ENABLING PV in Georgia

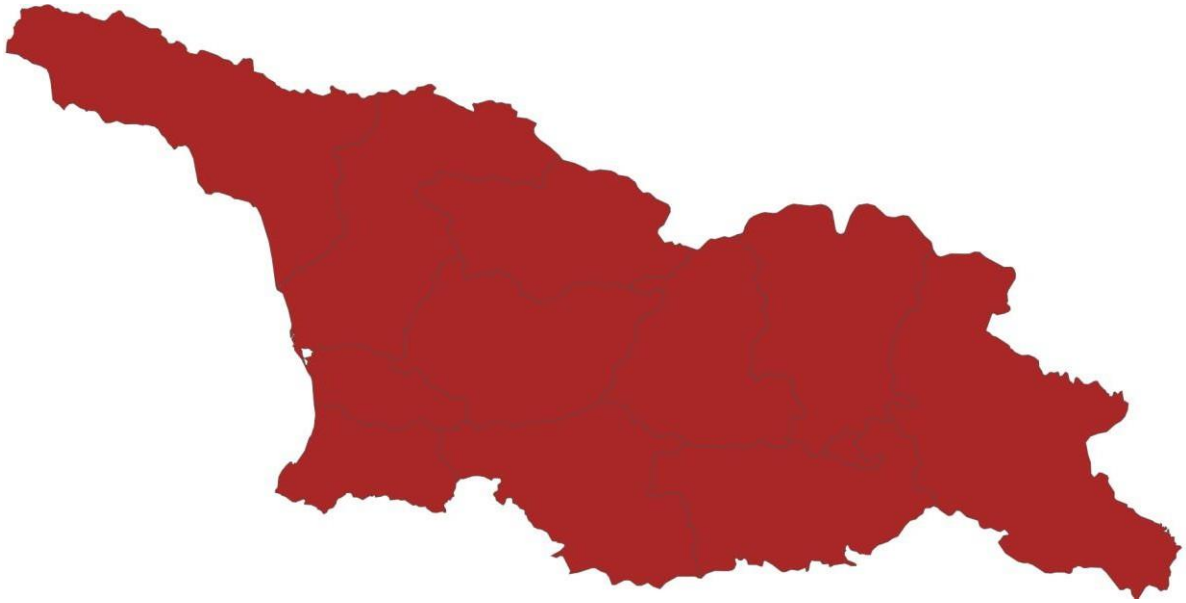

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Table of contents

List of Figures

List of Abbreviations

Acronym	Definition
“a”	Per Annum
ATS	Administrator of the Trade System
BM	Balancing Market
C	Celsius
CFD	Contract for Differences
CHPP	Combined Heat and Power Plant
DAM	Day-Ahead Market
DC	Direct Current
DSO	Distribution System Operator
EBRD	European Bank for Reconstruction and Development
ENIP	Energy Network Improvement Program
EPC	Engineering, Procurement, Construction
ESCO	Electricity System Commercial Operator
EU	European Union
EUR	Euro (currency)
FDI	Foreign Direct Investment
FIT	Feed-in Tariff
GDP	Gross Domestic Product
GEL	ISO-Code for the Georgian currency “Lari”
GEFF	Green Economy Financing Facility
GENEX	Georgian Energy Exchange
GGF	Green for Growth Fund
GIZ	German Corporation for International Cooperation GmbH
GNERC	Georgian National Energy and Water Supply Regulatory Commission
GSE	Georgian State Electrosystem
GTI	Global Tilted Irradiation
GWh	Gigawatt hours
HPP	Hydropower Plant

Acronym	Definition
KfW	Kreditanstalt für Wiederaufbau
kV	Kilovolts
kW(p)	Kilowatt (peak)
kWh	Kilowatt hours
m2	Square Meters
MW(p)	Megawatt (peak)
MWh	Megawatt hours
PP	Power Plant
PPA	Power Purchase Agreement
PSO	Public Service Obligation
PV	Photovoltaic
RE	Renewable Energy
SME	Small and Medium-Sized Enterprise
SPP	Solar Power Plant
TPP	Thermal Power Plant
TWh	Tera-Watt Hour
TSO	Transmission System Operator
USD	US-Dollar
V	Volt
VAT	Value Added Tax
WPP	Wind Power Plant
WPSO	Wholesale Public Service Organization
y/y	Year to year

Objectives of the ENABLING PV project

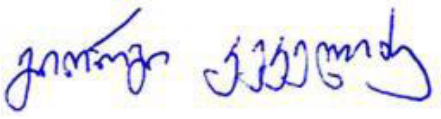
Solar photovoltaic (PV) is one of the fastest-growing sectors in the global energy industry, and it has been developing not only in advanced countries but also in other regions. A key driver of this growth is the increasing competitiveness of PV electricity due to continuous cost reductions, even in the face of supply chain disruptions in 2020-2022. The number of markets and business models operating in different countries has significantly expanded in recent years, with each project and the regulatory framework varying from one country to another.

It is in this context of the rapidly evolving international solar PV markets that the consulting company eclareon and the German Solar Association (BSW-Solar) initiated a joint research project in 2013, named "ENABLING PV". The aim is to promote the dissemination of those PV applications in foreign markets whose potential has not yet been fully exploited. To this end, we organise round tables in our partner countries that bring together local actors with German and local PV companies as well as with experts from science and education. As a basis for this, we provide the latest information on the potential applications of PV in the partner countries in our ENABLING PV studies. Based on this, pilot installations or training measures are discussed, planned and implemented together with local stakeholders.

The first ENABLING PV report on Georgia was released in 2020. This year, a study update was conducted reflecting the impressive changes in national policy and regulatory frameworks for solar energy that occurred during recent years. In the context of our cooperation with our partners in Georgia, it is essential to monitor these trends for German PV companies, provide support to market stakeholders from both countries and encourage an open and substantive dialogue among them.

We would like to thank Levan Tsulaia from EUROSOLAR Georgia for preparing this study update. We look forward to the next bilateral ENABLING PV round table which shall take place in Tbilisi in September 2024.

Berlin, 21 November 2023



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Executive Summary

Georgia covers most of its electricity needs from hydroelectric generation, thanks to its mountainous terrain and numerous rivers. Challenges with construction of new hydroelectric stations and increase in electricity consumption have made Georgia more dependent on import. In recent years, diversification strategies have been launched to increase the share of renewables in the energy mix and increase Georgian energy independence.

Despite favourable natural conditions for the deployment of PV, Georgia is still in the early stages of developing the renewable energies' sector. Georgia is committed to a target of reducing 50-57% of its total greenhouse gas emissions by 2030 as compared to 1990. One of the goals of this report is to identify economically viable business models that can enable the country to achieve this goal.

It is in this context, that the international consultancy company eclareon GmbH, which specializes in renewable energy and energy efficiency, with the support of the German Solar Industry Association (BSW-Solar), has analysed the current processes and possible barriers in the Georgian photovoltaic sector.

A fundamental aspect of the project is to provide the most significant and detailed information on the current state of the PV market in Georgia. All the information published in this report shall be used to support the development of the renewable energy sector in Georgia by both national energy sector participants and external stakeholders.

One of the main findings of this report is that small-scale PV stations up to 500 kW are already highly profitable in Georgia with hundreds of systems installed in recent years. Although, as of November 2023, there are currently no utility-scale PV stations in the country, the undergoing liberalization of the electricity market and favourable climate conditions might lead to a boom in PV investments in Georgia in the near future. Several schemes and support mechanisms have been introduced to further incentivize the development of utility-scale PV stations.

The report is structured as follows: Section 1 gives an overview of the energy market in Georgia, including key data on installed capacity, electricity consumption and demand, stakeholders as well as the structure of current and future energy markets. Section 2 sheds light on the regulatory and business framework of the Georgian electricity market. Section 3 outlines and discusses the current development of PV in Georgia, including training and educational opportunities in the PV sector and assesses opportunities on wholesale and net-metering markets.

1. Introduction to the Georgian Power Sector

1.1 Country Overview

Located at the eastern shore of the Black Sea, Georgia has historically played an important role in the Caucasus region. As part of the “Silk road” trading route, Georgia served as an an important economic and cultural knot between Asia and Europe for hundreds of years. Shortly after the Republic of Georgia was formed in 1918, the country became part of the Soviet Union in 1921. Independent since 1991, Georgia shares a border with Russia to the north, Turkey and Armenia to the south and Azerbaijan to the east [1]. The country stretches over a surface of 69,700 km^2 including the occupied territories of Abkhazia and the region of South Ossetia, and has a population of 3.7 million. The majority of the population (1.2 million) lives in the capital, Tbilisi [2][3].

Georgia, experiences a diverse climate due to its varied topography, which includes mountains, valleys, and a coastline along the Black Sea. Summers are humid and warm with average temperatures in July between +22C and +24C. The winters are mild with average temperatures in January between +4C and + 7C [4]. Along the coast of the Black Sea, the climate is mild and rainy, rainfall is abundant, it ranges from 1,500 mm to 2,500 mm, while in Eastern Georgia the rainfall amounts to 500 mm [5].

Figure 1: Map of Georgia

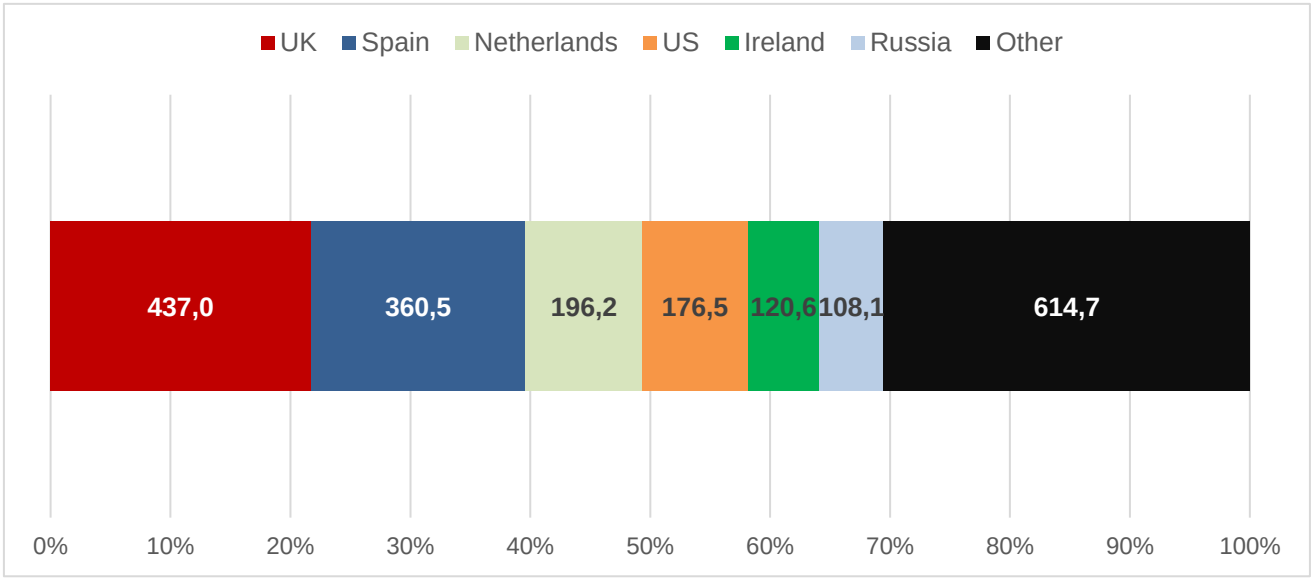
Source: Google maps, Georgia

Georgia is a free-market economy located at the crossroads of Europe and Asia. Georgia is considered a “moderately free” economy by 2023 index of economic freedom. Country is ranked 35th freest in the world and 21st out of 44 countries in the Europe region [6]. Georgian GDP (current prices) in 2022 amounts to USD 24.6 billion and is ranked 110th in the world [7]. Since the collapse of the Soviet Union, Georgia has lost 70% of GDP due to factors including civil war. In the last years, Georgia’s economy has suffered from several shocks, especially during the world financial crisis of 2008 and COVID pandemic. The country has since recovered and has a steadily growing economy with an annual GDP growth rate of 10% in

2021 and 2022 [15]. In 2023, GDP growth is estimated to reach 5.9% [8]. The Georgian economy is relatively well diversified, with the largest sectors of the economy being manufacturing, trade of motor vehicles, construction and real estate activities [8].

Foreign investments have doubled from 2012 to 2022, reaching USD 2.1 billion in 2022. Most foreign direct investments stem from the United Kingdom, Spain, the Netherlands and the United States. 26% of those investments were directed at financial and insurance activities, 17% at real estate activities and only 6% at the energy sector [9].

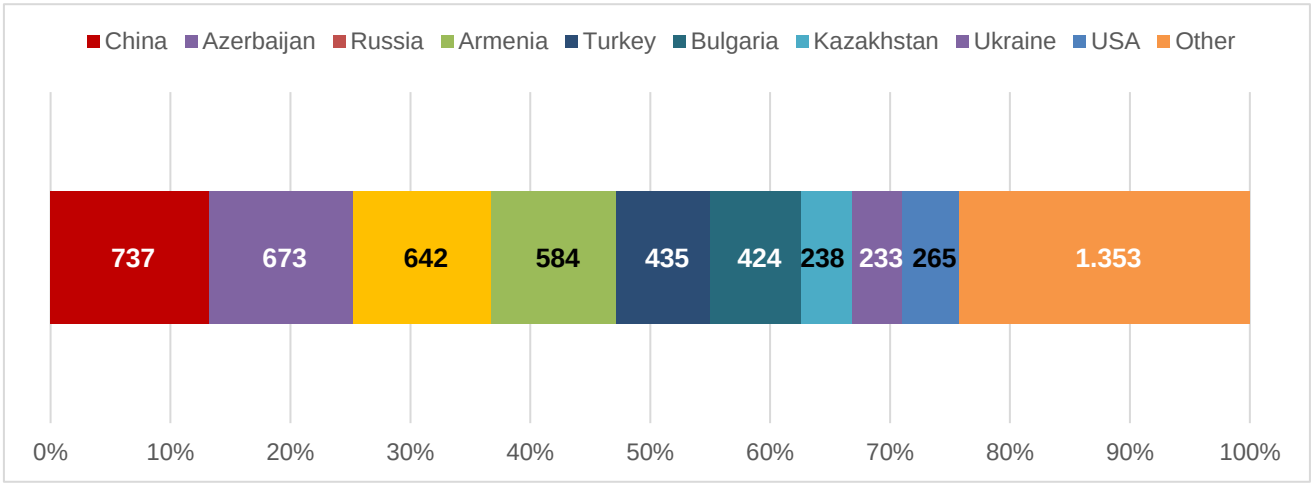
Figure 2: Foreign Direct Investment in Georgia by country in 2022 (in million USD)



Source: eclareon 2023; based on Geostat [9]

