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Governing for Growth in Georgia

MARKAL GEORGIA ASSUMPTIONS AND DATA SOURCES

REPORT ON MARKAL GEORGIA INPUT FOR BUSINESS AS USUAL SCENARIO

10 November 2014

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REPORT ON MARKAL GEORGIA INPUT FOR BUSINESS AS USUAL SCENARIO

USAID GOVERNING FOR GROWTH PROJECT

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ACRONYMS

G4G	USAID Governing for Growth in Georgia Project
USAID	United States Agency for International Development
GGTC	Georgian Gas Transportation Company
TED	Territories Electricity Demand (Abkhazia)
MoF	Ministry of Finance
GOGC	Georgian Oil and Gas Corporation
GDP	Gross Domestic Product
GEOSTAT	Georgian National Statistics Office
GNERC	Georgian National Energy and Water Supply Regulatory Commission
IMF	International Monetary Fund
IEA	International Energy Agency
RES	Renewable Energy Sources
EE	Energy Efficiency
NEA	National Environmental Agency
ESCO	Electricity System Commercial Operator
BBD	Basic Data and Directions
BAU	Business as Usual (MARKAL base scenario)
NBG	National Bank of Georgia
MARKAL	Market Allocation Model
HPEP	Hydro Power and Energy Planning Project

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INTRODUCTION

With the support of Hydro Power and Energy Planning (HPEP) Project, the staff of the Analytical Department of the Ministry of Energy developed the energy balance Business As Usual (BAU) scenario using the MARKAL Georgia model. The other three scenarios that the Analytical Department is planning to develop include: Energy Efficiency (EE), Renewable Energy Sources (RES) target and strong energy use growth scenarios. This document provides a comprehensive overview of the assumptions and data sources used in the MARKAL Georgia model. MARKAL Georgia model uses 2012 as the base year and includes the energy balance until year 2036.

Section I of this document reviews different economic growth forecasts, their potential impact on energy use growth and the projection of energy demand growth for various entities in the energy field. This section looks at individual sectors that may be the trigger of expected economic growth and assesses the potential of this growth to increase energy demand.

Section II takes a detailed look at various energy sectors: oil, natural gas, coal, geothermal, wood, electricity and hydropower. Assumptions are identified for each sector and the reasoning behind them is explained. A supplemental excel document provides further details on the numbers used in MARKAL Georgia and presented in this document.

I. PROJECTIONS OF ENERGY DEMAND GROWTH AND ITS DRIVERS

The projections on demand drivers were based on the following main data sources: National Bank of Georgia (NBG), National Statistics Office of Georgia (GEOSTAT), Electricity System Commercial Operator (ESCO), Georgian Oil and Gas Corporation (GOGC). Nearly all projections on the given demand drivers were made based on the historical trend (on average, last 5-10 years of time-series data) of the particular indicator, which is elaborated upon below. For calculating average change, the majority of the cases used the geometric mean method.

For real GDP growth rate of Georgia, forecasts of the Ministry of Finance (MoF) of Georgia stated in the Basic Data and Directions (BDD) 2015-2018[1] document (5% till 2015 and 5.5% in 2016-2018), forecasts of IMF[2] (till the year 2018) and World Bank[3] (till the year 2016) were used. Hence, projections for the given four main aggregates of GDP (commercial, agriculture, transport, industry) were also done considering the above-mentioned forecasts. In the state document of Socio-Economic Development Strategy of Georgia ("Georgia 2020")[4],

[1] Ministry of Finance, *Basic Data and Directions*. <http://www.mof.ge/BDD>.

[2] International Monetary Fund, *Georgia: IMF Country Report No. 14/250*. <http://www.imf.org/external/pubs/ft/scr/2014/cr14250.pdf)>.

[3] The World Bank, *Country DataBank: Georgia*. <http://databank.worldbank.org/data/views/reports/chart.aspx#>.

[4] Ministry of Finance, *The Government of Georgia approved the Socio-Economic Development Strategy of Georgia "Georgia 2020,"* February 12, 2014. <http://www.mof.ge/News/5991#>.

the projection of GDP annual growth rate from 2012 till 2020 (GEL 5,811 real GDP per capita in 2012 and GEL 9,200 real GDP per capita in 2020) is about 6%.

