia;
- inspecting the counters used in the wholesale accounting;
- promoting construction of new electric stations;
- carrying out other functions defined by the law.

### **Energy strategy and policy of the country.**

In spite of the fact that in 2006 the Parliament of Georgia approved “The main directions of the energy policy”, in which in 2008 insignificant changes were made, it was not proved possible to create basic strategic and programmatic documents of the energy sector of the country (here the particular scientifically grounded and yearly planned packets of measures are meant), which would formulate with sufficient analytical provision the long-term vision of the sector, and define the priorities for taking strategic decisions in the energy sector. Non-existence of these packets is partly filled by the governmental program – Renewable Energy 2008 (hydro-energy), although it fails to fulfill effectively this function. There is high probability of non-optimal actions and decision-making without qualitative strategic documents.

## **Oil and gas sector**

### ***Oil and Gas Corporation of Georgia***

JSC “Oil and Gas Corporation of Georgia” carries out operation and construction of main gas pipeline system, gas pipelines, and oil pipelines existing in Georgia. One of the main directions of its activities is restoration/rehabilitation of main gas pipelines system; designing/construction of new main gas pipelines and oil pipelines; creation, development, and operation of adequate infrastructure. Also, finding oil and gas resources, their development, production, designing of these activities, carrying out of transportation transit, export, import, storage, preparation, processing, realization, and marketing operations of oil and gas, their products on the territory of Georgia and beyond its borders (the Company also provides transit, supply, and transportation of gas to the Republic of Armenia).

Its function is gas expenditure accounting, mode protection, control over its correctness, finding the reasons for gas losses, and protection of safety of gas pipeline.

Gas Transportation Company operates total length of 1939.52 km (according to the article balance of the Gas International Corporation) of main gas pipelines and branches, 85 gas-distributing stations, 5 gas measuring junctions. Total project capacity of the pipelines constitutes 55 mln.m<sup>3</sup> per day, i.e. 20 billion m<sup>3</sup> per year. Total geometric volume of gas pipelines is 551,151 m<sup>3</sup>.

By the decree of the Minister of Economic Development of Georgia, in 2006 the “Oil and Gas Corporation of Georgia” was established. The Corporation comprised 100% of the stocks of the JSC “International Oil Corporation of Georgia”, JSC “International Gas Corporation of Georgia”, and JSC “Saknavtobi” existing in the state ownership. In September 2011, the Corporation changed its legal form, and was transformed from a company of limited responsibility to a joint stock company.

At present, the 100% of the Corporation stocks are owned by JSC “Partnership Foundation”, which, in its turn, is in state ownership. The right of ruling the Company is assigned to the Ministry of Energy of Georgia.

### ***Oil pipelines***

Transportation of oil into Georgia is carried out by two pipelines: Baku-Tbilisi-Ceyhan oil pipeline (BTC), and the Western Route Export Pipeline (WREP).

### ***Baku-Tbilisi-Ceyhan oil pipeline project***

Exporting of the oil produced from the “Azeri-Chirag-Guneshli” well is carried out via Baku-Tbilisi-Ceyhan oil pipeline.

BTC is the first direct route of transportation of oil between the Caspian and Mediterranean Seas. The total expenditure of its construction has reached 4 billion US dollars. Baku-Tbilisi-Ceyhan oil pipeline is one of the longest pipelines in the world. Its length is 1768 km.

Transportation of the oil via Baku-Tbilisi-Ceyhan oil pipeline started in May, 2005, and in October, 2005 the presidents of Georgia, Azerbaijan, and Turkey officially opened the Georgian section of BTC in Gardabani.

As a result of operating this oil pipeline, within the period of functioning of the project, the Budget of Georgia will receive approximately 50 million US dollars in the form of direct transit incomes.

Within the framework of Baku-Tbilisi-Ceyhan main export oil pipeline project, the investor companies implement population social support programs, whose objective is assisting of population residing in the oil pipeline corridor in solving the social problems.

### ***Western Route Export Pipeline***

Western Route Export Pipeline (WREP) is known under the name of Baku-Supsa pipeline. Western Route Export Pipeline is the first investment carried out by the BP in Georgia, and it has functioned since 1999.

Construction of the early Baku-Supsa oil pipeline was financed by Azerbaijan International Operating Company. Within the framework of pipeline construction, the construction of Supsa terminal has also occurred. The length of the early Baku-Supsa oil pipeline is 830 km (Georgian section is 375 km), capacity of Supsa terminal is 1 million barrel.

Western Route Export Pipeline carries out the loading of the oil into the Supsa terminal from Chirag well, situated on the territory of the Caspian Sea, passing the Sangachali terminal. Oil was piped in December, 1998 from Sangachal through WREP, and in the first week of January, 1999, it entered Georgia.

The territory of Georgia is divided into 25 license blocks. The General Oil and Gas Use License for the blocks is issued on the basis of open international tenders. At present, the activity of finding and producing oil and gas is carried out by 12 oil companies:

- Jindal Petroleum (India)
- Frontera Resources Georgia (USA)
- Strait Oil and Gas (Great Britain - Australia)
- Georgia Oil and Gas (Georgia)
- Ninotsminda Oil Company (Czech Republic)
- Vectra Investment Private Limited (India)
- Canargo Norio (Czech Republic)
- CanargoNazvrevi (Czech Republic)
- Marine Resources (Romania)
- ELENILTO (Israel)
- Trans Atlantic (Great Britain - Australia)
- Strait Oil and Gas (Adjara) (Great Britain - Australia)

### ***Gas pipelines***

The main gas pipeline system of Georgia has been functioning since 1959, when the first main gas pipeline in Transcaucasia was put into operation – Karadagi – Tbilisi. At the initial stage, the 500 mm-diameter and 50 km-long gas pipeline functioned from the Red Bridge to Tbilisi in Georgia. The gas distributing stations of Gardabani, Rustavi, and Navtlugi were in operation. In 1963, the 700 mm-diameter Ordjonikidze-Tbilisi oil pipeline was put in operation, which enabled Georgia of being supplied with natural gas from two mutually independent sources – Russia and Azerbaijan.

In the years 1967-68, the parallel 700-mm and 800-mm Karadag-Tbilisi and Ordjonikidze-Tbilisi pipelines were put into operation.

From 1979-80, 1000-mm Kazakh-Saguramo 89-km, and from 1988, 1200-mm North Caucasus-Transcaucasia gas pipelines function in Georgia.

From 1969, functions Saguramo compressor station, and from 1980-81 – Kvesheti compressor station. The main gas pipelines of Georgia carry out transportation of natural gas to Georgian objects, and transit service of Armenia. The operation of the main gas pipeline is carried out by Kazbegi, Kvesheti, Saguramo, and Terjola treasury operational branches.

The main gas pipeline system of Georgia includes 9 gas pipelines. These include North Caucasus-Transcaucasia, Kazakh-Saguramo, Karadag-Tbilisi, Vladikavkaz-Tbilisi, Saguramo-Kutaisi, Kutaisi-Sukhumi, Rustavi-Telavi-Zhinvali, TsiteliKhidi-Tsalka-Alastani, and Gomi-Khashuri-Bakuriani.

The length of distribution network of natural gas in Georgia constitutes 17236.181 km.

The city of Tbilisi is served by the natural gas distributing companies: “Kaztrngaz-Tbilisi” Ltd, “DidiDigomi” Ltd, “Varketilairi” Ltd, JSC “Energokavshiri”, “Gama” Ltd, and “Kamari M” Ltd. By the situation on 31 December, 2013, in Tbilisi the counters are installed in total for 401479 consumers, including domestic – 388237 and non-domestic – 13242. In 2013, the number of new consumers connected to the network constituted 9612, including domestic – 8550, and non-domestic – 1062.

By the situation on 31 December, 2013, the number of consumers of distribution companies of “Socar Georgia Gas” Ltd is total of 257047, including domestic – 250147 and non-domestic – 6900. In 2013, the number of new consumers connected to the network constituted 39 224, including domestic – 38345 and non-domestic – 882.

The number of consumers of JSC “Sakorggazi” is total of 167063, including domestic – 162552 and non-domestic – 4511. In 2013, the number of new consumers connected to the network constituted 6152, including domestic – 5727 and non-domestic – 425.

In 2013, total of 62829 new consumers got connected to the network in Georgia, including 60293 – domestic (population) and 2536 – non-domestic. Total number of consumers of natural gas constitutes 891117, including domestic – 864947, and non-domestic – 26170.

### ***Natural gas market regulations***

Natural gas market regulations regulate the relationships between the gas supplier, transportation and distribution licensees and direct consumer. Termination or reduction of supply of natural gas by the supplier or licensee is

forbidden except for the cases determined by the law. The participants of buying and selling of natural gas and associated transportation relationship with the purpose of balancing supply and consumption of natural gas may draw a bilateral or multilateral agreements.

Transportation licensee – Gas Transportation Company of Georgia is obliged: to promptly fulfill the notification of the supplier regarding supplying, termination of supplying, or restoration of supplying of natural gas to a certain person; to observe reliability standards and established security norms and regulations.

The supplier or natural gas sector licensee (in total 58 companies) has the right to terminate the service – if its consumer does not fulfill the obligations envisaged by legislation, market regulations, and agreement; termination of gas supply is needed because of planned or emergency renovation operations; if human life, health, or his/her property is endangered. The companies, which by means of transportation system carry out buying and selling of natural gas, its transportation, supply, distribution, or consumption, are responsible to be ready for avoiding the factors causing possible deficit in the system. According to the market regulations, in case of natural gas deficit in the transportation system, it is acceptable to reduce or limit the supply of natural gas.

The licensee of natural gas transportation – Georgian Gas Transportation Company – is obliged to have intact the transportation network of natural gas connecting to the systems of neighboring countries. It is also obliged to design and manage the system in such a way that the stability of natural gas transportation system be ensured even in cases when because of disasters, diversion, accident, or other phenomena one or more devices of transportation system fail(s). In case of deficit, natural gas should be redistributed according to the principles of necessity and justice. Georgian Gas Transportation Company is obliged, first and foremost, to provide with natural gas those direct consumers, who by means of natural gas produce electric energy.

According to the market regulations, if carrying out of planned renovation works causes temporary termination of the supply of natural gas, the relevant interested person should be informed about this at least 30 days earlier – in case of violation of the given procedure correspondingly the postponement of termination of natural gas supply will occur.

The market procedure regulates the mechanism of submission of application regarding buying-and-selling and transportation of natural gas and drawing of the agreement. In particular, after drawing the agreement on buying-and-selling of natural gas, the seller of natural gas is obliged to appeal to the transportation licensee with the application on transportation of natural gas, and provide for supplying natural gas within the ten days period.

The application on reduction or increasing of the volume of natural gas should be submitted by the service customer to the transportation company at least two days in advance.

In case of receiving the natural gas in more quantity than it was specified before, the receiver of natural gas is obliged within the reporting period to reimburse the cost of excessive natural gas obtained to the licensee of transportation or relevant distribution, or to compensate with the same volume of natural gas.

The procedure of joining the system of natural gas supply and natural gas transportation is regulated by market rules. In particular, the person, who wishes to join the transportation system, should submit the application to the transportation licensee. The transportation company is obliged to reject the joining if the joining of distribution licensee or direct consumer to the natural gas transportation network (system) will have clear negative influence over the general system of natural gas transportation. The joining of the consumer, whose annual natural gas consumption exceeds 15% of annual volume of natural gas distributed by the distribution licensee serving it, requires the preliminary agreement of the GNERC. The object joined to the system will be put into operation after the reimbursement of necessary costs spent on the joining the network.

In case of illegal consumption of natural gas, the natural gas transportation licensee is authorized to terminate the supply of natural gas without preliminary warning to direct consumer or distribution licensee.

The supply of natural gas without precise accounting is prohibited; the gas meter should be situated at both sides from the point dividing the receiving and supplying points of the licensee at the natural gas network.

## **Coal**

### ***Coal is extracted in Georgia***

In Tkibuli mine, the coal-extracting works started (resumed) in 2006. As a result of significant investment projects implemented after that, the “Saknahshiri” became the strategically important and one of the distinguished companies in the industrial space of Georgia. The company carried out rehabilitation of mines and resumed the extraction of coal in the Dzidziguri and Mindeli mines. In 2009, the Coal-cleaning Factory equipped with newest

technologies was put into operation. At present, the quality of Georgian cleaned coal corresponds to all international standards.

The company supplies the local market with coal completely. The majority of drawn contracts are long-term ones. In 2011, “Saknahshiri” produced 350,000 tons of coal and in 2012 it is planned to extract 500,000 tons of coal. The company plans to increase the production of coal to 1.5 million tons per year to completely satisfy in the future the increasing demand at the local market. “Saknahshiri” does not exclude that it may place its product on the international market and export cleaned coal to Eastern Europe and Black Sea region.

### ***Fuel wood***

Forest occupies about 40% of the territory of the country. 97-98% of it is of natural origin. The composition, structure, conditions of growth and development and other characteristics of the forests stipulate rich biological diversity – about 400 types of forests and shrubs grow in Georgian forests. The indicator of diversity of dendroflora is the multitude of endemic timber plants, in particular, in Georgian forests there are 61 local endemic species and 43 endemic species peculiar for Caucasus region.

After Georgia gained its independence, the condition of forests worsened significantly – forest management was inefficient, traditional methods and mechanisms of forest economy were lost. As a result, there was extensive illegal cut of the wood, regulation of grazing did not occur, erosion processes activated, in a number of cases ecological balance was disturbed, landscapes got severely endangered.

In many occasions, the problems are inter-chained and are of complex character. The main reasons are:

- incorrect policy of forest economy management;
- insufficient funding and limited human resources;
- imperfect legislative base;
- imperfect and inadequate information regarding the forest resources of the country;
- high degree of illegal actions and existence of illegal activities;
- High price of alternative energy carriers of fuel wood.

The forest resources of Georgia are managed by LEPL National Forest Agency, LEPL Protected Territories Agency, LEPL Adjara Forest Agency. Because of well-known events on the territories of Abkhazeti A/R and Samachablo, management and control of existing forests cannot be carried out from the Forest Foundation subordinate to National Forest Agency:

- In the period of 2006-2012, special licenses of wood production were issued for 159.6 thousand hectares;
- In the period of 2003-2012, with the purpose of creating the hunting economy, the licenses were issued for 71.1 thousand hectares.

