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ENERGY TRANSITION ASSESSMENT
GEORGIA

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ABOUT IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

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ENERGY
TRANSITION
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GEORGIA

Foreword

from the Minister of Economy and Sustainable Development of Geogia

As Georgia continues to align with global climate commitments, including its Nationally Determined Contributions under the Paris Agreement and the ambitious goals set out in the National Energy and Climate Plan (NECP), this energy transition assessment for Georgia serves as a critical roadmap for action.

This report highlights the challenges and opportunities in Georgia's energy sector, outlining the major role of renewable energy sources in reducing dependency on fossil fuel imports, strengthening energy security and promoting economic growth. With rich hydropower – and significant wind and solar - potential, as well as biomass and geothermal resources, Georgia possesses the natural benefits necessary to drive a low-carbon energy transition. However, realising this potential requires a co-ordinated approach to governance, policy implementation and financial mobilisation.

Climate action remains a key element of Georgia's energy strategy. The transition to renewables is not only an economic and energy security obligation, but also a commitment to reducing climate change and promoting environmental sustainability. This report provides valuable insights on integrating climate aspects into energy planning, supporting innovative approaches, and ensuring the energy transition is fair and inclusive. By implementing the recommendations outlined in this assessment - extending from improving governance frameworks to strengthening grid flexibility and assisting financial mechanisms - Georgia can accelerate its progress toward a clean and secure energy future.

These findings and recommendations are meant to provide a basis for policy makers, investors and stakeholders to collaborate to implement necessary reforms. As Georgia initiates this significant transformation, sustained collaboration between government institutions, private sector stakeholders and international partners will be essential to overcoming challenges and realising the full potential of renewable energy. We expect this report will serve as a guiding framework in advancing Georgia's energy transition, further establishing its leadership in sustainable energy across the region.

Levan Davitashvili

First Vice Prime Minister

Minister of Economy and Sustainable Development of Geogia

Foreword

from the IRENA Director-General

As the world approaches 2030, the goal to triple renewable energy capacity and double energy efficiency requires collaborative, cost-effective approaches to development, backed by an affordable and climate-resilient energy supply.

In Georgia, there are compelling arguments for the accelerated uptake of renewable energy. The resultant diversification of the country's energy mix would improve energy security, reduce the energy trade deficit, and deliver socio-economic benefits by improving energy access, boosting local value chains, establishing new regional partnerships and expanding workforce skills. Furthermore, the diversification of the energy mix through increased use of abundant solar, wind and biomass resources would also contribute to increasing the country's competitiveness in the region.

This assessment, produced in close co-operation with the Ministry of Economy and Sustainable Development, aims to inform Georgia's progress towards meeting its climate and energy commitments for 2030. It also aims to support the development of the country's upcoming NDC 3.0 by providing recommendations for alignment of targets, policies and measures in the energy sector with the recently approved National Climate and Energy Plan (2026-2030).

This report recommends tailored actions and provides best practices for decarbonising end-use sectors, empowering municipalities to take an active role in deploying renewables and establishing a dedicated fund to facilitate access to tailored financing for sustainable energy investments. It also provides targeted actions to enhance effective governance, facilitate the integration of renewable power, contribute to local value creation and capacity building, and ensure a just and equitable energy transition.

IRENA is grateful to the Georgian authorities for their support – particularly the Ministry of Economy and Sustainable Development – and to the local and regional stakeholders whose insights have enriched this study. I am confident that the actions and recommendations presented herein will help to advance the energy transition, and strengthen both energy security and climate resilience in Georgia.

Francesco La Camera

Director-General

International Renewable Energy Agency

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Abbreviations

BESS	battery energy storage systems
CfD	contract(s) for difference
ESCO	electricity market operator
ETA	energy transition assessment
GEL	Georgian lari
GHG	greenhouse gas
GNERC	Georgian National Energy and Water Supply Regulatory Commission
LCOE	levelised cost of electricity
LT-LEDS	long-term low-emission development strategy
LULUCF	land use, land-use change and forestry
MEPA	Ministry of Environmental Protection and Agriculture (of Georgia)
MoESD	Ministry of Economy and Sustainable Development (of Georgia)
NDC	nationally determined contribution
NECP	National Energy and Climate Plan
PV	photovoltaic
R&D	research and development
REDII	Renewable Energy Directive
TYNDP	Ten-Year Network Development Plan
UNFCCC	United Nations Framework Convention on Climate Change

Executive summary

Georgia is located in the Caucasus region, at the intersection of eastern Europe and western Asia. It is endowed with forests and water resources, with over half the country's land area covered by forests and more than 26 000 rivers flowing within its territory. As such, the country's domestic energy production is largely based on hydropower production and biomass. Nevertheless, domestic energy production accounts for less than a quarter of the country's total primary energy supply. This share has been declining over the past decade both in absolute and relative terms, increasingly jeopardising the country's energy security as the country is increasingly dependent on energy imports to meet energy demand. Over half the energy imports are natural gas and one-third are oil products. For the supply of these primary energy sources, the country is almost entirely dependent on the imports as it has negligible domestic reserves of the same. Overall, Georgia's energy sector is largely dominated by fossil fuels.

Although Georgia's power sector is largely based in hydropower, non-hydropower renewable energy is at a nascent stage of development in the country. However, Georgia is well endowed with renewable energy resource potential that presents a viable and sustainable pathway for the development of the energy sector. The accelerated development of locally available renewable energy sources has the potential to increase Georgia's energy security, ensure Georgia's competitiveness in regional and global markets, reduce the country's energy trade deficit, address energy poverty, support local value chain creation and align Georgia with its international commitments.

An energy transition through renewables could bring many benefits for the country. However, the development of Georgia's renewable energy sector faces several challenges in terms of energy sector governance, assessment of renewable energy resource potential; integration of renewables into the power system; decarbonisation of industry, buildings and transport; access to finance; consumer empowerment; and availability of a skilled workforce. With a view to addressing the key challenges identified through the energy transition assessment for Georgia, this report presents a set of short- to medium-term actions that would accelerate the deployment of renewable energy technologies and facilitate Georgia's energy transition.

Facilitating consolidated energy and climate planning

Georgia's energy and climate sector planning has faced delays in development and inconsistencies among various documents. For example, Georgia's nationally determined contribution (NDC) lacks clear renewable energy and efficiency targets and is therefore misaligned with the more ambitious National Energy and Climate Plan (NECP) and long-term low-emission development strategy. As a result of dedicated analysis to the alignment of Georgia's climate ambitions in the NDC and NECP, several targeted actions are focusing on supporting the development of the Georgian NDC 3.0. Inconsistencies in sector classifications and baselines hinder progress tracking and stem from the absence of a dedicated planning team to ensure co-ordination between key stakeholders. A permanent planning team with sufficient technical and human resources would enhance co-ordination, ensure consistency across planning documents, and interpret various planning scenarios for improved policy decision making.

Establishing an implementing body for the energy transition

For Georgia to accelerate its energy transition, the necessary renewable energy and energy efficiency measures and plans require implementation mechanisms that span beyond the current institutional structures of the energy sector. In some cases, institutions do not have either the legislative mandate or the technical capacity to facilitate the implementation of certain energy transition measures. The establishment of a dedicated implementing body, such as an energy transition agency, is therefore of great importance for the implementation of renewable energy and energy efficiency measures.

Facilitating an active role for municipalities in the energy transition

Municipalities play a key role in energy sector development by implementing local energy solutions, fostering investment and engaging citizens in the energy transition. However, Georgian municipalities lack the formal mandate, institutional capacity and financial resources to effectively contribute to the energy transition. Despite commitments under the Global Covenant of Mayors for Climate and Energy, only 12 out of 33 signatory municipalities in Georgia have developed sustainability plans, citing a lack of technical capacity and financial barriers. Limited financial decentralisation and restricted access to funding further hinder the municipalities' ability to implement energy and climate plans. It is therefore recommended that the role of municipalities in the energy transition, specifically pertaining to energy efficiency and renewable energy development, is clearly defined and mandated within Georgian legislation, along with clear annual budget allocations for this role. Provisions should also be made to increase institutional capacities and human resources at the municipal and/or regional level, which would facilitate municipalities engaging proactively in energy planning and project implementation.

Geospatial planning for large-scale generation projects

In its power planning, Georgia does not holistically include all elements of geospatial planning and the techno-economic potential of renewable energy zones. Generation capacity expansion for variable renewable power is planned based on resource assessments that indicate general areas of the country that have a high resource potential for wind power or solar power development, but not exact project development zones that can be prioritised and quantified by their techno-economic power generation potential. Generation capacity expansion and network planning therefore risks not fully recognising the highest-potential zones for renewable power development. Upon request from the Ministry of Economy and Sustainable Development, IRENA has mapped the most promising renewable energy zones for large-scale solar and wind power development, with their corresponding techno-economic parameters, and estimated the theoretical hydropower potential for Georgia based on the Global Atlas for Renewable Energy datasets. It is recommended that these renewable energy zones are incorporated into geospatial power planning tools and that geospatial planning for variable renewable power generation is integrated into the wider power system planning models, informing generation capacity expansions as well as network development plans.

Increasing grid flexibility to accommodate variable power generation

Georgia's power system faces flexibility and reserve shortages, making grid stability a challenge. With rising electricity demand, especially around Tbilisi, and the planned increase in variable renewable energy, the grid remains highly susceptible to disturbances and outages. The last two auction rounds have yielded a renewable energy pipeline of over 1 gigawatt (GW) total installed capacity, expected to be developed and connected to the grid by 2030. The Georgian power grid system therefore needs to urgently increase its flexibility by adding fast and flexible power reserves that can manage intra-day intermittencies of variable renewable power production. Flexibility can be increased with pre-emptive demand-side management, the addition of pumped storage hydropower plants and battery energy storage systems and the eventual development of green hydrogen systems – all of which can provide versatile energy storage solutions for fast and flexible ramping, frequency regulation, black start, load shifting and capacity firming.

Incentivising renewable power development through support schemes

Georgia currently supports renewable power projects under 500 kilowatts through a net-metering scheme, while larger projects rely on the contracts for difference (CfD) mechanism or direct contracting. According to the European Union *acquis*, beyond 31 December 2026, the issuance of new connections under the net-metering support scheme will no longer be permissible. To ensure continued adoption, regulatory revisions should extend support beyond 2026, encourage residential participation, and transition from net metering to net billing to prevent cross-subsidisation. For larger projects, delays in electricity market reforms have affected CfD mechanisms, and further auction rounds have been halted in favour of direct contracting at previously determined median prices, which may pose financial risks. To maintain market efficiency and grid stability, periodic auctions should be reinstated to facilitate price discovery and better network planning.

Developing a comprehensive decarbonisation strategy for heating and cooling in buildings and industry

The consumption of heat as a share of the total final energy consumption in Georgia is considerable, especially in the residential and industry sectors, and is predominantly fuelled by natural gas. Despite the crucial importance of decarbonising the heat supply, Georgia's NECP sets decreasing targets for the share of renewable energy in heat supply as it limits the role of renewables and focuses on expanding natural gas supply and introducing energy efficiency measures to reduce heat consumption. Further hampering the incorporation of renewables in heating is a lack of comprehensive assessments of heat energy supply and demand, including technical and economic assessments of different energy sources, technologies and systems for heating applications, both in the residential and industrial sectors. A comprehensive assessment of Georgia's heat energy supply and demand is therefore recommended, along with analysing the technical and economic potential of various renewable energy sources for heating, improving energy efficiency in buildings and industry, supporting the electrification of heating, and supporting bioenergy and other sustainable heating solutions.

Incentivising the decarbonisation of transport

Georgia's transport sector is heavily reliant on fossil fuels, making its decarbonisation essential for meeting climate targets, with a goal of achieving a 10.45% renewable energy share in the sector by 2030. While fiscal incentives have led to a modest increase in electric and hybrid vehicle adoption, further expansion is hindered by high initial costs and a lack of fast-charging infrastructure; measures are therefore required to boost investment returns and demand. To address the affordability of electric and hybrid vehicles and charging stations, tailored loans are to be introduced that would facilitate greater access to finance and fast-charging stations are to be incorporated within spatial plans at municipal levels. Beyond transport electrification, biofuel blending is a key measure for achieving renewable energy targets while enhancing energy security and rural development. However, the lack of a clear strategy, a feedstock assessment and biofuel production infrastructure – along with restrictions on waste imports – hinders the implementation of biofuel blending; policy development and sustainable sourcing solutions are therefore necessary to support its increased use.

Establishing a revolving fund for renewable energy and energy efficiency

Access to finance is a major challenge in Georgia, with high interest rates, complex loan procedures and high collateral requirements limiting investment in energy efficiency and renewable technologies. The challenge is further exacerbated by low electricity and natural gas tariffs, especially for residential consumers, which necessitates longer payback periods and longer loan tenures for investments in decentralised renewable energy technologies and energy efficiency. Municipalities too lack dedicated financing mechanisms for energy-related investments, such as investing in the energy efficiency of public buildings, which reduces their ability to develop or implement sustainability plans. The establishment of a dedicated revolving fund or facility for renewable energy and energy efficiency is recommended to support citizens, businesses and municipalities in readily accessing tailored financing for sustainable energy investments. Such financing options should be long term, lower cost and denominated in local currency.

Developing de-risking instruments for renewable energy projects

Regulatory unpredictability is reported as an element of risk in investing and accessing finance and is further exacerbated by the abrupt halt of long-term power purchase agreements in favour of CfD. However, with the delays in electricity market reform, the CfD mechanisms are currently based on the internal balancing market, whose trading prices are significantly lower than the prices of the winning bids of wind and solar power projects. As such, off-taker risk becomes an increasing perceived risk for financing, which impacts the bankability of such projects in the long term. It therefore becomes increasingly important for periodic auction rounds to be held to rediscover the market prices for large-scale projects. Such auction rounds should be announced in good time so that developers can prepare their bids and financing in a timely manner. De-risking large-scale projects and increasing their bankability can also be advanced by streamlining contractual agreements and aligning them to international standards as well as ensuring streamlined permitting procedures.

Defining research and development needs to support local value chains

In Georgia's NECP, there are no specific funding targets on public expenditure related to research and development (R&D). There is also a lack of clear policy measures on how R&D in the energy sector will be developed and implemented, which areas of research would be of focus and which institutional capacities would need to be strengthened to execute the necessary R&D. Inadequate research and analysis is a limiting factor for the energy sector's development and is increasingly risking underdevelopment of the skilled workforce and local resource potential needed to meet national energy and climate ambitions. A strategic plan for R&D areas is therefore necessary to take full advantage of local resources, satisfy industry needs and support the achievement of NECP targets. Research should also prioritise assessments of the potential for local value chain creation and of decarbonisation of heating and transport, along with techno-economic assessments of critical minerals and sustainable energy resources.

Building a skilled workforce for renewable energy and energy efficiency

The shortage of qualified personnel and the mismatch of skills with industry requirements have been a persistent and crucial challenge in all the productive sectors in Georgia, and an inadequately skilled workforce has been cited as the third largest obstacle to business development in Georgia. According to the latest labour market survey, a notable decline has been observed in the number of active students and graduates of higher education programmes in the field of energy, as well as a lack of energy service providers and of technical and training staff who can facilitate training programmes in energy. It is therefore of crucial importance for targeted certified retraining and vocational programmes to be developed as soon as possible to meet immediate industry demands and for more enrolments to be achieved in education and training programmes in renewable energy (including STEM, non-STEM and vocational programmes).

Facilitating the establishment of renewable energy communities

Renewable energy communities currently do not exist in Georgia given that there is no legal basis for their establishment; this undermines citizens' ability to contribute to and fully benefit from the energy transition. It is recommended that the concept of renewable energy communities is carefully developed to ensure that the mode of operation adheres to democratic governing principles that prioritise environmental, social and economic benefits for the wider community and facilitate the inclusion of energy-poor and vulnerable households.

Defining energy poverty and pathways to its alleviation

In Georgia, energy poverty is estimated to affect up to 43% of the population (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024). Some of the main drivers for energy poverty are the low energy efficiency of the building stock; lack of access to alternative and modern technologies, especially for heating; and the over-subsidisation of natural gas, which undermines efficient energy consumption and the competitiveness of alternative energy technologies. Despite being widespread and of crucial importance to alleviate, there is no legal definition of energy poverty in Georgian legislation, which impedes the identification and alleviation of the root causes of energy poverty. It is therefore recommended that a definition of energy poverty, in the Georgian context, is developed and legally adopted, along with energy poverty indicators and methodologies for identifying energy-poor households that would be eligible for subsequent support mechanisms. Moreover, the gradual phasing out of natural gas subsidies is necessary in order to redivert funds into support schemes that would address the underlying causes of energy poverty and encourage more efficient energy usage.

1 Energy sector overview

This energy transition assessment for Georgia provides a comprehensive overview of the Georgian energy sector, with particular focus on the conditions for accelerated renewable energy deployment in the country. The report begins by outlining the main characteristics of the energy sector, such as energy supply and demand, the potential of energy resources, the regulatory framework, and energy prices and subsidies. The second section of the report highlights the main rationale for the energy transition in the country: increasing energy security, enhancing market competitiveness, reducing the energy trade deficit, addressing energy poverty and supporting local value chains. Finally, a section on challenges and recommendations focuses on key short- to medium-term actions in the six following areas: effective governance, integration of renewable power, decarbonisation of end-use sectors, financing the energy transition, local value creation and capacity building, and consumer empowerment and just transition. A detailed report methodology is elaborated in Annex 1, and the supplementary data in the remaining annexes provide a wider perspective on the energy transition in Georgia.

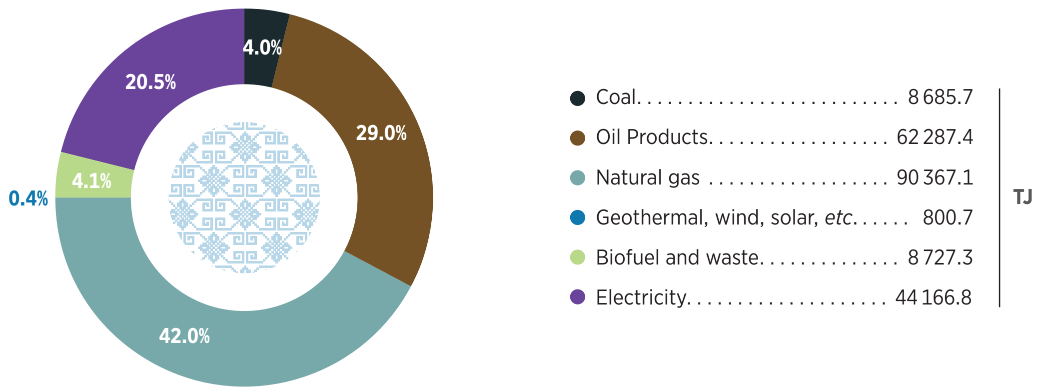
1.1. Energy supply and demand

Georgia is located in the Caucasus region, at the intersection of eastern Europe and western Asia. Its topography is predominantly mountainous; more than 26 000 rivers flow through the country, and over half the land area is covered by forests. Being rich in water and forest biomass resources, the country's domestic energy production is largely based on hydropower and fuelwood.[1] However, domestic energy production in Georgia accounts for under a quarter of the total primary energy supply (National Statistics Office of Georgia, 2024a), and this share has been declining over the past decade both in absolute and relative terms, increasingly jeopardising the country's energy security. To meet its rising energy demand, the country is increasingly reliant on fossil fuel imports. Well over half of all energy imports are natural gas, and one-third are oil products (National Statistics Office of Georgia, 2024a).

Georgia's final energy consumption is highly fossil fuel based. According to the latest energy balance of 2023 (see Annex 2), and as illustrated in Figure 1.1, natural gas composes the largest share (42.0%) of the final energy consumption, followed by oil products (29.0%), electricity (20.5%), coal (4.0%), biofuel and waste (4.0%) and, to an almost negligible extent, other renewable energy sources (National Statistics Office of Georgia, 2024a).

[1] *"Fuelwood is wood that is harvested from forestlands and combusted directly for useable heat in the residential and commercial sectors and power in the electric utility sector" (Wright et al., 2012: 263).*

Figure 1.1 **Gross final energy consumption by energy type (TJ), 2023**



Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

The residential and transport sectors are the country's largest energy consumers, each accounting for close to a third of final energy consumption[2] (National Statistics Office of Georgia, 2024a). The transport sector is the largest consumer of oil products but also relies on natural gas for road transport and, to a very small extent, on electricity, mainly for rail transport. The residential sector is the largest consumer of natural gas (National Statistics Office of Georgia, 2024a), which is the predominant energy source for heating applications[3] and is prominently used in urban rather than in rural settings (National Statistics Office of Georgia, 2023). The residential sector is also the sole consumer of biofuels and waste, largely in the form of fuelwood[4] (National Statistics Office of Georgia, 2024a), which is more widely used in rural households. The industrial sector has a large demand for heating. Over half the sector's energy demand is met by coal and natural gas, used mainly for heat applications in iron and steel production, in non-metallic mineral processing, and in the food and beverage industry (National Statistics Office of Georgia, 2024a). Electricity meets over a third of the industrial sector's energy demand and is largely used in iron and steel production (National Statistics Office of Georgia, 2024a).

Georgia's electricity sector is dominated by hydropower. Of the 4.6 gigawatts (GW) of total installed power capacity, hydropower capacity amounts to 3.4 GW (Georgian State Electrosystem, 2024a). In 2023, hydropower generation represented over 75% of annual total electricity generation (Georgian State Electrosystem, 2024b). However, hydropower production is seasonal and varies significantly throughout the year, resulting in the need for electricity imports and thermal power production in times of low hydropower production. From November through April, when there is increased electricity demand and diminished hydropower generation, thermal power production and electricity imports are significantly increased such that in peak months (*e.g.* February, according to 2023 data) net imports account for almost 20% of the country's monthly electricity consumption, while thermal power generation can account for over half of the monthly total electricity consumption (*e.g.* in January 2023) (Georgian State Electrosystem, 2024b) (see Annex 2 for more information on energy imports and exports). Georgia currently only has one wind power plant, which produces 0.6% of the total electricity generation (Georgian State Electrosystem, 2024b) (see Annex 3 for more information on Georgia's installed power capacities).

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2 *Followed by industry (15.1% of the final energy consumption) and commercial and public services (10.1%) (National Statistics Office of Georgia, 2024a).*

3 *Space heating, water heating and cooking.*

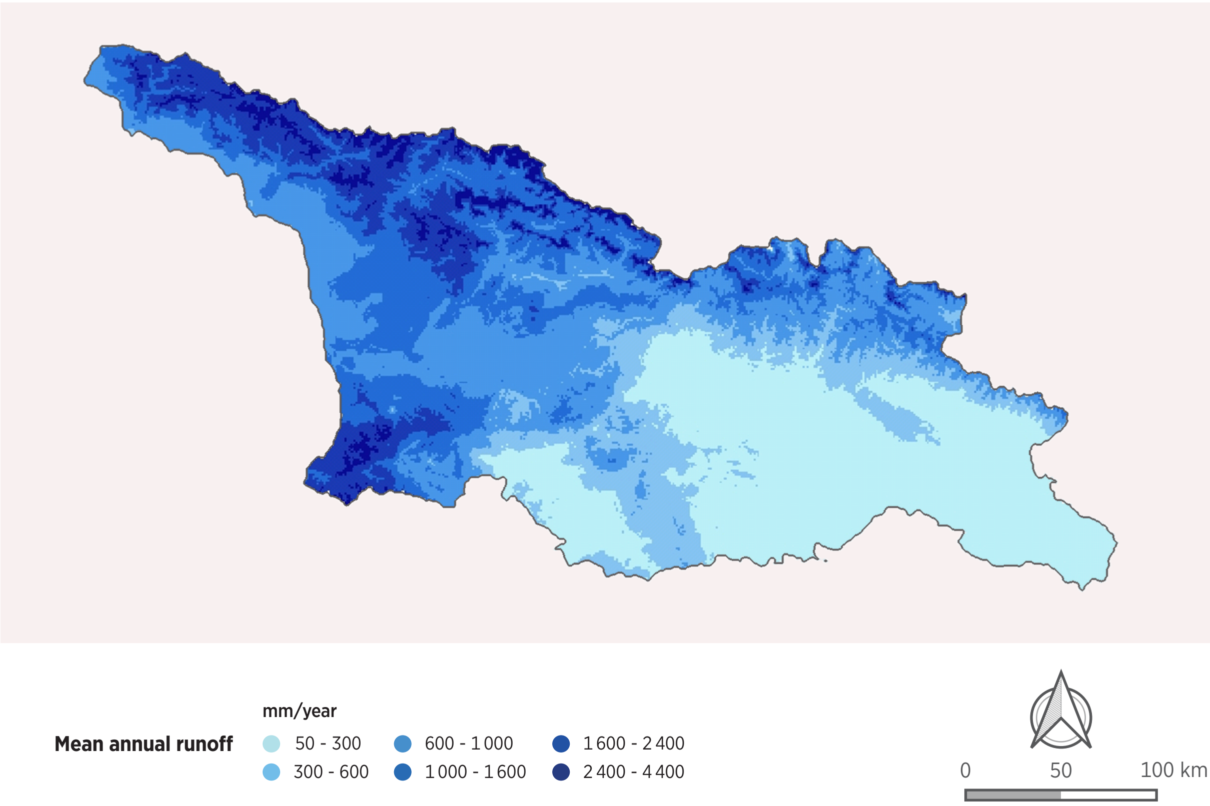
4 *However, the use of fuelwood in Georgia is not sustainable given that the rate of fuelwood consumption far outweighs forest regeneration, and the majority of woodstoves in the residential sector are of low energy efficiency and contribute to poor indoor air quality.*

1.2 Energy resource potential

Hydro resources

Georgia is endowed with plentiful hydro resources, with about 300 of the country's 26 060 rivers having significant potential for hydropower generation. Figure 1.2 shows the mean annual runoff[5] for Georgia. Hydropower potential is highest in the western part of the country. The total potential capacity for hydropower is estimated at 15 000 megawatts (MW), with an annual production potential of 50 terawatt-hours (TWh) (International Energy Agency, 2023), of which an annual production potential of 30 GW[6] is estimated (Arnesen *et al.*, 2021). To date, less than a quarter of the country's hydro potential has been tapped.