In the MARKAL projection, 2012 is set as a base year; for the next three years (2013-2015) GDP growth projection is set at 5% average annual growth rate. Although the 2013 real growth rate is already known to be about 3.2%, official forecasts for the coming years are estimated at 6% by the World Bank (2015-2016) and at 5% by IMF and MoF for the coming 2015-2018; considering the real GDP growth rates in 2003-2013, taking every next three years' geometric mean of growth rates and then again geometric mean of the given results, it comes to 4.5%. Hence, taking into account all of the above-mentioned data, eventually a relatively conservative 5% growth rate was used in the projection. GDP growth projection for 2015-2017 is set on a relatively higher rate of 6% as both IMF and WB forecast more than 6% real GDP growth from 2016 on, while MoF forecasts 5% growth (as well as about 6% real GDP per capita growth rate according to "Georgia 2020"). 5% annual growth rate was assumed for the period of 2018-2024 and then a relatively lower but stable 4%, as for 2024 economy would be expected to be more stable in its growth.

As for population growth rate projections, 0.5% was used as this figure was already in MARKAL 2006 model document since it is most realistic according to the trend during past years (an average growth rate of 0.46% in past 5 years). Similarly, the number of persons per household tends to decrease by 0.5% as the economic circumstances are expected to improve.

Non-energy gas consumption[5], taken from GOGC gas balances, is consumed by "Karat +" Co. with annual 6% growth rate of use. However, from year 2018 the non-energy gas consumption growth rate was assumed to be around 5%, then - 4.5% and from 2027 on - 4% annually. Territories Electricity Demand (TED)[6] growth rate is taken from ESCO balances, which looks at past 6 years' trends. TED was set at 4.5% growth rate for years 2012-2014, and for the next periods it is not assumed to change dramatically.

From the given four sectors of GDP – Agriculture, Industry, Commercial and Transport – growth projections were made looking at the past years' trends.

Commercial sector, which constitutes 53% of GDP, is assumed to grow at an average rate of 5%-6% annually, which is faster than any other sector in the given projected period.

The share of **Agriculture** in GDP is 10%. Production in this sector is assumed not to increase dramatically until 2016. Despite the fact that in the previous three years' (2011-

[5] International Energy Agency, *Definitions, Non-Energy Use.* <http://www.iea.org/interenerstat_v2/definitions/results.asp?id=168&Type=Flows>.

Non-energy gas consumption is use of energy sources as raw material for the manufacture of non–energy source goods. For example:

- Natural gas and petroleum derivatives (naphtha, reformatting, refinery gas, etc.), consumed in petro-chemistry to make plastics, solvents, polymers, rubber, etc.
- Bagasse for making paper or pressed board
- Use of animal waste as fertilizer
- Plant waste as feed for cattle

*Note: Some non–energy products such as asphalt for construction and lubricants for transportation are frequently placed in the respective sectors (construction and transportation) and not in the non-energy sector. However, the practice of placing them in the non–energy source sector is valid, since the use of these products is not for energy.

[6] Demand for electricity in Abkhazia

2013) growth rate in this sector was 7% on average, after considering the earlier data and the fact that the projection was set at 2.5% annual rate at the beginning, for the next period it was assumed to grow at about 7% again and then to remain at stable 3% average growth rate.

Transport sector (11% of GDP), is expected to grow at about 5% average growth rate per year until 2019, it is assumed that this sector will not grow more than 2-3% annually from 2019 to 2036.

As for the **Industry** sector (26% of GDP), its growth is expected to be faster in the first periods and then relatively slower, starting from 5% and reaching 3% annual growth rate in the second half of the projected future (2025-2036). Unfortunately, data on real growth rates of different industry sectors that are used in MARKAL aren't available (except construction) from the National Statistics Office of Georgia, which only has nominal values. So, in this case, the percentages were set based on analytical department's estimates relative to average industry growth rates. According to past years' statistics, most growth in industry sector is assumed to come from construction sector (7% until 2021), and also from food, beverages and tobacco industry (more than 5% in the beginning). Other fields of industry sector are assumed to grow at about 3-4% annually.

As agriculture is not an energy intensive sector at the time, its growth will not contribute significantly to energy demand growth. However, growth of commercial, industry and transport sectors may contribute to energy demand growth.

II. DIFFERENT ENERGY SOURCES AND CORRESPONDING MARKAL ASSUMPTIONS

NATURAL GAS

Data Sources:

- The Georgian Oil and Gas Corporation (GOGC), Georgian Gas Transportation Company (GGTC) - *Natural Gas Balances*
- Distribution Companies - Natural gas consumption by sector (most of the information provided was for only residential and commercial sectors)
- GNERC - the list of natural gas distribution companies (contact details)
- The Georgian Gas Transportation Company (GGTC) - *Natural gas Technical Balances* (various distribution and large companies are involved)

Assumptions:

The consumption in residential and commercial sectors is calculated based on the study of the Ministry of Economy.[7]

Since at this point, there is no exact data on natural gas consumption in the industrial and agricultural sectors, the assumptions in this sector were made in relation to GDP. The

[7] Ministry of Economy, *Survey of Georgia's Household Sector*, March-November 2012.

commercial sector gas consumption was reallocated to the consumption of this resource in industrial and agricultural sectors, based on the percentage share of these sectors in GDP. An analogous percentage share assumption was made regarding the breakdown of the industrial sector based on its sub-sectors.

