COUNTRY REPORT
GEORGIA

ener2i - ENErgy Research to Innovation:

Reinforcing cooperation with ENP countries on bridging the gap between energy research and energy innovation

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Abbreviations

ADB = Asian Development Bank

CDM = Clean Development Mechanism

CIS = Commonwealth of Independent States

CoM = Covenant of Mayors

EaP = Eastern Partnership countries

EBRD = European Bank for Reconstruction and Development

EE = Energy Efficiency

EIB = European Investment Bank

ENP = European Neighbourhood Policy

GNEWRC = Georgian National Energy and Water Supply Regulatory Commission

GoG = Government of Georgia

GRDF = Georgian Research & Development Foundation

GWh = Gigawatt Hour

HPPs = Hydro Power Plants

IEA = International Energy Agency

IFC = International Finance Corporation

IMF = International Monetary Fund

ISTC = International Science and Technology Center

KFW = Kreditanstalt für Wiederaufbau

KTOE = Kilotonne of Oil Equivalent

MDSPPSG = Main Directions of State Policy in the Power Sector of Georgia

MTOE = Million Tonnes of Oil Equivalent

NGOs = Non-Governmental Organizations

PEEREA = Protocol on Energy Efficiency and Related Environmental Aspects

RES = renewable energy sources

SEAP = Sustainable Energy Action Plans

STCU = Science and Technology Center in Ukraine

USAID = United States Agency for International Development

VAT = Value-Added Tax

Chapter 1: Introduction

The presented report has been developed within ENER2i project financed by EU Commission aiming to analyze the local energy sectors in Georgia and the various players and stakeholders acting not only in traditional energy sectors but also in the Renewable and Energy Efficiency field. In the below chapters, the current energy situation in the country, as well as its history of development, started from its collapse at the end of 1990s till its renovation are presented in detail. The report delineates the main energy sources and suppliers in Georgia, its total consumption by sectors, with consideration of the economic development in Georgia, as well as energy prices for the generation, transmission dispatch, distribution, import and consumption of electricity and for the transport, distribution and consumption of natural gas. The document also describes the legal basis and policy related to energy sector in Georgia.

The report describes the current situation related to renewable energy sources and energy efficiency, its potential and capacities as well as bottlenecks and barriers to development of innovative technologies. Furthermore, it examines to what extent these are currently relevant and applied in the business sector, along with existing linkages between energy research institutes, higher education institutions and business sectors.

At the end of the report are identified and analysed the strengths and weaknesses of the local energy sectors and of its innovative capacities in Georgia, and that what needs to be done to improve the EE/RES situation in the business sector and to encourage closer cooperation between research and business. The cooperation opportunities between the EU and the ENP partners on innovations in EE/RES and the projects and programmes being implemented at present in Georgia by various local and international organizations are also outlined in the report.

In addition, the report refers to the players and methods in the economy and energy sector in support of the development of innovative technologies , to what kind of support for energy efficiency and renewable energies are available in the Georgia. The main players and stakeholders active in the RE/EE field from different sectors such as governmental, non-governmental, research organizations and business in Georgia are also presented in detail. The report also talks about the international relations of the energy sector and the energy research community; with special focus on cooperation with international partners**.**

Chapter 2: Current energy situation in the country

2.1 Geographical and climate characteristics of the republic of Georgia

(General information influencing the renewable energy (RE) and energy efficiency (EE) targets in the country)

Georgia is an independent country since 1991 in the South Caucasus region. It is located at the crossroads of Western Asia and Eastern Europe, bounded to the west by the Black Sea, to the north by Russia, to the south by Turkey and Armenia, and to the southeast by Azerbaijan. The capital of Georgia is Tbilisi. Georgia covers an area of 69,700 km², and its

Picture 1: Map of Georgia

population is about 4.4 million. The capital, Tbilisi has population of about 1.15 million. Georgia is divided into 9 regions, 1 city (capital), and 2 autonomous republics. These are then subdivided into 60 districts.

A mountainous landscape determines the variety of Georgia's physical geography: there are mountains, valleys, plains, lowlands, glaciers, wetlands, arid lands, lakes, rivers and even 18 geysers. Mountains cover a significant part of the territory: 54% of it is located at an altitude of 1,000 m above sea level. In addition to the Great Caucasus range, there are several other mountain ranges in Georgia. The most important is the Likhi Range, running from the North to the South and dividing the country into its Eastern and Western parts.

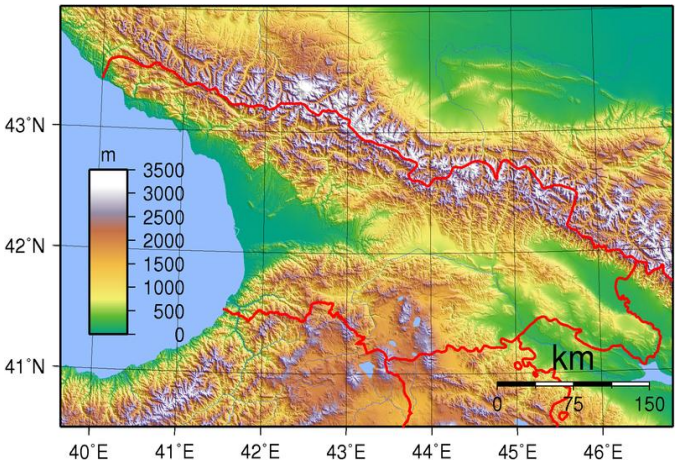
Almost every climatic zone is represented in Georgia except for savannas and tropical forests. To the North, the range of the Great Caucasus protects the country from the direct penetration of cold air. The circulation of these air masses has mainly determined the precipitation regime all over the territory of Georgia. The climatic picture totally differs in both parts of Georgia as divided by the Likhi Range.

The climate in Western Georgia is highly diverse, altering in certain areas very sharply from humid subtropical to permafrost. The climate is determined by the Black Sea coast to the West, and by the amphitheatre of three big mountain ranges (the Great Caucasus, the Likhi and the Meskheti), in addition to the surrounding Kolkheti lowland (wetland) in the very centre.

The Black Sea coastal zone has a humid subtropical climate. The average annual temperature there is 14-15^{0}C, with extremes ranging from +45^{0}C to -15^{0}C, and annual amounts of precipitation vary between 1,500 mm and 2,500 mm. The Black Sea influences the climate of West Georgia, resulting in mild winters, hot summers and abundant precipitation. Here in the mountainous and high mountainous areas, the annual air temperature ranges from 6-10^{0}C to 2-4^{0}C with an absolute minimum between -30^{0}C and -35^{0}C, and annual amounts of precipitation range between 1,200-1,600 mm and 2,000 mm.

The climate in the plains of East Georgia is dry: in the lowlands, it is a dry subtropical climate, and in mountainous areas it is alpine. The average annual temperature is 11-13^{0}C in the plains, and 2-7^{0}C in the mountains. The absolute minima are -25^{0}C and -36^{0}C respectively. The absolute maximum reaches +42^{0}C, and the absolute minimum falls to -42^{0}C in the high mountains (the slopes of Mount Kazbegi). The annual amounts of precipitation vary in the range of 400-600 mm in the plains, and 800-1,200 mm in the mountains.

Georgia is rich in fresh water: rivers, lakes and springs. The rivers are not large enough to be navigated but they are fairly potent for the purposes of hydro energy and fishery, owing to their fast and sloping run. The largest river is the Mtkvari (Kura), which originates in Turkey and, crossing through almost all Georgia, flows into the Mingechaur Reservoir (in Azerbaijan). Two other rivers also flow here – the Alazani and the Lori, originating in the mountains of the Great Caucasus, and running down the



Picture 2: Topography of Georgia

Kakheti region. The other important rivers of Eastern Georgia are the Liakhvi, the Khrami, and the Aragvi.

Western Georgia is even richer in rivers than Eastern Georgia. Most of these have their origins in the mountains of the Great Caucasus. The rivers Rioni, Enguri, Tskhenistskali, Natanebi, and Supsa, all flow into the Black Sea. In South Georgia, on the Javakheti Highland, at an altitude of 2,100 m, lies Georgia's largest lake, Paravani (37.5 km2). Other lakes include Paliastomi (18.2 km2), Tabatskuri (14.2 km2), Jandari (10.6 km2), and Bazaleti 12 km2). There are also over 20 reservoirs of fresh water formed by different rivers.

Georgia is rich in various ecosystems. The Kolkheti lowland stretches over 600 km2 of Western Georgia and is a vast wetland; in Eastern Georgia, the Kakheti region is the arid area of the Gareji semi-desert (70 km2), and glaciers along the Great Caucasus occupy an area of about 500 km^2. Forests cover 43% of the total area of the country. Georgia's magnificent forests, abundant in rare species of wood, are the true wealth of the country. The rich nature, diverse climate and large variety of healing geothermal and mineral waters in the country have resulted in a number of resorts being established, some of which are world famous. Georgia possesses certain reserves of various mineral resources, the most important of which are manganese, iron, copper, coal and marble[1].

2.2 Georgian Energy Sector characteristics

Before examining the energy supply and consumption by sectors in Georgia it should be noted that annual energy consumption has been significantly reduced in Georgia compared to that of the 1990s. Along with the collapse of the USSR a sharp drop in energy consumption was caused by economic and social crisis in the first years of the country's independence and occupation (about 20%) of the country's territory.

In the Soviet period Georgia imported most of its energy resources, including power, natural gas and oil from other former Soviet republics. Accordingly, the Georgian power system was once part of an integrated regional system of the South Caucasus that allowed for the balancing of seasonal deficit in hydropower in winter by power imports, and exported the surplus power in spring and summer due to the seasonal nature of production from Georgian hydropower plants.

Following the breakup of the USSR, the energy sector in Georgia and its capital, Tbilisi suffered a catastrophic collapse in the early 1990s. Power, oil and gas import and supply to industries and households dropped dramatically. At that time, no customer in Georgia had uninterrupted power supply. The regions of Georgia as well as the capital had a scheduled power supply, there were daily blackouts, and in winter periods some areas of Georgia had no power for several days, weeks and even months. Power sector assets were dilapidated and theft of electricity and corruption were rampant. Due to a lack of financial discipline in the sector, only a fraction of the fees payable by customers were collected, resulting in a massive debt accumulation by the sector's companies, making them unable to import the power needed for the country from the neighboring countries' systems, which in turn led to more power shortages. Deficits in management, financial control, maintenance and timely rehabilitation works on the energy infrastructure played a significant role in the near collapse of the power and gas systems. The disintegration of the centralized economic system and the drastic increase in prices of energy resources after the collapse of the former Soviet Union were followed by a serious energy crisis in Georgia.

[1] http://unfccc.int/resource/docs/natc/geonc2.pdf 2nd National Communication to UNFCCC

Since 2004, with a support from the International Development Association (IDA) within the Electricity Market Support Project, the new government transformed the power sector into a financially viable, modernized, and functioning sector. For the last few years, this sector has delivered 24-hour uninterrupted power supply to its customers including households, the public sector, industry, transport and commercial entities.

Currently Georgia is a net importer of natural gas and petroleum products, which are, together with hydropower and biomass for residential heating, the main energy sources.

Much of its electricity and gas infrastructure is scheduled for refurbishment but the costs of the necessary rehabilitation are large, considering the timeframe available. Acute situations have developed over the high rates of electricity losses and gas leakage and the non-collection of bills precipitated a crisis in the power supply. Reform efforts in power sector regulation and governance are well underway and large-scale refurbishment and the renewal of critical infrastructure is high on the government's list of priorities.

From the early 1990s through to 1996 primary energy demand was in free fall. This is illustrated in the figure below, where by 1996 energy demand was at one third of that at the beginning of the decade. Primary energy demand broadly reflects the fortunes of the economy and it only resumed growth in 2002, having bottomed out at 25% of the demand 12 years earlier.

2.2.1 Oil and Gas

Georgia imports about 90% of its primary energy requirements of natural gas and oil products, which together meet about two thirds of the primary energy supply. Because of this and the relatively high energy intensity of its GDP, the competitiveness of Georgia's economy is particularly affected at times of high energy prices. The graph below refers total primary energy supply:

Georgia's proven oil and gas resources are modest. The country's 15 oil fields have confirmed reserves of about 8.3 million tons but larger oil reserves are assumed to exist. The oil potential of the Black Sea shelf is estimated at 70 million to 1.3 billion barrels (GTZ, 2009). Oil extraction and exploration works are conducted by Georgian and foreign companies. In 2012[2] in Georgia the total crude oil production was 48977 tons, while the average annual natural gas production for the period 2009-2013 totalled to 6,3 mlm^3.(Georgian Oil & Gas Corporation).

