



# Georgia Energy Profile

# INTERNATIONAL ENERGY AGENCY

---

The IEA examines the full spectrum of energy issues including oil, gas and coal supply and demand, renewable energy technologies, electricity markets, energy efficiency, access to energy, demand side management and much more. Through its work, the IEA advocates policies that will enhance the reliability, affordability and sustainability of energy in its 30 member countries, 8 association countries and beyond.

Please note that this publication is subject to specific restrictions that limit its use and distribution. The terms and conditions are available online at [www.iea.org/t&c/](http://www.iea.org/t&c/)

This publication and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: IEA. All rights reserved.  
International Energy Agency  
Website: [www.iea.org](http://www.iea.org)

## IEA member countries:

Australia  
Austria  
Belgium  
Canada  
Czech Republic  
Denmark  
Estonia  
Finland  
France  
Germany  
Greece  
Hungary  
Ireland  
Italy  
Japan  
Korea  
Luxembourg  
Mexico  
Netherlands  
New Zealand  
Norway  
Poland  
Portugal  
Slovak Republic  
Spain  
Sweden  
Switzerland  
Turkey  
United Kingdom  
United States

The European Commission also participates in the work of the IEA

## IEA association countries:

Brazil  
China  
India  
Indonesia  
Morocco  
Singapore  
South Africa  
Thailand



# Table of contents

<b>Georgia Energy Profiles .....</b>	<b>4</b>
Country overview .....	4
Key energy data .....	5
Energy sector governance .....	6
Key policies .....	8
Energy statistics .....	9
<b>Chapter 1. Energy security .....</b>	<b>12</b>
Resource endowment .....	12
Energy security and diversification .....	12
Energy infrastructure and investment .....	14
Emergency response .....	19
<b>Chapter 2. Market design .....</b>	<b>21</b>
National market structure .....	21
Regulatory framework .....	26
Regional markets and interconnections .....	28
<b>Chapter 3. Sustainable development .....</b>	<b>31</b>
Renewable energy .....	31
Energy efficiency .....	34
Fuel switching .....	35
Environmental protection .....	35
Climate change .....	36
Technology research, development and deployment .....	38

# Georgia Energy Profile

## Country overview

Georgia is located in the Southern Caucasus region, at the crossroads of Western Asia and Eastern Europe. It is bounded on the west by the Black Sea, on the north by the Russian Federation, on the south by Turkey and Armenia, and on the southeast by Azerbaijan. Situated on the shortest route between Europe and Asia, Georgia's transport system is a key link in the historic Silk Road trade network. The capital and largest city is Tbilisi, and the country covers a territory of 69 700 km<sup>2</sup> with a population of 3.7 million. Georgia is a unitary, semi-presidential republic, with the government elected through a representative democracy.

Georgia's overall economic policy has been focused on creating a liberalised economic environment through minimal state interference, deregulation, privatisation, reduced and simplified licensing and taxation, and free trade. Georgia has pursued westward-leaning political, economic and foreign policies, and signed an Association Agreement, including assent to the Deep and Comprehensive Free Trade Area, with the European Union in June 2014. The Association Agreement was ratified by the European Parliament in December 2014, and in October 2016 the Georgian Ministry of Energy signed an Accession Protocol to the Energy Community Treaty, which was ratified by the parliament in April 2017. The reforms that followed have included adoption of the Law on Energy and Water Supply and the law in support of renewable energy sources in December 2019. Laws on energy efficiency and energy performance of buildings were adopted on 21 May 2020. Secondary legislation including balancing and ancillary services market rules, electricity retail market rules, rules to determine criteria and status of large electricity customers, and energy market monitoring and reporting rules were adopted throughout 2020. Robust economic growth of 4.1% per year on average was achieved between 2015 and 2019, following structural reforms that stimulated capital inflows and investment. The reforms improved the business environment, strengthened public finances, upgraded infrastructure facilities and liberalised trade. Growth was also supported by increased foreign direct investment and was driven by capital accumulation and sound use of excess capacity rather than by net job creation, with productivity gains concentrated mainly in the non-tradeable sectors. GDP per capita (in current prices) increased from USD 920 in 2003 to USD 4 696 in 2019. In 2020, during the Covid-19 pandemic, Georgia's economy declined by 6.2% due to Covid shocks and two lockdowns. As a result, GDP per capita decreased to USD 4 256.

Georgia has a developed, stable and reliable energy sector that has been largely unbundled since the mid-1990s; its primary domestic energy sources are hydropower and fuelwood. The government is focused on securing private investment to construct new hydropower stations, increase the efficiency in thermal generation, and diversify fossil fuel supply sources and routes, but further efforts are required to improve efficiency in domestic energy use and to capitalise on the country's ample renewable energy potential, which is facing development problems.

Georgia has been a signatory to the Energy Charter Treaty since 1995 and a member of the World Trade Organization since 2000 and has become a Party to the Energy Community Treaty following ratification of the Accession Protocol in 2017.

## Key energy data

### Supply<sup>1</sup>

- Georgia's energy production covers less than one-fourth of its energy demand (21.4% in 2019).
- Most of Georgia's domestic energy production (1.09 Mtoe in 2019) comes from hydro and biofuels/waste (0.768 Mtoe biofuels and 0.245 Mtoe waste).
- Production of fossil fuels exists but is very limited (6.2 ktoe of lignite, 35.6 ktoe of crude oil and 8.3 ktoe of natural gas in 2019).

### Imports

- Georgia depends on imports for all its natural gas (2.69 bcm in 2019) and most of its oil products (1.35 Mt in 2019).
- Oil is imported mainly in the form of refined oil products (diesel, 40.7%, and gasoline, 40.4%).

### Demand

- Georgia's energy demand was 5.1 Mtoe in 2019.
- Georgia's energy consumption per capita is two times lower than the world average, but it is growing very quickly. From 2000 to 2018, both energy demand and electricity consumption per capita multiplied by more than 1.6 times.
- The energy mix is relatively diverse compared with other countries in the region. In 2019, natural gas was the first fuel in the energy mix (45.4%), followed by oil (27%), renewables (20.4%) and coal (4.7%).

---

<sup>1</sup> [www.geostat.ge/media/37669/Energy-Balance-Publication\\_2019-ENG.pdf](http://www.geostat.ge/media/37669/Energy-Balance-Publication_2019-ENG.pdf)

- Nearly 75% of Georgia's electricity generation comes from hydro production (75.3% in 2019), with the remainder produced from natural gas and from a 20.7 MW wind power plant (84.7 GWh in 2019).
- The transport sector represents the largest share of final consumption (1.4 Mtoe in 2019), followed very closely by the residential sector (1.3 Mtoe in 2019).

## Renewables

- The share of renewable sources in Georgia's electricity mix is among the highest in the world (74.7% in 2020).<sup>2</sup>
- Among EU4Energy focus countries, Georgia has the highest share of renewables in its energy mix after Kyrgyzstan and Tajikistan and is the third-highest producer of renewable energy (after Ukraine and Belarus)

## Energy sector governance

### Executive

As the body in charge of governing the energy sector, the **Ministry of Economy and Sustainable Development (MoESD)** is responsible for state policy in the energy sector as well as policies related to the sustainable development of the country's economy.<sup>3</sup> It leads the reform in the energy sector to implement the relevant EU directives and regulations in compliance with Energy Community membership. It can adopt secondary legislation related to the energy sector (through ministerial orders). The MoESD took over the responsibilities of the former Ministry of Energy in 2017.

To ensure sustainable resource development and protection of the environment, the **Ministry of Environment and Natural Resources Protection** develops national policies and strategies on environmental and natural resource protection and engages in forest and waste management, among other activities.

**The Georgian Energy Development Fund** is a state-owned joint-stock company created in 2010 and reporting to the MoESD. Its mission is to develop Georgia's renewable energy potential by identifying promising renewable energy projects and supporting their development through pre-feasibility and preliminary environmental impact assessments, and by finding investors.

---

<sup>2</sup> [https://esco.ge/files/data/Balance/energobalans\\_2020\\_eng.pdf](https://esco.ge/files/data/Balance/energobalans_2020_eng.pdf)

<sup>3</sup> In November 2017 the Ministry of Energy was merged with MoESD, carrying over the respective functions.

**The Public-Private Partnership Agency** is a new body created following the adoption of the Law on Public-Private Partnerships in May 2018. The agency's mandate is to lead the development and implementation of public-private co-operation projects.

## Legislative

The legislative process for introducing primary legislation in the energy sector follows the procedure laid out in the constitution. Legislative initiative is the prerogative of the government, ministries (initiating laws through the government), parliamentary committees, groups or individual members of parliament, and citizens when an initiative has at least 30 000 supporters. By default, laws are adopted in three hearings by the parliament and enter into force 15 days after publication.

Regulations and secondary legislation can be also initiated and passed by the Georgian Energy and Water Regulatory Commission (GNERC) and the MoESD (ministerial orders). GNERC does not have the right to initiate primary legislation and its regulations cannot come into force until at least 21 days after initiation, but the time frame for ministerial orders is not regulated.

The parliamentary **Committee on Sectoral Economy and Economic Policy** oversees energy sector developments through regular or topical hearings with the participation of the MoESD and other stakeholders. The parliamentary **Environmental Committee** is concerned with the environmental impact of energy projects as well as forestry reform, which may influence the use of biomass as a fuel.

Georgia is in an active phase of implementing EU energy legislation under Energy Community membership. The directives on electricity and gas markets, security of supply, energy efficiency and energy efficiency in buildings, and support of renewable energy sources have been transposed into Georgia's legislation since December 2019.

## Judiciary

Resolution of disputes among regulated market participants or between consumers and service providers in the energy sector is conducted by GNERC. Cases are resolved in open hearings, but if parties disagree with the GNERC decision they are authorised to take the case to general courts.

Some cases have been taken to the Constitutional Court: for example, one case initiated in 2002 questioned the new tariff adjustment and amendments to the Electricity and Natural Gas Law and the ministerial order related to communal metering.

## Regulatory framework

GNERC, Georgia's independent energy and water supply regulator, was established in 1997 and its responsibilities include: regulating the activities of importers and exporters and the Electricity Market Operator (ESCO)/supplier; monitoring the electricity market and approval of market rules; licensing electricity generation, transmission, dispatch and distribution; licensing natural gas transportation and distribution; regulating electricity generation, transmission, distribution, and end-user tariffs and import prices; resolving disputes; developing metering, billing and collection services; and approving grid codes. GNERC also sets caps on wholesale prices for existing plants based on their costs, with the exception of small and medium-sized hydropower plants (HPPs) developed after 2008. GNERC also does not regulate the power purchase agreement prices for new HPPs under development.

