Electricity Cooperation Opportunities in the South Caucasus: 

The Role of Georgia

Occasional Paper

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Abstract

Following the disintegration of the Soviet Union, the newly independent South Caucasus states experienced an impressive deterioration in the economic and social sectors. Unresolved territorial conflicts such as Nagorno-Karabakh, Abkhazia and South Ossetia, as well as the wider insecurity of the region, have resulted in internal instability and economic depressions. Due to political conflicts, civil opposition and blockades, the South Caucasus region became a challenging area for trade, and this affected all areas of the economy including energy. The energy markets of the South Caucasus states, which were part of the unified Trans-Caucasus energy system during the Soviet era, broke down and energy supply became extremely vulnerable.

Opportunities for cooperation have been focused on the energy resources of the Caspian Sea and the role of the South Caucasus as both a source-rich area and a transit corridor for transportation of hydrocarbons to Europe.

Azerbaijan and Georgia started close cooperation, and the two countries, together with Turkey, have successfully built strategic partnerships and developed mutually beneficial energy projects such as the South Caucasus Gas pipeline (SCP), Baku-Tbilisi-Ceyhan (BTC) and Baku-Tbilisi-Supsa oil pipelines. The realization of these projects illustrates that energy has become an important precondition for South Caucasus states for reducing poverty and promoting regional economic growth and prosperity.

In recent decades, opportunities for cooperation in electricity have also been significantly explored. The governments embarked on a path to power sector reform through focusing on management and sustainment of their energy supply systems, which were a part of an integrated Trans-Caucasus system during the Soviet era and had never been designed to function as separate grids.

Since starting power sector reform, all three South Caucasus states have made impressive progress, including efforts towards developing bilateral cooperation based on mutual assistance. As a result, the current level of electricity cooperation in the form of bilateral trade between particular South Caucasus countries has already helped to develop physical interconnections and commercial relations. However, the South Caucasus has substantial potential for broader electricity trade and there is still scope for further expansion. The estimated large generation potential in the region is one of the most important conditions to develop electricity trade, in order to meet rapidly growing electricity demand in Turkey and offset deficits in other markets of the region.

Due to its favourable geographical location as a connecting bridge for the East-West and North-South energy routes in the Caucasus, Georgia is the only country which has electricity interconnections with all South Caucasus states, including Azerbaijan and Armenia as well as Russia and Turkey. As a result, Georgia could become a regional transmission ‘hub’ for power trade in the South Caucasus.

However, energy resources in the region are still largely untapped and require significant investments into new generation facilities, as well as into cross-border transmission links to further develop international trade.
Bilateral electricity trade is an important element of regional cooperation. On the other hand, multilateral arrangements are required to make use of full regional potential and to benefit from economies of scale, as considerable investments are necessary to develop interconnections and expand generating capacities.

It is important to note that Georgia, Azerbaijan, Turkey and Armenia are contracting parties to the Energy Charter Treaty (ECT). The ECT, with its large constituency, aims to encourage and facilitate international energy cooperation. Its key principles of openness of energy markets and non-discrimination have the potential to stimulate foreign direct investment and cross-border trade.

The International Energy Charter is a new political declaration adopted on 20-21 May 2015 which widens the scope of the original European Energy Charter to a global level. Given the globalisation of the energy market and the prevailing turbulence in the world’s economy, geopolitics and demography, the new International Energy Charter, with its present support from 75 countries (coming from five continents), is an important tool to help secure required energy investments.

Georgia, under its 2015 Energy Charter Chairmanship, proposed as its flagship initiative to foster electricity cooperation in the South Caucasus. As a starting point it has been proposed to establish two ministerial-level Task Forces based on the political particularities of the South Caucasus, comprising the east-west and north-south energy corridor countries. The major goal is to strengthen regional cooperation on electricity trade, develop efficient transport corridors and attract investments into regional energy infrastructure.

Georgia’s Flagship Initiative under the Chairmanship of the Energy Charter Conference is a good first step to establish a platform for political dialogue, which may play a role in fostering regional electricity cooperation in the South Caucasus.

This report gives a general overview of existing trade arrangements and potential opportunities for regional cooperation in the South Caucasus. It argues that bilateral electricity trade is an important starting point, but limited as far as making use of full regional potential and benefiting from economies of scale. Developing a multilateral legal framework would benefit the countries in the region and foster regional cooperation.
**Existing multilateral and bilateral legal frameworks for cross-border electricity trade in the South Caucasus**

Georgia, Armenia, Turkey, and Russia are Contracting Parties to the Marrakesh Agreement Establishing the World Trade Organization. Also, Georgia, Armenia, Azerbaijan and Turkey are Contracting Parties to the Energy Charter Treaty.

The ECT incorporates, by reference, provisions of the WTO Agreements, namely those which deal with trade in goods relevant to the energy sector (energy materials and products listed in Annexes EM I and energy related equipment listed in EQ I). Thus, WTO and ECT provisions applicable to trade between Georgia and its neighbours have important implications for energy trade through cross-border transmission infrastructures in the South Caucasus.

At present there are four major trading blocks in the region (the “free trade” agreements among the CIS countries; the Eurasian Customs Union of Russia, Belarus, and Kazakhstan; the Customs Union of Turkey and the EU; and the DCFTA Agreement of Georgia and the EU). These trading blocs do not create a common approach and space of cooperation in the South Caucasus, and on the contrary reflect the different approaches in both legal and political perceptions.

In addition, trade agreements among the CIS countries, signed in 1994 by all three Caucasus states, have largely been ineffective. As a result, they have been supplemented by different bilateral agreements. Georgia has concluded free trade agreements with Azerbaijan (1996) and Armenia (1995). The Free Trade Agreement between Georgia and Turkey entered into force on 1 November 2008, and since then customs duties on the import of industrial products have been eliminated. However, none of these agreements establish strong legal provisions with respect to a harmonized approach toward freedom of transportation/transit (of energy goods), nor to access conditions for the cross-border transportation infrastructure in the South Caucasus, an important element for power trade.

In fact, the different approaches among the South Caucasus states presently have important implications for efficient cross-border trade in the region, and currently there is no collaboration to converge the energy legislative frameworks of the countries.

**The role of the Energy Charter Treaty**

The only common legal framework of which “Common Principles”\(^1\) are shared by all South Caucasus states, including Turkey, is the 1994 Energy Charter Treaty (ECT). The ECT, which was established after the collapse of the Soviet Union, as a model legal framework for cross border energy trade incorporated the idea of energy cooperation by focusing on the following important areas:

- Protection of Foreign Energy Investments
- Free Trade In Energy Materials, Energy Products and Energy Related Equipment
- Energy Transit

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\(^1\) Leal-Arcas and Peykova, “Intergovernmental agreements on energy transit”, 2014
The ECT is a unique intergovernmental agreement on investment protection in the energy sector to which all South Caucasus states are contracting parties, including Turkey, and has played an important role in providing legal and normative security for cross-border energy trade and investments in the South Caucasus. The Treaty has had an essential role in assisting the process of regional cooperation by providing a rules framework for major cross-border energy infrastructure projects such as Baku-Tbilisi-Ceyhan (BTC) and South Caucasus Gas pipeline (SCP). This is well reflected in existing intergovernmental agreements as reference to “Common Principles” in relation to the region’s energy infrastructure projects.\(^2\)

However, currently the region lacks cooperation for a South Caucasus-wide energy market, for both political and legal reasons, and there is still scope for further expansion of cooperation.

The ECT, as the only common instrument for inter-state cooperation in the South Caucasus, can help the countries in the region to encourage and facilitate electricity cooperation and cross-border energy trade.