	RESERVE	RESOURCE
Coal, (Mtoe)	185	300
Brown Coal (Mtoe)	20	-
Oil (Mtoe)	42.5 (8.3+23.7+10.5)	850
Natural Gas (bcm)	8.4 (2.9+5.3+0.24)	180
Hydro (TWh)	32 (maximum economic potential)	80 (technical potential)

Table 1: Energy Resources of Georgia[3]

[2] "In-Depth Review of Energy Efficiency Policies and Programmes" – page 33
[3] Georgian Oil and Gas Trunk Pipelines by T. Gochitashvili, T. Javakhishvili – page 24

Although Georgia has no proven large-scale oil and gas resources or production, it can generate revenues from oil and gas transit because of its geo-strategic location. Despite its lucrative location, Georgia has struggled to secure a basic energy supply for its citizens since its independence.

		2005	2006	2007	2008	2009	2010
Natural Gas							
Local Production	Mln m^3	17.2	23.5	24.3	19.5	15.7	11.1
Total Imported Gas to Georgia	Mln m^3	1,335.0	1,808.8	1,702.0	1,473.2	1,180.9	1,113.3
Total Consumed Gas in Georgia	Mln m^3	1,332	1,806.400	1,700	1,471.2	1,188.8	1,121.14
Including:							
Commercial Sector	Mln m^3	n/a	n/a	n/a	552.4	482.5	478.8
Household Sector	Mln m^3	n/a	n/a	n/a	528.1	415.6	445.5
Power Generation	Mln m^3	317.6	674.2	455.4	390.7	290.8	196.9
Transit to Armenia	Mln m^3	1,685.10	1,715.70	2,054.3	2,254.3	1,628.7	1,440.1
Transit to Turkey	Mln m^3	0	0	1,212.5	4,488.2	4,787.9	4,355.7
Oil							
Local Production	Tens	66,700.3	63,500.7	56,635	52,814.5	52,867	51,444.1
Baku-Tbilisi-Ceyhan (Transit)	Mln Barrel	1.8	64.9	212.2	246.6	285.8	286.3
Western Route Export Pipeline (Transit)	Mln Barrel	51.5	41.6	0.04	5.2	31.4	29.6

Table 2: Local Production & Consumption of Primary Energy Sources [4]

Georgia remained a reliable energy partner for the EU in developing the Southern Corridor. Georgia and Ukraine are working on a new multilateral inter-governmental agreement to develop the Euro-Asian Oil Transportation Corridor (EAOTC). In June 2013, the Shah Deniz II (SD II) shareholders' consortium selected the Trans-Adriatic Pipeline as the European supply route for SD II gas. In September, long-term gas sales agreements were signed with nine European companies to supply 10 bcm/year of SD II gas to Italy, Greece and Bulgaria. The signature of these agreements marked an important step towards the Final Investment Decision, which was concluded in December at a ceremony attended by Commissioner Oettinger and several heads of state and government.

2.2.2 Natural Gas Supply in Georgia and Tbilisi Capital

Despite the fact that Georgia more or less has significant potential of internal energy resources, energy supply of national economy largely depends on the import of primary energy resources, especially such as oil and gas. The fuel and energy complex is composed of natural gas transportation and distribution sectors, power generation plants, state electro system of Georgia, up to 50 natural gas distribution companies and 4 large power distribution companies[5].

In 2011, 75% of the supplied primary energy was imported, out of which 43% was natural gas and 29% oil products. Imported gas is mainly used for heating and cooking by households and power generation. In rural areas of Georgia the main primary energy used for heating and cooking is local biofuels, mostly firewood. Most of Tbilisi is covered by natural gas distribution network. In Tbilisi natural gas is distributed by the Ltd “Kaztransgas”. Natural gas consumption in Tbilisi was more than 2.05 billion m^3 in 1989. Gas import and consumption dropped dramatically in the 1990s. The natural gas supply has improved in recent years. Currently annual consumption is about 500 million cubic meters. There is a trend of increasing gas consumption in the city. The major consumer is the household sector[6]. The district heating network in Tbilisi and main cities of Georgia collapsed in the 1990s due to the fuel shortages and lack of maintenance on the distribution network. At present the district heating network does not exist in Georgia and households usually use individual heating equipments (gas heaters and/or firewood stoves).

The total final consumption (TFC) by energy source is illustrated in the Figure 2: Total Consumption by energy source below, which show the dominance of oil and gas in the total final energy consumption[7].

[4] Source: Ministry of Georgia
[5] Energy Balance of Power Sector of Georgia – page 5
[6] GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia’s capital city – prepared with project of UNEP and OSCE
[7] *Source: Energy Efficiency Center Georgia data*

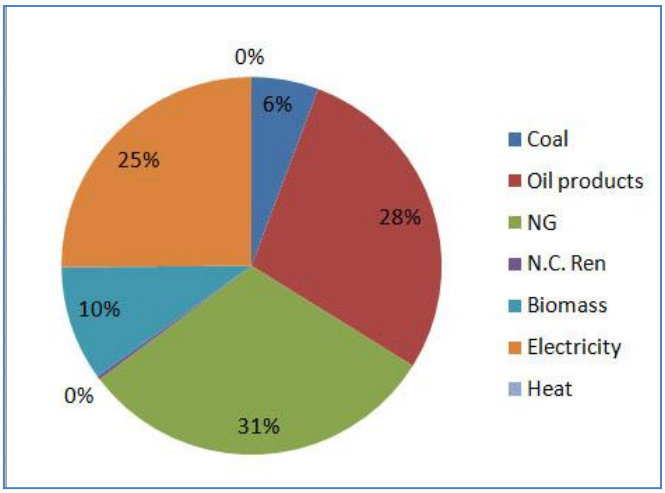


Figure 2: Total Consumption by energy source (2012) –Total- 3217ktoe

2.2.3 Electric Power Supply of Georgia and Tbilisi Capital

As for 2012 the installed generation capacity in Georgia totals 4,200 MW of which 2,700 MW is Hydro Power Plants. The other 1500 MW are thermal power plants mainly used to meet winter demand. The average annual electricity generation in 2011-2012 totaled to 9944GWh, of which approximately 76% was generated by hydro plants, 24% at thermal power plants and the rest was imported.[8]

Electricity generation in GWh in Georgia in 2011-2012 is presented in Table 3 below[9]:

Electricity generation in GWh	2011	2012
Hydro	7890	7222.62
Thermal	2297	2472.1
TOTAL	**10194**	**9694.72**

Table 3: Electricity generation in GWh in Georgia in 2011-2012

As for *e*lectricity, export and import data (GWh) in 2007-2012 is presented below table 4[10]:

	2007	2008	2009	2010	2011	2012
Import from Turkey	149	54,3	-	0.00014	0.002823	0.000548
Export to Turkey	215,6	216	182,3	303.366	218.625	79.008
Import from Azerbaijan	107,4	34,6	31.5	10.138	23.42	97.794

[8] www.minenergy.gov.ge
[9] *Source: Energy Efficiency Centre Georgia data*
[10] Source : Georgian Electricity System

Export to Azerbaijan	109,6	30,9	21.5	14.344	5.924	11.79
Import from Armenia	-	-	0.04	-	-	0.000408
Export to Armenia	-	-	19.3	89.447	117.474	67.917
Import from Russia	176,8	560,1	223.3	211.937	447.542	516.797
Export to Russia	300,2	432,7	525.8	1117.123	588.575	369.432
Total Import	**433,3**	**649**	**254.8**	**222.08**	**470.96**	**614.59**
Total Export	**625,5**	**679,6**	**749.4**	**1524.28**	**930.6**	**528.15**

Table 4: Electricity export- import (GWh) in 2007-2012

The state of the repair, flexibility and capacity of the transmission network in Georgia has been one of the major weaknesses of the electricity system. The construction of the larger planned HPPs (Khodoni and Namakhvani) will require large investments in additional transmission capacity, especially for eventual exports to the Turkish market. The potential for hydro generation is in regions where exports to Turkey are feasible and the stream of earnings should more than offset the cost of developing Greenfield power plants. This export capacity will enhance trading and facilitate support among countries in the region (EBRD, 2009).

In the electricity sector, work on the Georgian side of the Black Sea Energy Transmission Network (Azerbaijan-Georgia-Turkey) completed and in January 2013, Georgia and Turkey signed a cross-border agreement on electricity trade across new interconnections between them The construction of an electricity interconnection with Azerbaijan and related infrastructure were completed. Projects to expand electrical connections between Georgia and its neighbours and to strengthen the Georgian transmission grid received support from the EU-funded Black Sea Regional Transmission Network: a new 400kV Georgia-Turkey interconnection was completed in December. The EU's support for investment in Georgia's energy interconnections also included the approval in 2013 of a EUR 8 million contribution from the Neighbourhood Investment Facility towards a EUR 71 million investment in the Jvari-Khorga transmission line and substation. Renovation of the large Enguri hydro power plant progressed.

Georgia remained an active observer in the Energy Community. In January 2013 it submitted an application to become a full member. In February 2014, negotiations to become a full member of the Energy Community were launched in Tbilisi in the presence of the prime minister and Commissioner Oettinger.

The year-on-year changes in electricity consumption per capita illustrate the rapidity of the collapse, the slow return to growth and, with higher growth since 2003, the improvements in the overall efficiency of energy use in Georgia since 2003. According to information provided by the Georgian Ministry of Energy the electricity consumption per capita in 2010 was 1,970 kWh.

The evolution of energy production, imports and supply over the 18-year period since 1990 is illustrated below[11]. The bottoming out of the total primary energy supply in 2002 and the slow recovery until it accelerated upwards under the pressure of economic growth in 2004 is very evident.

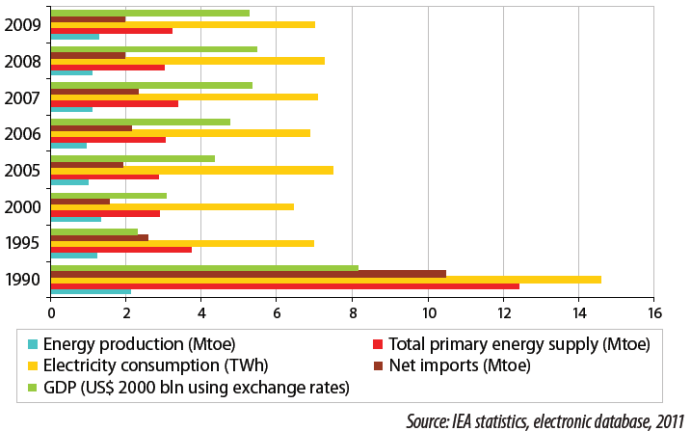


Figure3: The Evolution of Energy Production, Imports & Supply

The distribution of electric energy in Georgia is carried out by three (3) distribution companies: JSC Company "Telasi" in Tbilisi City, JSC Company «Energo-Pro Georgia" almost in all regions of Georgia and JSC Company "Kakheti Energy Distribution" in one of the region of Georgia (Kakheti).

As the capital city Tbilisi is the largest consumer of electricity that receives electricity from a national grid. As it was mentioned electricity in Tbilisi is distributed by the JSC Company Telasi. The major shareholder of Telasi is Inter RAO-UES JSC of the Russian Federation. JSC Telasi distributes about 2 billion kilowatt-hours of energy to 416,500 individual, public and commercial customers per year.[12]

2.3 Basic Description of the Economic Situation related to the Energy Sector

GDP per capita and its development

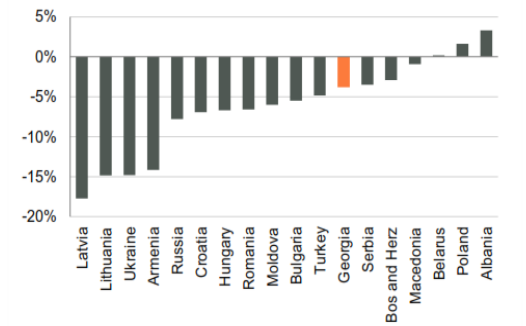
Georgia's macroeconomic performance and general progress with reforms in the past years have been strong. Georgia has achieved significant economic growth, mainly driven by large foreign capital inflows. Foreign investments across different sectors of the economy have contributed to broadening the economic base. Domestic credit has grown rapidly, supported by increased confidence in the banking sector and access to international financial markets. The level of dollarization in the sector has gradually decreased and progress with structural reforms has been significant. Reforms include the regulatory framework for business, free industrial zones, reduced corruption, a simpler tax system and large-scale privatization in critical sectors of the economy.

