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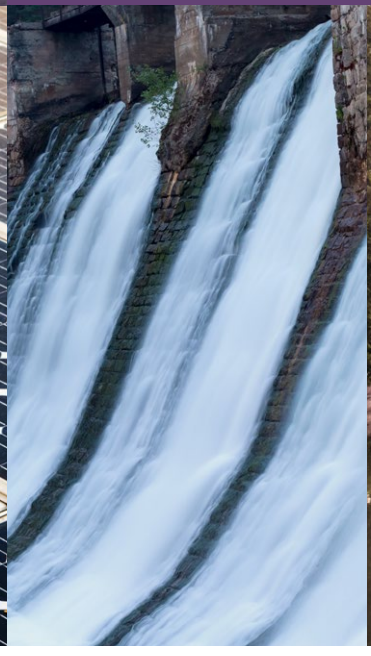

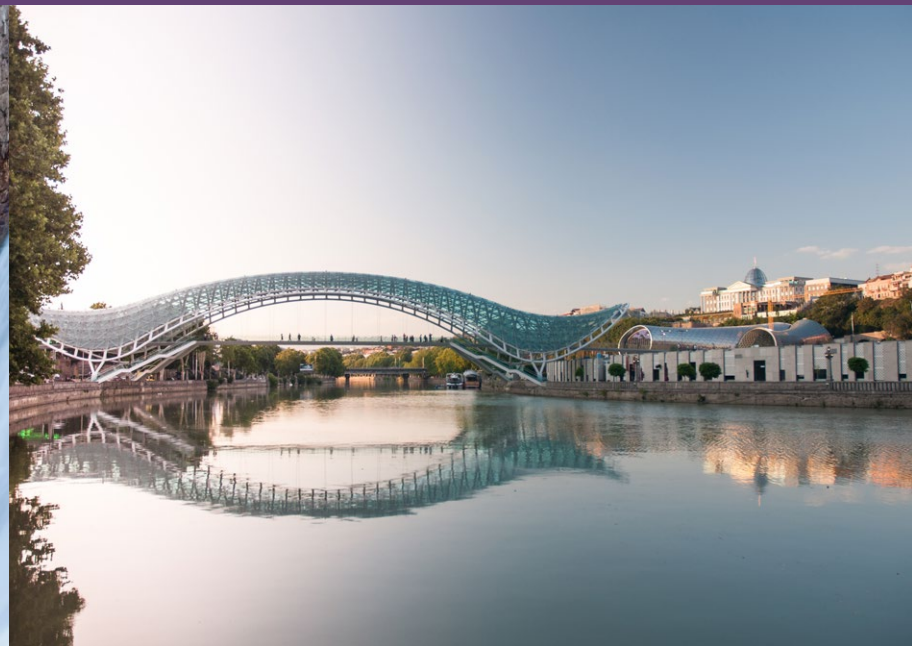

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United Nations Development Account project on promoting renewable energy investments for climate change mitigation and sustainable development

Case Study on Policy Reforms to Promote Renewable Energy in Georgia

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Preface

This case-study report was prepared for the Sustainable Energy Division, United Nations Economic Commission for Europe (UNECE) within the framework of the United Nations Development Account (UNDA) project Promoting Renewable Energy Investments for Climate Change Mitigation and Sustainable Development. The project focused on capacity-building for policymakers and project developers in order to promote investments in renewable projects. The project was led by UN ESCWA and implemented in partnership with the UNECE.

The UNDA project included case studies of the experience of renewable energy policy reforms in selected countries from each of the two regional commissions. Four countries were selected from each regional commission: Jordan, Lebanon, Morocco and the United Arab Emirates from UN ESCWA Member States; and Georgia, Kazakhstan, Serbia and Ukraine from UN-ECE Member States.

The present report covers the case study for Georgia, and was prepared by Ms Natia Arabidze (PhD), an associate professor of the Faculty of Energy and Telecommunication at the Georgian Technical University with more than 10 years of professional experience in the field of renewable energy, energy management and energy efficiency. Mr. Viktor Badaker, Regional Adviser, Sustainable Energy Division (UNECE), helped review and finalize the document.

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1. Sector characteristics: description of the energy-producing sector, including the level of greenhouse gas emissions in tons of CO_2 emitted, with a specific description of the renewable energy segment

The Georgian energy sector comprises several major stakeholders. The Ministry of Energy implements energy policy, monitors the sector and facilitates investment projects. The National Energy and Water Supply Regulatory Commission is an independent regulator, which sets the tariffs and their methodology, establishes rules on licensing and standards and resolves relations between customers and companies.

The Electricity System Commercial Operator is an energy market operator in charge of balancing market, emergency import/export and is a reserve capacity trader. The other key players of the sector are also the companies in the fields of generation, transmission and distribution.

At present, the power-generation sector of Georgia consists of seasonal regulation and the running of river hydropower and thermal power plants (TPPs) operating on natural gas and coal, with a total installed capacity of 3,720 MW. As of September, 2016 a total of 67 operational hydropower plants (HPPs) with 2,800 MW total installed capacity generated approximately 80% of total electricity generation in the country and the remaining 20% is generated from thermal power plants (TPPs). An additional 421 MW installed capacity is expected to became an operational (20.7 MW is from wind-power plants (WPPs) and the rest from HPPs) by the end of 2016.

