POLICY PAPER

THE EFFECTS OF INVESTMENTS IN CLEAN ENERGY IN GEORGIA

The research is conducted in the framework of the project "Policy Research for Sustainable Growth", implemented by Konrad Adenauer Foundation in cooperation with PMC Research Center

Author: Ivane Pirveli
Reviewer: Irakli Galdava

Contents

List of Abbreviations 3

1. Introduction 4

2. Methodology 7

3. Research Findings 11

3.1 Job Creation 11

3.2 Environmental Externalities 14

3.3 Result of Scenario Analysis 16

3.3.1 Reference Energy System Development Scenario (REF) 16

3.3.2 Clean Energy Development Scenario (CED) 17

Conclusions and Recommendations 20

References 22

List of Abbreviations

AYPEG	Association of Young Professionals in Energy of Georgia
BOO	Build, Own and operate
CCGT	Combined Cycle Gas Turbine
CED	Clean Energy Development Scenario
CHP	Combined heat and power
FREA	The Florida Renewable Energy Association
GDP	Gross Domestic Product
GHG	Greenhouse gasses
GoG	Government of Georgia
GWh	Gigawatt hour
HPP	Hydropower plant
ktoe	Kilo tonne of oil equivalent
LEAP	Long-range Energy Alternatives Planning System
MENRP	Ministry of Environment and Natural Resources Protection
MoU	Memorandum of understanding
MoE	Ministry of energy of Georgia
MW	Megawatt
O&M	Operations & Maintenance
TPP	Thermal power plant
REF	Reference Energy System Development Scenario
RES	Renewable energy sources
REN21	Renewable Energy Policy Network for the 21st Century
SME	Small and medium enterprises

1. Introduction

It was several decades ago when mankind observed that country's development is no more function of economic growth and technological innovation only, but also environmental stability, healthy ecosystem and social equity, hence the term sustainable development emerged. Sustainable development concept is important in energy sector as well, since this sector is one of the most polluting and at the same time it is an engine for economic growth and technological innovation. Energy needs today should be met without compromising the ability of next generations to meet them in the future. To achieve the latter objective, the best and perhaps the only option is to manage successful transformation from fossil fuel to predominantly clean energy based economies.

Before discussing the effects of clean energy investments, the very first step is to define what clean energy means. Representatives of different energy industries and politicians define the term "clean energy" with different meaning. These definitions will be reviewed and the one, which is used through the paper, will be underlined below. United States Senate Committee on Energy and Natural Resources defines clean energy as "1) electricity generated at a facility placed in service after 1991 using renewable energy, qualified renewable biomass, natural gas, hydropower, nuclear power, or qualified waste-to-energy; 2) electricity generated at a facility placed in service after enactment that uses qualified combined heat and power (CHP), generates electricity with a carbon-intensity lower than 0.82 metric tons per megawatt-hour (the equivalent of new supercritical coal), or as a result of qualified efficiency improvements or capacity additions at existing nuclear or hydropower facilities; 3) electricity generated at a facility that captures and stores its carbon dioxide emissions." (The Clean Energy Standard Act of 2012, US Senate Committee)

This definition of clean energy was subject to a massive critique from environmentalists. The key debates argue how clean nuclear, gas and "clean coal" energy sources are. While some experts of energy sector consider that nuclear power should be categorized as a clean energy source, as its exploitation of nuclear energy doesn't emit harmful greenhouse gasses (GHG), others state the opposite, due to harmful nuclear waste. If definition of "clean" is limited with the process of nuclear fusion, than nuclear power is pretty much clean energy resource due to the low level GHG emissions. However from environmental point of view, as it includes uranium mining and nuclear waste processing, nuclear power cannot be considered as a source of clean energy. The similar concerns exist regarding natural gas and coal. The former cannot be categorized as a clean energy source as on the one hand it's burning emits greenhouse gases and on the other hand "clean coal technologies" may capture emissions, but it is not clean due to its finite resource and extensive environmental damage during extraction.

The Florida Renewable Energy Association (FREA) defines clean energy as "any energy source that meets the needs of the present without compromising the ability of future generations to meet their needs. Alternatively, clean energy is energy produced from renewable sources in a process that has minimal impact on environment". In this paper the term "clean energy" is used as renewable energy, which is defined in EU directive 2009/28/EC[1] as follows: ""*energy from renewable sources" means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases".*

Clean energy investments can contribute to energy security through reduction of energy import dependency and also maintain cleaner environment.

Georgian economy is heavily dependent on import (in 2013 the import / GDP ratio was 0.5). In 2013, the indicator of import of goods and services is 7885 mln USD, which exceeds almost 3 times to the indicator of export for the corresponding period. Unfortunately, contribution of the energy sector in this gap is high. In 2013, the share of energy in total imported goods and services is 38%. In 2013, about 2/3 of gross energy demand is met with imported energy resources.