The State Agency for Oil and Gas was established in 1999 as an independent regulatory body under the Oil and Gas Law, for oversight and regulation of oil and gas exploration and production activities. Since 2013, the State Agency for Oil and Gas has been a legal entity under public law within the Ministry of Energy (currently MoESD) and is responsible for the regulation of oil and gas operations, oil refining, gas processing, and/or transportation activities in Georgia according to Amendment No. 467 of 25 March 2013 to the Oil and Gas Law.

## Key policies

The MoESD of Georgia is in the process

<sup>4</sup> of developing an Energy Policy document that will include the main directions of energy policy; short-, medium- and long-term gas and electricity strategies; and the National Energy and Climate Plan (NECP) for the period 2021-2030. The policy document will be submitted to the parliament in the spring of 2022. The NECP will define the climate and energy plans of Georgia according to the main directions of Energy Union: energy security, energy efficiency, market integration and competitiveness, decarbonisation and development of renewable energy sources, and research and innovation. The plan will be submitted to the Energy Community Secretariat for approval.

The [Ten-Year Network Development Plan of Georgia for 2021-2031](#) was developed by the Georgian State Electrosystem (GSE) and agreed by the government on 11 February 2021. The Georgian Oil and Gas Corporation

---

<sup>4</sup> As of October 2021.



approved the [Ten-Year Development Plan for Georgian Gas Transmission Infrastructure 2021-2030](#) in November 2020.

On 2 Dec 2020, the MoESD adopted [Security of Electricity Supply Rules](#), incorporating main provisions of the Regulation (EU) 2019/941 on risk preparedness in the electricity sector. Security of gas supply rules are under development.

The MoESD developed the [Power Supply Security Report](#) and the [Oil Supply Security Report](#) in 2021. The natural gas supply security report is under development and will be published in March 2022.

As a signatory to the Paris Agreement, Georgia has revised national climate goals and objectives in its [updated nationally determined contribution](#) (NDC) document, adopted in April 2021. The updated NDC aims to support sustainable development of the country and defines the following targets:

Unconditional limiting target of 35% below the 1990 level of its national GHG emissions by 2030 (business-as-usual scenario).

In the case of international support, Georgia is committed to a target of 50% below the 1990 level by 2030 if the world follows the scenario holding the average global temperature increase to 2°C.

If the world follows the 1.5°C average global temperature growth scenario, Georgia will target to reduce GHG emissions by 57% compared with the 1990 level by 2030.

The NDC is supplemented with the Climate Change Strategy and Action Plan, which provides sector-specific targets and relevant measures in detail. The Long-Term Low Emissions Development Strategy, which will be published by the end of 2021, is intended to be a visionary policy document with no concrete mitigation measures and action plan, extending its scope until 2050.

## Energy statistics

According to national law, Georgia's official statistics producers are the [National Statistics Office of Georgia](#) (Geostat) and the National Bank of Georgia. Official statistics in the field of energy are produced by Geostat. This includes the national energy balance (produced annually with a one-year time lag); electricity and natural gas price statistics; and monthly data on electricity, natural gas, coal and oil product consumption. Seven staff members dedicate part of their time to energy statistics in addition to industry and construction statistics.

Energy data are collected annually through a set of questionnaires sent to all sectors of the economy (services are surveyed every five years). Since 2015,

businesses have been obligated by law to reply to surveys and may do so through online forms, but in-person interviews are conducted for households. Geostat aims to increase the use of administrative data, as data sources or for data checking. Additionally, Geostat updated residential survey questionnaire and included energy related questions. This allowed Geostat to collect data for the residential sector on types of energy appliances used and types of energy consumption for various end uses (e.g. heating). The latest survey was published in 2019.

The main energy publication is the Energy Balance of Georgia. It contains annual data on supply and demand for all fuels, in physical and energy units, with a breakdown by sector. The underlying data can be downloaded from the Geostat website in Excel format.

Official annual data are shared with the United Nations Statistics Division (UNSD) and the International Energy Agency (IEA) through five joint IEA/Eurostat/UN Economic Commission for Europe questionnaires. Monthly oil and gas data are also collected and transmitted to the UNSD for publication through the Joint Organisations Data Initiative (JODI). In 2016, when Georgia became a member of the Energy Community, additional indicators for energy statistics were required in accordance with European Parliament and Council regulations. To fulfil these reporting obligations, Geostat submits annual energy questionnaire responses to the IEA and Eurostat (for coal, electricity, renewables, oil and gas).<sup>5</sup> Since 2018, Geostat has also been publishing monthly oil and gas data, as well as data on electricity and gas prices.

Geostat has an active institutional co-operation policy and holds regular meetings with main data providers and data users such as the MoESD, the Georgian Oil and Gas Corporation, and the Georgian National Energy and Water Supply Regulatory Commission.

Georgia's first official energy balance was published by Geostat in 2014 (2013 data). Future Geostat projects include collecting data on end-use consumption in households to formulate energy efficiency indicators and producing monthly data on gas and electricity prices. Part of these expansion plans are linked to Georgia's new requirements as a Contracting Party to the Energy Community.

Official energy statistics are open and are stored in the public domain.<sup>6</sup> Geostat also leads the informal national energy statistics consulting group that serves as a platform for dialogue and information-sharing among national data providers and users.

Since 2014, Geostat has been responsible for compiling the official Energy Balance of Georgia. To achieve this, it was necessary to introduce new data

---

<sup>5</sup> [www.iea.org/statistics/resources/questionnaires/](http://www.iea.org/statistics/resources/questionnaires/).

<sup>6</sup> [www.geostat.ge/en](http://www.geostat.ge/en).

collection to obtain information on the final consumption of energy resources, and at the same time Geostat adopted international standards and a methodology<sup>7</sup> for collecting and compiling energy data (solid biomass data are considered representative). Energy consumption data do not include end-use data from Abkhazia and South Ossetia, however.

Furthermore, Geostat conducted a household survey in 2017 to collect information on end uses of energy (e.g. for space heating and cooking), thus establishing a basis upon which the government may formulate energy efficiency indicators.<sup>8</sup> The survey is to be conducted every five years, and with IEA support, Geostat has also begun compiling datasets for the industry and residential sectors. The next household energy consumption survey is planned for 2022.

The MoESD is among the main users of energy data. The energy module of the national GHG inventory, prepared by the Ministry of Environmental Protection and Agriculture, is based mostly on the official energy balance. Although the available energy data could improve energy planning, including through long-term energy modelling, this potential is currently being realised only to a limited extent.

Geostat has therefore also included energy efficiency data production in its medium-term strategy.<sup>9</sup>

Geostat is working on the development of an Action Plan for the Development of National Statistics for 2022-2023. The action plan is in compliance with the National Strategy for the Development of Statistics for 2020-2023. Geostat plans to expand energy statistics and add additional indication for energy efficiency and forestry (biomass).

Administrative energy data are available at the website of the Electricity Market Operator (electricity balances), GNERC (annual reports with annual data from energy distribution and network companies, current energy prices and list of energy licence holders) and the GSE (hourly electricity load data).

---

<sup>7</sup> <https://unstats.un.org/unsd/energystats/methodology/ires/>.

<sup>8</sup> <https://webstore.iea.org/energy-efficiency-indicators-essentials-for-policy-making>.

<sup>9</sup> [www.geostat.ge/en/modules/categories/630/strategy-for-the-development-of-statistics](http://www.geostat.ge/en/modules/categories/630/strategy-for-the-development-of-statistics).

# Chapter 1. Energy security

## Resource endowment

Hydro resources are one of the most important natural riches in Georgia. Approximately 300 rivers are significant for energy production, with total annual potential capacity of 15 000 MW and production potential of 50 TWh. According to the Georgian State Electrosystem (GSE) Ten Year Network Development Plan 2019-2029, only 22.1% (3 323 MW) are used for hydropower.<sup>10</sup>

Georgia's wind energy potential is estimated at 4 TWh (1 500 MW); the country can be divided into high, mean and low speed zones where the wind speed fluctuates from 2.5 metres per second (m/s) to 9 m/s. The most favourable places for wind farms are being identified over the entire territory.

Solar energy potential in Georgia is high, with annual solar irradiance ranging from 250 to 280 days, amounting to 1 900 hours to 2 200 hours. Solar irradiance in Georgia varies between 1 250 kWh/m<sup>2</sup> and 1 800 kWh/m<sup>2</sup> annually, and total solar energy potential is estimated at 108 MW. Household solar water heating systems have been installed in rural areas, where solar energy warms water to 40°C to 50°C.<sup>11</sup>

Georgia's geothermal water stock is estimated at 200 mcm to 250 mcm annually. Temperatures range from 30°C to 110°C, and the total debit is 160 000 m<sup>3</sup> per day. More than 80% of geothermal deposits are in western Georgia and the Zugdidi-Tsaishi geothermal field, as well as in Abkhazia. However, the relatively low temperature of geothermal waters does not, allow for generation of electricity.

Economically viable reserves of crude oil were estimated at 5 Mt in 2012 with resources of 50 Mt, and natural gas reserves at 8 bcm with 102 bcm of resources. Hard coal reserves were 201 Mt in the same year, with 700 Mt of brown coal resources.

## Energy security and diversification

Georgia's energy policy is to raise the country's energy security, guaranteeing an uninterrupted supply of various energy products of acceptable quantity, quality and price to support national interests.

<sup>10</sup> [https://gse.com.ge/sw/static/file/TYNNDP\\_GE-2021-2031\\_ENG\\_NEW.pdf](https://gse.com.ge/sw/static/file/TYNNDP_GE-2021-2031_ENG_NEW.pdf)

<sup>11</sup> [http://energy.gov.ge/investor.php?id\\_pages=21&lang=geo](http://energy.gov.ge/investor.php?id_pages=21&lang=geo)

As a net oil and gas importer, Georgia relies heavily on imports of natural gas, oil products and hard coal to meet most of its energy needs; in fact, net imports in total primary energy supply rose from 47% in 2002 to 80.2% in 2019 to meet rising energy demand. After the contrived energy crisis in 2006 the country began reducing energy imports from the Russian Federation (hereafter, “Russia”) and increasing those from Azerbaijan, and 93.4% of natural gas and about 45% of oil consumption is now imported from Azerbaijan. Gas imports are highest during the winter months when there is a greater need for heating and less hydropower capacity is available for electricity generation.