In terms of electricity generation, according to the electricity balance of Georgia, the annual electricity generation reached 10.8 TWh in 2015. A share of electricity generated by TPPs reached 21.4% of the total generation, while the share of HPPs constituted 78.6%. In 2015, electricity generation increased by 4.3% compared to 2014 and by 7.4% compared to 2013. In recent years, Georgia has experienced a considerable increase in electricity generation with an average annual increase of 4.2% between 2006 and 2015, which resulted mainly from the commissioning of new HPPs. Since 2012, 14 HPPs (176 MW) were constructed. On the other hand, electricity consumption is increasing; in 2015 it increased by 2.1% compared to the previous year and by 7.1% compared to 2013. Furthermore, the average annual increase of electricity consumption amounted to 3.2%. The Government of Georgia therefore vigorously encourages investment projects to construct new electricity-generation stations along with the development of energy infrastructure.

Recent energy projects which are under construction and licensing stages are mostly HPP amounting to 1,646 MW of installed capacity with an expected total annual electricity generation of 5.476 GWh[1] . A WPP project with 20.7 MW of installed capacity is one of the projects and is planned to be commissioned by the end of 2016. Moreover, there are additional 70 perspective prospective renewable energy (RE) projects (3,043 GW installed capacity and annual electricity generation of about 13,010 GWh) on in different stages of implementation. In total, there are 110 RE projects (total installed capacity of which is estimated to be 4,668 GW with 18,485 GWh electricity generation), which also include projects for wind, solar and biomass (waste) utilization. However, high capital costs of other renewable energy sources (RES), compared to hydro resources and the problem of grid access still obstruct their implementation on a large scale in Georgia.

Currently, the main sources of emissions in the Georgian energy-producing sector are TPPs. There are four gas-fired TPPs and one coal-fired TPP with total installed capacity of 924.4 MW.

- Tbilsresi Unit 3 and Unit 4 in operation since 1963; installed capacity: 270 MW;
- Mtkvari Unit 9 in operation since 1991; installed capacity: 300 MW;
- Gardabani gas turbine (g-power) in exploitation since 2006; installed capacity: 110 MW;
- Gardabani combined cycle gas turbine (CCGT) in exploitation since Autumn 2015; installed capacity: 231.2 MW;
- Tkibuli coal-fired plant in exploitation since autumn 2015; total installed capacity: 13.2 MW.

The most significant power addition to thermal energy was a 231.2 MW combined cycle power plant, since Units 3 and 4 were already out of date and run with only 34% efficiency, although they were rehabilitated several times. They will be decommissioned by 2020. Additionally, the Ministry of Energy plans to construct another 230 MW CCGT in order to decommission Mtkvari Unit 9 by 2025. In order to promote the utilization of local resources, enhance energy security and solve unemployment issues, the Government of Georgia supports the construction of a 150 MW coal-fired TPP, which will be equipped with clean coal technologies.

According to the electricity balance, electricity generated from TPPs reached 2,378.8 million kWh in 2015 and 971.4 million kWh in the period January–August 2016.

Respective carbon dioxide (CO2) emissions are presented in Table 1.

Table 1: CO_2 emissions from power plants in 2015/2016

2015	Generation (million kWh)	EF (kgCO2/kWh)	CO_2 emissions (tons)
Mtkvari	1,212.0	0.555	672,660
Tbilsresi	760.8	0.681	518,105
G-power	24.9	0.627	15,612
Gardabani	355.9	0.45	160,155
Gardabani CCGT (test)	24.8	0.45	11,160
Tkibuli	0.4	0.8	320
	2,378.8		**1,378,012**
2016	**Generation (million kWh)**	**EF ($kgCO_2$/kWh)**	**CO_2 emissions (tons)**
Mtkvari	317.6	0.555	176,268
Tbilsresi	36.9	0.681	25,129
G-power	52.2	0.627	32,729
GARDABANI	560.1	0.45	252,045
GARDABANI CCGT		0.45	0
Tkibuli	4.7	0.8	3,760
	971.5		**489,931**

2. Current policy: a summary of relevant policies for RE investment in place before the reforms were introduced

The energy sector of Georgia was largely shaped since 2003, after a series of reforms. The priority of these reforms was to enhance the legal and regulatory framework for business and deregulation, which occasioned strong economic growth and solved many problems of the energy sector in the early 2000s.

The law on electricity and natural gas is the key part of legislation regulating the country's energy sector since 1997[2] . The objectives of the law include stimulation of local hydro-energy utilization and other RES. Although it provides a limited and imperfect definition of RES, it does define small power plants with an installed capacity of 13 MW, with emphasis on small-scale power plants operating on RES. Since 2006, the law has been amended several times and currently incorporates some European Union (EU) principles. The last amendment of the law encourages small-scale renewable energy utilization to some extent, but until there is a special law on RES, large-scale renewable energy deployment will remain complicated[3] .

In 2006, the first energy policy document Main Directions of the State Energy Policy of Georgia was adopted, according to which, utilization of the country's local, indigenous RES became one of the major factors for development of the energy sector. The key priority was full satisfaction of demand for electricity by the maximum possible utilization of local hydropower resources, initially with the help of imports and, eventually, by substituting them with thermal generation and the development of alternative energy sources such as wind, solar and geothermal. Although the policy document was amended by the new energy policy, adopted in June 2015, the key policy directions have not changed significantly.

The aim of the new energy policy is to elaborate a long-term comprehensive State vision, which will later become the basis for the development of short-, medium- and long-term strategies for 2030, with implications for the utilization of Georgia's renewable energy resources.