At the same time, country has unutilized potential of clean, environmentally friendly, renewable sources of energy. For instance, only 18% of economically feasible hydropower energy (40 bln kWh annually) is utilized so far. Besides, Georgia has a considerable potential for exploitation of untapped wind and solar energy. The Government of Georgia (GoG) has acknowledged the importance of clean energy investments and has been actively promoting hydropower investments since 2006[2]. This action is

[1] Article 2 paragraph a of the Directive 2009/28/EC of the European Parliament and the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

[2] The decree on "The main directions of the state policy in Georgian energy sector", issued by the Parliament of Georgia.

supported by the argument that currently hydropower energy is more cost-effective than solar or wind power.

As a result of hydropower investment promotion, massive interest among investors was generated. Currently 13 new hydropower plants (HPP) are under construction, with overall 437 MW[3] installed capacity. In addition, around 30 HPPs signed memorandum of understanding (MoU) to develop hydropower stations in predetermined date. Furthermore, the Ministry of Energy of Georgia (MoE) has published 51 potential sites for HPP developments and for wind farm constructions. Despite GoG's strong willingness to add new capacities to the national grid, investors' strategy remains to temporize and to delay investments. This tendency indicates that there are still some issues which have to be resolved to accelerate investments in Georgian energy sector.

Clean energy sources can help to reduce reliance on fossil fuel, to improve the security of energy supply, to meet the global commitments to protect the environment and to contribute to employment generation. Hence, it is important to analyze the impacts of investments in clean energy in Georgia on three main pillars of sustainable development: economic growth, environmental protection and social equity. The paper focuses on assessing environmental (emissions reduction for the country) energy (energy security, energy independence) and social (job creation) impacts of clean energy investments.

[3] http://www.energy.gov.ge/investor.php?id_pages=18&lang=geo

2. Methodology

The research methodology is based on both: qualitative and quantitative approaches. The qualitative analysis was mainly applied to study social impacts of clean energy investments, such as job creation. Qualitative analysis was conducted to examine the appropriate clean energy investment promotion policies and programs, to develop recommendations for utilizing clean energy resources in Georgia. Quantitative analysis was conducted using computer software to evaluate long term impacts of clean energy investments on import reduction, energy security and GHG emissions reduction.

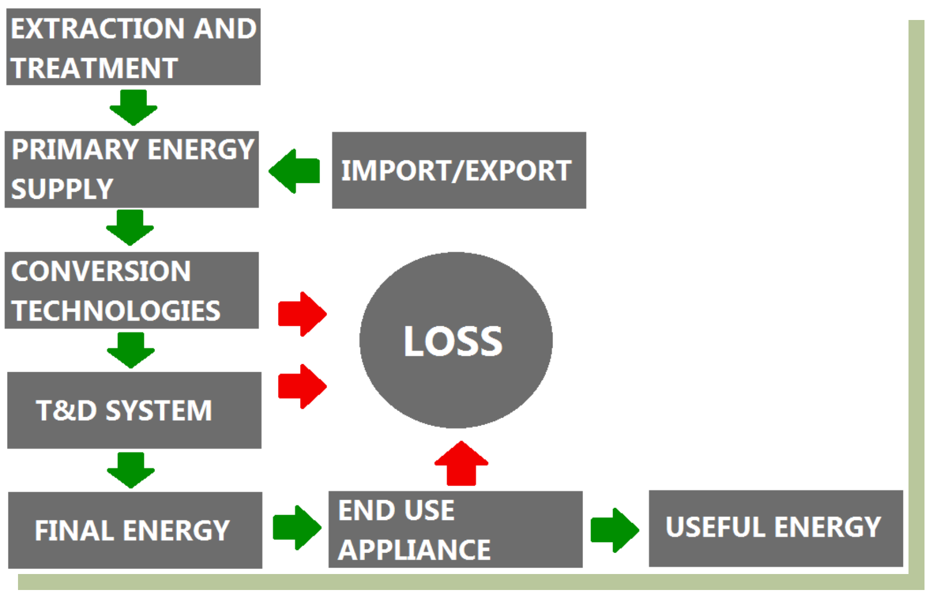
For assessing expected social impact of clean energy investments, relevant literature was reviewed. The scale of a renewable energy projects determines number of labor force needed. The benchmarking approach was employed to assess job creation as a result of the realization of potential renewable energy project scales in Georgia.