However, the Georgian economy was greatly affected by both the Russian – Georgian conflict in August 2008 and the international financial crisis. The August conflict undermined investor and consumer confidence, put stress on public finances and damaged the physical and other infrastructures. The intensification of the international financial crisis has put further pressure on Georgia's currency and foreign investments and affected the quality of its loan portfolios and the recovery of bank deposits. Remittances from workers living abroad have declined since the beginning of 2009 due to the global economic slowdown, in particular those from Russia, which is the source of

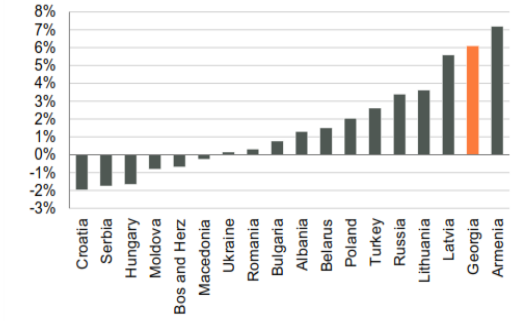
[11] Source: IEA Statistics, electronic database, 2011
[12] GEO-Cities Tbilisi: an integrated environment assessment of state and trends for Georgia's capital city – prepared with project of UNEP and OSCE.

two-thirds of remittances. This negative impact has been partly offset by large-scale international financial support, amounting to about $4.55 billion over three years, pledged in October 2008.

The IMF emergency 18-month stand-by programme of $750 million that started in mid-September 2008 (augmented by an additional $424 million and extended by 14 months in August 2009) also helped with the stabilization process. Ongoing internal political uncertainty has had an impact on investor confidence.



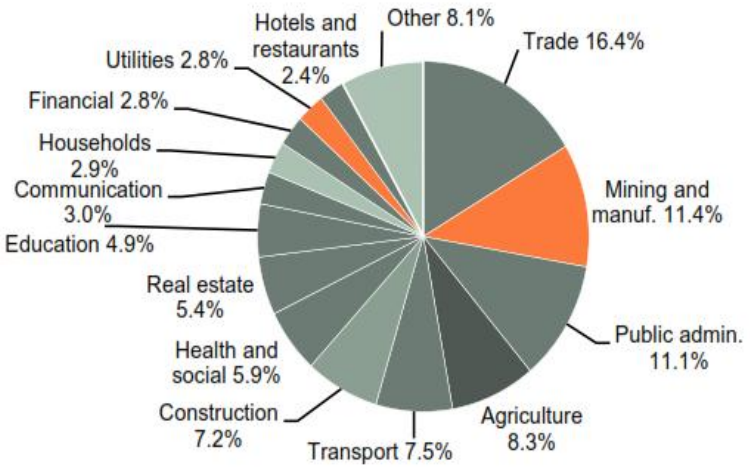
Source: IMF



Source: IMF

Figure 4: Real GDP growth in 2009 vs. peers **Figure 5: Real GDP growth in 2012 vs. peers**

Nevertheless, economic growth slowed in late 2012; Figure:4-5 Georgia's GDP Structure 2012[13]. The slowdown came on the back of the political transition after Parliamentary election in October 2012, as investors sought clarity on the country's development policy. For a country with no significant resources, economic growth has been healthy; except for trade which is diverse on its own, no single sector dominated growth. Real GDP grew only 1.9% y/y in 1H13(2.4% y/y in 1Q13 and 1.5% y/y in 2Q



Note: Households include processing of products by households and private households employing domestic staff

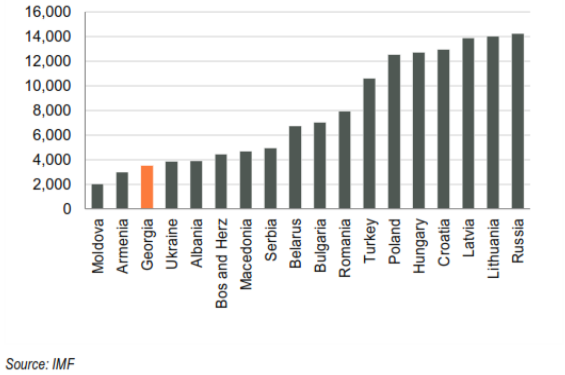
Source: GeoStat

2013).

Figure 6: Georgia's GDP Structure 2012-14

[13] Source: IMF

Georgia's per capita GDP lags regional peers: only Armenia and Moldova come in behind Georgia's



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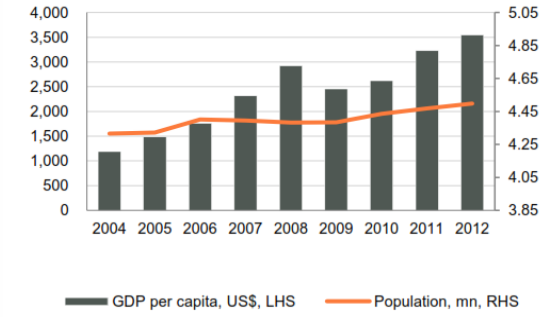


Source: IMF

US $ 3,500l.

Figure 7: Per-capita GDP vs. peers in 2012, US$ and population

Figure 8: Per-capita GDP

The International Monetary Fund (IMF) believes Georgia's economic forecast is optimistic. The Government has forecast a 5% GDP growth rate in 2014 and IMF 6%, respectively. Georgia's economy will increase by 2.5% by the end of 2013, the International Monetary Fund has said in its October report. In the beginning of 2013, the IMF forecasted a 6% growth of the Georgian economy, though downsized it to 4% in June.

The IMF explains the decline in economic growth in Georgia by slower private investment, weak credit growth, and budget under spending. According to IMF forecast, the Georgian economy will grow by 5% next year. The IMF recommends the Georgian government to timely diffuse internal political tensions in order to restore investors' trust towards the country. The forecast of Georgia's economic growth lags behind an average indicator of both the region (5.8%) and low-income CIS countries (6%). The IMF forecasts higher economic growth in Azerbaijan, Armenia and Turkey than in Georgia

According to the IMF report, the unemployment in Georgia will increase by 1.7% compared to the previous year and will reach 16.7%. Moreover, a further increase in this indicator to 17.3% is expected in 2014. According to the IMF, the unemployment will increase at a lesser degree in Azerbaijan, Russia and Turkey than in Georgia. Recent trends suggest the economy is shifting towards new drivers. Heavy investments in infrastructure, both external and domestic, are positioning Georgia better to realize its potential in transport, tourism, energy and agriculture.

	2012	2017F	CAGR %, real growth
Agriculture	8.3%	7.9%	4.7%
Energy	2.7%	2.6%	4.0%
Mining and Manufacturing	11.4%	9.3%	5.0%
Transport	7.5%	7.4%	6.7%

Source: GeoStat, BOG Research

Table 5: Shares of selected economic sectors in GDP

Electricity exports will become a strong contributor to GDP growth once major hydropower projects are completed. Georgia is a regional energy transit corridor for gas and crude oil. Although energy and water supplies account only for about 3% of 2012 GDP, electricity generation might become the fastest growing GDP components in future. After being electricity importer for more than a decade

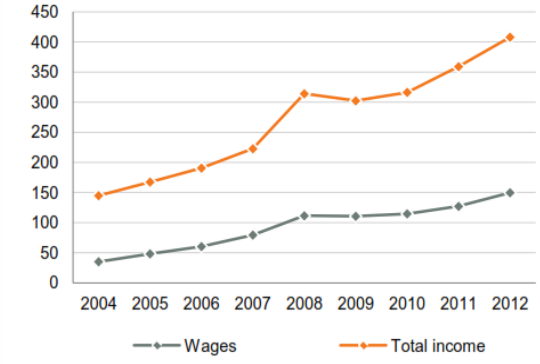
beginning from 2007 Georgia exported on average 0.9TWh annually; the country has the potential to produce 5 times more electricity, which is the cheapest in the region. There are significant export opportunities to neighboring countries, especially Turkey. With the completion of the transmission line between two countries the export potential to Turkey will increase.

Georgian regulation of the hydropower sector offers potential investors ownership advantages - newly built HPPs will remain property of the investors, HPPs with installed capacity under 13 MW have the right to operate without a license and sell electricity to consumers. After 2008 tariffs has been deregulated and Electricity System Commercial Operator (ESCO) guarantees purchase of electricity at market price if sold locally in winter.

15 % of Georgia's population is still unemployed. Agriculture is the largest employer, accounting for 53% of the workforce of about 2 mn people. 46 % of Georgians name unemployment as the country's most pressing issue[14].

Note: Unemployment rate is calculated as total number of unemployed to labor force.
Source: GeoStat

Figure 9: Total Employed and Unemployed Rate



Source: GeoStat

Figure 10: Averaged Monthly income per household US$

Tax collection is the main revenue source, accounting for 88% of total revenues in 2012. In 2013 according to IMF budget revenues are forecasted at 7.7 bn. There are following taxes in Georgia

- VAT- 18%
- Income tax-20%
- Social tax-nil
- Corporate Profit tax-15%
- Dividend & Interest Income Tax-5%
- Property tax- up to 1%[15]

Average monthly salaries in GEL of Georgians employed by business sector given in the Figure 11 and Table 8 below:

[14] Source: Geostat
[15] Source: Georgia's Pocket Tax Book

Table 8: Average monthly nominal salary of employees in business sector by economic activity, 2006-2011

GEL

	2006	2007	2008	2009	2010	2011
Total	**285.8**	**381.6**	**519.8**	**538.1**	**592.7**	**622.6**
Agriculture, hunting and forestry	143.0	185.8	300.7	261.3	278.1	392.0
Fishing	94.4	168.8	211.1	257.2	341.4	271.1
Mining and quarrying	352.3	657.7	808.9	677.7	812.3	838.6
Manufacturing	260.4	357.5	510.2	447.6	510.2	552.3
Production and distribution of electricity, gas and water	398.2	533.8	738.5	767.0	822.9	877.0
Construction	391.0	495.1	600.9	629.0	674.6	741.3
Wholesale and retail trade; repair of motor vehicles and personal and household goods	246.4	355.5	510.6	517.7	583.6	548.9
Hotels and restaurants	196.7	238.5	333.7	364.9	377.9	342.5
Transport and communication	391.3	491.0	666.9	729.4	786.5	866.8
Real estate, renting and business activities	332.3	462.9	611.6	714.9	765.1	717.9
Education	136.5	187.5	259.8	301.8	349.3	365.2
Health and social work	141.5	199.2	292.3	352.0	435.0	496.6

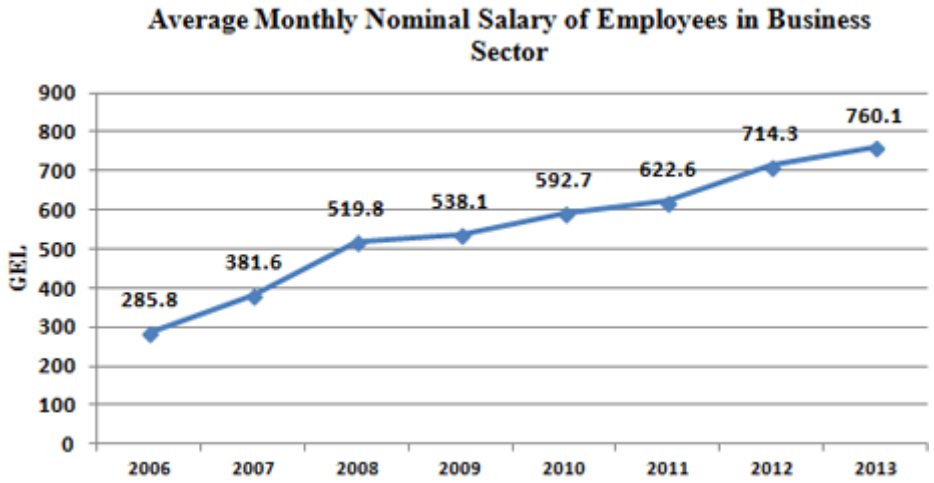


Figure 11: Average Monthly Nominal Salary of Employees in Business Sector

Exchange Rates	2006	2007	2008	2009	2010	2011
	2.287	2.40	2.06	2.45	2.34	2.22

Table 7: Exchange Rate of GEL with EURO

Table 8: Average monthly nominal salary of employees in business sector by economic activity, 2006-2011