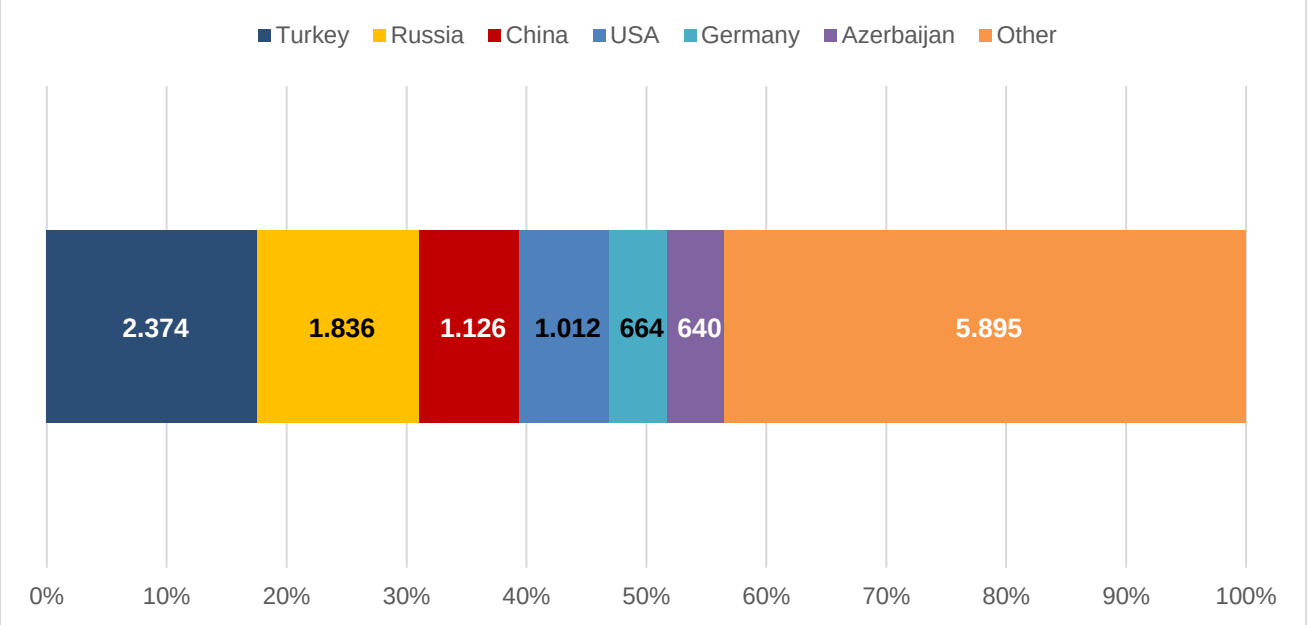
Georgia is a net importer of goods. In 2022, exports amounted to USD 5.6 billion and imports to USD 13.6 billion. In 2022, the country's main exports goods were copper ores (18%), re-export of motor vehicles (16%), ferro-alloys (8%), fertilizers (5%) and wine (5%). Georgia exported mainly to China (12%), Azerbaijan (12%), Russia (12%) and Bulgaria (8%) [10]. The main imported goods were motor vehicles (13%), petroleum (10%), petroleum gases (3%) and pharmaceutical medicaments (3%), with imports stemming mainly from Turkey (18%), Russia (14%), China (8%) and the United States (7%) [11].

Figure 3: Georgia's exports by country in 2022 (in million USD)



Source: eclareon 2023; based on Geostat [10]

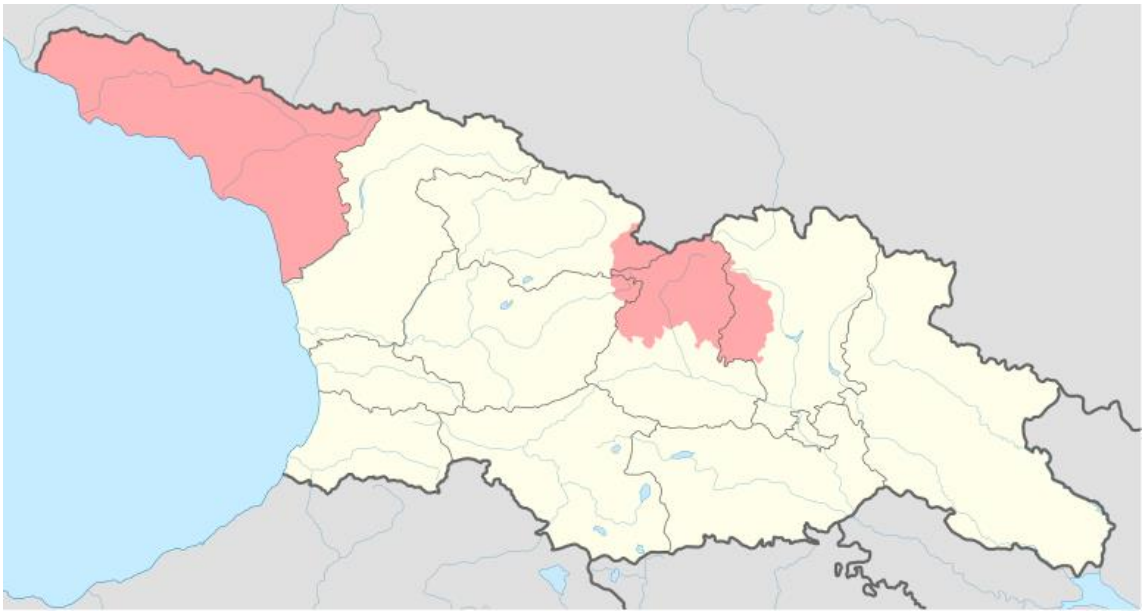
Figure 4: Georgia's imports by country in 2022 (in million USD)



Source: eclareon 2023; based on Geostat [11]

Inside the internationally recognized borders of Georgia there are two breakaway regions: Abkhazia in the western part of Georgia and South Ossetia in the central part. These areas have been a source of long-standing conflict between Georgia and Russia. The conflicts date back to the early 1990s, with both regions declaring independence from Georgia. Tensions escalated into armed conflicts, particularly in 2008, resulting in Russia's military intervention. Since then, Russia has maintained a military presence in these regions, effectively supporting their self-declared independence. The international community, including the United Nations, has not recognized Abkhazia and South Ossetia as independent states and considers them part of Georgia. As of November 2023, Georgia does not have any economic or political ties with the breakaway regions [12].

Figure 5: Georgia by regions and breakaway regions occupied by Russia (marked in red)



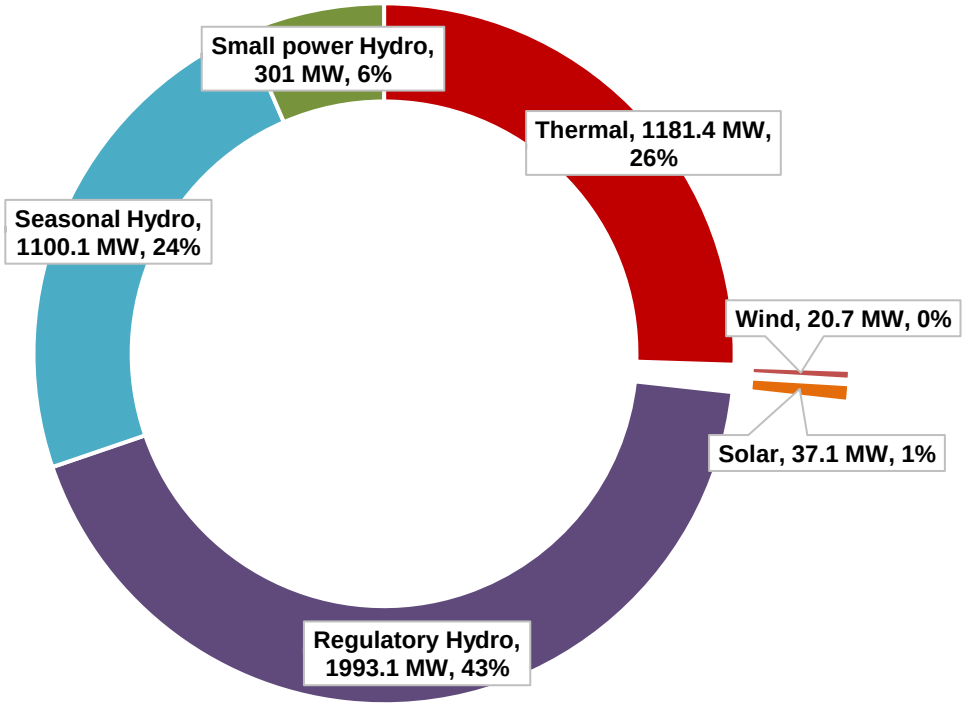
Source: Wikipedia [12]

Georgia has been actively pursuing closer integration with the European Union (EU) as part of its broader foreign policy objectives. Since the early 2000s, Georgia has undertaken significant political, economic, and institutional reforms to align itself with EU standards and values. The signing of the Association Agreement with the EU in 2014 marked a crucial milestone, fostering deeper political and economic ties [13]. This agreement aims to enhance cooperation in areas such as trade, mobility, and governance, while the Deep and Comprehensive Free Trade Area (DCFTA) promotes economic integration. In 2023, the European Commission has issued a recommendation to grant Georgia EU membership candidate status. Georgia's commitment to EU integration reflects its aspirations for political stability, economic development, and alignment with European norms. While challenges persist, including the issue of occupied territories, the EU-Georgia partnership continues to evolve, contributing to the country's ongoing transformation and its role in the wider European community [14].

1.2 Electricity Sector Overview

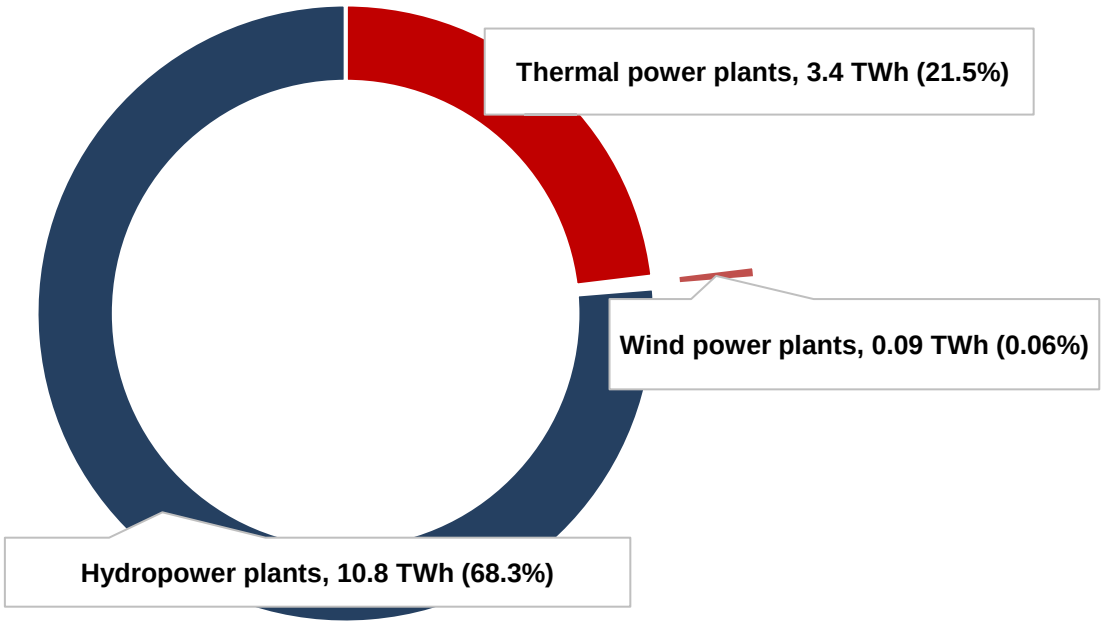
In 2022, Georgia's total installed electrical capacity was 4,596.4 MW. It is composed of thermal power plants (TPPs), hydropower plants (HPPs) and one wind power plant (WPPs) [17]. In total Georgia has generated 15.16 TWh of electricity with the main sources of electricity being hydro and thermal power plants [17]. Figures 6 and 7 show the shares of different power generation technologies in Georgia by source and installed capacity of each type.

Figure 6: Share of installed capacities in MW in Georgia by generation source (in 2022)



Source: eclareon, 2023; based on Georgian State Electrosystem [17]

Figure 7: Generation of electricity in Georgia by source (in 2022)



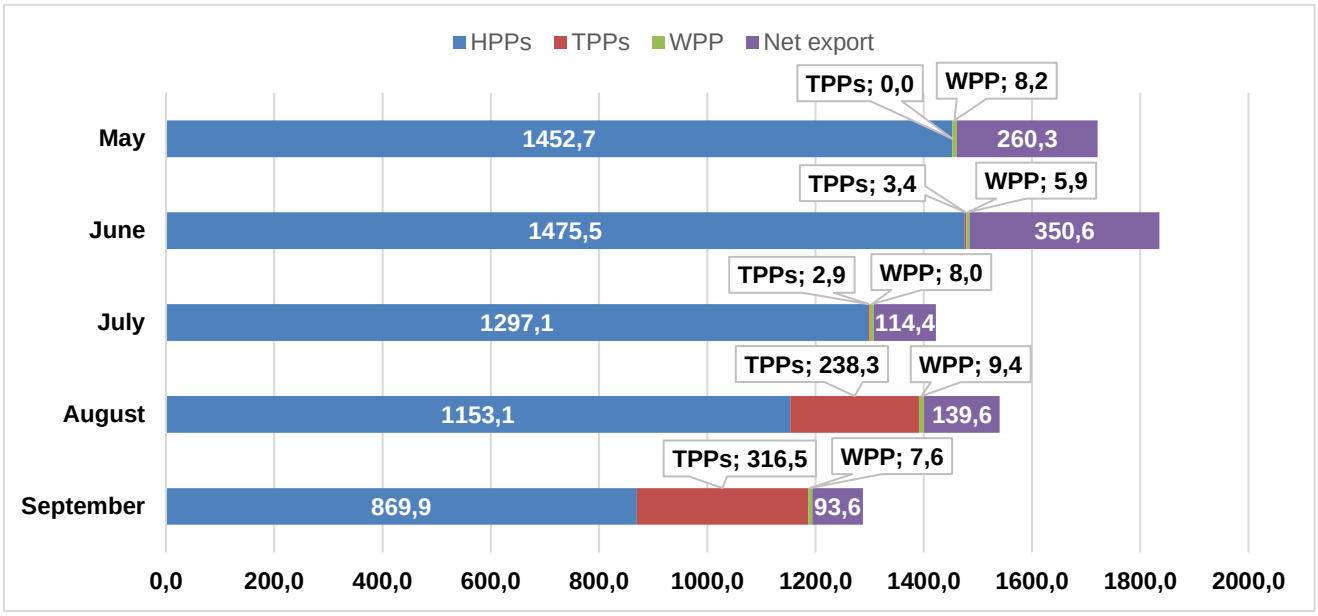
Source: eclareon, 2023; based on Geostat [18]

In 2022, electricity supplied to the grid reached 15.8 TWh, out of which 10.8 TWh (68.3%) was hydro generation, 3.4 TWh (21.5%) thermal generation, 0.09 TWh (0.6%) wind generation and 1.5 TWh (9.7%) of electricity was imported [19]. Generation from PV is not reflected in this data, as all PV installations in 2022 were micro stations. Out of a total of 15.8 TWh of electricity supplied to the grid in 2022, the majority, 14.2 TWh (89.8%) was consumed locally at wholesale level, 1 TWh (6.2%) was exported and 0.6 TWh (4.1%) lost in transmission [19].