Interconnected with Russia, Azerbaijan, Armenia and Turkey, Georgia exports its seasonal excess of electricity from hydropower. Although Georgia has had a growing negative net balance of electricity since 2012 (the exception is 2016), it still exports the small amount of excess electricity in the summer months. The main growth comes from uncontrolled consumption in the breakaway occupied region of Abkhazia. Despite the Covid-19 pandemic, consumption rose by almost 24% year over year. Since 2016, Azerbaijan has been transiting its electricity to Turkey via Georgia.

Because of the substantial rise in domestic energy demand and the seasonality of hydropower generation, the Georgian government is exploring avenues to diversify oil and natural gas supply sources at the same time as promoting further hydropower development. It is also co-operating closely with neighbouring economies to develop projects for transiting energy through Georgia to secure additional natural gas supply sources.

Crucial to its energy security, Georgia is developing underground gas storage with an active gas volume capacity of 210 mcm to 280 mcm (total volume 400 mcm to 500 mcm). In addition to holding strategic volumes of gas stocks, the storage facility will be used to regulate seasonal imbalances in supply and consumption. The feasibility study and respective predesign documents have already been prepared for the project, although, due to the Covid pandemic, the project has been delayed for an unspecified time.

Fuelwood used to be the main source of space heating in rural areas. Most wood for fuel is harvested unsustainably and used inefficiently, which has led to forest depletion and related environmental problems. The government has conducted a gasification programme that allowed a significant number of rural households to switch to gas. However, fuelwood still accounts for 22.4% of energy produced from domestic sources. To avoid energy poverty in rural regions and satisfy the population’s heating needs, it is essential that energy be used more efficiently, and that fuelwood be supplemented or replaced further by alternatives such as gas, upgraded modern biofuels made from waste biomass, and other fuels.

# Energy infrastructure and investment

## Electricity and heat

### Electricity generation

Hydropower plants (HPPs) provided 73.9% of Georgia's electricity, with natural gas combustion generating 25.2% and wind power generating about 1% in 2019. The 1 300 MW Enguri large hydro facility is the backbone of the country's electricity generation system. Other medium and small hydro facilities totalling 2 023 MW (2019) also provide domestic power, either on a regular basis or seasonally. Because Georgia's main long-term policy objective is to satisfy the country's overall demand for electricity with domestic hydro resources, in addition to tendering many new large HPPs the MoESD has sought foreign investments to develop new small and medium-sized HPPs.

The Georgian government plans to facilitate further development of smaller renewable sources, especially micro hydropower plants and solar power systems. Under the Electricity Supply and Consumption Rules, the Georgian Energy and Water Regulatory Commission (GNERC) has ensured micro power plants free access to the network and established fixed tariffs for electricity produced by those plants (Resolution No. 20, Amendment to Electricity Supply and Consumption Rules). Important steps were also taken in 2015 when GNERC developed a legal framework for net metering.

By the beginning of 2021, 52 HPPs (total 1 384 MW capacity) were at the licensing and construction stage; feasibility studies were in progress for 101 HPPs (total 1 063.3 MW).

Enguri HPP was closed for three months in 2021 when the derivation pressure tunnel was rehabilitated to prevent water leakages. According to the estimates, annual electricity generation should increase by 250 GWh.<sup>12</sup>

In 2016, the first wind power plant, Qartli Wind Farm, with installed capacity of 20.7 MW and annual generation of 88 GWh, was commissioned in the Shida Kartli region of the Gori and Kareli municipalities. Qartli Wind Farm, developed by the Georgian Energy Development Fund and the Georgian Oil and Gas Corporation, was privatised by Georgia Capital for USD 14.4 million in 2019.

---

<sup>12</sup> <https://bit.ly/3a4ObDa>.

There are six operational thermal power plants in Georgia: Mtkvari Energy (300 MW), two units at Tbilisresi (130 MW and 140 MW), G-Power Gas Turbine station (110 MW), and Gardabani 1 and 2 combined-cycle power plants (230 MW each).

## Transmission and distribution

The GSE is the single transmission system operator in Georgia operating the 500/220/110 kV grid. State-owned GSE owns transmission assets of 3 550 km of 220 kV, 110 kV and 35 kV overhead lines; 93 substations with total installed capacity of 8 400 MW; 3 500 kV substations and 17 220 kV substations throughout the territory of Georgia. Two companies carry out electricity distribution activities. JSC Telasi serves Tbilisi, which consumed approximately 2.6 billion kWh in 2020. The company has more than 650 000 consumers; customer services and network maintenance and operations are carried out from ten business centres situated in all administrative districts of the city. The total length of electric power grids in the capital is 5 886.9 km, including 2 316.1 km of overhead transmission lines and 3 570.8 km of underground cable lines. There are also 40 step-down and distribution substations with total installed capacity of 1 698.6 MVA, and 2 061 transformer substations of 6-10/0.4 kV.<sup>13</sup>

JSC Energo-Pro Georgia is the largest private owner of distribution assets. It covers annual power consumption of approximately 4.51 billion kWh (as of 2020), and its service area extends over 58 846 km<sup>2</sup> (84% of the Georgian land base) with total customers exceeding 1.2 million. It owns a 35 kV-to-110 kV high-voltage electricity grid, high-voltage 110 kV and 35 kV substations, and 6-10/0.4 kV transformers. Energo-Pro Georgia manages and maintains 15 small and medium-sized HPPs with total capacity of 469.25 MW and 1 gas turbine power plant with total capacity 110 MW. In August 2017, the company purchased Kakheti Energy Distribution Company.<sup>14</sup>

From 1 July 2021, JSC Telasi and JSC Energo-Pro have unbundled their activities. Telmico and JSC EP Georgia Supply were established to supply the electricity under public service obligation in their respective areas. The parent companies continue to carry out electricity distribution operations.

- According to the Ten Year Network Development Plan, Georgia's cross-border infrastructure for 2031 will include:
  - with Russia: 500 kV, 220 kV and 110 kV lines; 1 600 MW capacity
  - with Azerbaijan: 500 kV and 330 kV lines; 1 400 MW capacity
  - with Armenia: 220 kV lines; 700 MW capacity

<sup>13</sup> [www.telasi.ge/ge/about/activities](http://www.telasi.ge/ge/about/activities).

<sup>14</sup> [www.energo-pro.ge/en/company/](http://www.energo-pro.ge/en/company/).

- with Turkey: 500 kV, 400 kV and 220 kV lines; 1 400 MW capacity.

The Black Sea Transmission Network Project, commissioned in 2013 and connecting Georgia and Turkey via the Black Sea, includes a 700 MW back-to-back direct-current interconnection, 500 kV transmission lines to Vardzia and Zekari, a 400 kV interconnection line to Meskheti, and the 500 kV/400 kV/220 kV substation at Akhaltsikhe.

Cross-border electricity trade, electricity demand growth and anticipated seasonal energy exports require transmission infrastructure investments and further development of the network. In its capacity as transmission system operator, GSE developed a Ten-Year Transmission Grid Development Plan up to 2026 to meet emerging demand, incorporate new generation capacity and achieve even higher reliability standards. Projects to be completed by GSE during 2021-2031 are:

- Jvari-Khorga Project
- Batumi-Akhaltsikhe Project
- Ksani-Stepantsminda-Mozdok Project
- Marneuli-Ayrum Project
- Rehabilitation of 220 kV OHL Kolkhida-1 Project
- Jvari-Tskhaltubo-Akhaltsikhe Project
- North Ring-Tskaltubo Project
- Guria Project
- Akhaltsikhe-Tortum Project
- Batumi-Muratli Project
- Namakhvani-Tskaltubo Project
- rehabilitation of 500 kV overhead line (OHL) Imereti Project
- renovation of substations project
- reinforcement of Kakheti infrastructure project
- reactive power source (capacitor banks) project
- security of supply of Tbilisi region project
- rehabilitation of 220 kV OHL Navtlugi-CCGT-Gardabani (Navtlugi 1, 2) and construction second circuit of 220 kV backbone Zestafoni-Ksani Project
- construction of second circuit of 330 kV OHL Gardabani-Agstafa project
- Georgia-Russia-Azerbaijan power system connection project (feasibility study)
- Georgia-Romania Black Sea (submarine) interconnection cable project (feasibility study).

## Oil and natural gas

Georgia has gas pipeline connections with Armenia, Azerbaijan, Russia and Turkey, and oil connections with Azerbaijan and Turkey as well as a Black Sea oil terminal in Supsa. It imports natural gas from Azerbaijan and Russia, and transits



gas from Russia to Armenia and from Azerbaijan to Turkey. Georgia's oil product imports come from Azerbaijan and Russia, and it transits crude oil from Azerbaijan to Turkey.

The Baku-Tbilisi-Ceyhan (BTC) pipeline transports crude oil from Azerbaijan via Georgia to Turkey's Mediterranean port of Ceyhan, and from there the oil is shipped by tanker to world markets. The BTC pipeline is 1 768 km long, with 443 km in Azerbaijan, 249 km in Georgia and 1 076 km in Turkey, and has been in operation since May 2005. It has ample free capacity and transports some Turkmen and Kazakh oil as well.

Operational since 1999, the Baku-Supsa Pipeline transports crude oil from offshore oilfields in the Caspian Sea (belonging to Azerbaijan) to Supsa, Georgia, on the Black Sea, where it continues to European markets via tankers. Of the pipeline's 829 km, 375 km are in Georgia, and it has a capacity of 145 000 bbl/day.

The Karadaghi-Tbilisi gas interconnection is the main pipeline for Georgia for the import of gas from the Azeri gas field, by the State Oil Company of Azerbaijan Republic. Its construction began in 1959, its diameter is 700 mm, and the Georgian section is 46 km long.

More gas imports reach Georgia from Azerbaijan by way of the South Caucasus Pipeline (SCP), which transports gas from the Shah Deniz field parallel to the route of the BTC crude oil pipeline from Azerbaijan through Georgia to Turkey. The SCP is 692 km long (442 km in Azerbaijan and 250 km in Georgia), 1 067 mm in diameter and has a capacity of 8 bcm.

In 2019, with completion of the second phase of Shah Deniz gas field development, SCP Expansion (SCPX), and Trans-Anatolian Natural Gas Pipeline and Trans-Adriatic Pipeline construction, additional gas started flowing to Turkey and then to European countries for a total volume of 16 bcm. To increase system transmission capacity to 24 bcm, a parallel gas pipeline and additional compressor plants (61 MW capacity each) were constructed in Georgia under the SCPX and commissioned in 2018.