For analyzing energy security and environmental effects of clean energy investments extensive modeling was conducted through LEAP-Georgia model. LEAP (Long-range Energy Alternatives Planning System) modelling software was developed by Stockholm Environment Institute, while to describe Georgian energy sector its accounting framework was modified by AYPEG researchers. Hence LEAP-Georgia model is already adapted for the Georgian energy system and has dataset of the year 2012. Already developed LEAP-Georgia model framework was used as a base to build Clean Energy Development (CED) scenario, which was compared to Reference Energy System Development Scenario (REF, also called Business as Usual Scenario or Baseline Scenario). Assumptions of CED and REF scenarios are given in sections 3.3.1 and 3.3.2.

While selecting appropriate modeling tool, the availability of required data source was taken into account. Georgia lacks energy statistics at national level and consistent time-series data on final energy consumption. Hence, LEAP model was chosen as it is a flexible software tool with less data requirements compared to other energy planning software models and does not assume perfect competition. Due to the lack of statistical data, model was built in combination of bottom-up (more data intensive) and top-down (less data intensive) approaches.

As an integrated energy planning model, LEAP covers both, demand and supply sides of the energy system. The model follows the accounting framework approach to generate a consistent view of energy demand and supply based on the description of the energy system. The graphical representation of general modelling approach in LEAP for describing energy supply chain and energy demand is depicted on figure 1.

Figure 1: Energy supply chain in the model



The main variables and processes of the model are given in the following four subsections: key assumptions, demand, transformation and resources. Interactions between key assumptions and demand branches generate energy demand that should be satisfied by resources and transformation module. The LEAP-Georgia is demand driven model based on accounting framework approach.

Key Assumptions

Key assumptions cover macroeconomic and demographic variables that determine total energy demand of the country. These are the following variables: Total population, number of households, household size, urbanization, real GDP, value added of real GDP from each sectors and income are the main exogenous variables of the model, which drive energy demand in different sectors.

Table 1: The assumptions of LEAP-Georgia model

	2015	**2020**	**2025**	**2030**
Real GDP (Bln USD)	10.7	14.7	17.9	21.7
Real income per person (USD)	2,335	3,136	3,721	4,415
Population (thousand person)	4,565	4,681	4,799	4,920
Households (thousand)	1,237	1,300	1,367	1,437
Household size	3.7	3.6	3.5	3.4
Rural population	45%	43%	40%	37%
Urban population	55%	57%	60%	63%

Demand module

Final energy demanded is normally useful energy consumption by end - users, who cannot sell or transfer the energy to others. To reflect the structure of Georgia's energy sector, the end-users are grouped into five categories: households, industry, transport, services, and agriculture. In addition, separate branches are created to illustrate that energy is also used as feedstock in production processes or for non-energy purposes. The analysis is carried out at a disaggregated level. The disaggregated structure of energy consumption is organized as a ''hierarchical tree'', where the total or overall activity is presented at the top level and the lowest level reflects the fuels and devices used. Generally, the product of activity and the energy intensity (i.e. demand per unit of the activity) determines the demand at the disaggregated level. At the end-use level, useful energy is considered to forecast the energy demand.

The socio-economic drivers of energy demand were identified. Average historical elasticity of energy demand to real GDP for a given subsector was calculated to link sectorial energy demand projections to real GDP. Households' energy demand is linked to the number of households, urbanization level, saturation level of energy end-use devices and energy intensity. In the transport subsector, energy demand was linked with population growth and income. The energy demands in remaining subsectors (industry, agriculture and services) were linked to the projected real GDP.

Transformation module

In this module, energy conversion structure is defined. The structure is simpler in comparison with developed countries. Georgia is poor with energy resources except hydropower. On average 80% of electricity is produced by HPPs and remained 20% comes from TPPs, which generates base power during winter, when there is a lack of water inflow. In the periods of spring and summer Georgia exports electricity to all neighboring countries, but mostly to Russian Federation.

To develop Clean Energy Development scenario, the most cost-competitive HPPs, wind farms and solar projects were selected in terms of location, connection to transmission system, construction cost and capacity usage factor, based on the available estimations and prefeasibility studies. The projects are grouped in a six different categories and their characteristics are presented in table 2.

Table 2: Additional electricity generation and capacities according to scenarios

Technology / Scenario	Number of plant		Capacity MW		Generation GWh	
	REF	CED	REF	CED	REF	CED
Large Run of River HPPs	5	10	497	1327	1973	4707
Small Run of River HPPs	7	21	86	125	346	466
Large Reservoir HPPs	0	3	0	1362	0	3663
CCGT	1	1	230	230	1821	1821
Wind	1	4	20	300	92	1050
Solar	0	2	0	100	0	262

New CCGT power plant construction is envisaged with efficiency over 50% in 2016 while old TPP is planned to decommission with 32% efficiency in 2025.