Figure 1.2 **Mean annual runoff (mm/year) for Georgia**



Source: (Norwegian Water Resources and Energy Directorate, 2017).

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

Notes: km = kilometre; mm = millimetre.

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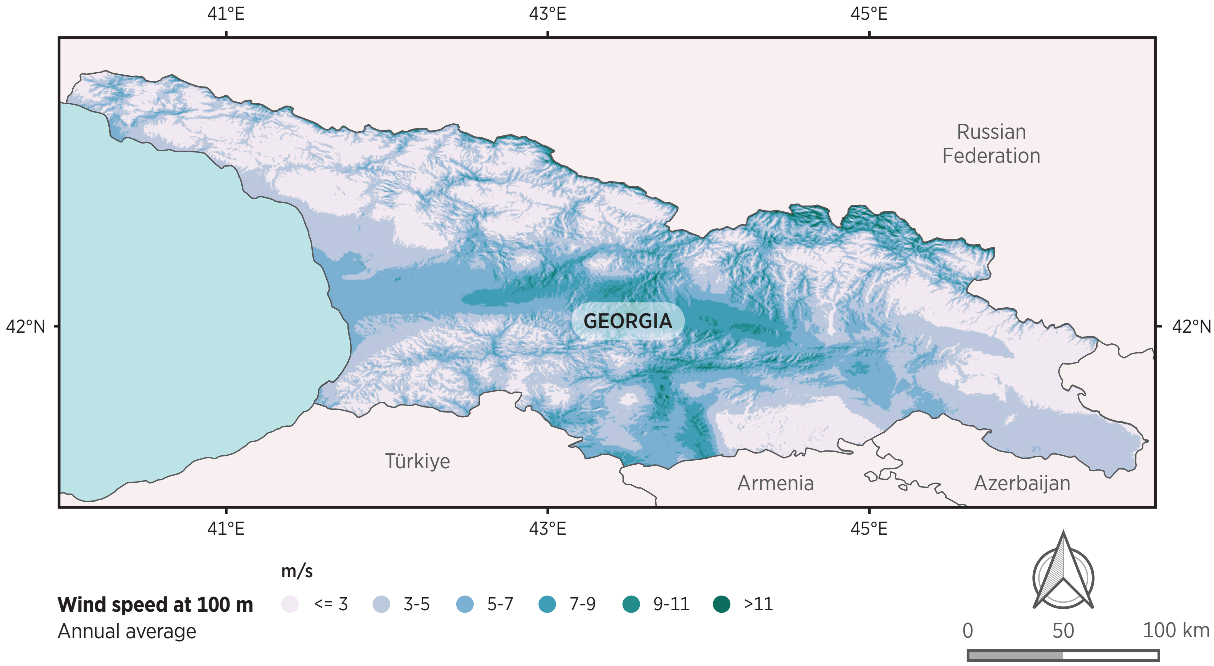
5 *"The runoff map is determined using results from a spatially distributed hydrological model that simulates the water balance for the entre land surface of Georgia and upstream areas in neighbouring countries" (Norwegian Water Resources and Energy Directorate, 2017).*

6 *This excludes the potential for hydropower production in environmentally protected areas, and generation from already installed hydropower plants, and hydropower generation potential whose construction costs are higher than USD 0.35 per annually produced kilowatt-hour.*

Wind resources

The average wind speeds in Georgia range from 1 to 14 metres per second (m/s), as shown in Figure 1.3. Georgia's wind energy potential has not been comprehensively assessed with geospatial analysis accounting for wind turbine hub heights, topographic and land use, grid and road networks, and other factors, but according to Georgian State Electrosystem, preliminary wind potential capacities have been estimated at 4 GW (Georgian State Electrosystem, 2024c). According to the latest Ten-Year Network Development Plan 2024-2034, a maximum 750 MW of variable wind power capacity can be integrated into Georgia's power system by 2028, taking into account the current operational conditions of the power system (Georgian State Electrosystem, 2024c).

Figure 1.3 **Wind speeds at 100 m hub height**



Source: Global Wind Atlas (DTU, 2023); Base map: UN boundaries.

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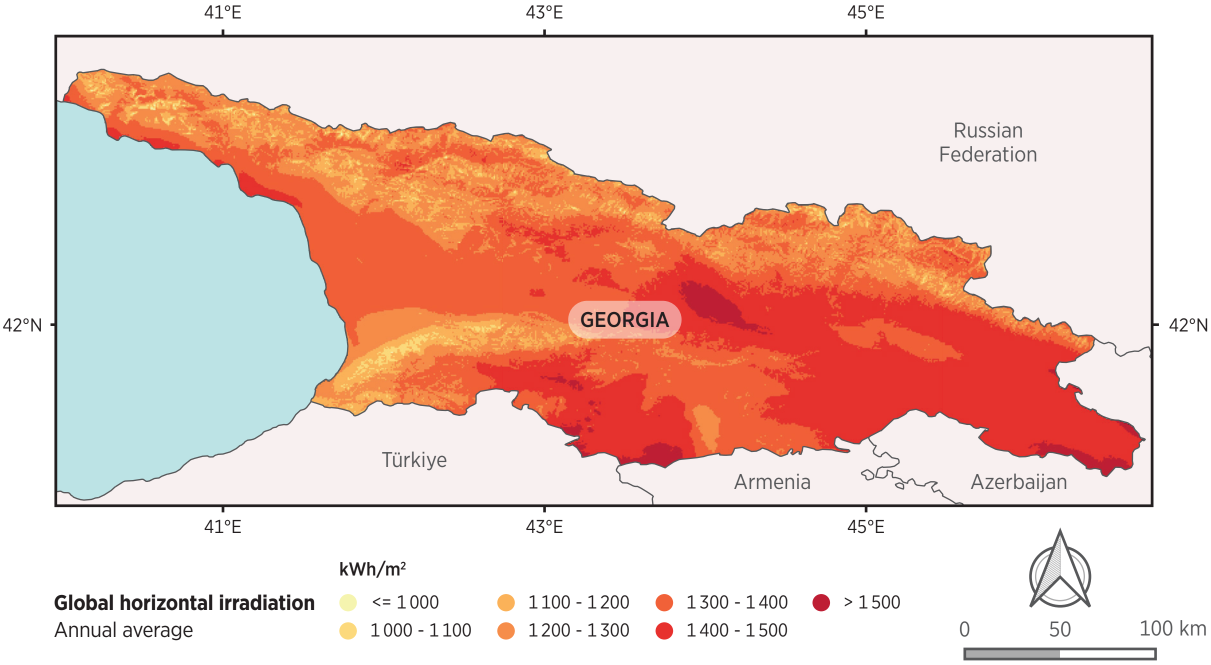
Notes: km = kilometre; m = metre; m/s = metre per second.

Solar resources

Annual global horizontal irradiation in Georgia ranges between 1100 and 1600 kilowatt-hours (kWh) per square metre (m^2), with the highest irradiation in the south, south-east and central regions of the country (Figure 1.4), indicating substantial potential for solar photovoltaic (PV) development. According to Georgian State Electrosystem, preliminary solar PV potential capacities have been estimated at 4.5 GW. Currently, the country has no large-scale solar PV installed (Georgian National Energy and Water Supply Regulatory Commission, 2023). According to the system operator's network development plans, taking into account current grid constraints, the integration of a maximum 500 MW of solar PV capacity will be possible by 2028 (Georgian State Electrosystem, 2024c).

Figure 1.4 Global horizontal irradiation of Georgia



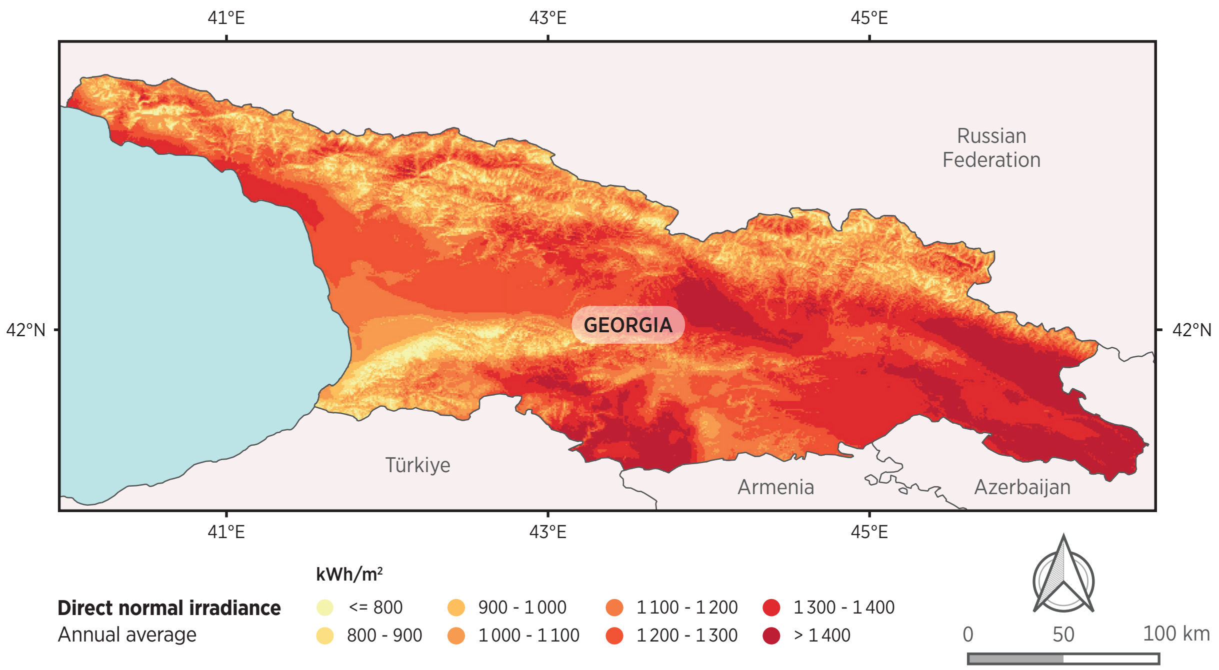
Source: Global Solar Atlas (ESMAP, 2019); Base map: UN boundaries; also available on the IRENA Global Atlas for Renewable Energy web platform.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Notes: km = kilometre; kWh/m² = kilowatt hour per square metre.

In terms of solar thermal potential, annual direct normal irradiance reaches up to 1600 kWh/m^2, with the highest-potential areas in the south and east of the country (see Figure 1.5). Currently, small-scale solar thermal installations can be found for water heating purposes in rural areas, with average water heating temperatures of 40-50°C.

Figure 1.5 Direct normal irradiance of Georgia



Source: Global Solar Atlas (ESMAP, 2019); Base map: UN boundaries; also available on the IRENA Global Atlas for Renewable Energy web platform.

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Notes: km = kilometre; kWh/m^2 = kilowatt hour per square metre.

Biomass resources

Georgia has abundant and varied biomass potential. About 44.5% of the country (3.1 million hectares) is covered by forests (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024), and firewood has historically been used for space heating, especially in the residential sector. Efforts to conduct an inventory of forest resources are currently under way, and according to preliminary estimates, approximately 600 000 cubic metres (m^3) of sustainable woody biomass resources (approximately 40 hectares of forest area) could be harvested per year, with an energy generation potential estimated at over 3 200 terajoules (TJ) (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024). Woody biomass cannot be considered a sustainable energy resource in Georgia at present because consumption outweighs the regeneration of forests by a factor of four. According to the National Forestry Agency, an unquantified but very large part of Georgian forests is degraded,[7] due mainly to the growing demand for fuelwood and the reduction of timber quality due to unsystematic felling.

[7] *Degradation reduces forests' capacity to absorb carbon, which is a crucial role of Georgian forests in regulating the country's greenhouse gas emissions.*

More significantly, Georgia also has abundant and currently underutilised potential in forest residues and agricultural waste, which could be used for the production of upgraded solid biofuels such as briquettes, pellets and wood chips. It has been estimated that Georgia produces over 1.5 million tonnes of agricultural waste and over 1 million m^3 of forest residues annually (United Nations Development Programme, 2018). These have the potential to generate a total of 36 500 TJ of energy, which could cover 50% of Georgia's residential energy demand (United Nations Development Programme, 2018). Of the agricultural residues, the largest potential is found in corn straw, of which over a million tonnes is produced annually, particularly in the western part of the country, with an energy generation potential of 18 300 TJ (United Nations Development Programme, 2018). Vine pruning also generates about 108 900 tonnes of residue, with an estimated energy generation potential of 2 000 TJ (United Nations Development Programme, 2018). Sawdust, which is produced as waste from sawmills, has the potential to be upgraded into briquettes and pellets; its energy generation potential in Georgia is estimated at 300 TJ annually (International Energy Agency, 2020).

Residential solid waste and municipal sewage also have the potential to be used to produce biogas, which can be used as a blending gas to decarbonise natural gas supply. Approximately 900 000 tonnes of solid waste is produced annually, and about 75% of this is deposited on the 77 landfill sites throughout the country (Caucasus Environmental NGO Network, 2023). Currently, waste is not systematically separated as biodegradable or non-biodegradable at the source. With proper waste treatment and separation, the annual biogas potential of municipal solid waste is estimated at 80 million m^3 (of which 40 million m^3 is methane). Furthermore, from the treatment of municipal sewage in Tbilisi alone, an estimated 17 million m^3 of biogas (8.47 million m^3 of methane) is obtainable. Overall, the country's biogas generation potential from municipal solid waste and sewage is estimated at a calorific value of 760 gigawatt-hours (GWh) per year (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).

Geothermal resources

Georgia has low- to moderate-enthalpy geothermal resources, which according to the Georgia Geothermal Association are concentrated in 44 deposits (thermal waters) whose technical potential is estimated at a maximum of 2.7 million megawatt-hours (MWh) per year (Georgian Geothermal Association, 2023). Temperatures range between 30°C and 110°C (Georgian Geothermal Association, 2023), which provides significant potential for heating applications but less so for electricity generation. More than 80% of geothermal deposits are in western Georgia (Georgian Geothermal Association, 2023). Geothermal resources are currently not widely used, except in balneology resorts and greenhouses. However, there are plans at municipal levels to provide funding for the development of geothermal energy for space and water heating in public buildings such as schools (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).

1.3 Policy and regulation

The main legislative act governing the energy sector of Georgia is the Law on Energy and Water Supply (No. 5646-RS of 2019), which was adopted on 20 December 2019[8] (Government of Georgia, 2019a). Further relevant legislative acts include the Law on Promoting the Generation and Consumption of Energy from Renewable Sources (No. 5652-RS of 2019), adopted on 20 December 2019 (Government of Georgia, 2019b); the Law on Energy Efficiency in Buildings (No. 5900-SS of 2020) (Government of Georgia, 2020a); and the Law on Energy Efficiency (No. 5898-SS of 2020) (Government of Georgia, 2020b), adopted on 21 May 2020 and subsequently amended on 27 June 2024.

The State Energy Policy of Georgia (Ministry of Energy and Sustainable Development, 2024) was adopted in June 2024 and outlines the country's main energy sector development directions. These include diversifying imported energy commodities to increase energy security, increasing the resilience of the energy sector by developing strategic infrastructure, increasing the use of renewable energy, increasing energy efficiency in both supply and demand, developing regional trade and international co-operation in the energy sector, and reforming the energy market by establishing competitive markets for electricity, natural gas and biomass. In line with the Energy Community *acquis communautaire* and the State Energy Policy, and as an appendix to it, the Integrated National Energy and Climate Plan (NECP) was developed. The NECP was adopted in June 2024 and outlines the national energy and climate targets and the accompanying policies and measures required to achieve those targets. Within the NECP, focus is placed on reducing greenhouse gas (GHG) emissions, increasing renewable energy utilisation, increasing energy efficiency, and strengthening regional power system interconnections. Table 1.1 shows the main renewable energy targets (as renewable energy share of the gross final energy consumption), and Table 1.2 shows the main GHG projections to be achieved by 2030 and beyond, as documented in the NECP.

Table 1.1: **NECP renewable energy targets in electricity, transport and heating (%)**

	2019	2030		2040		2050	
Sector		Baseline	NECP	Baseline	NECP	Baseline	NECP
Transport	2.85	1.51	10.45*	1.43	20.43	1.29	34.11
Electricity	77	77	85	74	88	70	90
Remaining energy**	13	8	7	10	5	9	4
Total	18.77	20.4	27.4	19.4	26.7	18	29.5

* In compliance with the Renewable Energy Directive, a minimum 7% share of renewable energy should be achieved in the transport sector by 2030.

** According to Georgia's NECP, "remaining energy" refers to heating and cooling.

[8] *Subsequent amendments were adopted in June 2024 in accordance with the Renewable Energy Directive.*

Table 1.2: GHG emissions from 1990 and projected in the baseline and NECP scenarios

	1990	2030		2040		2050	
GHG		Baseline	NECP	Baseline	NECP	Baseline	NECP
Emissions ($ktCO_2eq$)*	45 813	30 301	23 224	39 326	27 817	50 240	32 895
Compared with 1990 levels (%)	n/a	–34	–49	–14	–39	10	–28
Emissions ($ktCO_2eq$)*	39 460	24 371	17 070	32 480	19 953	42 479	23 631
Compared with 1990 levels (%)	n/a	–38	–57	–18	–49	8	–40

* Excluding land use, land-use change and forestry.

Source: (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).

Note: ktCO2eq = kilotonne carbon dioxide equivalent.

To support the adoption of small-scale renewable power generation, in August 2020, Resolution No. 47 "On approving the Electricity Retail Market Rules" (Georgian National Energy and Water Supply Regulatory Commission, 2020) was approved. It regulates net metering for renewable energy power producers who are retail customers and whose installed capacities are 500 kilowatts (kW) or lower (micro-generating power plants). Micro-generating power plants under this scheme are able to inject the electricity they produce into the grid, and if they produce more electricity than they consume (have a positive electricity balance at the end of the month), the surplus electricity can be used to offset any negative electricity balances in the following months. If they have a positive yearly balance (from May to 30 April), they are eligible to be compensated for the surplus at a weighted-average wholesale tariff set for distribution companies by the Georgian National Energy and Water Supply Regulatory Commission (GNERC). According to the GNERC Annual Report for 2023, 1143 customers with a total installed capacity of 67 552 kW were participating in the net-metering scheme, with almost half of that capacity added in 2023 alone (Georgian National Energy and Water Supply Regulatory Commission, 2024).

For larger-scale renewable power generation, as of July 2020, hydropower plants of installed capacity higher than 5 MW have been eligible for a feed-in premium. In 2021, the support scheme was amended to include other renewable energy projects (wind and solar PV). Under this scheme, power producers, irrespective of technology, are paid a feed-in premium of USD 0.015/kWh up to a strike price of USD 0.055/kWh. The support period is eight months out of the year; the excluded months are May to August (Georgian National Energy and Water Supply Regulatory Commission, 2021). However, as of December 2022, the feed-in premium scheme is no longer applicable for new projects, with the adoption of Resolution No. 556 "On Approval of the Scheme for Supporting the Production and Use of Energy from Renewable Sources and Rules for the Electricity Auction". In February 2023, following amendments to Resolution No. 556,[9] the Ministry of Economy and Sustainable Development (MoESD) announced the country's first renewable energy auction, with a total allocated renewable energy capacity of 300 MW[10] for individual renewable energy power plants larger than 0.5 MW.

[9] *An unofficial translation of the consolidated version of resolution is available here: www.economy.ge/uploads/files/2017/energy/2023/auqcuoni/government_of_georgia_resolution_556_consolidated_feb_7_2023.pdf.*

[10] *The bidding period was open from 22 March to 27 March 2023 and attracted 78 bids, totalling over 900 MW. On 17 April, the following bid winners were announced: 15 hydropower plants, 2 wind power plants and 10 solar PV power plants (Ministry of Economy and Sustainable Development, 2023a).*

A second renewable energy auction was opened in December 2023 for a total allocated renewable energy capacity of 800 MW.[11] The winning bidders were those whose proposed tariffs were lower than the median tariff of all proposed bids (see Annex 4). The support scheme is implemented by the Joint Stock Company Electricity Market Operator (ESCO), and the price difference agreement is signed between ESCO and the power producer (see Annex 5). The price difference will be paid by ESCO to the power producer as an addition to the day-ahead market price, only if the day-ahead market price during the power plant support period is less than the agreed tariff. If the day-ahead market price is higher than the agreed tariff, ESCO will be paid the difference. The price difference payments (contracts for difference [CfD]) will be made in local currency (Georgian lari [GEL]), in accordance with the rules stipulated in the agreement. The total amount corresponding to the price difference of the reporting month will be reimbursed after the end of each month (Government of Georgia, 2022). However, with the delays in the opening of the day-ahead and intra-day markets, the CfD will be applied to existing balancing market prices until the full implementation of the market reform. Additionally, a decision has been taken not to hold further auction rounds in the foreseeable future and to instead allow interested project developers to apply for direct contracting at the median prices selected under the second auction round.

There is currently no support mechanism for renewables in heating and cooling. For electric mobility, various fiscal incentives are in place. Electric vehicles are fully exempt from excise and import duty and from public parking fees within the Tbilisi municipality, and a 20% discount is applied to the regular technical inspection fee for electric vehicles (Ministry of Economy and Sustainable Development, 2023c). Additionally, employees who utilise their employer's electric vehicles for personal use are exempt from accounting such vehicle usage as a salary benefit, and such usage is exempt from income tax (Ministry of Economy and Sustainable Development, 2023c). Taxi licences are also issued for free to electric vehicle drivers (Green Economy Financing Facility, 2021). Electric buses and mini-buses are exempt from value-added tax (Ministry of Economy and Sustainable Development, 2023c).

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[11] *The bidding period was open from 30 December 2023 until 12 February 2024. The capacities were allocated as follows (Ministry of Economy and Sustainable Development, 2023b):*

- *hydropower plants (regulatory): 300 MW in total*
  - *hourly regulation, from 1 hour to 4 hours: 50 MW*
  - *daily regulation, from 4 hours to 8 hours: 100 MW*
  - *per-day regulation, 8 hours and over regulation: 150 MW*
- *hydropower plants (downstream): 100 MW*
- *wind power plants: 125 MW*
- *solar power plants: 125 MW*
- *wind power plants with storage: 70 MW*
- *solar power plants with storage: 70 MW*
- *other renewable energy sources: 10 MW.*

The auction round was not able to attract bidders in the categories with storage, hydropower plant with over 8 hours of regulation, and other renewable energy sources.

1.4 Energy prices and subsidies

Georgia's electricity retail tariffs are fully regulated and, of the countries in the region, are only higher than those in Azerbaijan and the Russian Federation. Consumer electricity prices are differentiated by residential and non-residential customers as well as by tariff structure (*i.e.* distribution, transmission and supply tariffs) (see Annex 6). The state provides a reimbursement of 50% of the monthly electricity fee for up to 100 kWh consumed by household consumers in the highland settlements. Large electricity consumers can trade bilaterally, determining their electricity tariffs according to bilateral agreements, and they can participate in the recently launched Georgian Energy Exchange, for which the wholesale electricity price is currently determined through the balancing market (until the Georgian Energy Exchange is fully implemented, at which time the wholesale price will be competitively determined).