Underground gas storage is one of the facilities crucial to Georgia's energy security, to provide seasonal balancing of supply and demand as well as compensate for possible supply interruptions. A 2016 feasibility study by the French company Geostock concludes that it is technically feasible to build an underground gas storage facility in the depleted Samgori Southern Arch oilfield and defines conditions for its commercial viability. The project is postponed for an unspecified time as the funding was diverted for the Covid-19 relief package.

Oil and gas exploration in Georgia is conducted by 11 investors under 23 production sharing agreements (PSAs). There are 338 active wells, and nearly 30 000 tonnes of oil and 10.2 mcm of gas were produced in 2020.

PSAs are executed in most of the country's oil and gas prospective land areas and the Black Sea shelf. Oil and gas operations in Georgia are carried out by the following contractor companies: oil company OMV Petrom S.A (Black Sea II licence block); Ninotsminda Oil Company Ltd (licence blocks XIE); Nazvrevi Oil Company Ltd (licence block XID); Martkopi Oil Company Ltd (licence block XIC); Frontera Eastern Georgia Ltd (licence block XII); West Gulf Petroleum Engineering Company Ltd (licence block V); Georgia Coalition Energy Ltd (licence blocks VIA, VIB); Georgia Oil and Gaz Ltd (licence blocks VIII, XIG, XIM, XIN, XIC Martkopi, XIC North Satskhenisi, XIV, IXA, XIK, XIL, XIA; XIH); Nautic AWT Energy Pte Limited (licence block VIIB); JSC Georgian Oil and Gas Corporation (licence block XIB South dome of Samgori); Block Energy (licence block XIF, XIC Norio-Satskhenisi, XIC satskhenisi, IX, XIB).

An open international tender has been announced for the licence block III. The tender ends on 1 March 2022.

Six investment companies are currently carrying out extraction work in Georgia: Ninotsminda Oil Company, Block Rustaveli Company Limited, Frontera Resources Georgia, Nautic AWT Energy Pte Limited, Block Energy, and Georgian Oil and Gas Corporation. Other companies are conducting exploration work only.

## System reliability

Reliability in both natural gas and electricity systems is improving. According to the MoESD there have been no major outages in recent years, owing to rehabilitation and refurbishment of gas and electricity networks. Outages and losses are reported to GNERC as part of licensing obligations and are measured by the standard System Average Interruption Duration Index and the System Average Interruption Frequency Index.

Electricity transmission network losses are around 2% and outages are rare. The collection rate is nearly 100% and there are minimal estimated commercial losses. The level of technical losses in the gas sector is about 0.5% in the transmission network; detection of losses is performed using the Global System for Mobile Communications and during regular field visits. Equipment for loss detection includes some advanced leak-detection technologies and leakage metering equipment.

## Emergency response

Emergency response is regulated by [the Law of Georgia on State of Emergency](#) (1997). [The Law on Energy and Water Supply](#) defines the state of emergency in electricity and gas sectors and conditions for the development of a national emergency management plan for the natural gas sector. The Ministry of Economy and Sustainable Development (MoESD) is responsible for developing strategies and action plans for a state of emergency in the electricity and natural gas sectors. The strategies are under development. The government of Georgia is authorised to approve the list of strategic priority facilities for provision of electricity in state of emergencies.

On 2 December 2020, the MoESD adopted [Security of Electricity Supply Rules \(SoS rules\)](#), incorporating main provisions of the Regulation (EU) 2019/941 on risk preparedness in the electricity sector; it includes three annexes:

- 1. Methodology of Identification of National Electricity Crisis Scenarios
- 2. Methodology of Seasonal and Short-Term Adequacy Assessments
- 3. Methodology of Medium and Long-Term Adequacy Assessment.

Pursuant to SoS rules, the ministry, in co-operation with the Inter-institutional Group for Energy Security), will establish a risk management plan. The SoS rules also define the content of the plan and conditions for electricity crisis management. The plan will be updated at least every four years.

Security of gas supply rules are under development. The MoESD developed the [Power Supply Security Report](#) and the [Oil Supply Security Report](#) in 2021. The natural gas supply security report is under development and will be published in March 2022.

The country consumes 3.5-4 times more natural gas in winter compared with summer and has no own means of balancing the demand and hedging the supply risks increased due to high strain on exporting countries and their systems. It is planned to construct about 400 mcm to 500 mcm of gas storage, and development of an underground gas storage facility at Samgori is under way. However, due to the Covid-19 pandemic, construction was delayed for several years. The technical parameters of the gas storage will comply with the European Energy Union 994/2010 Regulation (on security measures for gas supply).

As an Energy Community member state, Georgia must fulfil the requirements of the EU Acquis on oil – Directive 2009/119/EC – imposing an obligation on member states to maintain minimum stocks of crude oil and/or petroleum products. The implementation deadline is 1 January 2023.

The draft law on maintaining the mandatory stocks of crude oil and oil products establishes rules for the creation, management and use of mandatory reserves to ensure continuous supply of petroleum products. The required volume of supplies is calculated for at least 90 days of average daily imports or 61 days of consumption — whichever is higher, by the following products: motor gasoline, jet fuel, kerosene, diesel fuel, light fuel and heavy fuel oil.

The State Agency of Oil and Gas is defined as the Central Stockholding Entity. The emergency stockholding obligation will apply to any economic operator that imports crude oil or oil products and bituminous minerals on a commercial basis or produces them in Georgia.

From 1 January 2023, every compulsory stockholder will be required to hold emergency stocks equal to 25% of their annual imports.

# Chapter 2. Market design

## National market structure

### Electricity

Georgia's electricity sector is partially deregulated and unbundled into generation, transmission, distribution and supply companies. Most generation and distribution assets are fully privatised.

The wholesale electricity market operates predominantly under bilateral contracts, while the state-owned Electricity Market Operator (ESCO) purchases and resells unsold power through bilateral contracts. ESCO is responsible for balancing and settlement according to market rules, and exports surplus power. About 80% of all electricity generated is sold through bilateral contracts and the rest through ESCO.

The Georgian Energy Exchange (GENEX) is a new electricity market operator jointly owned by the Georgian State Electrosystem (GSE) and ESCO, created as a platform for electricity and power trade between market participants. GENEX will ensure the operation of day-ahead, intraday and bilateral contracts markets and manage financial clearance system for these markets. The formation of market rules and the trading platform is still in process, with the opening planned for January 2022.

GSE is an electricity transmission system operator. The company owns and operates 3 550 km transmission lines and 93 substations all over the country. The transmission network is managed by the National Dispatch Center, and its technical maintenance is provided by the three regional networks (East, West and Kakheti). GSE also manages the cross-border transmission lines interconnecting with the neighbouring countries: Russia, Turkey, Armenia and Azerbaijan.

Two distribution system operators (DSOs) operate in Georgia:

Energo-Pro Georgia – owned by Energo-Pro (Czech company)

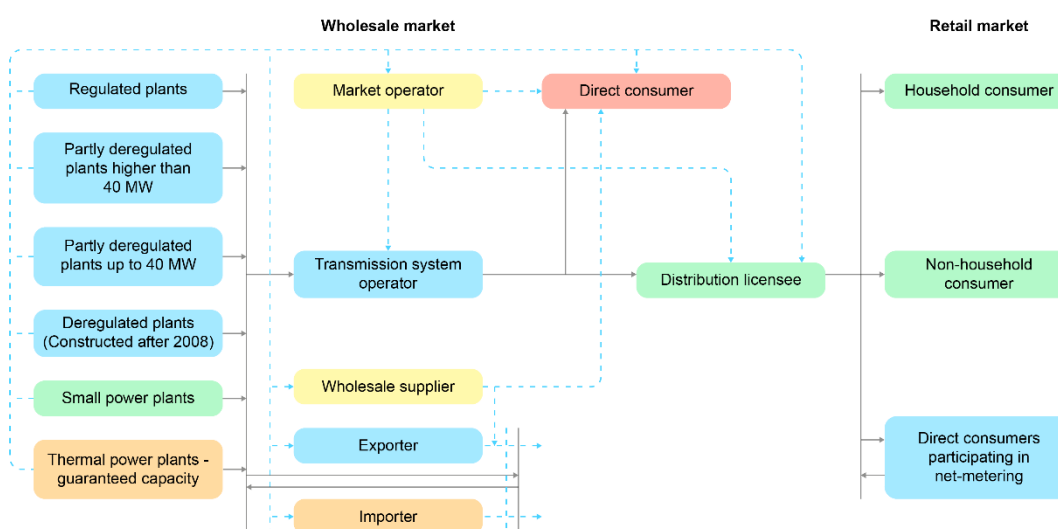
Telasi – 75% owned by Silk Road Holdings B.V. (and ultimately Russia's Inter-RAO) and almost 25% by Best Energy Group (Georgia).

Two suppliers, Telmico and JSC EP Georgia Supply, were unbundled and appointed as universal suppliers for the supply of electricity in their respective areas.

Electricity generators are regulated, partially regulated or deregulated. Regulated generators with Georgian Energy and Water Regulatory Commission (GNERC) tariffs are the state-owned Enguri and Vardnili hydropower plants (HPPs). Most other HPPs have tariff caps, while small HPPs (15 MW or less) and HPPs built after August 2008 are fully deregulated and can sell their electricity at competitive prices to ESCO or any other market participant.

The anticipated electricity market structure is given below:

### Expected Structure of Georgia's Electricity Market



Source: [GNERC annual report 2020](#).

## Oil

The Georgian Oil and Gas Corporation (GOGC) is owned by the state-owned Partnership Fund, which has transferred 100% of GOGC shares to the MoESD for oversight as well as management rights. The GOGC administers the state's share of oil produced under production sharing agreements (PSAs) and manages its processing, storage, transportation and sales. It owns the main gas pipeline system and contributes to unimpeded operation of transboundary oil and gas transportation systems on the territory of Georgia. The GOGC is participating in and implementing national and international projects to explore, transport and supply energy resources to ensure Georgia's energy security and provide transit. The GOGC funded construction and commissioning of two 231.2 MW combined-cycle gas turbine plants in 2015 and 2019, and a 20 MW wind farm in 2016.

The Georgian Gas Transportation Company (GGTC) is a gas TSO that ensures stable operation of the main gas pipeline system, increases its efficiency, and

promotes the uninterrupted and safe supply of natural gas. The company transports natural gas from Azerbaijan and supplies Georgian regional distribution companies. It also operates North South gas pipeline and delivers natural gas to Armenia. The GGTC is responsible for planning and developing the transmission system; designing and constructing new pipelines; and building, sustaining and operating necessary infrastructure.