## **ASSESSMENT OF ENERGY SECTOR OF GEORGIA AND GENERAL RECOMMENDATIONS**

I am representing a non-governmental organization – Georgian Energy Resources Effectively Using Association. The proposed topic refers to brief review of the organizations of the country energy sector, assessment some aspects of their activities and recommendations of general character.

Because of the time-limit of the Conference I am not presenting the description of present situation of energy sector, this material you can find in your paper-cases. For the presentation there have been used the results of the work carried out by the Association during the last years, public materials of the studies carried out by the organizations united in the Third Platform, also the data of the officially published annual reports of the organizations belonging to energy sector.

For the analysis energy and ecological safety of Georgia were selected as the main targets, provision of the economy and population with energy resources reliably and continuously. For this purpose the whole energy balance of Georgia for 2013 and its constitutive - electric power and gas balances - have been studied. While energy power and gas balances are defined and officially published, it has not been possible until not to draw up the whole balance.

Analysis of the energy balance shows that the difference between the used and generated energy resources by the country is filled in by the imported energy resources of different types, for example, in total balance the amount of in-house resources comprises 33,5%, while 66,5% is imported.

### Total energy balance of Georgia in 2013

#	Energy supply	coal	oil		gas	energy			Fuel wood	total
			Crude	products		hydro	geothermal	Electric power		
1	2	3	4	5	6	7	8	9	10	11
2	production	140	47		5	715	8		304	1219
3	import	4		966	1513			42		2525
4	export		-41	-11				-39		-107
5	bunker	-2	-6	-3	12				-15	-5
6	Change of supply									
7	<b>Primary energy</b> <b>7=1+2+3+4+5</b>	<b>142</b>		<b>952</b>	<b>1530</b>	<b>715</b>	<b>8</b>	<b>3</b>	<b>289</b>	<b>3639</b>

On the basis of this, it can be concluded that despite the fact that the country has relatively developed energy sector with its infrastructure, Georgia is a country of energy deficiency and it needs well developed energy protective mechanisms, which would ensure growing development of the country with strong observance of sustainable principles.

### Electricity balance of Georgia in 2005-2013 (million kWh)

#	Name	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	production	6.880,2	7.419,8	8.169,5	8.279,1	8.278,1	9.919,2	9.912,2	9.471,9	9.860,6
2	Hydropower station	5.850,2	5.321,6	6.724,5	7.053,7	7.314,6	9.263,3	7.788,7	7.122,1	8.163,5
3	Thermal power station	1.030,6	2.103,8	1.445,0	1.225,5	963,5	655,9	2.123,4	2.349,8	1697,1
4	Import	1.398,6	777,6	433,3	649,0	254,8	222,1	470,9	614,6	484,1
	Russia	615,7	465,0	176,9	560,1	233,3	211,9	447,6	517,05	460,5
	Armenia	752,9	185,7	-	-	-	-	-	408,0	0,001
	Turkey	9,3	106,7	149,0	54,3	0,0006	0,0001	2,8	629,0	0
	Azerbaijan	20,7	7,1	107,4	34,6	31,5	10,1	23,4	94,54	23,6
5	Export	121,8	84,2	625,0	679,6	749,4	1.524,9	930,6	528,2	450,4
	Russia	-	-	-	-	525,8	1.117,1	588,6	369,43	370,6
	Azerbaijan	-	-	300,3	432,7	21,5	14,3	5,9	11,79	6,6
	Turkey	121,8	84,2	215,6	30,9	182,3	303,4	218,6	79,0	0,00005
	Armenia	-	-	109,6	216,0	19,8	89,5	117,5	67,9	73,2
6	Losses	314,8	232,5	164,7	173,7	143,4	175,1	195,93	178,9	204,1
		3,8%	2,84%	1,91%	1,95%	1,68%	1,73%	1,89%	1,77%	1,97%
7	Use	7.842,8	7.882,6	7.812,6	8.074,8	7.640,1	8.442,0	9.256,6	9.379,4	9.690,1



Gas supply (mln. m3)	total	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Azerbaijan	1787	249	228	229	121	75	67	72	75	62	151	207	246
Russia	180	30	30	30	0	0	0	0	0	30,0	10	20,0	30,0
Local production	6	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
<b>total</b>	<b>1973</b>	<b>279</b>	<b>259</b>	<b>259</b>	<b>122</b>	<b>76</b>	<b>67</b>	<b>72</b>	<b>76</b>	<b>92</b>	<b>162</b>	<b>228</b>	<b>276</b>
<b>Energy sector</b>	<b>667,8</b>	<b>108,3</b>	<b>102,4</b>	<b>117,6</b>	<b>21,5</b>	<b>0,0</b>	<b>0,0</b>	<b>0,0</b>	<b>5,1</b>	<b>14,0</b>	<b>75,9</b>	<b>107,0</b>	<b>116,0</b>
Mtkvari energetic	304,9	46,4	45,0	50,0	21,5	0,0	0,0	0,0	5,1	14,0	41,9	40,0	41,0
Tbilsresi	331,5	58,5	51,4	58,6	0,0	0,0	0,0	0,0	0,0	0,0	34,0	63,0	66,0
Gazoturbina	31,4	3,4	6,0	9,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	4,0	9,0
<b>Population</b>	<b>552,1</b>	<b>92,9</b>	<b>89,7</b>	<b>74,1</b>	<b>42,6</b>	<b>25,9</b>	<b>19,4</b>	<b>17,2</b>	<b>15,0</b>	<b>17,3</b>	<b>25,1</b>	<b>54,5</b>	<b>78,3</b>
Kaztransgazi	337,2	60,0	59,0	50,0	25,0	14,0	10,0	9,0	8,0	9,2	13,0	30,0	50,0
Ittera	132,7	21,7	19,6	16,5	11,2	7,6	6,0	4,8	3,6	4,3	4,5	15,7	17,0
Sseki	5,6	0,6	0,6	0,6	0,4	0,4	0,3	0,3	0,3	0,3	0,4	0,6	0,7
Wisol	6,1	0,8	0,8	0,7	0,3	0,3	0,3	0,3	0,3	0,3	0,4	0,7	0,8
Socar Georgia	70,4	9,7	9,6	6,2	5,6	3,6	2,8	2,8	2,8	3,2	6,8	7,5	9,8
<b>Commercial</b>	<b>741,2</b>	<b>77,4</b>	<b>66,3</b>	<b>67,1</b>	<b>57,1</b>	<b>49,2</b>	<b>47,4</b>	<b>54,5</b>	<b>55,1</b>	<b>60,3</b>	<b>60,1</b>	<b>65,6</b>	<b>80,9</b>
Rustavi Azoti	257,6	22,0	19,0	22,0	21,0	20,2	20,0	22,4	22,4	22,5	22,0	22,0	22,0
Kaztransgazi	135,6	22,0	19,0	15,0	10,0	6,0	5,0	5,0	5,0	7,8	8,0	11,8	20,9
sseki	88,1	7,1	6,7	7,1	6,4	6,0	6,0	7,6	7,6	8,0	8,0	8,5	9,0
itera	103,8	11,0	8,0	9,0	8,0	7,0	6,8	8,0	8,0	9,0	9,0	9,0	11,0
sokarjorjia	26,9	3,2	3,0	2,0	1,7	1,5	1,3	1,4	1,5	2,0	2,0	3,1	4,0
FgazexportiF	94,3	9,0	8,0	9,0	7,0	6,0	5,8	7,5	8,0	8,0	8,0	8,0	10,0
visoli	34,8	3,0	2,6	3,0	2,9	2,5	2,5	2,5	2,5	3,0	3,1	3,2	4,0
<b>Total</b>	<b>1961,0</b>	<b>278,6</b>	<b>258,4</b>	<b>258,8</b>	<b>121,2</b>	<b>75,2</b>	<b>66,8</b>	<b>71,7</b>	<b>75,2</b>	<b>91,7</b>	<b>161,1</b>	<b>227,1</b>	<b>275,3</b>
Losses of gas during transportation	12,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0

### Gas balance of Georgia for 2013

#### Volumes of natural gas provided to Georgia in 2000-2013 (mil. m<sup>3</sup>/y)

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1093	836	700	1009	1231	1440	1881	1684	1463	1184	1094	1750	1933	1973

#### Country rating and the state of the branch

Stable social state is generally considered as the most important condition of the development of society. By today's status Georgia is a developing country. According to the 2013 studies of international analytical company "Legatum Institute" according to the well-being rating Georgia is on the 84th position out of 142 countries. The position of the country in the rating is based on 8 categories – economics, entrepreneurship, management, education, health protection, safety, personal freedom and social capital. In accordance with the study, from the point of view of economic indices Georgia is on the 90th position, entrepreneurship – 72th position, management – on the 44th

position, education – 67th position, health protection – 92th position, safety – 60th position, personal freedom – on the 73th position, from social capital stability – on the 138th position.

Such a rating does not facilitate to the broad importation of investments in the energy sector and further development of the branch.

According to the 2013-2014 indices when there was defined the index of the global competitiveness, by the electricity provision quality Georgia is on the 52nd position (5.3 points). This relevantly modest index was defined according to two main parameters of electric power: voltage and frequency (14 quantities in total) and frequent and uncontrolled turning off the light which speaks about the fault and instability of backbone transmission lines, distribution network and electricity generation sources.

By today for the purpose of improving the existing situation there have been developed and during the nearest 3-4 years will be implemented several “mitigating” projects which will need about 5-6 years. Until that time, the viewpoint of non-governmental organizations is that for avoiding the emergency situations there should be urgently carried out organizational and technical measures, among them:

With the help of independent audit there should be conducted a study of existing technical situation in all segments of the branch (generation, transmission and distribution), relevant intersystem automatic should be updated and brought into order;

Improvement and perfection of legislative base: in the preamble of the ratified document of “Eastern Partnership” it is noted that for us the priorities should be energy saving and energy efficiency. Taking into account the fact that all enterprises with their installations and equipment of the country’s energy system are significantly amortized, for the realization of above mentioned requirements, in addition to radical changes to the legislation, there should be formed all-embracing model of technical monitoring of energy system including the inspection of actual situation and safety mechanisms.

Completeness and quality of the legislation of energy sector defines the efficiency of its functioning and possibilities of its development. As a result of energy system reform by the beginning of 2000 more or less rectified energy legislation at a later stage continuously underwent conceptually wrong, one time changes answering only to private needs and not the long-term development interests. As a result, we got contradictory, incomplete and inactive energy legislation which does answer significant questions and gives possibility of outlying interpretation. This hinders the functioning of the sector and limits the coming in of qualified investors. There is no available a number of necessary normative and technical documents including the fundamental laws:

- **On Energy Efficiency;**
- **On Renewable Energy Resources;**
- **On Energy Safety.**

On the basis of these laws there should be worked out specific measures with relevant action plans and programs. Due to the absence of necessary financial resources the adoption of modern standards is being hindered.

There is need of renovation of the country energy policy and strategy. The necessary part of the energy strategy development is the long-term planning of the system (we mean 5 year long and then 10 year long electric system development vision). Despite the availability of the planning means in Georgia, not enough attention is paid to the long-term planning of energy sector with the introduction of modern installations and management systems. This once more proves that during the management of the sector substantiated strategic decisions are not made.

By the agreements of the Mayors of European Capitals the taken decisions and initiatives shall be implemented with the help of donors. In this direction, the necessary political decisions could not be taken because of the lack of information, absence of system vision and insularity from innovations. As a result, the international obligations under the Energy Charter and European Neighborhood Policy are left without implementation and the future harmonization of the Georgian legislation with the EU energy legislation becomes more difficult, also there is lost the gain which country could obtain by the participation in the climate change mitigation processes. And what is even more important, the significant potential of energy efficiency and renewable energy resources is not used and the dependence on the energy import is increasing.

### ***Regulation and defining tariffs***

Until recently economic regulation actually was disordered. Tariff scale was defined for long period without any economic substantiation on the base of commercial type memorandums between the Government and energy companies and not on the grounds of calculations by the Georgian National Energy and Water Supply Regulatory Commission. This most probably already caused significant undeserved excess earnings by the energy companies

at the cost of consumers. The character of the ongoing discussions about the tariffs once more shows how necessary it is to inculcate the adopted tariff procedure and economic principles and their thorough observance. It is true, that just recently there have been adopted a changed procedure of tariff establishment, however neither this meets the requirements of our poor country in relation to the at least partial equalization of uneven daily load schedule by introduction of stimulating tariffs.

For the purpose of introduction of renewable energy resources and energy efficient technologies, also for the purpose of the improvement of ecological background, Georgian National Energy and Water Supply Regulatory Commission shall start the study of the issue of green tariffs.

### ***Competitive energy markets***

Companies that generate and provide electric power are integrated with the distributing and consuming companies. A united energy company that existed 20 years ago - SakMtavarEnergo - was disintegrated into separate producing, transmitting and distributing companies which in several years in a disfigured way was recovered as Energo-Pro-Georgia. There do not exist any clear requirements for the separation of its activities and control of its transparent functioning at the market. The cheap electricity of the State owned Enguri Hydroelectric power station is distributed without any system and transparency with the intrusion of the Ministry. Thus, in Georgia actually there are no competitive energy markets.

### ***Information base for decision taking***

This has been mentioned many times. Since 2001 the Statistical Department has never developed and analyzed the official energy balance of the country. There are only known the data of electricity and gas provision and this without any information of their consumption in sectors. Absence of enough information makes inevitable the probability of making incorrect decisions. At the same time, a united system of energy safety management has to be developed.

### ***Investments***

Despite the extremely liberal payment regime, the unstable and contradictory legislative and normative base, incoherence of the decisions of the previous government, absence of energy strategy and development plan, encumbers the coming of western strategic investors to the country and attraction of investments necessary for the development of energy potential of the country, including the hydro potential. The practice of conducting negotiations on the conditions and tenders in a non-transparent way hinders the investments in the energy sector of Georgia by the qualified investors. Serious work up is needed for energy production resources structure, construction of basic electricity stations.

### ***Looking for/ production of unused natural and subsoil energy resources***

Despite the existing potential reserves, in Georgia there has not been well developed the subsoil energy resources seeking practice. Nobody facilitates relevantly to the seeking and production of local oil and gas resources. Sufficient attention is not paid to the seeking of nontraditional subsoil heating resources. The significant energy reserve of the country is the production of energy from nontraditional renewable energy resources. The energy obtained this way is estimated at tens of billion kWh. And this, along with the electricity power increases the energy stability of the country.