Since the adoption of the new energy policy, the Georgian Government has continued working on the improvement of self-sufficiency through the utilization of local renewable energy resources by constructing new generation units – hydro, wind and solar power plants – to reduce dependency on imports, as well as combined cycle natural-gas-fired turbine plants to ensure base load capacity.

In order to support the construction of new generation units, the Government adopted State programmes and several resolutions and decrees, in particular:

- Resolution No. 107 on the approval of the national programme, Renewable Energy 2008, which defines the procedure for initiating and implementing RE projects in Georgia, although it does not contain targets or a national action plan in the field;
- Resolution No. 214 on the approval of rules for expressing interest in conducting technical and economic feasibility studies for the construction, ownership and operation of power plants in Georgia effectively replaced Resolution No. 107 for new power-plant projects and at the same time somewhat modified the approach introduced by the 2008 resolution;
- Decree No. 40 of the Ministry of Energy regulates the construction and operation of HPPs and WPPs, which will be identified by the investors.

Implementation of the regulations listed above simplified the regulatory framework for small and medium-sized HPPs and WPPs and facilitated renewable energy utilization. Since 2012, 14 new HPPs have started. As of September, 2016 31 HPPs are at the construction and licensing stage, among them four HPPs and one WPP are expected to be operational before end of 2016. A number of prospective RE projects are at various stages of implementation and potential projects are also under consideration.

In addition, in 2015, the Ministry of Energy approved and adopted the strategic document "Ten-year network development plan of Georgia for 2015–2025"[4], which is the time-bound programme designed for reinforcing the national transmission-system infrastructure, addressing the existing problems, responding to future challenges and realizing the opportunities. One of the core subjects identified in the document is the integration of RES into the network, which yet remains a major challenge for wind- and solar-based electricity generation.

Despite the existing regulations and plan, Georgia still lacks a law on renewable energy and a strategy that would cover the entire legal framework for effective utilization of all kinds of renewable energy resources. There are no renewable energy targets, either. Biomass, mostly firewood, has a major share in primary energy consumption, with a tendency to increase annually, causing forest degradation.

The existence of a legal framework would regulate this issue from both the energy and environmental perspectives. The lack of legislation is an obstacle for the effective utilization of geothermal and solar energy resources.

Based on electricity balances, the promotion of renewable energy resources in terms of hydropower is well established in Georgia (an average 80% of annual generation). A different analysis of renewable energy policy, however, shows that Georgia is premature in having proper renewable energy legislation and does not, therefore, satisfy most of the principles of the Renewable Energy Directive 2009/28/EC. It is becoming a matter of urgency, especially now, when the country has applied for full membership of the Energy Community (European Commission) and has signed the association agreement with EU. It will have to adopt a mandatory renewable energy target and develop a renewable energy action plan in the near future.

3. Renewable energy potential assessment of CO_2 emission reductions possible from the envisaged increased share of renewable energy

While it is recognized that hydropower is the dominant source of electricity generation in Georgia, it is estimated that only about 20% of its potential is currently utilized. According to the Ministry of Energy, a potential installed capacity of greenfield HPP projects is estimated to be equivalent to 15,000 MW with an annual generation potential of 50 TWh per year.

Other RES, such as solar, wind and geothermal sources also have considerable economic potential.

The average annual electricity generation from wind in Georgia is estimated to be 4 TWh with an installed capacity of 1,450 MW[5] and total annual solar energy potential is calculated to be 108 MW[6] , but considerations are different regarding solar potential. As for geothermal resources, hydrogeological studies show that geothermal water reserves reach 250 million m3 per year and the average temperature of geothermal waters ranges from 30 °C to 110 °C in more than 250 natural and artificial water channels; the total potential amount to be withdrawn is 160,000 m^3 per 24 hours. Another source of energy – biomass – is a considerable renewable resource and, despite the available potential of various sources, the major part in primary energy consumption is firewood and is increasingly causing forest degradation.

Based on these research results, it can be roughly estimated that effective utilization of RES would produce an additional 20 billion kWh in the near future, saving about 7 million tons of conventional fuels. At the regional scale, the exploitation of renewable energy resources outlined above would give the country an opportunity to reduce its utilization of fossil fuel and consequently reduce greenhouse gas (GHG) emissions into the atmosphere: some 9 million tons of CO2. Moreover, it would contribute to reducing air-polluting gases, such as carbon monoxide, by approximately 5,000 tons and nitrogen dioxide by approximately 44,000 tons.

Furthermore, in the case of construction of 95 HPPs[7] considered as potential projects, the reduction of CO_2 emissions would reach 2,376.0 tons annually.

Table 2: Electricity production in Georgia, 2006–2011

Year	Thermal power generation (million kWh)	Hydropower generation (million kWh)	Total
2006	2,225	5,396	7,621
2007	1,515	6,831	8,346
2008	1,279	7,162	8,441
2009	991	7,412	8,403
2010	679	9,368	10,047
2011	2,216	7,891	10,106
2012	2,477	7,220	9,697
2013	1,787	8,271	10,058
2014	2,036	8,334	10,370
2015	2,379	8,454	10,833

Currently, electricity in Georgia is generated mainly by HPPs and gas-fired TPPs. The dynamics of power generation (together and separately for HPPs and TPPs) for the years 2006–2015 are given in Table 2.

According to the data provided, electricity generation increased over the years. The share of hydropower generation increased until 2011; in 2010 it reached 93% and only 7% was from TPPs.