Resources' module

In this module, data on the availability of primary energy resources, including both fossil and renewable ones, as well as the information regarding the costs of indigenous production, imports and exports of both primary resources and secondary fuels are included and analysed. Future utilization levels of fossil fuels and renewable energy and related costs are also studied. As for LEAP-Georgia model, estimations of maximum potential of economically feasible fossil and renewable resources of Georgia are used

Given that LEAP model uses what-if analysis, it mainly relies on the scenario development to describe a consistent storyline of the possible paths of energy system evolution. The baseline scenario or Business as Usual scenario is designed to project the energy sector development for the year of 2030, assuming preservation of the present-day policy. The REF scenario is compared to CED scenario to evaluate its impacts on energy and environmental indicators.

The paper estimates benefits of investments in clean energy – such as estimated reduction of GHG emissions, improved energy security, reduced imports, new job opportunities and estimated costs of renewable energy projects in Georgia. However, the major outcome is policy suggestions and recommendations based on the research findings.

3. Research Findings

This section of the paper presents the research findings. The first subchapter gives information regarding the expected impact of clean energy investments in terms of job creation. The second subchapter presents environmental externalities due to the clean energy investments. Finally, outcomes of comparative analysis of baseline and clean energy development scenarios are discussed.

3.1 Job Creation

Investments in renewable sources of energy can have positive impact on employment level in the country. Increase in employment can be observed at both, construction and operational, stages. Kammen, Kapadia and Fripp

[7] state that "every technology in renewables industry generates more jobs per average of megawatt power in the construction, manufacturing and installation sectors, as compared to the coal and natural gas industry". Hence, renewable energy is able to generate more jobs per average megawatt of installed capacity, however it does not necessarily imply more jobs per GEL of investment, since investment costs per megawatt is higher for renewables than for fossil fuel based technologies. Depending on the type and size of the investment project, the number of jobs created can vary. Number of studies has been devoted to the assessment of the change in employment due to the investments in clean energy sources. Taking stock from those studies, makes it possible to get average number of jobs created over life cycle of a power generation utility. Table 3 below summarizes job creation potential from investment in different types of renewable energy. For instance, investment in solar PV appears to be the most labour intensive. Investment in wind power is capable of generating 278 jobs per 100 megawatt.

Table 3 Average employment over life cycle of a power generation utility Numbers represent jobs created per MW of average capacity[4]

	Manufacturing, Construction, Installation		O&M		Total	
	Min	Max	Min	Max	Min	Max
Solar	5.76	6.21	1.2	4.8	6.96	11.01
Wind	0.43	2.51	0.27		0.7	2.78
Small Hydro	0.26		2.07		2.33	
Large Hydro	4	4.5	0.25	0.28	4.25	4.78

Source: UNEP, ILO, IOE, ITUC (2008), Max Wei a, et. Al. (2010). For estimation of large HPP effect, Georgian studies and cases were analyzed.

CED scenario assumes different size of investments in four types of renewable energy. Based on the assumptions and the estimated numbers

[4] See Max Wei a, et. Al. (2010) for further information/explanation.

given in table 2, the average number of jobs created is calculated (see table 4).

Table 4 Average employment over life of power generation utility

	Manufacturing, Construction, Installation		**O&M**		**Total**	
	Min	**Max**	**Min**	**Max**	**Min**	**Max**
Solar	576	621	120	480	696	1101
Wind	120	703	76		196	778
Small Hydro	10		81		91	
Large Hydro	8768	9864	548	614	9316	10478
Total	**9475**	**11198**	**824**	**1250**	**10299**	**12448**

Source: Own calculations

Employment effect is, of course, higher during the construction process. Full utilization of most cost-competitive clean energy projects will create 10,299-12,448 new jobs per MW of average capacity over the lifetime of power generation utility.

The ability of the investment in renewable sources of energy to create additional jobs does not necessarily mean that this potential will be realized at country level. While construction process is labour intensive, it is skill-intensive as well. Skill mismatch and lack of professionals in the field of construction in Georgia reduce the employment effect of the investment for the citizens of Georgia[5]. Employment effect of investing in clean energy will further be reduced due to the fact that vast majority of construction equipment and materials are imported.

[5] The experience has shown that lack of qualified local workforce is one of the main problems for implementing international projects (e.g. Shah Deniz pipeline construction). Such conditions harm investors and hinder local development.

3.2 Environmental Externalities

Investment in clean energy will have substantial positive externalities on the environment. It will maintain clearer living environment, which on its turn has a vital importance for the health of a nation. Besides, cleaner environment has intergenerational gains, bequeathing healthier environment to future generations. Indeed These benefits are multidimensional and hence are difficult to quantify .Environmental economists employee various methods to quantify environmental benefits of investments in clean energy, but as all environment impacts cannot be quantified, approximate reasoning methods known as fuzzy logic are used, is applied. This method on its turn is often questioned by various experts.