### ***The project of the construction of natural gas storage building prepared by donors was not implemented.***

Implementation of this project would significantly increase the energy safety. Because of the absence of gas storage building the seasonal balancing of the obtained gas through the Southern Caucasus gas line under the transit agreement is impossible. The issue of giving this function to the company Socar needs to be studied. Most probably, the State cannot receive the full benefit from the Transit Agreement.

### ***Insufficient work conducted for Research and Development purposes***

There is no innovation policy in the country and the innovation introduction system shall be developed. This is a common problem of the country which greatly influences the energy sector amongst others. Taking into account all above mentioned, Georgian energy sector shall be radically transformed, proceeding from the present conditions, the own energy policy of an independent country shall be formed from the very beginning.

The work on the establishment of energy strategy is very slow; there is complete stagnation in relation with facilitating the introduction of innovations in the branch with regard to the improvement of legislation; there are no clear priorities.

56% of the population of Georgia lives in villages and generally in rural settlements. In our opinion, except for those rare cases when the joining of the settled area to the electricity supply central network is economically attractive, the majority of settled areas should be secured with autonomous electricity supply on the basis of local resources. It is obvious that this approach has a number of advantages: for example, autonomous electricity supply implies generation of electricity locally, without the use of high voltage transmission facilities through transmitting the electricity at short distances. The experts engaged in energy projects think that the significant improvement of the living conditions of rural population, particularly in mountainous regions at this stage is possible only through the projects which are connected with the small capacity energy resources and among them the construction of small hydroelectric power stations.

The proposed (autonomous energy security) model will make possible to turn the energy safety into reality for the population of this section during the short period of time; at the same time, local administrative bodies will obtain certain independence which is in complete conformity with the independent self-governance policy declared by the government. In addition, such an approach would increase the energy safety and energy independence of the whole country; most probably, the existing tariffs on the energy supply would decrease to some extent and in general, energy resources would become available for the wide groups of the population.

The most significant among the nontraditional energy resources of Georgia is small capacity hydro energy. According to the data provided by experts out over 26 thousand rivers of Georgia only 300 of them are distinguished with serious energy significance, but if we take into account that in rural areas population live sparsely for their provision with modest volume of electricity in an autonomous regime, most probably thousands of less effective small rivers can be used. In 60s there were about 400 small capacity hydroelectric power stations functioning in the country and their majority without any motivation became the victims of superficial, wasteful approach. In our opinion the rehabilitation in this direction is very urgent and it can play significant role in the provision of electricity to the rural population.

In the country one of the mechanisms if not the only one for the preservation of ecological situation is the use of nontraditional, renewable energy resources. These trends became very vivid energy development programs of the USA, EU and other developed countries where by 2020 it is supposed that the share of renewable resources in the whole energy balance will grow to 20%. The energy installations based on renewable energy resources are oriented at small capacities and they already have certain advantages as compared with powerful energy resources.

These advantages are most vividly seen in the case of autonomous energy networks which are in the first place demonstrated in the economical character and protection of the environment. Engagement of renewable energy resources in the autonomous energy supply can ensure economic development against the minimal negative impact of human activities on the environment and despite their relatively high prices their exploitation is beneficial from social implication (clean water and environment, hygiene and sanitation) not to mention others, which is reflected in the growth of life quality.

### **Problems of Institutional and professional development**

#### **The main reason for the emergence of above mentioned problems are:**

a) Deficit of qualified personnel which hindered the establishment of western type developed energy sector and functioning in Georgia. Closed centralized style of management and lack of processes characteristic for developed system (planning, development of strategy, information availability, competitiveness and others) did not provide the possibility of personnel initiatives and qualification development.

**Personnel of main enterprises and organizations of the branch.  
Electro energy sector**

**I. preparation of specialists at Technical University of Georgia**

	2005	2006	2007	2008	2009	2010	2011	2012	2013
<b>Bachelor's degree</b>									
Electro energy specialist	245	270	298	207	93	60	41	-	-
Thermal energy specialist	51	37	40	38	15	7	9		
Energy and electric engineering	-	-	-	-	-	-	-	66	123
<b>Magistracy</b>									
Electro energy specialist	-	16	34	28	18	30	27	24	21
Thermal energy specialist	-	3	9	9	6	8	3	5	1
Hydro energy specialist	-	-	-	2	3	-	3	5	2
<b>Doctoral candidacy</b>									
Energy and electric engineering	-	-	-	-	-	-	11	16	13
<b>In total there were prepared the specialists</b>									
-	296	326	381	284	135	105	94	116	160

As a rule, according to the higher educational curriculum the specialists get general theoretical knowledge without obtaining any skills of practical work. Because of this young specialists when coming to the enterprises are not ready to be engaged in the enterprise processes and carry out specific type of work.

**II. Providing personnel to the energy companies  
(as of January 1 2014)**

number, age organization	personnel (total)	age up to 25	age up to 45	age up to 60	age over 60
<b>Ministry of Energy</b>	83 100%	8 9,6%	57 68,7%	17 20,4%	1 1,2%
<b>Energo system of Georgia</b>	1169 100%	36 3,1%	406 34,7%	485 41,5%	242 20,7%
<b>Energo-pro Georgia</b>	5217 100%	125 2,4%	2173 41,6%	2109 40,4%	760 14,6%
<b>JSC "Telasi"</b>	2076 100%	55 2,6%	890 42,8%	881 42,4%	250 12%
<b>Kakheti energy distribution</b>	657 100%	30 4,6%	221 33,6%	304 46,3%	102 15,5%
<b>International energy corporation</b>	103 100%	4 3,9%	37 35,9%	38 36,9%	24 23,3%
<b>Sakrusenergo</b>	209 100%	10 4,8%	108 51,7%	59 28,2%	32 15,3%

For this they need to be trained at separate working places which envisage a number of requirements beginning from the study of those installations and equipment which are in use at a given enterprise and ending with the general technical regulations, general and specific normative acts, industrial sanitation and safety technique. Such a training end with the testing of the knowledge by the local commission and if the young specialist received positive evaluation he will be admitted to the work under the supervision of experienced specialist and if in this case there is a positive evaluation again, he will be admitted to an independent work. This procedure lasts from 3 to 12 months.

There is one more issue which should be envisaged in today's energy sector: since the branch potentially includes threats to the human health and installations, during the exploitation there is necessity of periodical review of all rules that should be observed at the enterprise and the checking of the personnel knowledge. In addition,

there is the introduction of innovative technologies and new technique. These functions shall be carried out by the centers of the improvement of specialized qualification and personnel retraining the work of which was stopped 20-22 years ago and is one of the hindering factors for the preparation of relevant personnel in energy sector.

The study of the number of the graduates from the Technical University and the number of the specialists working in different segments of the branch it is clear that the natural decrease in the number of personnel is much more than the number of specialists coming to the branch for work which speaks about the possibility of emerging deficit of qualified personnel at enterprises.

Serious concern is caused by the absence of the local specialists for carrying researches and projects implementation. Enterprises, with some exceptions do not carry out the observation on hydro technical constructions and buildings as required by the regulations. The cause for is the absence of obligatory audit supervision which would recommend the necessity of carrying out such observations.

Such approach to the issue makes impossible to timely reveal the technical and ecological discrepancies and violations. The government shall urgently make relevant changes to the present legislation and normative acts.

- b) Lack of transparent and effective management, absence of control in energy sector based on the adopted strategy and legislative base, creates instable, not protected environment from external and internal political influences. This hinders the attraction of investments in the sector, also development of international energy transit, contradicts the independent, sustainable and democratic development of the country, its aspiration for rapprochement with EU;
- c) Abundance of present problems and difficulties require high professional, targeted activities for which the internal resources of the sector will not be enough. It is necessary to timely start the action with the international strong expert assistance in order not to deteriorate the situation further.

### **What should be done in the first place?**

1. The present state of the branch shall be studied with the help of SWOT analysis. For this purpose there should be carried out the following:
  - a) A complex (financial and technical) audit should be conducted, analysis should be done and measures of the sector work for the short term (for example for one year) perspective should be developed. For this energy audit institution should be introduced;
  - b) “Organic relation of energy complex with different branches of economics is carried out through energy balance. Energy balance characterizes qualitative and quantitative side of these relations. It covers all types of fuel energy resources”. Proceeding from this necessary calculations have been carried out and 2013 balance has been officially made up. On its basis there should be planned the necessary amount of fuel energy resources for 2014-2015.
2. The work on the draft laws of energy efficiency and renewable energy resources should be completed and the laws should be adopted.
3. Regulating Commission should start the work on the introduction of “green” and differentiated tariffs.
4. Energy passports draw up of Georgian regions should be carried out.
5. There should be paid attention to the preparation of qualified personnel under the motto: “personnel are decisive in everything!”
6. The issue of energy safety should become one of the priorities for the government work. The topic and scheme of the Economic Department of the Safety and Crisis Management Council in energy sector should be improved and perfected.
7. For the improvement of ecological background it is necessary to activate the work on shifting of vehicles of internal combustion (in the first place of state owned vehicles) from petrol to natural gas.

## ENERGY AND ENERGY SAFETY

### (STRATEGY OF THE PRESENT LEVEL OF RENEWABLE ENERGY AND ITS IMPROVEMENT)

Professor Baadur Chkhaidze  
Georgian Technical University

It is well known that to secure energy is the necessary condition of the society existence and its development. Energy security does not mean the security of electricity only.

During its different stages of development the society satisfied its demand on energy in different ways, beginning from the fuel wood and animal physical force to atomic energy.

After the Man has discovered (found) fossil fuels (coal, oil and natural gas) and mastered the technologies for their use, the temp of technical development has drastically increased which, in its turn, increases the demand on the energy and consequently fuel and its extraction. Energy consumption all over the world in 2010 reached equivalent of 13 billion tons of oil or 150 000 billion kWh. Electricity share in the consumed energy constitutes 15%.

Relationship between the different energy units used in the report: equivalent of 1 ton of oil = 11 630 kWh; 1 billion kWh  $\approx$  86 thousand tons of oil.

Today, about 65% of the whole electricity produced in the world and used (22 500 billion kWh/y) is generated at thermo electric power stations, where the primary energy source is the fossil fuel (4, 4x10<sup>9</sup> tons of oil/y). Extraction of fossil fuel in the world by 2012 constituted: coal – 7 900 mil t/y; oil – 4 000 mil t/y; natural gas – 4 400 billion m<sup>3</sup>. The simple analysis of these figures shows that energy has very significant problem, namely, the supplies created during millions of years, from historical point of view, is catastrophically decreasing because its big consumption. According to experts, if this trend continues, the coal supply will exhaust during the nearest 200 years, oil and natural gas supply – in 60-70 years. The Dynamics of organic fuel extraction is given in figures 1-2-3.

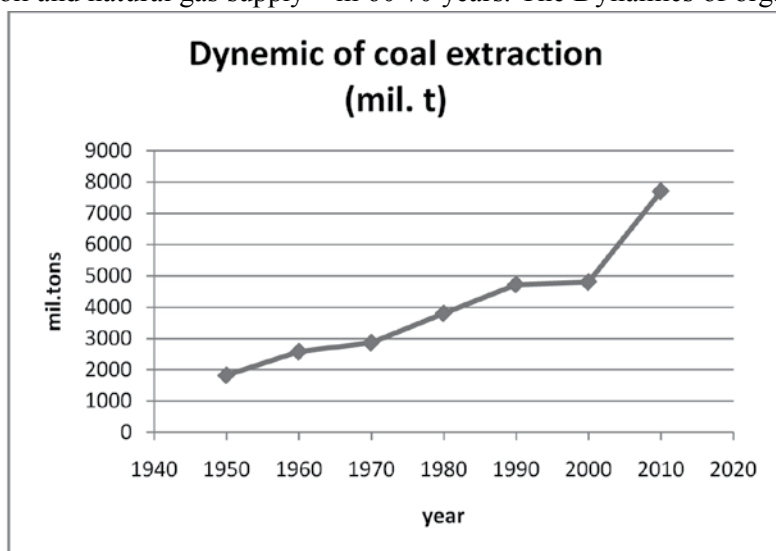


Figure 1

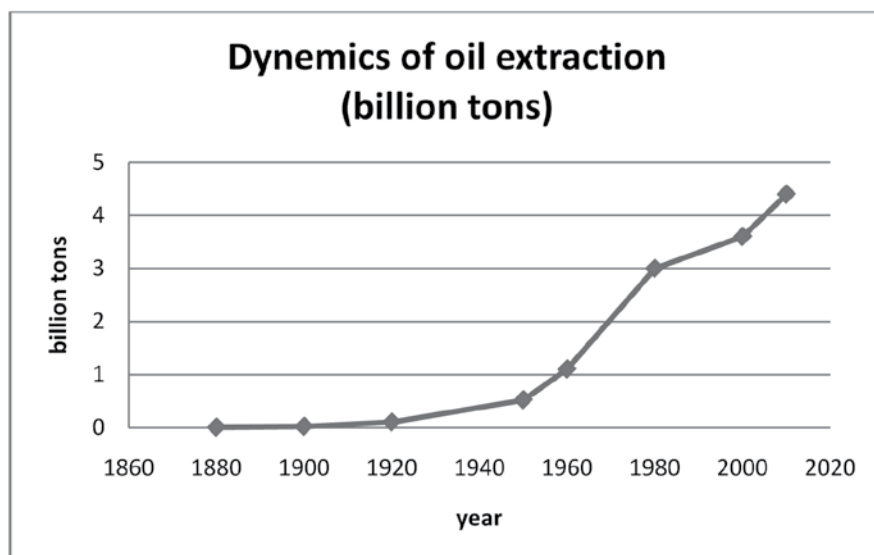


Figure 2

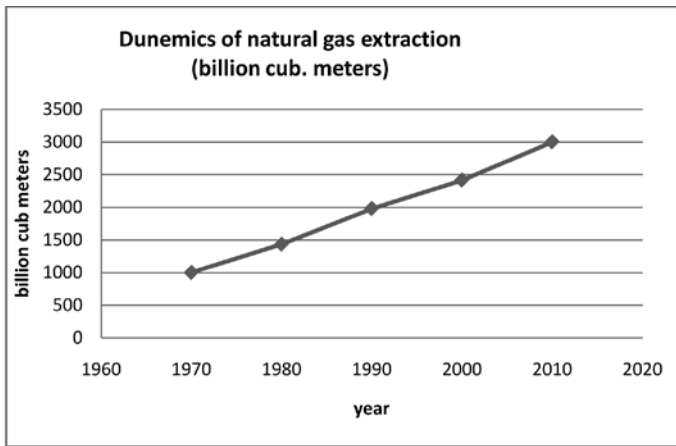


Figure 3

According to this data during the last 70 years the greenhouse emissions increased 8 times and reached 8 billion tons per year.