The figures 12 &13 below illustrate the energy consumption for 2012 by the various sectors of the economy[16]:

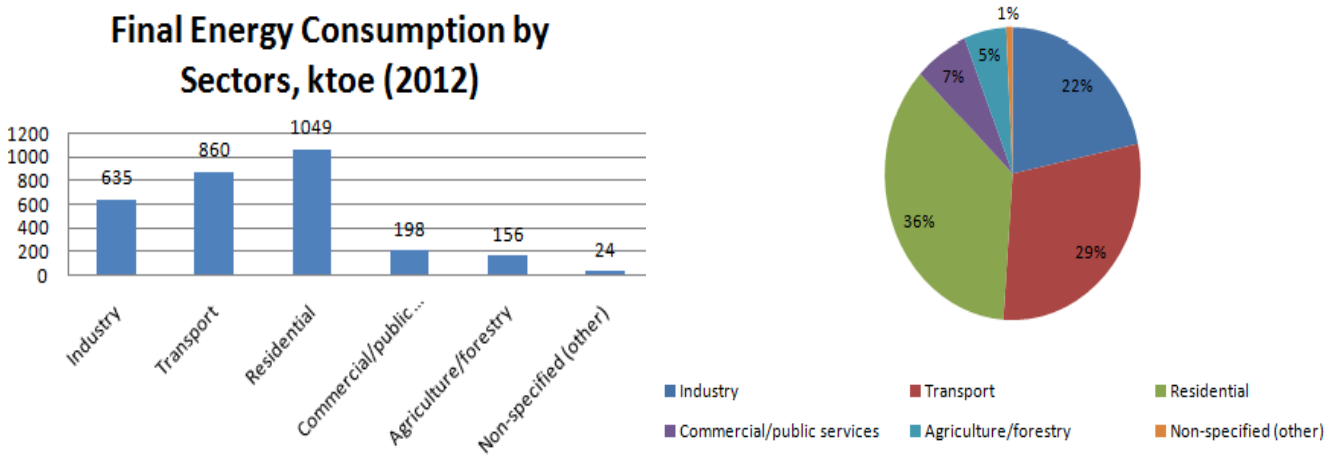
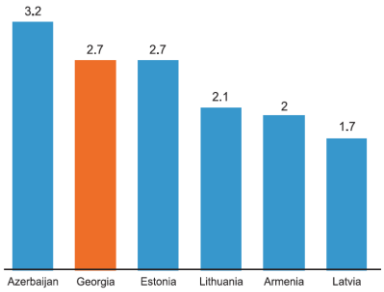


Figure: 12 & 13 Energy Consumption for 2012 by the Various Sectors of the Economy

Residential sector stands first in energy consumption which could be mainly attributed to the heating of living spaces. Georgia is dependent on imported natural gas and oil from Russia and Azerbaijan, and as a result, economic growth and resulting increases in energy demand indicate that the need in energy efficient improvements in industrial sector is of high importance.

[16] Source: Energy Efficiency Centre - database

Georgia has one of the most energy-intensive economies (Energy Efficiency: A new resource for Sustainable Growth. Researching energy efficiency practices among Georgian companies. IFC World



Bank Group) when compared with similar countries. Only Azerbaijan consumes more energy per U.S. dollar of gross domestic product adjusted to purchasing power parity in the region. In below Figure14[17] is presented the energy intensity in Georgia and its peers: ENERGY CONSUMED PER $ OF GDP *in kWh/$* (constant U.S. dollar at purchasing power parity)

Figure 14 is presented the energy intensity in Georgia and its peers

Energy Prices and Their Development

The Georgian National Energy and Water Supply Regulatory Commission (GNEWRC) sets tariffs for the generation, transmission dispatch, distribution, import and consumption of electricity and for the transport, distribution and consumption of natural gas.

Electricity consumption tariffs for electricity in Georgia are regulated by the GNEWRC. Large consumers can be supplied through direct contracts with generators in the bi-lateral market. The tariff policy methodology is based on a full cost recovery principle for production and supply, stipulated by the law and tariff methodology.

Regulated tariffs for electricity consumers are based on supply-distribution costs and total approximately 0.06 – 0.07 EUR/kWh for 6/10 kV consumers and 0.07 – 0.08 EUR/kWh for consumers supplied with 380/220 V electricity. In order to create additional guarantees for social protection and for the promotion of the rational consumption of electricity, rigid step tariffs were introduced: for the consumption of up to 100 kWh and 101-300 kWh, and for more than 301 kWh.

These values have to be compared with average prices in the European Union of 0.173 EUR/kWh for households and 0.105 EUR/kWh for industry (source EUROSTAT 2010). According to local experts the electricity tariff has not changed since 2006 despite an overall inflation of about 35% in the relevant period. Electricity bills of households amount to 3% of all total expenditures according to the latest analysis of WEG (www.weg.ge) and are considered affordable at the current level.

The metering system is based on individual meters installed in each household or commercial entity, though in some rural areas there are still communal meters. The system for electricity bill payment includes service centre payment points: dedicated bank branches or post offices. Current tariffs for natural gas consumption have to be differentiated between residents of Tbilisi and other residents.

Residents of Tbilisi, who consume low pressure gas, pay 0.23 EUR/m³. Those, who consume average pressure gas (mostly bakeries), pay 0.21 EUR/m³, while consumers of high pressure gas (large enterprises) pay 0.17 EUR/m³, including VAT.

[17] Source: Key World Energy Statistics, International Energy Agency,2008

Residents of various other regions of Georgia pay 0.23-0.25 EUR/m³ per cubic meter of gas, which corresponds to approximately 0.03 EUR/kWh when assuming 8,816 kWh heat can be produced with one m³. Residents in the European Union pay on average 0.054 EUR/kWh.

In winter period the government subsidies the natural gas consumed by the population in Kazbegi Municipality and several villages in Dusheti municipality.

Consumers	Tariff incl. VAT EUR/m³
Residents of Tbilisi, who consume low pressure gas	0.23
Residents of Tbilisi, who consume average pressure gas	0.21
Residents of Tbilisi, who consume high pressure gas	0.17
Residents of various regions of Georgia	0.23-0.25

Table 8: Current tariffs for natural gas consumption[18]

Energy Prices for Households (Q1 & Q2 2012)[19]		
Logwood	0.039	EUR/kWh
Pellets	0.24	EUR/kg
Heating oil	n/a	EUR/kg
Coal	0.16	EUR/kg
Natural gas	0.03	EUR/kWh
Electricity	0.07	EUR/kWh

Table 8: Energy Prices for Households (Q1 of Q2 2012)

2.4 Energy Policy

At present time Georgia does not have officially developed energy policy and/or energy strategy. Georgia is pursuing market-orientated policies to promote its economic development and where possible to better align its prospects for trade with neighboring markets. The potential for regional trade in electricity is real and current efforts are designed to secure the necessary generation and infrastructure to access markets in Turkey and earn revenue from sales. The ultimate aim and overarching consideration is to integrate into the wider regional and EU economy[20].

[18] Source: Georgian National Energy and Water Supply Regulatory Commission

[19] Source Energy Efficiency Centre Database

[20] In-Depth Review of Energy Efficiency Policies and Programmes: Georgia – prepared by Energy Chapter Secretariat , 2012

As was above mentioned, after political-economic crisis in the 1990s the Georgian energy sector has fallen in poor condition. Since 2004 a restoration/rehabilitation actions of energy sector were identified as a top objective which itself would promote the economic recovery as well. In 2006 the Parliament of Georgia approved Main Directions of State Policy in the Power Sector of Georgia (MDSPPSG) on which was started full utilization of energy resources and diversification of imported supply energy carriers and promoted the achievement following objectives: cover the full energy demand of industry and household sector, achievement of economic independence and provision security (technical, economic and political) of energy sector.

Currently, one of the Georgian government's top priorities is the maximum utilization of the abundant hydro resources. More specifically, the main objective of the long-term energy policy is to attract foreign construction investments to cover the country's demand from its own resources, which should be implemented in two stages: first, replacement of the import, and then the thermal generation replacement.

Based on the potential of the high-capacity power generation and the increasing demand, the main objectives of the energy policy were identified:

- Rehabilitation of the infrastructure connection to the neighbouring countries' energy systems;
- Construction of the new transmission lines and substations;
- Export of the surplus power generated in new and existing power plants[21]

2.5 Legal Basis

The principal energy sector's primary legislation is the "Law on Electricity and Natural Gas" (1997), which incorporates elements of energy regulation and market rules in line with EU principles. This law also stipulates the establishment and functioning of the energy regulator. The law has been amended many times (over the last years) to include regulations and decrees improving the market rules, etc. in line with the EU model. The law prescribes the roles and functions of the two main state institutions responsible for the development and operation of the electricity and gas markets: the Ministry of Energy and the National Energy Regulatory Commission. The Law of Oil and Gas that was passed in 1999 and later amended is the legal basis for the development of the oil and gas resources of Georgia. The main objectives are to:

- Support and promote investments in the oil and gas sector of Georgia;
- Protect the legal interests of the investors engaged in oil and gas operations (exploration and production) in Georgia;
- Create an effective legal basis for the state supervision and control of oil and gas operations in Georgia (Georgian Oil and Gas Regulatory Agency) inter alia, with the establishment of a relevant state body and the determination of functions of the National Oil Company of Georgia.

Approved resolution on the Main Directions of Energy Sector is addressed to Georgian legislative and executive bodies, and national regulatory commissions of power, oil and gas. They are to be reflected through legislative and normative acts, the implementation of state programmes and state-funded projects, participation in international actions, privatization and other actions foreseen by Georgian legislation.

[21] http://www.energy.gov.ge/investor.php?lang=eng&id_pages=16

The intent is to provide for the efficient utilization of power resources and energy security as well as third-party access to the electricity transmission and distribution networks. Wider goals include:

- Attracting local and foreign investments and privatization;
- The economic sustainability of the sector;
- Bilateral and regional cooperation;
- The liberalization of the energy markets. The key to sustainability is provision for a tariff policy and metering;

Secondary legislation comprises different statutory acts, such as government resolutions, ministerial orders and the GNEWRC (Georgian National Energy and Water Supply Regulatory Commission) resolutions. The latter include the methodology for electricity and natural gas tariff approval and setting (1998, 1999), various amendments in the period 2002-2010 and also supply and consumption rules that determine the retail market and power supply conditions for consumers22.

Despite the fact that Georgia doesn't have energy policy and/or energy strategy or even legislation related to the energy policy/strategy including renewable energy and energy efficiency policy, it has signed various international, multilateral and bilateral agreements that require concrete development and establishment actions from Georgia in terms of renewable energy sources and energy efficiency:

- Energy Charter Treaty and Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA);
- Framework Convention on Climate Change and the Kyoto Protocol;
- Clean Development Mechanism (CDM) under the Kyoto Protocol;
- European Neighborhood Policy;
- EU Green paper;
- MoU signed with Kingdom of Denmark in 2004;
- Covenant of Mayors;

All of the above international agreements oblige Georgia to implement the following actions:

- Harmonization with the EU legislation
- Enactment of the Laws:
    - *Law on Energy Efficiency;*
    - *Law on Renewable Energy Sources;*
    - *Enactment of Climate Development Mechanism;*
    - *Enactment of building standards and codes;*
    - *Enact the Standards on Energy Efficiency and Renewable Energy;*

Chapter 3: current situation with EE/RES

Despite the fact that Georgia signed different international agreements including the Energy Charter Treaty, the Framework Convention on Climate Change and the Kyoto Protocol, the Energy Community Treaty, the European Neighbourhood Policy which binds to develop RES/EE in Georgia. there is no State policy and/or legislation advancing RES/EE development. At the time this kind of approach was explained with Georgian government's belief in free economic development where the market regulates itself in energy sector. Consequently, the absence of a general vision and/or

[22] In-Depth Review of Energy Efficiency Policies and Programmes: Georgia – prepared by Energy Chapter Secretariat , 2012

realistic targets, the fragmented legislative initiatives (Law on Electricity and Gas, Main Directions of State Policy in the Power Sector of Georgia) do not fully address the needs of EE/RES development.