When calculating the price of the various sectors, social and commercial tariffs are taken into account. For the population and thermal power plants 2012 base year data was used with an average social tariff of 0.48 GEL per cubic meter, while for the industrial, commercial, agriculture – an average commercial tariff of 0.85 GEL was used per cubic meter, for the transport sector (gas stations) the market price used was 1.1 GEL per cubic meter.

Gas losses in transportation are shown in the gas balance provided by the GOGC, as for the losses during distribution, they were provided by the distribution companies separately.

MARKAL REPORT - OIL AND OIL BI-PRODUCTS AND TRANSPORT SECTOR

The information on the amount of oil produced in Georgia was provided by the Georgian Oil and Gas Corporation, the information on oil import-export was obtained from the Ministry of Finance web resources. The difference between imports and exports of petroleum products is considered to be the domestic consumption. Oil consumption breakdown for 2011 in terms of various sectors is presented in the excel spreadsheet, which was obtained from the International Energy Agency (IEA); this data can be used until more accurate and more recent information is obtained from the oil companies operating in the sector.

The volume of vehicles based on their types was obtained from the Analytical Department of the Ministry of Internal Affairs. The volume of passengers and goods was taken from the GEOSTAT yearbook. The number of cars that consume gas in Georgia was obtained in the following manner: the average monthly cost of a light vehicle for gas was assumed to be about 90 GEL (the price of gas 1.05 GEL), then its monthly consumption was calculated to be 90 / 1.05 = 85.71 cubic meters; annual – 1,028.6 cubic meters. It is known that in 2012 the gas stations' gas sales reached 54,650,969 cubic meters. It was assumed that 70% of total gas consumption in the transport sector was due to the light vehicles. Accordingly, the number of cars that consumed gas would be 38,255,678.3 / 1,028.6 = 37,193 cubic meters. As for the percentage distribution of gasoline and diesel-powered cars, the data was obtained from the survey results of the Ministry of Interior information-analytical services. The amount of benzin (gasoline), diesel and natural gas used in the other sub-sectors of the transport sector and the amounts of transportation facilities, based on the used fuel, were produced using the estimates of the Analytical Department of the MoE and also based on Georgia's two municipalities' (Gori and Rustavi) action plans within the framework of the Covenant of Mayors. For example, the number of transport facilities working on natural gas were calculated using the following assumptions:

- The volume of electricity consumed by railway and subway was obtained from "Energo-Pro" and "Telasi" reports.
- The annual mileage and fuel costs were compiled using assumptions, which are presented in the supplemental excel file, “Oil” sheet.

COAL

Data Sources:

- Saqnakhshiri (GIG Group)
- GEOSTAT

Assumptions:

- It was assumed that the imported coal is used in the industry to enrich the low-calorie coal;
- From the local coal, each year, 500 tons of coal is supplied to the poultry farm, which is about 0.1% of total coal use;
- For the local population approximately 1% of the enriched coal and all of raw coal use was assumed, the corresponding amount together with the data of the agricultural sector was subtracted from the commercial sector;
- The use of coal by the population was reallocated with the same percentage as wood, namely: heating - 59%, cooking - 17%, water heating -24%.

WOOD

Data Sources:

- National Environmental Agency (NEA)
- USAID, *The potential of the timber energy resources of Georgia and its effective use*, Temur, Kandelaki, Tbilisi 2010.

Assumptions:

- The firewood is mainly used by housholds. According to the NEA, wood consumption in 2012 was 369,951 cubic meters, which is a small amount. For this reason it was assumed that 60% of the population uses wood for heating and cooking purposes.
- The number of households is around 1,200,000, 60% of which would be 720,000 families. On average, a family uses 5 cubic meters of firewood per year, or more; Thus, it turns out that the annual consumption is 3,600,000 cubic meters.