In addition, the price on the energy resources is dramatically increasing. In Figure 5 is shown the dynamics of oil prices during the last 25 years. As the figures show the price on oil has increased 5 times.

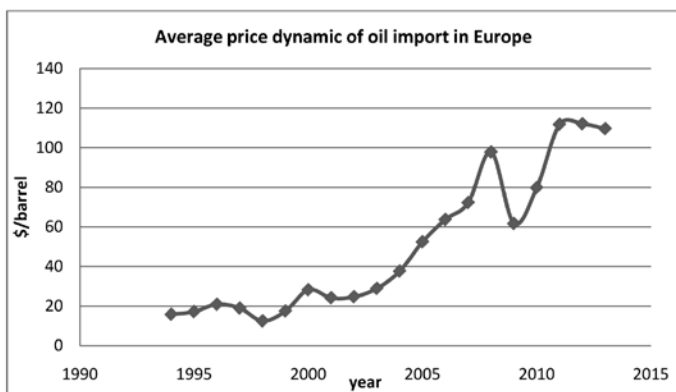


Figure 5

The inner industrial supply potential of organic energy resources in Georgia (except for coal) is rather scarce and the volume of extracted product is insignificant. In the nearest future their growth is not expected. The share of electricity in supplying the Georgian population with energy amounts to approximately 20%. 30% is ensured by imported natural gas, and another 30% with fire wood, the rest is ensured by imported fuel and the insignificant amount by the local coal. In 2013 there was imported 1,9 billion cubic meters of natural gas into Georgia (300 million GEL) and approximately 740 thousand tons of transport fuel. Thus, energy security of Georgia is significantly dependent on the energy resources import. This circumstance in parallel to the existing threats present in the region, significantly reduces the energy safety of the country. As for the fuel wood (consumed about 5-6 million cubic meters) its production about 7 times exceeds the permissible level. Under the conditions of such consumption of fuel wood and taking into consideration that during the wood burning there are emitted such harmful substances as methanol, acetic acid, acetone and others, in a very short time we will get ecological catastrophe in Georgia. At the same time, due to the weakness of state regulating system, actually there is not conducted (with several exceptions) any scientific researches and the number of professionals in the field is quickly decreasing.

The analysis of the electricity and energy resources use structure shows that about 45-50% of energy (both for household and industrial purposes) is spent for obtaining 50-150°C. In Georgia only for water supply there is used about 130 million cubic meters of natural gas (1,5 billion kWh), 0,5 billion kWh electricity and 2 million cubic meters of fuel wood (5 billion kWh). In total this makes 7 billion kWh which represents about 20% of the whole energy consumption. This is the field in which renewable energy resources may play the leading role.

Under these circumstances and against the challenges which were mentioned above, the issue of the necessity of the production of renewable energy resources arises naturally. Renewable energy resources (the sun, water flow,

The second important problem created by the modern energetic for the society is global warming which is caused by the fossil fuel burning with consequent "greenhouse gases" (mainly carbon and nitric oxide) emissions. The figure of greenhouse gases emissions growth is shown in Figure 4.

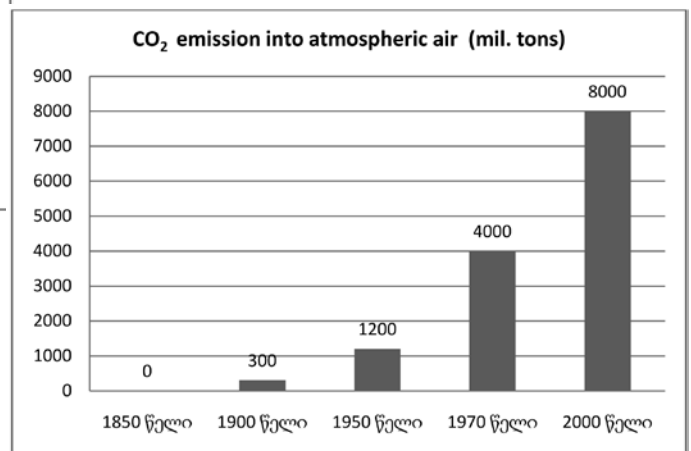


Figure 4

One of the main ways of the above mentioned energy problems solution lies in the step-by-step and large-scale development of renewable resources of energy.

In addition to the above mentioned problems, development of renewable energy resources is playing particular role in the energy safety of different countries. The indicators of a country's energy safety are the following: potential of existing energy resources and the efficiency of its use and level; the level of dependence on the imported energy resources and the threats of its import; state regulatory structure and scientific and technical potential. In this regard Georgia is not in a very enviable position.



biomass, wind, geothermy, waves, and ocean thermal energy) represent the continuously present in nature and resources which may be renewed during the short period of time. At the same time, their use actually does not cause greenhouse gases emission and do not pollute the environment with harmful substances for human health.

### **Review of Renewable Energy Resources Use situation in the World**

We should remember that energetic is not only electric energy. About 40-50% of the obtained energy resources in the world is spent in household conditions and different technological processes to reach 50-150°C. This is the field where renewable energy resources can primarily substitute other traditional resources.

On the basis of the analysis of the problems existing in the world in the field of energetic, experts and authorities of many countries came to the conclusion that for the purpose of sustainable development of energetic there is necessity of large-scale use of renewable energy resources (1992 Rio-de-Janeiro, 1997 Kyoto, etc).

A lot of countries in the world, both developed and developing, worked out programs and carry out step-by-step use of renewable energy resources. Figure 6 shows renewable energy resources use rate in 2004-2011. According to these data, by the end of 2013 the capacity of electric power stations of renewable energy resources (except for hydro) increased 4 times and reached 550 000 megawatt.

These results were reached with the supportive measures which had been developed and carried out in a lot of countries of the world. By 2013 in 140 countries of the world there have been developed and approved renewable energy resources use supportive policy and relevant legislation.

As a result, in wind energetic the capacity has increased up to 300 000 megawatts, capacity of the stations operating with solar PV system and thermo dynamical cycle (despite relatively high price) – up to 105 000 megawatts, solar hot water heater – up to 260 000 megawatt. From the timber production waste there were produced about 22 million tons of bio-briquettes and pellets, and from agricultural wastes and bio plantations 85 billion ethanol and 23 billion bio-diesel were produced.

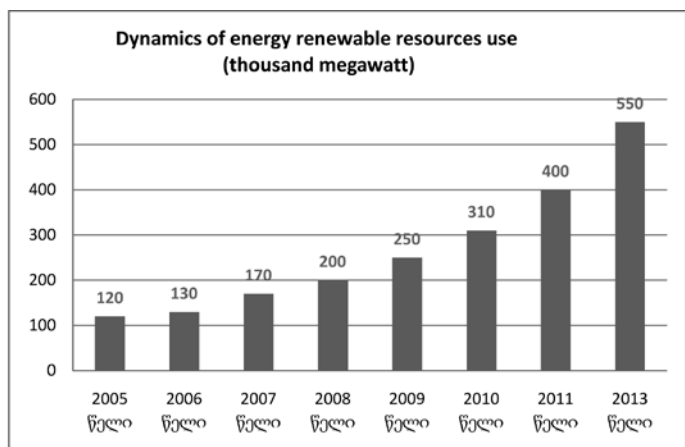


Figure 6

Experience showed that out of the renewable energy resources' supportive measures the most effective is the so called "green" tariff. "Green" tariff is based on three factors: guarantee of accessing to the energy network generated at energy renewable resource; long-term contract on the bulk purchase of the energy and the guarantee of the purchase of generated energy at fixed price. It was in the USA in 1978 for the first time that "green" tariff was introduced during J. Carter's presidency. Today it is used in over 60 countries of the world, including Ukraine and Armenia. In Ukraine at present there operates a wind electric station of 80 megawatt capacity and it is planned to construct a solar electric station (according to 2014 April 14 information,

Mr. Cheni, representative of a Chinese company New Energy Engineering Co., Ltd stated that if Ukraine maintains "green" tariff, the Chinese company is ready to invest 2 billion dollars in the Ukrainian energetic projects). In Armenia in two years after the approval of the Law a 2 megawatt capacity wind electric station started to operate with the help of Iranian investment, with the help of a Danish company investment there operates a Lusakert poultry factory waste biomass processing enterprise which along with electricity produces ecologically clean fertilizer for agricultural purposes. There also exists "green certificate" system and many other laws and regulations. For example, preference to banks with low-interest credits for renewable energy resources use projects (Germany), prohibition of new buildings construction unless they use hot water supply solar system (Israel) and others.

Significantly is increasing investments in the use of renewable energy resources. During 2009 there were invested 160 billion US \$, in 2010 – 210 billion, out of which 95 billion dollars were invested in wind energy. While 11 billion US \$ were invested for the biomass and biomass waste processing technologies development.

## **Challenges in the use of Renewable Energy Resources and the Ways to Overcome Them**

Below there are listed those main barriers that hinder the large-scale use of renewable energy resources. These are:

- Psychological barriers: formed stereotypes, adaptation to the existing system, distrust to the new and low level of energetic education in the main part of the society; and conservative thinking;
- Legislative barriers: objectives and priorities set by the State in regard with the renewable energy resources use and absence of laws and sub-laws which causes vagueness of the issue;
- Economic barriers: Absence of financing mechanisms. Absence of economic incentives for investments and so on;
- Scientific and technical barriers: Insufficient volume of scientific-technical and technological decisions; insufficient level of technical knowledge at decision making bodies;
- Information barriers: Scarcity of information provided to the society.

In the countries where they think seriously about their well-being, safety and future internalized the problems existing in the field of energetic and worked out the ways to overcome the barriers. By overcoming the psychological and information barriers by 2013 out of the 200 independent countries in the world in 140 there were adopted renewable energy resources supportive laws. In 2005 this number exceeded 50. Legislative measures carried out in the countries caused the attraction of finances in the mentioned field and consequently, solution of main technical and technological problems.

Solution of technical and technological problems resulted in the removal of obstacles and significant decrease of prices on electricity generated at renewable energy resources and other types of energy. According to 2013 data, the prices on generated electricity in developed countries are given in Table 1.

**Table 1**

	<b>Type of electric station</b>	<b>Price (cent/kWh)</b>
<b>1</b>	Thermo electric power station on coal	5-8
<b>2</b>	Thermo electric power station on natural gas	5-6
<b>3</b>	Atomic stations	4-8
<b>4</b>	Small hydroelectric power plants	3-4
<b>5</b>	Wind stations	4-5
<b>6</b>	Geothermal stations	5-6
<b>7</b>	On biomass waste	6-7
<b>8</b>	Solar (with concentrators) electric power plants	8-9
<b>9</b>	Solar photoemission electric power station (PV)	10-12

As we can see from the data, generated electricity at renewable energy resources (except for solar stations) has become competitive as compared with the traditional stations. It should be also noted that the price of the energy generated at solar photoemission stations has decreased 15 times during the last 15 years.

Clear defining of priorities and programs by the states and adoption of relevant supportive legislation caused significantly attraction and increase of investments. During 2009 there were invested 160 billion US \$, in 2010 – 210 billion, out of which 95 billion dollars were invested in wind energy. While 11 billion US \$ were invested for the biomass and biomass waste processing technologies development.

### **Energetic Potential of Renewable Energy Resources in Georgia**

Hydro energetic potential. On the basis of Agreement, in Georgia small hydroelectric power plants, whose capacity does not exceed 13 megawatts, belong to renewable energy resources category.



There has not been conducted any profound research of biomass wastes energetic potential. Relatively reliable data on biomass wastes are given in the science-related work “Energetic potential of biomass waste in Georgia (Cadastré)”, which was developed and published with the financial support of USAID. The main results are given in Table 2.

**Table 2**

Biomass type	Amount (10 <sup>3</sup> tons)	Energy (10 <sup>3</sup> kWh)	Saved fossil fuel	Saved means (10 <sup>6</sup> GEL)
Cereal and leguminous crops wastes	870	1,25	120 thousand tons of oil	140
Cattle-breeding and poultry farming wastes	1670	6,7	760 mil. cubic meters of natural gas	133
Household wastes	900	0,6	53 mil. cubic meters of natural gas	9,2
Treatment of sewage waters of Tbilisi	250	1,0	92 mil. cubic meters of natural gas	16,1
Timer production wastes	7	0,27	2 thousand tons of oil	2,2
<b>Total</b>		<b>9,82</b>		<b>300</b>

In addition to the above shown potential, attention should be paid to the planting of energetic plantations on the territories not suitable for and unused in agriculture and the evaluation of their potential. According to the international experience out of 1000 hectares of planted rape 900 tons of biodiesel, 1500 tons of oilcake and 3000 tons of dry mass is obtained.

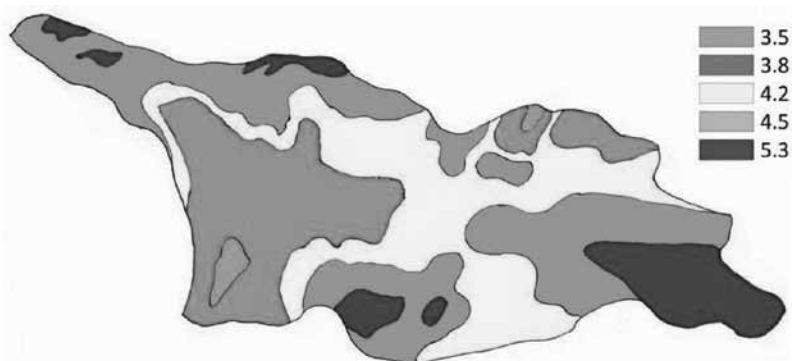
One of the prospective directions is considered to be laying out the plantations of perennial pilot weed on boggy and wetland territories. The area of boggy territories in Western Georgia comprises several thousand hectares. The yield of pilot weed per hectare comprises approximately 20 tons of dry mass the energetic potential of which amounts to 68 000 kWh. According to the experts estimations the price of biodiesel obtained from pilot weed will not exceed 1 GEL.

**Solar energy potential:** The solar radiation distribution on the flat surface in Georgia is given in the below given map in Figure 9.

The average annual value of solar radiation in Georgia is accepted to be 1550 kWh/m<sup>2</sup>y. Proceeding from this, theoretical potential of solar energy annually on the territory of Georgia constitutes about 10<sup>14</sup> kWh (100 000 billion kWh). On the territory of Tbilisi the annual solar energy amounts to 700 billion kWh, and on Kutaisi and Rustavi territories - 108 and 93 billion kWh respectively.