This paper assesses the effect of clean energy investments on the environment through potential reduction of greenhouse gas emissions. Specifically it is estimated how the investments will reduce CO_2 emissions in the electricity sector of Georgia, compared to baseline or REF scenario. The benefits associated with CO_2 reductions and other positive environmental externalities (or negative externalities, associated with hydro dam construction, noise from wind turbines etc.) of clean energy investments such as healthier citizens, cleaner environment, sustainable ecosystem, ecological variety, etc. are also interesting to be researched but for the purposes of general estimation of effects of clean energy investments from multidimensional point of view (environmental, social and energy security impacts), it is out of the scope of this paper.

Fuel consumption for power generation constitutes the main source of CO_2 emissions. Utilization of clean, green and renewable energy sources (hydro, solar, wind, etc.) for power generation is one of the most efficient ways to reduce CO_2 emissions. In addition generation from renewable energy sources can replace partly electricity generated by fossil fuel burning. “Clean electricity” generated by new hydro, wind or solar power plants can to some extent substitute electricity generated from thermal power plants, which are source of CO_2 emissions and, additionally, partially substitute the country’s electricity import (Georgia imports around 1/5 of its total electricity consumption from the neighboring countries where electricity is mostly generated from burning fossil fuel). In order to calculate the reduction of CO_2 emissions associated with clean energy investments, it is necessary to subtract baseline emissions in the electricity sector of Georgia from the emissions generated by the clean energy projects. Since emissions from the clean energy sources are almost zero, emission reductions equal to the substituted generation of natural gas and coal fired power plants multiplied on the emission factor. Applying this approach, makes it possible to avoid overestimating CO_2 reductions from exporting clean energy, but the same time it underestimates CO_2 reduction potential as a substitution of electricity imports.

The Ministry of Environment and Natural Resources Protection (MENRP) based on the "consolidated baseline methodology for grid-connected generation from renewable sources", calculates the baseline emission factor. The factor has been updated based on the latest version (version 02.2.1) of the "tool to calculate the emission factor for an electricity system" [8] in 2012. According to the MENRP calculations, Simple Adjusted Operating Margin Emission Factor is 0.52012 tCO2 per MWh.

Based on this factor and potential reduction of generation from natural gas and coal fired power plants resulted from hydropower, solar and wind energy projects included in CED scenario, potential for reduction of CO2 emissions is obtained. To summarize, the analysis has shown that the effect of investment of approximately 5 billion USD[6] in clean energy is a reduction of CO_2 emissions by 886,098 tons compared to the REF scenario for the year 2030.

[6] The number is estimated as an average of minimum and maximum required investment for large hydro, small hydro, wind and solar power plants per installed KW.

3.3 Result of Scenario Analysis

The reference energy system and clean energy development scenarios are developed and compared for evaluating the policy impacts on import reduction and sustainability measures.

Scenarios are story-lines of how the energy system might evolve in the future in a particular socio-economic setting and under a particular set of policy conditions. All scenarios share a common set of data for a single base year (2012). Each scenario runs from the first year (2013) to the last year of scenario (2030).

3.3.1 Reference Energy System Development Scenario (REF)

REF is constructed under numerous assumptions that are based on the statistical data analyses, already approved policy directions and experts' evaluations. in the framework of existing policies, REF scenario projects, that total energy demand of Georgia increases by 60% in 2030 compared to the base year 2012, and will be 5799 ktoe. Increased demand will be satisfied mainly from increased volume of energy imports, which on its turn will increase energy import dependency of Georgia. Overall increase of imports comprised 52% in 2030 compared to 2012. The mainly the import of electricity and natural gas will increase, due to rising demand on the services supplied from that energy sources.

In the REF, share of natural gas fired TPP generation increases due to increased electricity consumption and also due to the need, to satisfy seasonal electricity demand, when there is low level of hydropower generation during winter period. In reference scenario no construction of large reservoir HPPs are envisaged. The scenario illustrates building those new run-off river and seasonal HPPs that are already under construction or final feasibility study stage depending on the dates indicated in the signed Memorandum of Understandings between GoG and rewarded investors.

Based on the LEAP Georgia modelling assumptions described above, Georgia's energy balances under REF scenario in the period of 2013 – 2030 are given below (see table 5).