2011 was marked by a sharp increase in TPP generation, mostly because rivers contained insufficient water and generated hydropower capacity was lower than the average hydrological year. At the same time, demand on energy increased significantly: by 10% annually from 2009 to 2011.

In 2013, hydropower and thermal power generation started to increase again. Emissions from the energy sector, however, were roughly three times less compared to the records for 1990[8] when the energy sector was a heavy polluter (energy-sector emissions were about 36.6 million tons of CO2 equivalent (MtCO2eq), while emissions from different sectors amounted to a total of 48 MtCO2eq[9] .

According to Georgia's Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), the increase in emissions was particularly high in the heat and electricity-power generation subsectors, where emissions increased by 126% compared to 2010. It should be noted that the capacity of hydro resources has a great influence on emissions from the energy sector.

In 2015, the Ministry of Energy elaborated forecast scenarios[10] on electricity demand and supply for 2015–2030. There are several assumptions on domestic demand growth; each case shows that electricity generated from renewable energy resources has a surplus 25 TWh by 2030, while electricity generated from TPPs does not exceed more than 3.9 TWh by 2030. It can therefore be anticipated that utilization of renewable energy resources in Georgia can face the challenge of increased emissions.

Development of potential renewable energy power projects, together with the implementation of energy-efficiency measures in the power sector, which would include the rehabilitation of existing hydropower assets, optimization of reserves and seasonal operational regimes, reduction of losses in transition and distribution systems, decommissioning of outdated TPPs, etc. and would reduce the fuel consumption of conventional power plants. Consequently, the implementation of the above-mentioned measures would contribute to reducing GHG emissions from the energy sector.

4. Assessment methodology: a description of the analytical tool or models used to assess the potential energy production and CO_2 reductions

Renewable energy deployment and utilization is a strategic priority for the Government of Georgia. It is considered as a major alternative to imported energy. It also contributes to satisfying rapidly growing demand, ensuring enhancement of energy security and creating new jobs, attracting foreign investments and introducing clean, innovative technologies. In general, enhancement of renewable energy in the country supports the attainment of sustainable development goals. There is no doubt that the Government is keen to benefit from the advantages of RES. Accordingly, the country offers a desirable and attractive business environment to investors. There are remaining barriers and risks which might delay the implementation process, however.

The present case study identifies and analyses strengths and opportunities for renewable energy development, as well as weaknesses and risks which might obstruct their utilization and promote emissions from the energy-producing sector.

Generally, renewable energy projects operate on the basis of the build-own-operate principle. Since approval of the State Programme – Renewable 2008 – the energy sector is deregulated. All power plants operating on RES and constructed after 2008 are free to choose the buyer and set a price for the electricity produced. Moreover, the procedures related to obtaining permits and licenses have been simplified. Investors are supported through a guaranteed power purchase agreement (PPA)[11] . Energy infrastructure and grid line are in operational condition. In order to make the infrastructure more reliable, secure and sustainable, permanent rehabilitation and reinforcement activities need to be implemented.

Several studies have been conducted on the potential of utilizing hydro resources that have been transformed into power-project proposals. The list of these potential HPP projects was elaborated and approved by the Ministry of Energy. In addition, the Ministry conducted a study of four major river basins in Georgia, in order to identify further potential for hydropower development. In comparison to other RES, the hydropower sector has all the prerequisites for large-scale expansion. Large-scale HPP plans occasioned strong protests and objections, which seriously affected their development. The construction of large HPPs have the potential to solve existing problems in the energy sector; they could operate as an alternative to TPPs, provide peak loads and ensure energy independence. Approximately, at least 1.7 billion kW/h generated from renewable (hydro) energy is drawn from Georgia's energy mix. On the other hand, Georgian rivers have a seasonal nature and river HPPs are not able to provide electricity all year round.

With reference to the utilization of wind energy, Georgia's wind atlas (prepared in 2004, based on studies conducted in the early 1970s–1980s) is available on the Ministry's official web page, indicating nine suitable areas for WPP construction. It is estimated that it is feasible to construct WPPs with 1,450 MW installed capacity. On the other hand, seven memorandums of understanding (MoUs) have been signed between the Ministry of Energy and investors to conduct a technical-economic feasibility study for the purpose of constructing WPPs. In total, installed capacities of these potential projects are around 1,900 MW. Besides, some 10 proposals have been submitted by potential investors aiming to implement wind-power projects with about 900 MW of total installed capacity. Bearing in mind the foregoing, the Georgian energy system would absorb around 2,800 MW of wind energy in the next 5–10 years. The Ten Year Network Development Plan concludes, however, that the grid network would be capable of integrating only 100 MW of wind power by 2020 and 400 MW by 2026.

At the same time, network development describes the Georgian power system as a small-scale system, with radial topology of its western part and only 500 kV synchronous links with the Russian Federation provided by the Kavkasioni overhead transmission line. In order to enhance stability and reliability, therefore, bulk integration of wind- and solar-power facilities into the Georgian network prior to 2025 is unreasonable[12] .

A low amount of solar energy is utilized. Mostly small-scale photovoltaic (PV) and solar collectors were

installed by individual consumers, some of which were funded by donor organizations, while some households were able to afford installations without any support from the Government: that is why solar energy is not widely utilized. At the beginning of 2016, the Ministry of Energy decided to implement a pilot project for solar-energy utilization. Subsequently, the Georgian Energy Development Fund (100% Government-owned) launched the construction of 5 MW installed capacity solar power plant (SPP). A 20 MW WPP project is being developed by this Fund as a pilot project and an MoU was signed with a private investor to conduct a technical-economic feasibility study on a 50 MW SPP.

