GEORGIA'S FIFTH NATIONAL COMMUNICATION

To the United Nations Framework Convention on Climate Change

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MINISTRY OF ENVIRONMENTAL PROTECTION
AND AGRICULTURE OF GEORGIA

LEPL ENVIRONMENTAL
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UNDP

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FOREWORD

The Fifth National Communication (NC5) provides a detailed overview of the implementation of climate policies in Georgia. The document outlines adaptation needs, progress in this area, and ongoing efforts to mitigate climate change. It also underscores the critical support Georgia has received from international partners, including multilateral and bilateral financial and technical assistance in the area of climate change adaptation.

On behalf of the Ministry of Environmental Protection and Agriculture of Georgia I extend my sincere gratitude to the Global Environment Facility (GEF) for its generous support in funding the development of the NC5 and to the UNDP for its dedicated efforts in implementing this crucial project, also to all government organizations, private sector entities, and stakeholders for their invaluable contributions, dedication, and support, which have ensured the timely completion of this report. The NC5 exemplifies Georgia's steadfast commitment to transparency and accountability in the global effort to address climate change.

The latest research has updated data on the rise in the average temperature caused by climate change, the erratic trends in precipitation patterns, and the characteristics of glacier retreat. Future climate change scenarios once again highlight the anticipated risks, which require coordinated and sustained efforts to prevent or minimize. Addressing the risks associated with climate change demands climate-resilient, low-emission development across various sectors, including public health, the environment, and the economy.

In response to these formidable challenges, early warning systems are being developed in Georgia, along with improvements in data collection and analysis – particularly in the agriculture and healthcare sectors – and the initiatives to promote sustainable forest management for biodiversity conservation. These efforts are supported by international collaboration, particularly through assistance from the Green Climate Fund (GCF) and the Swiss Confederation.

Georgia’s long-term aspiration is to strengthen resilience and reduce vulnerabilities to climate change through integrated and evidence-based policies. With the provision of international support, enhanced collaboration, and the empowerment of local communities, Georgia aims for a sustainable future where short-term and long-term challenges posed by climate change are effectively managed.

In the context of low-emission development, Georgia has outlined its pathway to achieving climate neutrality by 2050, contingent on technological advancements and enhanced international cooperation.

Since the beginning of this decade the transformation of transport systems has commenced in Georgia's major cities to promote sustainable urban mobility. In the land-use sector, we have made significant steps by implementing sustainable forest management practices on 270,000 hectares and promoting natural forest renewal across 3,153.9 hectares. These efforts are expected to result in the removal of 3,065.3 kilotons CO_2 by 2030. Moving forward, we aim to further increase the carbon sequestration potential of the land-use, land-use change, and forestry (LULUCF) sector by prioritizing the restoration of degraded lands.

At the same time, we are progressing research into low-carbon solutions for agricultural development and promoting the circular economy. These are just a few examples of the wide-ranging measures Georgia has implemented to align with its climate objectives.

While this report highlights the significant progress Georgia has made in climate action, we recognize that much more remains to be done. With the continued collaboration of our partners, we will press forward to ensure a greener, more sustainable, and climate-resilient future for generations to come.

David Songulashvili

Minister of the Environmental Protection and Agriculture

of Georgia

ABBREVIATIONS

ADB	Asian Development Bank
NAP	National Adaptation Plan
NACAG	Nitric Acid Climate Action Group
AF	Adaptation Fund
WeM	With existing measures
WWF	World Wildlife Fund for Nature
non-ODA	Non-official development assistance
UNDP	United Nations Development Programme
GEF	Global Environment Facility
LT-LEDS	Long Term-Low Emission Development Strategy
NEAP	National Environmental Action Programme
MEPA	Ministry of Environmental Protection and Agriculture
EIEEC	Environmental Information and Education Centre
MES	Ministry of Education, Science, and Youth
ODA	Official development assistance
KfW	Kreditanstalt für Wiederaufbau /Credit Institute for Reconstruction
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit/ German Agency for International Cooperation
LT-LEDS	Georgia's Long-Term Low Emission Developmemnt Stategy
WaM	With additional measures
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
EU	European Union
NECP	Integrated National Energy and Climate Plan
MOESD	Ministry of Economy and Sustainable Development
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
CEB	Council of Europe Development Bank
WFD	Westminster Foundation for Democracy
CENN	Caucasus Environmental NGO Network
GCPF	Global Climate Partnership Fund
GCF	Green Climate Fund
RECC	Regional Environmental Centre for the Caucasus
CTCN	Climate Technology Centre & Network
CSAP	Climate Change Strategy and Action Plan
UNFCCC	United Nations Framework Convention on Climate Change

WB	World Bank
GEFF	Green Economy Financing Facility
SEAP	Sustainable Energy Action Plan
GGF	Green for Growth Fund
GGFGF	Green for Growth Fund Green Facility
BSTDB	Black Sea Trade and Development Bank
COP	Conference of Parties
CMA	Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement
GDP	Gross Domestic Product
LULUCF	Land use, land-use change, and forestry
MRDI	Ministry of Regional Development and Infrastructure
ICAO	International Civil Aviation Organization
NEFCO	The Nordic Environment Finance Corporation
ITMO	Internationally Transferred Mitigation Outcomes
eAIMS	e-Aid Information Management System
SCADA	Supervisory Control and Data Acquisition system
IPPU	Iindustrial processes and product use
NIB	Nordic Investment Bank
NSO	National Statistics Office of Georgia
FAO	Food and Agriculture Organization
DHW	Domestic hot water
SDC	Swiss Agency for Development and Cooperation
SIDA	Swedish International Development Cooperation Agency
BSTDB	Black Sea Trade and Development Bank
LULUCF	Land Use, Lnad-Use Change and Forestry
MoHLSA	Ministry of Internally Displaced Persons from the Occupied Territories, Health, Labour and Social Affairs
MoF	Ministry of Finance
WoM	Without measures
DCFTA	Deep and Comprehensive Free Trade Area

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R.1: NATIONAL CIRCUMSTANCES, INSTITUTIONAL ARRANGEMENTS AND OTHER INFORMATION

Georgia is a democratic country that shifted to a parliamentary model of government in December 2018. This transition has limited the president's powers while empowering the parliament and prime minister. The government comprises the prime minister, 12 ministries, and one state minister. Currently, Georgia's territory includes the autonomous republics of Adjara and Abkhazia, 5 self-governing cities, and 64 self-governing communities. Over 20% of the country, represented by the autonomous republic of Abkhazia and the Tskhinvali region, is under the Russian Federation's occupation, depriving the Georgian government of jurisdiction over these areas.

Georgia is situated at the intersection of Europe and Asia, having a total surface of 76,284.8 sq. km, of which 91% is land and the remaining 9% is water. The 44.5% of the country's total surface area is coverd by forest, while 39.7% of the land is used for agriculture.

As of January 1, 2023, the population of Georgia was estimated at 3.7 million, , with 48% male and 52% female. According to the analysis, in 2023 60.4% of Georgia's population resided in cities while 39.6% lived in rural areas. 20.7% of the total population were aged 0-14 years old, 63.8% were between 15 and 64, and the rest, 15.5% were 65 years and older.

There are different climate zones in Georgia, such as the coastal and lowland climates. It includes humid subtropical and dry-continental climates, as well as areas of eternal snow and glaciers. This diversity is in the position on the northern edge of the subtropical belt between the Black and Caspian lakes as well as the country's complex relief. The total flow of fresh groundwater thematic resources is quite sufficient in Georgian accrued altogether. The Western geographical part background runoff structure is 49.8 km^3, and that of the Eastern is 16.5 km^3. Reasserting, the greatest number of endemic species in Georgia proves that the country is well endowed with rich biodiversity. The WWF has named the Caucasus one of the 35 "priority ecoregions," while Georgia is located in two out of 36 biodiversity 'hotspots' declared by Conservation International, those being Caucasus and Iran-Anatolia.

R.1.1 ECONOMIC PROFILE

Georgia is ideally positioned as an international transit corridor linking Europe and Asia. It is strategically located within the framework of the Silk Road. Georgia's international economic relations are increasing due to its strategic location, which provides advantages as increasing energy resource transits, emerging rail and land transport infrastructures, links with the Black Sea, and developed telecommunication networks. In 2013-2022, gross domestic product (GDP) growth averaged 4.8% annually, largely driven by double-digit economic growth in 2021-2022. After the Covid pandemic, GDP per capita increased significantly and amounted to 6,731.2 USD in 2022. As a result, Georgia moved into the group of developing, upper-middle-income countries.

The largest share of GDP was realised through "wholesale and retail trade" (15%), "manufacturing" (11%), and "real estate" (10%) activities; "construction" (8%), "agriculture, forestry, and fishing" (7%), and "transport and storage" (6%); and "public administration and defence, social security" (6%) parts were also significant as well. Except for agriculture, these sectors seem to have at least a five-year increasing presence pattern, which is not likely to revert anytime soon.

Energy: In 2022, Georgia's total energy supply was 239,935 terajoules (TJ). The local energy supply consists mostly of hydropower, biomass and a relatively small amount of coal energy. Nearly 100% of petroleum and gaseous products are imported, amounting to about 68.9%of total final energy use. Transportation takes the largest share of consumption of petroleum products while the consumption of natural gas involves not only industry and household consumption but also electricity generation and transport. Thus, the level of energy dependence of the country on other nations still remains high. In Georgia electricity is primarily supplied by domestic generation resources - hydro (up to 70%) and thermal (up to 20%) plants-with the remaining amount of the unsatisfied demand being met by electricity imports (13% on average). The cornerstone of the energy policy of the country is on the establishment of energy security and energy independence of the country.

Industry: In 2022, the output of industrial economic activities increased 4.3 times compared to 2010, reaching 20.9 billion GEL. The sector's annual output consistently showed growth of at least 5%, often exhibiting double-digit increases. In 2022, the distribution of the industrial sector's output by type of economic activity was as follows: 77% from"manufacturing industry," 14% from "electricity, gas, steam, and air conditioning supply," 7% from "mining and quarrying," and 2% from "water supply, sewage, waste management, and remediation activities."

Transport: In 2022, the contribution of the transport sector to the GDP rose 2.9 times compared to 2010, reaching 4,109 billion GEL. From 2010 to 2022, the average annual growth rate of GDP was 10.0%. The advancement of the transport sector is a key priority for the Georgian government. Several significant projects and initiatives are currently underway, including the construction of the East-West highway, the modernization of the railway system, the expansion of airports, the enhancement of the Poti port, and the development of the Anaklia deep-sea port, among other infrastructure endeavors.

Agriculture: In 2022, total production output experienced a significant increase, rising 2.3 times to reach 7.4 billion GEL when compared to 2010. The average annual growth rate of GDP within this sector from 2010 to 2022 was recorded at 8.2%. However, despite this encouraging trend, a substantial portion of essential agricultural products is still imported, rendering the country's food security reliant on global market fluctuations regarding both supply and pricing. The advancement of climate-smart agriculture has been identified as a key priority by the government.

Tourism: Tourism has emerged as one of the most rapidly expanding sectors within the Georgian economy. Following the pandemic, the tourism industry began to rebound swiftly in 2022, with international visitor arrivals totaling 4.7 million, and the proportion of foreign visitor expenditures in the overall output rising to 8%.

R.1.2 NATIONAL CLIMATE CHANGE POLICY

In connection with the circumstances outlined in the Fourth National Communication and the Second Biennial Update Report, the nation has made considerable progress in formulating and advancing a climate change policy. Notably, throughout this timeframe, the government has approved:

- The document titled *"Georgia's Climate Change Strategy 2030 and Action Plan 2021-2023,"* along with the Action Plan for 2024-2025, outlines a comprehensive long-term vision aimed at reducing greenhouse gas emissions. It details the target indicators for the "national contribution" across various sectors and provides a list of specific measures, which will undergo updates every two to three years.
- The document titled *"Georgia's Long-Term Low Emission Development Strategy*" (LT-LEDS) evaluates the viability of achieving climate neutrality through an analysis of anticipated emission trends and highlights additional areas where mitigation efforts can be enhanced. Furthermore, it provides an estimate of the investment needed across various sectors to attain climate neutrality by the year 2050.
- The document " *Integrated National Energy and Climate Plan of Georgia"* outlines specific initiatives aimed at enhancing energy security, reducing greenhouse gas emissions, improving energy efficiency, fostering innovation and competitiveness within the energy sector, and increasing the utilization of renewable energy sources.
- The document *"Georgia's Fourth National Environmental Action Program for 2022-2026"* establishes goals and strategies that support the attainment of the mitigation and adaptation objectives outlined in the "Nationally Determined Contribution," addressing issues related to air quality, water resources, soil management, waste, natural hazard mitigation, and forestry.

A "Climate Technology Needs Assessment" document has been developed, informed by an evaluation of the technological requirements for both mitigation and adaptation.

To achieve zero emissions by 2050, Georgia requires extensive technological upgrades, which it plans to support through the carbon trading mechanism. The country has already initiated steps in this direction. Notably, under the emissions trading framework outlined in Article 6.2 of the Paris Agreement, Georgia has entered into bilateral agreements for the trade and transfer of emissions with the Swiss Confederation in 2021 and with Japan in 2022.

Implementing climate policy and pursuing climate neutrality will necessitate considerable transformations within the national economy, which will inevitably lead to social repercussions. Consequently, the principle of equity must be upheld. Currently, this aspect is not adequately addressed in national legislation or climate policy documents. Nevertheless, the forthcoming “Climate Change Law” is expected to incorporate considerations of a just transition.

Since the release of the Fourth National Communication, the quality of climate related issues has been more effectively integrated into policy documents enacted after 2021. This improvement can be attributed to better coordination among agencies in the formulation of policy documents and an increased awareness of climate change matters within state institutions compared to previous periods.

R.1.3 INSTITUTIONAL ARRANGEMENTS OF THE REPORTING PROCESS TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The accountable body for reporting to the UNFCCC is the Government of Georgia, while the Ministry of Environmental Protection and Agriculture has the coordinating function of the work carried out in this regard. The Environment and Climate Change Department of the MEPA, namely the Climate Change Division, is responsible for coordinating the preparation of regular reports to the Convention, their verification and organization of submission to the Convention Secretariat. The LEPL Environmental Information and Education Centre - State Agency of the MEPA, provides administrative, logistical and other support for the process of developing reports to be submitted to the Convention Secretariat, as well as ensuring the publicity of these reports. Georgia is leading the reporting process with funding from the Global Environment Facility (GEF) and support from UNDP Georgia.

R.1.4 PUBLIC PARTICIPATION IN THE DEVELOPMENT AND IMPLEMENTATION OF CLIMATE POLICY

The development of climate change policies and action plans in Georgia is carried out with active public engagement. This initiative is primarily led by organizations dedicated to environmental and climate change matters. These organizations have played various roles in the development of the aforementioned policy documents. The preparation of the Biennial Transparency Report, the Fifth National Communication, and the Climate Change Law is structured to allow participation from stakeholders interested in climate change and environmental matters, including consulting firms with relevant expertise, independent experts, and other concerned individuals. The Climate National Platform further enhances public involvement in this process.

R.1.5 GENDER AND CLIMATE CHANGE

Climate change impacts individuals differently based on gender, yet the understanding of these dynamics is relatively nascent within the Georgian context, resulting in a notable lack of awareness among stakeholders regarding these matters. Furthermore, obtaining information on these topics proves challenging, as such data is not systematically gathered or analyzed. Nevertheless, existing data derived from national statistics and research indicates that women residing in rural areas experience the effects of climate change more severely and, consequently, exhibit a heightened interest in these issues.

An fair climate policy necessitates the incorporation of the diverse needs of various social groups within policy frameworks. However, an analysis of relevant documents has shown that: a) the integration of gender considerations is currently minimal in both international and domestic commitments related to climate; b) there has been some advancement in recent years concerning gender mainstreaming, as evidenced by references in certain strategic documents that highlight the interplay between gender and climate and the imperative for action. It is important to note, however, that at this juncture, gender mainstreaming in the climate sector remains largely at the level of commitments, with fewer tangible advancements observable in terms of implementation.

R.2 ON THE NATIONAL GREENHOUSE GAS INVENTORY

This chapter provides an overview of the greenhouse gas inventory for Georgia covering the years 2018 to 2022. The data on emissions and removals is organized in tabular form, categorized by sector and by type of greenhouse gas, with specific attention to the land use, land use change, and forestry (LULUCF) sector.

The inventory details emissions across five sectors during the specified period. In the energy sector, emissions rose from 11,326 Gg CO2-eq to 13,218 Gg CO2-eq, reflecting an increase of approximately 14%. Conversely, the agriculture sector saw a reduction in emissions, decreasing from 2,411 Gg CO2-eq to 2,310 Gg CO2-eq, which equates to a decline of about 4%. The Industrial Processes and Product Use (IPPU) sector experienced a slight increase in emissions, rising from 2,019 Gg CO2-eq to 2,571 Gg CO2-eq, marking an increase of roughly 21%. In the waste sector, emissions grew from 1,900 Gg CO2-eq to 1,996 Gg CO2-eq, representing an overall increase of approximately 5.1%. The LULUCF sector showed a minor improvement in removals, with emissions changing from -5,884 Gg CO2-eq to -5,801 Gg CO2-eq, indicating a reduction in removal potential of about 1.4%. Throughout the 2018-2022 period, the IPPU sector is anticipated to experience the most significant rise in emissions, while the agriculture sector is noted for the largest decrease. Additionally, the removal capacity of the LULUCF sector has slightly diminished.

Tabe R2.1 illustrates the greenhouse gas emissions in Georgia by gas type from 2018 to 2022 (measured in Gg CO2-eq). The analysis encompasses emissions from nine different greenhouse gases over the five-year span.

Carbon dioxide (CO_2) emissions exhibit a distinct upward trajectory, increasing from 10,456 Gg in 2018 to 12,827 Gg in 2022, which signifies a 22% rise in CO2 emissions. Meanwhile, emissions of methane (CH_4) and nitrous oxide (N_2O) have experienced a slight decline compared to the figures from 2018.

TABLE R.2.1. GREENHOUSE GAS INVENTORY DATA FOR GEORGIA FOR 2018-2022, BY GAS (GG CO2-EQ).

Year	CO_2	CH_4	N_2O	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-227ea	SF_6
2018	10,456	6,047	905	10.40	66.44	95.40	72.38	0.31	0.93
2019	11,169	5,638	892	11.96	79.43	115.42	92.56	0.10	1.00
2020	11,048	5,859	943	14.45	122.91	153.60	152.04	0.61	1.06
2021	11,542	5,942	925	16.59	117.49	126.94	122.14	0.39	1.12
2022	12,827	5,905	879	14.82	121.06	207.04	136.20	0.47	1.14

Table R.2.2 displays the findings of the greenhouse gas inventory for the years 2022 and 1990, along with the variation in emissions for 2022 relative to 1990. Notably, there has been a substantial reduction in greenhouse gas emissions within the energy and agriculture sectors, whereas an increase in emissions has been observed in the PPE/IPPU and waste sectors.

TABLE R.2.2. *CHANGE IN GHG EMISSIONS IN 2022 COMPARED TO 1990*

Sector	GHG emissions, Gg CO2-eq		Change in 2022 compared to 1990
	1990	2022	
Energy	39,464	13,218	-66.5%
Agriculture	1,549	2,571	66.0%
Industrial processes and product applications	4,284	2,310	-46.1%
Waste	1,185	1,996	68.4%
Total, excluding LULUCF	**46,482**	**20,095**	-56.8%
LULUCF	-8,180	-5,801	-29.1%
Total, including LULUCF	**38,302**	**14,294**	-62.7%

The greenhouse gas inventory is described in detail in the “National Inventory Document”.

R.3. MITIGATION POLICIES AND MEASURES, ACTIVITIES AND PLANS, INCLUDING MITIGATION CO-BENEFITS ACHIEVED FROM ADAPTATION ACTIVITIES AND ECONOMIC DIVERSIFICATION PLANS, LINKED TO THE IMPLEMENTATION AND ACHIEVEMENT OF THE NATIONALLY DETERMINED CONTRIBUTION

R.3.1 AGREEMENTS CONCLUDED WITHIN THE FRAMEWORK OF INTERNATIONAL MARKET-BASED MECHANISMS

The Agreement between the Swiss Confederation and Georgia concerning the Implementation of the Paris Agreement is designed to create a legal framework for the transfer of results from mitigation policies aimed at fulfilling the Nationally Determined Contribution (NDC) or other mitigation goals. In this context, both parties are committed to fostering sustainable development while ensuring environmental integrity and transparency.

The Joint Crediting Mechanism (JCM) established by the Government of Japan and the Government of Georgia aims to facilitate the adoption of advanced decarbonization technologies, products, systems, services, and infrastructure. This initiative also aims to implement mitigation actions that will contribute to the reduction or removal of greenhouse gas emissions, promote sustainable development in Georgia, and support the achievement of the Nationally Determined Contribution (NDC) goals for both Georgia and Japan.

R.3.2 SECTORAL ISSUES

A significant aspect of Georgia's climate change policy focuses on the reduction of greenhouse gas emissions while enhancing the potential for carbon absorption. The strategy to limit emissions to designated target levels is informed by an analysis of six key sectors within the national economy. These sectors include transportation, construction, energy generation and distribution, agriculture, industry, and waste management. Additionally, Georgia is exploring ways to improve the carbon absorption capabilities within the land use, land-use change, and forestry sector.

R.3.2.1 TRANSPORT SECTOR

The transport sector in Georgia, particularly in relation to the advancement of road passenger transport, is experiencing significant growth. Road transport accounts for over 90% of the total greenhouse gas emissions within this sector. Therefore, substantial efforts are directed towards the development of road transport and its related subsectors to mitigate greenhouse gas emissions.

By the year 2030, it is anticipated that the transport sector in Georgia will be structured to achieve a 15% reduction in greenhouse gas emissions compared to the levels projected under a conventional business scenario.

As outlined in the 2021-2023 Action Plan of Georgia's Climate Strategy for 2020-2030, a total of 13 initiatives were scheduled for execution within the transport sector during the 2021-2023 period. Out of these, 7 initiatives have been completed, 5 are currently in progress, and 1 is still in the planning stage.

The initiatives that have been completed are expected to result in a reduction of greenhouse gas emissions from the transport sector by 260.41 Gg CO2-eq during the 2021-2023 timeframe. Should all 13 initiatives be fully executed, the anticipated annual reduction in greenhouse gas emissions by 2030 will amount to 243.41 Gg CO2-eq, culminating in a total reduction of 1,748.51 Gg CO2-eq.