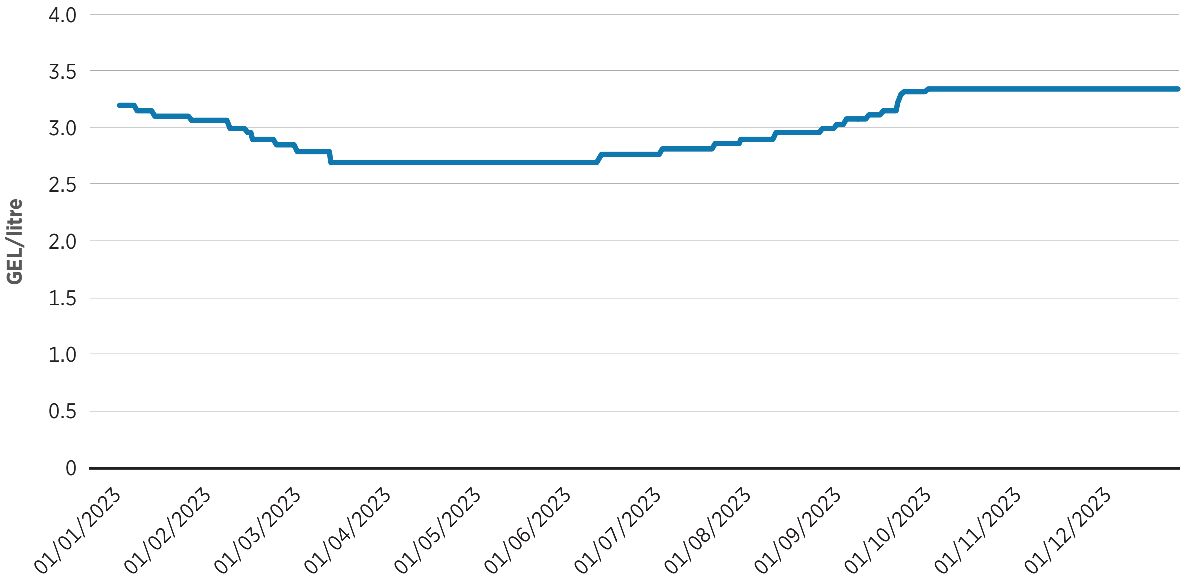
Georgia imports natural gas from the Russian Federation using spot market prices, but most natural gas imports (approximately 90%) come from Azerbaijan at discounted prices using long-term pricing agreements with Azerbaijan's state-owned oil and gas company. As much as 5% of the annual natural gas flow via the South Caucasus Pipeline is imported at no cost, in lieu of a transit fee for gas transiting Georgian territory via the pipeline, and a further 0.5 billion m^3 can be purchased by Georgia at a discounted price (Georgian National Energy and Water Supply Regulatory Commission, 2024). These arrangements in effect subsidise the natural gas prices, and according to some estimates, the difference between the market price and the "social" or subsidised price is as much as 40% (European Bank for Reconstruction and Development, 2021). This difference inevitably and significantly distorts the market for renewable energy technologies and the introduction of energy efficiency measures, especially in the residential sector.

The consumer natural gas price for households and thermal power plants (*i.e.* the "social" or subsidised price) is fully regulated and varies according to the gas supplier. The cost of natural gas per cubic metre for household consumers in Tbilisi, provided by Tbilisi Energy, is USD 0.21 (GEL 0.5397) (Georgian National Energy and Water Supply Regulatory Commission, 2022); the price varies between USD 0.18 (GEL 0.49297) to USD 0.22 (GEL 0.58864) (Georgian National Energy and Water Supply Regulatory Commission, 2022) in other areas of the country. The consumer natural gas price for non-household or commercial consumers is not regulated and is determined bilaterally between the consumer and the supplier. The average price for commercial consumers connected to the distribution network is USD 0.43 (GEL 1.10) per cubic metre, while for those connected to the transmission network the average price exceeds USD 0.24 (GEL 0.67) per cubic metre (Georgian National Energy and Water Supply Regulatory Commission, 2024).

As of July 2022, prices increased for non-household consumers by as much as USD 0.093 (GEL 0.25) per cubic metre, although they remained the same for household consumers (Georgian National Energy and Water Supply Regulatory Commission, 2022). For example, for non-household retail customers supplied by Tbilisi Energy, gas prices increased from USD 0.41 to USD 0.50 (GEL 1.10 to GEL 1.35) (Georgian National Energy and Water Supply Regulatory Commission, 2022), amounting to a 10% increase. Nevertheless, natural gas prices in Georgia are much lower than in other countries that are similarly import dependent.

Prices of oil products are not regulated. The average consumer petrol prices for 2023 (1 January 2023 to 1 December 2023) were USD 1.10 (GEL 2.98) per litre (for premium octane 95), with fluctuations (up to 12% from the average price), as shown in Figure 1.6.

Figure 1.6 **Gasoline price fluctuation (GEL/litre)**



Source: (SOCAR Georgia Petroleum, 2023).

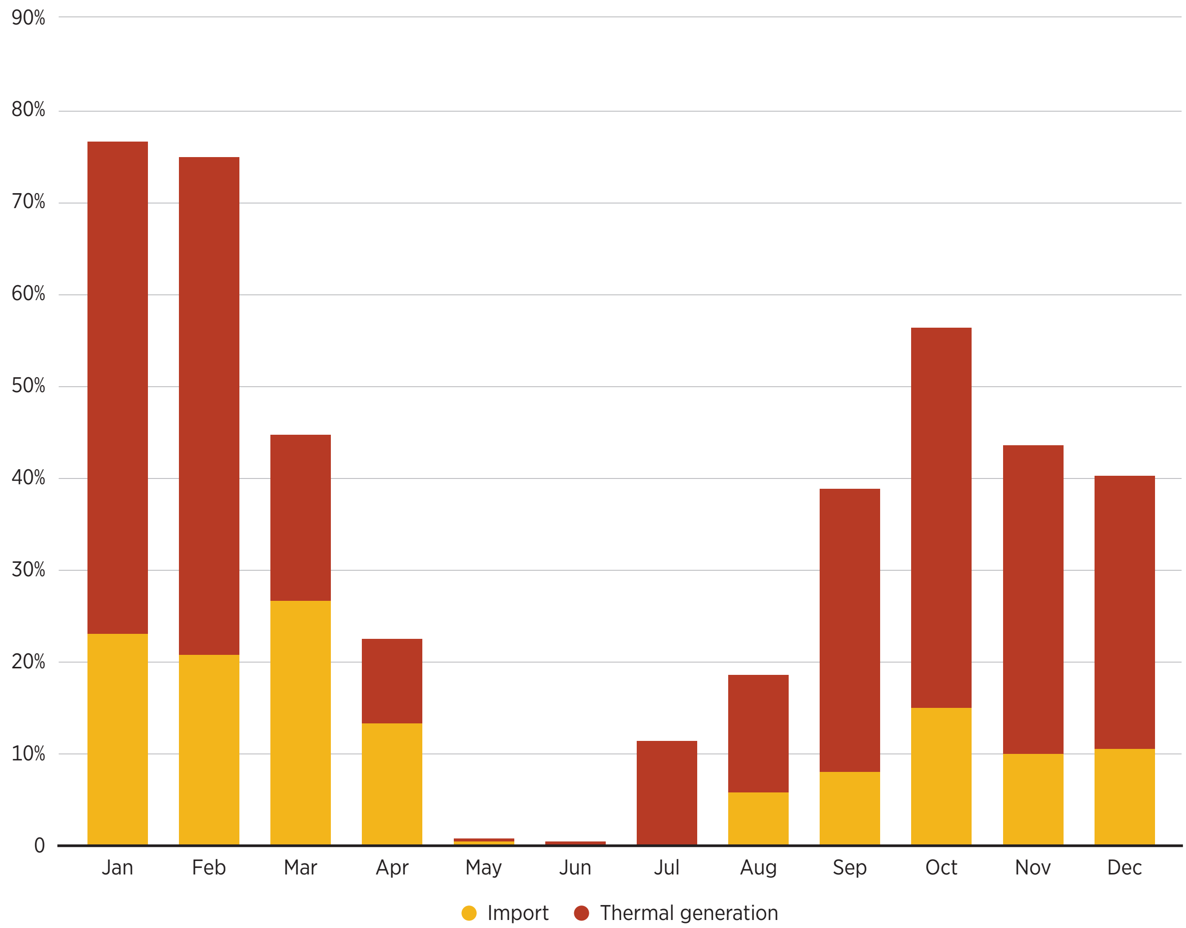
2. Rationale for the energy transition

2.1 Increasing energy security

Domestic energy production in Georgia accounted for under a quarter of the total energy supply in 2023 and has been declining over the past decade. Inevitably, this has led to increasing reliance on energy imports, which accounted for 88.9% of energy supply in 2023 (National Statistics Office of Georgia, 2024a) and which is increasingly undermining the country's energy security. The largest energy imports are natural gas and oil products; the country's dependency on these fossil fuels imports is almost 100%. Further undermining energy security is that the supply of these fuels is from undiversified supply sources, which exposes Georgia's energy system to price fluctuations in exporter countries. Therefore, for Georgia to increase its energy security and reduce its reliance on energy imports, it has an urgent need to use indigenous energy resources. Such domestic resources comprise only renewable energy potential, given that Georgia has no significant known fossil fuel reserves. In other words, the energy transition and the development of renewable energy resources, represents a crucial and strategic pathway for Georgia to increase its energy security.

Specifically in the power sector, Georgia's energy security is threatened by seasonal variations in power generation and the increasing threats of climate change. Because of the strong reliance on hydropower, Georgia lacks generation during the winter (especially between October and March) and relies on imported electricity and thermal power generation to meet electricity demand and maintain system reliability. As shown in Figure 2.1, in some months, electricity imports can account for over a quarter of electricity supply (*e.g.* March 2023), while thermal power generation can reach over half of the monthly total electricity supply (*e.g.* January 2023). As Georgia's electricity demand has been increasing in recent years, additions of hydropower capacity have been made. However, the proportional share of thermal power production in the total electricity supply has increased but the share of hydropower has decreased. This is largely because the hydropower capacity additions have also necessitated a rise in fossil-fuelled thermal power production due to the seasonality of hydropower and varying rainfall patterns over the years. It is therefore desirable for Georgia to diversify its electricity generation by using its abundant indigenous non-hydro renewable energy resources, such as wind and solar, for power production. By doing so, the country can reduce its current seasonal variations in power generation and offset the need for costly electricity imports in low-rainfall months. Furthermore, the development of non-hydro renewable energy has the potential to offset the increasing risks of climate change, specifically the risks of prolonged droughts, which can lower average annual water flows and decrease projected hydropower generation potential.

Figure 2.1 Import and thermal generation share in Georgia's electricity supply, 2023

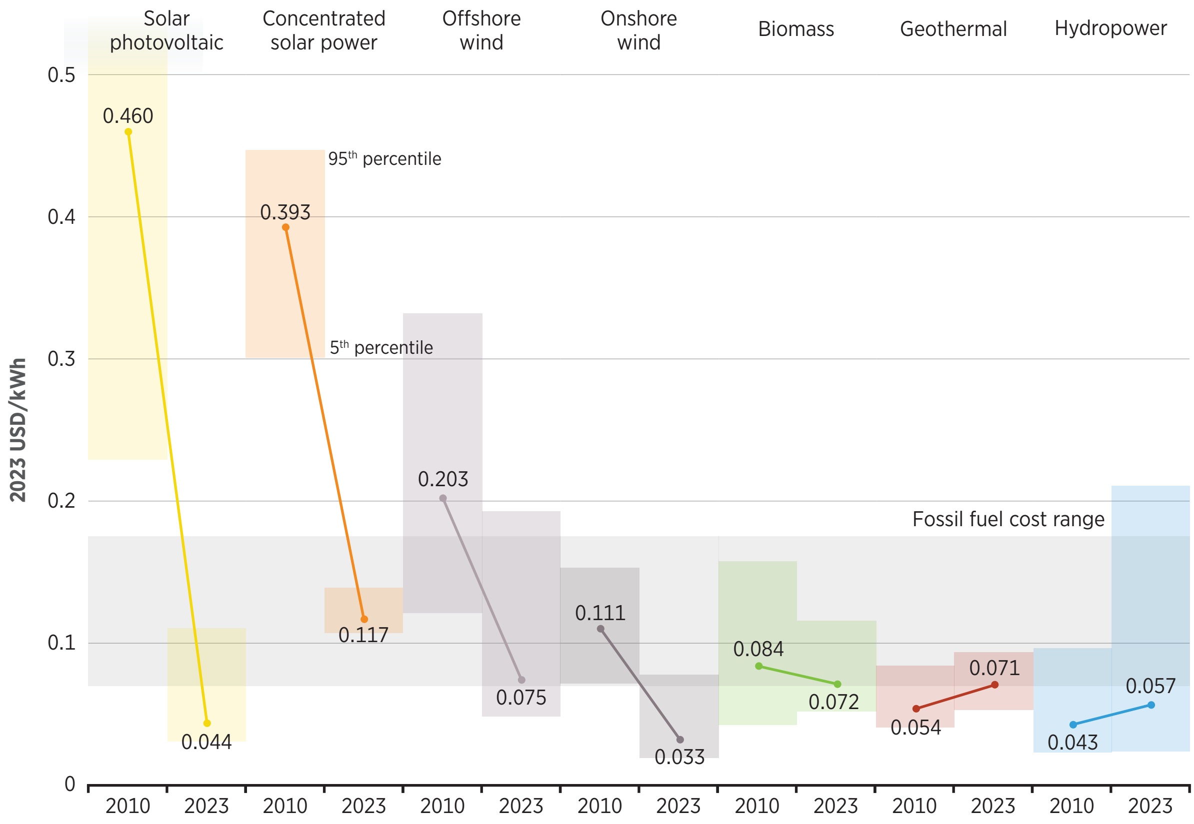


Source: Adapted from (Georgian State Electrosystem, 2024b).

2.2 Ensuring competitiveness in regional and global markets

Over the last few decades, renewable electricity technology costs have been steeply declining, while the technologies' performance efficiency has been increasing, providing compelling economic and environmental benefits while displacing fossil fuels. In fact, the last few years alone (since 2021) have seen the largest improvements in the competitiveness of renewables, especially given the soaring prices of fossil fuels (IRENA, 2023a). For example, as shown in Figure 2.2, in 2010 the global weighted-average levelised cost of electricity (LCOE) of onshore wind was USD 0.111/kWh, which was 23% higher than the weighted-average costs of new fossil fuel capacity additions of USD 0.090/kWh . By 2023, the global weighted-average LCOE of new onshore wind projects was USD 0.033/kWh, 67% lower than the weighted-average cost of the fossil fuel-fired option, which had risen to USD 0.100/kWh (IRENA, 2024a). Even more remarkable was the cost decline in solar PV: in 2010 the global weighted-average LCOE, at USD 0.460/kWh, was five times more expensive than the weighted-average cost of fossil fuel-fired technology, while in 2023 at USD 0.044/kWh it was 56% lower than the weighted-average cost of the fossil fuel-fired option (IRENA, 2024a).

Figure 2.2 Global LCOE from newly commissioned utility-scale renewable power technologies, 2010 and 2023



Source: (IRENA, 2024a).

Given the falling costs of renewable electricity technologies, the development of a domestic energy sector based on increasing shares of renewables is increasingly imperative for economic competitiveness. Specifically, the development of non-hydro renewable energy projects, with short development time frames, can ensure that Georgia meets its increasing energy demands in a timely manner. Furthermore, with the decarbonisation of its energy system through the development of renewables, Georgia will ensure that it stays competitive in regional and global markets, especially with the advent of the European Union's Carbon Border Adjustment Mechanism[12] and other carbon pricing mechanisms in Georgia's trading partner countries (European Commission, 2023). Given that Georgia has a sizeable iron and steel industry, and that iron and steel exports to the European Union are liable for compliance under the Carbon Border Adjustment Mechanism, the decarbonising of the production of iron and steel would be a crucial measure in keeping Georgia's exports competitive on the market.

[12] *The Carbon Border Adjustment Mechanism is a carbon tariff that will be imposed on carbon-intensive products imported into the European Union (European Commission, 2023). Such products currently include cement, iron and steel, electricity, hydrogen, aluminium, and fertilisers. In the transition phase of the mechanism's application, European Union importers of these products are required to declare the GHG embedded in their production. However, as of 2026, importers will be required to buy and surrender the Carbon Border Adjustment Mechanism certificates in accordance with the embedded GHG emissions of the imported products (European Commission, 2023). Thus, the lower the GHG footprint of the product, the more cost-competitive the imported product will be on the European market.*

2.3 Reducing energy trade deficit

Georgia needs to import over 80% of the energy resources required to meet its energy demand. In 2023, the largest share of these imports was petroleum products, accounting for USD 1 116.0 million and representing 7.4% of the total import expenditure (National Statistics Office of Georgia, 2024b). Although procured at discounted prices, natural gas imports amounted to USD 445.0 million (2.8% of total imports) in the same year (National Statistics Office of Georgia, 2024b), and coal and electricity imports amounted to USD 62.0 million (National Statistics Office of Georgia, 2024b). The unit costs of these products are also susceptible to fluctuations. As discussed in Section 1.4, in 2022 alone, global price increases for petrol were reflected in a 16.4% retail price fluctuation from the average price (Global Petrol Prices, 2023).

By developing its indigenous renewable energy resources, Georgia can significantly reduce its national expenditures on energy imports and divert funds towards the cost-effective development of its domestic energy industry, which would bring about larger socio-economic benefits.

2.4 Addressing energy poverty

Energy poverty in Georgia is of utmost concern, as a significant portion of the country's population lacks access to affordable, reliable and modern energy services and resources, which are necessary to ensure an adequate standard of life. According to the latest estimates in 2017, as much as 43% of Georgia's population lives in energy poverty, with rural households more affected than urban households (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024). Factors that contribute to energy poverty in Georgia include the low energy efficiency of the residential building stock whereby vulnerable energy consumers may underheat their homes or incur higher energy expenditures to achieve an adequate level of heating.[13] In fact, Georgian households in the lowest income brackets expend up to a quarter of their monthly income on natural gas for heating needs (World Bank, 2021), despite natural gas prices being highly subsidised and the lowest in the region.

The heavy subsidisation of natural gas prices also prompts consumers, even those who are not economically vulnerable, to consume energy inefficiently. Furthermore, inefficient energy technologies such as traditional woodstoves for heating and cooking are widespread throughout the country, especially in rural areas, leading to inefficient use of forest resources and to indoor air pollution, which poses serious concerns for citizens' health. Indeed, fuelwood from forest resources is increasingly challenging to access legally due to complicated permitting procedures and the need to fetch fuelwood from more inaccessible areas due to vast forest degradation.

[13] *According to the World Health Organization, households in Georgia barely meet the WHO guidance for indoor air temperature for a healthy living environment (World Health Organization, 2007).*

The energy transition presents an opportunity to address the energy poverty challenges in the country through the adoption of energy efficiency measures and the facilitation of access to modern and sustainable energy fuels and technologies. For example, through building renovations to increase the energy efficiencies of households, the promotion of upgraded biomass products such as wood pellets, the substitution of inefficient heating appliances, and the usage of decentralised renewable energy generation, citizens would have greater access to varied energy fuels and technologies and be able to significantly lower their energy consumption. However, the affordability of sustainable energy resources and technologies would need to be ensured so that the energy transition is a just one for all citizens.

The development of renewable energy technologies also has the potential to contribute to wider socio-economic benefits, such as the reduction of air pollution from fossil fuel emissions, the development of the domestic energy industry, the leveraging of local materials, the creation of jobs along the value chain, and contribution to economic growth.

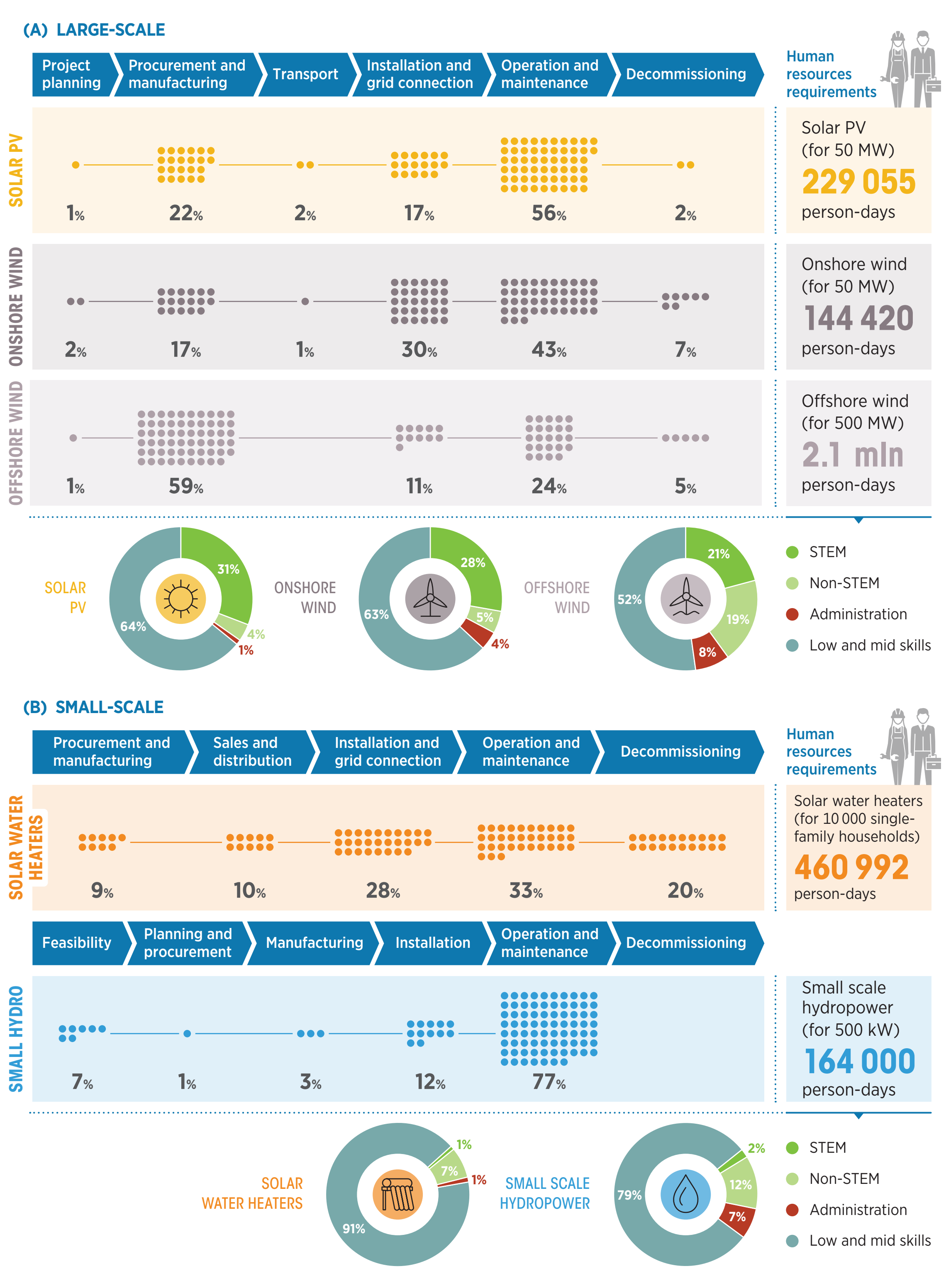
2.5 Supporting local value chains

The development of local value chains involves the domestic production, processing and distribution of goods and services related to renewable energy and energy-efficient technologies and the development of accompanying energy infrastructure, as well as the utilisation of locally available critical materials needed for the energy transition. The energy transition, with its accompanying policies and incentives, has the potential to stimulate and support local value chains, thereby enhancing economic resilience, reducing dependence on imports of energy products and creating employment. Energy transition scenarios developed by IRENA show that the renewable energy sector could employ approximately 30 million people by 2030 worldwide, increasing to up to 40 million by 2050 (IRENA, 2024b), nearly tripling the 16.2 million employed in 2023 (IRENA, 2024c). These jobs span all segments of the value chain, from manufacturing to construction and installation to operation and maintenance. With the right policies in place and by planning for needed skills through the monitoring of domestic capacities, many of these jobs can be created locally (see Box 2.1).

Box 2.1 **Leveraging local capacity**

IRENA's leveraging local capacity series examines how renewable energy projects create jobs and how countries can maximise these benefits by anticipating their national needs and building on existing skills and resources. These analyses outline the distribution of the person-days required across the entire value chain of selected technologies, from manufacturing to installation, operation and maintenance, and the required occupational profiles, to help decision makers identify opportunities for local value creation and workforce development (see Figure 2.3).

Figure 2.3 Distribution of person-day requirements across value chains of selected (a) large-scale and (b) small-scale renewable energy technologies and aggregated occupational profiles



Based on: (IRENA, 2017a, 2017b, 2018, 2021, 2023b, 2025).

As an example in large-scale power production, the installation and connection of 50 MW of onshore wind capacity is estimated to require 34 480 person-days, largely construction workers and technical personnel for site preparation, civil works, crane operation, equipment assembling, cabling and grid connection (IRENA, 2017b). Furthermore, every year, the maintenance and operation of a 50 MW wind power plant requires an estimated 2 665 person-days: power plant operators, telecommunication and industrial engineers, construction workers, and others (IRENA, 2017b).