**Energy Charter Model Agreements for Cross-Border Electricity Projects**

Cross-border electricity projects are subject to numerous specific legal requirements, as the transmission of energy requires a chain of cross-border connections and using local systems in the intermediate jurisdictions. The requirements mainly arise from international law and relevant supra-national and national legal systems.

In this sense, the Energy Charter Secretariat has developed Model Intergovernmental and Host Government Agreements for Cross-Border Electricity Projects, as possible drafting approaches that can be used by a state or investor involved in the negotiation of a cross-border electricity project.

These ECT model agreements are especially useful for a number of issues, relevant specifically to electricity transmission projects related to the following activities:

- The interoperability of electricity systems in different control areas;
- Determination of available cross-border capacity;
- System quality and security (e.g. frequency and voltage control);
- Allocation of cross-border capacity;
- Scheduling of cross-border exchanges;
- Settlement of deviations;
- Cost and benefit allocation;
- The valuation of electricity in different systems; and conditions for access to the systems.

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\(^2\) Rafael Leal-Arcas and Mariyaa Peykova, *Energy Transit Activities: Collection of Intergovernmental Agreements on oil and gas transit pipelines and commentary*, 2014
In general, the major idea of these model (IGA and HGA) agreements is to facilitate the efficient realization of prospective cross-border electricity systems by providing transparency regarding present practices in the areas of cross-border electricity project construction, operation and investment.

**Energy Sector Overview**

**Georgia**

Over the last decade, the electricity sector in Georgia, which was in critical condition, with electricity blackouts being common prior to 2004, has been transformed significantly. Regulatory and market-oriented reforms, focused on deregulation and privatization, have been improving service quality, maximizing domestic generation potential and reinforcing the transmission system in the country. Due to the intense rehabilitation works on existing hydro power plants (HPPs), improvement in the efficiency of energy use and reductions in losses (during 2002-2014 losses in the transmission system decreased from 16% to 4%\(^3\) and in distribution in 2013 amounted to 6%\(^4\)) the country managed to significantly increase the level of power generation, which has surpassed annual domestic demand since 2007.

*Figure 1: Power Generation and Domestic Supply of Georgia 2006-2015*

![Figure 1: Power Generation and Domestic Supply of Georgia 2006-2015](image)

*Source: Ministry of Energy, 2015*

The sizable hydroelectric capacity potential (40 TWh) of Georgia ranks as one of the best in the world in water resources per capita, and in Europe by water reserves volume, has become an increasingly important component of Georgia’s energy supply and policies. The country’s topography and abundance of hydro resources give it serious potential to dominate the hydroelectric market in the Caucasus region. Over 300 rivers (out of 26,000 total) in Georgia provide considerable sources for electricity generation. Hydro potential for

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\(^3\) Energy Balance of Georgia, official website of the Electricity System Commercial Operator (ESCO) of Georgia, http://esco.ge/index.php?article_id=111&clang=1

development is equal to 6,000 MW, which is technically and economically viable. Currently, only 18% of hydro potential is utilized.

The government launched a large hydropower investment promotion campaign in 2008 and a number of concession agreements for HPP construction have been awarded. Nowadays, 80 to 85% of total consumption is generated by HPPs, and only 15 to 20% by gas-fired plants.

Georgia’s reliance on imports and thermal generation has fallen over time as hydro output increased. As a result, the country managed to not only cover domestic needs in electricity but became a major exporter of electricity in the region.

*Figure 2: Export Statistics of Georgia by country 2007-2014*

![Export Statistics of Georgia by country 2007-2014](chart)

*Source: Ministry of Energy, 2015*

However, Georgia’s generation surplus is mitigated by the strong seasonality of electricity demand and hydro generation. The seasonal nature of both hydropower generation and electricity consumption creates excessive generation in summer months and a gap in winter. Currently, Georgia has to import power in winter and export surpluses during summer. Therefore, trade with neighbouring markets is mainly characterized by seasonal power exchanges comprising imports in winter months and exports in summer months when Georgia has excess hydro output.

The Government of Georgia plans to construct new large reservoir HPP plants Khudoni (702 MW) and Namakhvani (450 MW), with private investors, before 2020, which will increase the reservoir capacity of the country and facilitate improvement of the seasonal imbalance of power consumption and generation in the country.

Currently, Georgia conducts power trade with its all neighbours. While Georgia has interconnections with Russia, Turkey, Azerbaijan and Armenia, the vast majority of its trade is with the first two countries. Turkey is the most attractive market for Georgia’s hydropower given its summer demand peak and high market prices. Due to these interconnections, Georgia has a potential to become a regional trade “hub” for energy dispatch and transit through the Caucasus area, namely from Azerbaijan and Armenia to Turkey. With this aim, the government has entered into agreements with neighbouring countries for further
enhancement and development of transmission infrastructure and interconnection facilities to expand energy trade.

Georgia's grid network was not designed as a network for an independent state, as it was part of the power supply in the Caucasus linked to the Soviet republics. Therefore, the challenge was to break down existing barriers across the borders and to connect different power supply networks of varying technical parameters, while stabilizing power supply and enabling the export of excessive power. In order to overcome these barriers, Georgia with the support of EU financial institutions launched the Black Sea Transmission Network (BSTN), which came into operation in 2013. The project started in 2010 and envisaged to extend the Georgian transmission system to neighbouring states, especially to Turkey and Europe, through enhancing power infrastructure and network stability. By adding power transfer capacity with Turkey the project aimed at encouraging investments in new domestic hydropower resources in Georgia, as the growing Turkish electricity market represents a major precondition for investors to increase hydro power output in Georgia and to deliver it to Turkey.

The BSTN is the most significant energy infrastructure project in the region, aimed at providing a 700 MW capacity interconnection between the Caucasus electricity network and Turkish electricity network, through the 500 kV overhead line Gardabani-Akhaltsikhe-Zestaponi in Georgia, a 400 kV interconnection line from Akhaltsikhe to the Turkish border, and a 500/400/220 kV substation with a HVDC back to back plant in Akhaltsikhe. It creates an asynchronous interconnection between the 500 kV network of Georgia and the 400 kV network of Turkey.

The logical extension of the BSTN includes connections with Russia, Azerbaijan and Armenia to establish a regional power market which facilitates flexible and mutually profitable cross-border energy exchanges. At present, Georgia has recently completed a 500 kV line with Azerbaijan, rehabilitated a 500 kV transmission line with Russia and there is a plan to commission a 500 kV line with Armenia in the coming years.

The existing and planned interconnections make it possible to link the electricity grids of countries in the South Caucasus, thus making Georgia function as an "energy bridge" for power trade, which is intended to increase the volume of electricity exchange in the region. The map below highlights Georgia’s strategic position in the South Caucasus as a connecting bridge between the North-South and East-West energy corridors.
In the future, the Akhaltsikhe transformer substation will make it possible to create a connection between the South Caucasus and Europe's electrical grid through Turkey, which shares electricity interconnections with the eastern part of Europe.

The 10 years network development plan (TYNDP), elaborated and approved in Georgia for the first time, considers: reinforcement of the Georgian internal network and establishing a new cross-border connection to Turkey (planned as 154 kV, 350 MW and 400 kV, 350 MW); new connections with Armenia (500 kV, 700 MW); and also construction of a new line (500 kV, 1000 MW) to the Russian border with possible connection to the Russian network.\(^5\)

For economic and social development, the assets of Georgia’s location and its water resources have been identified as key elements for the development of both a surplus of hydroelectric power and available capacity for export, as well as the capability to serve as a “hub” for transmitting electricity to and between regional neighbours and into Europe through Turkey. In addition, while Georgia supplies clean energy from hydroelectric power and pursues the objective of satisfying 100% of its domestic energy needs, it also creates

opportunities for neighbouring markets to cut CO₂ emissions and facilitate green energy trade in the South Caucasus.