R.3.2.2 BUILDING SECTOR

The building sector represents one of the most substantial and rapidly expanding segments of the national economy. This sector encompasses commercial, public, and residential buildings. As reported by the Greenhouse Gas Inventory, emissions from the buildings sector contribute to 19% of the total national greenhouse gas emissions.

A significant portion of the existing buildings in Georgia was constructed during the Soviet era, spanning from 1921 to 1990. The aging of these structures has led to a notable decline in their energy efficiency. In contrast, the buildings erected in the three decades following independence predominantly exhibit low energy efficiency levels.

The building sector is characterised by high energy consumption and serious greenhouse gas emissions.

Georgia's Nationally Determined Contribution (NDC) does not establish a specific target for emissions from the buildings sector for the year 2030. Nevertheless, the 2021-2023 Action Plan associated with the 2030 Climate Change Strategy of Georgia stipulates that greenhouse gas emissions from this sector should be capped at 4.625 Gg CO2-eq by 2030.

Within the framework of the 2021-2023 Action Plan of the 2020-2030 Climate Strategy, the Ministry of Economy and Sustainable Development of Georgia has outlined 14 activities for the period from 2021 to 2023. Of these, 3 activities have been completed, 7 are currently in progress, and 4 are yet to be initiated.

Despite the implementation of 3 activities, which are primarily informational and educational, there has been no reduction in greenhouse gas emissions from the buildings sector as per the Action Plan. Consequently, the impact of these activities on greenhouse gas reduction is expected to extend beyond the designated reporting period.

Rehabilitation of municipal buildings using energy-efficient approaches

Several municipalities in Georgia are undertaking mitigation initiatives in the building sector as part of the Covenant of Mayors. To decrease energy consumption in municipal buildings, these municipalities are exploring rehabilitation projects that aim to lower greenhouse gas emissions and promote efficient energy use for heating, cooling, and lighting.

The rehabilitation efforts for municipal buildings primarily involve the replacement of doors and windows, the thermal insulation of roofs, walls, and floors, and, in certain instances, the installation of solar water heating systems (solar collectors).

By the year 2030, it is anticipated that greenhouse gas emissions from municipal buildings in the regions of Kvareli, Sagarejo, Bagdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti will be reduced by 227 tons of CO2 equivalent annually, resulting in an estimated energy savings of approximately 1,404 MWh.

Rehabilitation of non-municipal and residential buildings using energy-efficient approaches

Alongside municipal facilities, local governments are adopting energy-efficient and climate-conscious rehabilitation strategies for non-municipal and residential structures. By the year 2030, it is projected that energy consumption in non-municipal and residential buildings across Kvareli, Sagarejo, Baghdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti will decrease by 61,445 MWh, resulting in a reduction of greenhouse gas emissions by 12,412 tons of CO_2-equivalent.

Energy-efficient lighting of streets and building facades

In 2022, new outdoor lighting installations were completed in specific areas of the Kvareli, Sagarejo, Baghdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti municipalities. That same year, energy-efficient lamps were fitted to both the newly established and pre-existing outdoor lighting fixtures. The implementation of these energy-efficient lamps not only enhanced street lighting but also led to a substantial decrease in electricity usage. To evaluate electricity consumption and greenhouse gas emissions associated with outdoor lighting, a modification in the network emission factor has also been considered alongside the aforementioned initiatives.

By the year 2030, the upgrade of outdoor lighting systems in the municipalities of Kvareli, Sagarejo, Bagdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti is projected to result in a reduction of energy consumption by 2,808 MWh and a decrease in greenhouse gas emissions by 354 tons of CO_2-equivalent. Furthermore, the introduction of new LED lighting is expected to lower greenhouse gas emissions by an additional 155 tons of CO_2-equivalent when compared to the traditional business-as-usual scenario.

R.3.2.3 Energy generation and transmission sector

The economic development and overall well-being of the population in Georgia are heavily influenced by the energy production and transmission sector. This sector encompasses both the energy industry and the management of volatile emissions.

In the context of addressing climate change, Georgia prioritizes its obligations to enhance energy efficiency and promote renewable energy sources. To this end, several key pieces of legislation have been enacted, including the “On Energy and Water Supply,” “On Energy Efficiency,” “On Energy Efficiency of Buildings,” and “On Encouraging the Production and Use of Energy from Renewable Sources.”

The Long-term Concept of Low-Emission Development for Georgia integrates the transport, building, and energy generation and transmission sub-sectors into a cohesive energy sector, outlining emission reduction scenarios in a unified manner. By the year 2050, it is anticipated that greenhouse gas emissions from the energy sector will reach 5,191 Gg CO_2-eq.

The Climate Action Plan for Georgia aims to curtail emissions from the energy sector, with a target of 5,687 Gg CO_2-eq by 2030, reflecting the planned initiatives.

As per the 2021-2023 Action Plan of the Climate Strategy for Georgia 2020-2030, the Ministry of Economy and Sustainable Development has outlined six activities for the energy production and transmission sector during the 2021-2023 period, of which four are currently in progress and two are in the planning stages.

R.3.2.4 Agricultural sector

Greenhouse gas emissions from the agricultural sector in Georgia represent 12% of the country’s total emissions, as reported by the National Greenhouse Gas Inventory. This sector encompasses three primary categories contributing to these emissions: enteric fermentation, manure management, and agricultural soils.

The Long-term Concept of Low-Emission Development for Georgia anticipates that non-energy greenhouse gas emissions from agriculture will reach 1,868 Gg CO2-eq by the year 2050.

Georgia's updated Nationally Determined Contribution (NDC) does not specify a target for emissions from the agricultural sector by 2030. However, emissions from the agricultural sector are planned to be reduced through measures presented in Georgia's Climate Action Plan. According to the 2021-2023 Action Plan associated with the 2030 Climate Change Strategy of Georgia, the Ministry of Environmental Protection and Agriculture has planned eight activities for the agricultural sector during the 2021-2023 period. Of these, five have been completed, one is currently ongoing , and two are still in the planning stages. Despite the implementation of five activities, greenhouse gas emissions from the agricultural sector have not shown a decrease, as indicated by the 2021-2023 Climate Action Plan.

R.3.2.5 Industrial processes and product use sector

The industrial sector in Georgia demonstrates superior performance in terms of value added compared to other sectors of the economy. In 2022, the manufacturing sector contributed 11% to the country's GDP. Additionally, industrial products rank among the most significant exports, with ferroalloys and fertilizers being the top five exported goods in that year.

From 1990 to 2017, there was a notable decline in greenhouse gas emissions from industrial activities, encompassing both energy-related and non-energy sectors. By the conclusion of this period, emissions from energy-related activities represented 12% of the levels recorded in 1990, while non-energy emissions accounted for 47%.

It is important to highlight that the chemical and physical processing of raw materials within this sector results in substantial emissions of carbon dioxide and other greenhouse gases. Currently, there are opportunities to mitigate non-energy greenhouse gas emissions in three specific areas: cement production, ammonia production, and nitric acid production.

As outlined in the 2021-2023 Action Plan of Georgia's 2030 Climate Change Strategy, two out of three planned activities in the industrial sector were executed during the 2021-2023 period, with one additional activity scheduled for implementation. The activities carried out have led to a reduction of greenhouse gas emissions from the industrial sector by 629.24 Gg CO2-eq. If all three activities are fully implemented, it is projected that annual emissions will decrease by 844.21 Gg CO2-eq by 2030, culminating in a total reduction of 6,761.97 Gg CO2-eq.

R.3.2.6 Waste management sector

The waste sector encompasses both solid waste and wastewater management. As indicated by the greenhouse gas inventory, emissions from this sector represent 11% of the country's overall greenhouse gas emissions.

In accordance with the 2021-2023 Action Plan of Georgia's 2030 Climate Change Strategy, two out of fourteen planned activities within the waste sector were executed during the 2021-2023 period, seven are currently in progress, and five are scheduled for future implementation. The activities that have been completed resulted in a reduction of greenhouse gas emissions from the waste sector by 0.023 Gg CO2-eq during the 2021-2023 timeframe. If all 14 activities are implemented, the annual emission reduction by 2030 will be 46.86 Gg CO_2-eq, while the total reduction will be 328.76 Gg CO_2-eq.

R.3.2.7 Land use, land use change and forestry sector

Forests are a major source of carbon dioxide absorption in Georgia. The annual carbon dioxide absorption potential of the LULUCF sector ranges from 24% to 27% of the country's greenhouse gas emissions.

According to the 2021-2023 Action Plan of the 2030 Climate Strategy of Georgia, out of 8 activities planned by the Ministry of Environmental Protection and Agriculture of Georgia in the forestry sector in 2021-2023, 3 have been implemented and 5 activities are ongoing.

According to the implemented activities, carbon dioxide absorption from the forestry sector increased by -165.9 Gg in 2021-2023, and in case all 8 activities are implemented, the annual carbon dioxide absorption by 2030 will be -424.7 Gg, and the total absorption will be 3,065.3 Gg.

R.3.3 BRIEF INFORMATION ON GREENHOUSE GAS EMISSIONS AND REMOVALS

R.3.3.1 Greenhouse gas emission and removal scenarios

Three scenarios have been analyzed: one without any mitigation measures, one incorporating existing mitigation measures, and one that includes additional mitigation measures.

These mitigation scenarios are outlined in the Georgia's Long-Term Low Emission Development Strategy (LT-LEDS), which was developed by the Government of Georgia in alignment with the Paris Agreement, serving as a foundational document for the long-term vision. This document officially came into effect on April 24, 2023. The overarching goal of the strategy is to achieve climate neutrality by the year 2050. The LT-LEDS was developed by the Ministry of Environmental Protection and Agriculture with support from the European Union and the United Nations Development Programme, in close collaboration with various public agencies, civil society, and international stakeholders.

The LT-LEDS outlines the anticipated range of national greenhouse gas emissions and articulates a vision for 2050. This vision is grounded in projections created for both the emitting and absorbing sectors, which are encapsulated in the total national emissions.

According to the current policy documents, two sets of mitigation measures have been identified: optimistic and pessimistic, each accompanied by two scenarios: one with existing measures (WEM) and another with additional measures (WAM). Additionally, a scenario without any measures (WOM) has been developed. In total, six scenarios have been formulated: pessimistic and optimistic WOM, WEM, and WAM, which illustrate the expected ranges of greenhouse gas emissions for the year 2050.

R.3.3.1.1 Scenario without measures (WOM)

Under the WOM scenario, carbon dioxide emissions from the land use, land-use change, and forestry (LULUCF) sector, encompassing both projected emissions and removals, are anticipated to rise by 16,716 Gg CO2 by the year 2040 in comparison to the last inventory year (2022). Excluding the LULUCF sector, the increase is projected to be 16,460 Gg CO2.

Methane emissions from the LULUCF sector are expected to grow by 3,837 Gg CO2-equivalent by 2040 relative to 2022. Additionally, nitrous oxide emissions from the same sector are projected to increase by 549 Gg CO2-equivalent compared to 2022. For both methane and nitrous oxide, the projected emissions figures, whether including or excluding the LULUCF sector, remain largely consistent with those recorded in 2022.

R.3.3.1.2 Scenario with existing measures (WEM)

Under the WEM scenario, carbon dioxide emissions, inclusive of the LULUCF sector, are anticipated to rise by 7,660 Gg CO2-eq by the year 2040 in comparison to 2022 levels. When excluding the LULUCF sector, the increase in CO2 emissions is projected to be 8,872 Gg CO2-eq.

For methane (CH4) emissions, which also include the LULUCF sector, an increase of 1,975 Gg CO2-eq is expected by 2040 relative to 2022. Similarly, nitrous oxide (N2O) emissions, including the LULUCF sector, are projected to rise by 84 Gg CO2-eq by 2040 compared to 2022. The anticipated emissions for both methane and nitrous oxide, whether including or excluding the LULUCF sector, remain largely unchanged from 2022.

R.3.3.1.3 Scenario with additional events (D/WaM scenario)

In contrast, the Additional Measures for Greenhouse Gas Emissions and Removals (WAM) scenario predicts a reduction in CO2 emissions, including the LULUCF sector, by 1,587 Gg CO2-eq by 2040 compared to 2022. However, when excluding the LULUCF sector, CO2 emissions are expected to increase by 809 Gg CO2-eq.

Methane emissions, including the LULUCF sector, are projected to decrease by 1,545 Gg CO2-eq by 2040 compared to the last year of the inventory. Additionally, nitrous oxide emissions, inclusive of the LULUCF sector, are expected to decline by 71 Gg CO2-eq relative to 2022. The projected emissions for both methane and nitrous oxide, whether including or excluding the LULUCF sector, are anticipated to remain nearly constant compared to 2022.

R.4 CLIMATE CHANGE IMPACTS AND ADAPTATION

R.4.1 CLIMATE CHANGE ADAPTATION POLICIES

The focus on adaptation is a key element of Georgia's climate change policy, recognized as essential for safeguarding the country's natural resources, protecting public health, and minimizing the adverse impacts of ongoing climate change. This emphasis on adaptation is reflected in Georgia's Nationally Determined Contribution Document, which outlines and prioritizes this approach. The necessity for adaptation arises from the varied and detrimental effects of climate change, which have become increasingly evident in Georgia over the past twenty years. The country faces significant threats from frequent natural disasters and altered climatic conditions, jeopardizing its diverse ecosystems, natural resources, and public health, while also inflicting substantial economic damage and posing risks that impede sustainable development.

Despite the clear prioritization of adaptation, the development of a comprehensive climate change adaptation policy remains challenging. This complexity is exacerbated by the varied manifestations of climate change, limited local financial and technical resources for effective implementation, and a global focus on climate change mitigation that often diminishes attention to adaptation efforts. As a small nation with a minimal contribution to global greenhouse gas emissions, it is both reasonable and necessary for Georgia to enhance its adaptation strategies within its climate change policy framework. To achieve this, significant initiatives are underway, including the identification of vulnerable areas, the establishment of early warning systems across the country, the assessment of technological requirements, and the formulation of a national adaptation plan alongside a cohesive climate law. These efforts aim to create a robust legal and institutional framework for integrating climate policies, particularly adaptation, into Georgia's legislative system.

Information on climate change adaptation has been regularly reflected in Georgia's national communications to the United Nations Framework Convention on Climate Change. Reporting in the format of biennial transparency reports in accordance with the Paris Agreement will intensify work in the field of adaptation in the areas of research, data collection, policy development, implementation and monitoring, and will contribute to strengthening the country's adaptive capacity and resilience.

The information presented in this document, as part of Georgia's Fifth National Communication and First Biennial Transparency Report, follows the requirements of the modalities, procedures and guidelines of the Paris Agreement Transparency Framework and reflects the country's climate change adaptation activities in the period following the Fourth National Communication (2021-2024).

R.4.2 CURRENT CLIMATE CHANGE

To evaluate the present state of climate change, an analysis was conducted on the variations in the intensity and frequency of both average and extreme climate parameters, utilizing data from 38 stations within the Georgian meteorological network over a 60-year span (1961-2020). This assessment employed a methodology focused on elucidating the mechanisms of climate impact and identifying the occurrence of low-probability, high-impact events.

The primary trends regarding current climate change in Georgia are as follows:

Over the past 60 years, the average annual air temperature in Georgia has consistently increased. A comparison between two 30-year intervals (1961-1990 and 1991-2020) reveals a rise in average annual surface air temperature across the entire country. The overall increase recorded is 0.8°C, which exceeds the 0.3°C rise noted in the Fourth National Communication, which analyzed changes between the periods of 1956-1985 and 1986-2015. The warming trend is particularly pronounced in the Samegrelo-Zemo Svaneti region, Racha-Lechkhumi and Kvemo Svaneti, and Samtskhe-Javakheti, where the average temperature increase ranges from 0.9 to 1.0°C.

Changes in the precipitation patterns across the nation exhibit temporal instability and spatial variability. Recent observations indicate a general decline in precipitation levels throughout the country. Specifically, during the timeframe analyzed in the Fourth National Communication (1956-2015), an increase in precipitation was predominantly noted in Western Georgia, while Eastern regions experienced a prevailing trend of decrease. However, an analysis of data from 1961 to 2020 reveals that recent trends show a decline in precipitation across most of the country's territory. Despite these observations, the nature of precipitation changes remains largely uncertain, lacking definite trends. Generally, annual variations in precipitation are confined within ±10-15%. In the western regions, reliable trends indicate an increase in average annual precipitation, particularly along the Black Sea coast and in mountainous Adjara, whereas in the eastern regions, such trends are only evident on the southern slopes of the Kakheti Caucasus. The most significant decrease in precipitation in the east is observed in Mtskheta-Mtianeti.

Relative humidity has risen by approximately 1% in most areas of the country. The annual trends are consistent, with the most significant changes occurring in mountainous Adjara, as well as in the lowland regions of Samegrelo, Samtskhe-Javakheti, and Shida Kartli. This increase in humidity appears to be primarily attributed to higher levels during the winter and spring seasons. Conversely, during the summer and early autumn, a decrease in humidity is noted across nearly all regions, with the exception of the lowland areas of Samegrelo and the plains of Eastern Georgia.

The average wind speed has diminished by up to 1 m/s across Georgia. Furthermore, the trends observed at nearly all monitoring stations indicate a consistent downward trajectory for annual, monthly, and seasonal averages. Nonetheless, some exceptions have been noted, where increases in both average wind speed and the frequency of windy days have been recorded.

The examination of contemporary climate change patterns indicates that the previously observed warming trends within the country are intensifying and persist in the majority of regions. This is occurring alongside heightened air humidity and reduced wind speeds, although certain areas are experiencing stronger wind gusts. Additionally, there are notable alterations in the precipitation patterns, primarily characterized by a reduction in overall precipitation. However, in specific regions, there is an increased frequency of days with heavy rainfall and a rise in precipitation intensity.

R.4.3 CLIMATE CHANGE SCENARIOS

Future climate scenarios have been revised in light of new insights and findings presented in the IPCC's Sixth Assessment Report (AR6). This section evaluates the outcomes of the coupled global models utilized in the CMIP6 project, which have shown significant advancements compared to their predecessors from the CMIP5 project. Additionally, a new array of emissions scenarios has been established, informed by various socio-economic assumptions, referred to as the "shared socio-economic scenarios" (SSPs).

The global model and scenario employed in the Fourth National Communication were deemed the least realistic for that timeframe; however, recent evaluations indicate that this scenario is now less probable in terms of temperature increase. To update and enhance the scenario, three simulations from two CORDEX calculation regions were utilized, resulting in the creation of an ensemble. The socio-economic scenario in this instance remains RCP4.5. Unfortunately, the global models and scenarios from CMIP6 could not be incorporated into this forecast scenario, as their downscaling to regional levels is scheduled for the subsequent phase of CORDEX.

Trends in air temperature and total precipitation, along with changes in related indices, were analyzed over two 30-year periods (2041-2071 and 2071-2100) in comparison to the average values from 1971-2000, across 38 selected stations in Georgia, which provide a basis for characterizing climate change trends throughout the regions of Georgia.

In this scenario, it is noted that the annual rate of warming is projected to be higher, with temperature increases varying significantly by season. In both forecast periods, the most pronounced warming is expected during winter, primarily driven by increases in minimum temperatures. Nevertheless, the occurrence of cold days and nights with relatively low temperatures is anticipated to continue during winter and transitional seasons in both forecast periods. Regarding precipitation, an increase in both volume and intensity is expected in western Georgia, while eastern and southern regions are likely to experience a general decline.

R.4.4 ABOUT THE GREEN CLIMATE FUND PROJECT

UNDP, with financial backing from the Green Climate Fund, is supporting the Government of Georgia in formulating and executing a proactive strategy for integrated climate risk management. This initiative aims to enhance risk reduction, prevention, and preparedness by establishing a multi-hazard early warning system and incorporating climate data into planning and decision-making across various sectors.

The project will tackle significant obstacles to the creation of a multi-hazard early warning system while also addressing all other essential components of climate risk management necessary for an effective early warning framework.

As a result of this initiative, Georgia is expected to undergo a transformative shift in climate risk reduction and management through the establishment of a comprehensive, results-driven multi-hazard early warning system. The introduction of standards-based methodologies and technologies for hazard, risk, and vulnerability mapping and assessment will facilitate the dissemination of critical climate risk information, thereby supporting risk reduction policies nationwide. Additionally, the project will focus on building long-term institutional and community capacities in climate risk reduction, climate change adaptation, and multi-hazard early warning systems. Ultimately, the goal is to systematically transition Georgia's climate risk management approach towards risk reduction, prevention, and preparedness, thereby safeguarding the 1.7 million individuals (40 percent) residing in the country's 11 major river basins from disasters induced by climate change.

R.4.5 CLIMATE CHANGE IMPACT ON GEORGIA'S GLACIERS

The application of high-resolution satellite remote sensing (HRS) stands as the primary technology for examining the effects of ongoing climate change on glaciers. This technology facilitates the simultaneous analysis of glacier conditions across extensive areas, achieving the necessary resolution and accuracy while requiring minimal material resources and time. The investigation of glacier degradation dynamics through high-resolution HRS is particularly effective, as it incorporates global best practices alongside methodologies developed in Georgia.

In addition to utilizing data from various high-resolution satellites, the research also draws upon numerous globally available databases, such as those from NASA and GLIMS. The satellite-derived information underwent processing and quality control, enabling the calculation of various characteristics for all glaciers in Georgia, including area (km²), morphological type, general exposure, maximum length (km), and minimum and maximum elevation (m), as well as firn line height (m) and ablation area (km²).

The dynamics of glacier degradation are analyzed separately for Western and Eastern Georgia, acknowledging the significant climatic differences between these regions.

The nearly 60-year gap between the TDS data and the catalog data provides a framework for evaluating glacier melting within glacial basins, which is crucial for understanding the impact of ongoing climate change on glaciers.

This comprehensive approach has enabled a quantitative analysis of the degradation dynamics of Georgian glacial basins, facilitating an assessment of changes in the major glaciers of Georgia, identifying the nature of their retreat, and estimating the timelines for the complete melting of significant glacial basins, as well as those where large glaciers are absent. Important conclusions have been reached as a result.