As an example relating to smaller-scale decentralised technologies, the incentivisation and acceleration of Georgia's current domestic manufacturing of efficient cookstoves and advanced bioenergy products from forest and agricultural residues has the potential to alleviate reliance on unsustainable fuelwood and on natural gas imports, to tackle energy poverty, and to create employment, especially in underdeveloped areas of the country.

Georgia also has known reserves of the critical materials[14] needed for the energy transition, including copper,[15] which is already a strong contributor to Georgia's economy. As the demand for electricity increases, the demand for copper will intensify given its critical role in electric wiring for power generation, supply and use; solar panels; and electric vehicles (Gielen, 2021). In fact, the demand for copper is projected to double by 2030, rising by about 7 megatonnes per year from 2022 to 2030 (IRENA, 2023c).

Georgia's significant cement, iron and steel manufacturing industry are well established[16] to support the energy transition in a timely manner and alleviate reliance on imports, especially with increasing global demands for these materials. Global demand for steel and cement is expected to grow by 31% and 14%, respectively, from current levels by 2050 (Deetman *et al.*, 2020). If the building renovation rates triple by 2050 as foreseen in the 1.5°C pathway (IRENA, 2023c), the demand for steel and cement will be further increased.

Box 2.2 **Collaborative framework on critical materials for the energy transition**

In March 2022, Members of IRENA launched the Collaborative Framework on Critical Materials for the Energy Transition**,** through which IRENA aims to provide an inclusive platform to foster dialogue, co-ordinate activities on various topics, strengthen peer-to-peer exchanges and collaborations, increase transparency, and develop a set of insights into the gaps and solutions for the energy transition, which relies on critical materials. Working groups under the new framework aim to enhance understanding of the market situation and outlook; develop strategies to de-risk the supply of critical materials; and raise acceptance for new, more sustainable mining projects (IRENA, 2022).[17] As a contribution to technical discussions and to disseminate new findings on critical materials, a series of technical papers on the topic has been published and is accessible at www.irena.org/Education.

[14] *Various materials are considered "critical" for the energy transition, including copper, cobalt, nickel, lithium, aluminium, chromium, dysprosium, gallium, germanium, graphite, indium, iron, lanthanum, lead, manganese, molybdenum, neodymium, platinum, rhenium, ruthenium, scandium, silver, vanadium, tantalum, titanium, yttrium and zinc (Gielen, 2021).*

[15] *Georgia's largest export commodities in 2022 were copper ores and concentrates (USD 1.02 billion; 18.34% of total exports).*

[16] *These industries are currently highly carbon intensive and would need to be decarbonised to make a meaningful contribution to the energy transition.*

[17] *More information can be found at: www.irena.org/News/articles/2022/Mar/IRENA-Members-Pave-Way-for-New-Cooperation-on-Critical-Materials.*

2.6 Aligning with international commitments

Given that Georgia's energy sector is highly based on fossil fuels, energy use alone is responsible for approximately two-thirds of the country's GHG emissions (Ministry of Environmental Protection and Agriculture, 2021). The decarbonisation of the energy sector, through increased renewable energy development as well as energy efficiency measures, is therefore necessary to align Georgia with its international commitments on energy transition and climate change. These commitments include Georgia's nationally determined contribution (NDC) under the Paris Agreement to unconditionally reduce its domestic GHG emissions to 35%[18] below its 1990 levels by 2030 (Ministry of Environmental Protection and Agriculture, 2021), contributing to the global efforts towards a 1.5°C average global temperature holding scenario, to the tripling of global renewable energy capacities by 2030, and to Georgia's long-term ambition of net zero by 2050 as defined in the country's long-term low-emission development strategy (LT-LEDS), submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2023.

The development of renewables is also an obligation under the Energy Community's *acquis communautaire*. In July 2017, Georgia became a contracting party to the Energy Community, paving the way for the synchronisation of its national legislation with the Energy Community's *acquis communautaire*, which comprises legal acts in the areas of climate change, competition, electricity, energy efficiency, environment, gas, infrastructure, renewable energy, statistics and oil (Energy Community Secretariat, n.d.). Under the Energy Community *acquis communautaire*, Georgia has committed to a 27.4% target share of renewable energy in its gross final energy consumption by 2030 (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).

[18] *The conditional target is to reduce greenhouse gas emissions by 50-57% below 1990 levels by 2030 (Ministry of Environmental Protection and Agriculture, 2021). Both the conditional and unconditional targets exclude LULUCF emissions. In the revision of the NDC 3.0, the 35% target will be revised to 47%, in accordance with the NECP.*

3. Key challenges and recommendations

Although the energy transition through renewables can bring many benefits for Georgia, the development of the country's renewable energy sector faces several challenges in energy sector governance; assessment of renewable energy resource potential; integration of renewables into the power system; decarbonisation of industry, buildings and transport; access to finance; consumer empowerment; and availability of a skilled workforce. This chapter aims to highlight the key challenges identified throughout the process of this assessment (see Annex 1) that need to be addressed in the short to medium term to accelerate the deployment of renewable energy technologies and facilitate Georgia's energy transition.

3.1 Effective governance for the energy transition

Action 1: Facilitating consolidated energy and climate planning

The clean energy transition presents many challenges for policy makers and planners as they are tasked with developing strategies that need to be dynamic and consider rapidly changing trends, such as those related to technological developments, costs, evolution of markets and implementation of innovative policies. The complexity in planning and decision making is compounded by the need to account for the interdependencies within and outside the energy system, with consideration of the implications certain pathways could have for the overall socio-economic development of a country and for various economic sectors. To overcome these challenges and reap the full benefits of the energy transition, effective planning is key to ensuring the development of inclusive, unified and consistent energy and climate change action plans, informing policy decisions, and providing a stable regulatory environment that can instil investor confidence in energy transition technologies.

Energy sector planning in Georgia is guided by its State Energy Policy and the country's obligations to international treaties, which require different planning processes and have resulted in the development of the NECP, the NDC, the LT-LEDS, the Climate Change Strategy and Action Plan and, specific to the power sector, the Ten-Year Network Development Plan. However, the preparation and development of these documents have proven to be challenging and have been subject to delays in the past. Interlinkages and alignment between these various plans have also been shown to be lacking. The reasons for these challenges stem from the lack of a dedicated planning department whose primary role is to regularly interact and follow-up with the large number of stakeholders involved in the different processes and ensure alignment between energy and climate sector planning.[19] The lack of a dedicated planning team leads to discrepancies between different planning documents; discrepancies are also caused by the different planning processes being built on different modelling scenarios and objectives, focusing either on energy or emissions.

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[19] *Different ministries are responsible for leading different planning documents: NDC and LT-LEDS development is led by the Ministry of Environmental Protection and Agriculture, whilst the NECP development is led by MoESD.*

Scenario development and modelling for energy sector planning is outsourced. This by itself is not necessarily a challenge, as there are advantages to both outsourcing and insourcing (see Figure 3.1). However, a dedicated planning team would have the capacity to inform and interpret different modelling scenarios from outsourced entities and ensure that energy modelling scenarios and associated emission growth projections inform strategic policy decisions based on criteria that optimally take into account techno-economic considerations, technology costs, and social and political implications.

- A permanent planning team or department, with adequate human and technical resources, is therefore needed to analyse different modelling scenarios, inform policy analysis and decision making, ensure continued and co-ordinated planning for the energy sector in Georgia, and take the lead on aligning Georgia's energy and climate planning documents in subsequent update cycles.
- The planning team should also take the lead on ensuring a strong co-ordination mechanism among different national stakeholders – such as the MoESD and its subsidiaries in the energy sector and the Ministry of Environmental Protection and Agriculture (MEPA) and its subsidiaries in climate planning – in the development and alignment of energy and climate plans and subsequent policy making for implementation.
- GNERC should also be empowered with adequate technical resources to play a more active consultative role and ensure that subsequent network development plans, such as those developed by the distribution and transmission system operators, are aligned and coherent with broader energy and climate change action plans and policies before they are officially adopted.

Figure 3.1 **Insourcing vs. outsourcing of long-term energy scenarios**

INSOURCING **LTES capacity within ministries or energy agencies**		**OUTSOURCING** **LTES capacity out-sourced to research institutions or consultancies**
Ensure closer and faster interaction with policy makers	**GOVERNMENT INVOLVEMENT**	Can result in intermittent and shorter interactions with policy makers
Tends to have a limited number of scenarios, often reflecting more conservative viewpoints	**SCENARIO DIVERSITY**	Tends to cover a broader range of scenarios, reflecting the client's views and agenda
Depends on government technical capacity and access to tools and information	**QUALITY OF RESULTS**	Allows procurement from different high-end commercial tools tailored for purpose
Quick response to pressing government policy needs, subject to the capacity of the team	**RESPONSE RATE**	May take time to procure scenarios but offers a range of execution timing as specified by government needs
Ensures full transparency of inputs and outputs through closer interaction with an in-house modelling team	**TRANSPARENCY**	Tends to be black-box, and proprietary licenses may potentially limit full access to the tools
Can be cheaper but requires significant efforts to build modelling capacity	**COST**	Tends to be expensive to hire commercial consultancy firms
· Quality assurance (*e.g.* engaging with academia) **· Team or agency dedicated to modelling and scenario building.** **· Setting an institutional process for regular updates of LTES**	**KEYS FOR SUCCESS**	**· Absorptive capacity within a goverment to understand the modelling results** **· Full disclosure of scenario data and modelling methodology** **· Access to enough high-quality research institutions**

Source: (IRENA, 2020a).

In the effort towards aligning energy and climate planning documents, the MoESD and MEPA requested IRENA's support in performing a comparative study of Georgia's NDC, NECP and LT-LEDS in order to enhance the upcoming NDC update in 2025 (NDC 3.0). The study's focus was to align renewable energy, energy efficiency and GHG emission reduction targets in the NECP and NDC, as well as to align those targets with the mid-century vision set out in the LT-LEDS. Additionally, the targets outlined in these documents were analysed in the context of the COP28 United Arab Emirates (UAE) Consensus adopted by the UNFCCC Parties, which includes the global new target of tripling renewable capacity by 2030.

The NECP set a target of reducing GHG emissions by 47% by 2030 against 1990 levels, while the NDC sets an unconditional target of 35% and a conditional target of 50–57% of GHG emission reductions by 2030 compared to 1990 levels. While the LT-LEDS does not set 2030 targets, the pathway towards net-zero GHG emissions by 2050 includes projections for 2030 GHG emissions, which represent a 64% reduction compared to 1990 levels. Apart from the energy efficiency and renewable energy targets mentioned in the Climate Change Strategy and Action Plan, Georgia's NDC lacks a mention of renewable energy and its important role in achieving its climate targets and, consequently, does not establish renewable energy targets and also lacks quantitative energy efficiency targets. Moreover, contrary to the NECP and the LT-LEDS, which include full sectoral breakdowns of GHG emission projections, the NDC only has quantitative GHG emission targets for some sectors – transport, energy generation and transmission, and industry – and it does not include land use, land-use change and forestry (LULUCF) emissions.[20] Additionally, the NDC considers a different sector breakdown than the other two documents. For example, the transport and energy generation and transmission sectors have separate targets in the NDC, but they are both considered under "energy" GHG emissions in the NECP and the LT-LEDS.

In terms of renewable energy targets and projections for 2030, the country's target set in the NECP and the projections outlined in the LT-LEDS (82% and 87% of renewables in installed capacity by 2030, respectively) demonstrate a commendable level of ambition, exceeding the global average share of renewables projected by (IRENA *et al.*, 2024) under the 1.5°C Scenario (77%).[21] There are some differences between the most ambitious scenarios in the NECP and the LT-LEDS: the former has significantly higher shares of solar and wind power in the capacity mix projections towards 2050, while the latter relies more on hydropower. The LT-LEDS projections present slightly higher renewable energy shares in the power sector capacity mix towards 2050, although this difference does get smaller throughout the years. Furthermore, the GHG emission projections across sectors are misaligned between the two documents: the LT-LEDS has more ambitious GHG reductions in all sectors, with the difference being higher in the energy and agriculture sectors. There is also a lack of alignment in the baseline scenarios considered between the two documents.

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[20] *The NDC includes quantitative GHG emissions targets for certain sectors. Georgia's 2021-2023 Action Plan of the 2030 Climate Strategy and the 2024-2025 Action Plan of the 2030 Climate Strategy outline the national climate change mitigation policy in the following sectors: energy generation and transmission, energy consumption in transport, energy consumption in buildings, agriculture, waste management, forestry, energy consumption in industry, and industrial processes. The forestry sector's commitment is an additional pledge and is not included in the 35% national emission reduction target set in the NDC. Thus, the comparison of GHG emission targets and projections in the different planning documents – NDC, NECP and LT-LEDS – excludes the LULUCF emissions.*

[21] *IRENA's 1.5°C Scenario formed the intellectual basis for the COP28 UAE Consensus.*

- It is therefore recommended that the updated NDC (NDC 3.0) should include renewable energy and energy efficiency targets in line with Georgia's NECP targets. Both the LT-LEDS and the NECP highlight the role that a large increase in renewable energy capacity has on GHG emission reduction targets, which should be reiterated in the NDC 3.0. More specifically, the upcoming NDC 3.0 can be informed by the capacity mix projections in the LT-LEDS and the NECP, as well as by the NECP's renewable energy targets in transport, electricity and heating. Specifying renewable energy targets by sector and technology helps provide a clear roadmap for stakeholders, increases transparency and improves monitoring of progress. Clear targets and technology breakdowns also attract investment and reduce risks by providing a sense of certainty and commitment.
- Enhancing Georgia's NDC GHG emission reduction targets to align them with the pathway towards the ambitious goal of achieving climate neutrality by 2050, as outlined in the country's LT-LEDS, would create a strong and consistent national climate action framework. Further integration with relevant policy objectives at the European Union and Energy Community levels would enhance this alignment and demonstrate regional leadership. Elevating the ambition of the upcoming NDC 3.0 by setting enhanced emission targets that reflect this mid-century vision is encouraged. Consideration should be given to disaggregating economy-wide targets into quantitative sectoral targets for all sectors, including LULUCF, drawing on the GHG projections outlined in the NECP and the LT-LEDS. Such sectoral targets would foster greater accountability by providing clear emission reduction pathways for each sector, enabling more effective stakeholder engagement and supporting the development of targeted policies tailored to individual sector needs. Improving the comparability and consistency of Georgia's energy and climate planning documents by exploring options for aligning baseline scenarios across the plans, including the NECP and the LT-LEDS, could facilitate progress tracking and enhance transparency. Harmonising these baselines would provide a shared reference point for evaluating progress and further strengthen Georgia's climate action framework.

Action 2: Establishing an implementing body for the energy transition

Renewable energy and energy efficiency measures and plans for the energy transition require implementation mechanisms that span beyond the current institutional structures of the energy sector. For example, a preliminary study undertaken by the Energy Efficiency Centre revealed that to execute only the requirements under the current legal framework for energy efficiency, 28 functions and 138 tasks (Georgian Energy Sector Reform Programme, 2024a) would need to be undertaken that current institutions either do not have the legislative mandate or the technical capacity to execute (Georgian Energy Sector Reform Programme, 2024b).

- The establishment of a dedicated implementing body, such as an energy transition agency, is therefore of great importance to enable the implementation of various renewable energy and energy efficiency measures.
- Such an agency should be established with clearly defined institutional roles and accountability, mandated by law, with allocated funding streams, human resources and technical capacities to enable it to fulfil its mandate.
- The agency should have the authority to monitor compliance with renewable energy and energy efficiency regulation. For example, it could have the tasks of developing, monitoring and managing the Energy Performance Certification System, which rates buildings' energy performance, and the Energy Audit System, which identifies necessary energy efficiency improvements. Through such oversight and closer working relationships with municipalities on energy-related issues, the agency would be able to inform the development of the building renovation strategies and the development of heat decarbonisation strategies in a timely manner (see Action 7).

- The agency should be tasked with conceptualising, developing and monitoring the progress of various renewable energy and energy efficiency programmes, keeping updated databases on energy metrics to inform strategic policy and planning, and keeping registries of qualified energy producers and service providers, including certified human resources such as renewable energy system installers, energy auditors and engineers.
- The agency could also act as a knowledge hub, collaborating with bilateral, regional and international development partners, as well as facilitating collaboration among industry, municipalities, various ministries and academia to drive innovation, share best practices and provide information on existing gaps in the energy value chain that need to be strengthened. As a knowledge hub, the agency would be able to influence the overall development of the energy sector in line with emerging and evolving market and technology trends, regional and global best practices, and international commitments.
- The agency should be a single window for providing transparent information to the private and public sector on energy planning, policy and regulation, support measures, and permitting procedures.

Action 3: Facilitating an active role for municipalities in the energy transition

Municipalities can play a crucial part in energy sector development. Their effective governing role can facilitate bottom-up energy solutions that are customised to the requirements of the local region and local communities, thereby ensuring sustainability and acceptance. They have the local vantage point of their existing roles to leverage, such as in planning and regulating building development in their jurisdictions, and can develop energy programmes based on targeted needs and solicited input from citizens and industry. Such programmes are able to bring about local socio-economic development and local value creation, create a conducive investment environment, and empower citizens to engage in the energy transition and adopt energy-efficient practices. Moreover, municipalities have the potential to pilot energy programmes on a small scale and provide valuable input for their improvement and effective scale-up at the national level.

However, Georgian municipalities[22] lack a formal mandate with administrative and operational mechanisms to enable them to effectively plan for and contribute to the energy transition. Even though 33 municipalities (half of the national total) are signatories of the Global Covenant of Mayors for Climate and Energy, whereby they are obliged to develop medium- to long-term targets that meet or exceed national climate ambitions within their Sustainable Energy and Climate Actions Plans, only 12 municipalities have developed such plans (Covenant of Mayors for Climate and Energy Eastern Partnership, 2024). The municipalities report that, due to not having a formal mandate, they lack adequate institutional capacity and human resources in the field of sustainability to proactively develop their municipality's climate and energy ambitions. Furthermore, the Georgian municipalities that have developed their sustainability plans also face financial constraints to the implementation of these plans. This is due to budgetary constraints, given the limited level of financial decentralisation[23] of the state budget; a lack of dedicated funding possibilities; and limited flexibility on the part of municipalities to directly access funding sources.

[22] *Georgia is administratively divided into local self-governing units, which include 64 municipalities of which five are self-governing cities and the rest are self-governing communities. The municipalities, outside of Tbilisi and the Autonomous Republic of Adjara, are grouped into nine regions.*

[23] *Municipalities are highly reliant on financial transfers from the central state budget; on average, intergovernmental transfers make up about two-thirds of total local government revenues (Melua, 2021).*

- It is therefore recommended that the role of municipalities in the energy transition, specifically pertaining to energy efficiency and renewable energy development, is clearly defined and mandated within Georgian legislation, along with clear annual budget allocations in fulfilling the role. The facilitation of this, along with a higher decentralisation of local governance, is to be initiated by and subsequently strongly co-ordinated among the Ministry of Regional Development and Infrastructure, the Ministry of Finance, the MoESD and MEPA.
- Provisions should also be made for increased institutional capacities and human resources at the municipal and/or regional level, which would facilitate municipalities engaging proactively in energy planning and project implementation. Specific technical capacities that would need to be built include energy data analytics, public solicitation, and the development of municipal energy and climate change action plans and projects in alignment with national ambitions, monitoring their implementation, accessing financing and co-operating with other local and national stakeholders on energy- and climate-related issues. Such co-operation could also be facilitated through the proposed energy transition agency (see Action 2) and supported by the Ministry of Regional Development and Infrastructure.
- Municipal green procurement policies should also be encouraged in order to prioritise the procurement of renewable energy services and technologies from local suppliers and thereby create market demand for local value chains in energy provision and empower local industry.
- With dedicated administrative capacities and human resources, municipalities could also play a role in public-private partnership energy projects. For example, with adequate technical capacities and with the eventual establishment of renewable energy communities (see Action 13), municipalities would be able to actively engage as stakeholders in renewable energy projects and align municipal spatial planning to include renewable energy projects within local communities.
- To address financial constraints, innovative financing mechanisms would need to be developed to allow municipalities to implement their energy programmes. Such financing mechanisms could, as an example, involve the development of a dedicated revolving fund for municipalities, which would offset the risk-averse stance the Ministry of Finance has previously taken on any proposals for dedicated energy funding mechanisms (see Action 9).
- Municipalities should develop communication and awareness raising campaign strategies to inform and engage local populations in ongoing and planned energy programmes. Such communication efforts should ensure continuity and should be designed together with community leaders; outreach should make use of various communication channels, such as social media, conventional radio and television broadcasts, local events, and workshops. Communication should involve clear messaging and visual storytelling and emphasise the regional relevance and benefits of the energy programmes.
- For municipalities to co-operate with one another on specific technical issues related to the energy transition, including energy poverty, a dedicated platform should be facilitated within the proposed energy transition agency (see Action 2).

3.2 Integration of renewable power

Action 4: Geospatial planning for large-scale generation projects

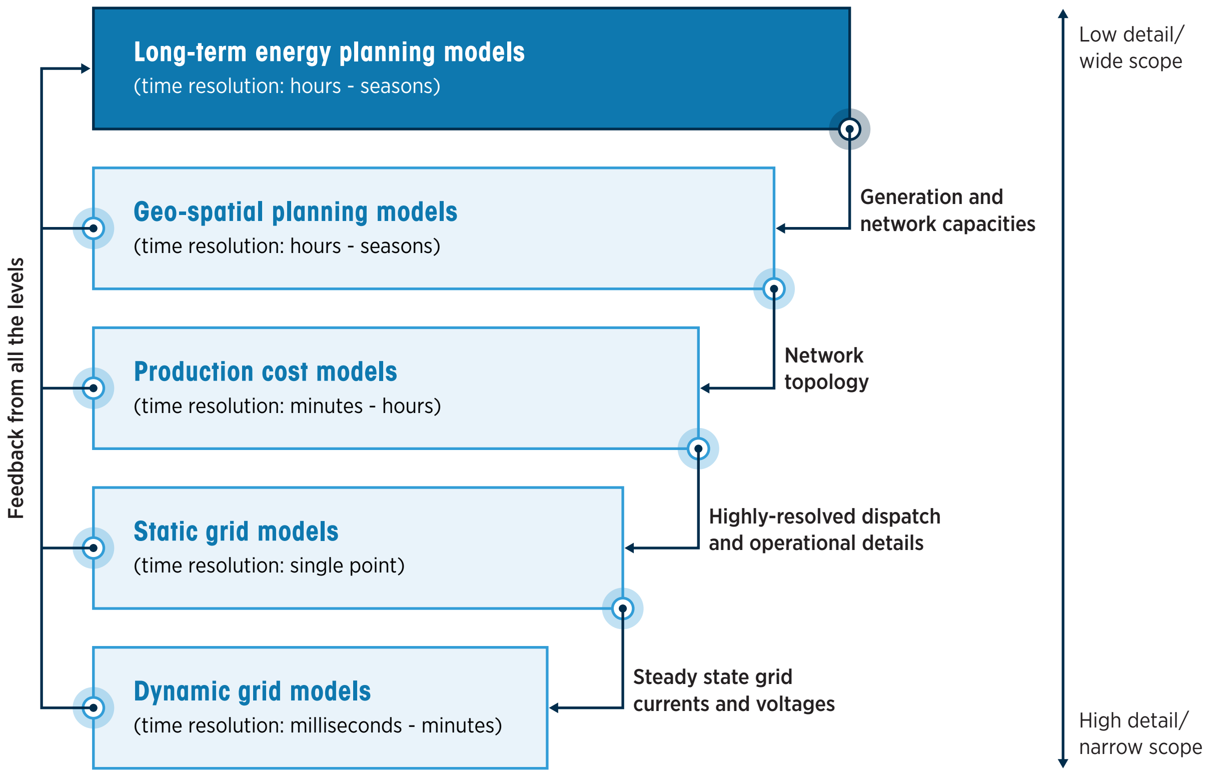
Geospatial planning involves the geospatial mapping of renewable energy resource potential, along with other relevant datasets such as proximities to grid infrastructure, load centres and road networks, as well as land use and topography. The analysis of these datasets, according to a multi-criteria methodology incorporating various economic and technical factors, enables the identification of the most optimal zones for project development and can inform network development planning. These sites, or renewable energy zones, have the potential to significantly lower investors' perceived risks in developing projects, especially in nascent markets that do not have a significant track record of variable renewable power projects. Zones signal to investors high-yield project areas that are accessible, that are in close proximity to existing or planned grid infrastructure with technical capacity for power evacuation, and that have no land usage restrictions for power project development, which can notably reduce pre-development costs. Moreover, the incorporation of renewable energy zones into geospatial planning models, and subsequently into generation capacity expansion models and dispatch models (see Figure 3.2), can more systematically and effectively identify the necessary power infrastructure developments.