At present, the key development challenges for Georgia are to attract more private sector participation in power generation, harness hydropower resources as a driver of economic development, increase Georgia’s role in regional electricity trade, and improve the efficiency of energy production and use.

From an investors’ point of view the seasonal pattern of Georgia’s generation and demand is problematic, since new HPPs generate the highest amount of electricity during summer months which already have excess supply, and thus are going to meet very tough competition domestically from existing HPPs. Therefore, the profitability of investments in new HPPs can be increased only by a substantial increase in the demand for Georgian electricity in the region and by a substantial increase of cross-border capacities with neighbouring markets.

**Azerbaijan**

During the last 10 years the economy of the Azerbaijan Republic has shown positive dynamics in almost all macro-indexes, which was achieved through the contribution of the oil and gas sectors, approximately 60% of which is export. Azerbaijan is the only country in the region to be both a transit country for resources and also produce natural gas and oil. It satisfies its energy needs from domestic production, and gains significant revenues from gas and oil exports. Following successful development of its hydrocarbons sector, Azerbaijan enters a new phase of economic development with the electric power industry as the major branch of economy.

Azerbaijan’s electricity generation is dominated by natural gas (combined cycle gas turbines), heavy oil (only on peak demand) and hydropower. Natural gas is envisaged as the primary fuel for power plants over the upcoming period of time. The country’s 13 operating fossil fuel power plants (nearly all fuelled by natural gas) accounted for 91% of total power generation in 2012.⁶

At present, the power sector, along with oil and gas fields, plays a leading role in Azerbaijan’s social and economic growth. Since 2009, large investments in power generation and transmission facilities have resulted in remarkable improvements in the quality of power supply, through improving the coverage of billing and the reduction of losses.⁷

Currently, electricity production in Azerbaijan is sufficient to cover domestic demand and even allow a surplus to be exported to neighbouring countries.

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⁶ U.S. Energy Information Administration (EIA), August 1, 2014
Figure 3: Domestic Electricity Generation and Domestic Supply in Azerbaijan 2005-2012

Source: IEA Statistic

As we can see from Figure 3, before 2006, as in case of Georgia, import by Azerbaijan was larger than export. From 2007 onwards, however, a fall in demand changed the balance to an export surplus and the country became a net exporter of electricity. The main reason for the fall in demand was increased electricity prices, coupled with improved metering and billing practices, as well as switch from electricity to gas for heating.\(^8\)

Currently power consumption in Azerbaijan can be fully met by domestic generation assets. Azerbaijan aims to maintain self-sufficiency in power supply, backed by large hydrocarbon reserves. The country intends to increase electricity production and also has plans to trade extra surplus with neighbouring markets, especially considering Turkey to be a profitable destination for Azerbaijani exports.

As stated by the Azerbaijani State Program for the Development of the Fuel and Energy Sector (2005–2015), the capacity of the electric power generating system of Azerbaijan should reach 6,500-7,000 MW by 2015 through construction of new thermal power plants, modernization of existing generating units, and utilization of renewable power sources (small water power plants, wind, solar power, thermal waters, etc.).\(^9\)

The Fichtner report regarding the Power Sector Master Plan for Azerbaijan for the years 2013 – 2025 forecasts the increase of power generation capacities, which is sufficient for meeting the internal demand in Azerbaijan in the next coming decade.

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\(^8\) Ibid.

\(^9\) STATE PROGRAM FOR DEVELOPMENT OF FUEL AND ENERGY SECTOR IN AZERBAIJAN (2005-2015)
Azerbaijan's power system is connected to all of its neighbours, however, due to the political dispute between Azerbaijan and Armenia there is no power exchange between the two countries. Currently, Azerbaijan’s trade is limited to the following neighbouring countries: Russia, Turkey, Georgia and Iran.

Table 1: Azerbaijan Interconnection voltage levels in operation

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Connection</th>
<th>Maximum Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>One line 500 kV</td>
<td>850</td>
</tr>
<tr>
<td></td>
<td>One line 330kV</td>
<td>250</td>
</tr>
<tr>
<td>Turkey</td>
<td>One line 150kV</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Two lines 220-230kV via Iran</td>
<td>40</td>
</tr>
<tr>
<td>Iran</td>
<td>Two lines 154kV (to Nakhchevan)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two lines 132kV</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td>One line 330kV</td>
<td>500</td>
</tr>
</tbody>
</table>

Azerbaijan is looking at possibilities for reinforcement of interconnections to neighbouring countries, in particular the construction of a second 330 kV line to Russia and a second high-voltage (330 kV) line to Iran.¹⁰

Over 2015-2017, there is a plan to connect the Azerbaijan power market to the Turkish power market via Georgia through the "Power Bridge", with the aim of exporting electricity to Turkey. This is important for Azerbaijan as it strengthens the strategic perception and importance of Azerbaijan as a supplier in both hydrocarbons and electricity.

While Baku is trying to develop power generation facilities and diversify its electricity exports, there is still a problem of line losses. Currently transmission system losses amount to around

¹⁰ Ibid.
3.8%, and in the distribution system, 16.6% of general production.\textsuperscript{11} The high loss level in distribution networks is caused both by their extensive length and the need for substantial investment to restore and upgrade the network’s infrastructure.

A big part of the network is very old and in need of renovation.\textsuperscript{12} Power system expansion plans, which consider replacement of deteriorated assets with new units based on proximity to the load centre in the east, require significant investments into the power sector. The power sector of Azerbaijan currently requires continued efforts to improve the adequacy and quality of energy supply and to optimize energy utilization efficiency in an economically sustainable and environmentally friendly manner.

**Turkey**

Rapid economic growth, industrialization, and steady population growth in Turkey over the last decade resulted in speedy growth of Turkey’s energy demand. Nowadays, Turkey experiences the fastest energy demand growth in Europe, with expectations of further increase.

*Figure 5: Generation Capacity and Energy Demand in Turkey 2009-2018*

![Project Generation Capacity and Energy Demand Balance 2009-2018](image)

(Source: Turkish Electrical Energy 10-year generation capacity projection (2009-2018))

According to the state Turkish Electricity Transmission Corporation (TEIAS), demand for electricity is expected to increase rapidly in the coming years. The high and low forecasts estimate that demand will increase by 6-7.5% on average annually to 2017, resulting in double consumption by 2021. Peak demand is also expected to double between 2011 and 2021.

\textsuperscript{11} Fegan Aliyev Azerbaijan National Case Study for Promoting Energy Efficiency Investment/An analysis of the Policy Reform Impact on Sustainable Energy Use in Buildings, 2014

\textsuperscript{12} Fichtner, “Update of the Power Sector Master Plan of Azerbaijan 2013-2025”
Given these Turkish market demand forecasts, the energy market of Turkey is becoming more competitive in the global market. Currently, the energy cost of Turkey's power market (6.73 US cents/kWh\textsuperscript{13}) is the highest priced compared to the South Caucasus and Russia. As a result, Turkey is becoming an attractive market for surrounding power producer countries in terms of regional export diversification.

Due to growing electricity demand in the country, Turkey intends to increase electricity production capacities from hydroelectric, thermal and nuclear power plants utilizing coal-based generation.\textsuperscript{14} Turkey also has potential in all types of renewable energy sources—existing HPPs already account for 30% of country’s economic needs.\textsuperscript{15}

However, the above mentioned projects aimed at increasing energy production capacities in the country require huge financial investments. Therefore, Turkey is interested in cooperation with its Caucasus neighbours to import relatively cheap energy for domestic consumption.