R.4.6 CLIMATE CHANGE IMPACTS AND ADAPTATION ON GEORGIAN FORESTS

44.5% (3,100,500 ha) of Georgia's territory is covered by forests. More than 98% of forests are of natural origin and their structural composition is complex and diverse. Most of Georgia's forests are covered with groves formed by deciduous species - 83%, while coniferous groves account for 17%. 130 woody species have been described in forests, which are characterized by different growth and development depending on the regions and, by mixing with different species, create a diverse spectrum of groves - dendroflora is distinguished by the abundance of endemic species. Forests primarily perform soil protection, water conservation, water regulation, sanitary-hygienic and other useful protective functions and are of particular importance in terms of supplying the country's population and economy with forest resources. In addition, the remaining forest areas of the Greater and Lesser Caucasus are of global ecological importance, as they represent the last intact forests remaining in the temperate climate zone. Despite this, even the assessments reflected in previous national communications show that climate change is already affecting Georgia's forests and in the future this negative impact may lead to a sharp quantitative and qualitative reduction in forest resources and, accordingly, ecosystem services. According to the National Forest Inventory, 35.4% of Georgia's forested area is degraded. Against the backdrop of ongoing climate change, problems caused by pests and diseases in forests are becoming increasingly relevant, there are significant changes in the frequency of forest fires and seasonal changes. Due to the lack of consistent research and high anthropogenic impact, it is currently impossible to collect reliable evidence on the impact of climate change on species shifts, however, taking into account climate scenarios, this clearly poses a threat for the coming years.

For an extended period, the presence of inaccurate and outdated information regarding the country's forests has posed a significant obstacle for the sector, impeding effective forest management planning and decision-making processes. To enhance forest accounting and monitoring, the inaugural national forest inventory was finalized in 2022, resulting in the availability of updated statistical data concerning both quantitative and qualitative forest indicators. To bolster sustainable forest management within the country, regulate the utilization of timber and non-timber resources, and guarantee their sustainable extraction, substantial legislative reforms have been implemented over the last decade. Additionally, there has been a marked increase in the scale and quality of initiatives aimed at restoring degraded forests. The strategies outlined in sector-related documents are designed to cultivate a forest management system that is responsive to climate change; however, a comprehensive assessment of the country's forests in terms of their vulnerability to climate change, along with the assignment of appropriate categories, continues to be a challenge. This assessment is crucial for facilitating the planning of specific adaptation measures at both regional and municipal levels.

R.4.7 CLIMATE CHANGE IMPACT ON PROTECTED AREAS

Georgia's protected areas are crucial for safeguarding the country's diverse biodiversity. Furthermore, the healthy ecosystems found within these areas provide essential ecosystem services, enhancing resilience to climate change and mitigating the adverse effects on local livelihoods.

Nevertheless, the effects of climate change will still influence these protected areas. Such impacts may include the shifting of protected species, the colonization of new habitats, or even the extinction of species in their natural environments. The highland regions are anticipated to experience the most rapid and severe changes, as they are particularly vulnerable to climate fluctuations. Additionally, the ongoing climate change may lead to the resurgence of previously identified diseases and their vectors, as well as the emergence and proliferation of new diseases. It is also projected that climate change will result in an increase in the number of visitors to protected areas, which heightens the risk of introducing non-native invasive species and escalates conflicts between humans and wildlife.

It is important to recognize that various strategies concerning protected areas outline specific objectives and actions aimed at mitigating and adapting to climate change. Climate change is identified as a significant challenge in the conceptual framework for protected and other conservation areas. The management plans recently developed for these protected areas include actions to assess the potential impacts of climate change on species and habitats, along with the formulation of suitable adaptation strategies. For protected areas to effectively safeguard target species and their habitats, the implementation of targeted adaptation measures is essential. To date, adaptation plans have been established for the Kazbegi, Pshav-Khevsureti, and Tusheti protected areas.

R.4.8 CLIMATE CHANGE IMPACT ON HUMAN HEALTH

The effects of heat waves on human health and the healthcare system are examined, highlighting the most at-risk populations, including the elderly, individuals with chronic illnesses, those with disabilities, pregnant women, outdoor workers, socially disadvantaged groups, and ethnic minorities. The discussion also encompasses diseases linked to heat waves in Georgia, such as cardiovascular and respiratory conditions, which have been on the rise annually, potentially due to climate change.

Additionally, this section addresses the healthcare system's role in adapting to climate change, detailing healthcare institutions that are involved in climate response efforts. It reviews strategic documents that emphasize the importance of addressing climate change, including the National Action Plan for Environment and Health, which identifies "Surveillance of health status and risk factors related to climate change" as its fifth priority. Furthermore, it evaluates the Action Plan for the Management of Public Health Risks Related to Heat Waves for 2024-2030, approved in December 2023. This plan aims to enhance national capacity for climate change adaptation by implementing mechanisms to respond to heat waves, benefiting the entire population of Georgia. The Action Plan seeks to achieve two primary objectives by 2030: the establishment of a real-time surveillance and assessment system for public health risks associated with heat waves and a reduction in morbidity and mortality rates linked to heat waves in Georgia.

Heat waves are recognized as a significant urban challenge, prompting a focus on the susceptibility and adaptive capacity of cities. An evaluation of the current and anticipated vulnerability of urban areas was conducted utilizing a multi-criteria vulnerability analysis method, which involved comparing climate data from two distinct periods (1961-1990 and 1991-2020). The analysis identified Batumi as the city with the highest vulnerability, followed by Oni, Poti, Kobuleti, Kutaisi, and Khashuri. For future projections, two time frames were considered (2041-2070 and 2071-2100), revealing that Kutaisi is expected to be the most vulnerable city, succeeded by Batumi, Zestaponi, Akhaltsikhe, and Lanchkhuti. The only variable that alters in the future scenario is the effect of heat waves, suggesting that the shifts in rankings are likely influenced by changes in climatic conditions.

The subsection concludes with suggestions aimed at enhancing the population's adaptation to the risks associated with climate change, particularly concerning heat waves.

R.4.9. CLIMATE CHANGE IMPACTS ON THE TOURISM SECTOR AND ADAPTATION

This sub-chapter examines and evaluates the connection between climate change and the tourism industry, with a particular focus on the long-term implications for marine and mountain-ski tourism. To analyze the effects of climate change on the tourism sector, data was gathered from the National Environment Agency of Georgia, the National Statistics Service, and the National Tourism Administration. Additionally, findings from studies conducted by both local and international organizations were incorporated into the report.

The analysis revealed that Georgia's tourism sector is highly sensitive and susceptible to climate change. Notable changes include rising temperatures, irregular precipitation patterns, diminished snow cover depth, and a shorter winter season, alongside an increase in natural disasters, rising sea levels, and coastal erosion. Over the long term, global warming is anticipated to adversely affect the growth of both winter and marine tourism. Furthermore, it is projected that the costs associated with adaptation strategies will rise, thereby exerting additional strain on the national budget.

The significance of climate change's impact on the tourism sector cannot be overstated, as this sector is marked by rapid growth and possesses substantial potential given the country's resources. Approximately 11% of the employed population works within the tourism industry, and around 70% of the country's service exports are linked to tourism. The contribution of the tourism sector to the national GDP exceeds 7%. Consequently, the potential repercussions of global warming on the sustainable development of the country are of great concern, particularly regarding its effects on income, living standards, and overall well-being.

R.4.10 CLIMATE CHANGE IMPACT ON THE ECONOMY

This subsection examines and evaluates the economic connections between climate change and key sectors of the Georgian economy, specifically agriculture, tourism, and healthcare. To analyze the effects of climate change on Georgia's economy, data was gathered from the National Statistics Service of Georgia, the National Tourism Administration, and the Ministry of Finance. Additionally, the report incorporates findings from studies conducted by both local and international organizations.

Agriculture in Georgia is recognized as a particularly vulnerable sector in the face of climate change. As of 2022, the rural population stands at approximately 1.5 million, constituting 40% of the country's total population. In that same year, around 229,000 individuals were employed in agriculture, representing 18% of the overall workforce. The combined contributions of agriculture, forestry, and fisheries account for roughly 7% of the country's gross domestic product.

The phenomenon of global warming poses a considerable threat to the agricultural sector, as it can lead to increased occurrences and durations of droughts, irregular precipitation patterns, and shifts in seasonal cycles. These changes can adversely affect soil fertility and crop yields, thereby impeding the growth of farmers' incomes and the overall wealth generated by the sector. Furthermore, it is important to note that climate change may heighten the volatility of agricultural product prices in the future, which could elevate business and investment risks within the sector, ultimately hindering investment and development. Consequently, the aforementioned events and processes associated with global warming exert a predominantly negative influence on productivity, price stability, food security, and the decision-making of farmers.

Tourism represents one of the most rapidly expanding sectors in Georgia. Consequently, a pressing concern is the vulnerability and sensitivity of this sector to climate change. In 2022, the sector generated an estimated added value of around 4.4 billion GEL, accounting for approximately 7% of the country's GDP.

In the long term, climate change is anticipated to adversely affect the growth of tourism in Georgia. The costs associated with necessary adaptation measures are expected to rise, thereby exerting additional strain on the national budget. Furthermore, it is plausible that global warming will negatively influence investment decisions if the evolving tourism landscape becomes less appealing to visitors.

The healthcare sector in Georgia is also susceptible to the impacts of climate change. This vulnerability is particularly pronounced in economic sectors where workers, including self-employed individuals, are required to operate outdoors. Notable examples include construction, agriculture, trade, and logging. Climate change-related phenomena, such as elevated temperatures, increased frequency and intensity of heat waves, fluctuations in humidity, and natural disasters, heighten specific health risks and threats. Consequently, it is projected that there will be a rise in the incidence of respiratory diseases, infectious diseases, circulatory conditions, and injuries over time, which will adversely affect the labor force and overall productivity. This decline in productivity is likely to have negative repercussions on the income levels and well-being of the population. Additionally, the rise in disease prevalence due to climate change may further strain the healthcare system and the national budget.

R.4.11. GENDER ISSUES IN CLIMATE CHANGE ADAPTATION

Climate change impacts women and men in distinct ways, particularly regarding their vulnerability, the advantages they derive from climate change initiatives, and their involvement in decision-making processes related to the climate crisis. These disparities stem from pre-existing gender inequalities and imbalances in power, as well as unequal access to and control over resources.

Since 2012, the gender dimensions of climate change have been recognized as a critical issue within the Framework Convention on Climate Change. The 21st Conference of the Parties to this Convention affirmed gender equality and the empowerment of women as essential principles in the preamble of the Paris Agreement.

R.5. CONSTRAINTS AND GAPS AND RELEVANT FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER, AND CAPACITY BUILDING NEEDS AND SUPPORT RECEIVED

R.5.1 FINANCIAL NEEDS AND SUPPORT RECEIVED

The Nationally Determined Contribution (NDC) document outlines an allocation of approximately 13 billion GEL (5 billion USD) for mitigation strategies through 2030, which includes 8 billion GEL for unconditional commitments and 5 billion GEL for conditional commitments. Additionally, the estimated cost for adaptation measures during the same timeframe ranges from 3.9 to 5.2 billion GEL (1.5 to 2 billion USD).

To evaluate financial requirements, a review of the “2024-2025 Climate Change Action Plan” and the “Fourth National Environmental Action Program of Georgia for 2022-2026” was conducted for the short term. This assessment indicated a financial shortfall of 56.5 million GEL (20.9 million USD), with the majority of this deficit attributed to forest management (63.2%), followed by land resource protection (14%), water resource and Black Sea protection (7.2%), and waste management (5.3%). This shortfall pertains solely to the years 2024-2026, with a significantly larger deficit anticipated for the initiatives outlined in Georgia’s climate change policy for 2030 and 2050.

In analyzing the data on foreign aid received, the Government Administration's electronic information management system for foreign aid was utilized, revealing 78 projects associated with climate change that align with the Sustainable Development Goals, totaling 676.7 million USD. Of these, 53 projects, amounting to 211.5 million USD, have been completed (68%). The primary sources of funding are predominantly large financial institutions and the European Union, with 43% from the European Bank for Reconstruction and Development, 23.4% from the Asian Development Bank, 7% from the World Bank, and 11% from the European Union. The main sectors receiving funding include transport (40.54%), emergency management (10.43%), agriculture (9.72%), forestry (8.44%), energy and energy efficiency (7.94%), and construction and energy efficiency (6.97%).

The data obtained from state agencies, local governments, non-governmental organizations, and international institutions presents a somewhat altered perspective on the support received. After carefully filtering out duplications, a total of 101 projects were identified, amounting to approximately 1 billion USD. Among these, 39 projects have been completed, while 62 are currently in progress. In terms of sector distribution, the majority of the projects are concentrated in transport (40.5%), followed by emergency management (10.4%), agriculture (9.7%), forestry (8.4%), energy (7.9%), construction (7%), and multisector initiatives (7.2%), with the remaining sectors accounting for a relatively minor share.

In Georgia, the integration of programs and sub-programs related to climate change within the state budget commenced in 2022. To enhance the connection between strategic and policy documents and the budget, the "Policy Classifier" was incorporated into the electronic budget management system in 2022, as part of the Public Finance Management Reform Strategy for 2023-2026. This integration enables Georgian ministries and other spending entities, including municipalities, to associate the budget-defined programs and sub-programs within the electronic budget management system (ebudget.ge) with the relevant "Policy Classifier." The associations of programs with the policy classifier are documented in the program budget annex. Currently, the electronic budget management system (ebudget.ge) includes the following policy classifiers: **UN Sustainable Development Goals (SDG), Human Capital Goals, Gender Equality, Climate Change (encompassing mitigation, adaptation, and both),** Energy Efficiency, Human Rights, Green Budget, Rural Development, and Sectoral Strategies. The Government of Georgia's Resolution No. 88, dated February 25, 2022, titled "On measures to be implemented for the purpose of compiling the document of the country's main data and directions for 2023 - 2026," mandates that during the preparation of medium-term action plans, **Georgian ministries must identify and document the connections between their implemented programs and sub-programs and climate change in budget applications, utilizing the "Policy Classifier" in collaboration with the Ministry of Environmental Protection and Agriculture of Georgia.** To ascertain the aforementioned linkages and evaluate their fiscal implications concerning climate change, training sessions were organized with the collaboration of the World Bank and the participation of the Ministry of Environmental Protection and Agriculture of Georgia. These sessions targeted representatives from the finance departments of four ministries: the Ministry of Economy and Sustainable Development of Georgia, the Ministry of Regional Development and Infrastructure of Georgia, the Ministry of Environmental Protection and Agriculture of Georgia, and the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health, and Social Protection of Georgia. The training focused on mechanisms for identifying linkages and assessing fiscal impacts, including the utilization of the policy classifier feature within the electronic budget management system. Furthermore, information regarding financing from the private sector remains highly fragmented. Non-governmental organizations, particularly those receiving what is termed “informal development assistance,” benefit from specific support provided by international or local investors, as well as various financial or other institutions.

The Ministry of Environmental Protection and Agriculture sought information regarding current climate-related initiatives from a wide array of pertinent public and international organizations, as well as representatives from the non-governmental sector. The data collected was thoroughly vetted to eliminate duplicates and was subsequently organized into an appendix. Feedback from the recipients of this request yielded intriguing results; however, the information cannot be deemed comprehensive. Despite the Ministry’s diligent efforts, it was unable to secure data from several institutions engaged in climate matters, and the thoroughness and accuracy of the gathered information were contingent upon the willingness of the information providers.

The comprehensive identification of finance related to climate change continues to pose significant challenges. To address this issue, it is essential to establish a robust system for monitoring, reporting, and evaluation, alongside the implementation of a suitable regulatory framework and effective enforcement mechanisms.

R.5.2 SUPPORT NEEDED AND RECEIVED FOR TECHNOLOGY DEVELOPMENT AND TRANSFER

The requirements for technology development and transfer in the country are shaped by the national climate change policy, particularly the obligations outlined in the Paris Agreement under the Framework Convention on Climate Change. These obligations are encapsulated in the revised Nationally Determined Contribution document and other strategic frameworks related to climate change, including the Long-Term Low Emission Development Strategy (LT-LEDS) and the Climate Change Strategy for 2021-2030. The document “Climate Technology Needs Assessment in Georgia (third stage)” provides detailed insights into the climate technology requirements for both mitigation and adaptation over a specified timeframe, while also identifying priority sectors and the corresponding technologies needed.

An evaluation of existing technologies and local capacities reveals that the prevalence of outdated technologies, coupled with insufficient local capabilities to transition to newer technologies, poses significant challenges across all sectors. This situation acts as a considerable obstacle to the adoption and execution of innovative technologies. The deficiencies in local capabilities necessary for the deployment of new technologies stem from various factors, including the sluggish adaptation of the legal framework to align with European standards, a shortage of adequately trained technical personnel, insufficient technical materials and services, inadequacies in training and certification systems for technical staff, the absence of regulatory acts and standards, a lack of business motivation to adopt and implement new technologies, and inadequate financial backing. Consequently, the necessity to enhance local capabilities and technologies was particularly emphasized during the assessment of technological needs.

The development, transfer, and implementation of climate technologies in Georgia cannot be envisioned without external support. This support is provided through various technical assistance initiatives, as well as international and bilateral financial and technical aid, primarily aligned with national and sectoral policies and development programs. These efforts are aimed at facilitating Georgia's compliance with its international commitments regarding climate change. Financial contributions are sourced from the Climate Convention's financial mechanisms, the European Union, and development agencies from partner nations. Typically, this assistance encompasses both financial and technical elements. In instances involving large-scale and innovative technologies, where local expertise is lacking, technical assistance becomes particularly vital, as Georgia's limited technical capacity poses a significant obstacle to the adoption of new technologies. Several successful technologies have already been implemented across various sectors in Georgia.

An analysis of the gathered information indicates that most of the assistance directed towards technology development and transfer pertains to small-scale and straightforward technologies. The majority of the technology transfer process is concentrated in the research, development, and demonstration phases, with the most challenging aspects being the development and dissemination of these technologies. It is essential for the transfer of technologies and the enhancement of local capabilities to be coherent and ongoing to ensure the process's completion and sustainability. In this context, monitoring the process and facilitating regular information exchange are of paramount importance.

R.5.3 EXISTING NEEDS FOR CAPACITY BUILDING AND SUPPORT RECEIVED

The nation is actively engaged in enhancing its capabilities and understanding of climate change; however, a significant disparity persists between the existing needs and available opportunities. This situation necessitates both external support and domestic initiatives. The priorities for capacity building and the associated requirements are shaped by the country's climate change policy framework, which encompasses its international obligations and national climate policies, as well as the needs identified through various project frameworks.

The Nationally Determined Contribution document highlights the limited capacity for adaptation as a primary challenge for the country, emphasizing the necessity to bolster the ability to formulate adaptation strategies. This includes enhancing the capacity of policymakers to effectively plan for adaptation measures. Furthermore, it is essential to empower local communities to mitigate their vulnerability to climate-related hazards. The document also underscores the importance of strengthening national health systems to address long-term health risks associated with climate change.

In the realm of capacity development, it is vital to establish institutional capabilities that facilitate data analysis and consultation processes in response to climate change impacts, including both acute and gradual events. This approach aims to reduce or mitigate the losses incurred due to climate change. Enhancing skills and capacities at both national and local levels is essential for pursuing more ambitious climate initiatives. The development of technical skills and institutional capabilities is a fundamental requirement for effectively addressing the causes and effects of climate change and for advancing the overall green transformation. In this context, skills deficiencies represent a significant barrier to the progress of various sectors. Notably, the sectors that require substantial capacity development include agriculture, forestry, industry, renewable energy, energy efficiency, and waste management.

Georgia has made notable advancements in fulfilling its obligations under both international and national climate change policy frameworks compared to the previous reporting period. This progress is evidenced by a substantial rise in the implementation of climate change mitigation and adaptation initiatives. The enhancement of capacity has been achieved through a combination of domestic resources and technical assistance projects facilitated by international cooperation.

Almost all technology transfer initiatives executed within the country, whether as part of broader programs or specific projects, incorporate capacity building as an essential element. This approach equips the nation with the requisite experience and skills to effectively utilize the technologies acquired. The process encompasses raising awareness, executing targeted educational and training programs, disseminating information on best practices, and providing training on the mechanisms for technology transfer and the establishment of best practices.

In the realm of capacity building, the informal education and awareness initiatives led by the LEPL Environmental and Education Information Centre of the Ministry of Environmental Protection and Agriculture play a crucial role. This Centre is a key public institution in the country focused on environmental education and capacity enhancement. It engages with a diverse array of stakeholders, including ministries, local municipalities, the private sector, and other relevant groups. Throughout the reporting period, numerous medium and large-scale projects were carried out with the assistance of foreign grants, implemented through local non-governmental organizations or private entities. These projects facilitate knowledge and experience exchange among countries and contribute to the development of expertise across various sectors within Georgia.

In the realm of capacity development, several key areas of support can be identified: disaster risk management, forest management, and the promotion of alternative energy sources along with energy efficiency.

R.5.4 GENDER MAINSTREAMING IN CLIMATE CHANGE ISSUES, SUPPORT RECEIVED AND NEEDS

During the reporting period, several significant documents were developed concerning the integration of gender considerations into climate policy. Notably, the updated Nationally Determined Contribution document outlines commitments aimed at addressing gender and climate change, with a focus on enhancing the participation of women across various sectors. Furthermore, this document highlights the necessity of gathering sex-disaggregated data and utilizing it in national accounts related to climate change. Another critical advancement in the systematic integration of gender considerations into climate policy is the LT-LEDS, adopted in 2023, which incorporates a gender mainstreaming component and seeks to reflect gender dimensions throughout its implementation. Additionally, the Climate Change Law, introduced during the reporting period, is expected to play a vital role in the future organization of climate policy, including gender integration. The accompanying “White Paper” for the law’s development addresses various issues, including gender justice, and incorporates its principles. Gender justice within the climate change law entails the incorporation of principles and practices that tackle gender inequality, thereby fostering significant progress in gender equality within climate policy and legislation through capacity building, gender mainstreaming, and adherence to international obligations. A further enhancement to gender mainstreaming in climate policy, as well as its monitoring, is the amendment made to the electronic budget management system in 2023. This amendment mandates that Georgian ministries and other spending entities, including municipalities, connect budgeted programs and sub-programs in the electronic budget management system (ebudget.ge) to the relevant “policy classifier. The present electronic budget management system (ebudget.ge) encompasses a range of policy classifiers, which include the following: United Nations Sustainable Development Goals (SDG), Human Capital Objectives, Gender Equality, Climate Change Mitigation, Climate Change Adaptation, both Climate Change Mitigation and Adaptation, Energy Efficiency, Human Rights, Green Budgeting, Rural Development, and Sector Strategies.