In its power planning, Georgia does not holistically include all elements of geospatial planning and the techno-economic potential of renewable energy zones. Generation capacity expansion for variable renewable power is planned based on resource assessments that indicate general areas of the country that have high potential for wind power or solar PV power development, but not exact project development zones that can be prioritised and quantified by their techno-economic power generation potential. Generation capacity expansion and network planning therefore inevitably risks not fully recognising the highest-potential zones for renewable power development. As such, potential power generation risk project delays due to long lead times for accompanying network infrastructure. In parallel to the ETA, upon request from the MoESD, IRENA has mapped the most promising renewable energy zones for large-scale solar PV and wind power in Georgia, with their corresponding techno-economic parameters, and has estimated the theoretical hydropower potential for Georgia based on the Global Atlas for Renewable Energy datasets (IRENA, n.d.).

- It is recommended that the Georgian State Electrosystem (as the transmission system operator), the MoESD and the proposed energy planning department (see Action 1) incorporate the renewable energy zones developed by IRENA into geospatial power planning models.[24]
- Technical capacities should also be developed at the institutional and human level in using and integrating these geospatial models into power system planning, along with maintaining and updating the renewable energy resource assessments and the zoning methodology.
- Geospatial planning for variable renewable power generation should be integrated into the wider power system planning models, informing generation capacity expansions as well as network development plans (*i.e.* subsequent updates of the TYNDP).

[24] *Examples of sophisticated modelling tools for geospatial planning include ArcGIS, Quantum GIS (QGIS) and Geographic Resources Analysis Support System (GRASS GIS). More information on IRENA's zoning assessment can be found at: www.irena.org/Energy-Transition/Project-Facilitation/Renewable-potential-assessment/Zoning-Assessment.*

Figure 3.2 Role of geospatial planning in the iterative process of power system planning



Source: (IRENA, 2017c).

Box 3.1 The Global Atlas for Renewable Energy initiative

IRENA runs comprehensive renewable energy resource assessment activities through the Global Atlas for Renewable Energy initiative[25] to support countries in planning and deploying renewable projects at different scales (utility, off-grid and municipal). This initiative encompasses different online tools and country-level analyses, including site assessment,[26] which is a cost-effective pre-feasibility analysis developed to support countries in finding economically viable sites for solar (PV, parabolic trough collector, central receiver system, and linear Fresnel) and wind project development. The service relies on site-specific resource profiles, industry-standard energy yields, and financial assessment methodologies to establish a range of tariffs and levelised costs of a site for potential investment on ground measurements and subsequent development. Through this service, IRENA has assisted local authorities – ministries and public utilities – in several countries in Africa, Latin America and small island developing states, in the selection and screening of more than 153 promising sites for solar and wind power projects.

[25] *More information on IRENA's Global Atlas for Renewable Energy initiative can be found at: www.irena.org/Energy-Transition/Project-Facilitation/Renewable-potential-assessment/Global-Atlas.*

[26] *More information on site assessments can be found at: www.irena.org/Energy-Transition/Project-Facilitation/Renewable-potential-assessment/Site-Assessment.*

Action 5: Increasing grid flexibility to accommodate variable power generation

The Georgian power system was initially planned as part of a larger unified power system of the former USSR. After Georgia's independence, the country started facing a lack of flexibility and a power reserve deficit. All its neighbouring countries have different power markets and power system planning and operation philosophies; hence, access to the fast-acting flexibility of the neighbouring countries is difficult. Maintaining system stability is therefore an already challenging task. In fact, when all elements of the system are operating within their normal range, the overall transmission network's operation mode is in "caution". This state is characterised by the grid's security level falling below limits of adequacy and being highly susceptible to a disturbance (*e.g.* caused by storms), which can cause equipment overloading and force the system into a state of "emergency". This has been even more pronounced in recent years with the increase in electricity consumption, whereby the peak load of substations has increased sharply, especially around Tbilisi, which continues to adversely affect supply to customers and cause outages.[27] With the planned injection of higher shares of variable renewable power, maintaining system reliability will be increasingly challenging.

The last two auction rounds have yielded a renewable energy pipeline of over 1 GW of total installed capacity, expected to be developed and connected to the grid by 2030. The Georgian power grid system therefore needs to urgently increase its flexibility by adding fast and flexible power reserves that can manage intra-day intermittencies of variable renewable power production. Flexibility can be increased with the addition of pumped storage hydropower plants and battery energy storage systems (BESS) and with the eventual development of green hydrogen systems – all of which can provide versatile energy storage solutions for fast and flexible ramping, frequency regulation, black start,[28] load shifting, and capacity firming. BESS, particularly, can be a cost-effective option for increasing grid flexibility as the global average costs of BESS declined by 89% between 2010 and 2023 (from USD 2 511/kWh in 2010 to USD 273/kWh in 2023) (IRENA, 2024a).

Georgia's second renewable energy auction round allocated 300 MW of regulating[29] hydropower plants, of which 184 MW were awarded the auction bid. However, given that the development of new hydropower plants in the recent past has faced strong opposition from the public and caused delays and uncertainty, retrofitting existing reservoir hydropower plants with pumped storage systems may be a more acceptable option going forward. This would alleviate the environmental concerns of building new hydropower plants and require minimal land-use changes.

- It is recommended that the feasibility of retrofitting and upgrading existing reservoir hydropower plants should be assessed and, where technically and economically feasible,[30] the inclusion of pumped storage systems should be prioritised.

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27 *Losses of electricity in the grid network (in the transmission and distribution networks in total) have been reducing every year and, in 2022, amounted to 6.08% (1.97% in the transmission network and 4.11% in the distribution network) (Georgian National Energy and Water Supply Regulatory Commission, 2023). However, in terms of system reliability, the average outage duration for each customer and the number of interruptions per customer have been worsening over the years and, in 2022, amounted to 9.75 hours and 5.97 interruptions, respectively.*

28 *Black start is the function of restoring the operation of a power plant or part of the power network from a completely non-energised state after a system failure or shutdown, without needing external power from the grid.*

29 *50 MW of hourly regulation (1 hour to 4 hours), 100 MW of daily regulation (4 hours to 8 hours) and 150 MW of per-day regulation (over 8 hours).*

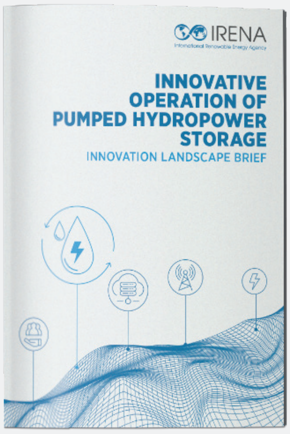
30 *Hydropower plants have different ownership structures, mostly private, and thus their retrofitting may not be justified without adequate incentivisation for the hydropower plant owners.*

- The development of BESS technologies should be more readily facilitated by designing subsequent auction rounds in which BESS technologies can bid as a separate technological category, facilitated through a legal framework and/or leveraging previous approaches in auction design that had hybrid categories of BESS with renewable technologies. However, both approaches would require clearly defined technical specifications and pricing for BESS in their primary role of frequency control that would not jeopardise their competitiveness with power generation projects (see Box 3.4).
- Pre-emptive demand-side management can play an important role in maintaining power system stability. Current intra-day wind and solar PV power generation has been found to be largely uncorrelated with Georgia's power demand profile, which can cause difficulties in maintaining grid stability and risking power curtailment once more projects come online. Such demand-side management could include, for example, incentivising the charging of electric vehicles during times of low demand and high solar PV and wind power supply (see Action 9) and introducing dynamic retail pricing, whereby lower retail electricity tariffs could be offered during these times of low demand and high solar PV and wind power supply to incentivise load shifting among both residential and commercial consumers.
- Hydrogen technologies can also be considered for balancing grid fluctuations caused by the lack of correlation between variable power supply and the demand profile. This is a novel application for hydrogen in the energy system and is currently only being demonstrated at small scales in some countries. This flexibility may be achieved both during hydrogen production and later via its use as a fuel for power generation. If variable renewable power is used for the production of green hydrogen gas (via electrolysis) in times of low power demand, or particularly high renewable supply, hydrogen can act as an energy storage medium. The stored gas can be readily available as a fuel for power production in converted gas turbines or, using hydrogen fuel cells, in times of high demand or for direct applications in hard-to-abate sectors, such as in industry. However, implementation of such hydrogen technologies would be a costly undertaking in the near term, with low round-cycle efficiencies and the need to retrofit existing gas power plants or build new ones. Important factors that should be considered when looking at this option include the daily and seasonal patterns of renewable energy resource variance in the country and the availability of geological hydrogen storage. Specific energy market frameworks and policy support would likely also be required to make this option feasible, due particularly to the costs associated with developing and maintaining hydrogen storage facilities.

Box 3.2 **Decarbonising end-use sectors with renewable power**

IRENA's *Innovation landscape for smart electrification* presents key innovations that can form the basis of smart electrification strategies, which can increase system flexibility, incorporate large shares of renewable energy in power systems, and offer cost-effective decarbonisation pathways to electrify end-use sectors. The report offers pathways to end-use electrification in the areas of power to mobility, power to heat and cooling, and power to hydrogen. These pathways are based on 100 key innovations, categorised within four dimensions: technology and infrastructure; market design and regulation; system planning and operation; and business models (IRENA, 2023d).

Box 3.3 **Innovative operation of pumped hydropower storage**



IRENA's innovation landscape brief on the innovative operation of pumped hydropower storage is part of IRENA's project "Innovation landscape for a renewable powered future", which maps relevant innovations, identifies synergies and formulates solutions for integrating high shares of variable renewable energy into power systems. This brief provides an overview of new ways to operate pumped hydropower storage to provide greater power system flexibility. The innovative operation of pumped hydropower storage and its complementarity with other power-generating technologies offer plenty of opportunities for variable renewable energy integration. Pumped hydropower storage represents over 10% of the total hydropower capacity worldwide and 94% of the global installed energy storage capacity (International Hydropower Association, 2018). Known as the oldest technology for large-scale energy storage, pumped hydropower storage can be used to balance the grid, complement other renewable energy infrastructure and facilitate effective supply shifts (IRENA, 2020b).

Box 3.4 **Case study on BESS auctions in Greece**

The steep increase of renewable power generation in Greece caused several challenges for the stability of the power system and forced the curtailment of renewable power during times of peak generation when both domestic demand and export capacity were exceeded. In its efforts to urgently address these challenges and allow for the full utilisation of the renewable power generated, the Ministry of the Environment and Energy announced the launch of its first energy storage auction round, for a total of 400 MW, in June of 2023. Requirements for participating in the bidding process included the need to obtain a storage licence from the regulator, have a planned operating power of no less than 1 MW and at most 100 MW, have a storage capacity of 2 MWh/MW, and be connected to the grid by the end of 2025 (Balkan Green Energy News, 2023). Project proposals needed to include letters of guarantee of EUR 35 000 per project, EUR 250 000 per MW for timely project completion, and EUR 200 000 per MW for proper project operation. The bidding prices were capped at a ceiling of EUR 115 000 per MW per year (Balkan Green Energy News, 2023). The winning bidders are supported through a ten-year CfD mechanism, whereby they have to participate in Greece's wholesale electricity trading and secondary balancing services markets; every year, the projects' market earnings will be assessed according to the CfD, and the difference will be remunerated accordingly. A minimum of four bidders were required for the auction round to be considered competitive. The first auction round attracted 48 bidders, and the full 400 MW were met by 11 selected projects with a weighted-average price of EUR 49 748 per MW per year (Energy Storage News, 2024). A second auction round has since been held for a total of 300 MW, which yielded a weighted-average price of EUR 46 680 per MW per year (Energy Storage News, 2024).

Action 6: Incentivising renewable power development through support schemes

As discussed in Section 1.3, renewable power projects below 500 kW[31] are currently supported through the net-metering scheme in Georgia. Larger projects are supported either through the CfD mechanism, if they were selected as winning bidders at the two renewable energy auction rounds, or through direct negotiations and contracting for all other proposed projects that were not selected during the auction bidding.

[31] *There are ongoing discussions with GNERC for the capacity threshold for net-metering schemes to be reduced from 500 kW to 100 kW.*

Under the net-metering scheme, commercial electricity end users make up the majority of installed capacity, over residential users. This is due to electricity tariffs being higher and more cost-reflective for commercial consumers, which means that the savings and eventual remuneration from surplus production of electricity secures faster investment returns and allows for larger investments. However, beyond 31 December 2026, the issuance of new connections under the net-metering support scheme will no longer be permissible.[32]

- It is recommended that the regulation for both new and existing small-scale decentralised systems is revised and promptly enacted so that there is longer-term certainty of the support scheme beyond 2026, at least until 2030 and preferably beyond, which will ensure continued and accelerated uptake of decentralised renewable power and BESS.
- In the revision, uptake of decentralised systems among residential consumers should be incentivised, for example through feed-in tariffs, while ensuring that consumers are subject to "cost-reflective, non-discriminatory and proportionate network charges" as per the Renewable Energy Directive (REDII) (Energy Community Secretariat, 2020). This could be ensured by transitioning fully from net metering to net billing,[33] whereby consumers will be charged separately for the volumetric part of consumed and grid-fed electricity, avoiding the cross-subsidisation[34] that net-metering otherwise causes.

In terms of larger-scale renewable power projects, the two auctions rounds together have managed to attract a sizeable project pipeline. However, due to delays in the opening of the day-ahead and intra-day electricity markets,[35] the CfD mechanisms for projects selected through the auction rounds will be based on the internal balancing market prices, until the full implementation of the market reform. A decision has been taken not to undergo further auction rounds for the time being and instead to allow for any proposed projects[36] to apply for direct contracting at the median prices selected under the second auction round (see Annex 4). Although this approach may allow for more installed capacity to be added to the project pipeline, it may pose several risks going forward. Offering developers the median prices determined in the second auction round, which were rather high compared with regional and global market trends, may attract investments but may also jeopardise the liquidity of the off-taker.

- A mechanism for allowing for real market price discovery for new larger-scale projects (*i.e.* above 500 kW) should still be enforced through periodic auctioning rounds. Such periodic auctioning can also provide more insight into the project pipeline and thereby allow for more timely network development planning and more certainty for the connection of generation projects into the grid network.

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[32] According to the European Union's Internal Market for Electricity Directive 2019/944, as adopted in the Energy Community legal framework, new net-metering schemes will not be allowed after 31 December 2026, and consumers under the current net-metering scheme will be allowed to switch to net billing (Energy Community Secretariat, 2020).

[33] Net metering, given that it considers the net kilowatt-hours consumed or fed into the grid, essentially regards the kilowatt-hours fed into the grid at the same retail tariff or price as the kilowatt-hours consumed. Net billing considers the kilowatt-hours fed into the grid at a different price, usually lower, than the retail tariff for kilowatt-hours consumed.

[34] Under the net-metering scheme, consumers receive a kilowatt-hour credit per kilowatt-hour fed into the grid. At the end of the accounting period, the consumer is only charged for the net kilowatt-hours consumed, which de facto does not account for distribution charges of wheeling the full volume of electricity back and forth.

[35] On 1 July 2024, Georgia launched a transitional model for its electricity market, commencing day-ahead and intra-day markets on a limited and voluntary basis, alongside the existing model for balancing electricity. The full implementation of the hourly balancing obligation, along with the balancing and auxiliary services market, is scheduled for 1 July 2025.

[36] Any new projects, projects with feasibility studies, and projects that were not selected during the auction rounds, may apply for CfD but with higher bank guarantee requirements: USD 50 000 USD per MW for feasibility study, and USD 100 000 per MW for construction, as opposed to the previous USD 10 000 per MW and USD 20 000 per MW, respectively.

3.3 Decarbonisation of end-use sectors

Action 7: Developing a comprehensive decarbonisation strategy for heating and cooling in buildings and industry

In the national energy balance, the consumption of heat is not reported as a disaggregated dataset by energy type and quantity. Nonetheless, its share of the total final energy consumption is considerable, especially in buildings and industry. The residential sector's energy consumption is 71.5% natural gas and 13.1% fuelwood, which is almost entirely used for heating applications, such as space heating, water heating and cooking. In the industrial sector, over 65.0% of the energy consumption is supplied by natural gas, coal and oil products, which are also predominantly used for heating applications, such in iron and steel manufacturing, non-metallic mineral processing, the chemical industry, and the food and beverage industry. Decarbonisation of heating in the residential, commercial and industrial sectors is therefore of paramount importance in achieving Georgia's climate ambitions and ensuring socio-economic benefits. Given that Georgia's energy intensity is much higher than the regional average for Europe and Central Asia (World Bank Group, 2022), increasing energy efficiency in heating is an important pathway towards achieving decarbonisation, while also alleviating energy poverty. Equally important to energy efficiency is the incorporation of other modern and renewable energy technologies.

Within its NECP, Georgia set targets for a declining renewable energy share of 7%, 5% and 4% in the "remaining energy"[37] segment of its gross final energy consumption by 2030, 2040 and 2050, respectively. The targets are decreasing because the country plans to reduce its heat consumption through energy efficiency measures and to displace biomass utilisation by increasing natural gas utilisation with the expansion of the natural gas network. The incorporation of other renewable energy and energy-efficient technologies for decarbonising heat supply, along with the electrification of heat supply, are not adequately planned for in terms of supporting policies and measures. The reasons for such omissions stem from a lack of comprehensive assessments of heat energy supply and demand, including a technical and economic assessment of different energy sources, technologies and systems for heating applications, in both the residential and industrial sectors. For example, through various disaggregated studies in Georgia, abundant and currently underused forest residues and agricultural waste from wine pruning and hazelnut shells have indicated high potential for the production of upgraded solid biofuels such as briquettes, pellets and wood chips, as well as local capacities for the production of energy-efficient biomass stoves and fuels. In certain municipalities or communities, the substitution of inefficient biomass stoves with efficient biomass technologies and upgraded biomass fuels could prove to be more cost-effective, more acceptable and faster to implement than the planned expansion of the natural gas network, which would still necessitate natural gas imports and increase energy security risks.

- A comprehensive assessment and characterisation of the current heat energy supply and demand across all sectors is recommended in order to optimally plan[38] for the decarbonisation of heating and increase the afore-mentioned targets.

[37] *In the NECP, "remaining energy" refers almost entirely to energy consumption for heating and cooling.*

[38] *The formulation of a heat decarbonisation strategy would require the close collaboration of MoESD, MEPA (as the ministry overseeing biomass use and climate-related activities), academia, industry associations, the National Statistics Office of Georgia (as the office in charge of data collection and statistical analysis), municipalities, and international development partners (who have already engaged in various biomass, geothermal and energy efficiency projects).*

- A basis for ensuring accurate assessments and reporting on the progress of the targets is the development of a methodology for quantifying the amount of heat energy consumption, along with a methodology for calculating the renewable energy share in heat consumption.
- The comprehensive assessment should include an analysis of the technical and economic potential of different energy resources, technologies and systems, which can bring about efficient heat energy utilisation, while leveraging local value chains.
- In close collaboration with individual municipalities, the comprehensive assessment for heat decarbonisation should start with an analysis of potential for heat supply from the sources most prominent in the respective municipalities.
- An analysis of potential heat sources should include municipal solid and organic waste for heating; geothermal district heating (especially in western parts of the country); waste heat and co-generation heat and power (especially in more industrialised municipalities and around Tbilisi, where the thermal power plants are located); solar thermal; and the potential of blending natural gas with biogas, given the country's existing and expanding natural gas networks.
- The potential of electrifying heat supply with efficient technologies, such as heat pumps, should also be assessed and planned for. It is known that the building envelope in Georgia is aged with low thermal insulation coefficients, which results in a higher demand for heat. The country is taking steps to address this by developing a building renovation strategy to increase the energy efficiency of buildings. However, the energy efficiency of heating technologies within such buildings should also be taken into account.
- An assessment of the current heat energy demands in industry would provide information on where efficiencies can be introduced and how heat supply in industry can be decarbonised. Given that Georgia has a sizeable iron and steel production industry, which has a high heat demand and is highly reliant on fossil fuels, the assessment would be able to indicate (i) which parts of the heat supply can be directly electrified, for example the use of electric arc furnaces for steelmaking or the use of industrial heat pumps, (ii) where bioenergy can replace fossil fuels, and (iii) which parts of the heat supply are hard to abate and would require further innovations (IRENA, 2023c).
- Following a comprehensive assessment, which would provide the evidence base, the heating decarbonisation strategy should be elaborated, the NECP targets should be appropriately revised, and subsequent policy measures to support decarbonisation in buildings and industry should be formulated.

Box 3.5 Case study on decarbonising heat supply in the municipality of Bogatić, Serbia

Similar to many regions in Georgia, the municipality of Bogatić in Serbia was long known to have moderate enthalpy geothermal potential with reservoir surface temperatures of 35-79°C (Martinović and Milivojević, n.d.) and no district heating network. In 2016, upon request of the municipality, the University of Belgrade School of Mining and Geology performed an assessment of the potential of the geothermal resources and the heat supply and energy demand of potential end users, which led to the conceptual design of a geothermal district heating system for public facilities, including technical and financial analysis of the proposed system. Based on the proposed design, the first geothermal heating system in the country was constructed in 2017, providing heating to seven public buildings with a combined ground area of 15 000 m^2, including a nursery school, a primary school, a secondary school with a sports hall, the municipal building of Bogatić, the court house, the social service office, and the public utility company (Interreg, n.d.).

The geothermal heating system was able to replace the fossil-fuelled boilers previously used in the public buildings. The system has an installed capacity of 2.1 MW from a 470 m deep production well with outflow temperatures of 75°C and yield of 25 litres per second. Through a 6-kilometre-long, constructed, pre-insulated heating pipeline, the hot water is transported from the well to end users. Heat exchangers in the buildings receive and provide heat as primary heat 75/55°C and secondary heat 70/50°C (Interreg, n.d.).

The total project costs were approximately EUR 1 million, of which 75% was financed through a loan and 25% was directly covered by the municipality's budget. The system has, over the years, ensured savings of up to EUR 150 000 per year and already paid off its initial investment cost. The project has also resulted in reduced air pollution, which would otherwise have been emitted through coal and heavy oil burning, and a reduction of 1 000 tonnes of carbon dioxide emissions annually. Based on the success of this project, the municipality plans to expand the thermal energy use to households and commercial entities through the installation of cascade systems. This pilot project, initiated at the municipal level, demonstrated the technical and financial feasibility of replacing fossil fuels with geothermal technologies. The Ministry of Energy and Mining of Serbia, with funding from European Bank for Reconstruction and Development, is currently working with ten other municipalities to implement similar geothermal heating systems (European Bank for Reconstruction and Development, 2024), based on the success of this pilot project.

Action 8: Incentivising the decarbonisation of transport

Georgia's transport sector is a high energy-consuming sector and heavily reliant on fossil fuels, accounting for approximately a third of the total energy consumption and close to 90% of all oil product consumption. The decarbonisation of transport, therefore, will play a crucial role in meeting Georgia's international climate agreements. According to its NECP, Georgia aims to reach a 10.45% renewable energy share in transport by 2030 (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).

The increased uptake of electric and hybrid vehicles is envisaged to contribute to the renewable energy share in transport.[39] Currently, as discussed in Section 1.3, various attractive fiscal incentives for hybrid and electric vehicle uptake have been introduced, which have resulted in a modest rise in the usage of such vehicles. However, their wider usage and uptake is still deterred by high initial investment costs and the lack of fast-charging stations. Although the connection of charging stations to the distribution network are incentivised by a 50% reduction in fees, the rates of return on such investments, especially for fast-charging stations, need to be increased by ensuring increased demand for them.

[39] *The NECP targets that passenger vehicles will comprise 40% hybrid and 10% electric vehicles by 2030 (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024).*

- To address the affordability of electric and hybrid vehicles and charging stations, tailored loans are to be introduced, which would facilitate greater access to finance.
- As part of the strategy for deploying more charging stations, it would be necessary to incorporate fast-charging stations within spatial planning at municipal levels to ensure their availability on all main roads. Apart from its role in decarbonising the transport sector, e-mobility can also greatly contribute to grid stability and facilitate greater deployment of renewable power generation.
- Incentivising electric vehicle charging during times of high mismatch between demand and supply (*i.e.* times of high renewable power production and low demand) would support grid stability and facilitate greater deployment of renewables (see Action 5). Such incentives could include the development of dynamic retail pricing schemes for e-vehicle charging. These schemes could include lower retail tariffs at times when electric vehicle charging should be encouraged.
- To increase the competitiveness of electric mobility compared with fossil-fuelled vehicles, the retail tariffs at commercial charging stations could be subsidised (through higher excise duties on fossil-fuelled cars) and regulated to ensure price-competitiveness.
- In striving to reach the renewable energy target in transport and to reduce air pollution, especially in urban centres, the development of sustainable mobility plans at the municipal level is recommended. The mobility plans should include measures for avoiding and reducing fuel consumption in transport, such as assigning low air pollution zones in urban centres and incentivising modal shifts in transportation that can improve energy efficiency (*e.g.* shifting from individual passenger vehicles to public transport or non-motorised vehicles and increasing rail-based transit systems).