Georgia has signed the above-mentioned agreements that are voluntary and in some cases mandatory which itself offer some financial incentives and project financing opportunities for Georgia to develop innovative EE/RES projects and undertake energy sector reforms to harmonize its energy legislation with international standards.

Georgia is the only country in the region, which has not adopted energy efficiency and renewable energy laws, and this is more of a sign of underdevelopment, rather than of a certain economic policy. Indeed, this field is related to modern technologies, research and development, advanced institutions, commercial and banking systems, and commercial companies. Its implementation requires high level of energy consciousness and subtle mechanisms of economic incentives, which are characteristic of a highly developed society. This is one of the essential elements for European energy cooperation and refusing it means rejecting development and international technological and financial assistance.

Some main positive changes in terms of EE/RES policy have taken place from 2010 when some Georgian municipalities (Self-governing Tbilisi City, Self-governing Rustavi City, Self-governing Batumi City, Self-governing Kutaisi City, Self-governing Poti City, Gori municipality, Zugdidi municipality and Telavi Municipality) have joined EU initiative and signed a Covenant of Mayors taking the commitments to reduce CO2 emissions by 20% by 2020. Some of the Georgian signatories of the Covenant of Mayors (Self-governing Tbilisi City, Self-governing Rustavi City, Self-governing Batumi City and Gori municipality) elaborated the Sustainable Energy Action Plans (SEAP) which envisages the implementation of EE/RES measures in various sectors. So, it could be said that these (SEAPs) are the only real political documents which reflect EE/RES policy on local municipal level. Some positive changes are also observed on state/governmental level as well. More specifically, at the Ministry of Energy of Georgia, the department of Energy Efficiency and Renewable Energy responsible for the development of EE/RES policy of the country has been recently created. Currently this department is actively working on the development of the country's EE/RES policy/strategy, with USAID support.

At present the leading role in the development of EE/RES in Georgia is played by the international institutions & donors (EU Commission, USAID, the United Nations Development Program (UNDP), BP to Georgia, the German development Bank of KfW, the Global Environment Facility (GEF), EBRD, the Norwegian Government and etc.) which also give the major encouragement and ensure financial support for various EE/RES programmes and projects. Nowadays, almost every EE/RES innovative projects and/or programmes in Georgia are implemented by local and/or international non-governmental organizations with the support of foreign international financial institutions or private companies. Most popular EE/RES innovative projects are solar, hydro and biogas technologies and various weatherization measures in the buildings, etc.

Since 2000, a new phase of the energy sector's rehabilitation has started and new, modern equipment and control systems were introduced in all rehabilitated HPPs. According to the Ministry of Energy, currently 13 hydro plants are under construction. The installation of modern equipment is envisaged for these plants.

One of the most interesting developments is that natural gas is starting to substitute diesel and gasoline in the transportation sector.

O&G is adopting a lot of new technologies, and a lot of funding is going into innovations that can help oil and gas companies work smarter.

Private investments made by gas distribution companies in construction of new structures equipped with up to date equipment and devices, introduction of modern metering systems for consumers has positive impact on both supplied gas pressure and improvements in the settlement system.

The EE/RES technology market is still evolving in Georgia. Most of the EE/RES innovative technologies are imported from Turkey, China, Ukraine and Germany. The imports and/or exports are not regulated due to the absence of relevant legislation. Accordingly the energy market in terms of EE/RES in Georgia is a bit chaotic, with different technologies in use, with and/or without relevant certifications. A small number of locally produced EE materials/technologies are available on the local market. In general, Georgian producers cover some areas of production of energy efficient construction materials and light construction materials. Along with EE technologies there are a number of companies which provide innovative RE technologies and servicing as well. As estimated by private sector representatives, currently only about 10-15% of market potential is absorbed. New market players are welcome in these areas for further growth of already existing capacity and launching of the new EE/RES productions lines.

A quite an interesting pattern is unfolding in terms of consumers' attitude towards EE/RES technologies on the market. More specifically, at present there is interest in EE/RES innovative products but there is still a lack of demand for them from any sector, such as household or business. The mentioned situation could be explained by several factors: first, due to the absence of EE/RES legislation there is no obligation for any sector to develop and establish EE/RES initiatives, secondly, low awareness of society and thirdly, high cost of EE/RES on the market. Accordingly at present its development fully depends on customers' willingness, knowledge and financial abilities. At the same time despite the current situation, EE/RES innovative projects are being implemented in the country in personal initiatives both in business sector and households. Nowadays the most popular in the rural areas of Georgia are solar systems (solar water heating systems) and biomass applications (EE stoves, biogas and etc.), while the in urban areas EE technologies (EE construction materials and heating systems). As to business sector, local banks recently started financing energy efficient measures in newly constructed buildings. JSC '$m^{2'}$ Real Estate, a wholly owned subsidiary of JSC Bank of Georgia is an example of such commitment. The company is among pioneers in introducing energy efficient technologies in residential building construction. Another example is also bank supported – the new environmentally friendly Green LISI Town. The Green Lisi Town will occupy an area of about 400 acres around the Lisi Lake in Tbilisi and besides residential buildings will include a big recreational zone. The construction works started in the autumn of 2011 and only the first phase of works has been completed. Within the framework of the Project "LISI Veranda" particular attention is paid to the quality of the construction materials, its ecological properties and energy saving properties. Based on the research and recommendations of invited European experts, the following construction brands were selected: "SCHUCO" aluminum stained-glass windows of German origin, Leegwater Houtbereiding bv, S.ANSELMO for façade finishing, etc. Another example of energy efficient building is American Academy in Tbilisi (GZAAT). The building is constructed based on the green principle and uses energy-efficient elements: natural lighting, geo-thermal heating, special control and regulation systems, energy-efficient materials. Pro-credit Bank has also established green loans for its customers willing to introduce RE/EE technologies in their homes or businesses.

Chapter 4: Innovation situation in the energy sector

4.1. General description of economic situation related to EE/RES

For Georgia, innovative economy means opening its rich natural capital to new business opportunities that drive economic growth and development, while simultaneously ensuring that these assets continue to provide the resources and environmental services on which our well-being relies. Accordingly, developing of innovative economy especially in the energy sector is a step forward to sustainable energy development for Georgia, which itself will facilitate the economic growth and create new jobs.

In the past years Georgia's macroeconomic performance and general progress with reforms has been strong. Georgia has achieved significant economic growth, mainly driven by large foreign capital inflows. Foreign investments across different sectors of the economy have contributed to broadening the economic base. Domestic credit has grown rapidly, supported by increased confidence in the banking sector and access to international financial markets. However there are no significant shifts/changes in the economy in terms of developing innovative mechanisms, especially in the energy sector, excluding rehabilitation works.

In Georgia during the soviet epoch a number of research institutions acting in various fields, including the Institute of the Energy of Georgia, were very active. But after the USSR collapse some of them were abolished and/or affiliated to universities as research centers. Accordingly, due to the reorganization of the research centers their activities and scale of financial support was reduced and their work is presented in small-scale studies which are mainly funded by international organizations.

It should be noted that some university based research centers are trying to establish innovative technologies individually in the Georgian market. The tendency mentioned can be observed especially in EE technologies/innovations for the building sector. The linkages between energy research institutions/centers and business are very weak and there's almost no cooperation between them. The reason of this could be explained by:

- No interest in EE/RES innovations from the local business sector;
- No incentive measures for supporting EE/RES development on the market;
- No sufficient government support for research centers ;

Although the Georgian government declared that development of EE/RES innovations is one of the priorities, no specific changes, nor any kind of support from government for development of EE/RES innovations are expected before the development of EE/RES policy/strategy and/or legislation, .

Until now the changes that occurred in the energy sector of Georgia were supported by international organizations. Energy issues are an important component of the EU's cooperation with Georgia. Within the framework of the Eastern Partnership, launched in 2009, the policy cooperation between the EU and the partner countries was enhanced in several fields of importance such as energy efficiency, renewable energy and support for infrastructure development, interconnection and diversification of supply; regulatory framework and approximation to EU energy policies. The projects that EU implements in Georgia aim at improvement within these fields. The EU supports the Black Sea Transmission line between Turkey and Georgia with € 8 million, which will facilitate future electricity exports. The EU support aimed at preparing the tender documentation and to enable an alternative routing of the line which mitigating the environmental impact on the national

parks in Georgia (Borjomi-Khalagauri national park).The EU has also granted €11.5 million for the refurbishment of turbines of the Enguri hydro power plant.

Under the regional INOGATE programme, the EU has financed numerous projects – mainly through technical assistance. One of them supports the Tbilisi Municipality's participation in the Covenant of Mayors, which is a European movement involving local and regional authorities, voluntarily committing to increase energy efficiency, reduce CO2 emissions and to increase Renewable Energy. Specifically, this project will deliver solutions to increase energy efficiency in public buildings and disseminate the experience to other cities of Georgia. The support from the EU amounts to € 500 000.

With an INOGATE technical secretariat having opened in Tbilisi at the beginning of 2012, the process of identifying further relevant projects in Georgia will be facilitated.

The EU recently extended financial support to strengthen the capacities of the Georgian National Electricity Regulatory Commission (GNERC) in updating its incentive based electricity tariff methodology. This aims at promoting long term investments and functions in line with EU standards and best practices. The total budget of the project is € 1 million.

Georgia remained a reliable energy partner for the EU in developing the Southern Corridor. In the electricity sector, work on the Georgian side of the Black Sea Energy Transmission Network (Azerbaijan-Georgia-Turkey) is progressing well. The construction of an electricity interconnection with Azerbaijan and related infrastructure were completed. Renovation of the large Enguri hydro power plant progressed. In January, Georgia and Turkey signed a cross-border agreement on electricity trade across new interconnections between them. Georgia remained an active observer in the Energy Community. In January 2013 it submitted an application to become a full member. Georgia is encouraged to strengthen the energy regulator’s independence and capacity and to continue working on gas market reform, including unbundling. It is also encouraged to step up efforts on renewable energy and energy efficiency including by adopting legislation in these areas.

Investment in research and innovation continued to remain at a relatively low level. Georgia ranked 71 out of 141 countries on the Global Innovation Index in terms of its innovation capabilities and results. Its expenditure for research and innovation over the last few years remained below 1% of GDP. Based on the Georgia ENP Progress report for 2012 since 2008, Georgia has become increasingly involved in the FP7 through 31 projects covering infrastructural and networking measures, and to a lesser degree, pure research, in the areas of health, information technology and communication, environment, social sciences and humanities. A total EU contribution to these projects amounts to EUR 156 million, more than EUR 3 million of which is given to the 26 Georgian public and private institutions participating in these projects.

As stated in Georgia ENP Progress report for 2013, cooperation with the EU progressed in the field of research and innovation. Georgia increased its participation in the Seventh Framework Programme (FP7), being involved in 63 projects with a total EU contribution of EUR 5.4 million. Six new FP7 projects (R2I-Research to Innovation) involving Georgian stakeholders were launched with EU funding of around EUR 6 million, aiming at fostering research-industry partnerships, supporting Georgian capacities in the innovation domain and facilitating the commercial exploitation of research results. A new FP7 regional project, the INCONET EaP, involving the Shota Rustaveli National Science Foundation, was launched in September 2013 for three years with a view to preparing the transition to Horizon 2020 and promoting the cooperation opportunities this new programme will bring.

The most popular partners for Georgia in international cooperation activities besides EU are:

- **United States Agency for International Development (USAID);**
- International Finance Corporation (IFC);
- European Bank for Reconstruction and Development (EBRD);
- Asian Development Bank (ADB);
- Kreditanstalt für Wiederaufbau (KFW);
- European Investment Bank (EIB) and others;

Chapter 5: overview of critical stakeholders

When talking about stakeholders acting in EE/RES field in Georgia the following sectors could be emphasized: international and local non-governmental sector, international financial institutions, governmental sector, local and municipal authorities, business sector, household sector, educational sector (universities, research institutions).