The main weakness of the ministry in terms of promotion of non-hydro renewable energies is the lack of a legislative framework. A long-term strategy, primary law and a renewable energy development action plan, together with proper awareness-raising campaigns and relevant support schemes could have synergetic results in the rational utilization and sustainable deployment of renewable sources. All the above-mentioned could make renewable resources affordable and accessible for individual households or small and medium-sized enterprises and for the integration of renewable technologies (non-hydro technologies as well) in agriculture, where the potential exists in biomass and bioliquid production. Renewable energy utilization could therefore also contribute to reductions of emissions from these sectors.

A tendency towards a rapid increase in energy demand, delays in construction of large-scale HPPs and the wind-power integration issue could be considered as a threat to the renewable energy share in the total energy mix. It must also be taken into consideration that, if the renewable energy projects do not succeed, it is assumed that thermal power generation will increase in order to meet demand.

While two more natural-gas-fired TPPs and an additional coal-fire TPP are planned to be constructed, the share of imported gas will increase, hindering sustainable development and energy independence. Technical barriers related to the integration of non-hydro renewable power plants into the grid might lead to investment outflow in this field. Lack of or inappropriate awareness of different parts of society, in addition to poor communication between parties might be a reason for delays in energy-infrastructure development.

The Ministry of Energy has elaborated several forecast scenarios of electricity generation and demand. These scenarios were elaborated for the following categories of generation facilities.

- Category 1 (C1) power plants under construction, which are provided with relevant implemented memorandums;
- Category 2 (C2) power plants that are the objects of interest officially expressed by reputable investors and for which feasibility studies have begun;
- Category 3 (C3) large strategic power plants of national importance; feasibility studies are expected to start in the near future.

Table 3 shows various cases with different growth rates regarding demand (load) and generation.

Table 3: Cases of different growth rate regarding demand (load) and generation

Integrated load/generation growth rates (cases)	C1-100%, C2-50% (G1)	C1-100%, C2-50%, C3 -25% (G2)	C1-100%, C2-100%, C3 -100% (G3)
3% increase - L1	L1G1	L1G2	L1G3
5% increase –L 2	L2 G1	L2G2	L2G3
7% increase – L3	L3 G1	L3G2	L3G3

The most realistic scenario that assumes an annual demand growth of 5% and integration of 100% of renewable energy projects (mainly HPPs) is included in all three categories. The annual electricity energy balance given in Table 4 has been developed, based on forecast L2G3 and shows increase of potential renewable energy generation.

The most important advantage of renewable energy production relates to the use of domestic resources, followed by the multiple benefits of providing new business opportunities and a reduction of CO2 emissions, while contributing to the country's long-term energy demand. In conclusion, the Government of Georgia has to take more transformational steps to achieve the forecast presented in Table 4.

Table 4: Electricity generation forecast for 2015–2025

Year	Generation	RES	TPP	Demand	Export
2015	11.09	8.68	2.41	11.25	- 0.16
2016	11.82	9.36	2.46	11.71	0.11
2017	12.38	9.82	2.56	2.56	0.09
2018	13.17	11.11	2.06	12.91	0.26
2019	15.06	12.53	2.53	13.55	1.51
2020	18.16	14.16	4.0	14.23	3.93
2021	21.19	18.64	2.55	14.94	6.25
2022	24.54	22.26	2.28	15.69	8.85
2023	24.68	22.32	2.36	16.48	8.20
2024	26.41	23.93	2.48	17.30	9.11
2025	26.93	24.37	2.56	18.16	8.77
2026	28.17	24.78	3.39	19.07	9.10

5. Economic, environmental and policy analysis: an appraisal of the overall impact of policy measures introduced

The power sector is a major driver of Georgia's economy and has considerable effects on social welfare. After significant policy reforms over the last 10–12 years, the situation of the power sector has improved substantially. Major priorities were identified which advocated the development of hydropower resources, enlargement of capacity and ensuring the stability of the power-transmission system in order to give the country a role of power transit country.

Since 2005, rehabilitation works have been conducted at all existing HPPs (large, small and medium) and TPPs, which increased hydro-electricity generation by 40%. A major rehabilitation work was conducted at Enguri HPP and Vardnili HPP[13] . Although a full rehabilitation of Enguri HPP units were finalized in 2015, the current plan is to rehabilitate the deviation tunnel of the power plant. Rehabilitation of the power stations was followed by major privatization of the sector, which also accelerated development. In parallel with power-station recovery, a full registry of the communal meters and installation of individual meters were conducted in 2004–2007, resulting in a significant reduction of losses in the electricity-distribution system. As a result of privatization, the distribution company Telasi Joint Stock Company (JSC)[14] fulfilled the obligation for individual metering in Tbilisi in 2006, while Energo-Pro Georgia JSC[15] is expected to accomplish individual

metering by 2017. Major rehabilitation and construction works of the national grid started and are still ongoing.

A number of projects have been implemented in order to improve the reliability of the transmission system and ensure effective and uninterrupted transmission and dispatch services. Successful completion of rehabilitation and upgrade of the Dispatch and Telecommunications System is a major accomplishment, with a fully operational National Control Centre at Georgian State Electrosystem's[16] headquarters equipped with state-of-art technologies. Such rehabilitation works led to a decrease in energy losses and made the system more sustainable; a reliable connection between the eastern and western parts of the Georgian power system has been established.