In addition to electrifying transport, another measure for reaching the renewable energy targets in transport is biofuel blending, which also has the potential to improve energy security, rural development and job creation. However, there is no planned strategy for enacting mandatory blending, including which feedstocks are to be considered for biofuel production and how biofuel production and blending facilities will be facilitated. One of the underlying challenges for taking a decisive pathway for biofuel blending stems from a lack of assessment of the feedstock available for biofuel production, of the technical and operational implications for blending, and of how fair competition in the biofuel market would be ensured. Given that biofuel blending is also a driver for increasing energy security and supporting local value chains, local and sustainable sourcing of feedstocks should be prioritised over imports. Of specific importance are the feedstocks listed in annex IX to REDII for the production of advanced biofuel (see Annex 7 to this report). According to REDII, the minimum target share of advanced biofuels should be 3.5% of the transport sector's energy consumption by 2030.[40] As the current domestic market for such feedstocks for the production of advanced biofuels is not well assessed and biofuel production facilities are not well developed, imports of feedstocks should also be considered in order to accelerate the development and expansion of local facilities for biofuel production and facilitate biofuel blending in its piloting and early stages of application. However, importing of any type of waste products into Georgia is prohibited, including those waste products that may be used for advanced biofuel production.

[40] *The development of food-based biofuels is optional and currently capped at 2% of the final energy consumption in transport, with a gradual decrease of the share to 0% by 2030. Therefore, the prioritisation of advanced biofuels, over food-based biofuels, is necessary.*

- As a first step, a comprehensive assessment of the resource potential of the feedstocks listed under annex IX to REDII should be carried out to inform the subsequent development of an advanced biofuel market with domestically available feedstocks.
- In the meantime, an exemption on the import of waste products for the production of biofuels (*i.e.* those listed under annex IX to REDII) should be facilitated by legislation to incentivise local enterprises to develop and expand biofuel production facilities.
- Sustainability criteria for biofuels, bioliquids and biomass fuels should be developed to ensure sustainable sourcing of feedstocks, especially of forest biomass, for fuel production and should account for emissions resulting from land-use change.
- A phased approach should be planned for the introduction of biofuel blending and its adequate incentivisation by, firstly, piloting biofuel blending in a selected municipality to test the technical feasibility of sourcing, processing and blending of biofuels. The MoESD, MEPA, the Biomass Association of Georgia, the private sector (including biofuel companies) and interested municipalities, together with development partners, should define the learning objectives that such a pilot project is expected to provide. The pilot scheme could start by testing lower percentages of blending with the most readily available biofuels for use in public transportation fleets. Such a pilot project would help demonstrate the feasibility of the commercialisation of biofuels and help set percentage shares for biofuel blending in preparation for a biofuel-blending mandate.
- Given that excise duties are currently levied on both mineral fuels and biofuels, the excise duties for biofuel-blended fuels should be fairly imposed so that double-charging is avoided.
- A multi-stakeholder platform for biofuel development should also be established, with clear roles and responsibilities for the stakeholders engaged; the platform would facilitate communication among different stakeholders, enable the sharing of knowledge gained from the pilot testing and of international best practices, and inform the continued development of local value chains for biofuel production.
- Legislative and regulatory preparations should be started to oblige fuel suppliers to mandate a certain renewable energy share in their fuel supply. Provisions for adequate monitoring of fuel blending, as well as incentivisation for establishing biofuel-blending facilities, should also be adequately planned.
- To track the fulfilment of renewable energy targets in transport, the proposed energy transition agency (see Action 2) could be tasked with maintaining a system for data collection, analysis and monitoring.

Box 3.6 **Case study on state management of the use of alternative fuels in transport in Lithuan**

Within its NECP, Lithuania set a transport target of at least a 15% share of renewable energy sources in the gross final energy consumption by 2030. In fulfilling the target, the country's objectives are to diversify energy sources in the transport sector, increase the use of advanced fuels, develop alternative fuel infrastructure, introduce renewable energy obligations on fuel suppliers, and increase the use of zero-emission vehicles. In 2021, the Law of the Republic of Lithuania on Alternative Fuels was passed; the law set requirements for public institutions to procure zero-emission vehicles and mandated a minimum share of biofuels per litre of fuel sold (*i.e.* 6.6 % in petrol and 6.2 % in diesel as a share of the total energy content of the blended fuel) (Ministry of Energy of the Republic of Lithuania, 2023). Furthermore, all fuel suppliers are obliged to reach a 16.8% renewable energy share in their fuel supply by 2030, which is to be achieved through the biofuel-blending mandate and by purchasing fuels from renewable energy sources from other fuel suppliers, whereby each fuel supplier's fuel balance would have at least a 3.5% share of advanced biofuels.

The delegation of responsibilities pertaining to the use of alternative fuels in transport was also enacted by the Law of the Republic of Lithuania on Alternative Fuels. Responsibilities are divided among various line ministries, the energy regulator, the consumer rights protection office, and municipal institutions.

The line ministry in charge of energy is in charge of forming policies for alternative fuels and administrative procedures for data collection and accounting systems, and for determining mandatory quality indicators for biofuels (together with the environment and transport ministries). The transport ministry formulates the infrastructure development policy for alternative fuels and vehicles (together with the energy ministry), co-ordinates the development of sustainable mobility plans in cities (together with municipalities), develops procedures for determining the energy efficiency and environmental protection requirements applied to the purchase of road vehicles, and approves the recommendations for establishing low-pollution zones. The environment ministry determines the rules for calculating the impact of GHG emissions during the production of biofuels and determines the related environmental protection conditions for biofuel production. The agriculture ministry supervises the implementation of support measures for the use of biomass in the production of biofuels and the use of animal manure and biodegradable waste for the production of biogas. The ministry of interior ensures the registration of all non-fossil-fuelled vehicles and the alternative fuel they use, in the road vehicle register. The education ministry is in charge of formulating educational programmes on the need to reduce the use of fossil fuels and switch to cleaner transport means.

The energy regulator, financed by state budget allocations, is tasked with supervising all fuel suppliers in their obligations to reach their renewable energy targets and with imposing fines on non-compliant entities. Municipal institutions are instrumental in developing sustainable mobility plans (in co-operation with the transport ministry); encouraging public transport and the use of cleaner vehicles, fuels and means of transportation; assigning low-pollution zones within their municipality; facilitating preferential conditions for the participation of electric vehicles; and facilitating the installation of charging stations. The consumer rights protection office is responsible for the sampling of fuels on the market to determine their composition and conformity with fuel quality indicators.

Source: Law No. XIV-196 'Alternative Fuels Law' of the Republic of Lithuania (Republic of Lithuania, 2021).

3.4 Financing the energy transition

Action 9: Establishing a revolving fund for renewable energy and energy efficiency

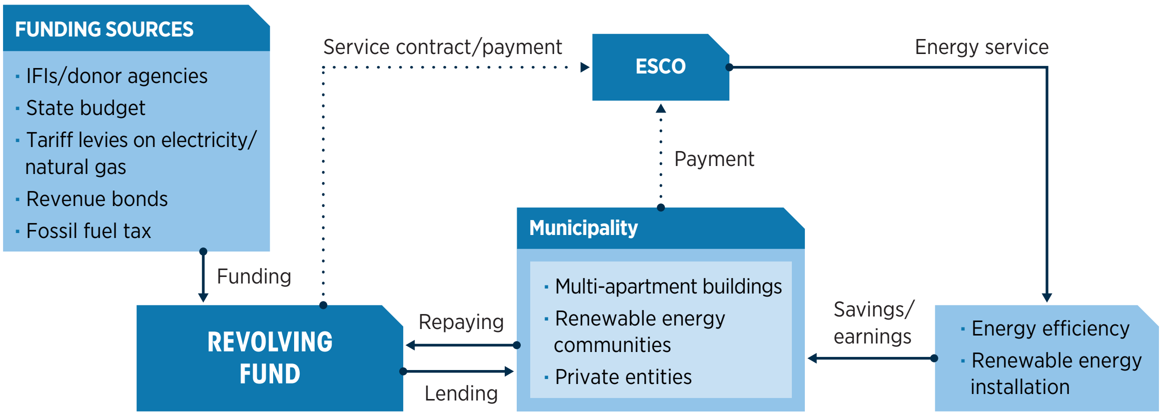
Access to finance is cited as the second largest obstacle to business development in Georgia, according to an analysis done by the European Bank for Reconstruction and Development (European Bank for Reconstruction and Development, 2021). The most significant deterrent for access to finance is high interest rates, followed by banks deeming projects non-bankable, complex loan application procedures and high collateral requirements.[41] These deterrents also impede citizens' ability to engage in energy efficiency upgrades and invest in renewable energy technologies. The challenge is further exacerbated by low electricity and natural gas tariffs, especially for residential consumers, which necessitates longer payback periods and longer loan tenures for investments in decentralised renewable energy technologies and energy efficiency. Moreover, as discussed in Section 3.1, municipalities too lack dedicated financing mechanisms for energy-related investments, such as investing in the energy efficiency of public buildings, which reduces their ability to develop or implement sustainability plans. Currently, the only funding streams available to municipalities are the Municipal Development Fund, which does not prioritise investments for the energy transition nor necessitate green public procurement practices. Viewing municipal lending as high risk and wary of increasing public debt, the Ministry of Finance has shown continued reluctance to create new funding streams for municipalities.

- It is recommended that a dedicated revolving fund or facility for renewable energy and energy efficiency is established to facilitate citizens, businesses and municipalities to readily access tailored financing for sustainable energy investments. Such financing options should be long term and lower cost and denominated in local currency.
- Such a fund would require an effective and independent governance structure, which would ensure the functionality and transparency of the fund and would be liable for regular auditing.
- Financing of projects should be based on clearly defined eligibility and selection criteria that take into account how the fund would be most optimally replenished and reinvested into while achieving its overall objectives to increase access to finance for energy investments, ensure energy savings and increase renewable energy utilisation.
- In ensuring its longevity and successful operations, the fund should ensure that the financing it provides, and the payback it receives, would still allow for enough cashflow into and out of the fund and optimally leverage the fund's seed capital. The fund's seed capital can be provided by international financial institutions, donor agencies and the state budget and can be supplemented through taxes and tariff levies.
- Since lending for energy efficiency and renewable energy projects requires longer payback periods, periodic replenishments may be necessary to facilitate continued operations after the initial seed capital has been used.

[41] *Land is still the most commonly requested collateral asset in Georgia.*

A revolving fund would be able to provide tailored long-term financing for energy investments by providing loans that would cover the initial investment costs of energy projects at non-commercial interest rates. The fund would be replenished, or in other words the loans would be repaid, through earnings in the case of renewable energy generation projects or through energy bill savings in the case of energy efficiency projects. Through these repayments, the fund would "revolve" and allow for further investments in more energy projects. Moreover, such a fund would have the capacity to aggregate projects, develop simplified energy service company models and decrease energy investment costs through the centralised implementation and procurement of energy technologies and services. In the medium term, a revolving fund would demonstrate the bankability of energy investments as well as the credit ratings of municipalities and other borrowers, which would in turn instil confidence among other commercial financial institutions. Along with providing technical assistance, such a fund would also play a supporting role in building the capacities of energy service companies, renewable energy installers, energy auditors and others. The establishment of the fund can be initiated by the MoESD, municipalities, the Ministry of Finance, the Georgian Energy Development Fund, the Municipal Development Fund, as well as other international financial institutions.

Figure 3.3 **Example of structure and operational mechanism of proposed revolving fund**



Adapted from: (World Bank Group, 2014).

Box 3.7 Case study on the Bulgarian Energy Efficiency and Renewable Sources Fund

The Bulgarian Energy Efficiency and Renewable Sources Fund (EERSF) was established in 2005, as a legal entity independent from government institutions operating under the provisions of the Energy Efficiency Act, the Renewable Energy Act and donor agreements. Its seed funding came from the Global Environment Fund through the World Bank (USD 10 million), the government of Austria (USD 1.5 million), the government of Bulgaria (USD 1.5 million), and private companies (Energy Efficiency and Renewable Sources Fund, 2024). The EERSF is managed by a private fund management team, which was selected on a competitive basis; the Management Board of the fund consists of four government and five non-government members (World Bank Group, 2014).

The main financing mechanisms of the EERSF include a loan financing facility for the co-financing of bankable renewable energy and energy efficiency projects, including direct financing with a maximum loan tenor of 10 years and interest rates between 4% and 6%, depending on the size of the investment (Energy Efficiency and Renewable Sources Fund, 2024b); portfolio guarantees for 5% of the project value and interest rates of 0.5% to 2% for energy service company and residential portfolios; and partial credit guarantees for credit risk sharing (Energy Efficiency and Renewable Sources Fund, 2024c). The EERSF also provides technical assistance for energy project development (World Bank Group, 2014).

The Fund finances the following projects for municipalities and commercial entities (ECONOLER, 2021):

- rehabilitation of buildings to improve energy efficiency, including industrial, commercial, public, and multi- and single-family residential buildings
- improvement of energy efficiency in industrial processes
- heating installations and heat distribution system improvements
- rehabilitation of municipal facilities, such as street lighting
- end-use applications, such as energy management control systems, power factor correction measures, air compressors and fuel switching
- renewable energy technologies, including solar thermal, small solar PV, biomass heating and power generation, and geothermal heating installations.

Since its establishment, the EERSF has been operating on a self-sustaining basis. All the funds raised through initial capitalisation were fully invested in projects, and the fund fully relies on revenues from loan repayment to keep revolving. With its initial capital of USD 15 million, the EERSF has catalysed USD 72 million worth of energy investments. From 2006, when the first projects were launched, to 2020 the EERSF provided loans to 212 projects worth USD 7.7 million, partial credit guarantees to 33 projects with investments of USD 14.7 million, achieved 129 160 MWh/year in energy savings and avoided 93 052 kilotonnes per year of carbon dioxide equivalent in emissions (ECONOLER, 2021).

Action 10: Developing de-risking instruments for renewable energy projects

Attracting private sector investments in renewable energy projects is necessary to achieve Georgia's renewable energy and climate commitments. This requires a conducive investment environment for the private sector, which minimises investment risks and thereby reduces the cost of financing. De-risking instruments include both policy instruments, which reduce the risk of an adverse event occurring, and financial de-risking instruments, which reduce the financial losses to an investor if an adverse event occurs.

Policy de-risking instruments include energy policy, regulation and long-term planning, which signal to investors the country's commitment to the energy transition and the crucial role the private sector is expected to play. The foundations for securing a proper environment for investment in the energy sector is establishing robust long-term energy planning frameworks (see Section 3.1). Country experiences collected through IRENA's global support in energy planning show that effective and co-ordinated national energy planning processes provide a clearer view of investment needs, reduce uncertainties, avoid *ad hoc* decisions, enhance institutional capacities, and align energy policies and investment strategies with socio-economic goals, guiding the development of de-risking instruments within a stable and predictable policy framework. These elements boost investor confidence.

As discussed in Section 1.3, energy sector investments in Georgia were adversely impacted by the abrupt discontinuation of ten-year power purchase agreements for new projects (with a feed-in premium) in 2022, until the announcement of the auction rounds (for a CfD support mechanism) in 2023. This regulatory unpredictability is still reported as an element of risk in investing and accessing finance, and the perception of risk is further exacerbated by the delays in electricity market reform relating to the opening of Georgia's intra-day and day-ahead market trading. This delay has forced CfD mechanisms to be based instead on the internal balancing market, whose trading prices are significantly lower than the prices of the winning bids of wind and solar PV power projects. As such, off-taker risk becomes an increasing perceived risk for financing, which impacts the bankability of such projects in the long term.

- It is increasingly important for periodic auction rounds to be held to rediscover the market prices for large-scale projects. Such auction rounds should be announced in good time so that developers can prepare their bids and financing in a timely manner.
- Beyond long-term planning, the cornerstone for de-risking large-scale projects is streamlining contractual agreements, such as power purchase agreements or CfD, especially in nascent markets, and aligning them to international standards. The standard power purchase agreements in Georgia are yet to be aligned with international standards and thereby ensure project bankability, specifically in relation to key investor and lender protections such as termination payments and the provision of non-recourse project financing.
- Such contractual agreements require clearly articulated clauses, including the definitions of non-compensable and compensable power curtailments, "take-or-pay" mechanisms,[42] balancing responsibility, minimum power generation thresholds,[43] guaranteed access to the grid, and *force majeure* protection. Arbitration, with expert arbitrators, should be the primary mechanism for dispute resolution as it can be more efficient and effective than reliance on lengthy judicial proceedings and thereby reduce risks in contract enforcement.
- Contractual agreements should also take into consideration other upcoming legislative reforms that may impact the bankability of the investment and make provisions to hedge the financial risk this may pose to investors.

[42] *In the event that the power producer is able to produce power but is forced to curtail for reasons beyond the power producer's control, then the power producer should be compensated for the loss it incurred for the power it would have otherwise been able to sell. This "take-or-pay" mechanism ensures certainty in the project revenue stream for the power producer.*

[43] *For wind power projects, minimum thresholds of guaranteed availability are usually 95% of the plant's mechanical availability. For solar PV projects, minimum thresholds of committed power generation are typically 85% of the committed energy supply.*

- As Georgia currently only has one large-scale non-hydro renewable energy project, the Qartli Wind Power Plant, there is no track record of how streamlined construction, environmental authorisation and grid connection permitting will be for future renewable power projects.
- To minimise perceived permitting risk, it is imperative that streamlined permitting procedures are ensured, especially as the first planned renewable energy projects are developed. Preliminary environmental authorisation should be an integral part of the technical qualification process, and alignment among different authorities should be ensured to allow for eventual environmental concerns to be addressed in a timely manner. Alongside preliminary environmental authorisation, land-use rights should be part of the technical qualification requirements to offset the risk of inadequately prepared site selection. Financial de-risking instruments, such as currency hedging, also need to be enabled. The domestic capital markets in Georgia are extremely underdeveloped and do not have the necessary capacity to cater for local currency funding needs.[44] More than half of loans (55%) are in foreign currency (European Bank for Reconstruction and Development, 2021), which is also caused by interest rates being much lower for loans in foreign currency than in local currency.[45] Given that energy tariffs are payable in local currency and debt payments are usually made in foreign currency, currency hedging instruments are needed to protect investors from fluctuations in the exchange rate and increase the bankability of their projects.
- It is recommended that contracted price agreements (in either power purchase agreements or CfD) should be at least partially indexed to a chosen hard currency, along with legislative provisions for such indexation.

Given that only one in every three firms that require a loan are successful in their loan application (European Bank for Reconstruction and Development, 2021), the local financial sector in Georgia is characterised as having very stringent and risk-averse project appraisals. These are even more pronounced for renewable energy financing, which is in its nascent state of development in the country and usually requires high collateral due to perceived high risks and low bankability. Currently, local commercial lending has high collateral requirements, most often land. The proposed de-risking measures would all contribute to increasing the bankability of energy projects but would also facilitate wider access to finance for renewable energy projects, such as through project financing structures rather than traditional collateral-based financing.

- To reduce the perceived high technical and financing risks for renewable energy and energy efficiency projects, long-term low-cost credit lines, along with technical assistance, should be provided by international financial institutions to local financial institutions to provide targeted debt financing to eligible borrowers. Through such mechanisms, local financial institutions can be supported in learning how to adequately appraise project proposals, observe cash flows from savings or repayments, and become familiar with energy market players and thereby build their capacity in developing financial products for clean energy investments beyond the time span of the credit line.

[44] *Increasing dollarisation is a long-term concern of the National Bank of Georgia, as a large share of medium- and long-term financing is sourced in foreign currency from foreign investors (including international financial institutions), which exposes the banking sector to foreign exchange refinancing risk.*

[45] *Average interest rates in local currency in 2020 were 18.3% for short-term loans (less than one year) and 14.9% for longer-term loans, while average interest rates for short- and longer-term loans in foreign currency were 7.4% and 6.8%, respectively (European Bank for Reconstruction and Development, 2021).*

3.5 Local value creation and capacity building

Action 11: Defining research and development needs to support local value chains

Investing in energy sector research and development (R&D) is vital in informing evidence-based policy making and planning, for both energy and other sectors, such as agriculture, mining and education. Facilitating research and innovation can indicate optimal solutions tailored to the country context and industry needs that take advantage of local resources and value chains to bring about maximum socio-economic benefits and attract needed investments for the energy transition. However, planning for and allocating funding for R&D is often not duly prioritised, which perpetuates the challenges of adequate institutional capacities for energy sector development. The case in Georgia is no exception.

In Georgia's NECP, there are no specific funding targets for public expenditure related to R&D. There is a lack of clear policy measures on how R&D in the energy sector will be developed and implemented, which areas of research would be of focus and which institutional capacities would need to be strengthened to execute the necessary R&D. Inadequate research and analysis is a limiting factor for the sector's development and is increasingly risking the underdevelopment of the skilled workforce and local resource potential needed to meet national energy and climate ambitions.

- It is recommended that the MoESD, in consultation with the Georgian Agency for Innovation and Technology, academia and industry, develops a strategic plan for the R&D areas necessary to take full advantage of local resources, satisfy industry needs and support the achievement of NECP targets. Furthermore, the plan should identify current gaps in institutional capacities that need to be strengthened.
- To fully reap the socio-economic benefits of the energy transition, research should also prioritise assessments of the potential for local value chain creation in the energy transition to inform pathways for maximising the local production of energy technology components, tailoring education and skilling programmes to meet skills shortages in industry, and capitalising on local extraction and refining of locally available critical minerals for the energy transition. While considering the potential for developing local value chains, the assessment should also consider how to leverage existing manufacturing capabilities and increase the share of manufactured goods and local and export market potential.
- Techno-economic assessments of critical minerals and other locally available materials are needed to support the local manufacturing and processing of energy sources and technologies.

There is a lack of comprehensive country-wide technical and economic assessments of renewable energy resource potential, which impedes effective energy sector planning. To begin to address this, IRENA undertook renewable energy zoning analysis for Georgia and identified optimal large-scale wind and solar PV project sites. However, Georgia still lacks comprehensive resource assessments of other renewable energy technologies, such as biomass, hydro and other waste for energy production.

- It is recommended that, in addition to further refining the renewable energy zoning study in the future, analysis should be done on the techno-economic potential for energy production of biomass and waste resources, such as agricultural and forest residues.

- Due to its abundant resources but unsustainable utilisation, the techno-economic potential of biomass – in line with sustainability criteria – should inform effective energy sector planning, especially for the decarbonisation of heating and transport. The development of these assessments could be carried out by academia in collaboration with the MoESD, MEPA, the National Forestry Agency, municipalities, and other international organisation previously involved with biomass potential research, such as United Nations Development Programme and GIZ.
- As discussed in Section 3.3, a comprehensive assessment of the decarbonisation of heating is required, including consideration of hard-to-abate industries such as iron and steel, which would require planning for green hydrogen.
- There is a need to start collecting evidence-based research for the applicability of hydrogen and its highest value-add in different areas of Georgia's energy system.
- This research would lay the foundations for the finalisation of the national hydrogen strategy, with defined levels of ambitions in the medium to long term.

Action 12: Building a skilled workforce for renewable energy and energy efficiency

To support Georgia's successful implementation of its renewable energy and energy efficiency legislation, plans and strategies and to drive the energy transition forward, an adequately skilled workforce is required. However, the shortage of qualified personnel and the skills mismatch with industry requirements have been a persistent and crucial challenge in all the productive sectors in Georgia. In fact, an inadequately skilled workforce has been cited as the third largest obstacle to business development in Georgia (European Bank for Reconstruction and Development, 2021). The Georgian government has made efforts to change this outlook by, in 2019, implementing a comprehensive education reform. Several steps were undertaken to address prominent gaps, especially in vocational education and training. The adoption of the Vocational Education and Training Strategy 2022-2027, the adoption of SME Strategy 2021-2025 and the modernisation of the Labour Code have all started to show positive results. Furthermore, the Skills Agency was established in 2020 as a public-private partnership between the Ministry of Education, Science and Youth and the Georgian Chamber of Commerce and Industry to facilitate practical training in real work environments and vocational colleges.