Currently the process of forming interconnections with Georgia through the BSTN supports this assumption, as the current capacity for electricity exchange with neighbouring countries is quite limited.

Turkey has interconnections with all its neighbouring countries, and electricity is being traded with Georgia, Azerbaijan, Greece, Bulgaria, Iraq and Iran. On the other hand, there is only an Intergovernmental Agreement with Georgia regarding cross border trade between Turkey and Georgia. For cross border trade with Azerbaijan, Greece, Bulgaria, Iran and Iraq, TEİAŞ relies on recently signed Interconnection Operation Agreements with its counterparts in those countries. Moreover, a Long Term Agreement between TEİAŞ and ENTSO-E was signed in April 2015 to govern technical and legal conditions of the synchronous operation of ENTSO-E Continental Europe.

\textsuperscript{13} EMRA Official Gazette (Decision No: 5536), 31/03/2015
\textsuperscript{14} Dr Stephen Mills, IEA Clean Coal Centre, “Prospects for coal and clean coal technologies in Turkey”, July 2014
\textsuperscript{15} “In-Depth Energy Efficiency Policy Review of the Republic of Turkey”, 2014, prepared by the Energy Charter Secretariat
Armenia

In the wake of the Soviet Union’s disintegration, Armenia, like other former Soviet republics, faced economic challenges including the need to upgrade its power sector. In the electricity sector, this meant managing and sustaining a system that had never been designed to function as a stand-alone grid. After the last 15 years of continued development, Armenia embarked on a path of reforms and progress in the power sector. As a result, Armenia’s power sector has made impressive progress since the beginning of reforms. Currently, Armenia can meet its own electricity demand and even export excess capacity.

Figure 7: Electricity Generation and Domestic Supply in Armenia 2005-2012

Source: IEA Statistic

At present, Armenia’s power generating system has over 4,115 MW of installed capacity, out of which only 2,700 MW is used.\(^\text{16}\) Of the total installed capacity, 53% is thermal, 34% is hydro and 12% is nuclear. Armenia also has a small wind power plant with 2.6 MW installed capacity.

Armenia is the only country in the South Caucasus to use nuclear energy. Electricity production in 2012 was 8,036 GWh, of which 29% was provided from nuclear, 29% by hydro and 42% by thermal. Thermal generation relies entirely on imported natural gas from Russia and Iran. The share of thermal power plants in capacity and generation has increased in recent years, as several new plants have been built.\(^\text{17}\)

Among the major Armenian plans to further expand domestic generation capacities include development of nuclear energy, life-time extension of the existing nuclear power plant, and construction of new generating facilities at the least cost. The country also plans to enhance Renewable, Energy Efficiency and Energy Saving measures. At the same time, Armenia

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\(^\text{16}\) In-depth ICMS Review in the energy sector of Armenia, 2015
\(^\text{17}\) Energy Strategy of Armenia Accomplishments, Challenges, Next Steps, 2014
pays major attention to the diversification of energy (geographic) sources and routes, as well as regional integration of the country.  

Armenia continues to modernize and expand its power generation capacities with thermal power plants (a TPP with installed gas turbine capacities of 300 MW and 180 MW was commissioned in 2011) and renewable energy plants. By 2020 Armenia plans to construct HPPs with around total of 900 MW capacity, wind power plants (up to 200 MW total capacity), as well as construction of second combined cycle unit at the Yerevan TPP with 250-450 MW capacity.

Commissioning of a new nuclear unit (or units) is among the major goals of the government. In October 2009, the RA law “On construction of new nuclear unit(s) in the Republic of Armenia” was adopted, which will serve as a legal basis for construction of the new nuclear unit in Armenia. For the new NPP the Russian NPP-92 design (capacity – 1,060 MW; operating life – 60 years) was approved, which has a certificate in accordance with requirements of European Utilities. According to Government decree 511-A, as of 19 May 2014, the new nuclear power unit has to start operation in 2027.

However, due to restrictions on providing credits to the Republic of Armenia by sovereign guarantee, the implementation of the construction project for a new nuclear unit(s) in Armenia was slowed. This was the major incentive of the government to approve a decision on the lifetime extension of the existing old Metsamor NPP (which began operation in 1976 and covers 43% of domestically-produced electricity) on 27 March 2014, in order to ensure a sustainable and secure electricity supply to Armenian customers. The construction of new NPP is intended for domestic demand and also for regional electricity sales, as long as the plant’s capacity will exceed the country’s whole system demand (electricity demand is expected to increase between 2010 and 2020 at about 2.7%). Therefore, the energy strategy of Armenia pays major attention to reinforcement of the interconnection links with Georgia and Iran.

Armenia has operating high voltage interconnections only with Iran and Georgia, as the lines going to Turkey and Azerbaijan are currently unused for political reasons.

*Table 2: Armenia Interconnection voltage levels in operation*

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Connection</th>
<th>Maximum Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>One line 220 kV</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Two lines 110kV</td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>Two Lines 220kV</td>
<td>400</td>
</tr>
</tbody>
</table>

For Armenia, synchronous operation with Iran is the first priority in terms of technological aspects (frequency control, support in emergency situations, etc.) and in terms of the

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18 Ibid.
19 In-depth review of the investment climate and market structure in the energy sector of The Republic of Armenia, Energy Charter Secretariat, 2015
20 Ibid.
21 USAID funded Report, “Regional Electricity Market Review”, August 2013
22 Energy Strategy of Armenia Accomplishments, Challenges, Next Steps, 2014
economy. The “electricity for Iranian gas” swap (Armenia delivers 3 kWh electricity for each cubic meter of the Iranian gas) contract, signed in 2010 between Armenia and Iran, is effective until 2027. The deal is important for Armenia as it plays a significant role in the operation of Armenian TPPs and helps to increase export capacities.  

However, despite the progress achieved in the power sector of Armenia, it still faces the great challenge of system quality, which contributes to energy security problems. Much of Armenia’s installed capacity and transmission/distribution infrastructure is old, and requires modernization or replacement. Transmission assets are, on average, more than 45 years old. 25-30% of substations and energy equipment/networks need rehabilitation, and require significant investments.

Russia’s Southern Grid

Russia is one of the top producers and consumers of electric power in the world, with more than 220 GW of installed generation capacity. Fossil fuels (oil, natural gas, and coal) are used to generate around 68% of Russia’s electricity, followed by hydropower (20%) and nuclear (11%). Electricity production was 1,071 TWh in 2012, with 178 TWh coming from nuclear power, 525 TWh from gas, 169 TWh from coal and 167 TWh from hydro. Net export was 16.4 TWh, some of which was exported to Georgia, Ukraine, and Azerbaijan, and final consumption was 742 TWh (after transmission losses of 107 TWh and own use/energy sector use of 204 TWh).

In February 2010 the government approved the federal target program that envisages an increase of generation capacity to 355-445 GW by 2030. It requires construction of new power plants with 78 GW of installed capacity by 2020, and 173 GW by 2030, including 43.4 GW from nuclear. The plan also envisages decommissioning 67.7 GW of capacity by 2030, including 16.5 GW of nuclear (about 7% of present capacity).

More than half of the electricity consumed in the united system of Russia’s Southern Region, which is located on the territory of Russia’s South and North-Caucasus Federal Districts and bordering the South Caucasus and the Black Sea regions, is generated by thermal power plants. In 2014 total power generation was 80.2 BkWh, from which 56.5% was thermal, 25.4% hydro and 18.1% Nuclear. The Southern Russia Region has one of the highest demand growth rates in the country, which in 2014 accounted for 85.734 TWh and generation of 80.16 TWh.