The State Agency of Oil and Gas ([www.saog.gov.ge](http://www.saog.gov.ge)) is a legal entity of the MoESD. Under the Oil and Gas Law, it regulates oil and gas operations, oil and gas refineries, and transportation.

The [Association of Oil Product Importers and Distributors](#) was established in March 2004. Its main objective is to assist in creating flexible, simple and clear customs and tax codes for oil production, import and distribution. It is involved in aligning oil market legalisation with the Georgian constitution and other legislation, and co-operates with legislative and executive powers to prepare draft legislation. It also monitors available oil market information and conducts its own research. Private businesses carry out oil product import, storage and transportation.

Six investment companies are currently carrying out extraction work in Georgia: Ninotsminda Oil Company, Schlumberger Rustaveli Company Limited (Georgia), Frontera Resources Georgia, VPI Georgia Satskhenisi Georgia, Norio Khevi Georgia and GOGC. Seven other companies – GOG Limited, Elenito, Marexin, Georgia New Ventures Inc., Norio Oil Company, West Gulf Petroleum Engineering Company and Coalition Energy Limited Company – conduct exploration work only.<sup>15</sup>

## Gas

In the gas sector, the GOGC administers the state's share of gas obtained under PSAs and manages its preparation, storage, transportation and sale. The GOGC ensures the long-term sustainable development of the wholesale natural gas market to safeguard energy security. The GOGC has been unbundled from its ownership of the gas transmission system.

Ninotsminda Oil Company, a subsidiary of Blake Oil and Gas, extracts associated gas in the Ninotsminda oilfield, and Jindal Petroleum Georgia, an Indian company, extracts associated gas along with oil on the XI B licence block. The Romanian company Marexin is carrying out gas hydrate extraction on the Black Sea shelf, and American-owned Frontera Resources produces minor amounts of gas and has announced the discovery of huge gas reserves, although no progress or confirmation has yet followed.

---

<sup>15</sup> <http://gogc.ge/en/oil-production>.

Natural gas transmission, distribution and retail services are fully unbundled in Georgia. GOGC's subsidiary GGTC is the gas TSO, and the numerous gas DSOs are all private companies. The State Oil Company of Azerbaijan Republic (SOCAR) is the largest DSO with its two subsidiary companies (24.94% and 36.05% on a retail market) and distributes gas to Georgian regions. Tbilisi Energy is a largest DSO in Tbilisi with a share of 24.87% on a retail market. Many private companies are involved in gas retail. GGTC operates the main gas pipeline system, except the Georgian section of the South Caucasus Pipeline (SCP), which is operated by SOCAR.

GNERC determines licensing rules and conditions for natural gas transportation and distribution, and regulates the tariffs for natural gas transportation, distribution, pass-through, supply and consumption.

## Coal

Saknakshiri LLC owns and operates all coal mines in Georgia.<sup>16</sup> According to the issued licences, the proven reserves at Tkibuli mines is 331 Mt.

## Large hydro

In 2020, seven large HPPs used for seasonal regulation of electricity generated 36.5% of the country's total generation:<sup>2</sup>

- Engurhesi (1 300 MW) – state-owned
- Vardnilhesi 1 (220 MW) – state-owned
- Khrami 1 (113 MW) – owned by Inter-RAO
- Khrami 2 (110 MW) – owned by Inter-RAO
- Shaorhesi (40.3 MW) – owned by JSC Energo-Pro Georgia
- Dzevrulhesi (80 MW) – owned by JSC Energo-Pro Georgia
- Zhinvalhesi (130 MW) – owned by Georgian Water and Power Ltd.

## Renewable energy

The Division of Energy Efficiency and Renewable Energy Policy Promotion, as a structural unit of the Energy Reforms and International Relations Department at MoESD, is concerned with implementing state policies supporting renewable energy resource development and deployment of energy-efficient technologies.

In 2010, the Georgian Energy Development Fund (GEDF) was established by the government to realise the country's energy potential by mobilising funding to develop and implement projects. The fund identifies prospective renewable

<sup>16</sup> The final beneficiary of the company is Giorgi Chelidze.



energy projects and promotes their development through preliminary screenings, feasibility assessments and environmental impact assessments; it then finds investors and secures their interest in the projects.

LLC Qartli Wind Farm, a subsidiary of the GEDF and GOGC, constructed the first wind power plant, Qartli Wind Farm, with installed capacity of 20.7 MW and annual electricity generation of an all-time high of 90.8 GWh in 2020.

By the end of 2019, the Georgian parliament adopted the Law on Promotion of Energy from Renewable Sources. It promotes and encourages the use of renewable energy sources and sets the national targets for 2030. According to the law, the share of renewable fuels in all types of transport should be at least 10% of the total consumption in the transport sector. Also, the share of renewable energy should be 35% in total consumption in 2030 (29.5% in 2019). This target is, however, going to be revised down in the National Energy and Climate Action Plan under development, in view of reduced unsustainable use of biomass.

A market premium of USD 0.015/kWh was introduced in 2020 to provide potential renewable energy investors the effective tariff up to USD 0.055/kWh. The regulation on the net-metering system adopted in 2016 and revised in 2019 allows individual customers to connect microgeneration power plants up to 500 kW. According to GNERC, at the end of 2020 there were 243 prosumers with PV installations, with the total installed capacity of 3 848 kW.

## Energy efficiency

The MoESD and the Division of Energy Efficiency and Alternative Energy Resources are the key policy-making entities supporting development of energy-efficient technologies in Georgia.

The MoESD develops, implements and co-ordinates country-relevant sustainability actions; it also supports and co-ordinates energy efficiency in the industry, construction, transport and services sectors, and creates measures favouring a green economy.

In 2015-2016, the European Bank for Reconstruction and Development helped the Ministry of Energy prepare, draft, adopt and publish the country's first National Energy Efficiency Action Plan (NEEAP). The NEEAP identifies energy efficiency improvement measures and energy savings in the buildings, transport, power generation, industry and services sectors, based on the country's potential.

Law of Georgia on Energy Efficiency adopted on 25 May 2020 transposes the Directive 2012/27/EU on energy efficiency. The purpose of this law is to determine the legal basis for the measures required to promote and implement energy efficiency in the country and to implement an energy efficiency policy, and its

co-ordination, control, supervision and monitoring in the country. The establishment of the procedures for developing a national energy efficiency target and adopting energy efficiency action plan are also in the scope of this law.

The Law on Energy Performance of Buildings, adopted on 21 May 2020, transposes Directive 2010/31/EU on the energy performance of buildings. The purpose of the law is to promote the rational use of energy resources and to improve the energy efficiency of buildings, considering the external climate and local conditions of buildings, the demand for indoor climate conditions and cost-effectiveness.

The Law on Energy Labelling was adopted on 20 December 2019 by the parliament of Georgia. It transposes Regulation (EU) 2017/1369 on energy labelling and sets the framework for labelling of products using energy that are placed on the Georgian market or put into service. The labels should provide information about energy consumption, energy efficiency and other standard information about the product, which will help the customer to choose more efficient products and reduce energy consumption.

## Regulatory framework

The new Law on Energy and Water Supply was approved by the Georgian parliament in 2019. The law was developed in co-operation with the Energy Community and is in alignment with Energy Community membership-related requirements and the key EU principles. The law creates the legal framework to support development of a more independent, competitive and liquid market by unbundling and granting certification to transmission and distribution system operators.

In 2019-2020, the parliament approved the following laws: Law on Energy Efficiency, Law on Energy Efficiency of Buildings, Law on the Promotion of Production and Use of Energy from Renewable Sources, and Energy Labelling Law. However, for effective implementation of these laws a number of secondary pieces of legislation are needed. Secondary legislation will be developed in 2020-2021 period.

According to the energy efficiency law, the state policy envisages the creation of a legal framework for energy efficiency, the definition of a national energy efficiency target and the elimination of barriers that hinder energy efficiency development. On 23 December 2019, the government of Georgia approved the NEEAP 2019-2020 for the implementation of the energy efficiency policy by Decree N2680.

The National Renewable Energy Action Plan (NREAP) was adopted by the government in December 2019. The NREAP includes activities only for the period 2019-2021.

The MoESD is currently developing the integrated National Energy and Climate Plan (NECP) that is expected to be sent for approval by the middle of 2022. The NECP covers the following domains:

- energy security
- internal energy market
- energy efficiency
- decarbonisation and renewable energy sources
- research, innovation and competitiveness.

The targets for energy efficiency and renewable energy will be defined in the NECP and negotiated with the Energy Community.

The Law on Energy and Water Supply provides the legal basis for power-related secondary legislation, the main pieces of which are the Electricity Market Model Concept and the Electricity Market Rules. On 16 April 2020, the government of Georgia adopted the Electricity Market Model Concept by its Decree No. 246. Throughout 2020 several pieces of secondary legislation were adopted, mainly related to electricity trading on the GENEX platform.

The market concept introduces general principles for the organising and functioning of the wholesale trade market of electricity:

- competitive, transparent and free trade on the electricity markets
- avoidance of the conflict of interests and discrimination
- sale of electricity on the wholesale market by means of competitive market, particularly, by bilateral agreements and/or on organised electricity markets including day-ahead intraday and balancing markets
- trade of electricity only on the organised markets by public service provider energy enterprises and providers using the facilitation mechanism/scheme envisaged by the Law on Facilitation of Production and Use of Renewable Energy
- determining hourly schedules of generation and consumption, means of generation/consumption of electricity and their loading capacity by the responsible persons (self-dispatching)
- hourly trade on organised markets and, accordingly, liability of the market participants for the hourly imbalance
- purchase of electricity only on the day-ahead and intraday markets to reimburse the losses

- allocation of cross-border capacities in accordance with the transparent and fair rules.

In 2019 the first energy exchange was established in Georgia. GENEX is a neutral, unbiased and transparent organisation that acts as an operator of organised electricity markets. The exchange ensures introducing and operating day-ahead and daily markets through the software services of consulting company Nord Pool Consulting. Electricity Supply and Consumption Rules and the Electricity (Capacity) Market Rules (2006; amended 2010 and since) outline electricity and natural gas tariff methodology, and conditions for retail and power supply markets. In 2013 the government approved Resolution No. 214 on the Rule of Expression of Interest for Conduction of Technical and Economic Feasibility Study, Construction, Ownership and Operation of Hydropower Plants in Georgia.