Nevertheless, there are currently only three[46] institutions that provide a total of four retraining programmes specific to renewable energy and energy efficiency technologies, according to the minimum standard qualification requirements.[47] These programmes include the training of personnel for the installation, maintenance and repair of solar PV systems, solar thermal systems, small-scale biomass systems, and geothermal systems and heat pumps. There are currently no training programmes for certified energy auditors for industry and building sectors, energy auditors performing energy efficiency certifications, or inspectors of heating and cooling systems in buildings; however, the establishment of such training programmes is envisaged to commence in 2026.[48]

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[46] *Georgian Technical University provides all four training programmes in Tbilisi, Esco-S Ltd provides a retraining programme on the installation and service of auto-controlled hybrid energy systems (20-500 kWh) in Mtskheta-Mtianeli, and Chiatura Multifunctional Centre provides a retraining programme for the installation of solar PV systems in Imereti.*

[47] *The minimum recommended requirements were developed in co-operation with the MoESD, the Georgian Energy Development Fund, GIZ and the Energy Efficiency Centre.*

[48] *In the latest amendment of the Energy Efficiency Law, effective as of 31 December 2025, training programmes have been provisioned for energy service providers, energy auditors in industry and transport, building energy efficiency certifiers, energy managers, and inspectors of heating and air-conditioning systems in buildings.*

According to the latest labour market survey, a notable decline has been observed in the number of active students and graduates of higher education programmes in the field of energy, as well as a lack of energy service providers and technical and training staff who can facilitate training programmes in energy (Ministry of Economy and Sustainable Development, n.d.).

- It is recommended that targeted certified retraining and vocational programmes be developed as soon as possible to meet immediate industry demands, such as programmes for certified energy auditors and inspectors of heating and cooling systems. These programmes could start as retraining programmes, developing the capacities of existing occupations, such as electricians and engineers, to reduce lead times in addressing the workforce gaps.
- Training of trainers should be prioritised in the immediate term to ensure sufficient qualified technical staff for existing and planned education and training programmes. Such capacity-building programmes could be facilitated in co-operation with international development partners and training institutions in the European region and beyond.
- The academic curricula of university programmes need to incorporate engineering and design principles specific to sustainable energy systems within existing electrical, mechanical and environmental engineering degrees.
- Universities need to enhance partnerships with other public and private sector entities to incorporate more applied and industry-related energy research into academic programmes.
- With the increasing digitalisation of the energy sector and the incorporation of smart grids, engineering degrees should incorporate more training on data analysis and programming languages, as well as various energy planning software.[49]
- As the energy transition requires a dynamic and iterative approach to energy policy and regulation, it is recommended that law and public policy degrees should include more focus on energy and environmental legislative and regulatory affairs.
- In addition, green and climate financing should be incorporated into existing finance and business degrees.
- Along with attracting more enrolments into education and training programmes in renewable energy (including STEM, non-STEM and vocational programmes), the participation of vulnerable groups, including women, should be emphasised. This inclusive approach is essential for addressing skill shortages and driving innovation to achieve the energy transition.

[49] *Energy planning software currently used in Georgia includes MESSAGE, PLEXOS-ST/LT, LEAP, Power Factory, and TIMES. Other software that could be included in the future, especially for geospatial energy planning, includes geographic information systems such as ArcGIS.*

3.6 Consumer empowerment and just transition

Action 13: Facilitating the establishment of renewable energy communities

Consumer empowerment can be supported by facilitating the active participation and involvement of citizens and local communities in the energy transition. One modality to allow for their active involvement is through renewable energy communities.[50] These communities can empower citizens to more easily access financing and have more control and decision-making power over their energy usage and production, instilling a greater sense of ownership and collective responsibility towards the energy transition. Moreover, such initiatives can be instrumental drivers of change, raising awareness of the importance and benefits of sustainable energy practices within communities and encouraging the wider uptake of renewable energy technologies.

The legal basis for the establishment of renewable energy communities currently does not exist;[51] hence, Georgia has not introduced enabling policy and regulatory measures to facilitate the formation and operation of such communities.[52] As such, renewable energy communities currently do not exist in Georgia, which undermines citizens' ability to contribute and fully benefit from the energy transition.

- It is recommended that the concept of renewable energy communities is carefully developed so as to ensure that the mode of operation adheres to democratic governing principles that prioritise environmental, social and economic benefits for the wider community over mere financial profit. Of importance for Georgia is the need for renewable energy communities to also facilitate the inclusion of energy-poor and vulnerable households.
- In formulating the accompanying bylaws, it is recommended that renewable energy communities are to be registered legal entities, autonomous in their operation and based on transparent and voluntary participation. Their shareholders could consist of natural persons or legal entities that are, at most, medium-sized enterprises (not large enterprises), as well as local governing units such as municipalities, who are in close proximity to the renewable energy projects owned by the renewable energy community. The communities should be clearly differentiated from self-consumer models[53] and have a clearly defined support mechanism, if any, which is not necessarily the existing net-metering scheme for installations below 500 kW; they should not have to participate in auction bidding, and thereby incur high transaction costs, that they would not have the technical or financial capacity to undergo. For example, renewable energy communities with less than 6 MW installed capacity (18 MW for wind power) are to be exempted from any requirements to participate in competitive bidding processes.[54]

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[50] *Renewable energy communities are legal entities that comprise local citizens, businesses and public entities that can produce and share renewable energy, and collectively manage their energy consumption.*

[51] *The legal basis for renewable energy communities (in line with the provisions of REDII) is planned to be established following the finalisation of the draft amendments to the renewable energy law.*

[52] *The current net-metering scheme includes provision for a group of consumers to have a "joint micro generator" connected to the distribution network, as long as the consumers are supplied from the same transformer as the distribution system operator. Group members may submit to the distribution system operator their agreed model for the distribution of the generated electricity; in the absence of such a model, the electricity will be distributed equally among the members of the group.*

[53] *Self-consumer models include individual or collective self-consumers of renewables, such as those eligible for the net-metering scheme.*

[54] *In line with Article 4(4) of REDII and the 2022 Guidelines on State Aid for Climate, Environmental Protection and Energy, para. 107(b)(iv)(v).*

- Targeted incentives can further be developed to facilitate and encourage the inclusion of energy-poor households. Such incentives can include direct subsidies to renewable energy communities that focus on energy poverty alleviation and subsidies to vulnerable households that can partially offset the initial costs of their participation.

Action 14: Defining energy poverty and pathways to its alleviation

A symbiotic relationship exists between alleviating energy poverty and facilitating a just energy transition. Actions to alleviate energy poverty can socio-economically empower energy consumers and drive the energy transition. The energy transition, through greater access to modern and sustainable energy sources and services, can in turn alleviate energy poverty.

As discussed in Section 2.4, according to the latest estimates in 2017, energy poverty affects up to 43% of the population in Georgia (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024). Despite being of crucial importance, there is no legal definition of energy poverty in Georgian legislation beyond the definition stated in the State Energy Policy.[55] Currently, there are legal acts that define social assistance in the form of electricity and natural gas subsidies to "vulnerable consumers",[56] which are customers who are either below certain income levels or living in mountainous regions. However, energy poverty is a more encompassing phenomenon in Georgia. In addition to household income, some of the main drivers of energy poverty are the low energy efficiency of the building stock; lack of access to alternative and modern technologies, especially for heating; and the over-subsidisation of natural gas, which undermines efficient energy consumption and the competitiveness of alternative energy technologies. The lack of a legal basis defining energy poverty impedes the identification of the main drivers and root causes of energy poverty.

- It is recommended that a definition of energy poverty in the Georgian context, building on the mentioned root causes, is developed and legally adopted, along with provisions for establishing energy poverty indicators and methodologies for identifying energy-poor households.
- Based on these indicators, a comprehensive cadastre or register of energy-poor households should be developed, or the existing register of vulnerable consumers could be revised to incorporate energy-poor households.
- Subsequent support mechanisms also need to be developed to address the root causes of energy poverty and reach the energy poverty targets as set out in the NECP (*i.e.* less than 15% of the population living in energy poverty by 2030) (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024). Examples of such support schemes could include the refurbishment of the residential building stock, greater access to locally produced energy-efficient woodstoves, and direct subsidisation of energy-poor households to enable them to afford modern and sustainable energy fuels and technologies.

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[55] The State Energy Policy defines energy poverty as "the situation in which households do not have affordable access to essential energy services, including adequate heating, air conditioning and lighting and energy to operate appliances to preserve a decent standard of living and health" (Ministry of Economy and Sustainable Development; Ministry of Environmental Protection and Agriculture, 2024: 72).

[56] The Law of Georgia on Energy and Water Supply (Articles 3, 114) includes a general definition of a vulnerable consumer as "a domestic consumer who, due to his status or condition, has been granted the right to use the system and / or electricity and / or natural gas and / or water supply under preferential terms".

Currently, natural gas is supplied to thermal power plants and household consumers at a "social" or subsidised price. According to some estimates, the difference between the market price and the subsidised price is as much as 40% (European Bank for Reconstruction and Development, 2021). This subsidisation inevitably and significantly distorts the competitiveness of renewable energy technologies and impedes energy efficiency measures, especially in the residential sector. Furthermore, it greatly debits the state budget.

- It is necessary to gradually phase out natural gas subsidies and bring natural gas tariffs closer to true cost-reflectivity in order to redivert funds into support schemes that can address the underlying causes of energy poverty and encourage more efficient energy usage.

However, phasing out natural gas subsidies requires a carefully developed plan based on transparent and extensive communication and consultation with all relevant stakeholders: the Ministry of Finance, the MoESD and GNERC, among others. It is imperative that this plan also includes measures to protect energy-poor households and vulnerable consumers, leveraging already existing mechanisms to protect socially vulnerable consumers from energy price increases.

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Annex 1:
Energy transition assessment Georgia methodology

The ETA is a tool developed by IRENA to comprehensively evaluate the conditions for accelerated renewable energy deployment in a country. It is a country-led, multi-stakeholder, consultative process that allows for the identification of existing challenges in renewable energy deployment and recommends short- to medium-term actions to guide decision makers and other stakeholders in addressing these challenges. The ETA for Georgia was initiated by the MoESD in technical co-operation with IRENA.

The ETA process has greatly benefited from stakeholder input, including from ministry officials, utility companies, power project developers, development partners, financial institutions, civil society and academia. As a first step in the ETA process, a background report on the energy sector in Georgia was developed that provided an overview and preliminary analysis of the energy sector context in the country. Thereafter, various interviews were held with institutional energy sector stakeholders in the country (a list of the interviewees follows), supplemented with a set of detailed questionnaires aimed at further assessing the energy sector and determining the main barriers for renewable energy deployment. Based on desktop research, bilateral interviews and questionnaires, an issue paper was developed highlighting some of the challenges for renewable energy deployment in the country.

A multi-stakeholder consultation workshop was organised by IRENA and the MoESD and was held in Tbilisi on 21-22 March 2024. Over 60 representatives from governmental institutions, the private sector, development partners, civil society and academia attended. The workshop facilitated further discussions among stakeholders on the challenges in renewable energy deployment and allowed for the identification of recommended actions in overcoming these challenges. The outcomes of the consultation workshop, along with insights gained from bilateral consultations and the supporting documentation that was developed, constituted the basis for this ETA report. The ETA, with its recommended short to medium-term actions, was validated on 17 July 2024 at a virtual multi-stakeholder validation workshop attended by over 60 representatives from the energy sector in Georgia.

List of interviewees

1. Ministry of Economy and Sustainable Development
    - Margalita Arabidze, Head of Energy Efficiency and Renewable Energy Policy and Sustainable Development Department; Associate Professor of the Energy Faculty, Georgian Technical University
    - Zurab Arveladze, Head of Division, Energy Policy and Investment Projects Department
    - Nikoloz Kholodov, Chief Specialist, Energy Efficiency and Renewable Energy Policy Promotion Division

- Ani Peradze, Specialist, Energy Efficiency and Renewable Energy Policy and Sustainable Development Department
- Vladimer Piradashvili, Head of Division, Energy Policy and Investment Projects Department
- Omar Tsereteli, Deputy Head of Energy Efficiency and Renewable Energy Policy and Sustainable Development Department
- Jubo Turashvili, Head of Energy Policy and Investment Projects Department

2. Ministry of Environmental Protection and Agriculture
   - Tekle Gurgenidze, Senior Specialist, Environment and Climate Change Department
   - Kakha Lomashvili, Senior Specialist, Environment and Climate Change Department
3. National Statistics Office of Georgia
   - Marina Gogoladze, Head of Industry, Construction and Energy Statistics Division
4. Georgian National Energy and Water Supply Regulatory Commission
   - Nugzar Beridze, Head of the Electricity Department
   - Ana Nebieridze, Chief Specialist, Legal Department
   - Nikoloz Sumbadze, Director, Market Monitoring Department
5. Electricity Market Operator, ESCO
   - Tamar Tsurtsumia, Head of International and Investments Relations Department
6. JSC Georgian Energy Development Fund
   - Nugzar Khaindrava, Adviser to the Chief Executive Officer
7. Georgian Renewable Energy Development Association
   - Mata Gordeziani, Project Manager
   - Maia Melikidze, Executive Director
8. JSC Georgian State Electrosystem
   - Archil Kokhtashvili, Head of the Strategic Planning and Analysis Department
9. JSC Telasi
   - Misha Antadze, Deputy Commercial Director
10. JSC Energo Pro Georgia
    - Irakli Kokhodze, Head of Reporting and Tariff Policy Division
11. Public Private Partnership Agency
    - Levan Batiashvili, Deputy Chairperson

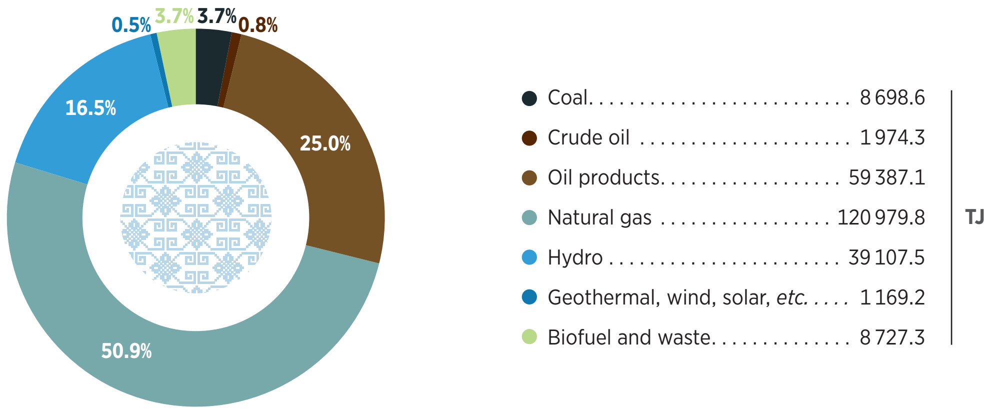
12. European Bank for Reconstruction and Development
    - David Managadze, Regional Director, Energy for Turkey and the Caucasus
13. ProCredit Bank
    - Aleksandre Jashiashvili, Head of Sustainable Development Department
    - Zeinab Lonashvili, Member of the Management Board / Director
14. Georgian Technical University
    - Gia Arabidze, Professor, Energy Faculty
15. Caucasus Environmental NGO Network
    - Rezo Getiashvili, Deputy Director, Environment, Natural Resources, Energy
16. Association of Young Professionals in Energy of Georgia
    - Nikoloz Sumbadze, Co-Founder
17. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
    - Lutz Jarczynski, Team Leader, Georgia
18. United Nations Development Programme
    - Nino Antadze, Team Leader, Energy and Environment Portfolio
19. World Bank
    - Florian Kitt, Senior Energy Specialist, Energy & Extractives Global Practice, Europe and Central Asia Region
20. National Agency of Mineral Resources
    - Merab Chalatashvili, Head of Mineral Resources Management Department
    - Shorena Iosebidze, Head of Legal Unit
    - Nana Zamtaradze, Deputy Head
21. Energy Efficiency Centre Georgia
    - George Abulashvili, Director & Founder Partner; Country Expert in Georgia for Covenant of Mayors
22. Kreditanstalt für Wiederaufbau (KfW)
    - Bodo Schmulling, Director, Energy Sector Coordination South Caucasus

Annex 2:
Energy balance

Total energy supply

According to the latest official energy balance statistics at the time of drafting this report, in 2023 a total of 237 601 TJ of energy was supplied. As shown in Figure A2.1, approximately 80% of the total energy supplied was from fossil fuels: natural gas accounted for over a half of the share (50.9%) followed by oil products (25.0%) and coal (3.7%) (National Statistics Office of Georgia, 2024a). Renewables represented approximately a fifth of the total energy supply in 2023, mostly hydropower (16.5%), followed by biofuels and waste[57] (3.7%), and other renewables[58] (0.5%) (National Statistics Office of Georgia, 2024a). The share of renewables in the total energy supply in 2023 was lower than in previous years (21.5% in 2021), while natural gas supply had increased considerably (from 45.6% in 2021) (National Statistics Office of Georgia, 2024b).

Figure A2.1 **Total primary energy supply (TJ), 2023**



Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

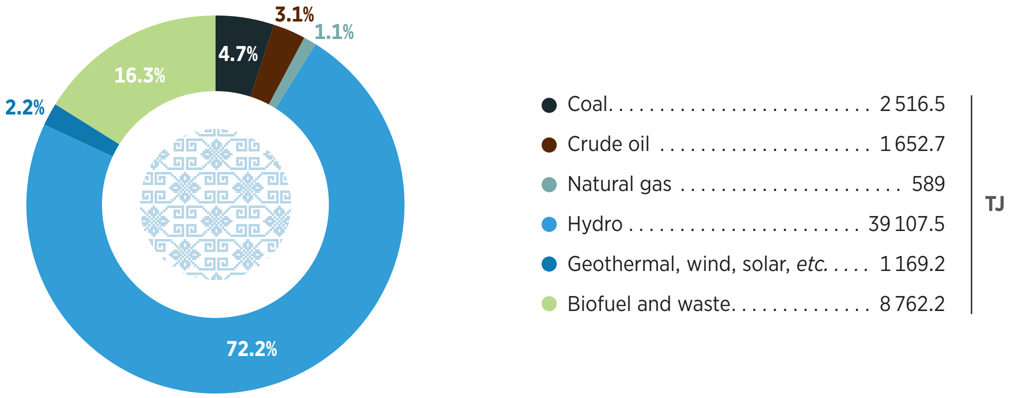
[57] *In the energy balance, "biofuels and waste" almost entirely refers to fuelwood and, to an almost negligible extent, to other agricultural and forest residues.*

[58] *"Other renewables" mainly refers to wind power production.*

Energy production

Domestic energy production in Georgia accounted for less than a quarter of the total primary energy supply in 2023 and has been declining over the past decade both in absolute and relative terms. Between 2013 and 2023, domestic energy production dropped by 22.2%, from 58 820 TJ (34.3% of total energy supplied) in 2013 (National Statistics Office of Georgia, 2013) to 53 797 TJ (22.6% of total energy supplied) in 2023 (National Statistics Office of Georgia, 2024a). This has led to an increased reliance on energy imports, inevitably compromising the country's overall energy security. As shown in Figure A2.2, domestic energy production is largely based on hydropower (72.2% of domestic energy production in 2023), followed by biofuels and waste (16.3%), coal (4.7%), crude oil (3.1%), other renewables (2.2%) and natural gas (1.1%) (National Statistics Office of Georgia, 2024a).

Figure A2.2 **Domestic energy production by energy type (TJ), 2023**

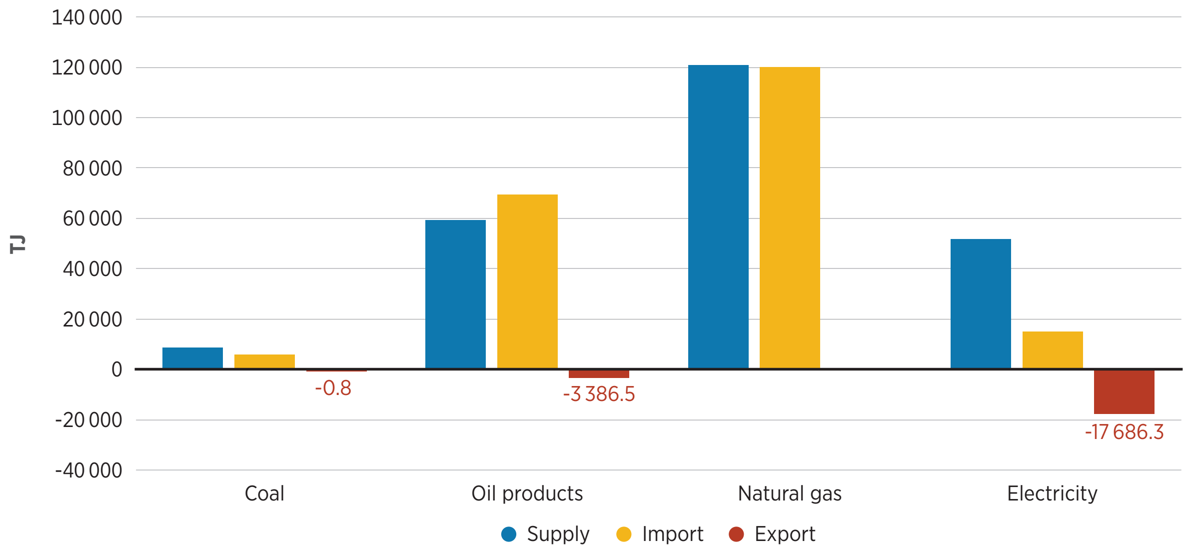


Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

Energy exports and imports

As there is insufficient domestic energy production to meet growing energy demand, Georgia imports a large share of its total energy supply. In 2023, net energy imports amounted to 80.0% of energy supplied (National Statistics Office of Georgia, 2024a), compared with 67.9% in 2013 (National Statistics Office of Georgia, 2013). The largest share of energy imports is natural gas, which accounted for well over a half of all energy imports (57.0%) (National Statistics Office of Georgia, 2024a). In fact, as shown in Figure A2.3, the country is almost entirely reliant on imports of natural gas to meet the domestic demand for natural gas and is totally reliant on imports of oil products. Georgia imports natural gas mainly from Azerbaijan and, to a small extent, from the Russian Federation, but natural gas mostly transits through Georgia to Armenia via the North-South Gas Pipeline. About a third (33.0%) of Georgia's energy imports are oil products (National Statistics Office of Georgia, 2024a), which are mainly supplied from Azerbaijan, the Russian Federation and Turkmenistan.

Figure A2.3 Energy imports and exports versus energy supply (TJ), 2023

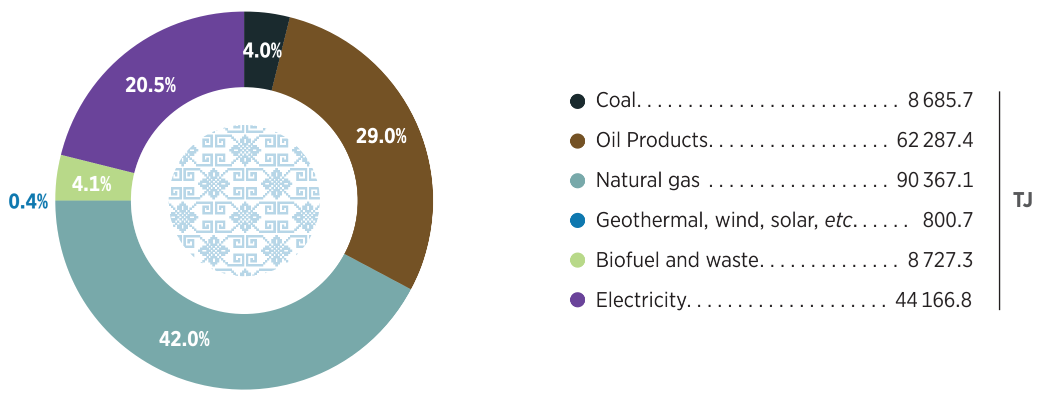


Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

Gross final energy consumption

The gross final energy consumption of Georgia in 2023 amounted to 86.8% of total energy supplied (*i.e.* 206 150 TJ), after accounting for transmission and distribution losses and for non-energy use (National Statistics Office of Georgia, 2024a). As shown in Figure A2.4, natural gas makes up the largest share of final energy consumed (42.0%), followed by oil products (29.0%), electricity (20.5%), coal (4.0%), biofuel and waste (4.1%) and, to an almost negligible extent, other renewable energy sources (National Statistics Office of Georgia, 2024a).