The untapped potential of hydropower in the country is estimated to amount to up to 80 TWh/a, 75% of which could be economically attractive to develop [20]. Developing this capacity could boost Georgia's economy and increase the country's electricity exports generated by hydropower during the summer. As Georgia produces only 0.5% of the country's total natural gas consumption by itself [21], all thermal power plants operate with imported gas. Regarding the potential for wind and solar, the Georgian Transmission System Operator of Georgia (GSE) has given a positive outlook, estimating that the Georgian grid could allow the capacities of 333 MW for wind and 130 MW for solar energy [22]. In a ten-year grid development plan, Georgian State Energosystem is estimating, that by 2033 total installed capacity will be 9848 MW consisting of 4348 MW of regulatory hydro power plants, 2887 MW of run of river hydro power plants, 1589 MW of thermal power plants, 850 MW of wind power plants and 174 MW of solar power plants [23]. It is important for the country to utilize this potential in renewable energies to become self-sufficient in electricity, not rely on electricity import and increase the amount of electricity exported to neighbouring countries.

Georgia switches from being an importer to becoming an exporter of electricity, depending on the season of the year [18]. This is caused by an overreliance on small and seasonal hydro power stations. Georgia is a net electricity exporter from May until September when higher water flow of rivers allow small and seasonal hydropower stations to produce more electricity than the local market demands. The cost and demand for electricity is usually low in these months, so thermal power plants are not operating and hydro power plants with dams are filling up their reservoirs. In 2022, a typical year for the Georgian electricity sector, in the months of May, June and July, Georgia was not using thermal power plants for electricity generation and was thus an electricity exporter.

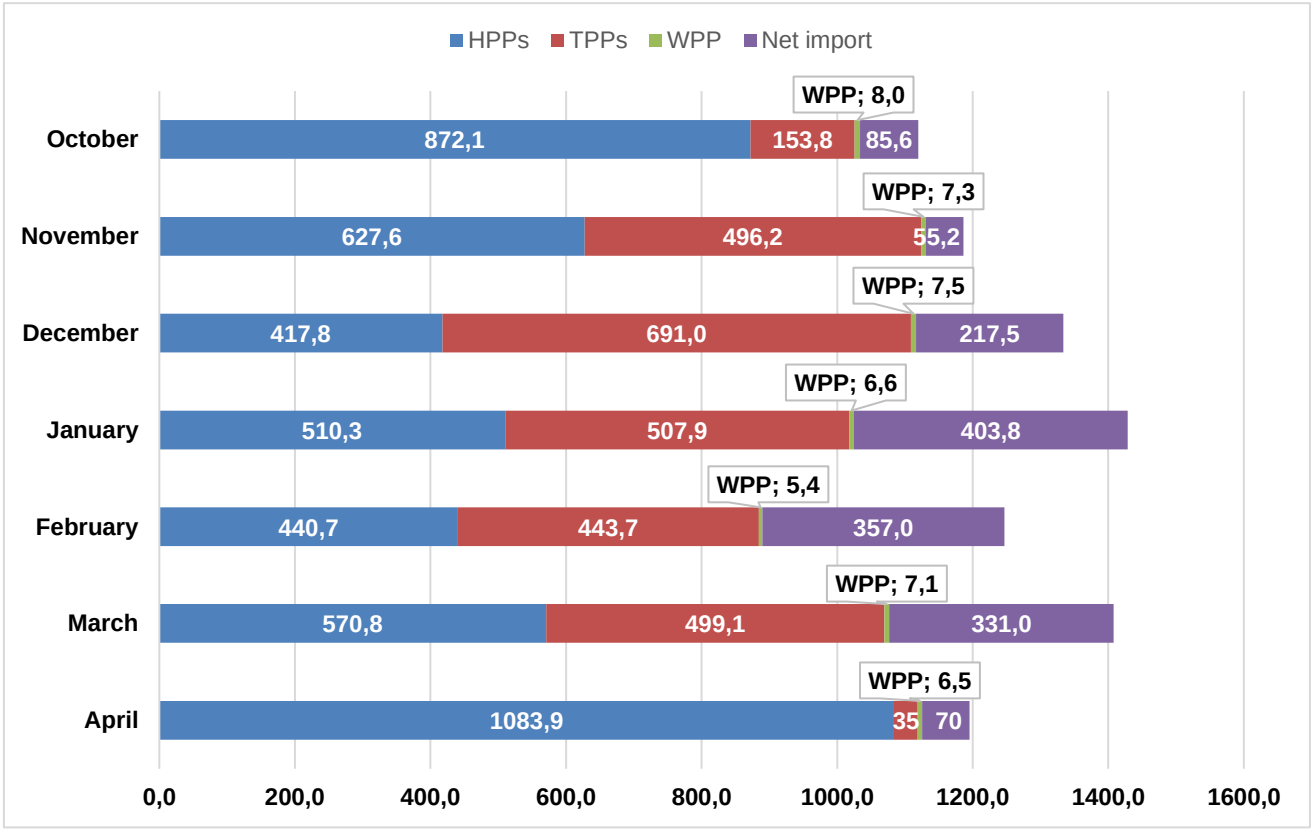
Figure 8: Generation of electricity by source in Georgia in summer months, 2022 (GWh)



Source: eclareon, 2023; based on Geostat [18]

In the autumn months of September, October and November, waterflow in rivers is decreasing, small HPPs cannot produce as much electricity as in summer and regulatory hydropower plants are using water accumulated during summer. Thermal power plants inside the country start producing electricity and energy grid gets more and more dependent on electricity imports. During January and February, up to two thirds of electricity consumption is generated by thermal power plants, or directly imported.

Figure 9: Generation of electricity by source in Georgia from October to April, 2022 (GWh)



Source: eclareon, 2023; based on Geostat [18]

1.3 Electricity Generation and Demand

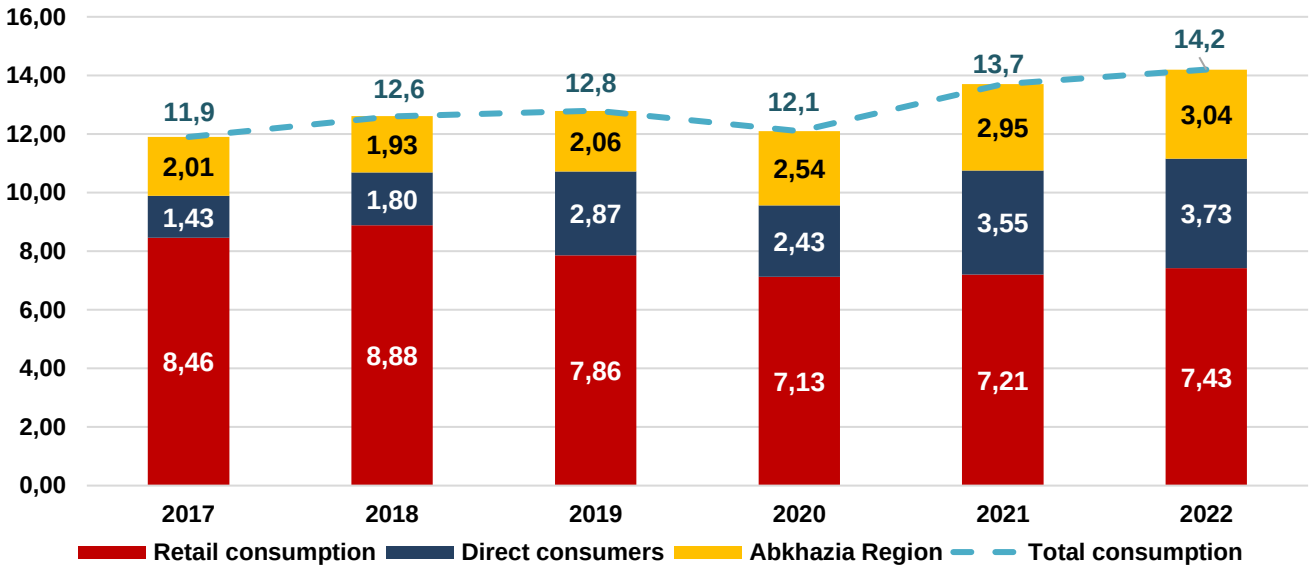
In 2022, electricity supplied to the grid reached 15.8TWh, out of which 10.8 TWh (68.3%) was hydro generation, 3.4TWh (21.5%) thermal generation, 0.09 TWh (0.6%) wind generation and 1.5 TWh (9.7%) of electricity was imported. [19] During the last decade, there has been a steady increase in energy demand and consumption in Georgia. Electricity consumption increased by 3.3% y/y to 14.2 TWh in 2022. In the first half of 2022, the consumption of electricity saw a 9.8% y/y increase, however, in the second half, it decreased by 2.7% y/y. The reduction in consumption during the 2nd half of the year was primarily due to a decrease in electricity consumption by Georgian Manganese, BFDC Georgia (Bitfury) and several metallurgical companies. The reduction in electricity consumption by these companies was caused by a decrease in production levels, which was in turn tied to a drop in demand and prices for their final products [19].

Table 1: Electricity consumption in Georgia in 2022 and year-on-year changes in consumption

		1 January 2022 to 30 June 2022	1 July 2022 to 31 December 2022	2022 (Total)
Total domestic consumption	Total (TWh)	7,307	7,938	15,246
	% Change y/y	+9.8%	-2.7%	+2.9%
Abkhazia Region	Total (TWh)	1689	1524	3213
	% Change y/y	+6.6%	-3.5%	+1.6%
Direct consumers	Total (TWh)	2,006	2,045	4,050
	% Change y/y	+33.4%	-12.6%	+5.4%
Retail consumers	Total (TWh)	3,613	4,370	7,983
	% Change y/y	+1.2%	+3.0%	+2.2%

To paint a clearer picture, Figure 10 shows electricity consumption by groups for the past six years. Between 2017 and 2022 total consumption has increased by 19.3%. Consumption is expected to increase more as the Georgian economy grows. As more and more enterprises are, by regulation, required to register as direct consumers their share in total consumption is increasing, too. At the same time, the share and amount of electricity consumed by the occupied territory of Abkhazia is rising as well. Abkhazia technically receives electricity at extremely low prices from Georgia and Russia. The powerhouse and generator units of the Enguri HPP are located on territory de facto controlled by Abkhazia, while the respective dam, i.e. the source of the hydropower plant, is located on territory controlled by the Georgia. As per agreement between the two sides, Abkhazia receives 40% of the generated electricity and the remaining territory of Georgia receives 60% [28]. At the same time, due to political reasons, Russia supplies Abkhazia with very cheap electricity, at a price below USD 0.005/kWh [19]. The cheapness of electricity has caused a crypto-mining boom in the region [27]. Due to corruption Abkhazian separatist authorities cannot collect electricity fees, so most of the crypto-miners and consumers in the region do not pay fees for electricity. This has caused a region industrially less developed than other parts of Georgia and has 8% of the population to consume over 21% of the total electricity consumed in Georgia. The excessive consumption of electricity in Abkhazia has also caused power outages inside the region [29].

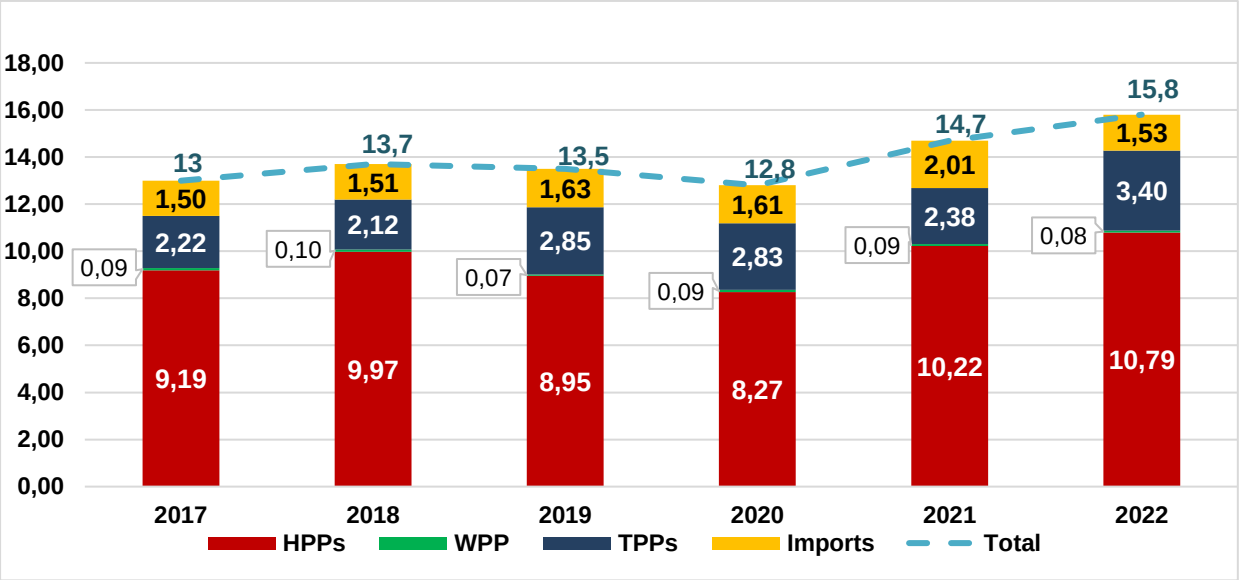
Figure 10: Electricity consumption in Georgia by customer, TWh



Source: Galt & Taggart [19]

Electricity generation in Georgia has not been increasing with the same rate as consumption which has made the country more and more dependent on electricity imports. As stated above overreliance on hydropower plants makes Georgian generation highly season-dependent. Increasing generation is a priority for the Georgian government as producing electricity locally benefits the price of electricity and even national security. 7 small hydro power plants were commissioned in 2022, with a total installed capacity of 26.9 MW, which does not cover the increase in consumption. Figure 10 shows electricity generation and imports since 2017. The figure shows an increase of the share and amount of imported electricity, while electricity generation remained almost at the same level. Thermal generation increased by 42.4% y/y, while electricity imports dropped by 23.6% y/y in 2022 [19]. This shift from electricity imports to thermal generation, which runs on imported natural gas, was influenced by the cost difference between the two. In reality, generation from thermal power plants can even be considered import, as the natural gas, fuel required for generation, is imported.