In 2010-11, as a result of reorganization, a number of scientific-research institutions in subordination of the Ministry of Education and Science were affiliated to higher education institutes and universities as independent research units. The main aim of this policy was to promote a gradual integration and to increase the effectiveness of scientific and research activities, and that of higher educational institutions. In addition, the reorganization of higher education institutions was aimed to facilitate the development of science and capacity building of scientific researchers in higher educational institutions and to improve the cooperation with international scientific community. Thus currently the scientific research institutes conduct their research work in universities. In the below listed universities various scientific researches in EE/RE field areas conducted:

- *Science Department at the Technical University* - is a structural unit of technical university, with core activity to promote and develop the latest fundamental and applied research of engineering problems arising at the university departments and scientific research centres. This at large determines education focused on new, up to date scientific achievements. Several scientific research centres and institutes at GTU work in the field of EE/RE innovations like Thermal and Hydro Energy, Thermal Power Plants, Renewable Energy and Energy Efficiency.
- *Faculty of exact and natural science at the Tbilisi State University (TSU)* is known for its outstanding scientific activities. 39 scientific directions comprise wide range of research activities. The faculty undertakes a number of scientific projects funded by national and international foundations. Lots of scientific-technological innovations are patented. The Research Management in TSU is carried out by the Department of Scientific Research and Development (R&D). Department helps Faculties'/Institutes' staff to secure external funding to support their research, promotes, supports and administers quality research activity at TSU. Nowadays TSU combines and provides basic financing to 16 scientific research Institutes, which operate under the aegis of the Department of Scientific R&D. The main source of financing of research is external grants.
- Ilia State University (ISU) is a higher education institution that strives for academic excellence and integrity in teaching and research. ISU's recognition at home and abroad, amongst many of its partners worldwide is due to ISU's unique institutional capacity that is reflected, primarily, in the quality of academic staff recruited successfully throughout Georgia and beyond. Secondly, in the strong focus on and commitment to research conducted in the

areas relative to Georgia's geopolitical standing and social, political and cultural development, and in its distinctive ability to initiate an open, unbiased public policy discussion. Over a short period of time, ISU has emerged as one of the leading reformers in Georgian higher education system and has managed to evolve into one of the most selective universities and prestigious study destinations in the country.

ISU was established in 2006 as a merger of six different institutions, each having a long history and a diverse institutional profile. With its over 800 academic staff, the university strives to provide excellence in all areas of academic practice and scientific research in Georgia. Four Schools – Arts and Sciences, Business, Law and Engineering - each offer distinctive training in their respective direction.

Ilia State University unites 25 Research Institutes, Centers and Laboratories dispersed across the country. The diverse profile of these research institutions and laboratories create a unique opportunity for research and practice on the topics relevant to Georgia's role and contribution to the international community.

Currently, Ilia State University has:

- Reached the highest research citation index in Georgia; fourteen percent of ISU's annual budget is allocated for research and ISU is the first University in Georgia to use international peer reviewing in its pub publications;
- One of the top positions among Georgian HEIs in Webometrics Ranking Web of World Universities that ranked 12,000 HEIs worldwide indicating performance and visibility;
- Academic and research infrastructure in every region of Georgia (25 large and small research centers and stations);
- 10,000 student places: strong competition in the university entry examinations is rising and/or the demand has been maintained in spite of an increased intake of student body each year;
- Pioneered to transform itself into the first Liberal Arts Educational Institution[23];

There are also scientific foundations that support various innovative researches and projects in EE/RES:

- Shota Rustaveli National Science Foundation;
- Georgian Research & Development Foundation (GRDF);
- Science and Technology Center in Ukraine (STCU);
- International Science and Technology Center (ISTC);
- Scientific and technological research council of turkey (TÜBİTAK);
- Centre National de la Recherche Scientifique(National Center for Scientific Research);

As it was mentioned above, nowadays in Georgia the majority of EE/RES innovative projects are actively financed by international financial institutions. International financial institutions (EBRD, KFW, IFC, USAID, UNDP, etc.) usually finance projects both in state and private sectors. Georgian banks, basically the Bank of Georgia and TBC Bank have been the main financial intermediaries of those funding, usually with low interest rates, generally distribute the loans among large-size participants of the system. Private companies which mainly adopt the funding are local generation,

[23] http://www.iliauni.edu.ge/index.php?lang_id=ENG&sec_id=3

distribution or transmission companies. Usually for those companies the procedures of loans are more or less simplified and out of the typical rules.

Without the International Financial Institutions' (IFI) active support to energy investment projects, the situation with the financing of such projects would be even worse. Among the large infrastructure projects, IFI are funding energy projects dealing with power transmission, power generation and energy efficiency issues.

The most active IFI community in Georgia is represented by the following institutions:

- International Finance Corporation (IFC)
- European Bank for Reconstruction and Development (EBRD)
- Asian Development Bank (ADB)
- Kreditanstalt für Wiederaufbau (KFW)
- European Investment Bank (EIB)

Asian Development Bank (ADB) financed large scale projects where the main stakeholder was the Government of Georgia (GoG). Regional Power Transmission projects with 350 and 48 million USD lent to GoG, respectively, can be highlighted among the energy loans.

In terms of government organizations in EE/RES innovations' sector, the Ministry of Energy of Georgia plays an important role. It is responsible to develop EE/RES policy and strategy for the country and is a country coordinator of the Covenant of Mayors (CoM) related issues, along with the Ministry of Environment and Natural Resources Protection of Georgia. The Ministry of Economy and Sustainable Development of Georgia is responsible for EE innovation policy. In February 2014, the decision to establish Technology and Innovation Agency of Georgia was made at the Government meeting. The aim of the agency is to create an innovative ecosystem, promote the use of innovation and technologies in various field in Georgia and promote commercialization of innovative research and development.

The Technology and Innovation Agency of Georgia will implement the specific projects and programs in order to support the innovation and technology adoption in the country. It will also promote the commercialization of the research and development, as well as IT business, distance employment and creation and implementation of Georgian program software. The Agency will develop technological infrastructure. Special attention will be paid to the formation of the export oriented IT industry, as well as innovative start-ups and creation of technology companies and the increase of the effective use of innovation and technology.

Both financial and non-financial institutions are being created in order to achieve the agency's goals. The Technology and Innovation Agency of Georgia will form the infrastructure for the innovation and technology commercialization, including technology parks, innovation centers, accelerators and innovation laboratories. The Technology and Innovation Agency of Georgia will start operating in the near future[24].

As for EE/RES policies in local municipalities, those ones which joined EU initiative of Covenant of Mayors by taking commitments to reduceCO2 emissions by 20% by 2020, develop, plan and implement EE and RE projects. In Georgia, 5 self-governing cities and 3 municipalities are CoM signatories.

[24] http://www.economy.ge/en/media/news/technology-and-innovation-agency-of-georgia-will-be-established-according-to-the-decision-of-the-government-of-georgia

It should be noted, that local non-governmental organizations play an important role in the promotion and popularisation of RES/EE technologies in Georgia. At present there are some organizations that implement various RES/EE related projects, including practical demonstration projects as well as energy audits, policy research papers, consultancy, trainings, workshops etc. financed mainly by different international donor organizations. The most active local NGOs in Georgia in the RES/EE field are:

- "Sustainable Energy Centre – Sun House";
- Greens Movement of Georgia/FoE;
- Sustainable Development and Policy Centre;
- World experience for Georgia;
- Caucasus Environmental NGO Network;
- Rural Communities Development Agency (RCDA);
- Union for Sustainable Development – Ecovision;
- Regional Environmental Centre for the Caucasus (REC Caucasus);
- Union "Energy Efficiency Centre Georgia" etc.

One of the important stakeholders in the implementation of EE/RES innovations is the business sector represented by two types of stakeholders: companies importing the EE/RES innovative technologies and companies producing local EE innovations mainly for the building sector. Also, it should be noted that local companies producing EE innovative products at the same represent the research centres.

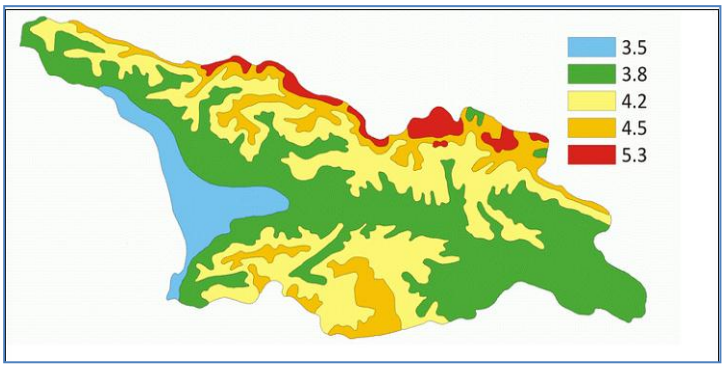
Chapter 6: Analysis

6.1. General information of Renewable Energy Sources in Georgia

Georgia has considerable resources of almost all types of renewable energy sources (RES) - solar, wind, geothermal, hydro, and biomass. The achievable annual potential of all RES can be estimated at 10-15 terawatt hours (TWh). This is enough energy to meet a third of Georgia's annual energy needs. Although only a very small part of this potential is used currently. The share of renewable energy in Georgia's energy balance is approximately 1%. Currently apart from large hydro power, the amount of electricity generated from renewable energy source is approximately 3% of the total amount of electricity produced.

6.1.1. Solar Energy Capacity

The climatic conditions of Georgia are favourable for utilizing solar energy. Most regions of the country have 250–280 days of sunshine per year. Direct and global radiation reaches daily values from 3.5 to 5.3kW/m² and an annual average of about 1,550kW/m². The potential of solar energy, however, is strongly seasonal and varies by a factor of more than four from mid-summer to mid-winter. The achievable potential of solar energy in Georgia is estimated at



Picture 3: Average daily solar radiation in kWh/m2; Source: the solar energy cadastre of Georgia.

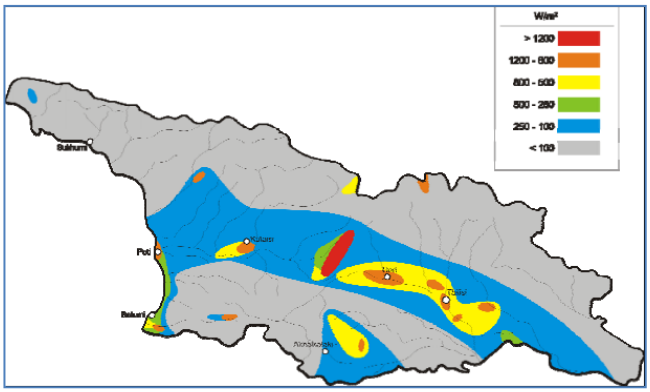
60–120 GWh annually. Based on these estimates, one can calculate that on average about 190 kWh of electric energy can be annually obtained from one m² surface of solar PV panels and 1,200 kWh of thermal energy (hot water) from solar water heating panels.

The use of solar energy in Georgia is still low, but during the last 10-15 years, solar water heaters became increasingly popular in regions of Georgia. Solar systems are mostly imported from China, Turkey, and Germany. Based on the offered price the most widespread are Chinese solar water heaters. Several private companies are specializing in import and installation of solar systems. The 180 l/day systems cost approximately 1,000–1,500 USD. Currently there are no legal acts or tax benefits supporting the development of solar energy use in Georgia. For water heating systems, the investment payback period is about 3–9 years; these are most profitable in applications where hot water expense is high and the main load is in summer (swimming pools, hotels). Although more than 70 % of this potential is realizable in the months of April through September, solar power can contribute to reducing energy dependence by almost completely replacing the need for gas currently used for hot water supply throughout the year.

As to solar PV panels, due to their very high price they are less common and basically their installation is justified in off grid high mountain villages of Georgia. It should be noted that such kind of projects are mainly supported and financed by international organizations within the various projects and programmes.

Currently there are no legal acts in support of development of solar energy use in Georgia. Until recently, the solar systems received tax benefits and were exempt from the VAT. However the new tax code has eliminated these and other benefits. As a result, the price of solar panels in Georgia has increased by 35-40% due to transportation and the taxation costs after importing.[25]

6.1.2. WIND ENERGY CAPACITY OF GEORGIA



Picture 4: Average daily solar radiation in kWh/m2; Source: the solar energy cadastre of Georgia.