The Law on Oil and Natural Gas (1999) has created a unified legal framework for state regulation, supervision, control and development of oil and gas resources and oil refining, gas processing and transportation, and for pursuing a unified national policy in these fields. It also defined the responsibility of the Oil and Gas Agency to regulate the subsector.

## Regional markets and interconnections

### Electricity

Georgia's electricity system is interconnected with those of Russia, Azerbaijan, Armenia and Turkey. ESCO has the authority to trade electricity with neighbouring countries to balance the needs of the Georgian market, and regional trade is arranged through bilateral agreements and memorandums of understanding. The TSO ensures operations with each neighbouring country and signs relevant agreements on technical issues.

In January 2012, an agreement on cross-border electricity trade using the Akhaltsikhe-Borcka interconnection was signed by Georgia and Turkey. The agreement sets out the competitive market trading rules and identifies the terms for managing electricity imports and exports on the line.

In 2015 the Khorga substation was completed under the Regional Power Transmission Enhancement Project funded by the Asian Development Bank, and the electricity transit corridor began operating from Russia to Armenia (daily average 30 MW) and from Azerbaijan to Turkey (daily average 80 MW). Energy transfer between Georgia and Turkey continues through the 700 MW high-voltage direct-current converter station and the related 500 kV and 400 kV lines.

In 2009, the Azerbaijan-Georgia-Turkey Power Bridge project was established by the TSOs of the three countries (AzerEnergy, GSE and TEIAS). The energy bridge became operational in 2015, and 813 million kWh of electricity were transited from Azerbaijan to Turkey in 2016. Existing and planned electricity interconnection lines are listed below.

### Power exchange capabilities with neighbouring power systems

Country	Cross-border line, conductor	Nominal voltage (kV)	Exchange	TTC summer, (MW)	TTC winter, (MW)	Mode
Russia	Kavkasioni AC-3x300	500	Export	570	650	S
			Import	570	650	S
	Stepantsminda (Ksani-Stepantsminda- Mozdok) AC-3x300, <sup>2025</sup>	500	Export	1 000	1 000	S
			Import	1 000	1 000	S
	Salkhino AC-400	220	Export	50	50	I
			Import	150	150	I
Azerbaijan	Mukhranis Veli AC-3x300	500	Export	630	710	S
			Import	630	710	S
	Gardabani <sup>2022</sup> AC-480	330	Export	630	710	S
			Import	630	710	S
Armenia	Alaverdi AC-300	220	Export	150 / 100	150 / 100	S / I
			Import	150 / 100	150 / 100	S / I
	Marneuli (Marneuli-Ayrum) AC-3x330, <sup>2025</sup>	400	Export	700	700	B
			Import	700	700	B
Turkey	Meskhети AC-3x500	400	Export	1050	1050	B
	Tao (Akhalsikhe- Tortum) AC-3x500, <sup>2024</sup>		Import			
	Batumi-Muratli <sup>2030</sup>	154	Export	350	350	B
			Import	350	350	B
	Adjara AC-400	220	Export	150 / 150	150 / 150	I / R
			Import	150 / 150	150 / 150	I / R

Note: TTC – total transfer capacity, S -synchronous mode, I-isolated mode, B-operation with Back-to-back station, R-in the reserve

Source: Ten-Year Electricity Network Development Plan of Georgia for 2021-2031.

## Natural gas

Georgia has gas pipeline connections with Armenia, Azerbaijan, Russia and Turkey; it imports natural gas from Azerbaijan and Russia and transits gas to Turkey and Armenia. The 1 200 mm and 700 mm North-South Gas Pipelines transport between 2 bcm and 2.4 bcm of natural gas from Russia to Armenia

annually. The 692 km SCP, now operated by a SOCAR subsidiary, transported about 6 bcm of natural gas from the Shah Deniz gas field and connects to the Turkish gas system in Erzurum; after expansion of the pipeline system the SCP Extension has the capacity to transport 16 bcm/year, of which 10 bcm will be delivered to Italy.

Cross-border agreements are bilateral, with suppliers in neighbouring countries, but Georgia is also focused on developments in the transit of gas from the Caspian Sea to European markets to diversify its imports and to collect transit revenue.

The oil pipelines passing through Georgia are directly connected to the terminals on the Black Sea coast and, through Turkey, to Mediterranean terminals and Southeast European countries, and are integral to planned oil and gas pipeline projects (Trans-Adriatic Pipeline, Trans-Anatolian Natural Gas Pipeline, White Stream and the Euro-Asian Oil Transportation Corridor) as well as to the Azerbaijan–Georgia–Romania Interconnector LNG project.

# Chapter 3. Sustainable development

## Renewable energy

To create an investor-friendly environment, the government offers greenfield projects based on the build-own-operate principle, attractive export markets, free third-party access to the grid, and an efficient legal and regulatory framework. Liberal tax legislation, double taxation avoidance agreements with Organisation for Economic Co-operation and Development (OECD) member countries, a rapidly expandable export market, simplified procedures, and a strong commitment to developing renewable energy sources also create a favourable business climate for potential investors.

Additionally, a new law on the Promotion of Energy Production and Use from Renewable Sources<sup>17</sup> was adopted in December 2019. The same year, the first National Renewable Action Plan (NREAP) was developed. The NREAP was developed in compliance with Renewable Energy Directive No. 2009/29/EC to define renewable energy targets and government actions for achieving them up to 2020. As the document was only approved in late 2019, it has missed the 2020 targets. The government aims to set the 2030 targets in the new National Energy and Climate Plan (NECP), which is currently being developed.

## Small hydro

Georgia has a hydro-dominated electricity generation system. At the end of 2020, seasonal and daily regulating hydropower plants (HPPs) with installed capacity of 2 381 MW, run-of-river HPPs with installed capacity of 942 MW and a single wind power plant with installed capacity of 20.7 MW were operating in Georgia. Renewable energy thus accounted for 73.7% of the country's total installed capacity and for 74.7% (8.3 TWh) of its electricity generation. In addition, during 2020, six small HPPs were commissioned with total installed capacity of 22.73 MW, and one combined-cycle gas turbine plant with installed capacity of 255 MW.

Under Georgian energy legislation, HPPs are considered small if they have a capacity of 1 MW to 15 MW. Many memorandums of understanding (MoUs) to develop small and medium-sized HPPs have been signed, but most of them have not reached financial closure and implementation. According to Electricity Market

<sup>17</sup> <https://matsne.gov.ge/ka/document/view/4737753?publication=0> (available in Georgian only).

Operator (ESCO), over 90 MoUs and 48 power purchase agreements had been signed as of September 2019. Several of these MoUs were signed before 2008, and they continue to be legally valid even if there has not been any progress in project development.

Georgia's electricity transmission system operator, the Georgian State Electrosystem (GSE), has estimated that the country's power system can integrate 333 MW of wind and 130 MW of solar capacity in 2020-2021 without any negative effects. These capacities can be increased to 1 332 MW (wind) and 520 MW (solar) if certain assumptions, restrictions and requirements are met.

## Solar and wind

In 2015, the Georgian National Energy and Water Supply Regulatory Commission (GNERC) passed a regulation introducing net metering for small-scale power plants (with installed capacity of less than 500 kW) owned by retail consumers. Customers who participate in this scheme are eligible to transfer excess capacity into the grid. Electricity generated above the self-consumption level can be injected into the grid and then resupplied upon request for self-consumption; otherwise, excess electricity can be sold to distribution companies at the weighted average purchase price.

### Projected system integration of variable renewables

	2020-2021	2030
Wind	333 kW	1 332 kW
Solar	130 kW	520 kW

In the middle of 2021 there were 316 installations of solar PV with total capacity of 10 MW. The Ministry of Infrastructure has also initiated and financed a GEL 2 million (Georgian lari) project to install autonomous micro-PV plants in mountainous, hard-to-reach, sparsely populated villages (according to the Ministry of Economy and Sustainable Development [MoESD]).

At the larger scale, the government formed two MoUs for solar power plants (SPPs). The first SPP will be built in Udabno village with a capacity of 5 MW and expected generation of 6.9 million kWh. The investment cost is USD 4.8 million. The second project is located in the Marneuli municipality, with total installed capacity of 68 MW and annual production of 87.9 MWh; initial investment cost is EUR 35.6 million. One 50 MW SPP project is on the finalisation stage.



There are 25 MoUs signed for wind power plant projects (WPPs) with total capacity of 1 219 MW and expected generation of 4.77 billion kWh. For 2025, up to 500 MW of wind power capacity is expected to be commissioned. .

A 20.7 MW WPP at Kartli was commissioned in 2016. The total cost of the facility was USD 29.7 million, with USD 22 million covered by a loan from the European Bank for Reconstruction and Development (EBRD) and the rest funded by the Georgian Energy Development Fund (GEDF) and the Georgian Oil and Gas Corporation (GOGC), the plant's stakeholders. In September 2019, the GOGC and GEDF announced a public auction to sell their 100% stake in this plant, and it has been sold for USD 14.4 million, with its gross debt of USD 17.4 million.

## Geothermal

Georgia has over 250 natural and artificially drilled geothermal sources grouped into 44 geothermal fields, most of which are in western Georgia. Geothermal water, used mainly for primitive household or agricultural (greenhouse) purposes, varies in temperature from 30°C to 110°C. The share of geothermal energy in the country's energy balance is very small.

The Energy Strategy 2020-2030 anticipates geothermal sector development, for instance through state and/or grant funding to use geothermal energy for heating and to supply hot water in municipal buildings (kindergartens, schools) within the Covenant of Mayors framework ([Georgia's in Depth Review, IEA, 2020](#)).

More than 80% of Georgia's geothermal water deposits are in western Georgia. In the Zugdidi-Tsaishi geothermal area, there are nine productive, seven reinjection and three observation borehole wells considered to be exploitable. In addition, two deposits are known to contain geothermal water, from which up to 30 000 m<sup>3</sup> could be obtained for reinjection twice a day. Poti, Georgia's main port city, could be supplied with geothermal water through the Kvaloni and Menjisi water deposits.

## Biomass

Fuelwood makes up 25% of domestic primary energy supply; households in Georgia's rural areas consume wood for heating. Georgia currently has a "social cuts" mechanism whereby the population is allowed to cut trees within a certain volume quota allocated by the Forestry Agency. Implementing this policy is challenging, however, because of safety concerns and the agency's inability to strictly monitor illegal cutting. Annual fuelwood consumption is around 1.3 million m<sup>3</sup>, which is a dramatic reduction from previous consumption, but still abuses the sustainability of use in volumes as well as the form of harvesting. A considerable amount of residual biomass (up to 35%) remains in the forest after trees have been cut. A draft strategy for upgraded solid biofuel has been

developed to support sustainable utilisation of accumulated biomass residue; however, the document has not been adopted. In addition to the problem of deforestation, the use of wood for heating in inefficient stoves results in poor energy efficiency and poses a health hazard.