- Based on the same indicators the seasonal consumption of firewood was derived. When creating a breakdown based on the months of consumption, the following assumptions were used: wood use in May-August period is minimal; for this reason, calculations used the amount of wood needed for cooking only during this period; the seasonal consumption of firewood was derived based on the same indicators as mentioned above. When creating a breakdown based on the months of consumption, the following assumptions were used: wood use in May-August period is minimal, only the amount needed for cooking was used.

$$\frac{1{,}224{,}000}{12} = 102{,}000 \text{ cubic meters}$$

- April, September, October - are relatively warm months, and during this time only half of monthly supply of firewood is used for heating.

$$\frac{\left(\frac{7{,}569{,}197 - 102{,}000 * 4}{8}\right)}{2} = 447{,}574.8125 \text{ cubic meters}$$

- In November-March period, the remaining amount of wood is reallocated.

$$\left(\frac{7{,}569{,}197 - 102{,}000 * 4 - 1{,}193{,}533 * 3}{5}\right) = 1{,}163{,}695$$

- The average density of wood used in Georgia is 420 kg/m^3, heat content is 7.5 gj/m^3.[8]

GEOTHERMAL

Data Sources:

- National Environmental Agency

Assumptions:

- Sectors were divided based on the tables and indicated functions for use (excel sheet "geothermal") provided by the National Environment Agency, part of it was obtained based on Analytical Department's estimates.
- It was assumed that production equals consumption.

RESIDENTIAL SECTOR

Data Sources:

- GEOSTAT
- Presentation of the Ministry of Economics

[8] Teimuraz, Kandelaki, *The potential of the timber energy resources of Georgia and its effective use*, pg.13-14.

Assumptions:

- Amount of houses were counted using average (arithmetic and weighted) data from presentation made by Ministry of Economics;
- 2,391.7 thousand people live in Georgian cities;[9] from which 1,171.2 live in Tbilisi. Correspondingly, 316,541 families live in Tbilisi, and (2,391,700 -1,171,200) / 3.7 = 329,865 families live in other cities (3.7 members per family). 1,200,000 – 646,405 = 553,595 people leave in villages (assuming that total amount of families in Georgia is 1,200,000) 1,200,000 – 646,405 = 553,595. According to the Ministry of Economics presentation, 73% of population of Georgian cities (excluding Tbilisi) lives in houses; in case of Tbilisi this indicator was assumed to be 10%. Weighted average data looks as follows:

Total	***Not apartment***	***Apartment***
Urban	**42%**	**58%**
Rural	**91%**	**9%**

Using the figures from the presentation made by the Ministry of Economics, assumptions regarding use of different types of fuel sources were made, which are presented in the excel file.

ELECTRICITY

Data Sources:

- "Energo-pro Georgia" (Breakdown of data with 95% confidence interval)
- "Kakheti Energy-distribution" (Breakdown of data with 80% confidence interval)
- "Telasi" (Database sent by "Telasi")
- Electricity System Commercial Operator (ESCO)

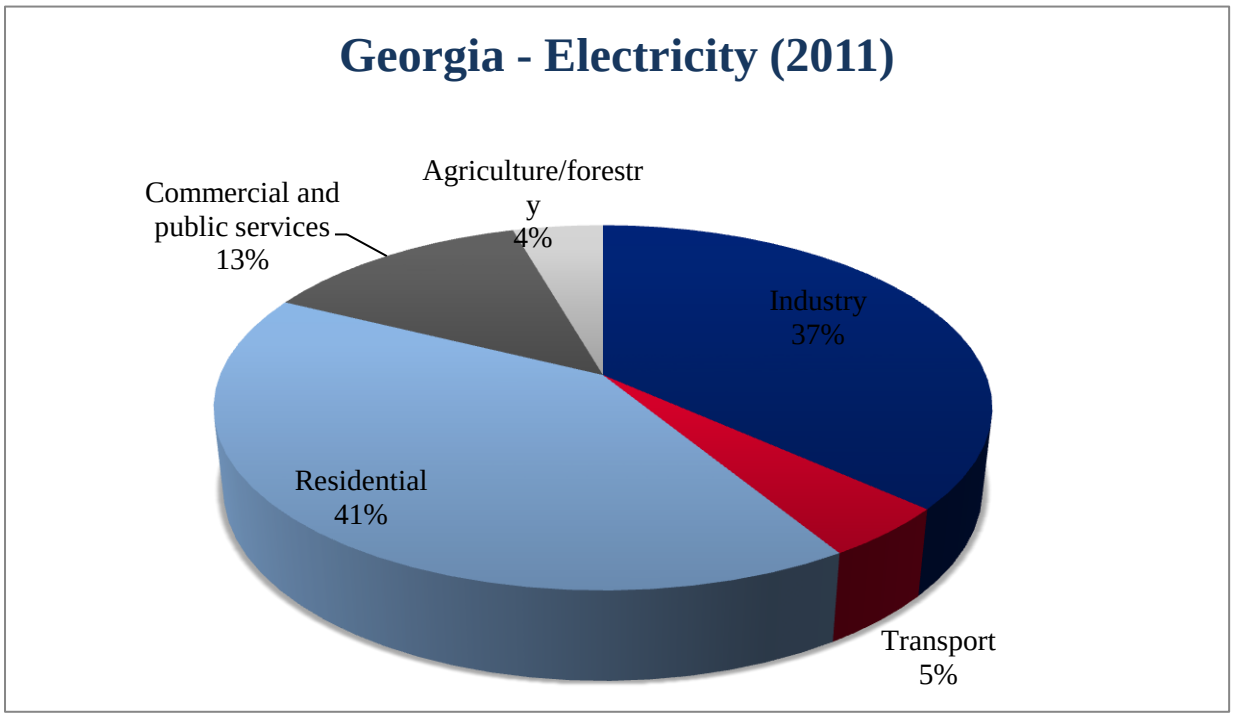
Breakdown of electricity use by different sectors:

For breaking down the total electricity use by different sectors, data from three companies and direct consumers in year 2012 was summed. Moreover, proportionally to the shares of sector use, commercial losses[10] were added. For the breakdown, assumptions were made due to the differences in Tax ID number in "Telasi" and GEOSTAT databases. Regarding several, applicable sectors and sub-sectors, data was extracted from "Telasi" database, whereas, others (except electricity use for industrial production of chemicals and metals) were distributed according to Kakheti percentages, with insignificant corrections

[9] Georgian National Statistics Office (GEOSTAT)

[10] Above normative losses

(Kakheti construction - 7%, other production – 33%, and in “Telasi” – Construction – 10% and other production – 33%).



Source: International Energy Agency (IEA)

Residential Sector:

For allocating electricity use in residential sector, amount of families, refrigerators and washing machines was extracted from GEOSTAT data, whereas, data regarding water heating, space heating and cooking in cities and villages was extracted from the presentation made by the Ministry of Economics. For the average power consumption of various electrical appliances, data was used from a Ukrainian company "Gals", which is engaged in the development and production of backup and uninterruptible power supply.[11]

For use of heating, January, February, March, November and December were used. The consumption in May was subtracted from the consumption of the above months and the sum of the obtained differences was assumed to be the total kWh used for heating during a given year.

24% of population uses electricity for water heating. It is assumed that the electricity for water heating is used on daily basis (half of 24%, i.e. 12%, uses it twice a day). For cooling only July, August and September months were used. We subtracted the consumption in May from the consumption of the above months and summing the differences the amount of electricity used for cooling per year was obtained.

[11] Gals, *Average Electricity Consumption by Various Appliances*. <http://www.leoton.ua/rashodi-energy-pribori.php>.

Use for lighting: On average 3 light bulbs per family, 8 hours, 365 days; 6% of population uses electricity for cooking, 365 days; they mainly use spiral electric heater, which consumes 2.5 kWh electricity per 1 day. Refrigerator – 72% of population has it, which on average uses 7 kWh – per week. Washing machine is owned by only 49% of population, on average used 2 times a week, 1 use – 2,5 kWh. It is assumed that no one owns electric clothes dryer; It is assumed that dishwasher is used by 0.2 % of population, 1 use – 2kWh. Other electricity use, lighting in the elevators, and entrances and other use (consumption after substracting other use).

Consumption in rural and urban areas, also for allocation based on apartment and a private home (non-apartment): heating is used 5 months of the year, 30 days per month and 14 hours per day. Water heating - 365 days a year; used kWh is divided by the amount of families using electricity for heating water and the result is generalized. For cooling 1 hour-1.5 kWh rate is used; duration of use is 3 months a year, 5 hours a day. Based on kWh used for cooling and spent for 1 hour, amount of families is calculated.

Commercial use:

For calculating kWh spent on commercial cooling, consumption in May was taken and was subtracted from electricity consumption in July, August and September (in all sizes of enterprises). The differences were summed and assumed to be kWh spent on cooling per year.

For calculating electricity use on heating, kWh spent in May was subtracted from electricity use in January, February, March, November and December (in all sizes of enterprises). The differences were summed and assumed to be kWh spent on heating.

Electricity use for commercial heating – outdoor lighting, the rest of the use is allocated according to percentage shares in residential sector.

CONCLUSION

For developing Renewable Energy Sources (RES) and Energy Efficiency (EE) scenarios, further analysis is required; commercially based energy efficiency is ongoing. While developing the BAU scenario, no explicit decrease in forecasts of load have been assumed as it relates to Energy Efficiency programs. Geothermal resources have not been included as an optional source in the given scenario. Further studies are needed for geothermal and other Renewable Energy Resources.

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