The wind potential capacity for Georgia is studied by the Wind Energy Research Center of Kanergo. Measurements of wind speed have been carried out in Georgia on 165 meteorological substations during several decades. By processing and analysing these data, it has been proven that the total theoretic wind energy potential amounts to 1300 gigawatt hours (GWh) and exceeds the total theoretic river energy potential (135 GWh) almost ten times. The wind energy research center “Karenergo” has developed the “Georgian Wind Energy Atlas based on existing meteorological data and their own perennial measurements using contemporary measurement equipment. Based on the wind energy potential, the technical potential of wind power has been assessed with the use of analytical methods and specialized software. The calculations showed that annual power generation might reach 4 GWh.

[25] “Renewable Energy Potential in Georgia and the Policy Options for Its Utilization” -2008

By wind speed the territory of Georgia is divided into four zones:

1. A high speed zone – mountainous regions of Southern Georgia, Kakhaberi Vake and the Central region of Kolkheti Vally. The working duration period is more than 5000 hours per year;
2. A partly high speed and low speed zone - the Mtkvari gorge from Mtskheta to Rustavi, Southern part of Javakheti, Black Sea line from Poti to Kakhaber Vake. The working duration is 4500-5000 hours per year;
3. A low speed mountain range effective exploitation zone - Gagra mountain range, Kolkheti Valley and Eastern Georgian lowlands;
4. And a low speed mountain range limited exploitation zone - Iori Zegani and Sioni water reservoir. The rest of the mountain ranges on the territory of Georgia cannot be used for exploitation by wind power stations.

Based on the research conducted on the territory of Georgia several prospective sites for the wind farm construction have been identified. The total installed capacity of these potential wind farms is 1450 MW with annual generation of about 4160 mln.kWh.

In 2013 the Ministry of Energy together with the “Georgian Energy Development Fund” started the development of the project for the pilot wind farm “Qartli”with an installed capacity of 20 MW.The project investment cost is about 30mln.USD.

6.1.3. Geothermal Energy Capacity of Georgia

According to modern hydro-geological studies, the forecasted Georgian geothermal water reserves reach 250 mln m3 annually. At present there are more than 250 natural and artificially drilled water channels where the average temperature of geothermal waters ranges from 30 to 110^0C, located in 44 deposits throughout Georgia with a total daily yield of 160 000 m3.

About 80% of this geothermal potential is located in West Georgia. The total theoretical thermal capacity of all geothermal sources at t 0-250^C was estimated at 300 MW of thermal capacity. Total achievable potential is estimated at 30% or 100MW of thermal capacity (N. Tsertsvadze, G. Buachidze, O.Vardigoreli “Thermal Waters of Georgia”, Tbilisi, 1998). The temperatures of geothermal deposits are not very high and are mostly suitable for heating and hot water supply[26].

The use of geothermal sources is already developed to a considerable extent. In capital Tbilisi, the output of geothermal water of 4,000 m³ per day is used to supply around 100 residential blocks. The prices are not regulated and are determined by the supplier. In other locations the geothermal water is used by the neighboring population in an unorganized way. There are projects in the planning stage to better utilize and expand the use of thermal waters from the existing wells. The feasibility of these and other projects requires further study in order to determine economically viable options and volumes of geothermal energy utilization. In order to promote the use of geothermal energy in other locations it is necessary to implement a number of policy measures including:

- Transparent rules for obtaining licenses for geothermal wells;
- Clear regulations on land use and property rights for wells and pipe routes;
- Clear definitions on price regulations and subsidies for different groups of consumers[27];

[26] “Renewable Energy Potential in Georgia and the Policy Options for Its Utilization” -2008

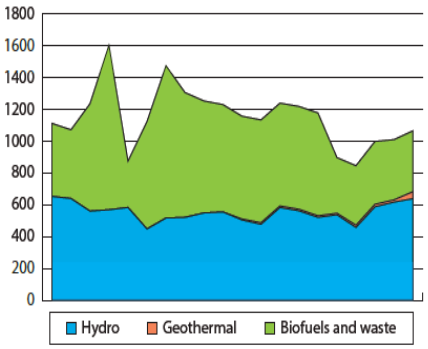
[27] Renewable Energies in Central Asia - Country Chapter: Republic of Georgia

6.1.4. Biomass Energy Capacity of Georgia

Georgia has a considerable potential of biomass resources. It is conditioned by its geographical position and a favourable climate for growing forests and agricultural products. In some regions, it is even possible to have two yields per year. Unfortunately, the current use of biomass in Georgia is rather inefficient and unsustainable. Firewood consumption is estimated at 8 million m³ per year, which covers almost 50 % of the population's energy demand. This consumption is far above sustainable forest development level, which should not exceed 1 million m³ per year. Therefore, the RE potential of forest and forest residues must be set to 1 million m³ of bark energy, amounting to approximately 2,700 GWh. Residential waste is another type of biomass. 900,000 tons of waste per year accumulates in the Tbilisi and Kutaisi dumps according to municipal data. An estimated 90 million m³ biogas can be obtained by re-treating these residues; this would equal 64 million m³ of natural gas. Approximately 160 million m³ of biogas can be annually obtained from the sewage water cleaning station of Tbilisi (serving 1.2 million). The resulting biogas energy is estimated to be 1,000 GWh/year equaling 100 million m³ of natural gas. Therefore, the technical potential of the major biomass sources in Georgia amounts to 12, 5 TWh/year. The achievable potential is estimated at 3-4 TWh/y. This estimate does not incorporate the potential of farming energy crops. For comparison, one can note that total annual electricity generation in Georgia is in the range of 8,000 GWh. Apart from firewood, which is used for cooking and heating, and a few donor supported biogas initiatives, the biofuel potential remains untapped[28].

6.1.5. Hydro Energy Capacity of Georgia

Hydro resources take the first place among the natural riches of Georgia. There are 26 000 rivers with a total length of about 60 000 km in the country. Approximately 300 rivers are of significance in terms of energy production; their total annual potential capacity is equivalent to 15000 MW, while the average annual production equals to 40-50 TWh.



Source: IEA statistics, electronic database, 2011

Picture 5: Renewable Sources in Primary Energy Supply

Considering peculiarities of Georgian rivers, which are characterized by distinct seasonality, these resources can be distributed only by building hydro power stations with regulating water reservoir in the short and long term perspectives. However, from ecological point of view, such kind of constructions are difficult. That's why hydro power stations with small reservoirs are more common. The Government of Georgia has approved the State Program – "Renewable Energy 2008" which includes the list of potential greenfield projects and rules for construction of new renewable energy sources.

In the scope of the above-mentioned program memorandums of understanding were signed between the Government of Georgia and investors on such projects as: Khudoni HPP – with the installed capacity of 750 MW and generation of 1,5 bln KWh; Cascade of Namakhvani HPPs - with an installed capacity of 450 MW and generation of 1 670 mln KWh; Faravani HPP - with an installed capacity of 78 MW and generation of 425 mln KWh; Cascade of HPPs on the rivers: Chorokhistkali,

[28] Renewable Energies in Central Asia - Country Chapter: Republic of Georgia

Lukhuni, Tekhura, Gubazeuli, Mtkvari, Bakhvistskali da etc., altogether 21 HPPs (total installed capacity of 1 583 MW and generation of 5,5 bln.KWh) are under negotiation.

At present time water is the main renewable resource of energy supply in Georgia and accounts for the major part of electricity generation. Consequently, Georgian government's main approach is to create attractive conditions for large-scale capital investments, more specifically:

- To renew and extend current electricity infrastructure;
- To renovate existing hydro generation plants;
- To develop the small and medium-sized hydro resources;
- To provide access to the markets in neighboring countries (Turkey) for power exchange;
- To reform Georgian energy sectors into a net electricity exporter;

Hydroelectric power plants provide almost 92% of Georgia's electricity, with the remaining 8% generated from natural gas combustion. Georgia has been the main exporter country in the region from 2007 and delivers electricity to all neighboring countries throughout the year.

In general, the main objective for the long term policy of the country has been to fully satisfy the country's overall demand for electricity from domestic hydro resources. Besides tendering a number of new large HPPs, the Ministry of Energy has sought foreign investments for the development of new small and medium HPPs. As a result of rehabilitation activities carried out on large HPPs, the hydro generation of electricity increased up to 9.7 TW/h. In addition, the Georgian government plans to facilitate further development of new renewable sources by creating favorable conditions for the development of micro electric power plants up to 100 MW. Currently there are a number of medium and small hydro facilities providing approximately 1,540 MW of domestic power, either on a regular basis or seasonally.

Thus the estimated potential of different types of RES in Georgia could be summarized in such way:

RES Type	Theoretical Potential	Technical Potential	Achievable Potential	Economical Potential
Small Hydro	40 TWh	19.5 TWh	5TWh	
Wind	1300TWh		5TWh	
Bio Mass		12.5 TWh	3-4TWh	
Solar	1550 kWh/m^2			60-120GWh
Geothermal	300MW	100MW	700-800 GWh	

In Georgia almost all RES technologies are imported and accordingly Georgian market is provided various RES technologies by various companies. Below a short overview of current RES market in Georgia is presented.

Solar energy (solar water heaters & PVC panels) – Georgia is a sunny country and the potential of using solar energy is very high. Solar energy transforms into heating energy (solar water heating system) and electric energy (solar power station). Solar water heating systems (collectors) are produced in Georgia (price of 2 sq.m. – US$ 400-500) or are imported (price – US$ 500-1,000). The price of a 50 W solar power station (module, accumulator, electric equipment) with a surface area of 2 sq/m is about 700-800 US$; 500 W (4 sq/m) –7,000-8,000 US$; 1,000 W (8 sq/m.) – US$ 15,000; 3,000 Wt (25 sq.m.) – US$ 45,000. The following companies are working in this field:"Solar Energy Georgia Ltd.", Association Sustainable Energy Center "Mzis sakhli", "Sichinava da Kompania Ltd.", "Technoimporti Ltd.", "Therma Arsenali Ltd.".

Wind energy – The potential of wind energy is underused in Georgia yet. Only some small (100-400 watt) plants are working. In the last period, because of improvement of technologies, the price of electric energy generated by wind power plants approaches to the price of electric energy by hydroelectric power plants. It increases the perspective of using wind energy in the country. The component parts of wind power plants are imported. The price of turbines of wind power plants is: 450 watt – US$ 1,000, 750 watt – US$ 1,350. Ltd "Qarenergo" (research and design works for using wind energy) and "Mzis sakxli" (equipment for wind power plants) operate in this sphere.

Hydro energy – Hydro power has great potential in Georgia. 85% of electric energy is generated by hydroelectric power plants. During the last years the quantity of small hydroelectric power plants reduced from 400 to 50, but theoretically it is possible to build 1,000 small hydroelectric power plants. The turbines for receiving hydro energy are imported. Water wheels with simple machinery are made by local resources. JSC "Saqhtskalproeqti", JSC "Saqhidroenergomsheni", "Soreli Ltd." are engaged in the construction of hydro objects, research and design works on hydro energy objects.

Biogas – There are about 400 biogas plants in Georgia. The following constructions are the most common:

- Plant with hard dome;
- Gobari type plant;
- Plant made from polymer-fibres;
- Above-ground methyl tank, operatedin a thermophilic regime.

The price of locally manufactured bio digester with a volume of 4-6 cubic meter is US$ 2,000 – 3,000. The construction of bio digester needs skilled technicians. Bioenergy Ltd and "Global Energy Ltd." are working on a turn-key basis in this sphere, though in various regions of Georgia there are individual entrepreneurs who specialize in the construction of bio-digesters.

6.2. General information on Energy Efficiency Materials in Georgia

The sector of energy efficient construction materials in Georgia is evolving, with high growth potential supported by a strong and competitive construction industry. The most common materials in Georgia are perlite, glass wool, rock wool and polystyrene. Perlite and polystyrene insulation materials are produced locally or imported from Iran, the Czech Republic, Italy, France and Turkey. Glass wool and rock wool are imported to Georgia from Turkey, Russia and Germany. The most frequently used local natural resources for production of construction materials are perlite, basalt, pumice, slate and tuff, the vast reserves of which are owned by Georgia. During the last 4-5 years the use of energy efficient building materials has grown by 30-35% per year. Currently the most common EE materials in the Georgian market of constrcution materials are:

- **Pearlite** –amorphous volcanic glass with high water content. Pearlite manufactured in Georgia is imported in Azerbaijan and Russia. In Georgia there is only one undertaking manufacturing pearlite – ltd "Samto Kompania Paravanperliti". The pearlite blocks/bricks are produced by ltd "Semi" and ltd "HB".
- **Polystyrene** –a polymer produced from liquid hydrocarbon. Polystyrene is frequently used in extruded form. It is imported by ltd "GRC" from Turkey, Russia, Poland and Finland. There are some companies importing polystyrene together with other building materials, because polystyrene is very light, not compact and importing it by itself is not profitable. Local producers of polystyrene are ltd "Kemkheli" and ltd "Interplasti".