CHAPTER 1 NATIONAL CIRCUMSTANCES, INSTITUTIONAL ARRANGEMENTS AND OTHER INFORMATION

1.1 NATIONAL CIRCUMSTANCES

1.1.1 POLITICAL OVERVIEW

State Arrangement

As a consequence of the constitutional amendments enacted in 2017, Georgia has been undergoing a transition to a parliamentary republic model of governance since December 2018. The distribution of power within the country is organized among the representative, executive, and judicial branches. This governance structure has enhanced the role of the Parliament and introduced new, effective mechanisms for executing its legislative and oversight functions. The Parliament is composed of 150 members, each elected for a term of four years.

The revised Constitution has curtailed the powers of the President. While the President serves as the head of state, the Supreme Commander-in-Chief of the Defense Forces, and represents Georgia in international relations, he is no longer tasked with ensuring the operational effectiveness of state bodies within his jurisdiction. Beginning in 2024, the President will be elected not through direct elections but by an electoral college.

The amendments to the Constitution have also augmented the responsibilities of the Prime Minister. The Prime Minister is responsible for setting the primary objectives of government operations and overseeing its activities. Additionally, the Prime Minister supervises regional state bodies and is accountable to the Parliament for the government's performance, providing an annual report on the implementation of the government program. The government is comprised of the Prime Minister, 12 ministries, and one state minister.

The judicial branch is represented by the Constitutional Court of Georgia and various common courts. Furthermore, the High Council of Justice of Georgia functions as an independent entity overseeing the judicial system, while the Supreme Court of Georgia serves as a court of cassation.

The region of Georgia encompasses the autonomous republics of Adjara and Abkhazia, along with five self-governing cities and sixty-four self-governing communities. It is important to highlight that the areas of Abkhazia and Tskhinvali are under the occupation of the Russian Federation, preventing the Georgian government from exercising effective jurisdiction over these regions. Consequently, this report does not include data from the occupied territories.

State management of climate policy

The national climate change policy of Georgia is established by the government, with consideration given to the international agenda.

In 1994, Georgia became a signatory to the United Nations Framework Convention on Climate Change (UNFCCC). The country is not a member of Annex 1 of the Convention. In 1999, Georgia joined the Kyoto Protocol associated with the Convention, followed by its accession to the Doha Amendment to the Kyoto Protocol in 2020, and the Paris Agreement in 2017 Additionally, 32 self-governing units within Georgia have signed the Covenant of Mayors.[1]

The national climate change policy adopted by the Government of Georgia aligns with its international obligations. To ensure the effective and coordinated execution of these commitments, the Government of Georgia established the Climate Change Council in 2020.[2]

The responsibilities of individual ministries in shaping and executing climate change policy are established by legislation. Specifically, the Ministry of Environmental Protection and Agriculture of Georgia serves as the primary coordinating entity for the national climate change policy. This ministry is also tasked with formulating Georgia's stance for international negotiations within the ongoing processes of the Convention. Additionally, the Ministry of Economy and Sustainable Development plays a significant role, particularly in developing a cohesive, long-term state vision for the energy sector and overseeing the fulfillment of commitments made under the Treaty establishing the Energy Community.[3]

Several factors significantly influence the development of climate change policy in the country. Firstly, the "Association Agreement between the European Union and Georgia" outlines various obligations, including the implementation of measures at the national

1 The Covenant of Mayors is a large-scale initiative of municipalities with climate and energy ambitions. It is a voluntary association of local governments with the aim of implementing the EU's climate and energy policy objectives.https://com-east.eu/ka/about-us/covenant-of-mayors/

2 https://www.matsne.gov.ge/ka/document/view/4780380?publication=0.

3 **The Energy Community is an organization whose main goal is to spread European energy legislation and market principles to non-EU countries.**http://weg.ge/ge/ra-gansxvavebaa-energetikul-kavshirsa-da-energetikul-gaertianebas-shoris

level aimed at enhancing climate change policy. Secondly, since 2017, Georgia's involvement in the "Energy Union" has committed the country, alongside other member states, to share the responsibility for climate change mitigation through the advancement of renewable energy and energy efficiency initiatives. Thirdly, the "Covenant of Mayors" establishes a requirement for local authorities to create sustainable energy and climate action plans by 2030.

In December 2023, Georgia was granted candidate status for EU membership, which necessitates the country to undertake political, institutional, legal, social, and economic reforms to align with EU regulations and standards. This includes, among other responsibilities, actions to be taken in the area of climate.

1.1.2 GEOGRAPHY

Georgia is located at the crossroads of Europe and Asia, specifically in the southeastern region of Europe and the southern part of the Greater Caucasus. Its geographical coordinates range from 41°03' to 43°35' north latitude and from 40°00' to 46°44' east longitude. The country shares its northern border with Russia, while Azerbaijan lies to the southeast, Armenia to the south, Turkey to the southwest, and the Black Sea to the west. Georgia encompasses a total area of 7,628.4 thousand hectares, with land constituting 91% and water 9%. The overall length of Georgia's borders measures 2,148 kilometers, which includes a coastline along the Black Sea that extends for 310 kilometers. Notably, 195 kilometers (63%) of this coastal area is situated within the occupied Autonomous Republic of Abkhazia.

The topography of Georgia is varied, featuring a mix of high, medium, and low mountains, plateaus, and plains. The Likhi Range naturally divides the country into Western and Eastern Georgia. Approximately two-thirds of the country's territory is mountainous, with over one-third occupied by the Caucasus mountain system. The territory stretches from the Black Sea to the peak of Shkhara, which rises to 5,203 meters. Remarkably, 54% of the land is situated at elevations exceeding 1,000 meters above sea level. Forests cover 44.5% of the country, with 97% of these being mountainous forests located on the slopes of the Caucasus. Only 3% of the forested area consists of lowland forests.

The region of Abkhazia, which is currently under occupation, is situated along the eastern shoreline of the Black Sea, nestled between the Enguri and Psou rivers. This area exhibits distinct climatic zones characterized by significant vertical differentiation and a wide array of climatic conditions. Within a span of 50 kilometers from the Black Sea coast to the principal ridge of the Caucasus, one can observe all climatic zones, ranging from humid subtropics to permanent glaciers. These climatic conditions contribute to the richness, diversity, and extreme fragmentation of both soil and vegetation in Abkhazia. Although the process of soil formation aligns these landscapes with humid subtropical characteristics, the relatively cold winters in the foothills inhibit the proliferation of humid evergreen forests.

Georgia possesses abundant water resources, though their distribution is uneven across the eastern and western regions of the country. Approximately two-thirds of these resources are found in Western Georgia. The landscape is characterized by a complex network of river systems; however, most rivers are relatively short, with lengths under 25 kilometers. Only 121 rivers extend between 25 and 100 kilometers, while 16 rivers reach lengths of 100 to 500 kilometers. Glaciers occupy a mere 0.5% of the national territory and are among the most susceptible natural systems in Georgia to the impacts of climate change.

A study conducted in 2020 utilizing satellite remote sensing technology indicated a notable reduction in the number of glaciers in Georgia, which has decreased to 383, covering a total area of 337 square kilometers. In contrast, approximately 50 years prior, there were 541 glaciers documented, including 409 in Western Georgia and 132 in Eastern Georgia, with a combined area of 543 square kilometers. The rate of glacier retreat is more pronounced in Eastern Georgia compared to Western Georgia, with a recorded decrease of 21% (27.4% of the occupied area) in the west and 54.5% (47.3% of the area) in the east. This disparity can be attributed to the continental climate prevalent in Eastern Georgia versus the humid maritime climate [4]of Western Georgia. Consequently, the melting of glaciers in the Caucasus is anticipated to result in an initial increase in water runoff in Georgian rivers during the 21st century, followed by a significant decline in runoff due to the substantial reduction of glacier mass.

The geographical landscape of Georgia encompasses a variety of environments, including semi-desert regions in Eastern Georgia, humid subtropical areas in Western Georgia, and permafrost-glacial landscapes characterized by glacial and nival features.

Agricultural land constitutes 39.7% of the total land area, with 23.6% designated for pastures, 10.5% for arable farming, 3.5% for perennial crops, and 1.9% for hayfields. Conversely, non-agricultural land makes up 60.3% of the total area, with approximately half of this being forested. The remainder includes water bodies, urban and industrial zones, roads, and various infrastructure.

The changing climate and the increasing frequency of extreme hydrometeorological events are significantly affecting regions that are particularly susceptible to climate change, notably the Black Sea coastline, as well as the mountainous and forested areas of the country.

1.1.3 DEMOGRAPHICS

As of January 1, 2023, the total population was recorded at 3,736.4 thousand individuals. Yearly fluctuations in population size are observed, with natural growth exhibiting a negative trend. The migration balance has also been predominantly negative. The demographic composition consists of 48% men and 52% women, resulting in an average population density of 65.3 individuals per square kilometer.

4 L. Shengelia, G. Kordzakhia, G. Tvauri, M. Dzadzamia, Degradation of Georgia's glacial basins due to climate change, STU Institute of Hydrometeorology Proceedings, Volume 129, 2020.

In the occupied region of Abkhazia, the population at the start of 2023 stood at 244,926 individuals, with men constituting 47% and women 53%. Between 2011 and 2019, the population experienced an increase of 4,541 individuals, followed by a decrease of 1,288 individuals from 2019 to 2023. Abkhazians represent slightly more than half of the population, with their numbers rising by 3,168 individuals from 2011 to 2022. Notably, 26.67% of the Abkhazian population resides in the city of Sukhumi.

FIGURE 1.1.1: POPULATION DYNAMICS[5]

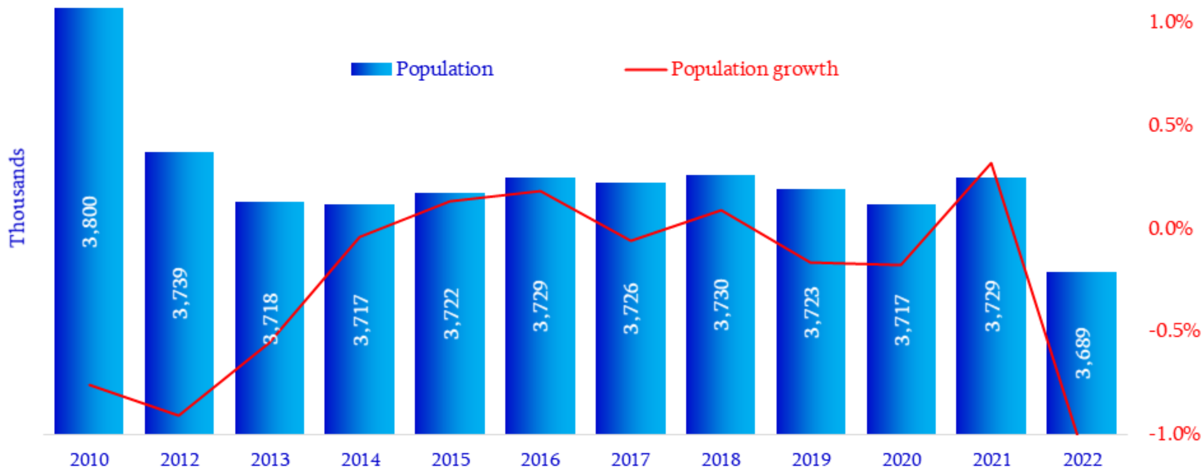
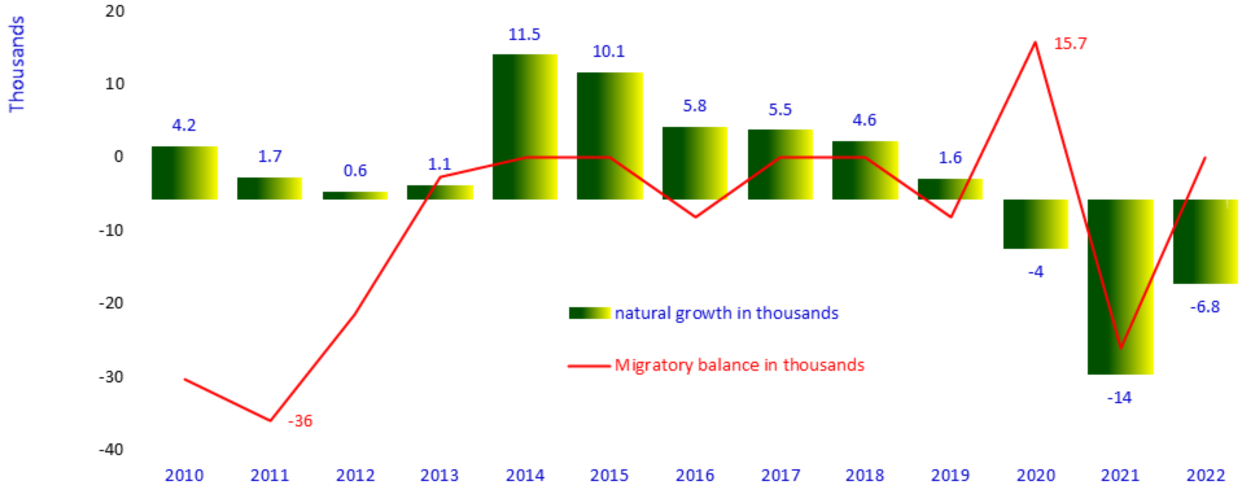


FIGURE 1.1.2: DYNAMICS OF NATURAL INCREASE AND MIGRATION[6]



Tbilisi is the most populous city in Georgia, with a population of 1,241.7 thousand, accounting for 33.2% of the country's total population, and a density of 2,462.5 individuals per square kilometer. Among the regions, the Autonomous Republic of Adjara (124.6 individuals/ km^2), Shida Kartli (72.9 individuals/ km^2), and Imereti (72.2 individuals/ km^2) are notable for their elevated population densities. Following Tbilisi, the municipalities with populations

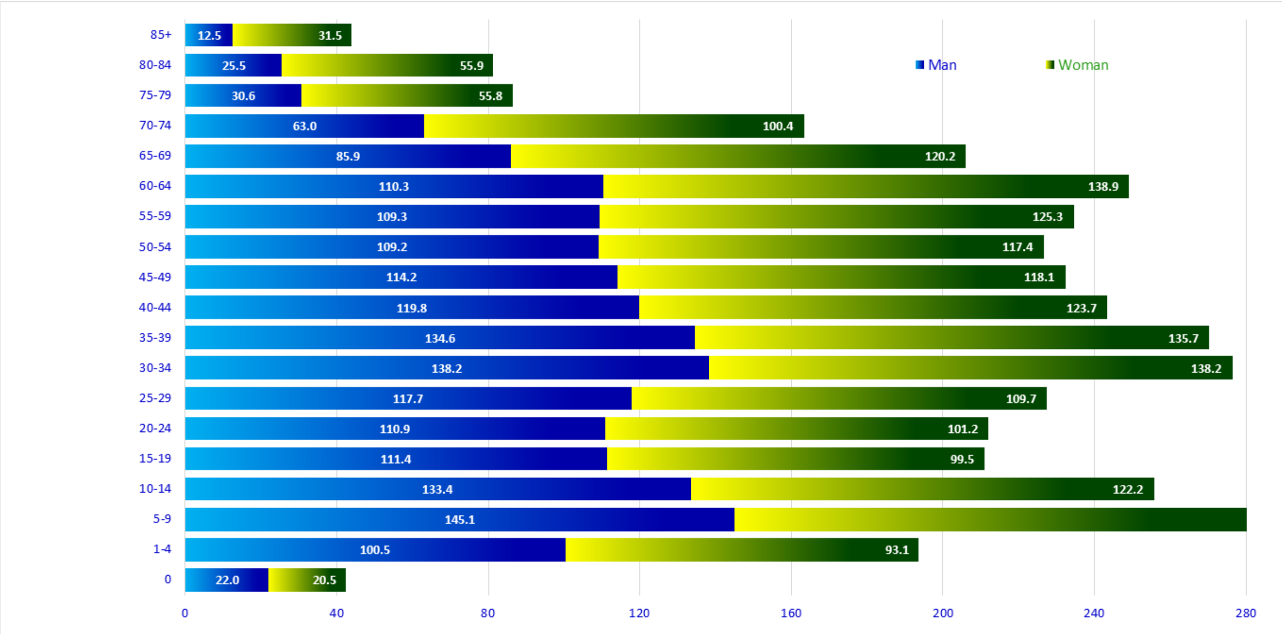
5 Population. https://www.geostat.ge/ka/modules/categories/41/mosakhleoba

6 Natural increase. https://www.geostat.ge/ka/modules/categories/321/bunebrivi-matebaMigration. https://www.geostat.ge/ka/modules/categories/322/migratsia

exceeding 100 thousand include Batumi (179.2 thousand), Rustavi (132.3 thousand), Kutaisi (130.4 thousand), Gori (118.3 thousand), and Marneuli (109.1 thousand).

As of 2023, 60.4% of Georgia's population resides in urban areas, while 39.6% live in rural regions. The demographic distribution indicates that 20.7% of the population is aged 0-14, 63.8% falls within the 15-64 age bracket, and 15.5% are aged 65 and older. Consequently, the overall age dependency ratio stands at 56.8%, with the youth and elderly dependency ratios at 32.4% and 24.4%, respectivelyIn 2023, the labor force, comprising individuals aged 15 years and older, represented 42.7% of the total population. The labor force participation rate stood at 53.3%, while the employment rate was recorded at 44.5%. Additionally, the unemployment rate was noted to be 16.4%[7].

FIGURE 1.1.3: AGE AND SEX DISTRIBUTION OF THE POPULATION (THOUSAND PEOPLE)[8]



The demographic analysis reveals a trend towards an aging population. Both the age and sex distributions present challenges in achieving a sufficiently positive reproduction rate. In 2022, the life expectancy at birth was recorded at 73.7 years.

Based on the latest census conducted in 2014, the predominant ethnic groups within the population are Georgians, comprising 86.8% (or 3,224.6 thousand individuals), followed by Azerbaijanis at 6.3% (or 233 thousand), Armenians at 4.5% (or 168.1 thousand), Russians at 0.7% (or 26.5 thousand), and Ossetians at 0.4% (or 14.4 thousand). The least represented groups include Yezidis (12.2 thousand, or 0.3%), Ukrainians (0.2%), Kists (0.2%), Greeks (0.1%), and Assyrians (0.1%).

1.1.4 HEALTHCARE

The World Health Organization identifies three primary ways in which climate change adversely affects human health: 1) heat waves; 2) natural disasters; and 3) alterations

7 Employment and unemployment https://www.geostat.ge/ka/modules/categories/683/dasakmeba-umushevroba

8 Average annual population size by age and sex. https://www.geostat.ge/ka/modules/categories/41/mosakhleoba

in the infectious disease landscape. The section on adaptation addresses the health risks associated with climate change in Georgia. The heightened risk of mortality from cardiovascular and respiratory diseases due to extreme heat makes the mortality rates from these conditions a critical metric for evaluating health risks. Furthermore, elevated temperatures significantly increase the concentration of allergens in the air. According to Geostat, as of 2022, respiratory diseases accounted for 36% of the primary morbidity diagnoses, followed by circulatory system diseases at 9% and various infectious and parasitic diseases at 6%. The influence of climate change on the prevalence of water-borne and communicable diseases is not clearly established. There are sporadic instances of malaria, Crimean-Congo fever, leishmaniasis, and other vector-borne diseases in Georgia, which may experience slight fluctuations in incidence over the years.

The leading cause of death was found to be diseases of the circulatory system (36%), followed by cancer (9%) and respiratory diseases (6%). Both circulatory and respiratory diseases exhibited an upward trend until 2019, peaking at 46% and 8%, respectively. The alterations in death registration patterns due to the COVID-19 pandemic have somewhat diminished these statistics; however, it is anticipated that these figures will rise again in the future.

In 2018, the Government of Georgia endorsed the National Environment and Health Action Plan for 2018-2022, which includes strategic objectives that incorporate a climate change component, emphasizing the integration of health considerations into climate change adaptation and mitigation strategies.

1.1.5 EDUCATION

Raising awareness and fostering education regarding climate change constitutes a critical issue of our time. In this context, it is essential to recognize both formal and informal avenues of environmental education.

With respect to formal education, the initiatives undertaken by universities in the realm of environmental protection are noteworthy. For instance, the Master's Program in Environmental Management and Policy at the Georgian Institute of Public Affairs includes a course titled "Climate Change and Its Aspects." Furthermore, the Bachelor's Program in Economics at Caucasus University offers a course on "Climate Change Economics." Beyond these specific courses, climate-related topics are actively incorporated into the curricula of hydrology, geology, ecology, and other disciplines associated with the environmental sector.

In the realm of formal education, it is important to highlight the advancements made in vocational education over recent years. Following the reforms that have been enacted, a procedure for the development and approval of professional standards, as well as vocational educational standards and modules, has been established within the vocational education framework. A methodology for the formulation and enhancement of professional qualifications has also been sanctioned. Beginning in 2023, a proactive approach to updating professional qualifications has commenced in line with this new methodology. Modules focusing on "Occupational Safety and Health Protection" and "Rules for Environmental Protection and Waste Management" have been created and incorporated into various educational standards. Furthermore, the "Basic Principles of

Green Construction and Environmental Protection" have emerged from the educational standards/modules as a result of the learning process. The revised vocational educational standard for forestry has received approval. Additionally, the educational standard for renewable energy management and energy management (energy efficiency) has been ratified, leading the Georgian Institute of Public Affairs (GIPA) to announce the opening of admissions for the professional educational programs "Renewable Energy Management" and "Energy Management" for the fall intake of 2024.

By directive of the Director of the National Center for the Development of Quality of Education of the LEPL, the minimum recommended standards for the professional retraining program titled "Installation of Equipment for Renewable Energy Sources" have been officially approved. This document was created as part of a memorandum established between the Ministry of Economy and Sustainable Development of Georgia, the Energy Development Fund of Georgia, the Ministry of Education, Science and Youth of Georgia, and the National Center for the Development of Quality of Education of the LEPL. The primary objective of this initiative is to enhance compliance with Georgian legislation in the energy sector, promote the training of skilled personnel in energy efficiency, and foster the production and utilization of energy derived from renewable sources, thereby improving the quality of education in this field to meet the commitments outlined in the Association Agreement between Georgia and the European Union.

Currently, in collaboration with the Agency for Professional Skills of the A(A)I and the Ministry of Economy, four vocational training programs focused on energy efficiency are under development. It is important to highlight that the revised professional standards emphasize environmental protection as a key responsibility. Within the construction, agricultural, and related standards and programs, waste management has been identified as a necessary task and learning outcome.