It is natural that very small part of this potential (100 000 billion kWh) may be used for obtaining thermal energy or electric power. While evaluating technical and economic potential it is necessary to know the price of solar energy generating equipment at the local market. After January 1,2005 when the VAT exemption on the imported heliosystems was lifted their prices increased and at present they cost by 30-40% more than in neighboring Turkey. During the last decade in Turkey the level of solar energy use reached 0,4% of the total used energy and it is obvious that this is not the limit. If we take this figure as reachable for Georgia we will get that only in the field of hot water supply annually we would save the energy equaling 13 thousand tons of oil (151,2 million kWh that is 2,8 million GEL equal natural gas). Is it not necessary to promote the use of solar energy?

**Geothermal energy potential:** the temperature of geothermal resources in Georgia does not exceed 110°C. There are registered about 250 natural and man-made sources (wells) whose total debit constitutes 60 million cubic meters per year. According to different data the technical potential of geothermal resources of Georgia amounts to approximately 1,3 billion kWh. 80% of this potential is accumulated in Western Georgia.



**Figure 9. Average annual distribution of solar radiation in Georgia**

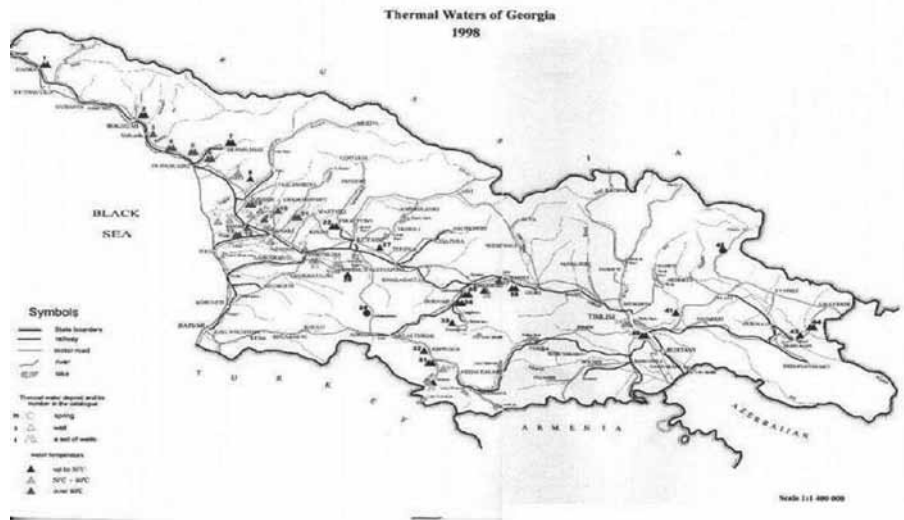


Figure 10. Thermal resources map of Georgia

### Total potential of Renewable Energy Resources (hydro, solar, wind, biomass and geothermal)

In this review there is not given the energy potential of the sea incoming tide, waves and sea thermal energy because they have not been studied. In Table 3 there is given the total potential of renewable energy resources. According to these data the potential of renewable energy resources exceeds ≈30 thirty) billion kWh.

Table 3

	Name of RER	Potential	Notes
1	Small hydroelectric power stations	5 billion kWh	Economic potential
2	Wind	5 billion kWh	Economic potential
3	Biomass	9,8 billion kWh	Technical potential
4	Geothermal waters	1,3 billion kWh	Economic potential
5	Solar radiation	≈ 5÷10 billion kWh	Technical potential

### Review of the situation of Renewable Energy Resources use in Georgia

Hydro-energy: Economic potential of small hydroelectric power plants is estimated at 5 billion kWh. In Georgia only those hydroelectric power plants whose capacity exceeds 13 megawatt are included in the category of renewable energy resources. Georgia has rather good tradition of hydro resources use in the generation of electric power. Until 1960, there were constructed and operational about 400 small hydroelectric power stations of ≈220 megawatt capacity. By today (2014) there are 35 small stations operational with overall capacity of 146 megawatt and ≈322 million kWh generating capacity which constitutes ≈4% of electricity power generated by all hydroelectric power stations and ≈6,5% of the overall potential (5 billion kWh) of small hydroelectric power stations.

According to the data of the Ministry of Energy of Georgia after the ongoing investment projects completion the capacity of small hydroelectric power stations will increase by 63 megawatt and 340 million kWh of electricity will be added to the electricity system. In addition, the Ministry plans to construct about 46 new small hydroelectric power stations whose total capacity will be ≈300 megawatt with the generations of ≈1,5 billion kWh electricity. Analysis of the data of the Ministry's ongoing investment projects show that the capital expenses on small hydro-

electric power stations constitute  $\approx 1700\div 2000$  \$/per kW. Implementation of the projects will result in obtaining additional  $\approx 1,8$  billion kWh of electricity and  $40\div 45\%$  of the total potential will be used.

Thus, the actual state of small hydroelectric power stations construction and use and future plans is rather satisfactory. However, in our opinion it needs further support. Today small hydroelectric power stations are attached certain privileges which are regulated under normative acts: Law on the Electro Energy and Natural Gas of Georgia, Policy of Energy of Georgia, Market Rules of Electricity Power, and Normative Acts of Georgian National Energy and Water Supply Regulatory Commission. In accordance with these acts small hydroelectric power stations do not need license for electricity generation and tariffs are not set for them. They have right to sell energy under direct agreement with any user, ESCO is obliged to purchase all the surplus energy left after the realization of energy under direct agreements and does not need any license for the electricity export.

Attached certain privileges to small hydroelectric power stations seems to be enough for stimulating their development; however, in our opinion it is not enough. In the first place these privileges should include other types of renewable energy resources as well and to them should be added: setting such tariffs which would ensure high efficiency of investment in relatively short period of time ( $5\div 10$ ); guaranteed purchase of electricity by ESCO; setting easy term on construction, production of equipment and reduced rates import and exemption from profit tax for certain time ( $5\div 10$  years).

Wind energy: despite presence of significant wind energy resource (5 billion kWh) it is actually not used in Georgia. There have been conducted only search and preparatory work: the data on the wind speed for the whole territory of Georgia has been published; "Wind Energy Atlas of Georgia" has been developed; Japanese companies ("Nichimen Corporation" and "Tomen Corporation") carried out study works in Kutaisi, Tbilisi and mountain Sabueti regions for identifying the availability of wind energy use. "Feasibility Study Reports" which have been prepared show that on these territories construction of wind stations will ensure significant effect to the country energetic. Japanese side was ready to allocate low-interest loan (0,75%) for the construction of these stations. Despite all these positive expert opinions these projects and many other projects have not been developed until now. With the financial assistance of USAID and support of the Ministry of Energy in 2010-2011 "KarEnergo" installed 10 kW capacity wind plant near the settlement Skra (Figure 11) which was designed to join Energo-pro Georgia network.



Figure. 11



Figure. 12

Despite such a "patronage" of joining the plant to the network Energo-pro Georgia did not agree. Today the plant in dismantled condition is under the possession of State Technical University (Figure 12). The main causes why these projects were not implemented are unfortunately those psychological, legislative and information barriers which existed previously and continue to exist at present in the country. Psychological barrier is mainly caused by the absence of traditions of using wind energy and consequently by certain distrust and fear to something new. Legislative barrier or the absence relevant law on the wind energy which would be similar to the law on hydro energy; this is caused by underrating of those positive results which could be obtained by the development of the wind energy. Information barrier – in the society and among them specialists exist the opinion that the wind energy is

rather costly and also due to its non-regulated character will create problems to the united electricity system. Here once again attention should be paid to the circumstance which was mentioned above that the energy obtained today at the wind stations is already competitive and under the conditions of present day regulations does not create any threat to the united electricity system. In the publication of the Ministry of Energy of Georgia “Ongoing investment projects” there is included the Paravani wind electricity station in the list which must be put into operation in November 2014 by the Check company “Wind Energy Invest”. If this information is true, the station capacity will be 50 megawatt with 70 million kWh energy generation; however, on the basis of verified information the station construction even has not been started yet.

**Geothermal energy:** there is a rather good experience of using geothermal energy in Georgia. Until the end of 80s of the last century geothermal waters were successfully used: for hothouse purposes (Tsaishi, Kindgi, Okhurei and others); for industrial technologies (Zigdidi pulp and paper plant, Tsaishi and Kindgi tea factories); pig-breeding farms (Khobi, Saberio, Tbilisi); for cattle-breeding and poultry farming (Khobi, Khorga) and so on. By today these units have almost completely stopped operating. The condition these units are today is shown in Figure 13

Geothermal Association of Georgia with the foreign financial support has completed several projects which were mainly of research and evaluation character: “Study of the present condition of geothermal deposits of Western Georgia for their use and introduction of rational exploitation regime and rehabilitation of Khobi regional hospital heating system with the use of geothermal energy” (USAID, 2010-2011); “Evaluation of available geothermal deposit resources of Tbilisi and making up of geothermal circulating pilot system” (UNDP, 2011). It is clear that carried out work is not enough. For information: in case of reasonable use of Tsaishi 10 deposits annually there will be saved approximately 7 000 tons of oil; in case of the use of the technical potential of all existing geothermal resources -  $\approx 100\ 000$  tons of oil.



**Figure 13. Tsaishi 18 (4, 2 megawatt) and Tsaishi 10 (11, 9 megawatt) minefields today**

**Solar energy:** There is a rather good and qualified experience in Georgia of using solar energy. In 50s of the 20th century there were implemented projects whose total area of the collectors constitutes 1 600 m<sup>2</sup>. By that time the cut of the prices on organic fuel caused their closing down. Due to the global energy crisis of 70s the interest toward the solar energy use renewed and by the end of 80s there were installed water heating installations with the total area of  $\approx 80\ 000$  m<sup>2</sup>. During the events of 90s of the last century these installations stopped operation. There is big interest today towards the use of solar energy. Because of the circumstance that at the Georgian markets the price of the equipment using the solar energy are higher than in the neighboring countries, their development does not meet the demand. Despite the fact that there was not rendered any support, the company “The Sun House” implemented about 250 small projects during the last years (Figure 14). In total the capacity of the photoemission equipment installed by them reached 100 kW and the capacity for water heating -  $\approx 20$  tons of hot water per 24 hours. The most part of the projects was implemented with foreign financial support (80%), private orders (10%) and only 10% by the State in the framework of agricultural support projects.

**Biomass:** Out of the variety of biomass the fuel wood is the most intensely used in Georgia. Every year about 5 million cubic meters of fuel wood is cut in the country which exceeds the permissible level 5 times. At the same time, the efficiency of wood use is very low. As for the other types of biomass the share



**Figure 14. Examples of solar energy use in Georgia**

of their use in the energetic balance actually equals zero. Several pilot projects were implemented with foreign financial support for obtaining biogas from the cattle-breeding and poultry farming wastes. But no desirable results

were achieved for the simple reason that there is no law on the wastes recycling. The mentioned measure along with the energetic good could give us significant effect from the point of view of environmental protection. In Figure 15 is shown adjacent area to one of the poultry farming territories where the wastes are disposed.



**Figure 15. Adjacent territory to the poultry farm**

As for the use of agricultural, household and timber production wastes, the approach in this direction has not changed for the last 50 years. Solution of these issues along with the economic effect would significantly improve the ecological situation.

### **Conclusions**

- Georgia has significant energy potential of renewable energy resources (solar, hydro, wind, biomass and geothermal heat);
- The development level of the renewable energy resources potential is very low (hydro) and actually equals zero for the rest of the sources (wind, sun, biomass and geothermy);
- There is no renewable energy resources development supportive legislation.

### **Recommendation**

The government should as soon as possible develop and send to the Parliament for consideration the renewable energy resources supportive law.

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### **“United energetic system and regime appertains to the particular supervision of the Georgian state bodies “ – Constitution of Georgia.**

General Assembly of the United Nations declared 2014-2020 years as international decade – sustainable energy for everyone - with which underlined the significance of ecologically sustainable energy saving field for poverty reduction and, generally, improvement of development level. From 2015 until 2030 the main task of sustainable energy is to double the energy efficiency level. Investments in energy efficiency create new jobs, stimulate economic growth and create energy safety for those countries which do not have their own energy resources. Energy efficiency growth is well known and easily achievable task the implementation of which is fully justified.

Governments have the means for the solution of this problem if they pursue reasonable, successive and forethought economic, energetic and ecological policy (СвенАлкалайИсполнительныйсекретарьЕвропейскойэкономическойкомиссииОрганизацииОбъединенныхНаций)

It is declared that Georgia strives to become a country based on the European values and integrate into Europe politically and economically. Consequently, Georgian legislative base shall become approximated to the European legislation. Among others, for the economic development of our country it is important that our energy policy changes.

### **Georgia legislation with regard to energy efficiency and energy saving**

On June 2006 the Parliament of Georgia approved the document prepared by the Ministry of Energy and defined the main directions of energetic policy. “In the energetic field of Georgia under the main directions of the state policy” it is defined that in the development of local energy resources the key role will be given to the main wealth – hydro energy development potential.

At the same time, the long-term objective of the energy policy is to satisfy the demand on electricity by the electricity generated at the local hydroelectric stations. This is an official piece of information from the web-page of the Ministry of Energy which has not been changed since 2006.

The approach of the Ministry of Energy with regard to the energy efficiency and energy saving has not been formed until today which is represented by the absence of legislative normative base in this field.

The potential of Georgia with regard to the energy efficiency and energy saving has been assessed many times; however, none of the government has made any practical steps in this direction, on the contrary, all activities directed at the development of relevant legislation were actively blocked.

In the legislation of Georgia we can read the following about energy efficiency and energy saving: The Law of Georgia on Electro energy and Natural gas. Chapter I. Article 1. Main objectives and tasks of the Law. d) Promote the privileged use of local hydro energy and other renewable, alternative and natural gas resources (9.06.2006. N3292 In force from September 1, 2006)

Chapter II. State Policy in the field of Electro Energy and Natural Gas Article 3. State policy development and implementation in the field of electro energy and natural gas. L) Promotion of expansion of energy resources extraction, privileged development of renewable (alternate) energy resources, measures of energy efficiency, which are connected with the expansion of production efficiency. (27. 12. 2005 N 2537)

There is no legislative act on the energy efficiency in the country, which makes us an exception among the former republics of the Soviet Union.

It should be mentioned that the Parliament of Georgia in 2007 when ratifying the second loan agreement for the rehabilitation of Enguri Hydroelectric power station took an obligation to have the full package of legislation on the energy efficiency and renewable energy resources. Which are waiting for until today.