- **Glass wool** – is imported to Georgia from Turkey, Iran and Russia. The demand for wool glass is higher, than for mineral wool, because it is a cheap thermal isolation material. The importers of glass wool are ltd "GRC" and distributors of "Knauf". Price of 1 square meter of glass wool in Georgia is US$ 1.75 (with foil) and US$ 1.45 (without foil).
- **Mineral wool** –is also imported from Turkey, Iran and Russia. There is a growing demand for it. The price of 1 square meter of mineral wool is about US$ 8-10. The main importers are ltd "GRC" and ltd "Knauf Marketing".
- **Alufoam –** heat, steam and noise insulating material composed of 1 or 2 layers of special clean (99.4%) aluminum and foamed polyethylene. It keeps its insulating properties in moist environment. This material is ecologically clean, light and lasts at least 25 years. Another insulating material with similar properties is **Terrafoam**. Those materials are imported from Ukraine.
- **Sandwich-panels –** are imported in Georgia from Turkey and Germany, the local producer is "Interplasti Ltd.".
- **Pumice blocks –** pumice blocks are a traditional building material in Georgia. The demand for pumice blocks is higher than for other light building materials (pearlite blocks, foam concrete). There are some companies producing pumice blocks in different regions of Georgia having pumice stocks, ("Geokabadoki Ltd.", "Delta Ltd.", "Karieri Ltd.").
- **Foam concrete** – is produced in different regions of Georgia by a few production units, but production is unsteady. The general consumers of foam concrete are big building companies. Foam concrete is 20 times lighter than traditional concrete and 8 times lighter than silicate brick. The main producers of foam concrete are ltd "Dugabi +", ltd "Porobetoni", ltd "Evrobloki".

6.3. Mounting of energy efficient heating and water supply systems

In the regions of Georgia where population generally uses firewood for heating, utilization of energy efficient firewood stoves is very important. Energy efficient firewood stoves use less firewood to get the same amount of heat (price: 200-250 USD).There are a number of local manufacturers producing such stoves as well as a number of local companies importing EE stoves to Georgia, for example from Turkey.

For water heating, electric or gas-fuelled instantaneous or storage water heaters are used. These devices as well as other systems used for HVAC are imported from Turkey, Germany, Italy, China, Russia, Ukraine. Locally manufactured natural gas space heaters are also popular as their price is relatively lower. The "KERA" gas-fuelled space heaters are manufactured by "Tam Kera" Ltd.

It is noteworthy that there are various insulating materials available on the local market without any information about their insulating properties, producers and consequently of doubtful quality. Therefore, it is desirable to purchase insulating materials with all above mentioned information on labels.

6.4. EE windows and Doors

As a means of improving energy performance of buildings, installation of double glazed PVC windows and doors became very popular in Georgia in recent years. There is a producer of such windows and doors in almost every town/district centre in Georgia. These production units import all necessary supplies and accessories mainly from Turkey & Germany.

6.5. Use of lighting energy saving systems

Currently, there is no production of EE bulbs (diode & fluorescent lamps) in Georgia; they are mainly imported from China, Turkey, Germany, the Czech Republic, and Poland. Their prices in accordance with quality and lighting power are from 5 to 15 GEL. Principal importers are: ltd “Akhali Nateba”, ltd “Insta”, OSRAM and others.

As it was mentioned above, after the breakup of the USSR, the energy sector in Georgia experienced a catastrophic collapse in the early 1990s. Consequently, when the Georgian government decided to restore the Georgian energy sector, it was revealed that existing energy infrastructure needed full rehabilitation and equipment with innovative technologies. In 2004, the Georgian government, with the support of the International Development Association (IDA) transformed the power sector into a functioning sector. The rehabilitation process of the energy sector included equipping existing thermal and hydro power plants and transmission lines with modern innovative technologies.

It should be noted that the renovation of the energy sector is an ongoing process, especially in the hydro power sector, where the construction of new hydro power plants, transmission lines and substations is one of the main objectives of the Ministry of Energy of Georgia.

In terms of implementation of technical and social innovations in the energy field the significant contribution of international and local non-governmental organizations has to be noted. Most of these projects were implemented in the rural areas of Georgia.

One of the most players in this field in Georgia appears to be USAID-sponsored Winrock International, which runs a range of RES/EE programs. Winrock Georgia is an official representative of Winrock International in Georgia, carrying out USAID projects since 2005. Winrock Georgia has accomplished several projects 1) Rural Energy Program29, 2) New Applied Technologies Efficiency and Lighting Initiative - NATELI 1 , NATELI 2, and just recently started Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) supported by US Agency for International Development (USAID).

The Rural Energy Program developed renewable energy and energy-efficiency procedures in rural Georgia. Technical assistance and training helped rehabilitate small hydropower plants, introduced and promoted renewable energy and energy efficiency technologies, increased access to financing for small hydropower and strengthened the capacity of the energy sector in Georgia.

The program NATELI 1 that was financed by USAID program was intended to support energy efficiency and renewable energy usage in Georgia (with lesser scope). The main objective of the program was to promote energy efficiency in the Georgian public and business sectors, and to design financial, technical and operational frameworks to foster the development and implementation of energy efficiency projects.

The main objectives of the NATELI project were to help large institutions reduce their energy consumption with a special focus on hospitals. The work activity included: energy audits; examination of financial costs and benefits of various energy efficiency improvements; assistance to hospitals with implementation on a limited basis; teaching the local stakeholders how to manage

[29] The Georgia Rural Energy Program (REP), implemented by Winrock International, was a four-year (2005-2009) project designed to develop the basic regulatory, technical, financial and operational building blocks for commercial generation of small hydro power and other renewable power sources in rural Georgia.

their energy consumption; evaluation the financial viability of energy efficiency improvements, facilitated access to financing, and the promotion of results to the public.

The second task of the project included support to pilot projects that promote residential energy efficiency. The project's stakeholders in which Tbilisi Municipality was involved have been condominium associations. A separate project was accomplished with Georgian State Technical University (GTU) to incorporate energy efficiency matters into their curricula, and to implement energy efficiency retrofitting in several GTU buildings.

An innovative approach for raising public awareness was a 3-year project primarily focussing on rural communities, that was initiated by EEC Georgia and BP & partners, and funded by USAID/Winrock Georgia. The Energy Bus toured Georgian communities and educated Georgian citizens about energy efficiency and renewable energy in general, as well as their practical application. Energy Efficiency Centre (EEC) deals with energy efficiency issues and has a representation in Georgia since 1998, after it was funded by the EC's TACIS Program. EEC studies delivered as recommendations have always emphasized the lack of institutional and legal framework that turns out to be the main obstacle for the realization of energy efficiency policy.

Projects implemented by EEC include feasibility studies, technical and economic studies, comprehensive market research, pilot and demonstration projects, trainings in various RE & EE technologies, promotion and dissemination, project financing, as well as a deep understanding of the wider policy and investment issues facing the energy sector. In addition, EEC has recently become a Covenant Supporter to Georgia which uses its leverage along with another covenant supporter to Georgia (NGO "National Association of Local Authorities") to lobby, communicate and make networking activities to promote the Covenant of Mayors initiative and support the commitments of its **signatories**.

Another USAID-sponsored firm, Advanced Engineering Associates International (AEAI), was running (2008-2011) an energy capacity initiative to further enhance energy policy analysis capacity within Georgia, promote stakeholder dialogue on policy issues and support higher education programs in energy.

Local NGO "Sustainable Energy Centre-Sun House" with financial support from various international organizations has been implementing innovation projects in order to promote solar systems. The main aim of the organization is to research and promote the practical applications of solar, wind, water and biogas applications in Georgia. The organization installed mainly solar applications (solar water heaters & solar PV panels) supported with wind systems, in various rural areas of Georgia. The applications were installed mainly in high mountains regions of Georgia, for various beneficiaries such as individuals (shepherds) living in high mountains throughout the years, churches and monasteries, administration buildings of protected areas managed by agency of protected areas, public buildings located in various regions of Georgia.

Georgia does not have programs or developed strategy in place to jump start EE/RES market development. These instruments should incorporate realistic numerical parameters for EE/RES capacity and output and have clear and achievable benchmarks. The document of "Main Directions of State Policy in Energy Sector" provides some targets, but only for small hydro power and wind power development. Furthermore, these numbers are already outdated and need to be reviewed based on realistic assumptions and using sound planning methodology and analytical tools. Finally, given that the government is very keen to attract new investments, it would be very beneficial for a

government program to provide information on EE/RES innovations possibilities and optimal locations.

The main bottlenecks and barriers of developing EE/RES innovations in Georgia are:

- Insufficient capacity of the government and business sector which does not allow to properly address all the challenges facing RES/EE innovations development;
- The taxation system is no longer supportive of RES/EE innovation development. In 2005 Georgia abolished tax benefits for RES/EE investment in the country's new tax code. Tax reductions or local tax exemptions are the main tools encouraging RES/EE development;
- Absence of the legislation related to the development of EE/RES innovations. Some legal initiatives in support of RES/EE introduced are scattered in various legal documents;
- Public awareness on EE/RES innovations potential and opportunities is low. There are no efficient information campaigns or analytical research projects to promote EE/RES;
- Absence of energy policy and/or strategy including EE/REC development;
- Low interest of local energy sector to invest in the development of EE/RES innovations, especially in solar, wind, biomass energy sector;
- Low capacity of research centers to establish local EE/RES innovations on the local market
- Lack of effective cooperation between local business sector and research institutions;
- Difficulties in connecting renewable electricity generators to the national grid;
- Absence and/or insufficient financial support to research centers/institutions from government for developing of EE/RES innovations;
- High cost of EE/RES innovations on Georgian market;

SWOT analysis of Georgian energy field and EE/RES:

Strengths	Weaknesses
• High RES/EE potential, especially water, solar and biomass; • Declared objective of Government to develop small and medium hydropower plants; • Member of international agreements (Covenant of Mayors) to develop and establish sustainable energy policy; • EU funds available for such projects;	• The local experience in EE & RE projects is not sufficient. The lack of experience in the field of technology in Georgia makes the technology investment cycle long, and as a result of early technology development, early adaptation must be subsidised, well ahead of commercialization. So far, there are no special VAT exemption incentives (green certificates) for the consumers to purchase this type electricity ; • High interest on loans to industrial or households projects related to energy efficiency and renewable energy;
Opportunities	**Threats**
• Several EE/RES innovations have been implemented and other projects are in the line;	• Stricter conditions related to the connection of electricity generation facilities using RES to the transmission or

• With support of IFI through local banks, credit lines opened for EE/RES innovations; • Growing market for EE/RES developers; • Newly drafted law on Spatial Planning and Construction Code including EE/RES components in the building sector ; • Renewable Energy Sources can comprise a large stake in Georgia's total Primary Energy Supply; • Renewable Energy Sources can be price-competitive with traditional energy sources; • Creating a favorable investment environment which will set Georgia on a path of self-propelling developmentin EE/RES;	distribution system; • The technical capacity of the Georgian electricity grid needs upgrading for the development of RE generation facilities; • First of all government should initiate such encouraging initiatives as listed below to develop EE/RES innovations • VAT exemption, low-interest loans, legal regulations on EE/RES, capacity building of business sector and/or research centres in the field of EE/RES innovations; • Support the research and development in the field of EE/RES in order to support the activities in this sector with sound information and the analytical base; • Develop and approve the law and/or policy on EE/RES; • Develop long term and short term EE/RES plans. • Expand and strengthen the activities of specialized institutions such as research centers • To promote the specific incentives of EE/RES for business sector; • To strengthen cooperation between business sector and research centers;

Table 9: SWOT Analysis

In the development of EE/RES innovations in ENP countries, cooperation and experience sharing with EU is very essential. Accordingly, ongoing ENER2i project will strengthen cooperation between research and business actors in EE/RES in the participating countries and at the same time facilitate the cooperation between EU and participating EaP countries. All this will encourage improvement of knowledge transfer and innovation support in the field of EE/RES through a comprehensive trans-national cooperation.

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