Table 5: Projected energy balance for Georgia, Scenario: Baseline, Units: Thousand Tons of Oil Equivalent

	2012	2015	2020	2025	2030
Production	1,377.2	1,496.2	1,611.8	1,611.9	1,613.3
Total Primary Supply	4,040.9	4,500.4	5,391.4	6,105.9	6,838.9
Total Transformation	-535.0	-618.3	-770.7	-932.5	-1,039.5
Agriculture	118.7	131.2	154.9	171.5	189.9
Household	1,079.1	1,123.1	1,202.8	1,296.6	1,400.8
Commercial	402.0	455.4	560.5	636.7	723.3
Industry	585.4	677.3	863.5	1,002.2	1,163.3
Transport	949.9	1,071.8	1,310.9	1,483.2	1,678.3
Other	370.8	423.3	528.2	583.2	643.8
Total Demand	3,506.0	3,882.1	4,620.7	5,173.4	5,799.4

Source: LEAP-Georgia model calculation

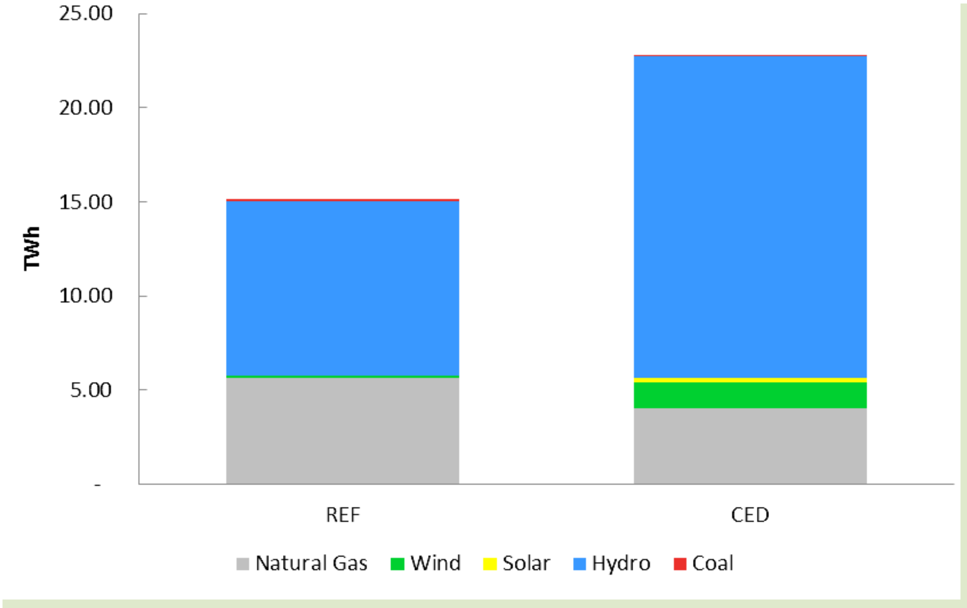
Other REF projections and results will be presented below in the context of deviations from baseline energy sector development path as a result of implementation of renewable energy development scenario.

3.3.2 Clean Energy Development Scenario (CED)

CED scenario models additional electricity production from domestic hydro power, wind and solar energy to satisfy increased energy demand.

CED and REF scenario outputs are compared for the last year (2030) of scenario (see figure 2). As it is shown, electricity generation is significantly (50%) increased under CED scenario as a result of hydro generation increase (84%) and utilization of wind and solar power, which implies decreasing electricity generation from imported natural gas by 28 %. Difference between total generation under CED and REF scenarios is excess generation from HPPs during spring-summer periods and is assumed to be exported.

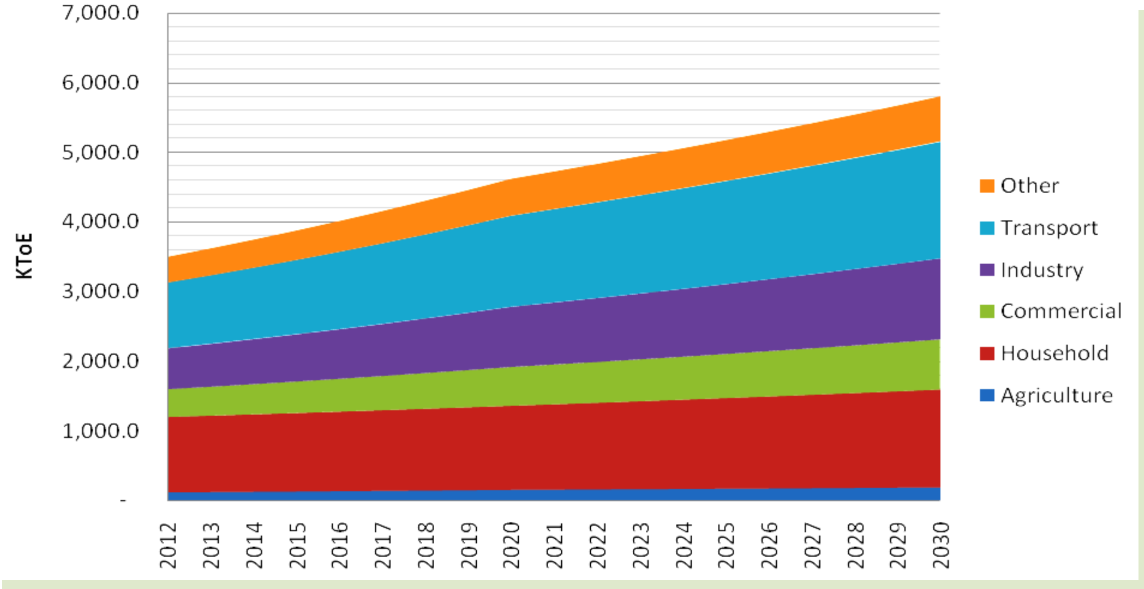
Figure 2: Projected electricity generation by fuel sources in 2030: REF vs CED scenario