In the framework of European Neighborhood Policy EU-Georgian Action Plan directly requires “Approximation of Georgian energy policy objectives to the European Union energy policy” through the development of well-

designed and long-term energy policy and its implementation for step-by-step approximation to “European energy policy objectives, including energy resources safety”. In Georgia there has not been developed the country economic development policy yet on the basis of which the energy policy is generally developed. The country energy development shall provide with necessary resources the economic development with preceding rate. At this stage our approach towards the energy development is completely unjustifiable and is based on general principles: energy is never excess, and if we have surplus energy we can sell it to the neighboring countries. This means that the development of energy does not imply the development of the country industrial potential. It should be noted that for the development of industry and for the compatibility of the made products energy efficiency is very important and necessary condition.

### **Relevance of executive authorities towards energy efficiency and energy saving**

The state regard towards the energy efficiency is more negative than positive. Representatives of the state structures try to avoid to carry out the obligations of energy saving and energy efficiency. In some cases there are taken some measures, however most frequently they are only of demonstrative character. As such can be considered the agreement of city mayors where already there are eight signatures: Tbilisi city (2010), Batumi (2011), Rustavi (2011), Kutaisi (2011), Gori (2012), Poti (2012), Zugdidi (2013) and Telavi (2014); four out of them have actions plans (SEAP) – Tbilisi, Batumi, Gori, Rustavi. It should be noted that despite the presence of Action Plan the authorities of these cities are not interested or do not have enough competence to implement these Action Plans.

Energy saving is one of the significant reserves of the country. In order to realize this reserve it is necessary to direct work into three directions, these are:

- Thermal insulation of the binding constructions of the existing buildings and establishment of standards for the buildings under construction;
- Modernization of the energy consuming systems;
- Selection of optimal sources of heating and lightening.

It should be particularly noted that in the city hall structures of our cities there are not energy related services. Respectively, there are not energy field specialists who could implement the obligations taken by the mayors’ agreement at a highly qualified level. Particular attention is paid to Tbilisi because 30% of the whole population of the country lives in this city (officially Tbilisi population constitutes 1 152 500). According to the Tbilisi City hall data of 2009 the consumed energy by the population equals 798.03 million kWh, and the expenditure of the state budgetary organizations constitutes 166,59 million kWh. As the figures show the whole population of Tbilisi consumes 4,79 times more electricity than the organizations budgeted by the Tbilisi city hall (Action Plan of Sustainable Development of Energy, Tbilisi”. As for the consumption of natural gas by the budgeted buildings there are no data at all.

It is the fact that in Georgia it is impossible to obtain information on the energy consumption by the budgeted buildings because state organizations do not consider it of primary importance to carry out this type of calculation. Not to say anything about separate calculation of energy resources, that is electro power expenditure, heating energy expenditure and separate calculation of water expenditure. There is not defined the necessary energy expenditure for the buildings and the budget pays the amount of tax according to the spent energy. This directly indicates how wastefully are spent the budgetary funds. In budgetary institutions in 2010 except for budgetary organizations (except for local bodies – local municipalities) the expenditure on energy resources constituted 106 105 500 GEL.

Our buildings are actually constructed without any standards and the necessary features are not simply monitored. It happened so that decision making bodies completely omitted the theme of thermo technical features in newly adopted construction standards. The argument is that the construction business in Georgia is the most profitable business and they did not want to decrease the excess profit received by the construction companies.

The attitude of the State towards the energy efficiency and energy saving is always vividly reflected in architecture. Our country is not an exception out of this rule and the architecture of the last years (which is very often the object of our politicians’ pride) is a vivid example of wasteful expenditure of finances and seriously affects the image of the country. Below there are given several examples.

Modern construction technologies provide possibility to construct a building of any view, but one of the main requirements for all types of buildings is defined by sanitary and hygienic standards. In our country such standards do not exist. Consequently these buildings due to their climatic conditions become similar to below given greenhouses – with high humidity and high temperature. In addition, it is very costly to preserve warmth in winter and coolness in summer there. The binding constructions of glass of the buildings are characterised with very low thermal resistance because very often for these purposes there is used manifold plate glass.



The results of united energy audit carried out in Georgia makes it possible to calculate what amount of energy could be saved in the buildings of state offices; this figure constitutes 50%-60% of consumes energy, although due to the unwillingness of the state no actions have not been carried out in this direction. The audit of transparent building is very interesting which have been intensively built during the last years. There is another problem – in



most cases these buildings do not have central conditioners, which mean that there is no air circulation which causes drastic deterioration of working people' labor productivity. The winter period temperature re-

gime in municipal and state management establishments is also problematic. We pay money to replenish the budget with which is covered the energy expenditures in these buildings and very frequently in the budgetary establishments the temperature is higher than required by the standards. This lowers the labor productivity of personnel by 30-50%. It means that our money is spent to pay for the higher temperature and higher energy expenditure in the state establishment and the salaries of state budgetary establishments' personnel whose labor productivity is halved! And this happens when majority of our citizens can heat only one room during the winter period.

- It is necessary to create legislative, administrative and economic measures' united stimulating system for efficient use of energy;
- The measures for energy saving and efficient use of energy should become obligatory part of social economic development of regions and municipalities;
- The task of energy saving lies in the creation of the sustainable and effective system of making the users interested in investing in energy resources and energy saving with the use of the State oriented policy which with the help of reduction of expected financial and economic risks in the field would ensure more attractive conditions of capital investment.

### **Energy efficiency and energy saving in private sector**

Georgia is a country of ancient culture which respectively was reflected in its architecture. It should be noted that the construction of ancient cities discovered by the archeologists such as Nokalakevi and Dzalisi amazes us by the high culture of construction and the use of energy saving means. At a later stage in our reality there are preserved the examples of Georgian traditional architecture such as Shatili, Svaneti towers and living buildings with specific architecture characteristic for different regions of Georgia where it was very well envisaged the impact of

environmental conditions and inner climatic condition is very well observed. The orientation and insolation are correctly envisaged. The buildings and construction of Old Tbilisi should be paid also attention which according to their thermal technical characteristics satisfy the modern European standards.

During Soviet times, particularly after 50s the construction policy underwent changes and the main accent was made on the satisfaction of the population with living space with less attention to thermal characteristics of the buildings.

Massive construction required new approach; the use of monotonous concrete walls became frequent. The thickness of walls was defined on the basis of technological and structural and not on thermal requirements. The block walls were of 40 cm thickness, slab walls – 30 cm; framework slab walls – 25 cm. The windows were with unary windowpanes. This conditioned provision of surplus heat with 24 our thermal supply.

Majority of private houses were also build during the Soviet period and is relevant to the then spread practice.

It should be noted that as the years passed, the heat-protective characteristics of these buildings became even worse. This means that the initial obligatory heat preservation parameters became lower (decreased) and now more energy is consumed for heating these buildings, which is not cheap any more. Respectively, the living conditions of the majority of Georgian population are much lower of comfort level because they simply cannot pay for heating. For example, in Tbilisi for heating one square meter of space annually is spent 320-350 kW/m<sup>2</sup> energy. For comparison, today in Germany according to the standards annually there is defined 30 kW/m<sup>2</sup> per one square meter, while by 2020 it is planned to be reduced to 20 kW/m<sup>2</sup>.

In modern construction there are envisaged even the old standards, and since there are no new standards defined, construction companies build without any heating preservation measures. We can earnestly say that the construction of modern public buildings (with some exceptions) is much worse than the Soviet period construction.



### **Foreign experience in energy efficiency and energy saving**

Economic development requires clean environment not only in global but also in local aspects. If environmental degradation is not paid necessary attention, this step-by-step will bring the financial profit of the economic development to zero, and the economic growth will not bring us any gain for the population and the living standards will not grow. At the same time, the use of energy efficiently will make it possible to reduce the demand on energy which will result in the reduction of environmental pollution.

Today energy saving is the priority of developed countries. Generation of more rational and effective energy and its use, renovation of enterprises and social sector infrastructure, and innovative development is the most significant means of economic growth and formation of perfect society.

Activities according this principle lead quite a number of countries to the new height of their development.

By steepening the construction standards Denmark reached 25% thermal energy decrease as compare with 1999, while the electricity expenditure remained the same despite the significant economic development.

Japan: an attic of a typical Japanese house is about 120 square meters. By covering about half of this space with solar devices there is obtained 6 thousand kW/h energy annually per house or 558 liters of oil. The law on the energy efficiency in Japan has been in force since 1979.

Germany: By the introduction of energy efficiency technologies Germany was able to substitute atomic energy, developed the economy of the country and reduced the consumption of gas to the level so that in the energy consumption of the country it equals only 23%.

Russia which is very rich in energy resources today declares that energy saving is one of the main priorities of the State. Economic growth of Russia requires significant energy resources, but more profitable and ecological is the economical use of energy than the construction of new energy units.

### **Main conceptual directions of State energy efficiency and energy saving policy**

Georgian State shall without any delay carry out effective measures for the renewable energy resources development in long-term perspective and shall radically change the existing unjustifiable policy related to energy efficiency.

<b>Tasks</b>	<b>Functions</b>
<b>Authority</b>	<ol style="list-style-type: none"> <li>1. Development and realization of policy and legislative initiatives, legal normative and technical normative acts;</li> <li>2. For the purpose of energy efficiency growth development of National Action Plan and Strategy for the modernization of the sectors of economy;</li> <li>3. Introduction of sanctions for wasteful expenditure of energy resources, also development and introduction in life of stimulating mechanisms for energy efficiency;</li> <li>4. Development of mechanisms for the inclusion of producers of alternative electro and thermal energy into energy distribution (suppliers) networks.</li> </ol>
<b>Regulation</b>	<ol style="list-style-type: none"> <li>1. Carrying out unified State policy in energy saving and energy efficiency spheres;</li> <li>2. Creation of necessary conditions for investments attraction with the purpose of energy efficiency growth in thermal energy supply;</li> <li>3. Coordination of energy efficiency activities at republican and territorial levels;</li> <li>4. Control and monitoring of realization plans of energy efficiency and energy saving;</li> <li>5. Coordination of scientific research and structural testing works in energy efficiency and energy saving;</li> <li>6. Assessment of energy efficiency measures;</li> <li>7. Regulation of energy resources tariffs with the participation of energy suppliers, users including local authorities and public organizations.</li> </ol>
<b>Organizational</b>	<ol style="list-style-type: none"> <li>1. At the level of sectoral regulation;</li> <li>2. Establishment of management structures at territorial level who will be responsible for energy consumption and energy saving;</li> <li>3. Relations with civil sector, securing transparency in energetic sector.</li> </ol>
<b>Informative</b>	<ol style="list-style-type: none"> <li>1. Review of programs in energy saving sphere – systematic information about the tariffs on energy resources;</li> <li>2. Coordination of preparatory work for the demonstration projects of high energy efficiency;</li> <li>3. Arrangement of exhibitions of energy efficiency equipments, technologies and materials;</li> <li>4. Information provision to the energy resources users on energy saving issues;</li> <li>5. Popularization of efficient use of energetic resources.</li> </ol>

The structure which will carry out detailed study of energy saving potential is given below.

### **State Information System of Energy Efficiency (SISEE)**

State Information system of energy efficiency is one of the instruments of energy consumption control of State budgetary sector. With the help of this instrument the central, regional and municipal programs for carrying out

energy saving measures and preparation of energetic conditioning (passport issuing) is planned. These measures ensure the reduction of energy consumption by 5-10%. The next step should be carrying out energy audit in the revealed high energy consuming establishments on the basis of which energy use will be reduced by 40-45%.

**Providing data to State Information System of Energy Efficiency (SISEE).** Central, regional and municipal executive authorities and self-governance bodies are obliged to provide data to SISEE. The rules of information provision is defined by the State Resolution on the Inclusion into the State Information System of Energy Saving and Energy Efficiency Increase.

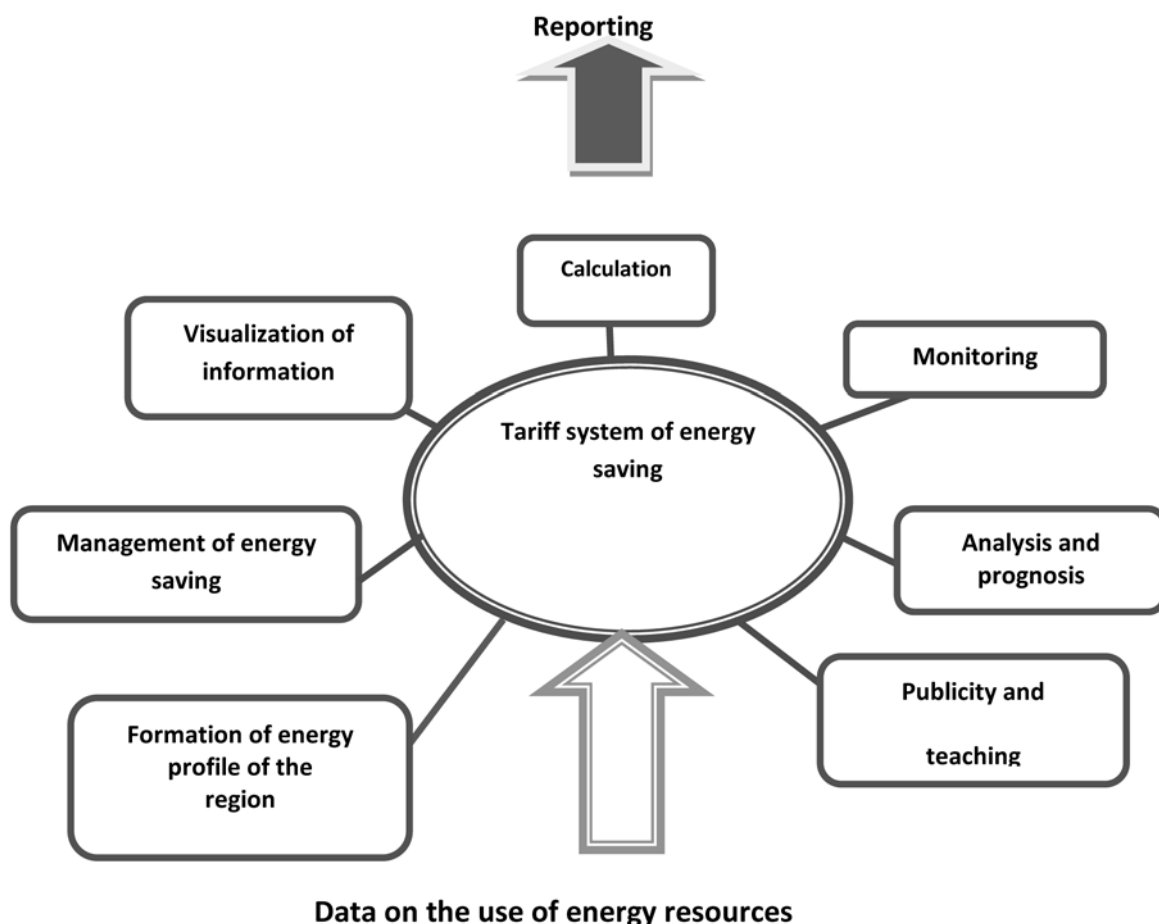
**SISEE powers and work principle:** For all buildings whose energetic expenditure is financed from the budget specific printed form (sheet) should be created in which there will be presented special data which will define final energy consumption. These are: a region where this building is located, the type of the building construction and its condition, capacity of the electric devices, capacity of the devices for hot water and heating system and others.