Investing in hydropower generation became even more attractive since construction of the 500/400/220 kV interconnection line between Georgia and Turkey under the Black Sea Transmission Network Project, requiring €283 million. This highly important project ensured sustainability and reliable operation of the transmission system and facilitated further development of the transit function. According to the report issued by the Ministry of Energy in 2015, a total investment of planned and current electricity infrastructure projects amounted to US$ 515 million[17] .

The Georgian energy sector became interesting not only for investors but also for international financial institutions such as the European Bank for Reconstruction and Development, European Investment Bank, World Bank, Asian Development Bank and Kreditanstalt für Wiederaufbau (a Government-owened German development bank).

Investment in the hydropower sector was promoted by the rehabilitation and reinforcement of energy infrastructure. On the other hand, simplified procedures and dedicated policy, as well as supportive instruments, were key drivers of investment flows in renewable energy uptake. Policy directions adopted in 2006 identified the strategic vision of energy-sector development and highlighted the issue of diversification of energy-supply sources and the maximum utilization of renewable energy resources to reduce dependence on imported energy resources. Policy approaches in 2006 were further strengthened after the renewable energy programme was launched in 2008. The energy sector was deregulated and all power plants operating on renewable energy sources and constructed after 2008 became free to choose the buyer and set a price for the electricity produced.

Moreover, the procedures related to obtaining permits and licenses were simplified. Since then, investors are supported through the guaranteed PPA, although PPAs are not determined by general conditions approved for all projects, but depends on negotiations between the Ministry of Energy and the investor.

A second round of policy reforms started in 2013. Amendments to the decree on the terms and conditions of the expression of interest for construction technical-economic feasibility studies, construction, ownership and operation of power plants in Georgia were enforced. As a result, a two-step project-implementation system was implemented, which identified the pre-construction and construction phase of project development.

The bank guarantee amount has been significantly decreased and the investor became obliged to sell eight months of energy generated annually during the first 15 years of operation on the local Georgian market only. Sanctions were modified and, in compliance with new rules, investors were able to keep the bank guarantee and have a right to continue project development, albeit in accordance with the timeframe set by the Ministry of Energy. These rules apply only to potential HPP projects, which are identified by the Ministry of Georgia. In order to boost the wider uptake of renewable energy resources, however, the Ministry of Energy issued Order No, 40, which has been in force since 10 April 2014. This order set the rules for construction, ownership and operation of HPPs and WPPs identified by investors.

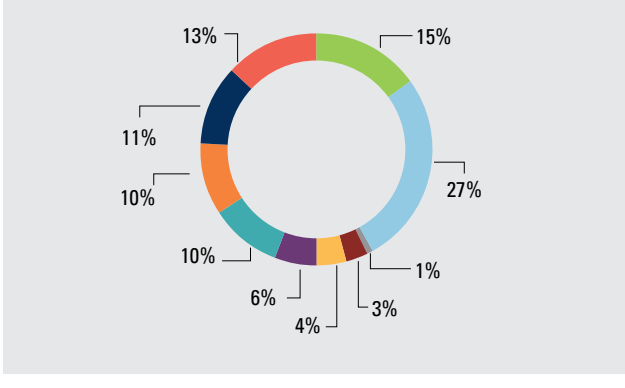
Order No. 40 gives an opportunity to investors to explore new projects other than those included in the list of potential projects identified by the Ministry. Unlike the case of Resolution 214, Order No. 40 sets only one phase system for project implementation, which obliges the investor to conduct a technical-economic feasibility study for the potential project; the investor is not required to submit the bank guarantee.
Since introducing new regulations, about 60 MoUs were signed during 2013–2015 between the Ministry

of Energy and investors. Among them is an MoU on implementation of the 280 MW installed capacity Nenskra HPP project. Nenskra HPP will produce around 1.2 billion kWh. The total investment of the project is US$ 1 billion[18] .

According to the Ministry of Energy, 14 small and medium-sized HPPs have been constructed since 2012; overall investment to develop HPP projects is around US$ 295 million. Total investment of those renewable energy projects which are expected to be commission by the end of 2016 is estimated at US$ 757 million[19] .

Figure 1 shows that from the fourth quarter of 2012 until the second quarter of 2015, US$ 500 million of foreign direct investments (FDI) were implemented in the Georgian energy sector, amounting to the second largest share (15%) of total foreign direct investments.

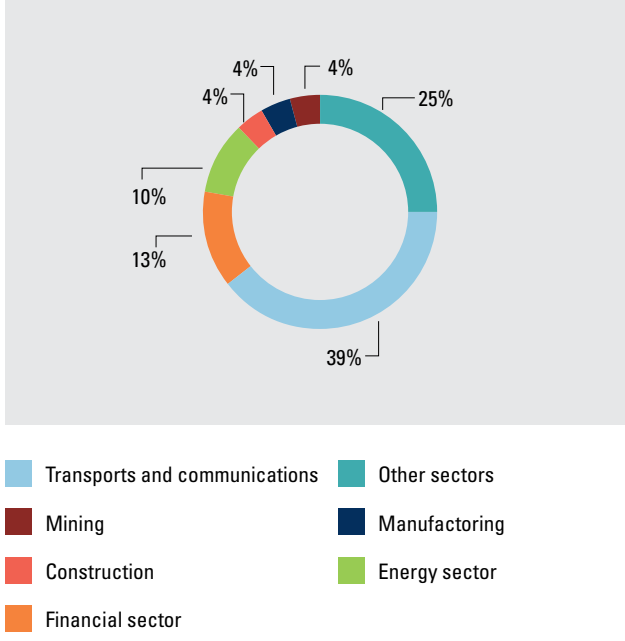
Figure 1: Share of energy sector in foreign direct investments in Georgia, fourth quarter of 2012 to second quarter of 2015



Source: Ministry of Energy of Georgia

According to the Georgian National Statistics Office for the second quarter of 2016, however, the share of FDI in the energy sector accounted for 10% of total investments made in the economy sector. Despite investments, the energy sector is economy-driven.