More than 20 years of constant pressure and over-exploitation have led to critical degradation of forests, resulting in the loss of biodiversity, soil erosion and landslides, flash floods, loss of springs, and other adverse effects.

## Waste

Georgia does not use waste in power and heat generation. Waste management legislation to encourage the collection of biological waste and its use for energy purposes is therefore needed. The old landfill in the Autonomous Republic of Adjara is going to be closed and remediated. A new modern landfill in adherence to EU requirements will be constructed. There are plans to introduce a landfill gas capturing facility and use this gas for energy purposes. However, construction on the project has not been started yet.

## Energy efficiency

In 2017 the Ministry of Energy, with the support of the EBRD, completed Georgia's first National Energy Efficiency Action Plan (NEEAP) identifying significant energy efficiency measures and anticipated energy savings in various sectors. The NEEAP was adopted in 2019. Additionally, the government is implementing Energy Efficiency and Energy Performance of Buildings EU directives. In spring 2020, the Law on Energy Efficiency and the Law on Energy Efficiency in Buildings were adopted by the parliament. The development of secondary legislation has started. The Law on Energy Labelling was also adopted in 2019.

The Law on Energy Efficiency, prepared according to the EU Energy Efficiency Directive No. 2012/27/EU, aims to establish a common framework to promote and implement energy efficiency within the country, to improve energy savings, increase energy supply security, enhance energy independence, and remove barriers to energy efficiency development.

The Law on Energy Efficiency of Buildings was prepared according to EU Energy Performance of Buildings Directive No. 2010/31/EU. Several secondary acts have already been drafted, but have not yet been finalised. These secondary acts will set buildings sector regulations to ensure the improved energy efficiency of existing and new buildings. They also introduce minimum energy performance standards and mandate the methodology for calculating the energy performance of buildings, establishing the energy performance certification and the inspection of heating and cooling equipment.

The NECP describes energy savings potential using business-as-usual development as a reference scenario. The energy efficiency targets were developed using the TIMES energy system model for Georgia. As it is now well into 2021, the government is focused on developing a new National Integrated Energy and Climate Action Plan with the targets until 2030. The NECP's energy efficiency section is largely based on the measures defined by the NEEAP.

## Fuel switching

Despite the general trend towards hydropower development, there is no formalised strategy for switching away from fossil fuels. In fact, a 230 MW combined-cycle gas turbine plant was constructed and commissioned in 2015, and a 250 MW one built and commissioned in 2020.

## Environmental protection

Environmental concerns relating to HPP development and construction of high-voltage transmission lines in the mountains of Georgia have yet to be addressed.

Georgia's membership in the Energy Community requires that it transposes the following directives into national legislation:

- Directive 2010/75/EU of 24 November 2010 on industrial emissions
- Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage
- Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants
- Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment
- Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC
- Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment
- Article 4(2) of Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds.

The third National Environmental Action Plan 2017-2021 was approved by government decree on 22 May 2018. It focuses on various environmental issues such as biodiversity, air quality, and water, soil and forest management. At the same time, it acknowledges the importance of climate change and highlights the links between environmental and climate change policies – particularly for air pollution, as most measures that aim to reduce it are also expected to curtail GHG emissions. Similarly, Georgia's Law on Environmental Protection (1996) and its

Law on Ambient Air Protection (1999) acknowledge the significance of GHG emissions and the need to mitigate them.

## Climate change

In 1994, Georgia acceded to the UN Framework Convention on Climate Change (UNFCCC), and on 21 February 2017, the government of Georgia approved the Paris Agreement. In April 2021, Georgia published its [updated nationally determined contribution](#) (NDC) document, setting more ambitious objectives and targets compared with the previous NDC. The updated NDC aims to support sustainable development of the country and defines the following targets:

- Unconditional limiting target of 35% below the 1990 level of its national GHG emissions by 2030 (business-as-usual scenario).
- In the case of international support, Georgia is committed to a target of 50% below the 1990 level by 2030 if the world follows the scenario holding the average global temperature increase to 2°C.
- If the world follows the 1.5°C average global temperature growth scenario, Georgia will target a reduction of 57% compared with the 1990 level by 2030.

Georgia's updated NDC is accompanied by the 2030 [Climate Change Strategy and Action Plan](#) to identify mitigation measures that facilitate unconditional and conditional commitments and mitigation targets in the following sectors: transport, buildings, energy generation and transmission, agriculture, industry, waste management, and forestry. The NDC document needs to be updated every five years. Each time, the country should set itself more ambitious goals and targets.

The current Climate Change Strategy and Action Plan provides the following targets by sector:

- reducing GHG emissions by 15% in the transport sector by 2030 compared with the baseline scenario
- promoting low-emission approaches in the buildings sector
- decreasing GHG emissions by 15% in the energy generation and transmission sector by 2030 compared with the baseline scenario
- encouraging low-emission approaches in the agriculture sector
- reducing GHG emissions by 5% in the industry sector by 2030 compared with the baseline scenario
- supporting low-emission approaches in the waste management sector
- increasing carbon capture capacity of forests by 10%.

Although Georgia has not yet developed the national adaptation plan, it has identified several adaptation objectives and needs of vulnerability assessments in the updated NDC:

- Assess the impact of climate change on coastline, glaciers, forest lands, mountain ecosystems and ecosystem services.
- Assess the impact of climate change on the availability of groundwater and surface water resources for sustainable use in different economic sectors.
- Assess and strengthen adaptive capacities for agricultural production to ensure food security.
- Assess the effects of climate change on human health and take measures to mitigate the damage caused by extreme weather events.
- Strengthen adaptive capacity of the most vulnerable winter and coastal resorts.

As part of the EU4Climate project funded by the European Union, Georgia started developing the Long-Term Low Emission Development Strategy document in 2020. The strategy intends to promote the goals and policies of the Paris Agreement and to ensure low-emission and climate-friendly development for the period 2020-2050.

The EU-Georgia Association Agreement which entered into force in 2016 defines the climate change-related collaboration. The agreement emphasises the co-operation in the process of transferring the technologies based on the Low Emission Development Strategies, Nationally Appropriate Mitigation Action and Technology Needs Assessment.

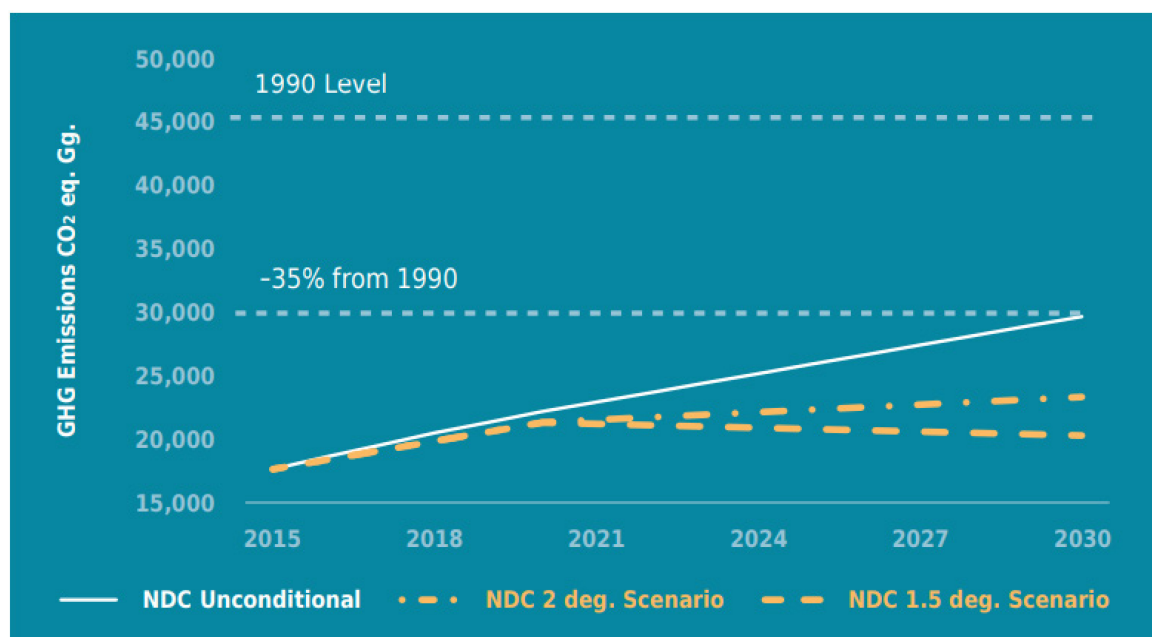
In 2017, GHG emissions (CO<sub>2</sub>, methane, nitrous oxide) from the energy sector amounted to 10 726 Gg of CO<sub>2</sub> equivalent, which is about 60% of Georgia's total GHG emissions (excluding land use, land-use change and forestry).<sup>18</sup> In 2017, the following source categories had the largest shares in the total GHG emissions from the energy sector: transport – 39%, other sectors – 24%, oil and natural gas – 13%, energy industries – 14%, manufacturing industries and construction – 9%. Compared with 1990, the total GHG emissions from the energy sector had decreased by 71%.

Climate change policy planning in Georgia is implemented also at municipal and city level. Twenty-four Georgian cities and municipalities joined the Covenant of Mayors initiative, committed to achieve 20% reduction of GHG emissions by 2020 and 40% reduction of GHG emissions by 2030 compared with the 1990 level.

---

<sup>18</sup> National GHG Inventory Report of Georgia 1990-2017, published in 2021: <https://unfccc.int/sites/default/files/resource/NIR%20%20Eng%2030.03.pdf>

## Georgia's Nationally Determined Contribution Targets



Source: Georgia's Updated Nationally Determined Contribution (NDC).

## Technology research, development and deployment

The Law of Georgia on Science, Technologies and Their Development recognises the development of science and research as a part of country's socio-economic policy. One of the goals of the state research and development policy is "to set priorities for certain fields of science based on the forecasts of socio-economic development of Georgia." Currently there are no officially defined research and innovation priority areas and no special energy-related RD&D provisions in the Development Strategy or in any strategic document related to science and innovation. However, recent reforms have increased the support for RD&D in general. The key institutions providing funding are the Shota Rustaveli National Science Foundation (SRNSF), which supports projects at the initial stages of development, and Georgia's Innovation and Technology Agency (GITA), which finances globally scalable start-up projects.