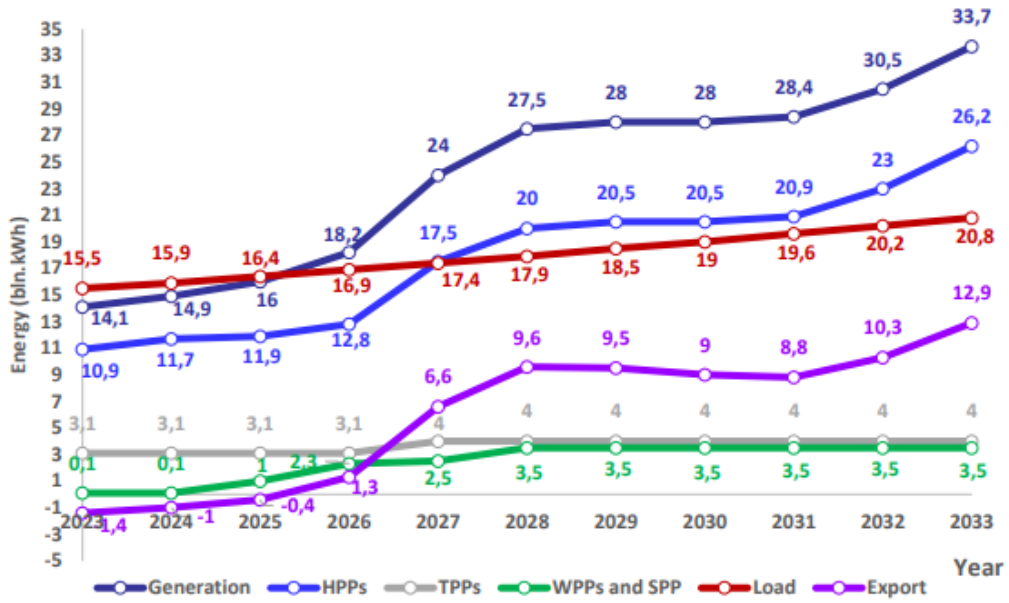
Figure 11: Georgian electricity generation by source and imports (in TWh)



Source: Galt & Taggart [19]

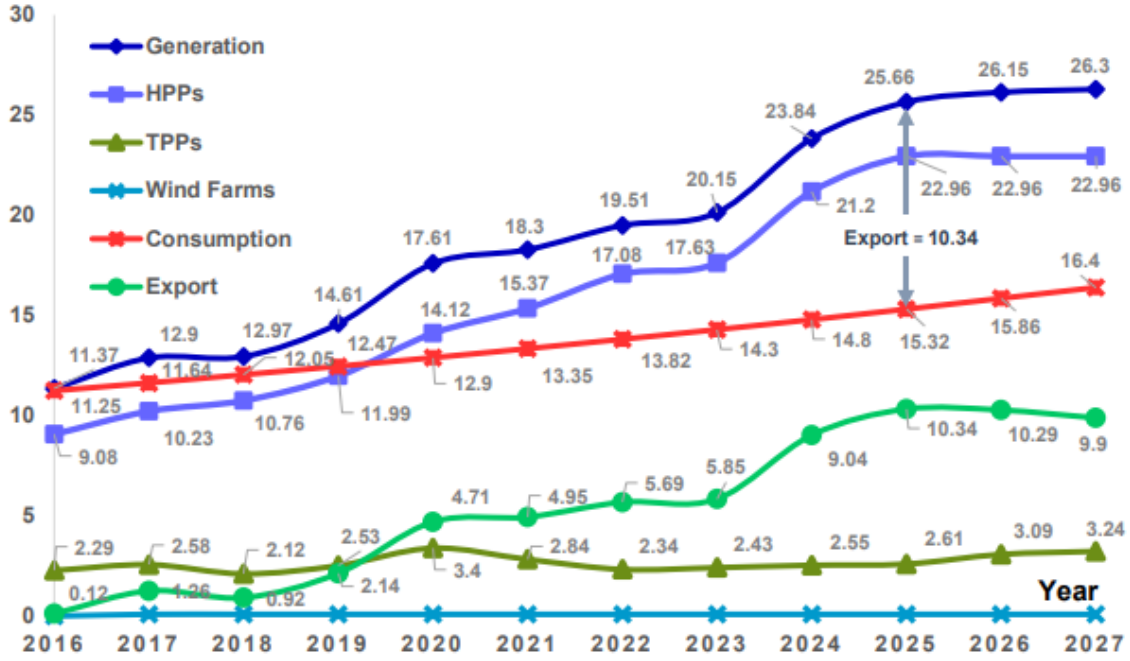
The only way to sustainably develop Georgian grid and generation capabilities is to construct new renewable energy capacities. Figure 12 shows the anticipated increase in the electricity generation until 2033 which is outlined in the Georgian State Electrosystem's ten-year development plan [23]. The plan is ambitious and anticipates for Georgia to become a net exporting country in 2026, with the main drivers of the increase being hydropower plants, with solar and wind power plants playing a role in the increase, too. There is however a difference between the planned amount of increase of generation and real increase. Figure 13 shows the same chart from the GSE's ten-year development plan published in 2016. In 2016, it was estimated that Georgia would become a net exporter of electricity, which by 2023 did not occur. Apart from that, it was also estimated that, in 2022, 17 TWh of electricity would be produced by hydropower plants, when in reality electricity generation by hydropower plants amounted to only 10.8 TWh in 2022.

Figure 12: Planned increase of electricity generation until 2033



Source: GSE ten-year development plan as of 2023 [23]

Figure 13: Planned increase of electricity generation (published in 2016)

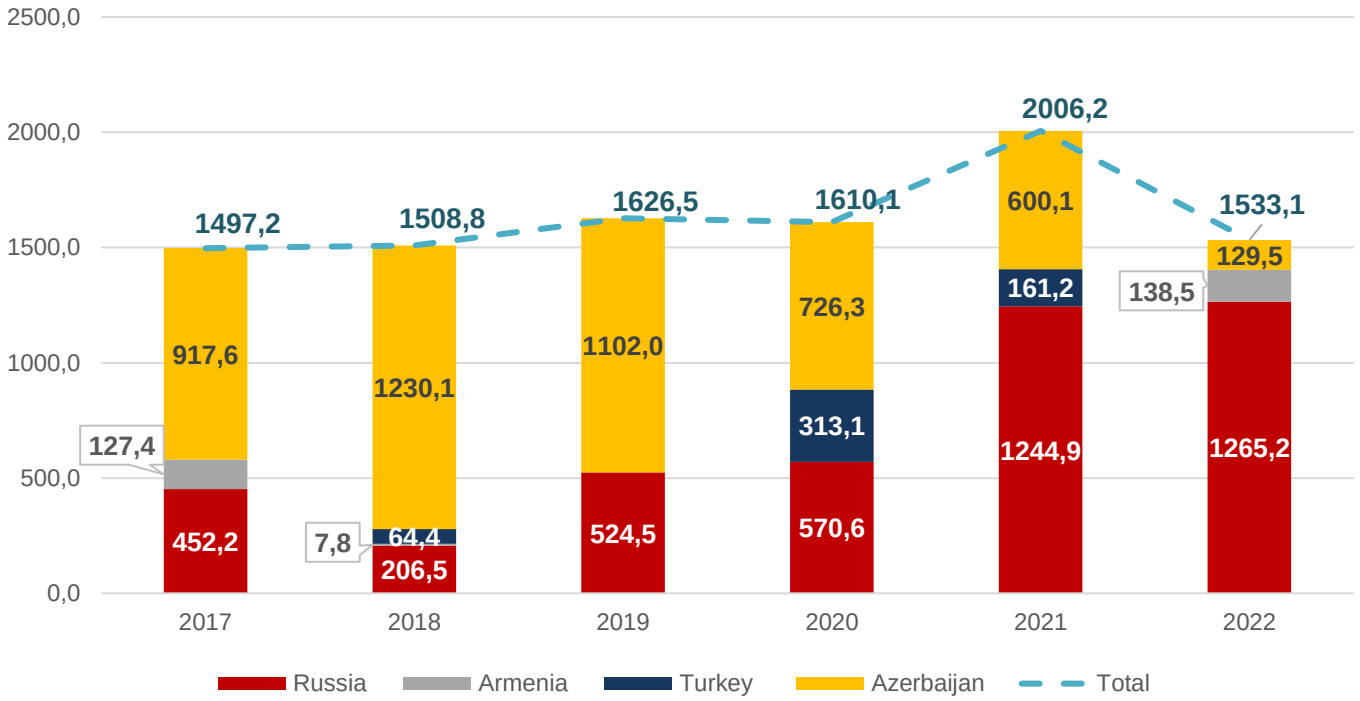


Source: GSE ten-year development plan as of 2016 [25]

The large difference in anticipated and real electricity generation for hydropower plants is due to several large-scale hydropower plants not getting constructed. The most often cited reason are protests from local population and environmental activists. The three biggest regulatory hydropower plants initially scheduled for entering operation until 2023 but currently frozen are the Khudon HPP, the Nestkra HPP and the Namakhvani HPP. These hydropower plants have been planned for several decades now and would add several MW of installed capacity to the grid. The first Deputy Minister of Economy and Sustainable Development of Georgia Romeo Mikautadze recently revealed that the government is working with the investors to restart those projects, but it is yet to see if those projects will ever be connected to the grid [35].

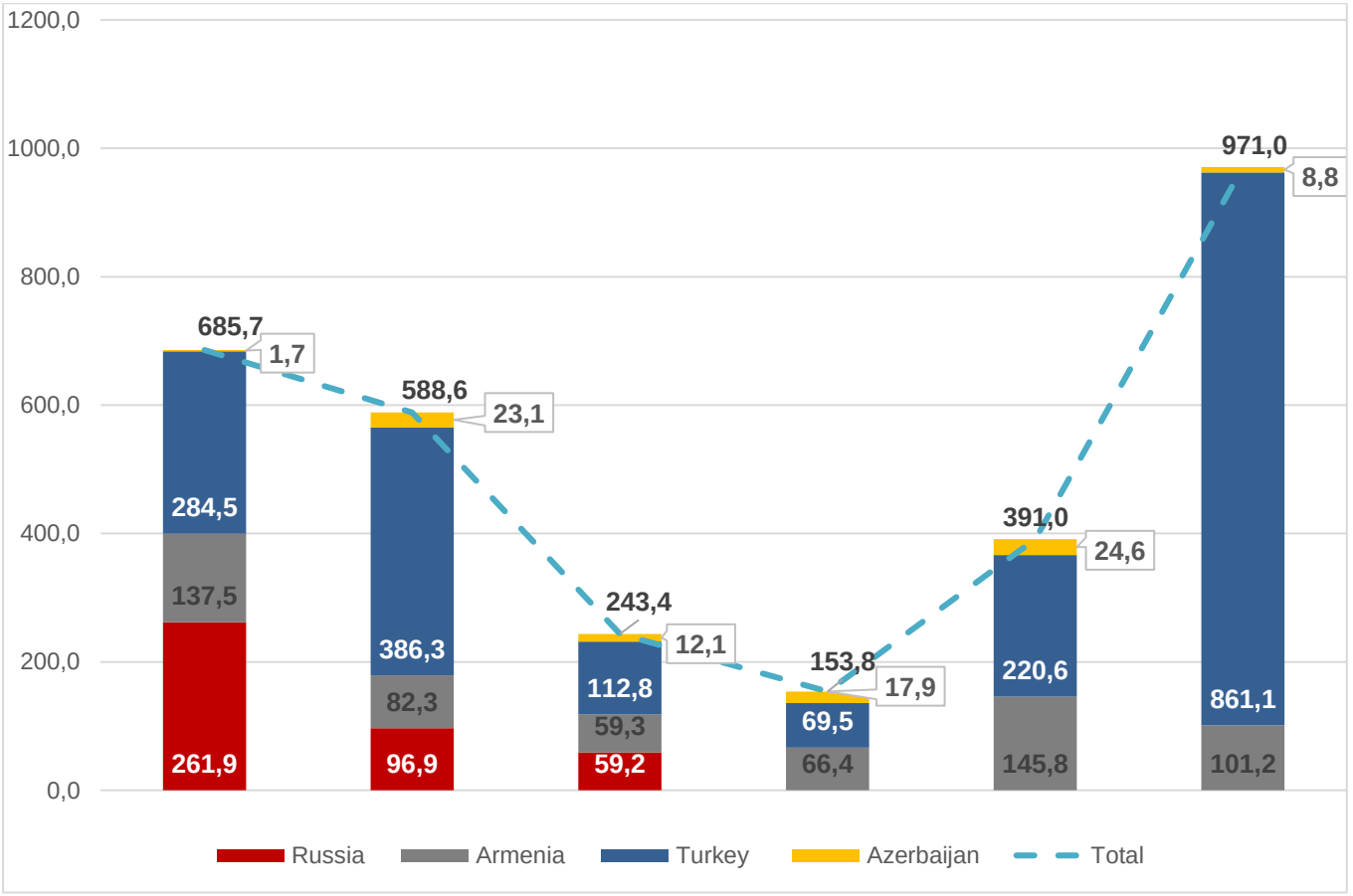
Due to the composition of the Georgian grid, generation is high in the late-spring and summer months, when Georgia is an exporter of electricity, whereas in the winter months the country is dependent on importing electricity from neighbouring countries. Figures 14 and 15 show total import and export of electricity from the country for the past five years. As stated above, electricity generated by thermal power plants is not considered as imported in Figure 14 and 15 and by Georgian regulatory bodies.

Figure 14: Import of electricity in GWh, Georgia 2017-2022



Source: Georgian national statistics bureau [18]

Figure 15: Export of electricity in GWh, Georgia 2017-2022



Source: Georgian national statistics bureau [18]

As stated above, import and export prices do vary from year to year and are dependent on factors such as electricity and natural gas prices in the neighbouring countries. 1.5 TWh of electricity was imported in 2022, accounting for 9.7% of the total demand. Of the total imports, 82.5% came from Russia (mainly for Abkhazia), 8.4% from Azerbaijan, and 9.0% from Armenia. Half of the imported electricity was sent to the Abkhazian region at the below market price of USD 0.005/kWh, lowering the official average import price in Georgia to USD 0.03/kWh [19]. The price of commercially imported electricity varied depending on the country and the part of the year. On average, imported electricity had a price of USD 0.074 – 0.075 per kWh. Thermal generation prices with imported fuel were much lower than the price of imported electricity, ranging from USD 0.033/kWh to USD 0.045/kWh. This was caused by an agreement between Georgia and Azerbaijan, according to which Georgia is provided with a special "social" tariff on natural gas import for electricity generation [30].

As seen on Figure 15, electricity export surged due to a rise in electricity prices in Turkey. The overall export of electricity from Georgia increased by 153.7% in volume to 1 TWh and a substantial increase of 436.5% (5.4 times) in value to USD 84.3 million. The average export price was USD 0.087/kWh, representing a 116.0% y/y growth. This growth was due to a substantial price increase of electricity on Turkish market [31].
Due to all these factors, the balance of electricity was positive in terms of monetary value for Georgia. Georgia earned USD 84.3 million via electricity exports and spent USD 41.2 million on electricity imports, resulting USD 43.2 million of net export. Despite the positive trade balance in monetary terms, Georgia remains a net importer in kWh terms. Georgia imported 1.5 TWh electricity and exported 1 TWh in 2022, resulting in 0.6 TWh of net import [19]. As the prices stabilize on Turkish market, it is expected that Georgia will return to a net importer status in both monetary and electricity terms.

1.4 Grid Infrastructure

The Georgian transmission network has different voltage levels, varying from 6 to 500 kV, but most distributors (DSOs) operate networks with a voltage of 110 kV or less [17]. 500 kV lines are a relic from Soviet infrastructure, as they were used for transporting high amounts of electricity from generation facilities in Russia to South Caucasus and then to Turkey and Iran. As previously stated, Georgia, being a net importer of energy, is connected to the power systems of neighbouring countries through 110-500 kV power lines. These lines are also used for electricity transit from Azerbaijan to Turkey. In 2015, the "First Edition of the Grid Development Plan" was approved by the government, the goal of which is to ensure continuous improvement of the grids and the integration of new generation capacities [25]. This plan is updated yearly. During the last years, extensive investments were put in Georgian grid infrastructure with the aim to develop a stable, reliable, cost-effective and efficient transmission system, ensuring network security and provide sufficient transfer capacity for the integration of renewable energy sources into the network and power exchange with neighbouring countries [32]. One of these projects is the Energy Network Improvement Programme (ENIP) with a total investment volume of EUR 270 million, co-financed by KfW and EBRD, including a EUR 9.9 million grant funding from the EU Neighbourhood Investment Platform (EU NIP) implemented by KfW [33].