Source: LEAP-Georgia model calculation

However, to analyse the whole energy balance behaviour under renewable energy scenario, it is interesting to describe figure 3 below which examines the future development scenario by activities. Based on the modelling results energy consumption by transport sector is the fastest growing one, followed by commercial, household and industrial sectors (figure 4). That is why it is highly recommended to introduce electric trams and at least partially replace existing public transport facilities.

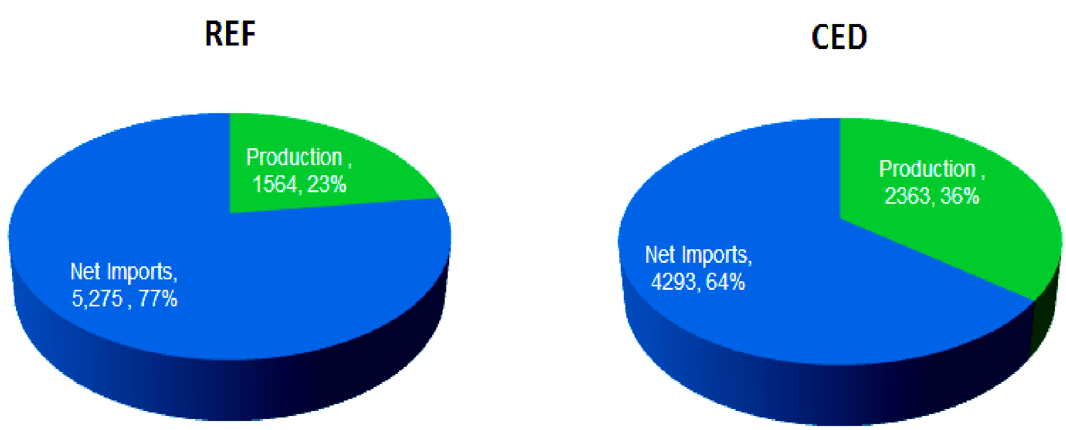
Figure 3: Projected total primary energy requirements for Georgia, by sectors in (Ktoe)



Source: LEAP-Georgia model calculation

Model results show that as a consequence of increased electricity generation from domestic renewable energy resources, energy import dependence of Georgia will decrease from 77% in REF scenario to 65% in CED scenario, in 2030. In figure 4 formation of TPES under reference and renewable energy scenarios in the end year of the study are compared.

Figure 4: Formation of TPES for different scenarios in absolute (ktoe) and relative (percentage) terms



Source: LEAP-Georgia model calculation

However, according to the modelling results, without any fuel switching policy (for instance partial switching from natural gas devices to electric devices for space/water heating or cooking in households, also in transport sector) renewable energy development scenario does not have a significant effect on import reductions.

Conclusions and Recommendations

Clean energy sources can help reduce reliance on natural gas import, improve security of energy supply, meet the global commitments to protect the environment and contribute to employment generation. To summarize research findings, clean energy investments in Georgia is supposed to create 10,299 - 12,448 new jobs, to reduce harmful greenhouse gas emissions, among which the reduction of CO_2 constitutes more than 886 thousand metric tons and to improve country’s energy security through reduction of energy import dependency by 16%, compared to the reference energy system development scenario. Such achievements, in case they will reached, are significant for a country like Georgia, but at the same time they require massive investments, amounting to around 5 billion USD. Moreover, clean energy sources (solar, hydro and wind) have a technical and economic potential but being insufficiently utilized, their share in the total gross energy consumption of the country is still low. Hence, the GoG should more actively promote investments in clean energy.