According to the baseline scenarios of the Scheme and Program of Development of Unified Energy System of Russia of 2014, the average annual growth of demand in the Southern Russian Region is estimated to be up to 1.46%, which is higher than the expected growth in the whole Unified Energy System of Russia. Overall, the share of demand growth of the
Southern Russia Region will constitute between 8.5 to 8.7% of the whole energy system of the country.

*Figure 8: Baseline Scenario for Electricity Demand and Generation in Southern Russia Region 2014-2020*

![Generation and Demand Forecast](image)

*Source: Scheme and Program of Development of Unified Energy System of Russia*

With the aim of offsetting the growing demand in the region, Russia plans to increase the share of nuclear energy from 18.5% in 2013 to 18.5% in 2020, while the share of thermal generation will be decreased from 66.1 to 64.3%. In the Southern Russia Region the share of nuclear generation between 2013-2020 will be increased from 20.7 to 28.5% and thermal generation will be decreased from 52.7 to 48.9%.

The United Energy System of the Southern Region borders the United Energy Systems of Centre and Volga, and is synchronized with Kazakhstan, Ukraine, Azerbaijan, and Georgia. The historical electricity network system is of 330-500 kV, which is extended from north-west to south-east along the Caucasus mountains. Intensive icing processes and unequal drainage of the rivers of North Caucasus (the Don, Kuban, Terek, Sulak) creates surplus in summer and deficit in winter. In the Caucasus, Russia shares interconnections with its southern neighbours Georgia and Azerbaijan.

*Table 3: Russia Southern Region Interconnections in operation*

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Connection</th>
<th>Maximum Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan</td>
<td>330 kV</td>
<td>500MW</td>
</tr>
<tr>
<td>Georgia</td>
<td>500 kV</td>
<td>850MW</td>
</tr>
<tr>
<td></td>
<td>220 kV</td>
<td>100 MW</td>
</tr>
<tr>
<td></td>
<td>110 kV</td>
<td>30 MW</td>
</tr>
<tr>
<td></td>
<td>110 kV</td>
<td>30 MW</td>
</tr>
</tbody>
</table>

28 Ibid.  
29 Ibid.
Russia’s exports to the South Caucasus from the Southern Grid during 2014-2020 will constitute around 190 MW, and this whole capacity is planned to be delivered to Georgia, while export volumes to Azerbaijan will be zero.

Figure 9: Electricity Export Forecast from Southern Russia Region to South Caucasus 2014-2020

Russia’s electricity market suffers from system inefficiency, as more than 70% of Russia’s generation capacity was commissioned prior to 1980, along with high power losses and inefficient consumption. In addition, subsidized low prices in the power market provide no return on investment. In the coming years Russia will need to invest into the electricity sector to rehabilitate aging thermal power plants and its transmission and distribution infrastructure.

Potentially, as an energy exporter country with its overall generation capacities, Russia is considered as potentially benefitting from trade with Turkey via the Black Sea Transmission Network through Georgia and the ability to export and sell electricity in the increasingly competitive market there. However, from the overall picture of the current situation in Russia’s Southern Grid Region, it is clear that the export potential there is quite limited. Although the country remains a major energy exporter, Russia’s Southern Region bordering Georgia keeps running a deficit, and has one of the highest demand growth rates in the country.

Existing Patterns of Electricity Cooperation in the South Caucasus

As pointed out in previous chapters, the Georgian energy system is connected with those of almost all of its neighbours. Until 2009 Georgia exchanged, imported and exported energy from and to the following neighbouring countries: Russia, Turkey, Armenia and Azerbaijan. Currently, the vast majority of its trade is with Russia and Turkey and there are very small quantities of exports to Armenia. Trade with Azerbaijan follows a similar pattern, although

30 Atlantic Council DINU PATRICIU EURASIA CENTER, Cross-border Electricity Exchanges: Bolstering Economic Growth in the South Caucasus and Turkey, October 2013
volumes are much smaller, and electricity trade with Turkey is in the form of exports during summer months.

Electricity trade between Georgia and Russia (Georgia exports in summer and imports from Russia in winter) is carried out by the technical coordination of Russian company InterRAO. Russia remains Georgia’s largest trading partner, as import from Russia is essential for Georgia to cover peak demand during winter months (especially before the new plants come online), while Georgia’s hydro power is profitable for Russia during the summer period.

Armenia, which is largely isolated due to unresolved conflicts with neighbouring Azerbaijan and Turkey, imports most of its primary energy (natural gas) from Russia, which fuels a large portion of thermal generation while at the same time maintaining trade relations with Iran and Georgia. The majority of trade volumes with Iran are through the “electricity for Iranian gas” swap contract, which is important for Armenia’s thermal generation. Armenia imports electricity from Iran during the winter period and exports to Iran in summer months when Iran has high domestic demand.

Although cooperation between Armenia and Georgia is limited to exporting or importing energy for seasonal exchange, Georgia remains a principal partner of Armenia in the energy sector due to Armenia’s closed borders with Azerbaijan and Turkey. From the national security perspective of both countries cooperation has been a necessity for shaping and stabilizing systems in both countries.

Until 2006, Georgia served as a consumption market for energy generated in Armenia. Electricity trade was carried out according to the scheme of the separated “island” in the radial regime, through acting power lines (HVL 220kV “Alaverdi”, HVL110kV “Lalvar” and HVL 110kV “Ninotsminda”).

The Georgian power system is mainly operated synchronously with the Russian system (500 kV), while Armenia is connected in a synchronous way to Iran (400 kV). Therefore, synchronous operation for Armenia and Georgia is not possible. The Armenian and Georgian power systems will provide asynchronous operation through a B2B converter, which is planned to be built together with a new 500 kV transmission line by 2018. The new interconnection line will enhance power flow volumes between Georgia and Armenia and reinforce stability of the system. This substation will be the second high-technology unit in the Caucasian Region, following the equipment installed and operating in the Akhaltsikhe SS that connects to the power systems of Georgia and Turkey.

The Azerbaijani electricity system is currently connected to the electricity systems of Russia (North Caucasus), the Islamic Republic of Iran and Georgia. Therefore, the actual power exchange of Azerbaijan takes place with these countries. In order to supply electricity to all parts of the country, Azerbaijan has been importing power from Turkey and Iran. Azerbaijan is not able to supply the entire country, due to the geographical isolation of the Nakhichevan Autonomous Republic (NAR) and ongoing tensions between Armenia and Azerbaijan. Power
imports from Turkey and Iran have been used for energy supplies in Nakhichevan since 1993.\textsuperscript{31}

Power trade between Azerbaijan and Georgia is characterized mainly by small daily exchange volumes (the maximal flow 160 MW). Georgia imports in winter months to meet demand, and exports in summer months when Georgia has excess hydro generation.

Preparation for further increases of power trade to Turkey via Georgia is ongoing. Recently Georgia and Azerbaijan have constructed the 500 kV (850 MW) Mukhrani field power transmission line, which increases the energy exchange between the two countries. This project is a part of the general project to interconnect the power systems of Azerbaijan, Georgia and Turkey, and is expected to provide significant economic benefits and raise power generation in the region to a qualitatively new level. The Mukhrani field power interconnection is a major component of a large-scale power flow project from Azerbaijan to Turkey via "the energy bridge Azerbaijan-Georgia-Turkey", which will be discussed below.