Import and export of electricity is facilitated by the 220 – 500 kV power lines which are operated by the Transmission System Operator (TSO). Maximum cross border power capacities are

displayed on Figure 16. Construction of additional power lines is already planned to increase energy trade between Georgia and its neighbours [32]. There are plans to connect Georgian and European grids via an underwater power cable [34]. The project was met with political will from all stakeholder countries, but is still in very early stages. As of Q3 2023 only pre-feasibility studies have started and there are many questions if the project will be economically profitable at all. The cable is not estimated to start operation before 2030.

Figure 16: Georgia's main high voltage infrastructure for energy trade

Source: JSC Georgian State Electrosystem

1.5 Off-Grid Energy Generation

Georgia has a well-developed power grid system and most settlements are connected to it. According to the Georgian statistics bureau, 100% of the population had access to the electricity grid in 2012 [35]. However, in 2019, the "USAID/Energy Program" in association with the Regional Development and Infrastructure Ministry of Georgia identified 760 households, which did not have access to electricity grid [36]. All of these households were located in mountainous regions of Georgia and did not have connection with energy grid due to their remoteness. As a consequence, the "USAID/Energy Program" in collaboration with the Regional Development and Infrastructure Ministry of Georgia implemented the installation of 1.5 kW PV-systems for 207 households, mainly used for lighting, remidying the problem to a certain extent [36].

1.6 Electricity Market Stakeholders

Georgian energy sector stakeholders include both private and state-owned companies that are producing, transmitting and distributing energy. The commercial activities of these companies are regulated by a state commission called GNERC (Georgian National Energy and Water Supply Regulatory Commission). Activities, functioning and the economic relationship between all market participants are defined by the "Law of Georgia on Electric Energy and Water Supply"

[38], issued on 20 December 2019.

The “Law of Georgia on Electric Energy and Water Supply” groups the stakeholders of the electricity market into the following categories [38]:

- Government (Ministry) and legislative bodies: Ministry of Economy and Sustainable Development of Georgia, responsible for policies and facilitating investment projects
- Independent federal regulator: GNERC, issuing licenses and setting electricity rates
- Power generating entities
- National transmission and technical service operator: (TSO)-JSC “Georgian State Electro System”
- Regional distributers/licensees: JSC “Energo-Pro Georgia”, JSC “Telasi”
- Customers (retail or “direct” customers)
- Licensed importers and exporters /exporter licensees
- Federal Electricity System Commercial Operator (ESCO), a technical-commercial commission that has an exclusive right to conduct trading with the providers of guaranteed reserve sources according to the “Electricity Market Rules” [56]

The roles and responsibilities of some of the key stakeholders are described in the following sections.

1.6.1 Ministry of Economy and Sustainable Development (MENR)

Georgia had a dedicated Ministry of Energy from 1991 to 2017 in charge of regulating the activities in the energy sector [40]. In 2017, the Ministry of Energy was integrated in the Ministry of Ministry of Economy and Sustainable Development of Georgia. The first deputy minister of the Ministry of Economy and Sustainable Development is responsible for energy topics and is leading the departments of [41]:

- Energy Efficiency and Renewable Energy Policy and Sustainable Development Department
- Energy Policy and Investment Projects Department
- Energy Reforms Department
- State Agency of Oil and Gas

The Ministry is responsible for the legislative framework of the energy sector and is monitoring its technical and economic conditions.

1.6.2 GNERC

The Georgian National Energy and Water Supply Regulatory Commission (GNERC) is the national body responsible for the regulation of electricity and water supply services. According to the “Law on Electricity and Water Supply” [38], the commission has the following responsibilities:

- Issuance of licenses for energy-related operations (energy generation, transmission, dispatching, distribution as well as import and export-related operations)
- Establishment of rules and standards for energy-related operations
- Stipulation, calculation and regulation of the wholesale and retail electricity tariffs for

energy-related operations

- Regulation and establishment of energy tariffs for the end consumers as well as a marginal tariff. These tariffs are also defined by the Decree 33 “On the Tariffs of Electricity” [42]
- Control and monitoring of activities relating to mandatory certifications in the energy sector
- Protection of consumers from monopolistic prices, especially in areas without a competitive market

The goals of the commission are [43]:

- Fostering energy market liberalization;
- Advancing quality of service;
- Facilitating implementation of the investment projects;
- Offering modern and simplified remote services to the customers;
- Increasing awareness of the customers on their rights and duties;
- Promoting green energy generation and net-metering;
- Promoting energy efficiency

1.6.3 Electricity Producers

There are different types of electricity generating companies in Georgia. They can be distinguished in terms of power generation sources, installed capacity and the type of regulation that applies to them. Many bigger power stations built in the past century are owned by the Georgian state, while most smaller stations are owned by private companies. The true costs of electricity production vary by power plant and details are not made public. For many hydro stations it is even impossible to calculate the cost of electricity production. For example, it is estimated that the cost per kWh generated for Enguri HPP (the largest HPP in Georgia) is around GEL 0.02 (EUR 0.007), which is substantially less than the cost for any modern HPP. GNERC sets a ceiling tariff, which sets an upper limit to the potential gross margins which producers can achieve by selling generated electricity on the wholesale market:

- Regulated power plants (e.g. “Enguri”, “Vardnilli”, “Krhhami-1”, “Krhami-2”) are operating under a license and sell their energy for fixed rates, both regulated by the GNERC.
- Semi-deregulated seasonal power plants (such as “Jinvalhesi”, “Vartsikhehesi” and “Rionhesi”) operate under licenses and tariffs determined by the GNERC.
- Guaranteed Capacity Sources (GCs) represented by thermal power plants (such as “Mtkvari Energetika”, “G Power”) operate under GNERC licenses and sell energy based on direct contracts. They are bound to ceiling tariffs set by the GNERC and therefore secure the stability and reliability of the country’s energy system. Projections of monthly generation and energy trading volumes are conducted by ESCO.
- The “Law on Electricity and Water Supply’ [38] Art. 2, defines “deregulation” as a right to engage in “tariff-free activity” and “transmit energy freely”. Deregulated plants have either an installed capacity lower than 13 MW or were built after 1 August 2008 (except thermal power plants categorized as company capacity sources). Such power plants

have a generation license and can sell electricity for a freely negotiated price, either on the wholesale market to ESCO, to the retail market, or to exporters.

- Micro-generation: power plants with less than 500 kW installed capacity per unit are defined as microgeneration. Those stations usually are PV stations to which the net-metering scheme applies. According to GNERC, those stations numbered 740 and the total installed power capacity was 37 MW by the end 2022.

The largest company operating regulated HPPs, with a total installed capacity of 1.3 GW, is the state-owned “Enguri” (or “Engurhesi”). Enguri generates over a third of the electricity in Georgia [44]. There are also two large HPPs, “Khrami HPP-1” and “Khrami HPP-2” with a total installed power capacity of 227 MW, which belong to the Russian company “Inter RAO” [45][46]. The “Georgian Industrial Group” (GIG) owns different types of power plants with an overall capacity of 663 MW, mainly consisting of thermal power plants [47] (approx. 16% of the total installed capacity of the market). The third largest share of capacity is held by the Czech “Energo-Pro Georgia Generation”, which manages 592 MW (approx. 15%) of Georgia’s installed capacity.
7 small hydro power plants were commissioned in 2022, with a total installed capacity of 26.9 MW [19]. As of October 2023, 3 small HPPs have started operation with a total installed capacity of 6 MW. According to the Ministry of Economy and Sustainable Development, 7 additional stations are planned to become operational by the end of 2023 with a planned total installed capacity of 120 MW [48].

1.7 Energy Transmission and Distribution

1.7.1 Energy Transmission

The JSC Georgian State Electrosystem (GSE) is the single Electricity Transmission System Operator acting in Georgia. The entity is responsible for the overall coordination of the country’s electricity system and the balancing of electricity supply and demand. The company also regulates the exchange of electricity with neighbouring countries and is actively cooperating with network operators in neighbouring countries [49].

GSE, as the single Transmission System Operator, is responsible for balancing the power supply and demand in real time and to provide reliable power supply.

The organization owns and operates 4 357 km transmission lines and 93 substations all over the country. Transmission network is managed by the National Dispatch Center and its technical maintenance is provided by the 4 regional networks (Eastern, Western, Southern and Kakheti). GSE also manages the cross-border transmission lines interconnecting with the neighbouring countries: Russia, Turkey, Armenia and Azerbaijan [49].

GSE is a joint stock company owned by the LEPL National Agency of State Property, while its management rights are transferred to the Ministry of Economy and Sustainable Development of Georgia.

GSE provides power transmission and dispatch services all over the country. Transmission is provided from hydro, thermal and wind power plants to power distribution companies and direct customers.

The main areas of GSE activity are to:

- Plan and coordinate electricity generation and consumption
- Provide access to the transmission network
- Develop the transmission network (construct new cross-border and internal transmission lines and substations)
- Maintain the transmission network

1.7.2 Distribution System Operators (DSOs)

Two distribution system operators are currently operating on the Georgian market: JSC “Telasi” and JSC “Energo-Pro Georgia”. JSC “Telasi” operates only in Tbilisi, the capital of Georgia while JSC “Energo-Pro” operates in the rest of the country [50]. JSC “Telasi” is owned by the Russian company “Inter RAO” and carries out power distribution in Tbilisi [51]. JSC “Energo-Pro Georgia”, the largest private owner of distribution system assets, is owned by the Czech Energo-Pro Group [52].

Prior to 2020, both companies were vertically integrated: they owned power generating stations, were DSOs and were selling electricity directly to consumers. In July 2020, however, first regulatory changes entered into force to unbundle the distribution system operators [53]. This was one of the steps taken to liberalize the market, to divide the responsibilities of operating an electricity distribution network and selling electricity to consumers. The law states that the DSO that is a part of the vertically integrated undertaking shall be independent from other activities not related to the distribution at least in legal, organizational and decision-making terms.

1.8 Other Stakeholders

Direct Customers

Direct customers (also called “eligible” customers) are defined by Decree 144 “On the approval of mandatory criteria for the direct consumer of electricity” and are mainly large institutional electricity consumers. Certain requirements have to be fulfilled, e.g. regarding the point of network connection (voltage level) and monthly consumption of electricity, to be considered a direct customer. Direct customers receive electricity through 35-110 kV grids and consume on average at least 5 million kWh per month. They may purchase energy via direct contracts with qualified energy producers such as the ESCO or generate their own electricity [54].

There are restrictions regarding energy trading capabilities of direct customers. They are only eligible to trade electricity (capacity volumes) on the wholesale market if the capacity does not exceed 1 MW (for 2017). Moreover, they cannot act as wholesale customers and retail customers at the same time. From private conversations GNERC representatives confirmed that most of the businesses did not want to register as direct consumers as managing the electricity demands and trading for electricity would be a burden for them. As the electricity market becomes more and more liberalized, the threshold of being a direct consumer is decreasing and a number of direct customers has been increasing. In 2014 there were only 5 direct consumers, in 2020 – 17 and in 2022 – 47.

Tariff Customers/Retail Customers

Retail or tariff customers form the second customer category in Georgia. They are regionally bound to DSOs and purchase electricity at a fixed rate set by GNERC. The Directives 2003/65/EC and 2009/72/EC, also known as the "3rd Package" state that tariff/retail customers are allowed to switch energy suppliers (the only exception is that customers may purchase electricity from power plants < 13 MW). DSOs were decoupled from the roles of energy suppliers for that reason to give consumers capability to choose the electricity supplier. However as of Q3 2023, there are no other alternatives than sister companies of DSOs for the retail customers to choose.

Electricity importers

According to the "Law on Energy and Water Supply" [38], an importer is "the one who […] receives energy from abroad and sells energy abroad, and/or consumes electricity (capacity)". These activities are not subject to licensing. For all activities like registering with the dispatch licensee, selling the imported energy to qualified enterprises or own consumption, a direct contract is necessary. GNERC determines the upper marginal tariff for energy sold by electricity importers which is also based on direct contracts.

Electricity exporters

According to the "Law on Energy and Water Supply" [38], an exporter is "the one who sells electricity/capacity abroad at the point of delivery". Exporting energy is not subject to GNERC licensing. Similar to importing, a direct contract is necessary for all activities like registering with the dispatch licensee or reselling energy for export and electricity transmission. On the wholesale market the exporter purchases electricity from another qualified energy producer or from ESCO.

Electricity System Commercial Operator (ESCO)

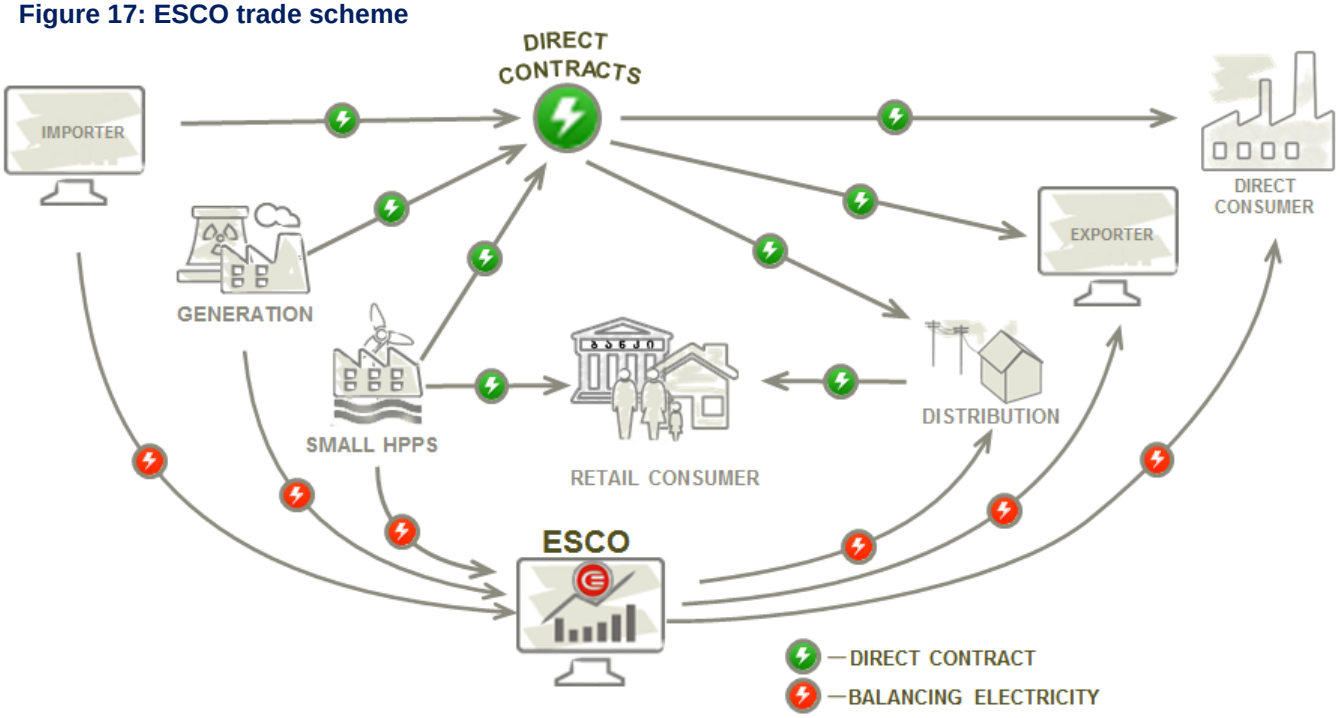
The "Electricity System Commercial Operator" (ESCO) plays a crucial role for the operation and development of the Georgian electricity market. ESCO is fully owned by the "JSC Partnership Fund", a state-owned investment fund established in 2011 [55].