Management of the Georgian science, technology and innovation system is regulated by several laws:

- the Law on Science, Technology and Their Development (1994)
- the Law on Grants (1996)
- the Law on Higher Education (2004)
- the Law on Education Quality Improvement (2010)
- the Law on Innovations (2016).

Policy directions and strategic decisions are made by parliament and government in consultation with academic and scientific research committees composed of relevant government and business representatives. Policy is prepared and implemented by the ministries: the Ministry of Education, Science, Culture and Sport of Georgia (MES) implements the policy of research and science development, while the MoESD and GITA, a legal entity under public law, in particular is responsible for the implementation of the innovation development policy.

No specific institution has been appointed to support energy RD&D, so energy-related research and innovation (R&I) projects are implemented within the general RD&D framework.

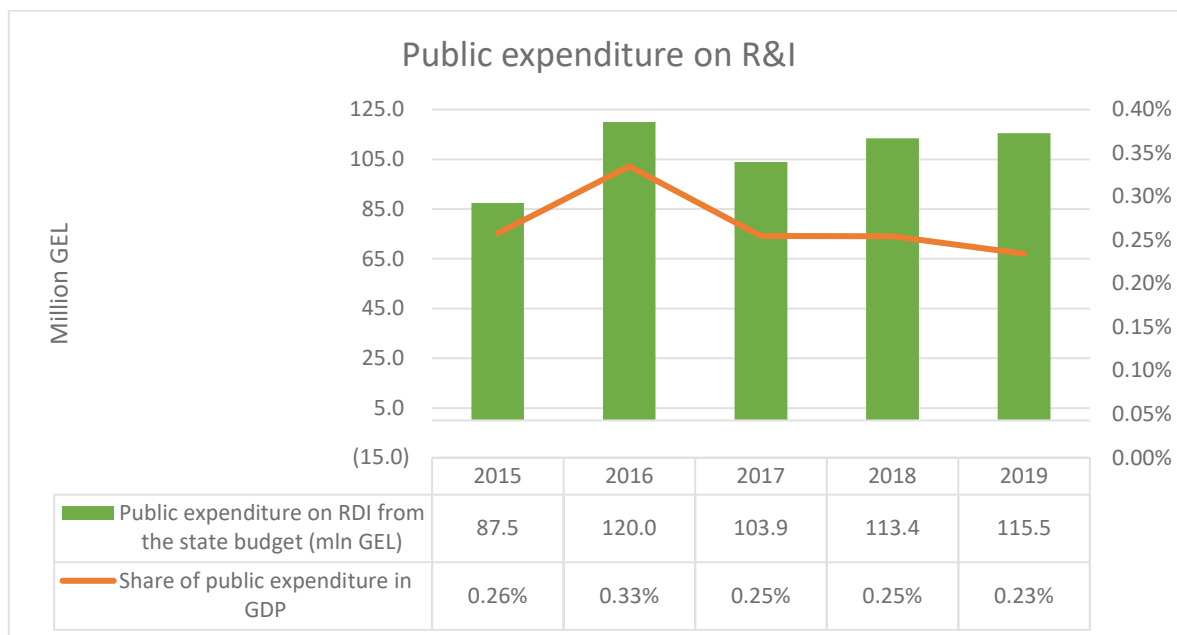
Energy-related research and innovation (R&I) projects are mainly financed by international programmes or donors. This is especially relevant for applied research projects. The share of national funding in energy R&I is quite small. At the same time, some energy companies are actively involved in international co-operation on expertise sharing. For instance, GSE is a member of CIGRE<sup>19</sup>. A National Committee of CIGRE has been established in Georgia at the initiative and under the guidance of GSE.

The figure below shows the dynamics of public spending on R&I in 2015-2019; however, energy and climate research expenditures cannot be singled out. Expenditures on R&I in Georgia mainly consist of public and private spending. In 2018, the private sector spent GEL 600 000 on R&I; in 2019, GEL 1 181 000. It is difficult to evaluate private-sector spending on R&I because reliable data and statistics are lacking. However, based on the experts' estimates and scarce data that are available, private spending on R&I is very low. There is some international funding as well, but it is attracted in an ad hoc manner.

---

<sup>19</sup> CIGRE is a global community committed to the collaborative development and sharing of power system expertise. The community features thousands of professionals from over 90 countries and 1 250 member organisations, including some of the world's leading experts. At its heart are CIGRE's 59 in-country National Committees offering diverse technical perspectives and expertise from every corner of the globe: [www.cigre.org](http://www.cigre.org).

## Georgia's government spending on R&I



Source: [Geostat](#) and [State Treasury](#).

The gross domestic expenditure on R&D (GERD) indicator that includes private and public spending was 0.3% of GDP (World Bank data), which is much lower than the average in the European Union (2%). Apart from the total volume of spending, the structure of expenditures is also very different in Georgia. While in the European Union only one-third of all spending on R&D comes from the government, in Georgia public spending makes up more than 90% of the total spending. The share of private spending is very low.

During 2012-2016, Georgia spent GEL 1.39 million on energy-related R&I. These data include information gathered from SRNSF and GITA. Almost 50% of the funding was used for R&I of renewable energy sources.

Public funding for RD&D in Georgia comes from several sources, and priority-setting and decision making on funding is decentralised. Project-based funding comes from the SRNSF, GITA and Enterprise Georgia, and funding for research institutes comes mainly from the MES.

The MES allocates funding to the universities, which then decide how to redistribute the money to the research units/institutes. The SRNSF also provides resources for maintaining and upgrading research facilities and infrastructure. In practice, there is no baseline funding for research in Georgia since MES allocations are mostly used to cover researchers' salaries (even though salaries in research and science are well below the country's average wage, especially for early-stage researchers).

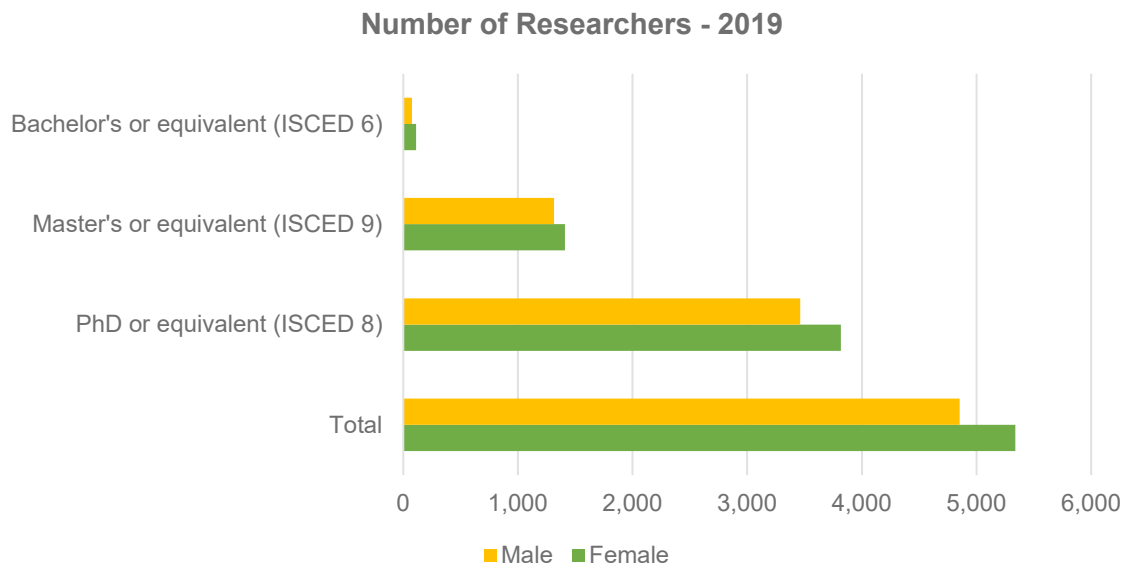


Georgia's MES signed an association agreement with the European Union's Research and Innovation framework programme Horizon 2020 (now Horizon Europe) in April 2016. Becoming an Associated Country means Georgian research organisations can participate in Horizon Europe's calls for projects with the same rights as organisations from EU member states. However, due to Georgia's lack of experience, the high level of competition, a lack of qualified research institutions and other country-specific reasons, the participation rate of Georgian organisations is quite low. For the whole period of Horizon 2020 (2014-2020), Georgia received EUR 358 630 for energy-related projects and EUR 207 000 for climate change mitigation-related projects. The general participation rate of Georgia is quite low, ranking 13th out of 16 Associated Countries. The total number of financed projects by Horizon 2020 for all thematic areas is just 50 for the six-year period with total EU contribution of EUR 7.03 million. As a Near Neighbour Country, Georgia is also eligible to participate in the European Cooperation in Science and Technology (COST) programme.

The government of Georgia, represented by the MES, is currently negotiating with the European Commission on maintaining the status of Associated Country for Georgia for the next framework programme Horizon Europe. The ministry has already appointed National Contact Points for respective clusters of Horizon Europe.

One of the reasons for the low number of energy research projects is the lack of qualified researchers and research institutes. Researchers in R&D per million of population in Georgia is 1 463 (2018, World Bank data) while the average EU indicator is 4 000 for the same period. In the energy sector, the deficit of qualified researchers and research organisations is higher than on a national level.

---

**Number of researchers**

Source: [Geostat](#).

---

The MoESD is currently developing an integrated NECP for 2021-2030. One of the domains in this plan is related to energy research, innovation and competitiveness. The plan will include the key challenges in the energy R&I field and policy measures for strengthening energy R&I in the country.

This publication has been produced with the financial assistance of the European Union and is part of the EU4Energy programme. This publication reflects the views of the International Energy Agency (IEA) Secretariat but does not necessarily reflect those of individual IEA member countries or the European Union. The IEA makes no representation or warranty, express or implied, in respect to the publication's contents (including its completeness or accuracy) and shall not be responsible for any use of, or reliance on, the publication.

EU4Energy is a collaboration between the IEA, the European Union, Focus Countries and other implementing parties, designed to support the aspirations of Focus Countries to implement sustainable energy policies and foster cooperative energy sector development at the regional level.

This publication and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

IEA. All rights reserved.

IEA Publications

International Energy Agency

Website: [www.iea.org](http://www.iea.org)

Contact information: [www.iea.org/about/contact](http://www.iea.org/about/contact)

Typeset in France by IEA - December 2021

Cover design: IEA