The execution of vocational training and retraining certificate programs focused on environmental issues within the context of formal education is ongoing. It is important to highlight that the establishment of the vocational training and retraining system in formal education commenced in 2019. The primary objective of these programs is to equip personnel with the necessary skills in alignment with labor market demands in the shortest timeframe possible. Presently, seven legal entities are conducting various vocational training and retraining programs, including "Woodworking and Fire Prevention Measures," "Woodworking and Forest Protection Works," "Utilization of Main Timber and Non-Timber Forest Resources," "Environmental Manager," "Forest Inventory and Taxation," "Forest Restoration-Planting," "Woodworking," "Performance of Forestry Works," and "Waste Management." Furthermore, in collaboration with the Agency for Vocational Skills of the Ministry of Environmental Protection and Agriculture of Georgia, a grant project titled "Short-term Programs in Vocational Education in the Forest Value Chain" is currently in progress, aimed at implementing vocational training and retraining initiatives in the forestry sector within vocational educational institutions.

In the realm of non-formal education, the initiatives undertaken by the LEPL Environmental Information and Education Centre of the Ministry of Environmental Protection and Agriculture are commendable. Additionally, various certification training courses and contests are being offered by universities such as Ilia State University and Tbilisi State University, as well as by donors, non-governmental organizations, and research groups.

1.1.6 CULTURAL HERITAGE

The cultural heritage of Georgia is extensive and varied, comprising 72 intangible cultural heritage sites[9] and 7,942 immovable cultural heritage sites,[10]) which encompass both tangible and intangible elements. The UNESCO World Heritage List features three cultural heritage sites and one natural heritage site from Georgia: the historical monuments of Mtskheta, Zemo (Upper) Svaneti, Gelati Monastery, and the forests and wetlands of the Colchis Lowland. Furthermore, UNESCO's Representative List of Intangible Heritage recognizes the ancient Georgian traditional method of wine production in qvevri, Georgian polyphony, the living culture associated with the three types of the Georgian alphabet, and Georgian wrestling.

Given that a significant portion of this cultural heritage is found outdoors, including buildings and cultural monuments, it is particularly vulnerable to the impacts of climate change. Altered climatic conditions and the associated increase in natural hazards can deteriorate the state of these cultural heritage sites and may even threaten their survival. Therefore, to address the risks posed by climate change and to mitigate its adverse effects, it is crucial to formulate appropriate policies and strategies, conduct necessary scientific research, enhance the knowledge of professionals in the cultural heritage sector regarding climate change impacts, and implement relevant modern standards for preventive conservation.

1.1.7 NATURAL RESOURCES

Climate

Georgia exhibits a variety of climate zones, including humid subtropical, moderately humid, moderately dry, and dry-continental climates, as well as areas characterized by eternal snow and glaciers. This climatic diversity arises from its position on the northern edge of the subtropical zone, situated between the Black and Caspian Seas, along with the country's complex topography.

The climate is shaped by mountain ranges of varying orientations and elevations. The Caucasus Mountains serve as a barrier, shielding Georgia from the frigid air masses that typically flow in from the north, while the Black Sea plays a crucial role in moderating temperature variations and contributing to significant precipitation levels. Consequently, Western Georgia experiences relatively high rainfall, whereas Eastern Georgia tends to have drier conditions. Furthermore, the coastal region along the Black Sea is noted for its mild and warm winters, with consistent precipitation throughout the year, particularly in the southern part of the Colchis Lowland, which receives over 2,500 mm of rainfall annually.

In recent years, particularly over the last two decades, climate change has led to irregular precipitation patterns along the Black Sea coast. There has been an increase in the intensity and frequency of storms at sea, particularly those exceeding 5 on the Beaufort scale. Notable alterations in storm seasonality and intensity, as well as changes in the temperature of the sea surface, have been observed. Additionally, rising sea levels,

9 List of Intangible Cultural Heritage Sites.https://www.heritagesites.ge/uploads/files/660d23d6561a3.pdf
10 Immovable monuments of cultural heritage.https://www.heritagesites.ge/uploads/files/66e31a54773fe.pdf

currently at a rate of 2-3 mm per year, coupled with the heightened occurrence of severe storms due to climate change, are expected to intensify ongoing erosion processes, further threatening the stability of the coastal areas.

The upward trend in average temperatures is evident across most regions of the country, presenting considerable challenges related to climate change and economic activities. Between 1986 and 2015, a notable rise in the average annual temperature was recorded when compared to the period from 1956 to 1985. This trend is consistent across the majority of regions. During the same timeframe, Western Georgia experienced an increase in annual precipitation, whereas the Eastern regions saw a decline.

In the context of climate change, there has been a rise in both the frequency and severity of natural disasters typical to Georgia, including floods, flash floods, avalanches, mudslides, landslides, strong winds, and droughts.

In recent decades, the climate in the occupied territory of Abkhazia has undergone substantial alterations, affecting both temperature and precipitation patterns. Over the last 30 years, the average annual temperature has increased by approximately 1.0 to 1.2°C in July and by 0 to 0.2°C in January, although a slight decrease of 0 to 0.2°C was observed in the eastern part of the region during January. Annually, the average temperature rise is estimated to be between 0.4 and 0.6°C. The effects on precipitation are seasonal; for instance, January has seen an increase of 15 to 20%, while July has experienced a decrease in precipitation ranging from 0 to 10%.

Water resources

Georgia is notable for its diverse and abundant annual water resources. The country possesses a wealth of both groundwater and surface water, including fresh, thermal, and mineral varieties. The total natural flow of fresh groundwater resources amounts to 21.7 km^3, which represents 23% of the precipitation that occurs locally. This distribution is uneven, as it tends to increase from the eastern to the western regions. The Georgian plain is particularly rich in thermal waters, which are extensively utilized for agricultural purposes and, in some instances, serve communal or recreational functions. The mineral waters found in Georgia exhibit significant diversity.

In Western Georgia, rivers flow into the Black Sea basin, while in Eastern Georgia they drain into the Caspian Sea basin. The primary sources of these rivers include glaciers, snow, rainfall, and groundwater. The total river runoff in Western Georgia, including transit flows, is 49.8 km^3, whereas in Eastern Georgia, it is 16.5 km^3. The Rioni and Mtkvari rivers are particularly abundant, along with several others such as the Enguri, Kodori, Bzipi, Tskhenistskali, Kvirila, Liakhvi, Aragvi, Ktsia-Khrami, and Alazani.

Georgia is home to approximately 860 lakes, although most are relatively small, covering a total area of 170 km^2, which constitutes 0.24% of the country's territory. Lake Paravani is notable for its size, Lake Tabatskuri for its volume, and Lake Ritsi for its depth. The country also features 44 reservoirs, with a combined surface area of 163 km^2 and a water volume of 3.315 million m^3. Wetlands cover a significant area of 627 km^2, primarily located in the Colchian Plain.

Forests

As of 2022, forests cover 44.5% of the territory of the country, amounting to approximately 3,100,500 hectares. These forests play a crucial role in soil protection, water regulation, and various ecosystem functions, including sanitary and hygienic benefits. Notably, the forested areas of the Greater and Lesser Caucasus represent the last remaining intact forests within the temperate climate zone, holding significant global ecological value.

The unique physical and geographical characteristics of Georgia, along with its distinct climatic conditions and its position at the intersection of various phytolands, contribute to a rich diversity of flora within a relatively compact area. Eastern Georgia features a semi-desert landscape typical of the foothills in arid regions, whereas the Colchis belt is characterized by a humid, subtropical climate. The challenging terrain results in geographical and ecological isolation of ecosystems, fostering a high degree of local endemism, including Caucasian, Colchis, Iberian, and Near Asian species. Georgia is home to approximately 5,000 species of wild and feral angiosperms and gymnosperms, alongside around 8,300 species of spore plants, which include about 75 species of ferns, 600 species of mosses, 5,000 species of fungi, and roughly 2,000 species of algae. The fauna of Georgia is equally diverse, comprising around 100 species of mammals, over 330 species of birds, 48 species of reptiles, 11 species of amphibians, and approximately 160 species of fish, in addition to thousands of invertebrate species. Consequently, the Caucasus region is recognized as one of the 35 “priority ecoregions” by the World Wildlife Fund for Nature (WWF), and Georgia is included in two of the 34 biodiversity hotspots identified by the American non-governmental organization Conservation International, specifically the Caucasus and Iran-Anatolia hotspot zones[11].

Environmental protection

Environmental policy in Georgia is fundamentally shaped by the Constitution, which stipulates that: “Everyone has the right to live in an environment that is harmless to health, to enjoy the natural environment and public space. Everyone has the right to timely receive full information about the state of the environment. Everyone has the right to care for the protection of the environment. The right to participate in decision-making related to environmental issues is ensured by law.” Given the intricate and cross-sectoral nature of environmental challenges, the actors involved in environmental governance encompass a diverse array of stakeholders, including governmental bodies, public organizations, the business sector, local communities, and various interest groups. Therefore, the key to effective policy formulation and implementation lies in participatory environmental governance.

The primary influence on the formulation of Georgia’s environmental policy is attributed to:

1. Sustainable development goals that specifically target environmental protection, along with those objectives that are either directly or indirectly associated with environmental considerations.

2. Multilateral environmental agreements and international environmental processes. Georgia has ratified 39 multilateral agreements concerning various areas, including biodiversity, climate change, air quality, water resource management, waste and

11 https://www.conservation.org/priorities/biodiversity-hotspots

chemical management, as well as nuclear and radiation safety, among others.

3. The Association Agreement between Georgia and the European Union (2014) serves as a significant catalyst for the adoption of contemporary methodologies and exemplary practices in environmental protection. This agreement stipulates the alignment of Georgian legislation with 22 EU directives and 4 regulations pertaining to environmental protection. Additionally, it addresses the reform of the forestry sector to promote sustainable management practices. The agreement encompasses various environmental concerns, including governance, air quality, water quality and resource management (inclusive of marine management), waste management, species conservation, industrial pollution and risks, chemical management, climate initiatives (including measures against substances that harm the ozone layer), and forestry management. To meet its obligations, Georgia has formulated an action plan that outlines specific measures and timelines for their execution[12].

The Ministry of Environmental Protection and Agriculture of Georgia is pivotal in formulating and executing environmental protection policies within the nation. Its responsibilities encompass state management and oversight regarding the utilization of natural resources, excluding minerals, oil, and gas. Furthermore, the Ministry is tasked with enforcing regulations related to environmental protection and the management of natural resources, with the exception of monitoring adherence to mineral extraction licenses or subsoil use permits.

Between 2018 and 2023, substantial reforms and initiatives were undertaken to enhance environmental protection and mitigate environmental degradation. Notably, several key reforms and measures were implemented in relation to climate change.

- The Law of Georgia concerning Industrial Emissions was enacted in 2023.
- An amendment to the Law of Georgia on Environmental Protection has been proposed, aimed at regulating the authorization process for greenhouse gas emissions.
- The Law of Georgia on Environmental Responsibility was adopted in 2021.
- In 2023, the Law of Georgia on Water Resources Management was also enacted.
- The legislation on Ambient Air Protection has been aligned with European Union standards, facilitating a gradual transition to European practices for managing air quality within the country.
- The automated atmospheric air monitoring network has been enhanced.
- An electronic platform for documenting stationary sources and their annual emissions, accessible at emoe.gov.ge, has been established; information is made publicly available through the portal map.emoe.gov.ge.
- A draft law titled "On Soil Protection" has been developed, which integrates the existing laws on soil protection and the conservation, restoration, and enhancement of soil fertility.

12 The Fourth National Environmental Action Program of Georgia for 2022-2026. https://mepa.gov.ge/Ge/PublicInformation/34047

- The law concerning Windbreaks (Field Protection) Strips has been enacted.
- The identification of hot spots and factors contributing to land degradation has been undertaken nationwide, leading to the establishment of national land degradation targets by the National Working Group on the Neutral Balance of Land Degradation.
- The National Waste Management Strategy for Georgia has been revised, accompanied by an Action Plan for the years 2022-2026.
- Several existing protected areas have been enlarged, and new protected areas have been established.
- The network of internationally significant wetlands, recognized as Ramsar sites, has been expanded.
- The “Forest Code” has been adopted, reflecting internationally accepted principles of sustainable forest management and addressing contemporary approaches to forest management.
- To enhance forest accounting and monitoring, the inaugural national forest inventory has been conducted.
- The revised document of the “Nationally Determined Contribution” received approval in 2021.
- The 2030 Climate Change Strategy for Georgia was also approved in 2021.
- The Long-term Concept for Low-Emission Development was sanctioned in 2023.
- The hydrometeorological monitoring network has been expanded, and the processing of historical data is currently in progress, alongside field hydrometeorological and geological surveys aimed at identifying natural hazards.
- Additionally, various information systems and online platforms have been established, providing access to information on atmospheric air quality (air.gov.ge), forest-related data (atlas.mepa.gov.ge), and legislation concerning water management resources and basin management plans (wis.mepa.gov.ge).

1.1.8 ECONOMIC OVERVIEW

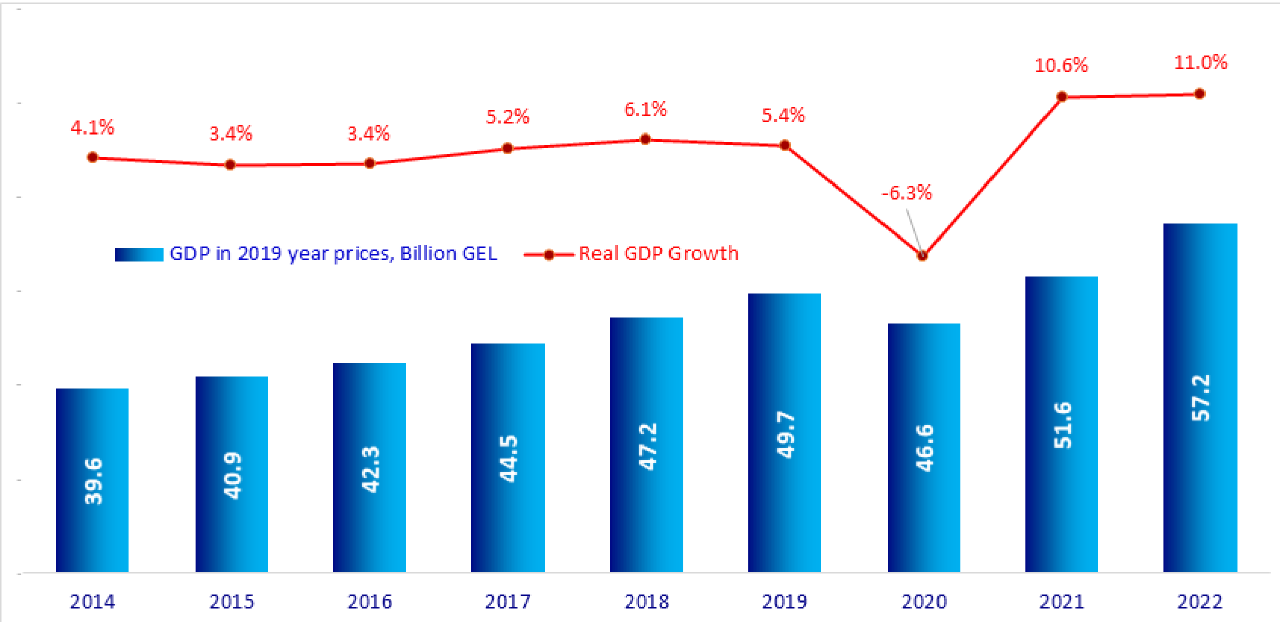
Macroeconomic Profile

Georgia’s advantageous position within the Caucasus region, coupled with its commitment to democratic development, plays a crucial role in shaping the country’s economic landscape. The country serves as a vital corridor for international transit between Europe and Asia. Key elements such as the transit of energy resources (including gas and oil pipelines and potential electricity transmission), the enhancement of railway infrastructure (specifically the railway line linking Asia and Europe), the development of land transport networks (including a transit highway), access to the Black Sea (through port facilities), and telecommunication advancements (such as fiber optic cables for high-speed internet) are pivotal for Georgia’s long-term economic growth. Consequently, Georgia is deeply integrated into global economic networks, engaging actively through both international platforms and bilateral trade agreements, not only with neighboring countries but also on a broader international scale. The country’s ambition to join the European Union and align with Western democratic alliances provides significant economic incentives for collaboration with these entities, thereby fostering market development.

Georgia adopts a liberal foreign trade policy characterized by streamlined trade regulations and customs processes, low import tariffs, and minimal non-tariff barriers. As a result, the country enjoys a free trade arrangement with the European Union, Turkey, all CIS nations, the People's Republic of China, and the European Free Trade Association. To enhance market access for European countries, a Deep and Comprehensive Free Trade Area (DCFTA) was established between the European Union and Georgia in 2014.

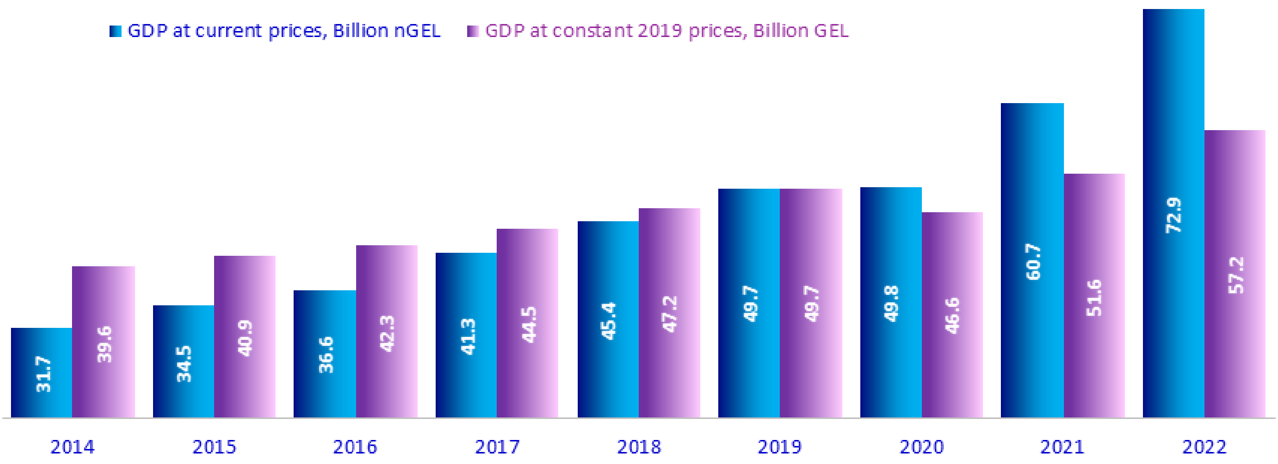
Over the past decade (2014-2023), Georgia has experienced an average annual GDP growth rate of 5.0%, significantly bolstered by double-digit growth in 2021-2022, despite a contraction of -6.3% in 2020 due to the pandemic (refer to Figure 1.4). During the 2014-2023 period, the GDP growth totaled 55% in constant 2019 prices.

FIGURE 1.1.4: REAL GDP IN CONSTANT 2019 PRICES AND REAL GDP GROWTH IN 2014-2022[13]



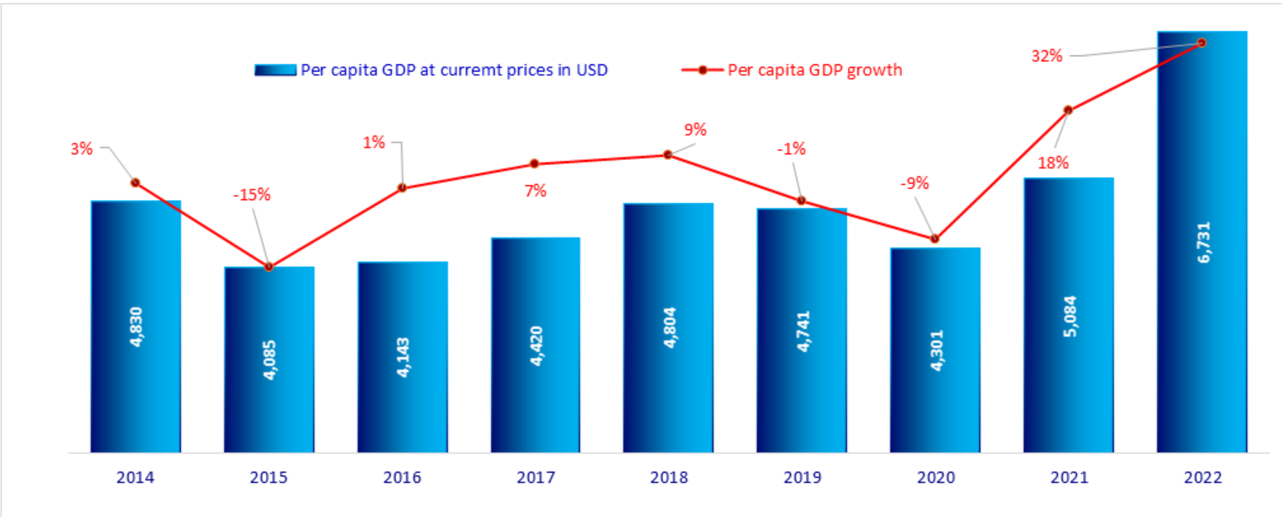
13 Electronic portal of the National Statistical Service https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

FIGURE 1.1.5: GDP IN CURRENT AND CONSTANT 2019 PRICES, 2014-2022[14]



GDP per capita has experienced substantial growth since the onset of the COVID pandemic. In 2021, it reached 5,084 USD, surpassing the pre-pandemic level of 4,804 USD recorded in 2018. The following year, this metric rose to 6,731.2 USD, reflecting a 33% increase, and in 2023, it further increased to 8,218.8 USD, marking a 22% rise. Consequently, as noted in the revised Nationally Determined Contribution (NDC) document of Georgia, the country is classified among developing, upper-middle-income nations within the context of a small, open, and transitional market economy[15].