ESCO is responsible for the uninterrupted and reliable power supply and plays hence a key role for the stability of the Georgian Electricity Power Sector. Among its duties as the commercial market operator are balancing electricity on the wholesale market, balancing guaranteed capacity and identifying electricity import/export needs. The share of balancing electricity trade on the wholesale market through ESCO is 20% to 30% and is based on direct contracts. The remaining electricity consumption is contracted by the DSOs. For direct customers, the energy producers sign bilateral contracts with large electricity consumers or distribution companies assisted by ESCO. The tariff of every commercial transaction depends on the status and the type of qualified energy stakeholder (regulated/deregulated, transmission, distributer) and is based on Decree 33. The service fee finances and is also determined by Decree 33 (Art 5) [42].

ESCO operations are defined by the "Law on Electricity and Water Supply" [38] and the "Order on the Approval of Electricity (Capacity) Market Rules" [56]. In brief, the main functions of ESCO are:

- Purchase and sale of “balancing electricity (capacity)” and management of the electricity trade between Georgia and neighbouring countries
- Trade with guaranteed capacity
- Inspection of meters used in wholesale trade
- Set up and operation of a unified data base on the volume of electricity traded on the wholesale market
- Submission of information on the final settlement between the consumers and energy sellers
- Support construction of new hydro power plants

Figure 17: ESCO trade scheme



Source: ESCO

1.9 Electricity Markets

When discussing the electricity market structure in Georgia, it is necessary to note, that Georgia is in the process of liberalizing the electricity market and transitioning towards a new market structure. The third energy package by the EU energy community requires liberalization of market rules and the launch of a new wholesale electricity market [59]. Georgia is a part of the EU energy community since 2014 [60] and is adopting the third energy package into the Georgian system. The launch of a new electricity market – GENEX, which is one of the most important parts of the package, has been delayed for several years, with the official launch date now set for 1 June 2024 [61] [62]. This chapter discusses both existing and upcoming market structures; however, it is important to note that as the new structure has not been implemented yet, several key aspects are to be confirmed.

Wholesale Electricity Market

According to Art. 22 of the "Law on Electricity and Water Supply" [38], the Georgian wholesale market is based on direct bilateral, short or long-term contracts balanced, supported, registered and scheduled by or through ESCO (see 1.4). As a mediator between electricity producers and consumers, ESCO plays an important role on Georgia's wholesale energy market.

Energy actors have to comply with the electricity market rules [42], and are bound to tariffs (Decree 33) set by GNERC.

Producers of electricity and importers may sell electricity on the wholesale power market to any other of the following market players (or so-called qualified enterprises/customers):

- Large direct electricity consumers (direct wholesale consumers, industrial customers)
- Distribution licensees (companies / distribution companies (DISCOs or DSOs)) which are retailers purchasing electricity on the wholesale market
- ESCO ("Guaranteed Capacity" (GC)) or "Balancing Electricity" trading
- Grid operators (with the aim to compensate own grid losses)
- Direct customers (or so-called "eligible customers")
- Electricity traders

Moreover, electricity producers may directly export electricity and/or sell it to exporters.

HPPs smaller than 13 MW as well as other power plants built after 1 August 2008, fall into the category of deregulated plants. The operators of such plants are eligible to sell energy on both wholesale and the deregulated retail markets.

On the wholesale market, the energy is sold to the abovementioned qualified enterprises at freely negotiated rates (defined by the "Electricity Market Rules" [56]). At the same time, providers are able to sell electricity on the wholesale market to ESCO as "balancing electricity", via power purchase agreements (PPA). ESCO in this case sells the electricity to all other consumers on the retail market, where it can be purchased by direct consumers at freely negotiated rates (as defined by the "Electricity Market Rules" [56]).

Tariffs for Non-residential Consumers

There are several groups of electricity-related tariffs in Georgia: tariffs for balancing electricity, generation tariffs, import and export tariffs (regulated by GNERC) valid on the wholesale energy market or retail tariffs. There are two major types of costs that determine the rates, which all electricity-consumers (wholesale/direct or retail customers) have to pay indirectly, the generation costs and the costs for guaranteed capacity.

For the purpose of accessing PV potential in Georgia, electricity prices on the balancing market are irrelevant. Those tariffs set by ESCO are mainly for the power stations, which were built several decades ago. Every new power station, be it hydro, wind or solar power plants will have a special tariff negotiated with the Ministry of Economy and Sustainable Development, according to which electricity can be sold, or the power plant will be a free electricity supplier operating on the liberalized market. The new market structure, as well as potential finance opportunities, such as CFD will be discussed below.

Retail Electricity Market

Currently two companies are operating on the Georgian retail electricity market: “Telasi” operating only in Tbilisi, and “Energo-Pro Georgia” operating everywhere else in Georgia. Before 2020, electricity supply and distribution activities were not split, so both companies were horizontally integrated: in other terms, they owned electricity generating capacities and thus were both electricity distributors and electricity suppliers. Since unbundling rules set by the third energy package [59] were implemented, both companies have created the sister companies “Telmiko” and “EP distribution” for electricity supply activities. Retail electricity market roles are regulated by GNERC resolution N47 [63]. Electricity consumers on the retail market include household as well as small and medium business consumers. Electricity providers are grouped as:

- **Free suppliers** are companies which source electricity and provide electricity to its consumers. Those companies can change their rates to bigger consumers, but have to use tariffs set by GNERC for retail and small consumers. Currently there are no free suppliers on the market but it is expected that companies will show interest in being categorized as free suppliers after the full liberalization of the market.
- **Universal electricity suppliers** are sister companies of previously horizontally integrated companies. In almost all of Georgia (except Tbilisi where “Telmiko” is the universal electricity supplier), “EP Distribution” is the universal electricity supplier. Universal suppliers are bound by GNERC decrees on how much they can charge for electricity. Every consumer is a consumer of the universal electricity supplier and then will have an option of choosing a free supplier when the market will have free suppliers.
- **Last alternative electricity suppliers** are suppliers which will provide electricity in the cases where an electricity provider chosen by the consumer does not honour their agreement and is not providing electricity. Electricity will cost more with last alternative suppliers. Using last alternative supplier is only allowed for up to three months. As of Q3 2023, two companies which are universal suppliers are the only last alternative electricity suppliers.

Tariffs on the retail electricity market

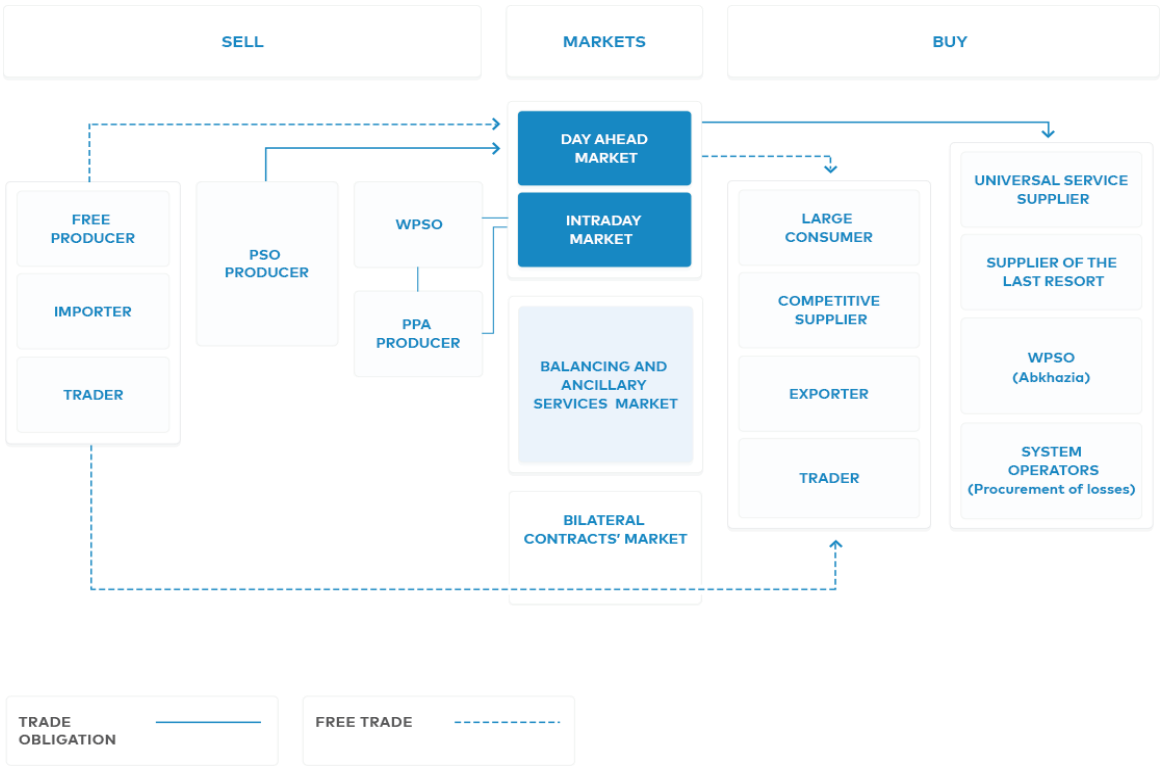
The retail tariffs for non-residential consumers (commercial or small industrial ones) depend on the voltage level and are regulated by GNERC. The tariff for each consumer includes electricity supply tariff (regulated by Resolution of GNERC No. 32/29 June 2021), distribution tariff (regulated by Resolution of GNERC No. 26/29 June 2021) and tariff of JSC “Georgian State Electrosystem” (regulated by Resolution of GNERC No. 26/29 June 2021) [42].
Prices differentiated by the amount of energy consumed during the month. As of Q3 2023, prices range from 0.18 GEL per kWh to including VAT, to 0.32 GEL including VAT. These prices were set on 1 January 2020, head of GNERC David Narmania recently declared that a tariff change is not expected before 2025 [64].

Future structure of the electricity market

Georgia is in the process of electricity market liberalization and the implementation of the European Energy Communities’ Third Energy Package. A new energy exchange (GENEX)

was established in December 2019 by JSC Georgian State Electrosystem and JSC Electricity System Commercial Operator. The mission of GENEX is to ensure transparent and competitive markets and to provide accurate price signals to existing and potential market participants through efficient operation of the electricity markets [65][65]. A new market structure has already been agreed upon, which is mainly based on the markets of Central and Eastern Europe. There are still many challenges left however and the date of the adoption of these changes has been postponed several times. The last deadline for the implementation of the free market was 1 July 2023, but the date was further postponed citing the reason that the market players are not yet ready for the changes and will not be able to trade successfully on the new market.

Figure 18 - Structure of the GENEX energy market



Source: GENEX [66]

As can be seen in Figure 18, the structure of the future energy exchange market is highly complex. It is composed of the following sub-markets and energy stakeholders:

- Day ahead market: Organized wholesale market segment (exchange), where electricity is traded on an hourly basis, with day ahead auctions held one day ahead of the physical delivery.
- Intraday market: Organized wholesale market segment (exchange), where the trading of electricity takes place through continuous trading transactions within the day.
- Free Producer: An electricity producer who does not have a public service obligation.
- Importer: Trader who sells electricity purchased in another country on the Georgian electricity market (imports electricity).
- Trader: According to the Law of Georgia on Energy and Water Supply, a trader is a person who trades electricity and/or natural gas on the wholesale market in accordance with the relevant market rules, except for the system operator. This includes the purchase of electricity for resale and does not include the purchase for its own

consumption or for selling it to the final consumer.

- PSO producer: An electricity producer who is legally responsible for a public service obligation.
- WPSO: Wholesale Public Service Organization (WPSO) is an enterprise selected by the government of Georgia, whose public service obligations are:
    - Support of renewable energy and PPA producers and the integration of their produced electricity trade on the organized markets
    - Support of universal service suppliers for ensuring the stable price of purchased electricity and integration in the organized markets
    - Security of supply for the customers in the occupied territory of Georgia (autonomous republic of Abkhazia) through the purchasing of electricity in organized markets
- PPA Producer: Electricity producer having a contract with the government of Georgia on guaranteed purchase of power (electricity)
- Balancing and ancillary services market: Organized wholesale market segment where the trade in balancing products and ancillary services is organized in order to balance the electricity system in real time. Different pricing principles apply to capacity and electricity traded on the balancing market: the pay as bid principle applies to capacity and the marginal pricing principle applies to electricity (uniform pricing mechanism).
- Bilateral contracts' market: Wholesale market segment, where electricity is traded through bilateral agreements.
- Large consumer: A final non-household consumer, the legal status of which shall be defined by the Commission.
- Competitive supplier: Electricity undertaking, which carries out the electricity supply function to the final consumers, based on their own choice, but not as a legal obligation (imposed by the Government).
- Exporter: Trader who sells electricity purchased on the Georgian electricity market outside the territory of Georgia (exports electricity).
- Universal Service supplier: Supplier designated by the Government of Georgia which supplies electricity with regulated conditions to those final customers, who are entitled to be supplied with electricity under such conditions, i.e. household customers and small enterprises, based on their choice or automatically, in accordance with the legislation of Georgia.
- Supplier of the last resort: Supplier of electricity as a public service for a limited period of time according to regulated conditions to those final consumers, who have failed to choose or lost their supplier of electricity under specified circumstances.
- WPSO (Abkhazia): Wholesale Public Service Organization (WPSO) is obliged to ensure the security of supply to customers in the occupied territory of Georgia (Autonomous Republic of Abkhazia) by purchasing electricity in the organized market.

  System operators (Procurement of losses): Electricity transmission system operator and electricity distribution system operators.

2. Regulatory and Business Framework

The most important legislation in the Georgian RE sector is the “Law on promoting generation and Consumption of Energy from Renewable Sources” [67]. The purpose of the law is to create legal grounds for the encouragement, promotion and consumption of energy received from renewable sources and determine the mandatory national common target indicators of the total share of energy received from renewable sources in the total final consumption of energy and in the consumption of energy by transport. The law provides legal framework and obliges the Georgian government to:

- Create a national action plan for renewable energy.
- Estimate the share of energy received from renewable sources with the standards provided by the law.
- Have statistical transfer and joint projects with the EU Energy Community.
- Develop support schemes in accordance with this Law and submit them to the Government of Georgia for approval. Before approval, to take into account competition principles, a support scheme shall be agreed with a state body authorised by the legislation of Georgia on state aid.
- Increase the capacity for renewable sources.
- Provide information support and trainings on RE topics.

2.1 Regulations on Micro Generation and RES

In March 2016, Article 23 on “Micro Power Plants” was added to the “Law on Electricity and Water Supply” [38]. By this definition, Micro Power Plants (MPP) in Georgia are those that do not exceed a capacity of 100 kW. Those changes were added to create a legislative basis for a net-metering scheme. In 2020, a new law, the "Law on Energy and Water Supply”, has changed the definition to 500 kW. They are owned by household or retail consumers and are connected to distribution networks. Net-metering is a scheme to increase connection to the grid of small wind, hydro and solar power stations. The introduction of the new net-metering scheme has led to a rise in installed capacity for the project which now exceeds 50 MW. The net-metering will be discussed more thoroughly in chapter 3.1.