Figure 2: Foreign direct investments by major economic sectors in the second quarter of 2016.



Source: National Statistics Office of Georgia.

Investments are expected to grow. A total of 110 renewable energy projects are planned to be implemented. Although they are at different stages, it is envisaged that in some US$ 800 million could be invested in the use of renewable energy recourses by 2025[20] . In line with a 10-year network development plan, additional investments of US$ 800 million are required to expand electricity infrastructure and distribute generated electricity.

Although HPP projects dominate in this list, there are seven projects for wind-power utilization, two for solar power and one for biogas utilization. With regard to the biogas project, the developer intends to produce biogas from agricultural waste, burn it later in the TPP and produce electricity. Expected electricity generation is estimated at 25 million kWh annually, which will be consumed in the fertilization factor, already built by the project developer.

By declaring its interest in renewable energy, the Georgian government attracted not only investors and financial institutions, but also gained the support of the governments of other countries and international donor organizations through grants facilities.

Extensive cooperation with the Japanese Government supported the solar utilization programme, whereby

a solar PV system became operational at Tbilisi international airport with 337,000 kWh of annual electricity generation, which covers 40% of the total consumption of the airport and Tbilisi State University. PV system, which is installed on the university building provides 30,000 kWh electricity a year, which is enough to cover 15% of the building's total energy use.

The project is the first of its kind in the South Caucasus and aims to promote the use of clean energy in Georgia. Solar PV installations will reduce approximately 205 tons of CO2 emissions per year, which is equal to saving some 569,000 m^2 of forest. A start-up of biomass fuel production is also on the list of projects funded and implemented by international organizations. Since 2013, a multi-stakeholder (Government of Georgia, local non-governmental organizations and international organizations) approach to the Promotion of Biomass Production and Utilization in Georgia has been implemented. The project is supported though the United Nations Development Programme and the Global Environmental Facility. The aim of the project is to promote sustainable production and utilization of upgraded biomass fuels in Georgia, encourage the stakeholders to establish pilot production projects through grant as well as start and develop biomass-fuel utilization in the municipal sector. Three completed active biomass fuels production companies will be operating by the end of 2016. Products will be utilized by municipal buildings and will also be sold on the market.

Policy reforms and strategy of renewable energy resources deployment became crucial aspects for the development of the economy. Improvement of the energy sector provided Georgia with additional generation capacities, imported electricity has relatively decreased and, what is more, it exports electricity when available. It should be noted that, while gas is fully imported, the construction of additional combined cycle gas-fired TPPs (which will replace outdated TPPs later on) and gas storage will solve this issue to some extent. Hydropower sector development has created new jobs and facilitated capacity-building of personnel and graduate students, who are able to gain experience of hydropower construction and operation during internships.

6. Policy design considerations: implications for promoting this successful policy more widely on a national basis

Georgia already consumes a relatively high amount of energy from renewable energy resources, but increasing the proportion of renewable energy in the mix has not been precisely set in the energy policy. Despite the fact that existing policy and regulations promote uptake of renewable energy resources, it is not utilized by individual households or farmers at a large scale. Only a few cases can be mentioned, while the potential of energy production in other sectors, especially in agriculture, is considerably high. Current policy, legal, regulatory and institutional frameworks designed to support renewable energy deployment are at a very early stage. Existing regulations provide rules to enable construction of renewable energy power plants and do not envisage any support scheme for the development of small-scale installations/productions, which might be of interest to households, micro-businesses, etc. Such projects are being developed and supported in the frame of international programmes through grants.
Although the law on electricity and natural gas provides only short and limited definitions about renewable energy resources, an amendment regarding the promotion of small-scale renewable energy use entered into force in May 2016. Electricity generated from micro-units, with installed capacity up to 100 kW, can now be sold to the national grid at a price determined by the National Energy and Water Supply Regulatory Commission. While this might incentivize households to install renewable energy technologies, it has to be noted that such technologies are not affordable for every household. It must also be taken into account that, in order to deliver the information to the target group and incentivize them to use this opportunity, the initiative has to be distributed appropriately, otherwise it will not bring any results. The introduction of more market-based support schemes, such as feed-in premium will not be a supportive mechanism, since

Georgia has not yet established transparent and well-functioning electricity-trading systems.

The most effective way to support deployment of renewable energy resources is to elaborate primary legislation, more effective regulations and secondary legislation, which can be represented by a national renewable energy action plan. On the other hand, comprehensive research has to be conducted on the country scale to identify the resources that are technically and economically feasible. A detailed study, which will include other sectors (agriculture, waste, transport, environment, industry, tourism, building, etc.) rather than energy and mapping the resources could identify the ways how, when and to what extent renewable energy resources can be utilized and, at the same time, avoid any market distortion or uncertainties in the power grid. Elaboration and implementation of a national renewable energy action plan tailored to Georgia's actual situation could promote greater deployment of diverse types of renewable energy technologies at the national scale.