Despite the fact that South Caucasus states presently experience limited power trade, the already existing technical arrangements on the strengthening of two-sided or many-sided cross-border interconnections obviously show the rational need for broader cooperation in power systems, which are the key driving factors today behind the desire of these states for enhanced electricity trade.

**Opportunities for regional cooperation—electricity trade and transit**

- **Export Diversification Opportunities:**

The South Caucasus states have made notable progress in terms of changing the energy balance of their power markets in the last few years. Sound energy strategies and market reforms turned them into net exporters of electricity, like in case of Azerbaijan and Georgia since 2007 and Armenia from 2009. Significant energy resources still remain underdeveloped, forcing states to rely on participation of foreign capital in generation projects in order to compensate for limited financial resources. The possibility of exporting electricity to neighbouring countries and the related revenues can be an important factor for foreign investors to be involved in large scale infrastructure projects. In addition to that, enhanced regional cooperation would help the states of the South Caucasus achieve energy security, improve the reliability of their respective systems, and access foreign electricity markets. The sections below focus on export diversification opportunities along two electricity corridors: East-West and North-South.

- **EWEC – East-West Electricity Corridor Countries**

It is a fact that energy price is a significant competitive factor for energy trade. Consequently, the Turkish economy is becoming increasingly interesting in the regional market place because of rapid growth in demand and a wholesale electricity price which is among the highest (average 6.73 US cents/kWh) in the region.

\textsuperscript{31} SILK ROAD REPORTERS: “Despite Low Oil Prices, Azerbaijan Increases Electricity Exports”, Published by John C. K. Daly, March 3, 2015
The discussion on regional cooperation of power grids, “The Unification of the Caucasian countries with Turkey”, started earlier in the 1990s. The creation of such a power system is profitable not only economically, but also from the viewpoint of the resolution of political conflicts.

Georgia was the first country to pursue the idea of establishing an interconnection bridge with Turkey. The price differential in Turkey’s electricity market stimulates investors to develop the vast hydro resources in Georgia, since there is an opportunity to sell electricity to Turkey at a lucrative price compared to the average prices of electricity generated in Georgia (around 1.43 US c/kWh).

As a result, Georgia’s endeavours resulted in the establishment of the Black Sea Transmission Network (BSTN) with Turkey, which also creates opportunities for Georgia to trade with European countries where Turkey’s electricity trading capacities are connected with its European neighbours (Bulgaria, Greece), and it enjoys Observer’s status within the ENTSO-E (European Transmission System Operators for Electricity).32

Potentially, Turkey’s membership in the Continental Europe Synchronous Area opens up new opportunities for South Caucasus states to export electricity not only to Turkey but further to European energy markets and to diversify their export markets. However, following the lack of any certain prospect for restoring political relations between Turkey and Armenia, the opportunities are principally opened just for Georgia and Azerbaijan.

Power trade with Turkey can also be profitable for Azerbaijan due to the energy price differential. In particular, today Azerbaijan sells gas to Turkey at a very low price of around $340 per 1000 cubic meters, which is the lowest cost compared with Iranian ($487 per 1000 cubic meters) and Russian ($418 per 1000 cubic meters) gas prices.33 At the same time, the current average private wholesale electricity price of Turkey is 6.73 US c/kWh, while the electricity price for Azeri thermal power plants based on subsidized gas prices is around 3 US c/kWh.34 In this regard, Azerbaijan is likely to have an interest in electricity trade with Turkey, while still selling its gas to Turkey for lower than the regional average price.

In 2009 Azerbaijan-Georgia-Turkey signed a Memorandum of Understanding to realize the AGT Power Bridge Project, the key electricity-grid component of the East-West Corridor. The project is an expansion of USAID’s Black Sea Regional Transmission System Planning Project, inaugurated in 2004.35 The memorandum envisages assessment and analysis of the high voltage electricity networks in Turkey, Georgia and Azerbaijan from a sub-regional perspective to determine their capacity and support increased trade and exchange of electricity.

32 TEIAS
34 Tariff Council of Azerbaijan
35 United States Energy Association, Black Sea Regional Transmission System Planning Project (BSTP)
According to official statements, the Azerbaijan-Georgia-Turkey Energy Bridge project envisages supply of about 1,200 MW of electricity to Turkey, of which around 600 MW is Azerbaijan's share. The project is intended to export up to 2,000 megawatt of electricity from Turkey to Europe.36

While the interconnector bridge project aims at enhancing development of Georgia’s hydro resources and strengthening Georgia’s transit role, for Azerbaijan it is an apparent chance for export diversification and increasing revenues in the form of both natural gas and electricity export.

➢ **NOSEC – North-South Electricity Corridor Countries**

Russia is another country which may potentially benefit from trade with Turkey via the BSTN through Georgia, which opens up new opportunities for Russian producers to export electricity to Turkey.

At present, Georgia and Russia transfer deliveries of summer power from Georgia to Russia, and the reverse in winter. After commissioning the direct link to Turkey, prospects for power transfers from Russia to Turkey have opened for Russia since the country is rich in energy resources, especially primary energy such as coal, natural gas and oil, as well as electricity produced from nuclear power plants at low generation costs.

The interconnection of Caucasus/Russia - Georgia - Turkey would provide access for the south western part of Russia to the commercially attractive energy market of Turkey, and create incentives for such trade. The talks on Russia’s plans of enlarging the export of Russian electrical energy to Turkey through Georgia started early in 2002. According to the

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36 “Azerbaijan to Export Power to Georgia via Energy Bridge”, azemnews.az, 16 DECEMBER 2013
official statements, Russia and Turkey even considered the possibility of signing a long-term contract on electricity deliveries to Turkey.\(^{37}\) However, as it was discussed above, the Russian Southern Region bordering the South Caucasus has the highest demand in the whole unified power system of Russia and runs a deficit. As a result, electricity exports from Russia to Turkey are not expected in the foreseeable future.

Trading with the Southern Russian Region may be possible in the future as a way of smoothing peak load demand (will be discussed below). However, sustained exports in both directions between Georgia and Russia will be decreased, as export from Georgia will be diverted to the Turkish market and its relatively lucrative market price.

Compared with Georgia, Azerbaijan and Russia, Armenia has less opportunity for export diversification, not in terms of surplus deficit but in terms of political restrictions and price factors. Due to the political tensions with its neighbouring countries Azerbaijan and Turkey, integration of Armenia into the regional grid is not expected in the immediate future. Even with Armenia’s plans to increase generation capacities in the coming years, Armenia is limited with broader trade in the region.

On the other hand, Armenian producers are forced to seek expansive markets in the region. The internal regulations of Armenia obliges local producers to export only “expensive” energy and to use cheap energy for domestic consumption. As a result, the electricity export price of Armenia (average 5.4 US c/kWh) exceeds the prime cost of energy generated in neighbouring countries.\(^{38}\)

Consequently, given Armenia’s internal regulation, local producers are forced to find growing power markets in the neighbourhood in order to get profit from exporting electricity. In this sense, in terms of price the export from Armenia to Turkey would be a rational option for Armenia.

Nowadays, the principal energy partner in the South Caucasus for Armenia remains Georgia. In the long-term, after the construction of a new nuclear plant, additional transmission capacity will be necessary to export electricity from the plant, as Armenia will have significantly larger generation capacities than what is needed for domestic consumption. However, if Armenia does not build a new nuclear plant, the relatively cheap hydropower imports from Georgia could be an option for Armenia to meet its energy deficit.