2.2 CFD Contracts

On 7 December 2022, the government of Georgia issued ordinance 556 [68] on the “Approval of the Support Scheme for Generation and Consumption of Energy from Renewable Sources and Capacity Auction Rules”. This ordinance replaces previous ordinance No. 403 [69] and implements a system of CFDs on Georgian market. A contract for differences (CFD) is a financial contract that pays the differences in the settlement price between the open and closing trades. The scheme is in place to help incentivize investment in the RE sector: Instead of dealing with individual investors, the Georgian government will conduct open energy

auctions. The winners of the auction are the bidders with the lowest amount (if that amount is lower than the median amount determined at the auction). The contract will have a duration of 15 years. The agreement will be concluded between the energy producer and ESCO.
To receive this benefit, energy producers must sell the electricity on the open market. ESCO will repay the electricity producer any difference between the CFD agreed price and the price the electricity was sold. If the real selling price of electricity is higher than the agreed amount, the plant must pay ESCO the difference. The total amount of CFDs issued will be at 1,500 MW, 250 MW of which will be destined for solar use only. The first auction was conducted in the beginning of 2023 [70] for a total of 300 MW (70 MW for solar). Energy producers can cancel CFD contracts once every 5 years and should inform ESCO 6 months before the decision. Entities will become the beneficiaries of this scheme for the following months of each year:

- For a hydroelectric power plant – 8 months (September, October, November, December, January, February, March, and April);
- For a wind power plant – 9 months (August, September, October, November, December, January, February, March, and April);
- For a solar power plant – 12 months (January, February, March, April, May, June, July, August, September, October, November, December);
- For other renewable energy power plants – 12 months (January, February, March, April, May, June, July, August, September, October, November, and December).

Participants should provide accurate projections of electricity productions, as the difference between production estimate and real production will result in a decrease of CFD price. If the difference between forecast and real price is 10-15%, the price indicated in CFD will be diminished by 10%. If the difference between forecast and real production is 15-30%, the price of CFD will decrease by 30%. If the discrepancy between projected and real production exceeds 30%, the CFD cost will be decreased by 100%. To participate in the auction, the applicant should provide [71]:

- Information about the participating company (including information about all owners and interested parties)
- Preliminary study about the proposed project
- Estimated timeframe of project completion
- Bank guarantee – 10 000 GEL for every installed 1 MW of power
- Location of the object and main parameters
- Topographic map of the object
- Short geological data and geologic map of the site
- Seismic map and seismic data of the location
- Hydrological and meteoroidal data. For solar stations – solar irradiation data
- Estimates of energy production and production curves
- Preliminary assessment of environmental impact
- Information about the neighbouring infrastructure (roads, connections)

- Preliminary cost estimate of the project
- Economic assessment of the project
- Financial model of the company

The first auction took place in February of 2023 with the winning projects revealed at the beginning of May [55]. The auction yielded very low prices for all energy sources, especially for solar energy. 70 MW of solar generation were auctioned and the winning prices ranged from 0.053 USD per kWh to 0.059 per kWh. Similar auctions have been conducted for hydro and wind power stations and the prices for electricity from those sources have been higher (up to USD 0.0685 for hydro energy projects and up to USD 0.06 for wind energy projects).

Table 2 – Winners of first CFD auction – Solar energy

Name of the plant	Installed power	Cost per kWh (USD cents)
Udabno SPP	6 MW	5,3
Iliatsminda SPP	30 MW	5,35
GeoSteel SPP	20 MW	5,5
Badiauri SPP	2 MW	5,9
Sakhenisi 1 SPP	2 MW	5,9
Gamarjveba SPP	2 MW	5,9
Vardisubani SPP	2 MW	5,9
Kheda SPP	2 MW	5,9
Eldari SPP	2 MW	5,9
Sagarejo 1 SPP	2 MW	5,9

Source: Ministry of Economy and Sustainable Development of Georgia [72]

According to an announcement of the Ministry of Economy and Sustainable Development of Georgia in September 2023, further auctions are to be expected in the near future [73]. It was outlined, that the Ministry considers the CFD scheme as one of the main means to increase investments into the RE sector in Georgia. Currently, 1200 MW out of 1500 MW are still left to be auctioned and the Ministry expects high interest from private sector. The main obstacle for the CFD project to unfold its full potential is the launch of GENEX.

2.3 Guarantee of Origin certificate

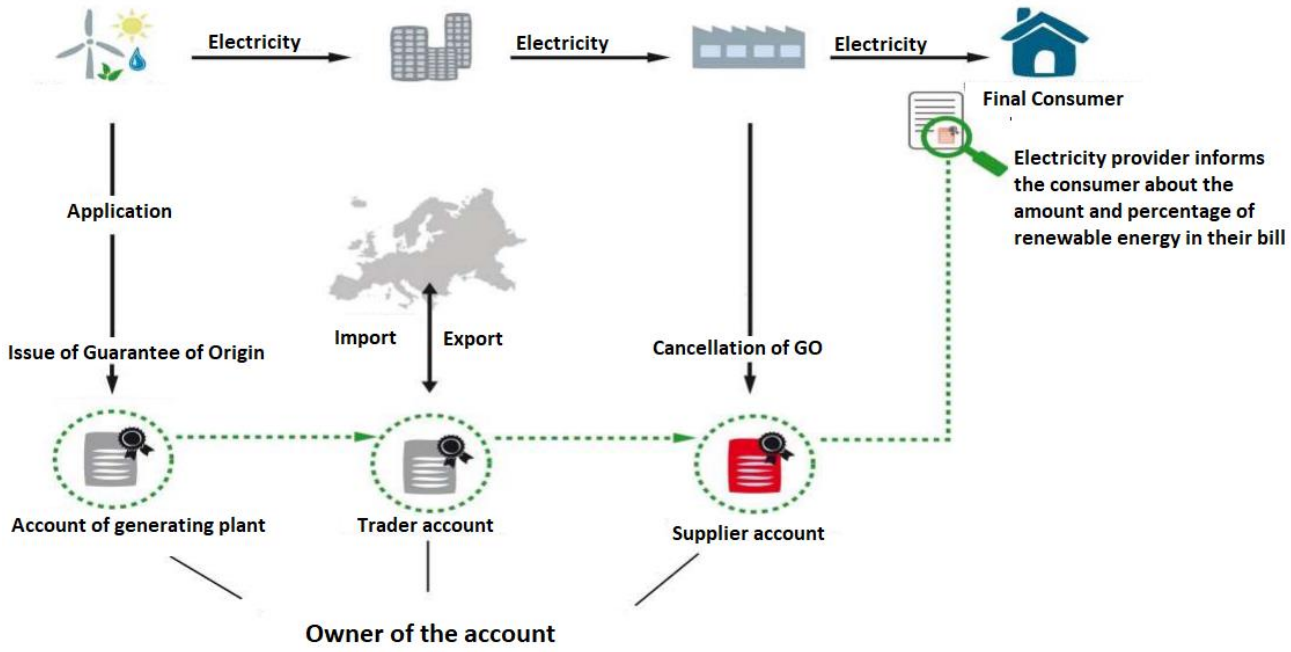
The certificate of origin is an electronic document that confirms that the share of electricity supplied to the customer is produced from renewable sources. Certificates are used to support the development of renewable energy sources and to encourage the use of renewable energy by energy suppliers and consumers [74]. The Georgian State Electrosystem signed an agreement with Grexel, a subsidiary of EEX Group, to go live with their national electronic registry for Guarantees of Origin on 1 December 2022. The system went live on 1 January of 2023 [75].

The certificate is not coupled with actual electricity being transmitted in the grid, it allows

consumers to choose the origin of their energy and in that way empowers them to contribute to the energy transition. They are also key for enabling corporate Power Purchase Agreements. The certificate will be issued by Georgian State Electrosystem to electricity producers registered in guarantee of origin programme for each megawatt hours of electricity generated.

The first certificate was issued in March 2023 and currently one supplier and 37 power plants including wind farms are registered [76]. The interest in certificates is very low on the Georgian market, but the demand is expected to rise substantially when the Georgian guarantee of origin trading scheme is integrated with the European guarantee of origin trading scheme.

Figure 19 - Guarantee of origin trading scheme

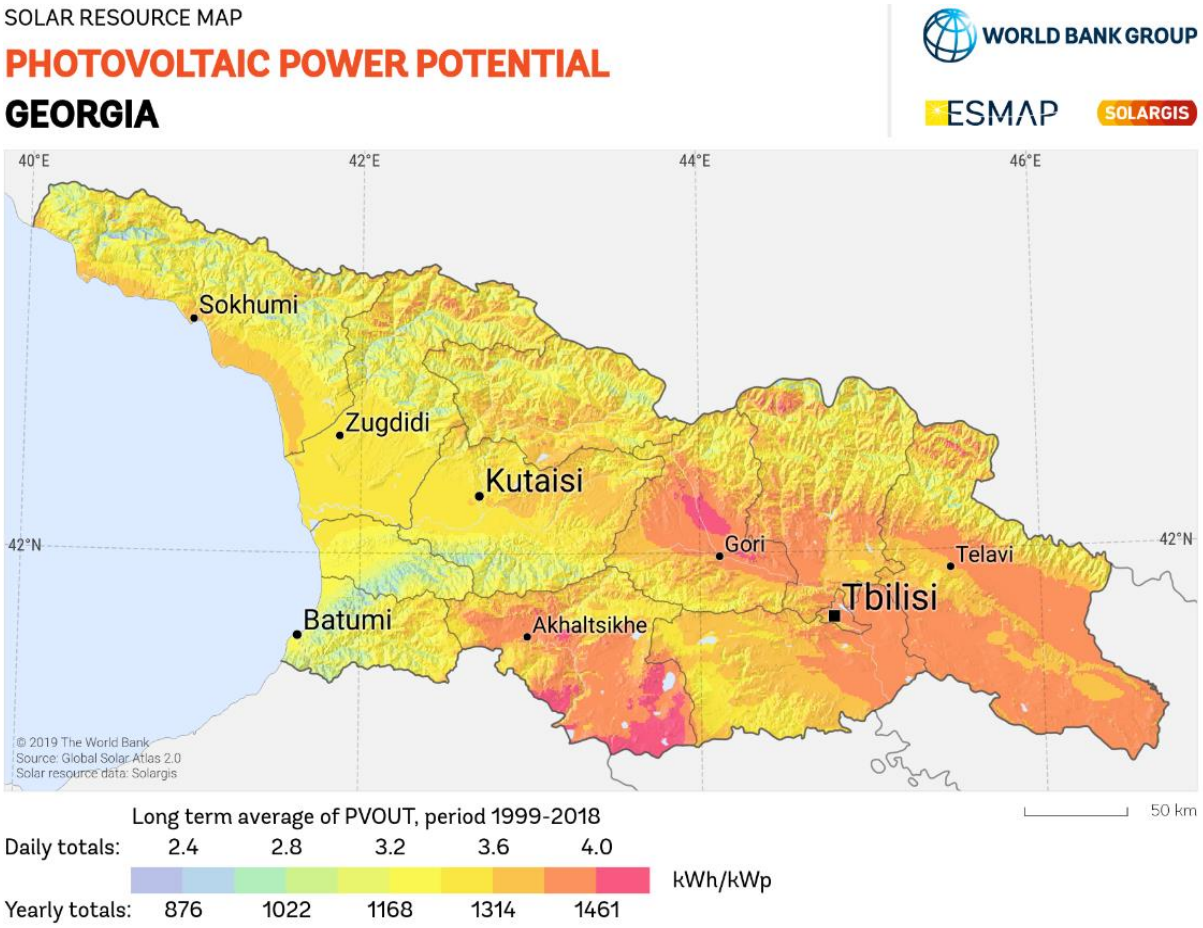


Source: ESCO [77]

3. PV in Georgia

Georgia is an ideal location for installing photovoltaic (PV) plants due to its geographical location and climate. Figure 20 illustrates that the eastern and southern regions of Georgia boast the highest solar energy potential. This is primarily attributed to the proximity to the equator and favorable climate conditions, making Georgia more conducive to solar energy compared to many northern and central European countries. Similar to southern European countries with high PV potential, Georgia stands out in terms of photovoltaic power potential. Notably, Tbilisi, the capital and economic hub of Georgia, falls within the 1250+ kWh/kWp solar irradiation zone. The southern part of the country is particularly promising, with a solar irradiation zone exceeding 1450 kWh/kWp. Although coastal and mountainous zones yield less than the Georgian average, they still outperform the average in most European countries [78]. Although coastal and mountainous zones yield less than the Georgian average, they still outperform the average in most European countries.

Figure 20- Map of Georgian PV potential



Source: World Bank Group

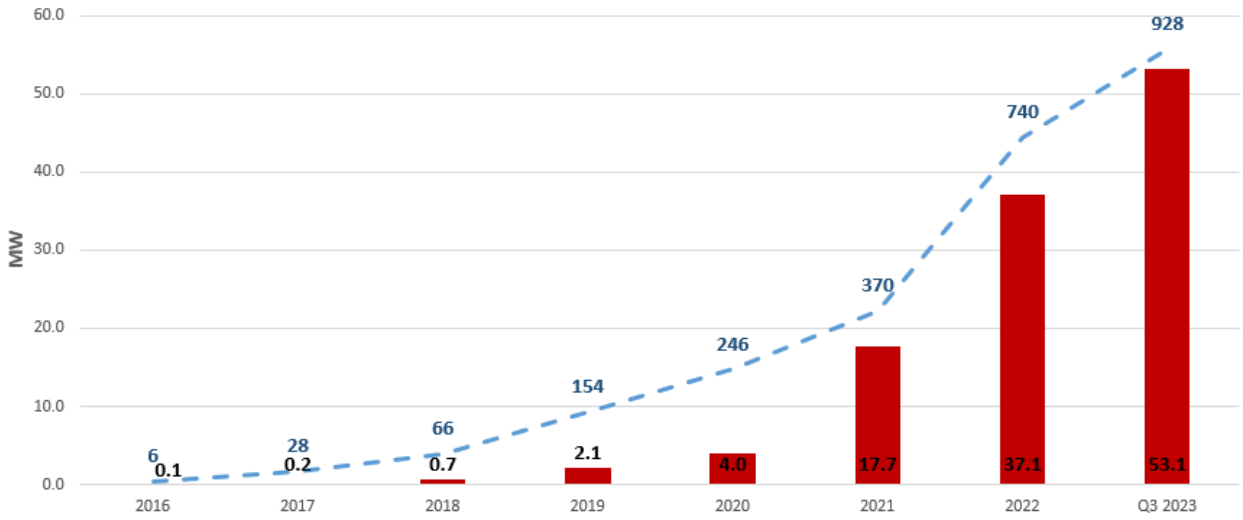
3.1 Micro solar power plants

As mentioned in chapter 2.1, in 2016, a net metering scheme was introduced and implemented in Georgia. At first, the maximum installed peak power allowance was 100 kW, but it was increased in 2020 to 500 kW to further facilitate adoption of the scheme by the market. The electricity supplied by the owner of the micro-generating power plant to the electricity network and the electricity received from the distribution network are metered separately by the reverse meter. Billing is conducted yearly in the month of May. The general conditions of net-metering are as follows [79]:

- If the micro-generating power plant generates excess energy and the amount of electricity supplied to the network exceeds the amount of energy received from the network, the difference, i.e. excess energy will be deemed as the energy supplied by the consumer to the network and will be credited to the next monthly bill.
- If the total amount of electricity generated by the micro-generated power plant and billed to the customer (supplied to the network) as a credit is lower than the amount of electricity received from the distribution network, the difference will be deemed as electricity purchased from the network and will be billed by the consumer tariff of relevant voltage/level;
- The electricity reflected as a credit in the bill of the final month at the end of the reporting year (from May to May) will be deemed as electricity purchased by the distribution network. Respectively, the company will make the final billing in accordance with the electricity purchase tariff set by the GNERC for the distribution license holder.
- After the end of the calendar year, the amount credited to the bill for the electricity supplied to the network may be reflected on the consumer's account and used for the next bill or upon their request, the company may transfer it to the bank account specified by the customer within three work days.