FIGURE 1.1.6: GDP PER CAPITA IN CURRENT PRICES (US$) AND GDP GROWTH IN 2014-2022[16]



The allocation of 10% or more of GDP was observed across various economic sectors, with the following distributions: 15.6% attributed to "Wholesale and retail trade," 9.5% to "Manufacturing industry," and 10.2% to "Real estate related activities." Additionally, sectors

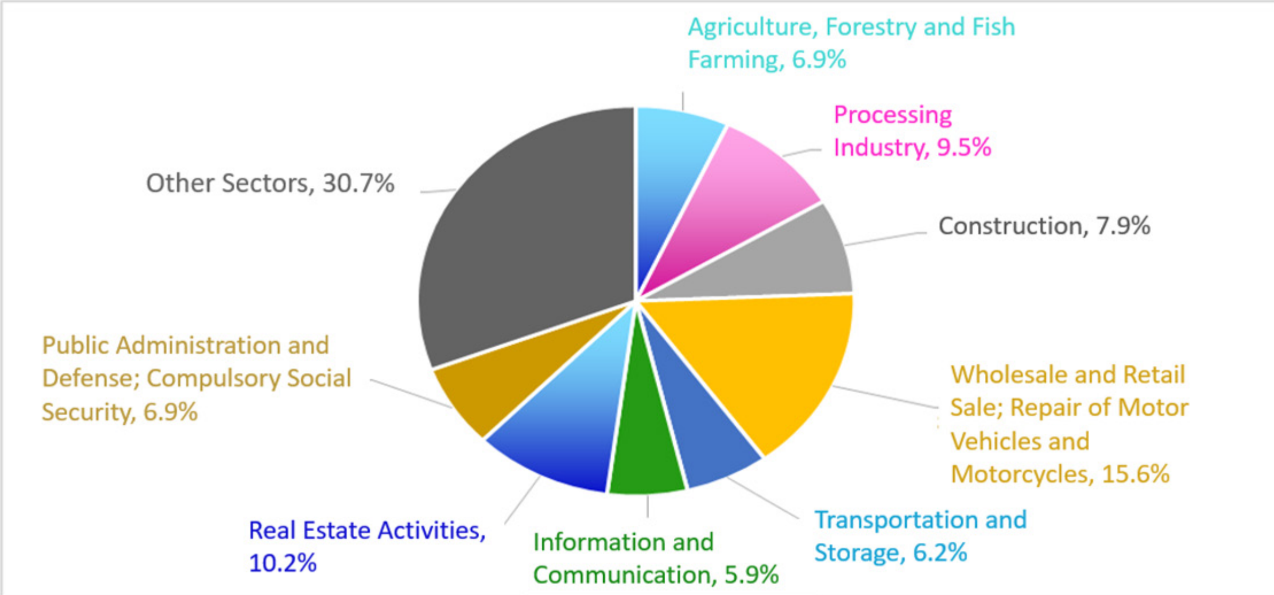
14 Electronic portal of the National Statistical Service https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

15 World Bank Grouphttps://civil.ge/archives/517755#:~:text=In%20line%20with%20those%20findings,the%20start%20of%20the%20decade.).

16 https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

with a share between 5% and 10% included: 7.9% for “Construction,” 6.9% for “Agriculture, forestry and fishing,” 6.2% for “Transport and storage,” and 6.9% for “Public administration and defense; compulsory social security” (refer to Figure 1.1.7). Furthermore, a retrospective analysis indicates that these economic activities exhibit a growth trend, particularly over a five-year horizon.

FIGURE 1.1.7: GDP BY TYPE OF ECONOMIC ACTIVITY, 2023[17]



In 2023, the total foreign trade turnover reached 21.690 billion USD, with imports constituting 71.9% (15.603 billion USD) and exports accounting for 28.1% (6.086 billion USD). The primary export commodities in 2022 included copper ores and concentrates (18.3% of total exports), re-exports of passenger vehicles (16.2%), ferroalloys (8.2%), wine and spirits (7%), fertilizers (5%), mineral and fresh water (2%), pharmaceuticals (2%), and nuts, predominantly hazelnuts (1.8%). The leading imports comprised passenger vehicles (12.7%), petroleum products (9.9%), copper ores and concentrates (5.7%), natural gas (3.4%), and pharmaceuticals (3%), along with “telephone sets, including those for cellular or other wireless networks” (2.4%) and calculating machines (1.4%). The remaining categories of imported goods each represented 1% or less.

Over the span of 18 years from 2000 to 2017, the average annual growth rate of greenhouse gas emissions was approximately 2.9%, increasing from 10,927 Gg CO2-eq to 17,766 Gg CO2-eq. There exists a strong correlation between the volume of emissions, real GDP, and the activities of high-emission sectors such as industry, energy supply, and agriculture. The last decade has seen a notable increase in the activities of these high-emission sectors, with their growth rate surpassing that of real GDP. Consequently, it is feasible to meet emission reduction targets while sustaining macroeconomic growth, provided that a transformation of emission-intensive economic activities is undertaken alongside the implementation of policies that promote energy efficiency and clean technologies.

The growth rate of emissions is linked to various factors, including demographics, investment levels, energy resource accessibility and consumption, and technology utilization. Georgia exemplifies this situation. Beyond the aforementioned elements, the fluctuations in

17 https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

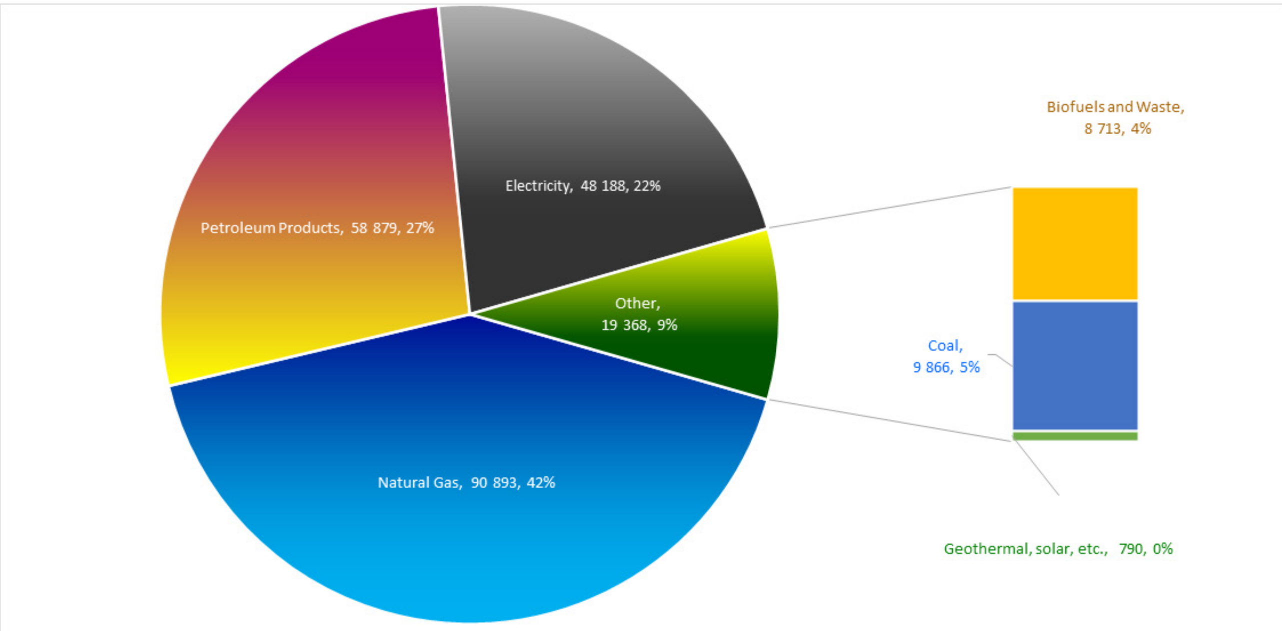
greenhouse gas emission trends can be attributed to numerous internal factors, such as economic downturns and unforeseen institutional changes, as well as external influences, including global crises, trade sanctions, economic turmoil in neighboring nations, and price volatility in the energy sector.

Energy

Over the last two decades, Georgia's energy sector has experienced a remarkable transformation. Notably, the security and sustainability of energy supply have seen significant enhancements, alongside crucial advancements in the development of internal grids and cross-border infrastructure, which have enabled Georgia to engage in regional electricity trading. Presently, ongoing reforms within Georgia's energy sector are focused on improving efficiency, competitiveness, and supply security by aligning with the EU energy regulatory framework.

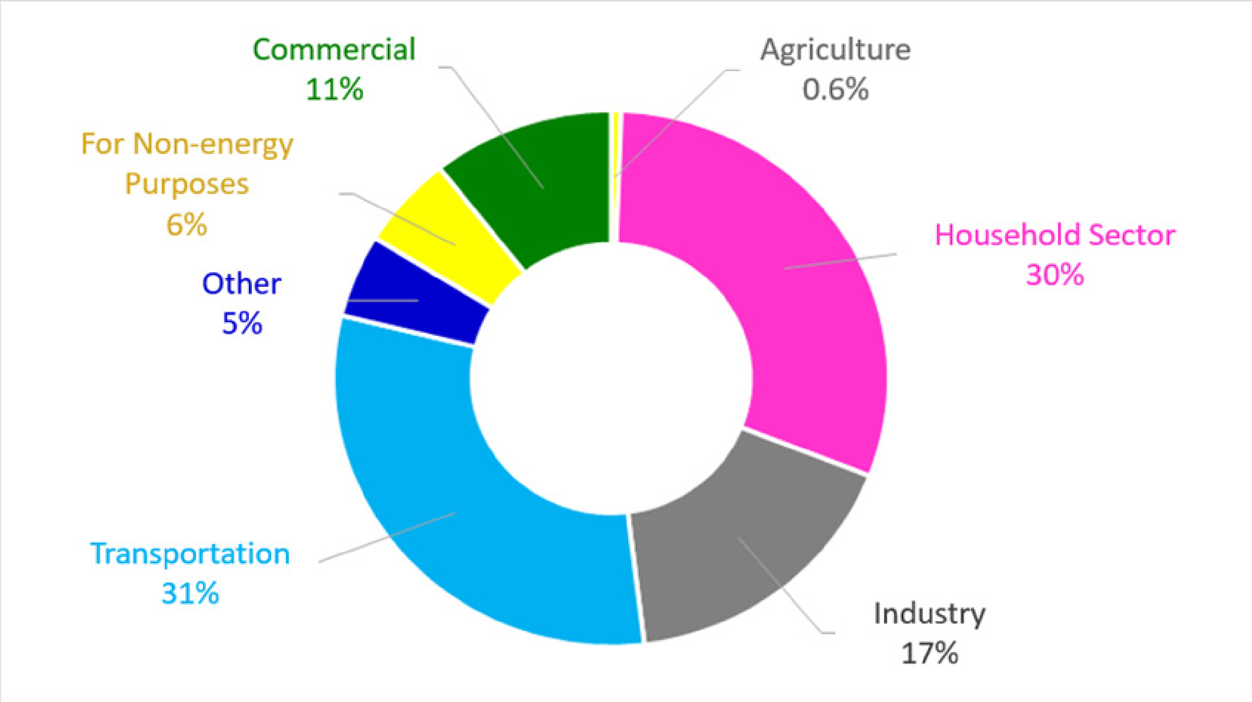
In 2022, Georgia's primary energy consumption reached 239,936 terajoules (TJ), with total final consumption at 217,328 TJ. The country's domestic energy resources primarily consist of hydropower, biomass, and a limited quantity of coal. Nearly all oil products and gas are imported, representing 68.9% of total final energy consumption. The majority of oil products are utilized in the transportation sector, while natural gas consumption spans industrial use, household needs, electricity generation, and transportation. Consequently, the nation remains heavily reliant on energy carriers sourced from abroad. The consistent supply of energy resources, coupled with price volatility, presents several challenges to the sustainable development of the country. Therefore, the central aim of the national energy policy is to enhance energy security and independence. To gradually diminish reliance on imported energy resources, state policy is directed towards the utilization of local energy sources and the diversification of supply sources and routes.

FIGURE 1.1.8: FINAL ENERGY CONSUMPTION BY SOURCE AND SECTOR IN 2022 (TJ)[18]



18 Aggregated energy balance of Georgia, 2022. https://www.geostat.ge/ka/single-archive/3403

FIGURE 1.1.9: FINAL ENERGY CONSUMPTION BY SECTOR IN 2022 (TJ)[19]



The largest share of energy consumption was distributed among households (31%), road transport (25%), private and public services (11%), and industrial iron and steel production (7%). The share of energy consumption of other economic activities was 5% or less.

TABLE 1.1: ENERGY CONSUMPTION BY ECONOMIC ACTIVITY IN 2022[20]

Field	Production sub-sector	Consumption, TJ	Share
Industry	Cast iron and steel	12,938	6%
	Chemical and petrochemical	4,758	2%
	Non-ferrous metals	-	-
	Non-metallic mineral products	7,745	4%
	Transport equipment	12	0%
	Machinery	106	0%
	Mining1	2,283	1%
	Food, Beverages and Tobacco	3,149	1%
	Pulp, Paper and Printing	228	0%
	Wood and Wood Products	30	0%
	Construction	4,602	2%
	Textiles and Leather	86	0%
	Other Industries	1,370	1%

19 Aggregated Energy Balance of Georgia, 2022. https://www.geostat.ge/ka/single-archive/3403
20 Aggregated Energy Balance of Georgia, 2022. https://www.geostat.ge/ka/single-archive/3403

Field	Production sub-sector	Consumption, TJ	Share
Transport	International Aviation	-	-
	Domestic Aviation	21	0%
	Road	54,061	25%
	Rail	797	0%
	Inland Waterway	14	0%
	Pipeline Transport	11,771	5%
	Other	31	0%
Other	Private and public services	23,069	11%
	Households	65,969	30%
	Agriculture, forestry and fishing	1,239	1%
	Other	10,903	5%
For non-energy purposes	Transformation sector	-	-
	Energy sector	18	0%
	Transport sector	860	0%
	Industry sector	11,267	5%
	Other	1	0%

To enhance the effectiveness of energy policy, substantial advancements have been made in the transmission and distribution systems for natural gas and electricity. To guarantee a continuous supply of gas, further research is being conducted to establish a gas storage facility with a capacity ranging from 210 to 280 million cubic meters. Additionally, efforts are ongoing to gasify various regions and to implement planned initiatives aimed at utilizing renewable energy sources and improving energy efficiency.

In 2017, Georgia became a member state of the European Energy Community, which initiated a phased process of aligning its national energy regulatory framework with EU legislation.

The Parliament of Georgia adopted a number of energy-related laws: in 2019 - "On Energy and Water Supply"[21] and "On Energy Labeling"[22], In 2020, "On Energy Efficiency"[23], "On the Energy Efficiency of Buildings"[24], and "On the Promotion of the Production and Use of Energy from Renewable Sources"[25].

In 2019, the Government of Georgia enacted an energy efficiency policy by approving the "National Energy Efficiency Action Plan 2019-2020" through Decree No. 2680. Subsequently, in 2020, the government also endorsed the "National Renewable Energy Action Plan until 2020." Additionally, the government resolutions included the approval of the "National Methodology for Calculating the Energy Efficiency of Buildings" and the "Minimum Energy Efficiency Requirements for Buildings, Parts of Buildings, or Building Elements."

By 2023, the development of the "State Energy Policy Document of Georgia" and its

21 https://www.matsne.gov.ge/ka/document/view/4747785?publication=8
22 https://matsne.gov.ge/ka/document/view/4745123?publication=1
23 https://matsne.gov.ge/ka/document/view/4873938?publication=0
24 https://www.matsne.gov.ge/ka/document/view/4873932?publication=1
25 https://www.matsne.gov.ge/ka/document/view/4737753?publication=1

accompanying annex, the “National Integrated Energy and Climate Plan,” was finalized. This document received approval on June 27, 2024.

Climate change exerts a considerable influence on the overall economy of Georgia, with the energy sector being particularly susceptible due to its reliance on hydropower for local electricity generation. The challenges faced by this sector are exacerbated by rising average temperatures, accelerated glacier melting, and an increase in natural disasters. Furthermore, as living standards improve, energy consumption rises, driven by greater technology use and the need to counteract the adverse effects of climate change, such as increased energy demands for heating and cooling. This situation necessitates the implementation of renewable energy policies and the adoption of energy-saving technologies, requiring collaborative efforts between the state and the private sector.

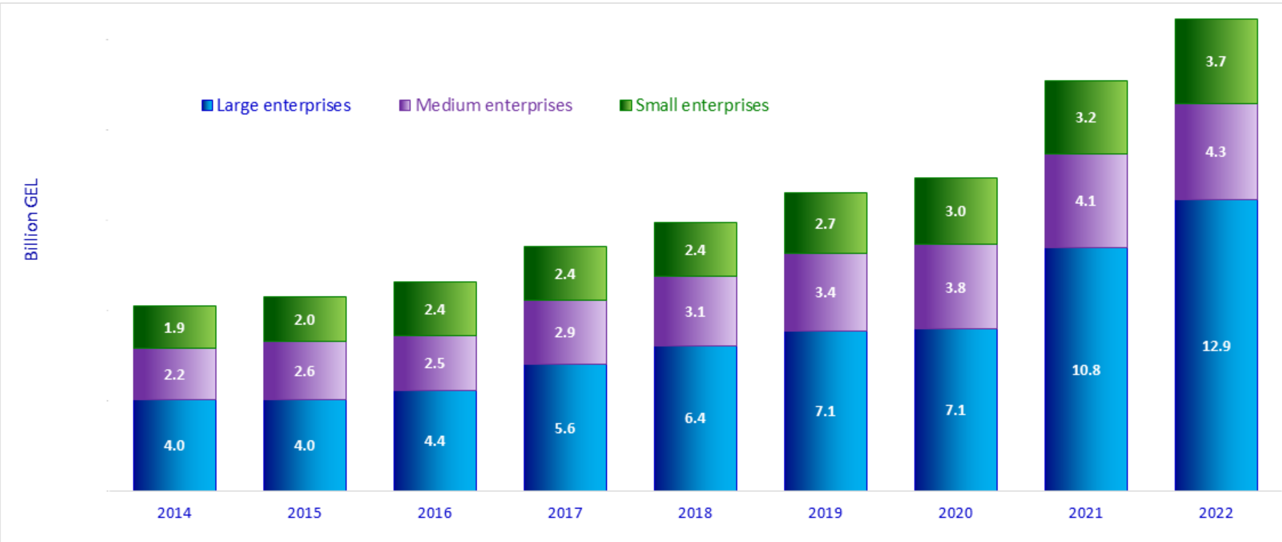
Industry

- In the initial ten years following Georgia’s restoration of independence, the majority of post-Soviet industrial production came to a complete halt, resulting in a significant decline in industrial output. However, over the last twenty years, a consistent upward trend in production has been observed. Official statistics indicate that production output in 2022 rose to 20.9 billion GEL, representing a 4.8-fold increase compared to 2010. The sector’s annual output has consistently demonstrated positive growth, predominantly in double digits, with a minimum increase of 5%, even amidst the challenges posed by the pandemic. The average annual growth rate over the past decade stands at 12%.

FIGURE 1.1.10: OUTPUT IN INDUSTRY[26]

The value added by the Industrial sector has demonstrated a consistent upward trajectory. In spite of the difficulties presented by the pandemic, this metric sustained a favorable trend, culminating in 8.2 billion GEL in 2022, with an average annual growth rate of 13% from 2013 to 2022. Furthermore, the distribution of this added value was as follows: 68% was allocated to large enterprises, 17% to medium-sized enterprises, and the remaining 15% to small enterprises (refer to Figure 1.1.11).

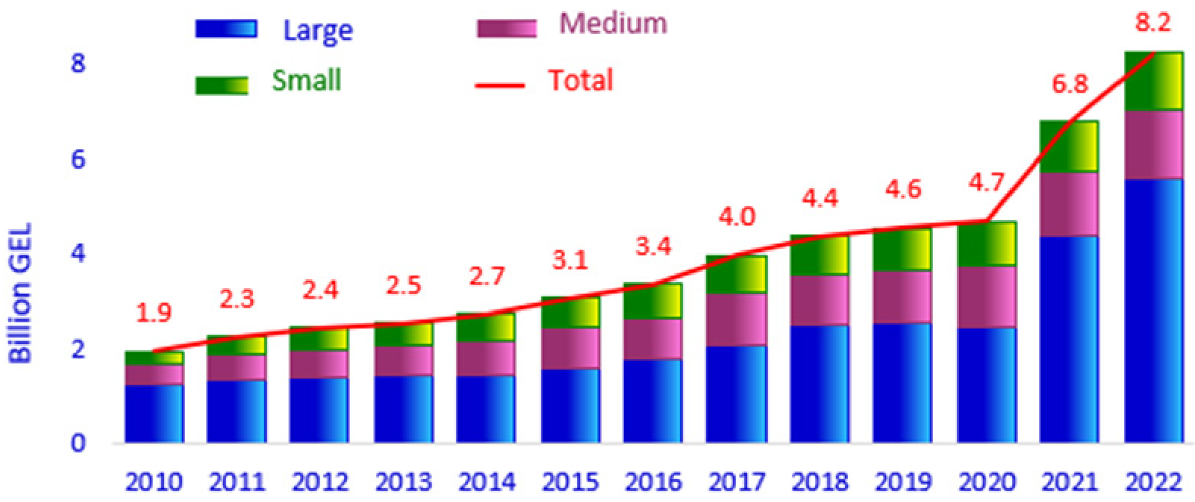
FIGURE 1.1.11: VALUE ADDED IN INDUSTRY BY ENTERPRISE SIZE IN 2010-2022, BILLION GEL[27]



26 Production in industry.https://www.geostat.ge/ka/modules/categories/77/mretsveloba

27 Prepared according to data from the electronic portal of the National Statistics Service. https://www.geostat.ge/ka/modules/categories/77/mretsveloba

FIGURE 1.1.12 INDUSTRIAL TURNOVER BY ENTERPRISE SIZE IN 2014-2022

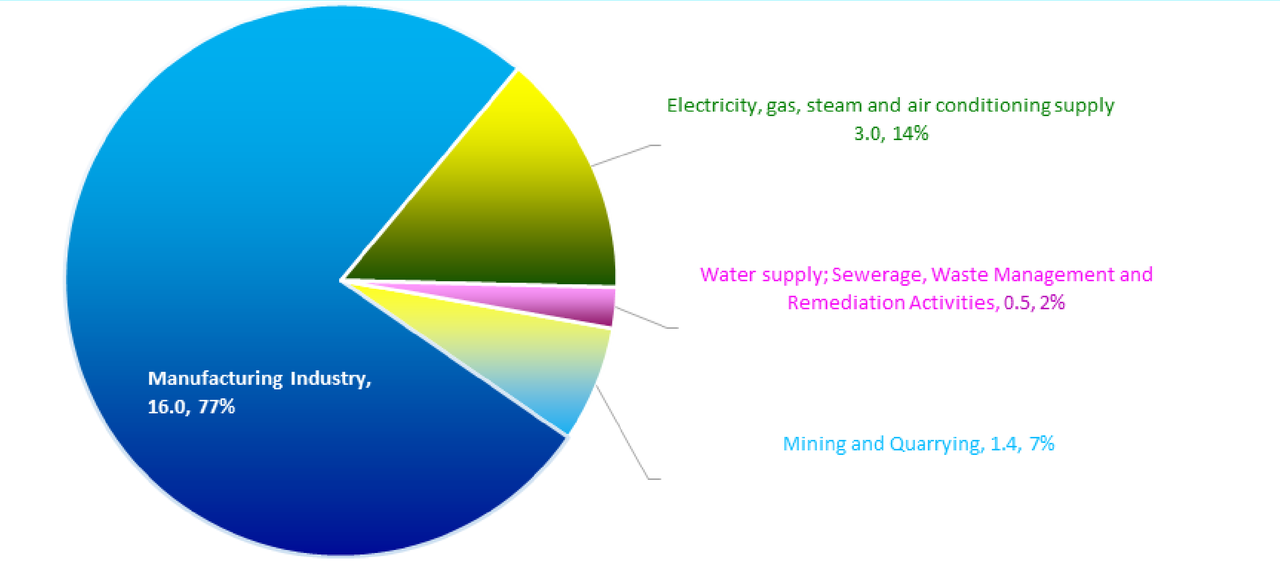


In 2022, the distribution of output within the industrial sector by type of economic activity revealed that 77% was attributed to the "manufacturing industry," 14% to "electricity, gas, steam, and air conditioning supply," 7% to "mining and quarrying," and 2% to "water supply, sewage, waste management, and remediation activities" (refer to Figure 1.1.13). Within the manufacturing industry, the largest proportions were represented by the following subcategories: "manufacturing of food products" (20%), "manufacturing of beverages" (19%), "manufacturing of basic metals" (17%), "manufacturing of other non-metallic mineral products" (12%), and "manufacturing of chemicals and chemical products" (7%). The remaining subcategories are relatively minor, each contributing less than 5% to the overall manufacturing output. A review of official statistics over the past decade, expressed in percentages, indicates a largely consistent distribution, barring temporary fluctuations due to the pandemic. Additionally, it is noteworthy that in 2022, the leading exports from Georgia included ferroalloys and fertilizers.