In addition, electricity export from Georgia can also be considered as an option given the Armenia-Iran contract on “Electricity in Exchange of Natural Gas” (valid until 2027). Based on the contractual volumes, which envisage increased trade volumes between the two neighbouring countries, Armenia will need to increase its export capacities to Iran. Thus, Georgia can be a supplier of the required volumes to Armenia, which can be re-exported to Iran during summer, when Iran has high electricity demand on its market.\(^{39}\)

\(^{37}\)“Russia is ready to deliver electricity to Turkey for 15 years for $60 Bln”, Daily News Bulletin Feb. 14, 2009

\(^{38}\)USAID funded report, Analysis of Opportunities for the Armenian Power System’s Regional Integration with Georgia, Turkey and Russia, 2012

\(^{39}\)USAID Funded Report, Regional Electricity Market Review, 2013
According to the official statements Armenia will complete, by 2017, construction of a new 500 kV electricity transmission line in the direction of Georgia and 400 kV line with Iran. After completion of these lines the direct delivery of electricity from Georgia to Iran can be potentially possible.

- **Georgia, as a Commercial Power Trade “HUB”**

Over the past decades, the power trading market has increasingly been concentrated at a selected group of specific geographic locations or “hubs”. But while the “hub” development process in the power market is progressing, the decision to trade at a particular “hub” using a particular contractual instrument can be as important - if not more important - than the price of the trade itself.

Georgia, as the only country having interconnections with all countries in the South Caucasus, including Turkey, is ready to serve as a power trading platform, facilitating wholesale electricity trade in the region. Reinforcing transmission capacity of the Georgian TSO would allow for serving as a marketplace for neighbouring countries to sell and buy surpluses of electricity for immediate or near future delivery, from border to border. With the implementation of all anticipated interconnection projects, this “hub” would provide trade opportunities to all countries of the North-South and East-West electricity corridors.

The main idea behind this approach is to optimize the use of energy resources at the regional level, give opportunities to the producers and consumers, and give the flexibility to export surplus electricity and to cover short-term deficits. The proposed approach would be simple enough for the participating states to limit their involvement to export/import transactions. In this case, this “hub” would not require market mergers or harmonization of regulatory frameworks. Governments of the states would nominate and authorize traders, who would be involved in the power trade through the agreement signed with the operator of the “hub”. No direct contacts and contracts between sellers and buyers would be needed. The major advantage is the opportunity for buyers and sellers to trade flexibly, as no special license or everyday trade is necessary, and occasional trade opportunities to sell, export, or cover deficits can be also possible.

Such a trading mechanism can be especially helpful in the South Caucasus, as it does not require market integration or the joint decision of all countries. At the initial stage, this approach could be tested between two or three countries, leaving space for the others to join. Given the fact that regional trade in the South Caucasus has been shaped by political factors moreso than by market forces, it can help to expand the scope of power trade between the countries of East-West and North-South energy corridors. The operator can provide technical feasibility of power transit. Thus, power can be delivered easily to any

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40 “Armenia to have new electricity transmission lines toward Iran and Georgia,” news.am, 05,11,2014
41 USAID Funded Report, UPDATE ON THE REGIONAL TRANSMISSION TRANSFER CAPABILITY FOR GEORGIAN NEW HPPS ELECTRICITY SALES, 2013
42 “Regional Power Trade Benefits and Opportunities” Presentation by Mikheil Tavberidze, July 2015

Georgian State Electrosystem, JSC
deficit market via Georgia and the participation of any interested “third party” can be easily possible.

However, the technical feasibility of power flow related to simultaneous synchronous operation of the Georgian power system with the power systems of several other countries will be dependent on the success of the expansion of regional power systems. In particular, on the progress of the power network reinforcement planned measures and the plans for installation of HVDC equipment in Armenia, which will significantly reduce technical congestions in the system. This technical connection with Armenia is important to the extent that it will provide flexibility to operate systems of North-South and East-West electricity corridors simultaneously (import/export power from/to various directions). Armenia’s asynchronous connection with Georgia limits trade between the two countries, and Armenia’s system cannot be synchronously connected to both Georgia and Iran because it would compromise grid stability in the IPS/UPS and Iran/Turkmenistan synchronous zones. Therefore, installation of this new HVDC equipment in Armenia would allow for increased trade between the two countries and increased transit of electricity from Georgia to Iran via Armenia.

For implementation of the “hub” and its successful operation, political decisions by each participating country will be essential. In particular, agreement between Georgia and each neighbouring and trans-neighbouring country.

From the legal perspective, it can be easily implemented as there is no market coupling and requirements for the harmonization of regulatory standards related to cross-border trade. Since the power traded at the “hub” will be similar to import/export activities, trading companies are not entering markets.

- **Reliability of Supply - Sharing Capacity Reserves on a Regional Level to Meet Peak Demand**

Peak electric demand is a significant component in the cost of electricity, requiring large capital investments and operating expenses for generation equipment that is only required to operate during the peak demand period. The impact of peak electricity demand results in significantly increasing peak load pricing, especially when electricity is generated by low efficiency power plants. In this sense, the hydropower of Georgia can be seen as an opportunity to meet peak electricity demand in the region, particularly taking into account the cost advantage of hydro power over thermal generation with fossil fuels.

As already pointed out, Georgia represents one of the world’s top countries in per-capita water resources, and has one of the largest frequency power plants (“Enguri” HPP) in the region. The Enguri HPP is a dominant hydro generator in Georgia, with its 271.5 meters high dam. This power generator is the fourth tallest concrete arch dam in the world. Its reservoir has a capacity of 1.1 billion m$^3$. With a nominal capacity of 1,300 MW and an average annual capacity of 4.43 TW/h, the plant is responsible for around one-third of total electricity generation in Georgia.

The Georgian government is presently promoting hydroelectric projects like the Khudoni HPP, which is another project for the Enguri cascade system and includes the Enguri HPP and the smaller Vardinili I, II, III and IV (340 MW in total). The project envisages the
construction of a 200 meter high concrete arch dam with an installed capacity of 702 MW and 1,500 GWh of output. The project will be further complemented by a number of other upstream hydropower plants on the River Enguri (Tobari Hydropower, installed capacity 250 MW, projected generation 810 GWh; Khaishi HPP, installed capacity 670, generation 1,470 GWh; Nenskra HPP, 280 MW).

The construction of the Khudoni HPP would increase the country’s electricity generation by 15%. This looks like a project that could produce significant clean energy and at the same time increase the reservoir capacity of the country.

The potential of Georgia’s planned and current hydropower stations, in conjunction with Georgia’s interconnection capacity with its neighbours, is important to the extent that it gives possibility in the region to substitute generation at TPPs with hydroelectric capacities. In particular, the ability to cover peak demand through electricity imports from Georgia rather than commit domestic thermal plants (existing or new) during peak load hours.

Due to the existing and planned interconnection lines between Georgia and its neighbours, there is an opportunity to use excessive power from Enguri and other HPPs in Georgia (with reservoirs to be constructed before and after 2025) to provide secure domestic power supplies during peak electricity demand in the region.

Given the major advantage of hydropower, which is the lower cost compared with using fossil fuels in thermal power plants, the operation of peak energy output based on Georgian hydroelectric power stations is an opportunity to reduce the costs of peak electricity demand throughout the region. This will also balance the operation of generation assets, and reduce the gap in generations.

At present, the generation tariff for hydroelectricity in Georgia (around 1.43 US c/kWh) is the lowest in the South Caucasus. Even with subsidized gas prices the tariff for thermal power plants in Azerbaijan is around 3 US c/kWh higher than in Georgia. Turkish and Armenian generating costs are even higher, and the construction of new capacities is likely to raise costs even more in these countries. Therefore, it is predicted that Georgia’s hydropower will remain competitive in the South Caucasus.