The sheet should be filled in by the responsible person, who will certify the provided information with his/her signature.

At SISEE provided information will be processed, analyzed, sectorally distributed and assessed.

The carried out work gives possibility to plan the annual decrease of energy expenditure, also to carry out earmarked planning of repair works and expenses on technical equipment.

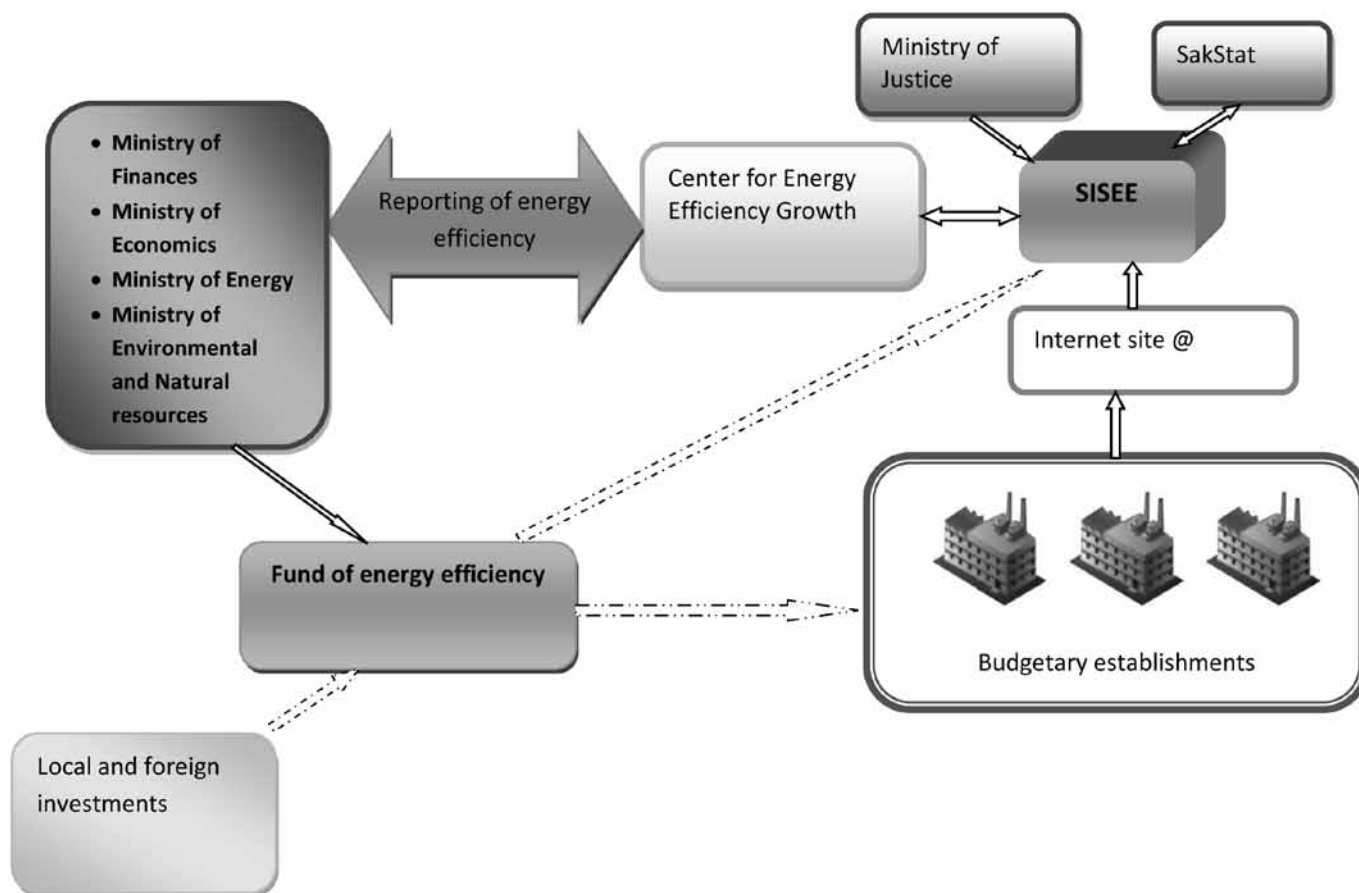
### Work Scheme of State Information System of Energy Efficiency



- Calculation - calculation (registry) of used energy by unit
- Monitoring – monitoring of the programs directed at energy efficiency increase
- Analysis and prognosis – analysis of collected information and defining the potential of energy saving caused by energy efficiency increase

- Publicity and teaching – preparation of information material of energy saving for responsible persons, consultations for specialists
- Formation of energy profile of the region – classification attaching on the basis of energy use
- Management of energy saving programs – management and supervision of the planned programs of energy saving
- Visualization of information – plotting of graphs and diagrams on the basis of obtained data, computer processing

### System structure



### Implementation of energy efficient programs and technologies for Georgia will ensure:

- Resource saving and industrial growth;
- Reduction of greenhouse gas emission and improvement of the environment;
- Absence of necessity of costly constructions of energy units.

### For the population:

- Reduction of taxes for public utilities
- Growth of comfort and respectively health improvement

### Investment in energy efficiency

- Creates jobs;
- Stimulates growth of economies;
- Creates safety for the country which do not have own energy resources;
- Is well known and easily achievable task implementation of which is fully justified;
- Promotes the growth of living standards.

**If the State policy with regard to the energy efficiency and energy saving changes only in household sector it will become possible to annually save 1 000 000 000 (one billion) GEL value energy (gas, electricity, fuel wood), in Georgian budgetary sector – 70-100 (hundred million) GEL value energy.**

# PROSPECTS AND EXISTING PROBLEMS OF DEVELOPING THE GEOTHERMAL POTENTIAL OF GEORGIA

Giorgi Melikadze

Doctor of Geological Sciences, President of Geothermal Association of Georgia

## Introduction

At a contemporary stage, when traditional organic thermal resources are reduced before our eyes, and energy crisis gets more acute, the attention of mankind becomes more and more focused on non-traditional, renewable resources of energy.

The deep heat of the Earth, which is traditionally called “geothermal”, is one of the inexhaustible sources of renewable energy, which comes to the earth’s surface in form of thermal waters, steam, and their mixture, and which is relatively easily accessible for the human.

Georgia is rich with natural thermal waters and has long history and tradition of their use, which, apart from archeological digging materials, is pointed by the names of the cities and other populated areas (Tbilisi, Tskaltubo, Tskaltbila, Abano, etc.). The legend of foundation of Tbilisi is also related to existence here of hot waters. In our country, these waters were used only in balneological and hygienic purposes.

Up to 250 natural (sources) and artificial (wells), individual and group outlets of the water of temperature of 30-108°C are registered on the territory of Georgia. Their total debit forms up to 160 thousand m<sup>3</sup>/day. Their perspective is not determined by this number. It is proved that in our country the envisaged stock of thermal waters forms 350-400 million m<sup>3</sup> per year. By the situation for January, 1993, the total balance stock of thermal water formed 90 thousand m<sup>3</sup>/day, i.e. 350-400 million m<sup>3</sup> per year. By preliminary estimations, their total thermal energy is up to 420 MW, while the generated thermal energy is 2.7 MW/hour/year, which according to its thermal potential is equivalent to 500 thousand tons of conditional fuel (TCF), or 500 million m<sup>3</sup> of gas per year.

Calculations have shown that in majority of cases the geothermal heat is 5-6 times cheaper than the heat generated by any other way, and respectively, the term of output of the invested sum comparatively short.

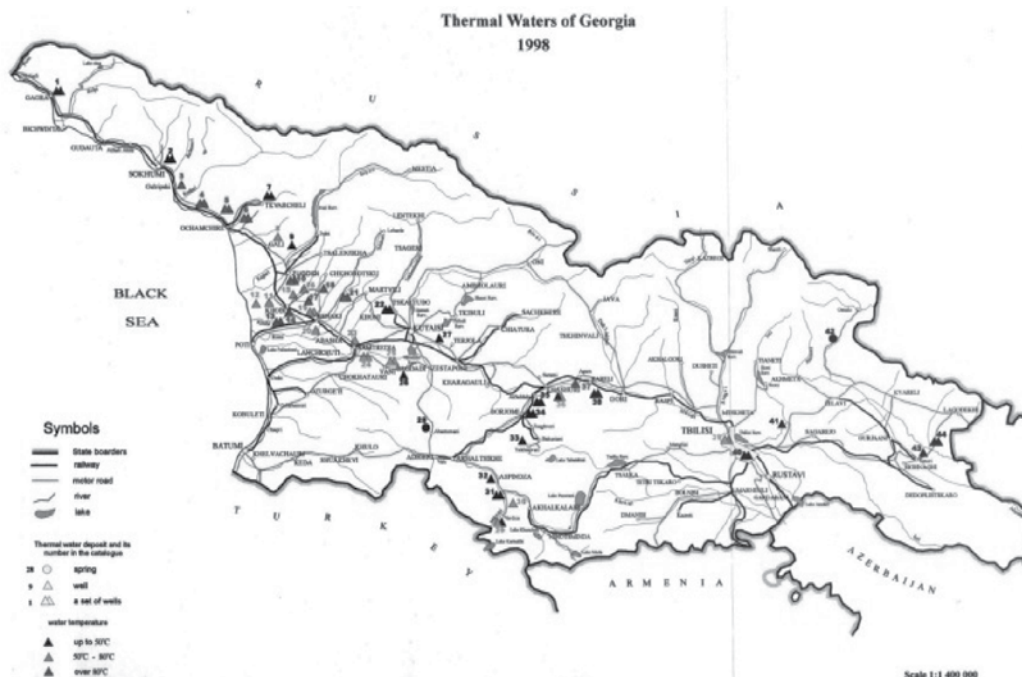


Fig. No.1. The distribution scheme of thermal deposits

The first part of existing 50 thermal wells is of average depth, with the water temperature 40 degrees, while the second part is deep, with the temperature 80-105 degrees. The first of thermal water deposits existing on the territory of Georgia are connected with the water-containing complex consisting of Paleocene-mid-Eocene volcanogenic-depositary rocks, which are spread in Adjara-Trialeti folded system from the Black Sea to Tbilisi. The second is connected with the water-containing complex consisting of neokomic limestone and dolomite, which is stretched across the whole Kolkheti lowland from the Black Sea to Kutaisi. Almost all important deposits of thermal water are connected to these two complexes, and these two complexes are to be studied best of all according to present situation.



### Present situation

At present, the license is issued for almost all deposits of thermal waters. Their largest part is used in thermal economy and hygienic purposes (baths), smaller part in fisheries. Only a small quantity – 730,000 m<sup>3</sup> per year – is involved in the hot water supplying system, and even that mainly for the Lisi-Saburtalo district population.

In regions, the heads of operational wells and thermal economies are arranged in a primitive way and with a lot of losses.



Fig. No.2. Zana and Kvaloni wells



Fig. No.3. Isula and Zeni wells

At present, the reserves of the assets are unreal, since in the conditions of uncontrolled exploitation the reduction in pressure and debits of the wells and in individual cases complete termination of gravity flow occurs. In particular, at the wells being in operation the regulation of thermal water expenditure in accordance of demand does not occur, and water is constantly spilled at full extent.

The wells being not in operation and other existing systems are simply out of order and thermal water is being spilled in vain, which causes the fall of pressure in the horizon and environmental pollution.



Fig. No.4. Nokalakevi and Zugdidi #2 wells



Fig.No. 5.Sakharbedio and Torsa wells

## **Problems**

- The systems existing at present are unregulated and primitive;
- Thermal economies are inefficient, in reality only a small portion of energy (20°C) is used, while the rest (40-70°C) is being spilled in vain and lost;
- Seasonal regulation of water expenditure or shutting of out-of-operation wells does not occur;
- Real situation of deposits and resources existing at present are not studied thoroughly.

## **Prospects**

The suspension of the tendency of pressure and debit falling at the thermal water deposits is possible only in those cases if we bring the withdrawn thermal water back into the water-containing layer after removing the heat from it, which is being widely carried out in the world practice of geothermal industry. Through this procedure, the artificial underground geothermal circulation system (GCS) is created. Their creation: protects the thermal water deposit from emptying, prolongs its operation terms to indefinite period, preserves the initial pressure and debit of the wells, and, what is the main thing, protects environment from pollution (swamping, thermal pollution, reduction of carbon dioxide emission by abolishment of boilers, etc.). Proceeding from this, while developing the thermal water wells and designing the development projects, it is necessary to plan the creation of the GCS's.

Because of all above-mentioned, it has become necessary to study the contemporary situation existing at the thermal water deposits, and evaluate the reserves anew. In this direction, Georgian Geothermal Association has implemented a number of projects with the support of international foundations, during which modern methods of investigation and equipment were applied. Below we present the results of three projects. While describing the deposits we both follow initial data and give their today's picture.

The first project has been funded by UNDP project "Georgia – Promotion of Development of Renewable Energy Resources with the purpose of Local Energy Supply (# 00034741) in 2010-2011".

With the purpose of specifying of the existing Tbilisi geothermal well three-dimensional digital model, the "Lisi" central ("Botanical garden" #1 and "Ponichala" #42 wells) and eastern ("Varketili #46 well) parts have been studied. The field works (preparation and immediate testing) and mode observations have been carried out in several stages at the noted area. With the purpose of creating the real model of geothermal circulation system, the reinjection from the Lisi #5 to the Lisi #7 wells was prepared and carried out at the Lisi-Saburtalo area.