The scheme has been considered a success: market adoption rates are high and growing year-to-year. Figure 21 shows the increase of installations in terms of quantity of net-metering PV stations installed and total installed capacity of those stations from adoption in 2016 to August 2023. As can be seen from the chart, the largest increase occurred in 2020. The underlying factors of this increase were an increase of maximum installed peak power allowance from 100 kW to 500 kW and the increased cost of consumer electricity.

Figure 21 – Net metering PV station quantity and total installed capacity (in MW)



Source: GNERC

Yearly installation statistics of net-metering stations are not published, GNERC provide information after a request. Since the introduction of the net-metering scheme in 2016, almost 1000 private home owners and businesses have installed PV stations connected to the grid via net-metering. GNERC statistics do not differentiate between homes and businesses and only show total installed capacity. Small and medium businesses typically have PV stations ranging from 50 kW to 500 kW, with the average PV system capacity amounting to approximately 150 kW. The compelling economic incentive lies in the favourable retail electricity tariff of 0.32 GEL/kWh for businesses, enabling these installations to yield profits approximately four years post-installation. Private home owners feature smaller PV stations, typically with capacities of up to 8 kW, situated on rooftops. These installations, characterized by an extended payback period, are primarily motivated by long-term investments rather than immediate cost savings.

3.2 Utility-scale PV

Currently, there is no utility scale PV station on the Georgian market. In contrast with net-metering, private investors have been very reluctant to invest in large-scale PV. There are some projects in feasibility and pre-feasibility stages, e.g. the construction of a 100 MW solar power plant in the proximity of Tbilisi with funding from Masdar. As of 2023, none of the planned projects has become operational [80].

The following factors can be cited as the main obstacles for utility scale projects to become operational:

- Low costs of electricity on the Georgian market – it is not profitable to sell electricity at the current balancing electricity costs. Investors need to agree on power purchase agreements (PPAs) to make the investment profitable.
- Uncertainty related to the liberalization of the electricity market – investor confidence will only be established once the electricity market is fully liberalized.

- Uncertainties with permits – as there are no utility scale PV stations built yet, it is unknown what challenge investors might face, be it with construction permits, grid connection permits or other related issues.
- Unwillingness from financial institutions to finance utility scale PV – due to the factors described above both local and international financial institutions are reluctant to finance utility scale PV plants.

3.3 Value Chain

Georgia currently lacks local production facilities for photovoltaic (PV) panels and inverters. Notably, a modest PV plant situated in the western city of Kutaisi, established by the German company AE Solar in collaboration with Chinese partners, was designed for the international market [81]. Capitalizing on Georgia's free trade agreements with the USA, Europe, and China, the plant aimed to import PV components into Georgia for assembly and subsequent sale in Western markets. However, the plant encountered managerial challenges, rendering it non-operational as of Q3 2023. While certain components, such as cables and mounting structures, can be sourced from local Georgian suppliers, the predominant practice involves ordering these items from Chinese manufacturers. Official information is not available, but EPC companies state, that in most cases the cost per kilowatt (kW) for a 100 kW PV station hovers around $600/kW. Most PV installers maintain a small stock in the country but rely on imports for the majority of installations.

Official data on the prevalent brands used in Georgian PV stations is unavailable. Nevertheless, industry insights indicate that JA Solar, Yingli Solar, Seraphim, and Leapton Energy are commonly utilized for PV panels, while Huawei, Fronius, and Solis dominate the inverter market. EPC (Engineering, Procurement, and Construction) companies operating in Georgia typically establish direct communication links with PV suppliers and often hold official dealership status for their preferred manufacturers in the Georgian market. Huawei, with an official dealership and limited stock in Georgia, enjoys a competitive advantage due to shorter lead times in case of in-warranty malfunctions [82].

Despite the absence of official data on the total installed power by EPCs (Engineering, Procurement, and Construction companies), information collected directly from interviews with industry players identifies key market leaders. Prominent entities include Helios Energy, Sun House, Innovation Energy LLC, and Green Energy Georgia. These companies, with several years of operation, have consistently held leadership positions. The surge in electricity prices in 2021 ushered in the entry of new companies into the PV market, ranging from startups to Georgian branches of established foreign firms.

Helios Energy, founded in 2017, aspires to achieve energy independence for both Georgian citizens and the country itself. The company, boasting a partnership with German firm IMS Erneuerbare Energien GmbH since 2018, has installed approximately 14 MW in net metering installations and has become a well-known entity in the public sphere. Notably, Helios Energy's co-founder, Tornike Darjania, frequently appears in news broadcasts and television programs, contributing to the company's widespread recognition. Additionally, Helios Energy has established Helios Academy, offering a two-month training course in the renewable energy field, energy efficiency, and eco-mobility [83].

Green Energy, established in 2016, claims to be the largest PV company in Georgia, having installed around 17 MW of PV stations. With a notable presence in neighbouring Azerbaijan and direct ties to the Yingli manufacturing factory in China, Green Energy engages in international tenders. While currently focused on self-consumption projects, the company aims to venture into large-scale solar farms in southern Georgia. Despite facing challenges in progressing beyond the pre-feasibility stage for a proposed 15 MW PV farm, Green Energy aims to be the first PV company in Georgia to sell electricity directly to end-users [84].

Sun House, operational since 2011, holds the distinction of being the oldest company in the Georgian PV sector. Specializing in both PV and solar water heating system installations, Sun House primarily targets the small PV market. Sun House often undertakes off-grid installations in remote and mountainous regions where the electricity grid is unavailable [85].

Innovation Energy LLC, an emerging player founded in 2016, distinguishes itself through its extensive expertise garnered from global partners. As of Q3 2022, the company has installed a total power capacity of 3 MW, with projections indicating a substantial increase in installations in 2024, driven by participation in internationally funded projects. Innovation Energy actively promotes solar power through various events that bring together diverse stakeholders [86].

A noteworthy segment of the Georgian PV sector comprises installations executed without the involvement of PV suppliers. This approach, driven by the ease of ordering components from China, allows companies with knowledgeable staff in electrics to undertake the installation, potentially saving up to 10-20% of total installation costs, particularly for larger net metering projects.

3.4 Incentives

For micro net-metering stations, numerous financial incentives are available to small and medium enterprises. Prominent institutions within the Georgian banking sector offer specialized packages for photovoltaic (PV) installations [87][88]. These incentives encompass preferential interest rates, reduced collateral requirements, and the exemption from loan disbursement fees. Notably, Georgian banks leverage financing from international financial institutions such as GEFF, EBRD, or GGF, facilitating the allocation of funds from these international entities to their consumer base. The Georgian banking sector exhibits a proclivity for disbursing loans for net-metering installations, given the clear advantages for consumers and the minimal financial risks involved, considering that the company installing the station already has inherent electricity consumption. In light of the comprehensive financial incentives, loans for net-metering PV stations likely represent the most economical form of credit accessible to SMEs in Georgia. The primary financial incentives for SMEs are:

- EU4Business

  The EU4Business-EBRD credit line is a joint initiative of the European Union and the European Bank for Reconstruction and Development to support Georgian SMEs with no more than 249 employees to access finance. The programme includes investments in fixed assets. After the successful project verification, the company receives up to 15% (in most cases 10%) of the loan value as a grant incentive, funded under the EU4Business initiative of the European Union [89].

- Enterprise Georgia

  Under the auspices of the "Enterprise Georgia" program, there exists a subsidy mechanism wherein the program subsidizes the interest on loans for the entire duration. The subsidy amount is determined by subtracting 5% from the National Bank of Georgia's refinancing rate. As of Q3 2022, this calculation results in a subsidized interest rate of 4.5% (9.5% - 5%). In practical terms, this initiative significantly reduces the cost of interest on loans for small and medium enterprises (SMEs). Additionally, the program offers the opportunity to access supplementary benefits within the insurance domain [90].

- Green Economy Financing Facility (GEFF)

  The Green Economy Financing Facility (GEFF) provides finance and advice to help businesses become more competitive and households to reduce residential energy costs by investing in high-performance technologies and adopting energy efficiency practices. The technology selector developed by GEFF helps potential consumers to choose trusted and already tested PV technology [91].

Financial incentives for utility-scale solar projects are comparatively limited, primarily due to the substantial scale of these endeavours, which necessitates project developers to secure financing independently. On the legislative front, Contract for Difference (CFD) agreements and the issuance of Guarantee of Origin certificates can be cited as utility-scale photovoltaic (PV) projects.

3.5 Trainings and Educational Opportunities

Currently, the primary impediment to the development of hydropower plants in Georgia stems from social protests typically associated with such constructions [92]. This challenge has not surfaced in the context of photovoltaic (PV) power plants, potentially attributable to the smaller scale of PV installations, often on private property. Although no formal studies have explored this preference, a prevailing perception in Georgia suggests a greater societal inclination towards solar as an electricity source due to its perceived futuristic nature and perceived fewer downsides compared to hydroelectric power.

Enhancing awareness among the Georgian population and energy industry stakeholders regarding PV technology and advanced financial and engineering methods employed in more developed markets is deemed crucial. Various organizations, such as the Georgian Technical University, offer knowledge and training in the PV domain. Despite the university's energy faculty having modern facilities and collaborations with prominent industry players, it lacks a dedicated course on photovoltaics [93]. Additionally, governmental initiatives, such as the collaboration between the Minister of Economics and Sustainable Development, Gesellschaft für Internationale Zusammenarbeit (GIZ), and LTD "Sun House," aim to establish certification criteria for renewable energy installer training programs, ensuring standardized education in the sector [96].

Several institutions contribute to the education and training landscape in the renewable energy sector in Georgia. The Helios Academy, initiated by Helios Energy, offers courses emphasizing solar energy, its potential, and prospects for development in Georgia. This includes practical lessons, enabling participants to design, build, and monitor solar power plants [97]. The Elizbar

Eristavi Energy Training Center, established by the Georgian National Energy and Water Supply Regulatory Commission (GNERC), provides courses such as the "Energy Media Club" and "Fundamentals of Regulation in the Energy and Water Supply Sectors," offering a comprehensive understanding of the energy market beyond PV [98].

Furthermore, the USAID Securing Georgia's Energy Future Program, operational since 2020, supports the modernization of Georgia's energy infrastructure and encourages investment in climate-friendly energy sources, including wind and solar. The program conducts various events, discussions, mentorship programs, and training sessions to facilitate knowledge exchange and promote renewable energy [100].

Despite these educational programmes, there exists a knowledge gap among certain participants in the PV market. Owners of small and medium businesses often lack information about the advantages of net-metering PV stations and the opportunities offered by Contracts for Difference (CFDs) for small PV installations.

3.6 Opportunities on the Wholesale Market

The incorporation of Contracts for Difference (CFD) contracts has proven transformative for the utility-scale photovoltaic (PV) sector in Georgia. As previously indicated, numerous companies have successfully secured bids in auctions and are in the process of planning the establishment of the first utility-scale PV stations in the country. The concluded auction prices do introduce an element of uncertainty, as some projects may prove financially unviable; however, it is essential to acknowledge that such risks are inherent to CFD contracts across various markets [102]. Future CFD auctions are scheduled, ensuring the procurement of contracts for additional projects. The inception of this burgeoning market may serve as a significant impetus for the integration of PV into the wholesale market. With the liberalized market yet to be launched, predicting potential investments remains contingent upon the prevailing electricity costs on the GENEX market. The nascent stage of utility-scale PV development also renders certain opportunities more appealing. Following the installation of initial stations, the land most suitable for utility-scale PV installations is expected to appreciate, and European experiences indicate the potential emergence of grid capacity constraints; however, these challenges are anticipated to be less pronounced for the first entrants into the market [101].

3.7 Opportunities on the Net-Metering Market

Observing the prevalent popularity of net-metering installations, it is plausible to anticipate continued growth within the net-metering market. However, it is essential to recognize that there exists a constraint on the capacity that the Georgian electricity grid can accommodate. For reasons related to grid stability, the Georgian National Energy and Water Supply Regulatory Commission (GNERC) implemented a countrywide limit for net metering allowances, initially set at 2% of the total installed capacity in 2016. Subsequently, this limit was augmented to 4% in 2021 to align with the concurrent rise in the total installed capacity. Conversations with grid operators affirm that, at the present level, net-metering has not engendered any grid instability. With the extant regulatory framework, the total installed capacity of net-metering photovoltaic (PV) plants could conceivably reach approximately 120 MW. Following the attainment of this threshold, regulatory bodies will engage in discussions regarding the potential allowance of additional capacity.

4. Conclusion

Georgia has historically relied on hydropower for electricity generation, but the country is now working to diversify its sources of electricity. Since joining the EU energy community in 2014, Georgia has been implementing reforms to open up and modernize its energy market in line with EU standards. The goal is to achieve energy independence and reduce network losses by upgrading the country's transmission, distribution, and generation infrastructure. Georgia is committed to reducing its total greenhouse gas emissions by 50-57% by 2030 compared to 1990, with a significant focus on decreasing reliance on thermal power plants for electricity generation.

Closer integration with the EU and the potential future status as an EU membership candidate are bringing EU standards and regulations to the Georgian energy sector and the economy overall. The implementation of the EU energy community third package is gradually transforming the Georgian electricity sector into a more liberalized market structure. While the transition has taken longer than expected, and the launch of a new energy market has faced delays, efforts from government officials aim to ease this transition. High-level decision-makers unanimously agree that liberalization is crucial for the Georgian energy market and will eventually be implemented.

Renewable energy (RE) support schemes, including Contracts for Difference (CFD), underscore the political will to diversify the country's energy sources and increase the total installed photovoltaic (PV) capacity. Information on electricity market rules and regulatory procedures is widely available in English on government and corresponding agencies' websites. The Georgian electricity sector maintains high overall data transparency, allowing access to up-to-date statistics and developments in English.

Potential investment opportunities, such as CFD auctions, are conducted transparently with well-defined regulatory requirements and rules. The auction dates are announced in advance, giving potential participants sufficient time to gather the required documents, and the winners are publicly disclosed along with their winning bids. The issuance of building and environmental permits follows clear criteria, and government agencies tightly control grid connection terms and costs to prevent excessive negotiating power for grid operators.

Net-metering has proven successful for photovoltaic installations, introducing PV technology to the market and demonstrating its profitability in Georgia. The CFD scheme aims to introduce utility-scale PV to the Georgian market, paving the way for larger PV power stations. Georgia's favorable climate conditions, undergoing energy market liberalization, and transparent legislation make it an attractive destination for foreign PV investment., which will be crucial for making Georgia energy independent.

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