Georgia is becoming a member of European Energy Community and will therefore be obliged to transpose directives on promoting renewable energy resources (Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources) to national legislation. Consequently, Georgia might indicate a renewable energy target by 2020 or 2025. Meeting the new targets and complying with the Directive are likely to require new policy commitments and extensive revisions of existing legislation, as well as the development of supportive regulatory and institutional arrangements.

7. Conclusions and recommendations:

The Georgian power sector has changed significantly in the last 10–12 years. Policy reforms and major rehabilitation of the power sector led to investment flows in the sector. The hydropower sector became a major interest for potential investors. Rehabilitation of existing power plants and construction of new hydropower units transformed a country with an energy deficit to an electricity exporter. Wide-scale hydropower development ensured a more secure and reliable energy system. Supply shortages were minimized; energy security has greatly increased. The policy reforms which took place were urgent and essential. Today, Georgia consumes a relatively high amount of energy from renewable energy resources but increasing the proportion of renewable energy in the mix has not yet been precisely set in energy policy.

Despite the existing regulations, Georgia still lacks a law on renewable energy and a strategy to cover the entire legal framework for effective utilization of all kinds of renewable energy resources. Moreover, there are challenges to integrate non-hydro renewable energy resources in the grid. Regulations are concentrated on hydropower and wind-power plant construction but there is a problem concerning integration of wind in the grid and only hydro resources are therefore widely used. There is no specific plan for theh development and efficient utilization of biomass, geothermal or solar energy, nor any support schemes, despite the promotion of 100 kW installations. The potential of agricultural waste as a renewable energy resource is not considered in any regulations.

In order to promote utilization of renewable energy resources other than hydro, a renewable energy law has to be adopted and a national renewable energy action plan has to be developed, based on comprehensive research and a technical-economic feasibility assessment of renewable energy potential.

Such research would examine meticulously the existing barriers in every field, such as: household, agriculture, transport, industry, as well as energy, and would identify solutions and support schemes in order to make the integration of renewable energy resources feasible in these areas. Such an approach requires multi-stakeholder engagement, synergy between cost-cutting sector entities; academics have to be involved and best international practice has to be considered. Private-sector engagement plays a crucial role, as it could support the deployment of renewable energy technologies. Only such an approach would pave the way to utilizing diverse renewable energy resources and a meaningful reduction of CO2 emissions.

Bibliography

[1]. http://energy.gov.ge/projects/pdf/pages/Ongoing%20Investment%20Projects%201426%20eng.pdf

[2]. Available on the official web page of the Ministry of Energy: http://energy.gov.ge/legislation.php?lang=eng&id_pages=33

[3]. According to the last amendment on the law on electricity and natural gas, installations of up to 100 kW are able to sell surplus electricity from to the grid at a price determined by the Georgian National Energy and Water Supply Regulatory Commission.

[4]. Available at: http://www.gse.com.ge/new/wp-content/uploads/2016/03/TYNDP_GE-2016-2026_ENG.pdf

[5]. Ministry of Energy of Georgia

[6]. Ministry of Energy of Georgia

[7]. http://energy.gov.ge/projects/pdf/pages/List%20of%20Potential%20Power%20Plant%20Projects%201428%20eng.pdf

[8]. Third National Communication to the UNFCCC

[9]. Third National Communication to the UNFCCC

[10]. http://energy.gov.ge/projects/pdf/news/Electricity%20DemandSupply%20Scenario%20of%20Georgia%20 20152030%201096%20eng.pdf

[11]. PPAs are not, however, determined by general conditions approved for all projects but depend on negotiations. Up to 6 US cent is PPA price according to Resolution No. 214.

[12]. http://www.gse.com.ge/new/wp-content/uploads/2016/03/TYNDP_GE-2016-2026_GEO.pdf

[13]. Installed capacity of Enguri HPP is 1,300 MW. Installed capacity of Vardnili HPP is 220 MW: http://esco.ge/index.php?article_id=17&clang=1

[14]. Telasi JSC is one of the major network companies of Georgia, carrying out distribution and sale of electric power in Tbilisi. At present the company employs more than 2,100 persons: http://www.telasi.ge/en/about/activities

[15]. The distribution area of Energo-Pro Georgia JSC covers 47,265 km2, which is 70% of Georgia's territory: http://www.energo-pro.ge/business-area/distribution/

[16]. Georgian State Electrosystem JSC is a 100% State-owned JSC providing transmission and exclusive dispatch services: http://www.gse.com.ge/new/?page_id=179&lang=en

[17]. Report on 3 year activities (2012–2015) of Ministry of Energy (available in Georgian only): http://energy.gov.ge/ projects/pdf/news/Energetikis%20Saministros%20Angarishi%202015ts%201238%20geo.pdf

[18]. Report on 3 year activities (2012–2015) of Ministry of Energy (available in Georgian only): http://energy.gov. ge/projects/pdf/news/Energetikis%20Saministros%20Angarishi%202015ts%201238%20geo.pdf

[19]. Ministry of Energy of Georgia

[20]. List of on-going projects: http://energy.gov.ge/projects/pdf/pages/Ongoing%20Investment%20Projects%20 1426%20eng.pdf

17-00748