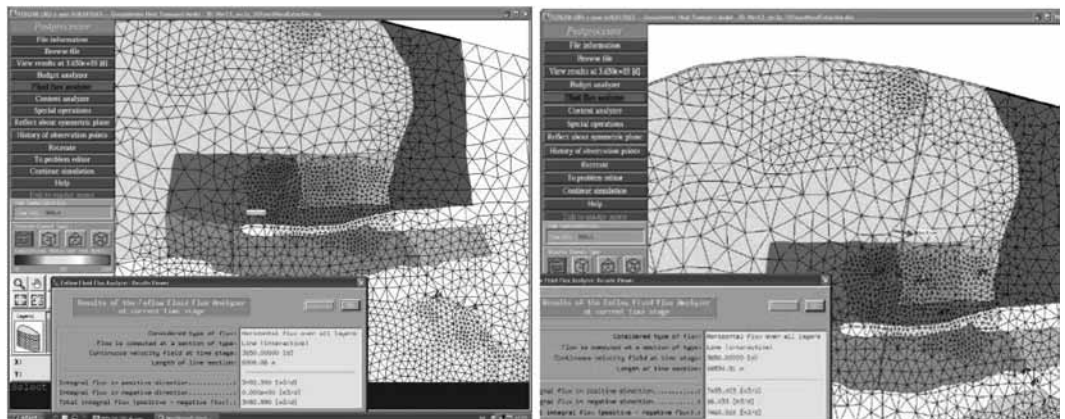
On the basis of the existing and newly obtained materials, the Tbilisi thermal region three-dimensional digital model has been specified, which envisages the complexity of the region, its separation by tearing into separate areas, their different hydro-dynamic zoning.

On the basis of modeling by computer programming (Feflow 5.3, AquiferTestPro and others) the water output capacity of main areas and individual wells as well as their energy potential has been identified. In particular, the best highest energy potential is marked at the "Lisi" area, whereas the worst one – at the "Varketili" area.

Inside the "areas" the relation is even more complex. It can be mentioned that the hydro-dynamic relation at the wells between #5, #6, #7, and #8 of the "Lisi" area, as well as #1 of the "Saburtalo" area is definite. The "Saburtalo" area well #4 proved to be outside the influence area, which indicates at its independent mode. With the purpose of identification of its formation conditions and its influence zone it is advisable to carry out additional works on them.

Thermal water expenditure of the "Lisi" area was calculated in the model, which instead of 3600 m<sup>3</sup>/day formed twice as much – 7485 m<sup>3</sup>/day. As for the "central" area, the water output instead of 1990 m<sup>3</sup>/day formed 4467 m<sup>3</sup>/day.

With the purpose of identification of optimal modes of use of geothermal resources, during modeling with the reinjection data the working out of different scenarios and carrying out of numerical experiments occurred. As a result of programmatic simulation, the 10-year perspective of Tbilisi thermal exploitation for all cases has been identified.



**Graph. No.6. The values of water output at the "Lisi" area (left) and completely at the northern wing of the model (right)**

In present conditions, exploitation will cause so-called “subsidence of horizons”. Only during preservation of the average annual expenditure at the “Lisi” area (1700 m<sup>3</sup>/day) the pressures during the 10 years period fall to 2-5 meters, while the quantity of released thermal energy is being reduced from 5.5\*10<sup>20</sup>J to 1.578\*10<sup>17</sup>J.

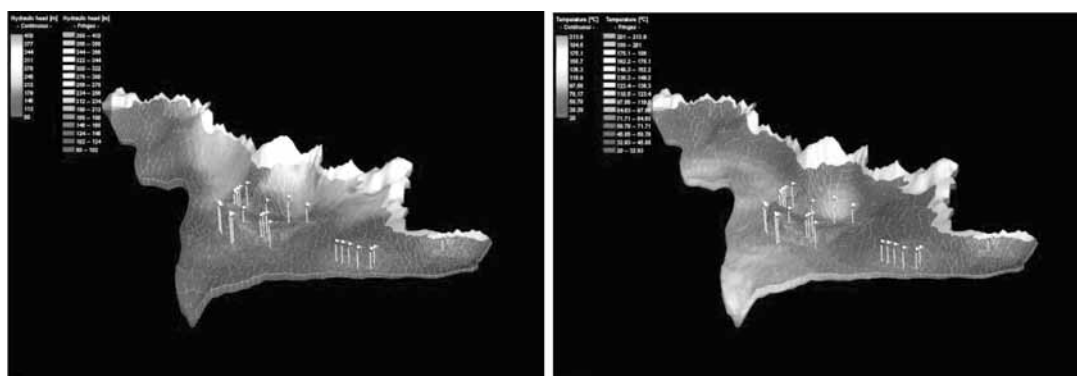
The versions of pumping of the total mass of water cooled to 30°C (1690 m<sup>3</sup>/day ) of the “Lisi” well No.5 or its part (20%, 50%, 75%) to the “Lisi” #7 or “Lisi” well No... have been considered. In all cases, with different intensity, the negative balance is reduced, and there is stopping of the tendency of “cooling and subsidence of the horizon”. From these, the version of pumping into the “Lisi” #7 well is the easiest to carry out technically (because of the existence of connecting pipeline). However, in case of overcoming technical problems (redrilling of the “Lisi” #1 well), the most profitable in terms of energy will be the “pumping into” the “Lisi” #1 well.

Also, it is desirable to consider further the selection of the pair engineering wells for other existing gravity flow wells (for example, Saburtalo #4 and #1; Lisi #6 and #8) and identification of the possibility of arrangement of creation of the GCS. In this way, we will protect the water-containing horizon from drying out and reduce the energy losses from the system. Thus, the creation and introduction of GCS’s at each well is recommended. This will eventually promote the economic and ecologically justified exploitation of the reserves.

In 2010-2011, with the support of the American Foundation (USAID # ECI-GA-R2-13), the existing situation of geothermal deposits in Western Georgia has been studied for the introduction of the mode of their development and rational exploitation, and the rehabilitation of Khobi regional hospital heat supply system with the use of geothermal energy has been carried out.

The field hydro-geophysical studies (trial testing, modal hydrodynamic and microtemperature observations) have been developed and carried out in several stages in order to identify the thermo-hydrodynamic parameters of main water-containing horizons.

Under field and laboratory modes the thermal properties of forming rocks have been studied and vertical and horizontal zoning of thermal stream has been identified. On the basis of existing and newly obtained geological, hydrogeological, and geophysical materials the Eastern Georgia’s thermal region three-dimensional digital model has been built, which envisages the complexity of the region, its separation into individual areas via breaking, their different hydrodynamic zoning.



**Fig.No.6. Distribution of hydraulic pressuring and thermal flow in the horizon**

The digital modeling computer programs (Feflow 5.3, AquiferTestPro) and other means were used for the first time for Western Georgia, which have enabled us of identifying hydrothermal resources and evaluating hydraulic parameters of water-containing layers.

As a result of modeling, the 10 year perspective of exploitation mode under present conditions of Western Georgia’s therms has been identified. Thus, for example, the so-called tendency of “horizon subsidence” is being fixed in the whole region. Only at the “Zugdidi” area during preservation of the average annual expenditure (1\*106 m<sup>3</sup>/day) the pressures fall by 5 atmospheres, while the value of released thermal energy is reduced from 5.5\*10<sup>20</sup> J/day to 1.578\*10<sup>17</sup> J/day. By means of the program, the geothermal circulation system simulation was carried out, when the water having come from Simoneti No.1 well was pumped into the well No.1. In this case according to the model, there is the tendency of stopping of “horizon cooling and subsidence”, which has confirmed the necessity of creation and introduction of geothermal circulation systems at the chosen area (Tsaishi, Zugdidi, Vani). This will eventually promote economic and ecologically justified expenditure of the reserves.

The water supply of the Khobi hospital with hot water and heat has been carried out with the use of ecologically clean, renewable energy source – geothermal energy.

As the next stage in 2012-2013, within the framework of USAID No.6371-12-10 project the organization of geothermal circulation system (GCS) at Tsaishi geothermal deposit and rehabilitation of thermal supply system of Tsaishi public school with the use of geothermal energy has been carried out. The thermal water obtained from the existing thermal well #10 is delivered to the thermal changer existing in the thermal aggregate of the school with the starting temperature of about 94°C. This water heats “network water” circulating in the second contour of the thermal changer up to about 75-85°C (according to necessity), while itself being cooled to 45-50°C. This temperature thermal water is delivered to the second thermal changer. In the second contour of the latter the “drinking water” is circulating, which is heated to 40-45°C, and is used after that in the hot water supply system (sport gym showers, etc.), and which is pumped by a reinjection pump by passing the Chirkhni #4 K well into the underground thermal water containing horizon. Here it gets the temperature existing in the horizon, and comes up again in the productive well #10. Correspondingly, the whole (over ground and underground) cycle of circulation of thermal water is completed. The digital modeling of thermal area and identification of efficiency of GCS has been carried out. Introduction of the “geothermal circulation system” allows of avoiding aimless spilling of used thermal water, which normally causes thermal pollution and, often, swamping of environment; at the same time, by returning of the used thermal water into the water-containing horizon, the water mass expenditure has practically become zero. Accordingly, the pressure fall in the water-containing layer will not occur anymore, which will increase the exploitation period of the deposit at indefinite period of time.

### **Recommendations**

- On the whole territory of Georgia, geothermal resources are to be studied with the purpose of identification of new deposits, and specification of the reserves of old deposits;
- It is necessary to introduce contemporary technological systems of exploitation at the deposits;
- Creation of the geothermal circulation systems.

**It is necessary to develop the legislative base to create favorable conditions for the enterprisers, in particular:**

- long-term beneficial credits;
- product purchase guarantees;
- Consideration of benefits and encouragement while using modern technologies in the conditions of a license.

This will eventually promote the development of geothermal energy in Georgia as one of the cheapest, ecologically friendly, practically inexhaustible source of energy, and the increase of its role in the energy balance of the country. This will contribute its share in the development of waste-free production and in the solution of the problem of global warming.

## **RESOLUTION**

**We, Georgian non-governmental (public) organizations, experts and representatives of scientific communities, signatories to this Declaration, full aware of the responsibility and relying on our experience and adjusted information:**

### ***Political aspects:***

Express our concern because of the fact that the functioning and development of the energy field in Georgia is being carried out without common vision, policy, concept and relevant legislative base of modern challenges;

Express our discontent and indignation because the development of separate strategic and legislative acts, as well as taking important decisions is carried out in “hush-hush” circumstances and the participation in this process is not guaranteed.

Express our discontent because the text of the Association Agreement between the European Union and the European Atomic Energy Community and their member states, of the one part, and Georgia of the other part became public only after its ratification when it was already impossible to make any changes to the text;

Agreeing that sustainable provision of energy is one of the components of the country safety, we consider that the energy system of Georgia requires fundamental systemic, that is radical institutional changes the purpose of which should be complete dismantling of Soviet type management methodology and development of own, national energy policy, creation of democratic, public and objective decision making guarantees.

Sharing the provisions related to the energy and environmental fields of the Association Agreement between the European Union and the European Atomic Energy Community and their member states, of the one part, and Georgia of the other part we think that in the shortest period of time there should end the stage of “drift” under the legislative vacuum and the Georgian energy system management (development) shall be carried out in close relations with the country sustainable economic development without damaging the environment on the basis of well-considered long-term policy, action plan and legislative norms accented in the same Agreement.

We demand that Georgian National Energy and Water Supply Regulatory Commission is freed from any political, monopolistic and any other type of pressure.

### ***Energy field management, energy efficiency:***

We categorically demand that Georgian Government without any delay limits inflicted to one legal entity power of electricity generation and distribution, also other incompatible powers and implements this at legislative level;

We express our discontent because of bureaucratic barriers existing in state (budgetary) sector and generally in the field of used energy resources registry, also statistical information accessibility and transparency;

We consider unacceptable from State structural entities ignoring the topic of energy efficiency as one of the most important energy resources;

We cannot agree with the arguments from the Government that obligatory legislative norms with regard to implementation of energy efficient measures and introduction of low energy consuming technologies will become heavier load for citizens social and country economic state;

We consider that rational use of energy and energy efficiency must become a priority in all directions and at every stage of energy generation and use;

We demand that in the shortest time a relevant legislative package related to the energy efficiency and in accordance with the obligations taken at international community level shall be adopted for all spheres (transport, buildings, technological processes and others);

In the new legislative package related to the energy efficiency shall be intensively and effectively introduced administration, economic, financial and other mechanisms for the promotion of dynamic process of permanently increasing energy efficiency level;

### ***Effective use of non-traditional renewable energy resources***

We express our concern because of the continuation of traditional approach towards some of the renewable (solar, wind, geothermal and others) energy resources and demand that beginning from 2015 Georgian Government

declares as priority issue the efficient use of solar, wind, geothermal energies, develops a specific program and secures this program with relevant financial resources annually.

**We cannot conciliate the fact of excessively intensive use of the forest resources of Georgia and demand from the Georgian Government:**

- Without any delay carry out such multiple reforms that the smooth settling ways of poverty reduction, unemployment, heating and other social problems “do not pass across the forest missives”;
- Speed up and in 2015 complete the gasification process in Georgian rural regions;
- Develop reforestation State program for already deforested and degraded forests and exclude the publicity campaign of this process.

**Scientific and human resources potential of energy sphere**

The institutions working in the field of energy have been either completely destroyed or degraded during the last years. The same has happened in the direction of human resources preparation which has drastically impacted the innovations in the sector and the process of presentation and introduction of new technologies.

Because of above mentioned, we express our concern and think that the growing of scientific potential in the energy field and relevant preparation of human resources should be the key issue in the sector development policy.

1. Greens Movement of Georgia/Friends of the Earth-Georgia
2. Georgian Energy Resources Effectively Using Association
3. Rural Communities Development Agency
4. Experts Union – Sustainable Energy and Environment
5. Ecological Farmers Association of Georgia (SEMA)
6. Society Development Akhaltsikhe Center
7. Baadur Chkhaidze, Professor of Technical University of Georgia



**Greens Movement of Georgia / Friends of the Earth - Georgia**

**16, Gr. Mukhadze str. Tbilisi, 0162, Georgia  
Tel/Fax: (+995 32) 2306221; E-mail: [info@greens.ge](mailto:info@greens.ge)  
URL: [www.greens.ge](http://www.greens.ge)    [www.cleanup.ge](http://www.cleanup.ge)**