Unfortunately, Georgia’s present energy policy does not provide sufficient incentives for investors to invest in clean energy sources and lacks well-developed regulatory framework. Without determined and coordinated effort, renewable energy potential will not be realized to a significant extent, resulting in missed opportunity to develop green electricity platform and to reduce greenhouse gas emissions significantly. The use of clean energy resources is considered one of the main factors for promoting transition toward low-carbon economies, for development of new highly technological industries and ensuring the so-called „green“ growth and „green“ jobs. In order to facilitate clean energy investments in Georgia the key actions, described below, have to be completed.

Recommendations

Based on the research findings the following recommendations are provided to be considered in order to foster the development of clean energy resources:

- Develop and implement electricity trading mechanism for the regional markets, with specific focus on Turkish electricity market, to support green electricity trading on regional level;
- Develop and implement a policy, which promotes renewable energy sources that will integrate regional initiatives encompassing a wide range of incentives: energy, environment, employment, taxation, competition, research and technological development;
- Enforce requirements to assess environmental for every considered power plant before securing of investments;
- The GoG should analyze the opportunities for the long-term cost effective use of RES in the process of diversifying the energy supply to meet national policy objectives;
- Develop and implement fuel switching policy, especially in residential and transportation sectors;
- Modernize current vocational education system in order to fill the gap between skills of Georgian citizens and clean energy industry job requirements. Provision of high quality vocational education should be provided with a particular focus on the skills needed in a power plant construction. In addition, it is important to send right signals to SMEs to specialize in providing supplementary services.

In order to achieve sustainable development goals in terms of desired level of clean energy resources utilization it is necessary that GoG actions are coordinated, meaning that the Ministry of Energy, the Ministry of Environment, the Ministry of Finance, and the Ministry of Economy and Sustainable Development should enhance the promotion and the utilization of clean energy sources in a coordinated manner. The GoG should enhance its participation in public private partnership which will encourage and maintain clean energy investments.

References

1. Abel A., Dixit A., Eberly J., Pyndick R., "Options, the value of Capital and Investment", August 1996
2. Bushnell J., Ishii J., "An Equilibrium Model of Investment in Restructured Electricity Markets", January 2007
3. Gochitashvili, T., Javakhishvili. T., "Georgian Oil and Gas Trunk Pipelines". Tbilisi: Meridiani, 2012. ISBN 978-9941-10-557-9
4. Joskow P. "Competitive Electricity Markets and Investment in New Generating Capacity", May 2006
5. Jung M." Host Country Attractiveness for CDM Non-Sink Projects", 2005
6. Kammen D. M. and Nemet G. F., "Reversing the Incredible Shrinking Energy R&D Budget," Issues in Science and Technology, Fall 2005
7. Kammen D.M., Kapadia K., and Fripp M., "Putting Renewables to Work: How Many Can the Clean Energy Industry Generate?", April 2014
8. Lazriev G., Bostonashvili R., and Arabidze M., "Baseline Emission Factor for the Electricity System of Georgia", Tbilisi 2012
9. Official Web-site of Ministry of Energy of Georgia , http://www.energy.gov.ge/
10. Official Web-site of ESCO, www.esco.ge
11. Pirveli I., Sumbadze, N., Galdava I., Kelbakiani G., "The Political Economy of Sustainable Energy". Tbilisi: Grigol Robakidze University, 2013. ISBN 978-9941-0-5771-7.
12. Pirveli I., Sumbadze, N., Galdava I., Kelbakiani G., Mukhigulishvili G., "Electricity Policy Modeling and Analysis". Tbilisi: Universal, 2013. ISBN 978-9941-0-5771-7
13. REN21. 2014. Renewables 2014 Global Status Report (Paris: REN21 Secretariat)
14. United Nations Environment Programme, 2011. Renewable energy- Investing in energy and resource efficiency
15. United Nations Environment Programme, 2008. Green Jobs: Towards decent work in a sustainable, low-carbon world
16. Wei, Max, Shana Patadia, and Daniel M. Kammen. "Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?." Energy policy 38, no. 2 (2010): 919-931.

KONRAD-ADENAUER-STIFTUNG

Regional Program Political
Dialogue South Caucasus

Tel.: +995 32 2 45 91 11
Fax: +995 32 2 24 01 03
E-Mail: info.georgien@kas.de

E.Akhvledianis Agmarti 9a
0103 Tbilisi
Georgia
http://www.kas.de/suedkaukasus/

PMC Research Center

Tel: (+99532) 2982 495, 2921 171
Fax: (+99532) 2969 185
E-mail: research@pmcg.ge

57 Uznadze Street, 4th floor
Tbilisi 0102, Georgia

http://www.pmcg-i.com/