In 2018, compared to 2012, the competitiveness index of Georgia's industry improved by 4 points and ranks 96th.[28]. However, despite the improvement index, the competitiveness of the industrial sector remains limited.

28 Competitive Industrial Performance Report 2020, https://stat.unido.org/content/publications/competitive-industrial-performance-report-2020

FIGURE 1.1.13: INDUSTRIAL OUTPUT BY TYPE OF ECONOMIC ACTIVITY IN 2022 (BILLION GEL)[29]



The development of the processing industry is significantly related to greenhouse gas emissions. Considering the peculiarities of the distribution of subcategories of the processing industry and the profile of industrial or energy-intensive activities related to their emissions, great importance is attached to the introduction of new relatively clean and resource-saving technologies, which should somewhat reduce the expected emission indicators. At present, significant efforts need to be made in these areas and certain works are underway by the government. With the support of donors, the introduction of energy-efficient technologies in energy-intensive industries is being promoted in various ways - preferential loans and grants for the re-equipment of enterprises, technology transfer for the introduction of low-emission practices. For example, with the support of donors, JSC “Rustavi Nitrogen” is implementing measures to reduce N2O emissions from nitric acid production.[30].

A further challenge lies in the inadequately trained workforce, which poses a considerable barrier to the advancement of the sector. Moreover, there is a lack of foreign direct investment in the industrial sector aimed at low-carbon development. Consequently, an increase in the sector’s production may result in heightened greenhouse gas emissions.

To address these challenges, it is essential to enhance efforts related to the measures and initiatives that support the industrial sector. This includes the introduction of competitive climate-smart market practices, the promotion of climate-friendly small and medium-sized enterprises, the exploration of international markets that demand products utilizing clean technologies, and the attraction of international investments.

The state climate policy, aimed at reducing and managing the necessary levels of industrial emissions as outlined by Georgia, identifies the following long-term priorities[31]:

- Implementation of energy-saving appliances and advancement of technological innovations;

29 Industrial output by type of economic activity in 2022 https://www.geostat.ge/ka/modules/categories/77/mretsveloba

30 JSC “Rustavi Azoti” is a member of the Nitric Acid Climate Action Group (NACAG).

31 Nationally Determined Contribution, p. 31. https://mepa.gov.ge/Ge/Files/ViewFile/50125

- Utilization of renewable energy sources;
- Dissemination of cutting-edge technologies and expertise.

Transport

The economic activity related to transport and warehousing in Georgia is experiencing significant growth. Official statistics indicate that in 2022, the sector's contribution to GDP rose 2.9 times compared to 2010, increasing from 1,415.8 billion GEL to 4,109 billion GEL. Concurrently, the output of enterprises involved in transport and warehousing activities tripled, reaching 6.9 billion GEL. From 2010 to 2022, the average annual growth rate of the transport sector's contribution to GDP was 10.0%, notwithstanding a decline of 4.4% in 2020 due to the pandemic, which was subsequently offset by robust double-digit growth rates in 2021 and 2022[32].

Georgia, benefiting from advantageous geographical and geopolitical circumstances, serves a crucial transit role as a junction linking Europe to Asia and the North to the South. Consequently, for the strategic advancement of the nation, the enhancement and prioritization of transport infrastructure and policies are essential for ensuring the country's sustainable development. The progress of neighboring nations is also closely tied to the evolution of transport systems within Georgia. As a result, there is considerable interest from these countries in engaging with initiatives across various transport modalities, including rail, road, air, maritime, and pipeline sectors. The demand for services related to transportation, as well as for internationally recognized and developed services, is on the rise. Thus, the advancement of the transport sector stands as a primary focus for the Georgian government, which is actively implementing several large-scale projects and initiatives. On August 15, 2023, the government ratified the "National Transport and Logistics Strategy of Georgia for 2023-2030,"[33] outlining the current transport landscape and future development vision. This strategic vision aims to position Georgia as a regional transport and logistics hub, with three principal objectives: 1. Enhancing the efficiency and competitiveness of the logistics sector; 2. Fostering human capital development; and 3. Promoting sustainable growth in transport sectors, along with secure connections and corridors.

The modernization of infrastructure, the streamlining of customs processes, and the liberalization of services in critical economic sectors have significantly bolstered the country's transit and logistics capabilities, thereby enhancing its international connections with global markets.

To effectively harness Georgia's transit potential and enhance mobility, it is essential to develop new infrastructure and upgrade existing facilities to meet contemporary standards. This endeavor must consider the country's challenging topography and diverse climatic conditions, alongside the potential adverse effects of climate change. The increasing frequency of geological, hydrological, and other natural disasters due to climate change poses significant threats to transport infrastructure and the overall provision of safe and reliable transport services. Consequently, to mitigate the infrastructure's vulnerability, the

32 Source: Geostat.ge, statistical information, national accounts, gross domestic product (GDP), https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

33 Resolution of the Government of Georgia #315, 2023. https://matsne.gov.ge/ka/document/view/5895599?publication=0

adoption of modern engineering solutions has become imperative. While these solutions necessitate additional time and financial investment for large-scale projects, they significantly diminish the likelihood of losses resulting from disasters. These initiatives are being executed with the robust financial and technical support of various donors, ensuring adherence to both international and national environmental standards.

At present, several major transport infrastructure projects are in progress in Georgia: 1) The construction of the East-West Motorway is underway, with over 70% of the route already open to traffic. A total of 302 kilometers have been completed, and work is ongoing on an additional 35 kilometers, with a target completion date set for 2030, ultimately achieving the planned 430 kilometers. In 2024, the primary construction activities for the most challenging section, the Rikoti segment of the motorway, were finalized, allowing transport to utilize 48 kilometers of this section, which comprises a total of 88 bridges and 89 tunnels.

2) The modernization of the railway involves the development of extensive infrastructure along the Tbilisi-Makhinjauri railway segment, aimed at enhancing cargo capacity from 27 million tons to 48 million tons annually, with the potential to reach 100 million tons per year. Currently, 96% of the project has been completed. Additionally, the establishment of the new Baku-Tbilisi-Kars railway is underway, which seeks to provide an alternative rail connection between Asia and Europe. 3) The expansion of airports has also been a priority; by 2021, the airports in Tbilisi, Batumi, and Kutaisi underwent significant expansions, resulting in a substantial increase in passenger capacity. 4) The Poti port is being expanded, and efforts are being made to attract investors for the construction of the Anaklia deep-sea port.

In addition, legislative approximation with the EU in the field of transport continues as a priority part of Georgia's European integration process. For example, in order to implement the latest standard developed by the International Civil Aviation Organization (ICAO), a draft legislative initiative is being prepared, which will concern the monitoring of carbon dioxide emissions from international flights by air carriers registered in Georgia. In addition, work continues on reforming the regulatory framework of the railway transport sector, including the reform of Georgian Railways in accordance with EU requirements (functional separation into independent companies), which will increase the development opportunities of the sector and the safety of railway transport operations; all seaports will be digitalized; modernization of the Georgian State Register of Ships and other measures are planned, which will significantly improve the quality of services in the sector.

The Georgian government continues to stimulate the "open skies" policy in the field of civil aviation, with the aim of attracting new airlines to the Georgian market, new direct air routes, increasing flight intensity and geographical area, and increasing the accessibility of air transport.

In addition to the above-mentioned planned measures, the central government, as well as local governments, are pursuing an active policy for the introduction of environmentally friendly innovative technologies.

The proportion of greenhouse gas emissions attributed to road transport exceeds 90% of the total emissions from the transportation sector. This considerable contribution to transport emissions is primarily a result of the aging vehicle fleet. In 2022, vehicles older than 10 years constituted 83% of registered cars, a figure that, while showing a decline from 87% in 2019, remains notably high. Additionally, there has been a discernible trend towards the adoption of clean energy within road transport. Data from 2022 indicates that electric vehicles represent a mere 0.2% of the market; however, the presence of low-emission vehicles is on the rise, largely due to the influx of hybrid cars. In 2022, hybrid vehicles accounted for 7.3% of the registered car fleet in the country[34].

The central government is actively promoting the importation of electric, hybrid, and new vehicles. To mitigate the prevalence of older vehicles, a ban on the import of passenger cars that do not meet the Euro 5 standard has been implemented since 2024. This restriction will extend to trucks and other vehicle categories starting in 2025. Additionally, the enforcement of technical inspections for vehicles has been strengthened, incorporating a road control component into the existing system. The standards for imported fuel are being elevated, and the mechanisms for enforcement are being enhanced.

Local governments, many of which are participants in the Covenant of Mayors, are diligently modernizing public transportation with an emphasis on clean technologies. For instance, Tbilisi has upgraded its public transport fleet to include buses that meet the Euro 6 standard, while Batumi has introduced electric buses to replace some of its older models. To promote the use of electric vehicles in Tbilisi, the city has established free charging stations for electric vehicles. Furthermore, the use of bicycles and public transport is encouraged through the creation of dedicated bicycle paths and bus lanes. The promotion of alternative electric vehicles, such as rental electric scooters and mopeds, is also being prioritized. Consequently, there has been a notable increase in the registration of hybrid and electric vehicles in Georgia, attributed to their cost-effectiveness and the benefits provided by the state.

The objective of Georgia's Long-Term Low Emission Development Strategy is to attain climate neutrality by the year 2050. To this end, significant measures must be implemented within the transportation sector. The government has outlined key long-term priorities[35]:

- Complete utilization of the region's transit capabilities
- Enhancement of transportation infrastructure
- Establishment of logistics hubs and value-added services
- Elevation of safety and service standards
- Advancement of pedestrian and cycling pathways
- Boosting the effectiveness of rail passenger transport
- Promotion of biodiesel production

Agriculture

The advancement of domestic agricultural production is a critical factor for a nation to achieve self-sufficiency in food products, thereby enhancing food security. A significant portion of essential agricultural goods is imported; for instance, the self-sufficiency rate

34 National Statistical Office,https://automobile.geostat.ge/ka/

35 Long-term Concept for Low-Emission Development of Georgia, p.84https://faolex.fao.org/docs/pdf/geo216936.pdfhttps://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

for wheat stands at merely 22%, while meat accounts for 50%, and oil and sugar are predominantly sourced from abroad. This reliance on imports renders the country's food security vulnerable to fluctuations in the global market, affecting both supply and pricing. The restrictions enacted during the pandemic, along with the protectionist measures or other intentional policies adopted by certain nations (such as bans, quotas, and tariffs), have underscored the necessity for local production and processing of key agricultural products to ensure uninterrupted supply and reasonable prices. Consequently, the government has introduced various incentives within the agri-food sector to foster the development of the value chain, with a particular focus on promoting the utilization of agricultural land and the establishment of greenhouse farms.

The agricultural sector faces significant challenges, including land fragmentation, insufficient capital, a lack of farmers' familiarity with modern technologies, limited agricultural services, and other contributing factors. Addressing these challenges is essential for the sector's continued growth, enhancing the efficiency of agricultural production, and minimizing greenhouse gas emissions.

The economic activities of agriculture, forestry, and fisheries in Georgia have demonstrated growth over a ten-year period, despite experiencing negative trends in certain years, specifically 2012 and 2016-2017. Official statistics indicate that by 2022, total production output had increased 2.3 times compared to 2010, reaching 7.4 billion GEL. From 2010 to 2022, the average annual GDP growth rate in this sector was 8.2%. Notably, after 2018, this sector continued to exhibit positive growth even during the pandemic, with some years witnessing growth rates surpassing double digits, specifically 12.5% in 2020 and 10.1% in 2022[36].

The sustainable advancement of agriculture amid the challenges posed by climate change represents a critical issue for Georgia. The promotion of climate-smart agricultural practices is a key priority for the government, given its direct connection to food security, as well as the mitigation and adaptation to climate change. In 2019, the Government of Georgia endorsed the "Agriculture and Rural Development Strategy of Georgia 2021-2027[37]. This strategy clearly outlines environmental protection and climate change challenges. Among its three primary objectives, the second focuses on climate change, specifically emphasizing the "Sustainable use of natural resources, preservation of ecosystems, adaptation to climate change." This objective encompasses various initiatives, including the promotion of environmentally friendly and climate-resilient agricultural practices, the advancement of bio/organic production, the encouragement of ecotourism development, the sustainable management of forest resources, the adoption of energy-efficient and renewable energy technologies, and the preservation of agrobiodiversity.

A variety of initiatives are currently being executed as part of the sustainable agricultural development policy. These initiatives include the expansion of agricultural land designated for reclamation, the adoption of water-efficient irrigation technologies, and efforts to restore and enhance soil fertility. Additionally, there are ongoing research projects focused on the restoration of windbreaks and the enhancement of the relevant regulatory framework. The creation of new protected areas, along with the improvement of management practices for existing ones, is also a priority. Furthermore, there is a

36 https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp

37 Resolution of the Government of Georgia #2665 https://www.gov.ge/files/524_74660_648714_2665.pdf

push to promote ecotourism, implement sustainable forest management practices, and safeguard agrobiodiversity through necessary research and actions. The development of a hydrometeorological observation network, along with the modeling and establishment of a national early warning system, aims to prevent or mitigate the impacts of natural disasters linked to climate change. Efforts are also being made to enhance the systems for recording, monitoring, and assessing the quality of air, water, and soil, as well as to implement an integrated water resources management system grounded in sustainable and basin management principles.

It is important to highlight the state policy focused on enhancing the development of cold storage facilities, which has produced notable outcomes. Specifically, during the period from 2014 to 2016, the total number of cold storage facilities remained below 60 units. However, by 2022, there was a sixfold increase in the number of operational cold storage facilities compared to 2017, reaching a total of 333 units[38].. This has greatly enhanced the practices surrounding the proper storage and continuous supply of various agricultural products. Consequently, this improvement has positively influenced the quality of these primary agricultural products available in the market, leading to an overall increase in total output. Such advancements are vital for ensuring the ongoing development of the sector and its adaptation to climate change. In 2023, the Georgian Refrigeration and Logistics Association was granted the authority to implement the professional retraining program titled "Cold Chain Management." This initiative was executed with the co-financing of the Professional Skills Agency, resulting in the training of ten individuals.

The agricultural sector is gradually recognizing the needs and opportunities for the advancement of high technologies. To enhance accessibility and streamline production processes, ongoing support for entrepreneurs is being provided. Furthermore, it is essential to address the low level of awareness among farmers regarding climate-smart agriculture and the implications of climate change.

The revised Nationally Determined Contributions (NDC) document emphasizes the necessity of developing low-carbon strategies within the agricultural sector by promoting climate-smart agricultural practices and agritourism. The adoption of new technologies and innovations is critical for the sector's growth and should encompass[39]: halting the degradation of agricultural lands, restoring them, and enhancing their efficiency; boosting the yield of agricultural crops, intensifying their processing, and achieving market and export standards; modernizing manure processing techniques; increasing the production of dairy and beef cattle; and expanding and technologically upgrading the processing and production of dairy and meat products.

Tourism

Tourism, recognized as one of the most rapidly expanding sectors of the economy, is a key focus for the economic advancement of Georgia. In this context, the Government of Georgia is committed to enhancing the country's tourism potential, which is evident in the development of specialized tourism infrastructure and services. Furthermore, Georgia engages in active marketing of its tourism offerings, facilitating the attraction of tourists and investments from targeted markets, thereby increasing overall demand and necessary

38 https://www.geostat.ge/ka/search?query=სასაკლაოები&page=1

39 Long-term concept of low-income development of Georgia p. 97-88. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

investments, and ultimately fostering sector growth. The government collaborates closely with the private sector to assess the needs of the industry and provide suitable support.

The tourism sector experienced considerable setbacks during the COVID-19 pandemic; however, the partnership between the government and private enterprises has strengthened in various domains. Through collaborative efforts, several initiatives were successfully implemented, such as the establishment of isolation facilities and loan deferrals, in conjunction with accommodation and other tourism-related businesses, to effectively address the challenges posed by COVID-19 and alleviate its adverse effects. In the aftermath of the pandemic, tourism began to rebound swiftly in 2022, with international visitor arrivals reaching 4.7 million and the proportion of foreign visitor expenditure in total output rising to 8%.

The swift recovery of tourism was evident in economic metrics rather than visitor numbers. Specifically, travel receipts for the third quarter of 2023 amounted to USD 3.25 billion, surpassing the figures from the same period in 2019 by 25.9%. However, the number of visitors in 2023 (during the first three quarters) decreased by 23% compared to the corresponding time frame in 2019.

1.2 NATIONAL CLIMATE CHANGE POLICY

The principal document outlining Georgia's climate change policy is the Nationally Determined Contribution (NDC), developed in accordance with the Paris Agreement under the United Nations Framework Convention on Climate Change. This document establishes the country's objectives for greenhouse gas reduction and climate change adaptation through the year 2030. As per Georgia's NDC, the country aims to achieve an unconditional reduction of greenhouse gas emissions by 35% relative to 1990 levels by 2030. Should additional financial and other resources be secured, this target may be elevated to a range of 50-57%. The NDC also specifies sectoral targets for emission reductions. In the energy sector, which encompasses energy generation and transmission, Georgia intends to lower emissions by 15% compared to the baseline scenario projections. The transport sector is also set to achieve a 15% reduction, while the industrial sector aims for a 5% decrease. Although no specific targets have been established for the buildings, agriculture, and waste sectors, efforts will be made to reduce emissions through the promotion of climate-smart and innovative technologies and approaches. The forestry sector is recognized as a crucial element in the overall emission reduction strategy, with plans to enhance its carbon absorption capacity by 10% by 2030 compared to the 2015 baseline. It is important to note that this commitment from the forestry sector is supplementary and not included in the 35% national emission reduction target.

In 2022, following discussions among the Energy Community, the European Commission, and the Government of Georgia, the country updated its greenhouse gas reduction target for 2030. The revised target now aims for a 47% reduction in greenhouse gas emissions (including land use, land-use change, and forestry (LULUCF)), compared to 1990 levels. This new target will be incorporated into the updated NDC document, which is scheduled for submission to the Convention in 2025.

Simultaneously with the decrease of greenhouse gas emissions, adaptation constitutes a crucial element in the battle against climate change. In this context, the Nationally Determined Contributions (NDC) document outlines the sectors and natural resources in Georgia that are most susceptible to the impacts of climate change. These include mountain ecosystems, tourism (particularly vulnerable winter and summer resorts), agricultural production, surface and groundwater resources, the forestry sector, biodiversity, and human health.

A significant influence on shaping the country's climate change policy is exerted by:

- The Association Agreement established between the European Union and Georgia in 2014 seeks, among other objectives, to align national regulatory frameworks concerning climate and energy. It also focuses on collaboration in the fields of climate change mitigation and adaptation, carbon trading, and the research, development, demonstration, deployment, and dissemination of relevant technologies. Furthermore, the agreement underscores the importance of formulating a National Adaptation Plan (NAP), a Long-Term Low Emission Development Strategy (LT-LEDS), and incorporating climate-related considerations into various sectoral policies.
- The Treaty that establishes the Energy Community, as part of the Clean Energy Package, mandates Georgia to formulate an Integrated National Energy and Climate Plan (NECP) for the period spanning 2021 to 2030. The NECP serves as a crucial tool in the domains of energy and climate, aimed at achieving decarbonization, enhancing energy efficiency, promoting the adoption of renewable energy sources, advancing the energy market, ensuring energy security, and fostering research, innovation, and competitiveness. Furthermore, Georgia is required to align its policies with EU energy legislation. This requirement has been largely met, thereby creating significant conditions for the advancement and execution of climate policy.
- The Covenant of Mayors for Climate and Energy (hereafter referred to as the "Covenant of Mayors") advocates for the establishment of climate change policies at the local level through the development and execution of sustainable energy and climate action plans. At present, 32 municipalities in Georgia are participants in the Covenant of Mayors, pledging to achieve a 30% reduction in greenhouse gas emissions by the year 2030[40].

1.2.1 CLIMATE CHANGE MITIGATION GOALS, PRIORITIES AND CONTEXT

- The mechanisms through which Georgia aims to fulfill its international obligations regarding climate change mitigation consist of four principal national documents:
- "Georgia's Climate Change Strategy 2030 and Action Plan 2021-2023" - adopted in 2021
- "Georgia's Climate Change Strategy 2030 and Action Plan 2024-2025" - adopted in 2024
- DGGC/LT-LEDS - adopted in 2023
- "Georgia's National Integrated Energy and Climate Plan 2021-2030" - scheduled for adoption by the end of 2024

40 https://eu-mayors.ec.europa.eu/en/signatories

- “Fourth National Environmental Action Program 2022-2026” - adopted in 2022

At the local level, the Sustainable Energy Action Plan (SEAP) serves as the principal document for self-governing units that are part of the Covenant of Mayors.