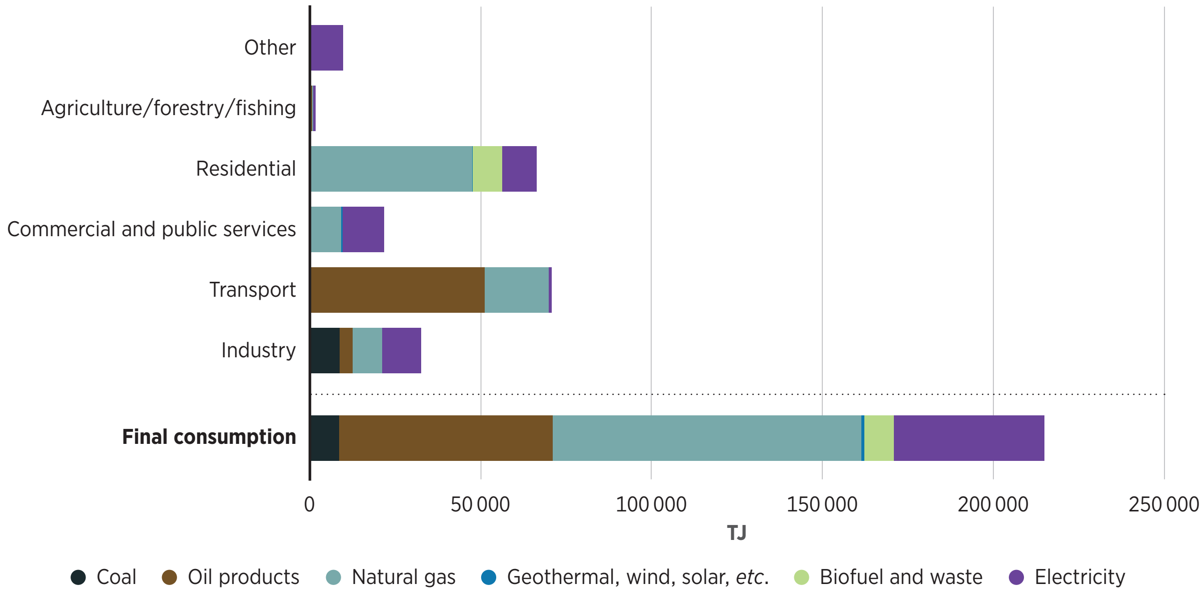
Figure A2.4 Gross final energy consumption by energy type (TJ), 2023



Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

Figure A2.5 shows the final energy consumption by sector and energy type in 2023. The residential sector and transport sectors are the largest energy consumers, each consuming close to a third of total final energy, followed by industry (16.1%), commercial and public services (10.7%), and others[59] (National Statistics Office of Georgia, 2024a). The agricultural, forestry and fishing sector has an almost negligible share of the final energy consumption.

Figure A2.5 **Final energy consumption per sector by energy type (TJ), 2023**



Based on: (National Statistics Office of Georgia, 2024a).
Note: TJ = terajoules.

The residential sector is the largest consumer of natural gas, accounting for over half (52.4%) of the total natural gas consumption and relying on natural gas to meet 71.3% of the sector's needs (National Statistics Office of Georgia, 2024a). Natural gas is the predominant energy source used for space heating, water heating and cooking and is more prominently used in urban than in rural settings (National Statistics Office of Georgia, 2023) . The residential sector is also the sole consumer of biomass, largely in the form of fuelwood, which supplies 13.0% of the sector's needs (National Statistics Office of Georgia, 2024a) and is more widely used in rural than in urban households. However, the use of fuelwood is not sustainable, and the majority of woodstoves in the residential sector are of low energy efficiency and contribute to poor indoor air quality. Electricity supplies only 14.9% of the residential energy demand (National Statistics Office of Georgia, 2024a).

The transport sector is the largest consumer of oil products, responsible for 82.0% of all oil consumption and relying on oil to meet almost three-quarters (72.3%) of the sector's energy needs (National Statistics Office of Georgia, 2024a). Natural gas meets just over a quarter (26.5%) of the transport sector's needs and is largely used for pipeline transport and road transport. Electricity supplies only 1.1% of the sector's energy demand, which is largely used in rail transport (National Statistics Office of Georgia, 2024a). Electricity use in road transport is not reported in the country's national energy balance.

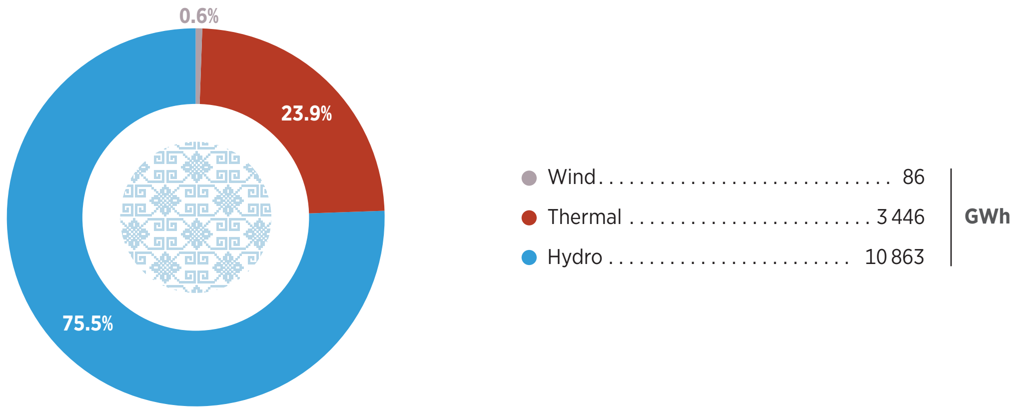
[59] *A sizeable share of this energy consumption is attributed to crypto-mining.*

Industry meets over a third (34.5%) of its energy demand with electricity, of which more than half is used in iron and steel production; electricity is used to a lesser extent in the chemical industry and for non-metallic mineral processing (National Statistics Office of Georgia, 2024a). All the national coal supply is used in industry, mainly for heat applications in iron and steel production and non-metallic mineral processing; coal meets over a quarter (26.5%) of the sector's energy demand (National Statistics Office of Georgia, 2024a). Natural gas also meets a quarter (26.9%) of the sector's demand and is mostly used for heating applications in the chemical industry and in the food and beverage industry (National Statistics Office of Georgia, 2024a).

Electricity balance

Georgia's electricity sector is dominated by hydropower, with thermal power production used more prominently in times of low hydropower production. Electricity generation has been increasing over recent years and in 2023 amounted to 14 396 GWh, of which hydropower represented over 75.5%; thermal power generation accounted for 23.9%, and a single wind power plant generated 0.6% (Georgian State Electrosystem, 2024a).

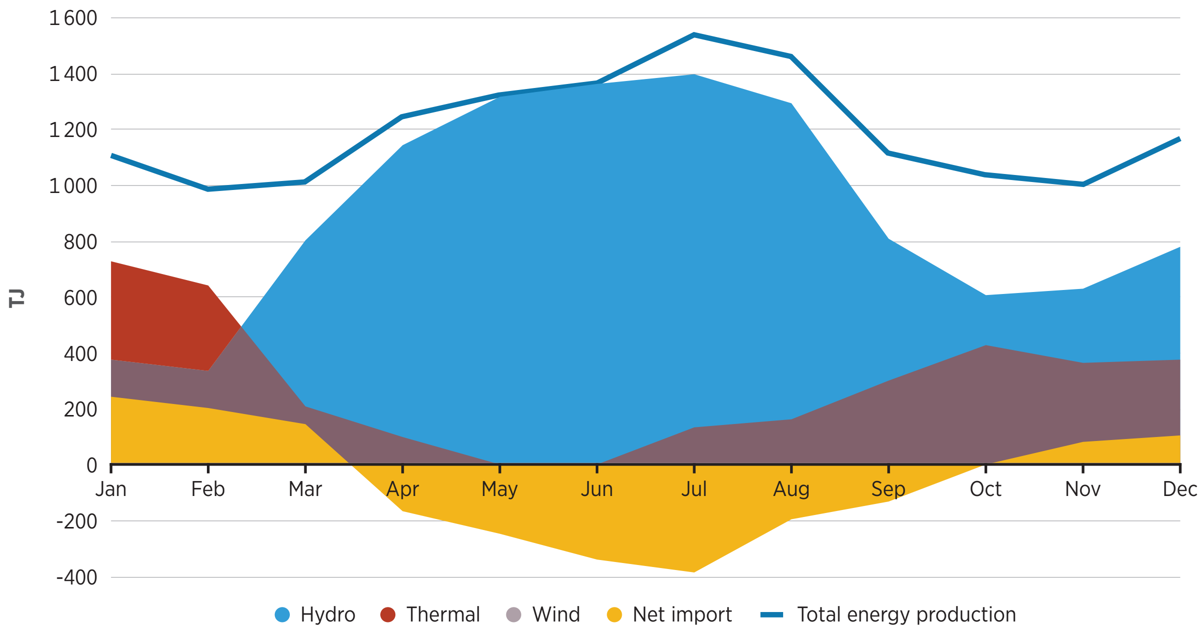
Figure A2.6 **Electricity generation by source (GWh), 2023**



Based on: (Georgian State Electrosystem, 2024a).
Note: GWh = gigawatt hour.

Despite the addition of hydropower capacity and power generation in Georgia over the years, net energy imports have been rising. Over the last decade, net electricity imports have increased sharply and accounted for 9.4% of total supply in 2023 (Georgian State Electrosystem, 2024a). The majority of the electricity is imported from Azerbaijan and the Russian Federation, and most electricity exports are to Armenia and Türkiye. Electricity imports and exports vary over the course of the year, largely dictated by the seasonal variations of hydropower generation. As shown in Figure A2.7, hydropower production is highest during the summer months (approximately May to October). At this time, the need for thermal power generation is lessened, especially as the demand for electricity is lowered. The country is able to meet most of its demand through hydropower during this time and even export some of the surplus. However, from November to April, with increased electricity demand and diminished hydropower generation, and despite an increase in thermal power generation, the country has a need to import electricity. So much so that in peak months (*e.g.* February 2023), net imports account for almost 20% of the country's monthly electricity consumption, while thermal power generation can reach over half of the monthly electricity consumption (*e.g.* January 2023) (Georgian State Electrosystem, 2024b).

Figure A2.7 **Monthly electricity generation vs. net imports (TJ), 2023**



Based on: (Georgian State Electrosystem, 2024a).
Note: TJ = terajoules.

Annex 3:
Energy infrastructure

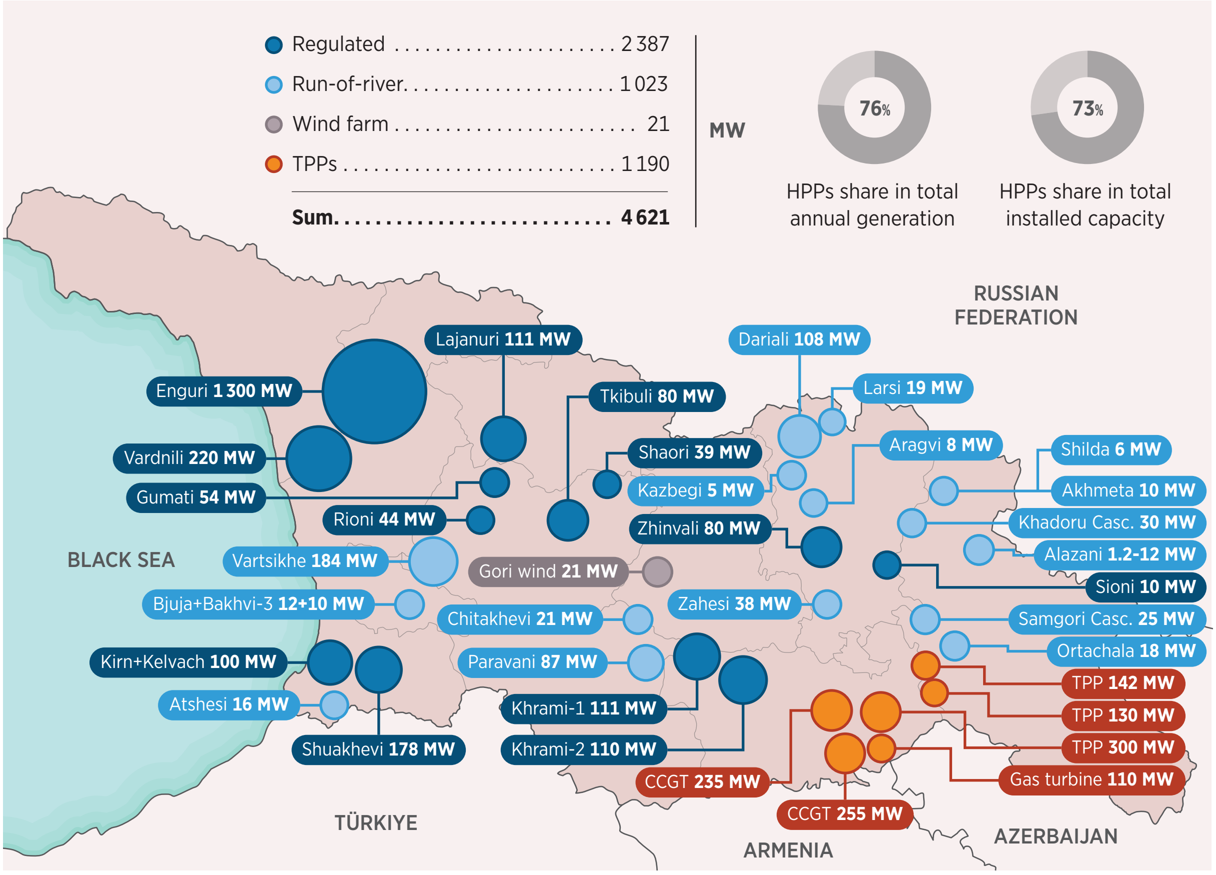
Georgia has 4 621 MW of installed power generation capacity, largely composed of hydropower plants (73.8%), followed by thermal power plants (25.8%) and one wind power plant (Georgian State Electrosystem, 2024b). More than half the installed hydropower capacity is regulated (has a water reservoir), whereas about a third is seasonal run-of-river production and about 10% is made up of small hydropower plants of less than 15 MW (Georgian State Electrosystem, 2024b). The largest hydropower plants are Enguri (1 300 MW), located on the Enguri River, and Vartsikhe Cascade, consisting of four power plants (total: 256 MW) located along a 27 km stretch of the Rioni River. The thermal power plants are mostly fuelled by natural gas and are located in the eastern part of the country close to the capital city. The largest thermal power plant is Unit 9 of the Gardabani plant (300 MW). The Qartli Wind Farm (20.7 MW) is currently the only operational wind power plant in the country and is located close to the town of Gori in central-eastern Georgia; it consists of six Vesta wind turbines at a hub height of 91.5 m (Georgian Energy Development Fund, 2019).

Overall, the bulk of the power generation is concentrated in the western part of the country, where the largest hydropower plants are located, while the highest load centres are in the eastern part, around Tbilisi and Rustavi. As such, the transmission network is largely geared towards power evacuation from west to east. This trend is especially pronounced between May and October, when hydropower production in the west is at its highest and when thermal power plants in the east are operated at lower capacities, which inevitably stresses the grid. The backbone of the transmission system includes a 500 kilovolt (kV) line from Enguri to Tbilisi and a 500 kV ring around Tbilisi. Georgia's interconnections with neighbouring countries include:

- 500 kV and 220 kV AC connections with the Russian Federation
- 400 kV DC connection with Türkiye
- 500 kV AC and 330 kV AC connections with Azerbaijan
- 220 kV AC connection with Armenia

Georgia also has plans for an undersea transmission cable to Romania, which would connect Georgia's power system to the ENTSO-E (the European Network of Transmission System Operators for Electricity). The technical and economic feasibility study for the undersea transmission cable was completed in 2024, determining the preliminary route for the infrastructure. The environmental and social impacts assessments are planned to be completed by 2026 (Ministry of Economy and Sustainable Development, 2024).

Figure A3.1 Installed power generation capacities in Georgia

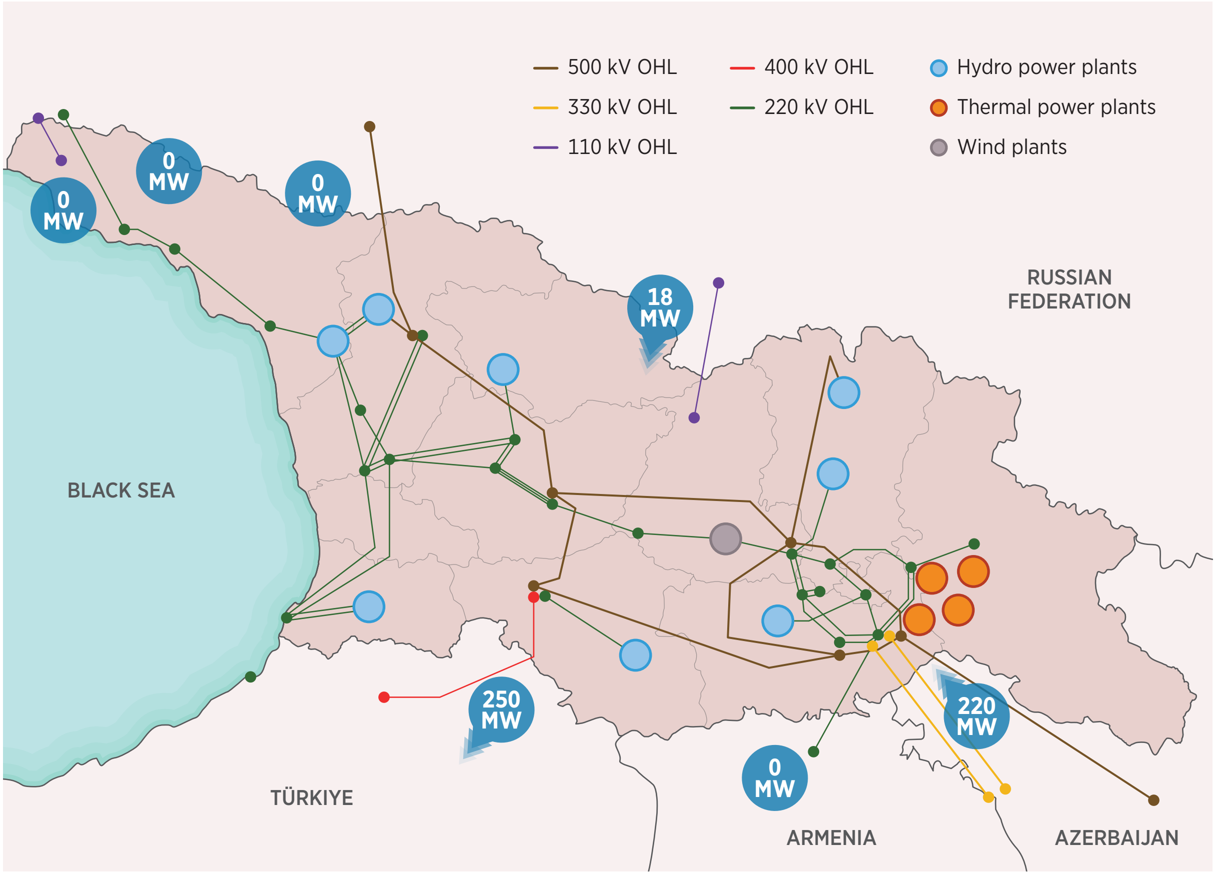


Source: (Georgian State Electrosystem, 2024d).

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Notes: HPP = hydro power plant; MW = megawatt; TPP = thermal power plant.

Figure A3.2 Georgia's transmission grid



Source: (Georgian State Electrosystem, 2024e).

Notes: The capacities shown in the green circles are momentary power flows with neighbouring countries at the time of extraction the map, but are indicative of relative power flows *i.e.* largely with Türkiye and Azerbaijan ; MW = megawatt; OHL = overhead line.

Disclaimer: This map is provided for illustration purposes only. Boundaries and names shown on this map do not imply the expression of any opinion on the part of IRENA concerning the status of any region, country, territory, city or area or of its authorities, or concerning the delimitation of frontiers or boundaries.

Georgia has an extensive natural gas transmission and distribution network. The main gas pipeline system includes the North-South Gas Pipeline, which is mainly transiting natural gas through Georgia from the Russian Federation to Armenia, and the East-West Gas Pipeline, the Southern branch and the Kakheti branch, which all import gas from Azerbaijan into Georgia. In addition, the South Caucasus Pipeline passes through Georgia, transporting natural gas from Azerbaijan to Türkiye. The main oil pipelines include the Western Route Export Pipeline, which pipes oil from Baku (Azerbaijan) via Tbilisi to the city of Supsa at the Black Sea coast for onward shipping to global markets, and the Baku-Tbilisi-Ceyhan Pipeline, which transits crude oil from Azerbaijan to Ceyhan (Türkiye).

Georgia does not have operational district heating and cooling networks, and its energy sector policy does not foresee the development of such centralised networks. In terms of infrastructure for electric mobility, Georgia has more than 110 charging stations throughout the country, including seven fast chargers, which are mainly located on the central highway connecting the capital to the western part of the country (Green Economy Financing Facility, 2021).

Annex 4:
Median prices resulting from renewable energy auction rounds

Renewable energy technology	Median price (USD)
First auction round	
Hydro	0.0685
Wind	0.0682
Solar PV	0.0637
Second auction round	
Run-of-river hydro	0.0650
Regulatory hydro (1-4 hours)	0.0750
Regulatory hydro (4-8 hours)	0.0774
Regulatory hydro (< 8 hours)	0.1035
Wind	0.0600
Wind with BESS	0.0860
Solar PV	0.0560
Solar PV with BESS	0.0639
Other renewables	0.1535

Annex 5:
Obligations following successful auction bidding

For the winning bids, a technical-economic feasibility agreement of the power plant is to be signed between the government of Georgia and the winning bidder. In addition, a pre-construction guarantee, in the form of a bank guarantee, is to be provided by the winning bidder to the government. The bank guarantee is to be no less than USD 20 000 per megawatt of capacity. Once the feasibility study has been approved, a construction guarantee of no less than USD 40 000 per megawatt is to be provided to the government. From the signing of the agreement on power plant feasibility, the power plant has to be commissioned within three years for solar PV plants, four years for wind power plants and five years for hydro and other renewable energy power plants.

The CfD support scheme is applicable for certain months of the year, as follows:

- Hydropower plant: 8 months (September to April)
- Wind power plant: 9 months (August to April)
- Solar PV and other renewable power technologies: 12 months

Annex 6:
Consumer electricity prices in Georgia

Voltage/step		Tariff (incl. VAT)	Tariff (excl. VAT)	Tariff structure (excl. VAT)		
				Distribution	Transmission	Supply
Residential						
3.3/6/10 kV		**USD 0.114 (GEL 0.309)**	USD 0.097 (GEL 0.262)	USD 0.020 (GEL 0.055)	USD 0.010 (GEL 0.027)	USD 0.067 (GEL 0.180)
220/380 V	**< 101 kWh**	**USD 0.066 (GEL 0.177)**	USD 0.045 (GEL 0.150)	USD 0.032 (GEL 0.086)		USD 0.014 (GEL 0.038)
	101 kWh to 301 kWh	**USD 0.080 GEL (0.217)**	USD 0.068 (GEL 0.184)	USD 0.044 (GEL 0.120)		USD 0.014 (GEL 0.038)
	> 301 kWh	**USD 0.097 (GEL 0.262)**	USD 0.082 (GEL 0.222)	USD 0.056 (GEL 0.151)		USD 0.017 (GEL 0.045)
Non-residential						
35/110 kV		**USD 0.105 (GEL 0.283)**	USD 0.089 (GEL 0.240)	USD 0.012 (GEL 0.033)	USD 0.01.0 (GEL 0.027)	USD 0.067 (GEL 0.180)
3.3/6/10 kV		**USD 0.114 (GEL 0.309)**	USD 0.097 (GEL 0.261)	USD 0.020 (GEL 0.055)		USD 0.067 (GEL 0.181)
220/280 V		**USD 0.118 (GEL 0.320)**	USD 0.100 (GEL 0.271)	USD 0.044 (GEL 0.120)		USD 0.046 (GEL 0.124)

Based on: (Georgia Supply, 2023; Georgian National Energy and Water Supply Regulatory Commission, 2023).
Notes: Exchange rate GEL to USD: 0.37 on 30 October 2023. VAT = value-added tax.

Annex 7:
Advanced biofuels feedstocks under REDII annex IX

Part A: Feedstocks which may be considered to be twice their energy content, and which are to count towards at least 1% of the transport target in 2025, and 3.5% of the transport target in 2030, include:

- Algae (cultivated on land, in ponds or photobioreactors)
- Biomass in municipal waste (excluding household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC);
- Biowaste as defined in point (4) of Article 3 of Directive 2008/98/EC from private households subject to separate collection as defined in point (11) of Article 3 of that Directive;
- Biomass in industrial waste not fit for use in the food or feed chain (including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex;
- Straw;
- Animal manure and sewage sludge;
- Palm oil mill effluent and empty palm fruit bunches;
- Tall oil pitch;
- Crude glycerine;
- Bagasse;
- Grape marcs and wine lees;
- Nut shells;
- Husks;
- Cobs cleaned of kernels of corn;
- Biomass fraction of wastes and residues from forestry and forest-based industries (such as bark, branches, precommercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil;
- Other non-food cellulosic material;
- Other ligno-cellulosic material except saw logs and veneer logs.

Part B. Feedstocks which may be considered to be twice their energy content, but which are not to exceed 1.7% of transport energy, include:

- Used cooking oil;
- Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009.

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