As a result, Georgia’s clean and relatively low peak load price is supposed to be one of the important opportunities for enhancing power trade in the South Caucasus and ensuring sustainability of power supply.

From the technical point of view, the systems can be interconnected and give long-term prospects to operate the system efficiently and keep electricity prices reasonable. In addition to the reduction of price and demand at peak times, this will also contribute significantly to reducing emissions in the region by taking the high polluting power producing plants offline.

- Economy energy trade – hydropower resources of Georgia
The sustainable supply of electricity is increasingly important in the world economy for sustaining continued economic activity. Hydropower represents one of the major components for ensuring sustainable energy supply, and plays an essential role in global efforts to reduce CO₂ emissions. In addition, emission-reduction plans also transfer higher environmental costs onto thermal power plants, which bring long-term benefits to hydro energy.

The share of hydropower in the world’s energy mix is growing steadily, which makes Georgia an interesting country due to its vast hydro potential. According to IEA statistics hydropower is the largest single renewable electricity source today, providing 16% of world electricity at competitive prices. It dominates the electricity mix in developed, emerging or developing countries.

So far Georgia’s immediate neighbours could potentially find great value from Georgia’s hydroelectric resources. Turkey’s electricity is largely fuelled by natural gas and coal, Azerbaijan’s power sector is largely on oil and natural gas, and Armenia’s primarily on nuclear and natural gas. From a utility planning viewpoint, Georgia’s regional contribution, as a major hydro producer country in the South Caucasus, offers valuable fuel diversity in addition to cost reduction.

In addition to the economics of the energy trade, Georgia’s hydro generation potential is important for the region from the perspective of environmental protection, as Georgia remains the only clean energy exporter in the South Caucasus.

As we can see from Figure 10, among the three South Caucasus states Georgia takes a leading role in hydro generation, which delivers low-carbon energy exports in the region.

Figure 10: Electricity Generation by Fuel in the South Caucasus in 2012
Thanks to the construction of electricity export infrastructure, clean Georgian hydropower can promote a cleaner environment throughout the entire region, and provide a gateway to renewable energy trade.

Azerbaijan could be the first country to be interested in clean energy trade. Along with rapid economic development, Azerbaijan faces significant problems regarding environmental protection. While Azerbaijan improves its economic performance, mitigating environmental impacts from high-impact economic sectors, including the oil and gas extraction industries, remains a key challenge for the country.\(^{43}\)

Figure 10 above highlights that, among the three South Caucasus states, Azerbaijan is the leader in thermal generation, and thus problems regarding environmental protection and the rational use of natural resources are essential for Azerbaijan today. In this sense, trade with Georgia can be an option for Azerbaijan to replace fossil fuel thermal generation with cleaner power imported during peak demand.

The benefit for Armenia also could be the same, to substitute generation at TPPs through importing hydroelectric capacities from Georgia. Given Armenia’s intentions to increase

generation from nuclear power, the benefit from replacing thermal generation at a higher price with import from Georgia during peak demand can be a favourable option.\textsuperscript{44}

As pointed out, Turkey’s high electricity prices and its proximity to Georgia, as well as Georgia’s low production costs for hydropower, set the goal for the government of Georgia for future growth in exports to Turkey.

The potential for increased electricity exports to the EU also looks promising, as trading with Turkey may allow Georgia to gain access to the European market through the transmission route to Turkey and a trading agreement as a basis to export excess power to Europe. As a result, Georgia’s hydro energy can be also important in terms of contributing to the EU 20/20/20 targets and commitments related to an increase to 20\% of total consumption from renewables by 2020.

Developing vast hydro resources and strengthening connections of the South Caucasus energy grid with the Turkish and European electricity systems is an additional opportunity to export hydro energy from Georgia to Turkey and, through energy swaps, to Europe.

**Main findings and next steps**

There are clear technical, economic and environmental benefits for regional electricity cooperation in the South Caucasus. Electricity cooperation and integration could be a unique opportunity for optimal use of available energy resources at the regional level. Improved grid interconnectivity will contribute not only to the security of supply and reliability of national power systems, but will also have a strong linkage with the socio-economic development of the region in general. On top of this, energy cooperation in the South Caucasus, with its rich and diverse energy resources, would be key to addressing climate change issues as well.

The already constructed Black Sea Transmission Network, establishing an interconnection bridge between the South Caucasus and Turkey, allows states in the region, including Russia, to diversify their export markets through Georgia and contributing to the overall economic growth of the region. The role of Georgia as a transit country and a major producer of clean electricity is essential in facilitating regional electricity trade. Indeed the country’s geographical location and its electricity interconnections with all its neighbours can serve as a power trade “hub” for the whole region. The expansion of cross-border power trade may have significant positive impact on the overall development process in the South Caucasus in general, and on each country’s national energy security. However, it is clear that the power markets of the South Caucasus states are still underdeveloped and require significant investments into new generation facilities as well as into cross-border transmission links.

At present, electricity cooperation in the South Caucasus is quite limited, in the form of bilateral trade. To attract private investment in feasible energy infrastructure development projects and foster trade, South Caucasus states will need to create an appropriate legal/regulatory environment, as the region remains one of high risk for investors. Electricity exchange and transmission regulations must be developed in order to make use of full regional potential and to benefit from economies of scale.

\textsuperscript{44} USAID Funded Report: Regional Electricity Market Review, 2013
The principles of the Energy Charter, as a multilateral framework for international energy cooperation, are shared by the countries of the region. In addition, Iran joined the Process by adopting the International Energy Charter in May 2015. This is a clear message that Iran is also ready to discuss a potential basis for regional cooperation with the Energy Charter members of the region.

In this sense, Energy Charter mechanisms could provide effective tools for the promotion of political dialogue and cooperation in view of improving the regulatory environment in the region, as it contains commitments on governmental cooperation with regard to energy trade. The Georgian Flagship Initiative on Regional Electricity Cooperation in the South Caucasus under the Energy Charter Chairmanship in 2015 comes to support the overall process related to the expansion of regional cooperation on electricity trade. Under the Flagship Initiative, it is proposed to facilitate regional cooperation by promoting political dialogue and revising energy priorities for the expansion of regional cooperation in the field.

At this stage it is important to identify and prioritise national development objectives in the electricity sector with common goals at the regional scale. The different stages of development of national markets, as well as incompatibility of legal and regulatory frameworks could be an obstacle to system integration. From this point of view, it is even more important to “test the waters” for political willingness to cooperate. The Georgian Flagship Initiative is the first step forward in the institutional setup to initiate political dialogue on regional electricity cooperation in the South Caucasus.

Based on the potential of the region in terms of power trade, there is an essential need to establish a legal and technical framework for secure electricity trade. Establishment of a regional platform based on the ECT can contribute to strengthening and promoting confidence building measures among the countries, and enhance already existing cooperation in the region. This political platform could also foster discussions and dialogues on the need to set up any legal frameworks, regional mechanisms or structures in order to facilitate the process of regional cooperation. The next immediate step could be establishing a technical working group comprising of TSOs and regulatory authorities to focus on specific implementation mechanisms, including a set of rules for cross-border electricity trade and transit. In general, it could provide the forum to address the following objectives:

- Promoting political dialogue for the expansion of regional electricity cooperation and the development of cross-border trade and transport corridors;
- Developing a legal, regulatory and technical framework for facilitating regional power trade and investments based on the ECT;
- Facilitating investments in power generation sources and construction of cross-border energy infrastructure;
- Enhancing cooperation through systematic channel for sharing knowledge, information and know-how.