The “Georgia’s Climate Change Strategy 2030 and Action Plan 2021-2023” articulates a long-term vision aimed at reducing greenhouse gas emissions by 2030. It delineates Nationally Determined Contribution (NDC) targets by sector, highlights priority areas, and establishes a comprehensive list of specific measures, which will undergo updates every three years. An Action Plan for the period 2024-2025 has also been formulated.

The Long-Term Low Emission Development Strategy (LT-LEDS) evaluates the spectrum of national greenhouse gas emissions and removals, thereby crafting Georgia’s vision for 2050. Through an analysis of anticipated emission trends, the document assesses the feasibility of achieving climate neutrality and identifies additional potential mitigation areas. Furthermore, it estimates the investment required across various sectors to attain climate neutrality by 2050. The total investment needed is projected to be around USD 50.5 billion under the With Existing Measures Scenario (WEMs) and USD 78 billion under the With Additional Measures Scenario (WAMs). Notably, the transport sector emerges as the most capital-intensive area for achieving mitigation objectives, requiring USD 44 billion in the WEMs (87% of the total) and USD 70.1 billion in the WAMs. The strategy also outlines potential measures, including both planned and additional actions.

1. Box 1: Key Focus Areas of the Long-Term Low-Emission Development Strategy by Sector

In the energy sector, the emphasis is on the extensive construction and advancement of renewable energy generation facilities. This includes a substantial increase in the contribution of renewable energy to the overall energy mix, the execution of comprehensive energy efficiency initiatives within the building sector, and the promotion of energy-efficient technologies across existing industries. Additionally, efforts will be made to secure further investments for the adoption of low-carbon technologies. Energy efficiency measures will also be implemented in various economic sectors to decrease the reliance on natural gas. Furthermore, the establishment of a supervisory control and data acquisition system for transmission networks, along with a production information management system, is essential, as is the mitigation of methane emissions from coal mines.

In the building sector, the focus will be on achieving optimal thermal insulation for structures and incorporating renewable energy solutions such as photovoltaic panels, domestic hot water systems, and heat pumps.

In the transport sector, efforts are focused on enhancing the efficiency of rail passenger transport, promoting biodiesel production, transforming urban road systems through technology, implementing smart technologies and artificial intelligence in transport systems, and boosting the sales of hybrid and fuel cell vehicles.

In the industrial sector, initiatives aim to support the adoption of energy-efficient machinery and equipment, promote the use of alternative energy sources, and facilitate the transfer of innovative technologies and expertise, particularly in low-carbon solutions.

In the agricultural sector, strategies are directed towards minimizing methane emissions from enteric fermentation and manure management, as well as reducing both direct and indirect nitrous oxide emissions from agricultural soils.

In the land use, land use change, and forests sector, the focus is on maintaining and enhancing the quality and quantity of forests, restoring degraded soils, and implementing sustainable pasture management practices.

In the waste sector, the emphasis is on increasing methane capture from regional landfills and new wastewater treatment facilities, expanding composting efforts, removing nitrogen from wastewater sludge, and utilizing municipal solid waste for energy recovery, particularly in cement production.

The National Energy and Climate Plan (NECP) outlines targeted initiatives aimed at enhancing energy security, reducing greenhouse gas emissions, improving energy efficiency, fostering innovation and competitiveness within the energy sector, and regulating energy demand. This document is thorough, and the measures for reducing greenhouse gas emissions and enhancing energy efficiency are consistent with the international obligations established in the Nationally Determined Contributions (NDC) document, as well as the Climate Change Strategy and Action Plan. Box 2 delineates the priority areas and objectives of the NECP.

Box 2: Key Priorities and Objectives of Georgia's National Integrated Energy and Climate Plan

To fulfill the commitments outlined in the "Nationally Determined Contribution," the strategies articulated in this document aim to elevate the proportion of renewable energy in Georgia's total final energy consumption to 27.4% by the year 2030, compared to 18.8% in 2019. To address the anticipated electricity demand by 2030, the focus will be on advancing the development of hydroelectric, wind, and solar power facilities. Additionally, there will be an initiative to replace inefficient thermal power plants with modern combined cycle plants to enhance gas efficiency.

The "Fourth National Environmental Action Program 2022-2026" does not primarily focus on climate change; however, the key goals, objectives, and measures outlined within the document support the attainment of the Nationally Determined Contributions (NDC) mitigation targets. This is achieved through planned initiatives in various sectors of environmental protection, particularly in atmospheric air quality, where strategies aimed at reducing emissions of harmful substances, including greenhouse gases, from diverse pollution sources are specified. Additionally, in the forestry sector, efforts to maintain forests and restore degraded areas are expected to play a crucial role in meeting the objective of a 10% increase in carbon absorption potential, as stipulated in the NDC.

Furthermore, a "Climate Technology Needs Assessment in Georgia" has been developed, which is informed by an evaluation of technological requirements for both mitigation and adaptation efforts. This document outlines priority technologies for mitigation and aligns with national strategic frameworks and the objectives established by the NDC.

The "Climate Technology Needs Assessment in Georgia" has identified several key focus areas: the integration of wind power generation with hydroelectric storage systems; the combination of photovoltaic energy systems with energy storage batteries; the synergy between tidal energy facilities and green hydrogen production; advancements in thermal insulation for building exteriors; the development of highly efficient heating and cooling systems, such as water-electric heat pumps; improvements in public transportation technologies; enhancements in electric vehicle infrastructure and capabilities; the promotion of biofuel production, including biodiesel and biogas; innovations in high-yield livestock farming; and the utilization of agricultural waste as a fertilizer.

Carbon trading

The long-term strategy for low-emission development outlines Georgia's goal of achieving climate neutrality by the year 2050. Realizing this ambition necessitates extensive technological upgrades, which can be facilitated through the carbon trading mechanism. This approach will enable the nation to further diminish global emissions while simultaneously attracting substantial financial investments for the broad adoption of climate-smart technologies.

Georgia has already initiated steps toward this objective. Notably, under the emissions trading framework established in Article 6.2 of the Paris Agreement, the country has entered into bilateral agreements for the sale and transfer of emissions with the Swiss Confederation in 2021 and Japan in 2022. These agreements foster collaboration in various sectors, including hydro, solar, and geothermal energy production, waste-to-energy conversion, hydrogen technologies, and energy-efficient transportation systems, thereby **allowing Georgia to implement climate-smart technologies.**

The execution of these agreements will be contingent upon Georgia completing the necessary preparatory work to facilitate the relevant transactions.

To commence emissions trading, Georgia must undertake several measures. Currently, there is no registry for mitigation measures eligible for international transfer, nor is there a system in place for recording and tracking "internationally transferred mitigation results." Additionally, an authorization system for international transfers and a procedure to prevent double counting are yet to be established.

1.2.2 PRIORITIES AND CIRCUMSTANCES FOR ADAPTATION TO CLIMATE CHANGE

The Nationally Determined Contributions (NDC) outline the key priorities for climate change adaptation in Georgia, addressing both economic sectors and ecosystems. These priority areas have been determined by assessing the vulnerability of various sectors to climate change impacts. Georgia aims to concentrate its adaptation initiatives on mountain ecosystems, tourism (including both winter and summer resorts that are susceptible to climate change), agricultural production, surface and groundwater resources, the forestry sector, biodiversity, and human health.

TABLE 1.2: PRIORITY AREAS FOR ADAPTATION IDENTIFIED BY THE NDC

Sector / Field	NDC targets
Mountain ecosystems, glaciers	Evaluation of the effects of climate change on mountainous ecosystems, glaciers, ecosystem services, mountain economies, and the quality of life of local communities.
Tourism	Enhancing the adaptive capacity of the most at-risk coastal resorts during both winter and summer seasons.

Sector / Field	NDC targets
Agriculture	Enhancing the adaptive capacity of the agricultural sectors that significantly contribute to the GDP.
Water resources	Evaluate the effects of climate change on the accessibility of groundwater and surface water resources, focusing on their sustainable utilization for agricultural irrigation, energy generation, and domestic needs over the long term.
Diversity	Encourage the preservation of endemic and Red Listed species, as well as indigenous species that are vital for food production and agriculture. Conduct research on the most at-risk regions of forest cover in designated areas.
Human health	Examine the influence of climate change on public health through interdisciplinary studies that explore the connections among social, economic, biological, ecological, and physical systems.
Natural hazard management	Implement strategies designed to mitigate losses and damages resulting from extreme weather events.

The primary tool for executing the Nationally Determined Contributions (NDC) related to adaptation within the country will be the National Adaptation Plan. This plan will outline the long-term adaptation priorities for the nation. Several sectoral and regional development documents incorporate actions that aid in fulfilling the adaptation objectives established in the NDC; however, these do not constitute a cohesive vision document with explicitly defined adaptation goals and strategies. Currently, the existing documents that encompass aspects of adaptation objectives include the following:

- "Vision 2030 - Georgia's Development Strategy" encapsulates the aspirations for all critical sectors of sustainable development in Georgia, spanning the years 2023 to 2030. A significant component of this document is dedicated to environmental protection, which aims to mitigate the population's susceptibility to climate change-induced disasters. This includes the implementation of an integrated water resources management system, the creation of a cohesive network of well-managed protected areas, and the enhancement of sustainable forest management practices. The vision emphasizes the importance of preventing health issues, disabilities, and fatalities linked to climate change and environmental influences.
- The National Environmental Action Plan for the years 2022-2026 encompasses initiatives aimed at protecting the environment across various sectors, including water resources, forestry, land management, natural hazard mitigation, and biodiversity. These initiatives are designed to support the adaptation objectives outlined in the Nationally Determined Contributions (NDC) document. Specifically, the plan emphasizes several key adaptation strategies: the extensive deployment of an early warning system for natural hazards and enhancements to disaster response mechanisms; the promotion of efficient water resource utilization; efforts to combat land degradation and desertification while rehabilitating affected areas; sustainable pasture management; the enhancement of biodiversity and the sustainable management of forest resources; and the maintenance and restoration of degraded forest areas. Furthermore, the plan includes provisions for the formulation of a national strategy for climate change adaptation.

- The “Agriculture and Rural Development Strategy 2021-2027” identifies climate change adaptation as a key objective. Significant focus areas for adapting the agricultural sector include the promotion of environmentally sustainable and climate-resilient agricultural practices, the responsible management of forest resources, and the conservation of agro-biodiversity. Comprehensive measures for executing the strategy are specified in the annual action plans.

1.2.3 PROGRESS AND CHALLENGES IN CLIMATE POLICY

The country has made considerable advancements in the development and enhancement of climate change policies and legislative reforms since the Fourth National Communication and the Second Biennial Update Report. These efforts serve as a foundation for progress toward the implementation of the Nationally Determined Contributions (NDC). The achievements since the Fourth National Communication, as detailed in Table 1.3, highlight this progress made post-2021.

However, despite these notable advancements, several challenges persist. In Georgia, climate change-related issues are currently regulated within the legislative context of specific areas (including: the Law on Environmental Protection, Environmental Assessment Code, Forest Code of Georgia, the Law of Georgia on Water Resources Management, the Law of Georgia on Ambient Air Protection, the Law of Georgia on Windbreak (Field Protection) Strip, the Waste Management Code, the Law of Georgia on Promoting the Generation and Consumption of Energy from Renewable Sources, the Law of Georgia on Energy Labelling, the Law of Georgia on Energy and Water Supply, the Law of Georgia on Energy Efficiency of Buildings, the Law of Georgia on Energy Efficiency, the Law of Georgia on Determination of Designated Purpose of Land and on Sustainable Management of Agricultural Land (Green Paper, 2023)) and there is a lack of cohesive legal structure that would legally transform climate change issues into a unified and comprehensive legislative framework. Duplicated commitments in various policy documents or action plans, weak coordination, and ensuring harmonization of climate-related processes remain as ongoing challenges.

TABLE 1.3: PROGRESS ON CLIMATE POLICY SINCE THE FOURTH NATIONAL COMMUNICATION (PUBLISHED IN 2021) AND THE SECOND BIENNIAL UPDATE REPORT (PUBLISHED IN 2019)

Sector / Field	National climate or related policy documents	New sectoral policy documents/legislative acts that contribute to the implementation of NDC targets (adopted since 2019)
Penetrating		
Penetrating		Legislation on Climate Change (currently in development) Vocational Education Strategy for the years 2021-2025 Strategy for the Advancement of High-Mountain Settlements in Georgia for the period 2019-2023
Mitigation		
Energy - electricity and heat generation	Georgia's Climate Change Strategy 2030 and Action Plan 2021-2023 (2021) Georgia's Long-Term Low-Emission Development Concept (2023) Georgia's National Integrated Energy and Climate Plan 2021-2030	Decadal Development Plan for the Transmission Network of Georgia covering 2023-2033 (2022) Action Plans for Municipal Sustainable Energy and Climate Initiatives Law of Georgia regarding Energy and Water Supply (2019) Law of Georgia on Incentives for Renewable Energy Production and Utilization (2019) Legislation on Energy Labeling (2019)
Transport		Batumi Green City Action Plan for 2020-2025 (2020) Tbilisi Sustainable Urban Mobility Plan (currently under development) Action Plans for Municipal Sustainable Energy and Climate Initiatives
Buildings		National Strategy for Enhancing the Quantity of Nearly Zero Energy Structures (currently in progress) Local Sustainable Energy and Climate Action Frameworks Legislation on Building Energy Efficiency (2020)
Industrial processes and product consumption		Vision 2030 - Georgia's Development Strategy

Sector / Field	National climate or related policy documents	New sectoral policy documents/legislative acts that contribute to the implementation of NDC targets (adopted since 2019)
Land use, land use change and forestry	eorgia's Climate Change Strategy 2030 and Action Plan 2021-2023 (2021)	The following documents outline key strategies and programs: Agriculture and Rural Development Strategy for the years 2021 to 2027 (2021) Fourth National Environmental Action Program of Georgia covering the period from 2022 to 2026 (2022) State Program for the Inventory of Windbreaks (Field Protection) Strips (2021)
Waste		Georgia's Long-Term Low-Emission Development Concept (2023)
Forest		Georgia's National Integrated Energy and Climate Plan 2021-2030
Adaptation		
Mountain ecosystems, glaciers	The Fourth National Environmental Action Program of Georgia for 2022-2026 (NEAP 4) Vision 2030 - Georgia's Development Strategy	-
Tourism		-
Agriculture		Agriculture and Rural Development Strategy for the period 2021-2027, accompanied by an Action Plan for 2021-2023 (2021).
Water resources		Law on Water Resources Management (2023). Law on Environmental Liability (2021).
Forests and Biodiversity		- National Biodiversity Strategy and Action Plan, with preparations underway for an updated version. Georgian Protected Areas System Development Strategy for 2018-2030, along with an Action Plan for 2018-2021 (2018). Forest Code (2020). Law on Environmental Liability (2021).
Human Health		National Environment and Health Action Plan for 2018-2022 (2018).
Natural Hazard Management		Fourth National Environmental Action Program of Georgia for the years 2022-2026 (2022).

To fulfill the obligations related to climate change that arise from Georgia's accession to the European Union, it has been considered necessary to commence the development of a Framework Law on Climate Change. This legislative initiative was launched by the Parliament of Georgia in 2023, with support from the Westminster Foundation for Democracy (WFD). The proposed "Georgian Climate Change Law" is designed to establish a cohesive system for sustainable, integrated, transparent, gender-sensitive, and inclusive governance of climate change matters. Its objectives include facilitating the country's adaptation to climate change—particularly through risk prevention, vulnerability assessment, and resilience enhancement—as well as promoting climate change mitigation. This includes establishing a legal framework for the accounting, reporting, and verification of greenhouse gas emissions and removals, alongside a national system for both international and domestic trading of greenhouse gas emissions. Furthermore, the law will create mechanisms for achieving nationally defined targets and will enhance the role of municipalities in executing climate change policies at the local level. It will also encourage research, education, and public awareness regarding climate change, as well as the introduction and advancement of innovative technologies.

The current legislation necessitates additional refinement across several sectoral domains to establish a comprehensive legislative framework that aligns with the objectives of the Nationally Determined Contributions (NDC) and ensures the effective implementation of associated measures. For instance, the legislative analysis reveals the need to[41]: enhance tax incentives to promote low-emission vehicles, create targeted mechanisms to support energy production from biomass, address sludge management challenges arising from wastewater treatment facilities to mitigate emissions, incorporate climate-conscious strategies into public procurement laws, and revise technical regulations related to construction, among other requirements.

The execution of climate policy and the attainment of climate neutrality entail considerable transformations within the country's economy, which inevitably bring about social repercussions. Consequently, this matter necessitates focused attention to uphold the principle of equity and guarantee a fair allocation of the costs and benefits associated with climate change initiatives within society. Currently, these concerns are not adequately addressed in national legislation or climate policy frameworks. Nevertheless, the forthcoming Law on Climate Change is being formulated with an emphasis on just transition, aiming to mitigate potential adverse socio-economic effects stemming from climate neutrality policies through appropriate measures.

The Fourth National Communication recognized the challenge of monitoring the execution of policy documents and action plans, as well as evaluating the progress made, primarily due to inconsistent methodologies in document preparation, a lack of assessment indicators, and other deficiencies. Since the release of the Fourth National Communication, Georgia has undertaken substantial reforms in the development of policy documents. Notably, the Rules for the Development, Monitoring, and Evaluation of Policy Documents have been enacted, establishing a foundation for a results-oriented approach to policy planning, monitoring, and evaluation, which is crucial for measuring outcomes. As a result, the strategies and action plans subsequently formulated now incorporate specific outcome

41 A brief overview of sectoral legislation related to Georgia's Nationally Determined Contribution, 2022. Georgia's Environmental Outlook (GEO), commissioned by the Westminster Foundation for Democracy (WFD).

indicators to facilitate progress assessment.

The integration of climate-related issues within policy documents adopted after 2021 has notably improved. This enhancement can be attributed to better coordination among agencies during the formulation of these documents, a heightened awareness of climate change challenges compared to earlier periods, and an increased emphasis on the Green Agenda. Notable examples include the National Integrated Energy and Climate Plan of Georgia, which aligns energy development initiatives with commitments related to climate change. Additionally, the “2024-2030 Vocational Education Strategy” explicitly highlights the necessity for green transformation and the development of green skills. Furthermore, the “2019-2023 Strategy for the Development of High-Mountain Settlements of Georgia” recognizes environmental protection and natural resource management as key objectives, incorporating actions for the sustainable use of forest resources, awareness campaigns, restoration of areas affected by fires, and protective measures in conservation zones.

Throughout the reporting period, a digital climate change data management system was established, which facilitates: 1) the monitoring of the Climate Change Action Plan’s implementation; and 2) the oversight of the Sustainable Energy and Climate Action Plan by municipalities that have signed the Covenant of Mayors. State agencies are responsible for inputting data into this system regarding the measures undertaken, progress made, and budget expenditures. The electronic platform enables efficient electronic reporting.

1.2.4 GEORGIA’S PARTICIPATION IN VARIOUS CLIMATE FINANCING MECHANISMS

Georgia employs a range of established financing mechanisms to address climate change, alongside programs from bilateral and multilateral donors and international financial institutions to secure funding. For instance, during the reporting period, the country successfully mobilized resources from the Green Climate Fund (GCF) for two national and two international initiatives in which it is involved. One of these projects is receiving co-financing from the Adaptation Fund (AF)[42]; Additionally, a technology needs assessment and the development of an action plan were conducted with support from the Climate Technology Centre & Network (CTCN) under the Technology Mechanism, as well as the Global Environment Facility (GEF). The preparation of the Fifth National Communication and Biennial Transparency Report was also facilitated by the GEF. Furthermore, substantial climate financing is provided by the European Commission through the EU4Climate and EU4Energy projects.

Financial institutions have allocated funds for activities related to climate change from several sources, including the European Investment Bank (EIB), the Council of Europe Development Bank (CEB), the European Bank for Reconstruction and Development (EBRD), the Asian Development Bank (ADB), the Black Sea Trade and Development Bank (BSTDB), the Nordic Investment Bank (NIB), Kreditanstalt für Wiederaufbau – Credit Institute for Reconstruction (KfW), the Nordic Environment Finance Corporation (NEFCO), and the World Bank Group. Additionally, the country has received climate change financing from various bilateral donors, which include international development agencies from Austria, the United States, Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, and other governmental entities.

42 Two GCF projects directly focus on Georgia, while Georgia is one of the countries in the other two projects (implemented by the EBRD).

In October 2023, Georgia hosted the 37th GCF Council Meeting, marking the first occasion this event had taken place in the Eastern European region. During the meeting, the Council deliberated on decisions that are to be executed over the forthcoming four years.

1.3 INSTITUTIONAL ARRANGEMENTS

1.3.1 INSTITUTIONAL ASPECTS OF CLIMATE POLICY DEVELOPMENT

The Climate Change Council was formed in Georgia to facilitate the effective execution of the obligations outlined in the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Paris Agreement.

Since its inception in 2020, the Climate Change Council (CCC) has been active in the nation, primarily aimed at enhancing the coordination of initiatives aimed at reducing greenhouse gas emissions and addressing the challenges posed by climate change.

The Council is composed of a Coordination Group and Working Groups from municipalities that have signed the Covenant of Mayors, alongside members of the Government of Georgia, including ministers, the Chairman of the Government of the Autonomous Republic of Abkhazia, the Chairman of the Government of the Autonomous Republic of Adjara, the Chairman of the Coordination Group, and the Executive Director of the LEPL - National Statistics Office of Georgia. The Minister of Environmental Protection and Agriculture of Georgia serves as the Chairman of the Council. Within the Council the Coordination Group is established, which acts as an advisory entity to the Council, focusing on the coordination between state and local government bodies regarding climate change, and includes mayors from the Covenant of Mayors signatory municipalities, the Deputy Mayor of Tbilisi Municipality, and state representatives. The Working Group serves as an advisory body to the Council, addressing specific climate change policy issues within the economic and social domains, and is comprised of civil servants, experts, and members of the scientific community. The establishment and composition of the Working Group are determined and approved by the Council.

The Council is tasked with reviewing all significant reports and documents produced by the country, ensuring their alignment with the stipulations of the Convention and the Paris Agreement. It evaluates Georgia's National Program created for the Climate Green Fund, as well as projects submitted to the Adaptation Fund (AD), the Climate Technology Center and Network (CTCN), and various financial institutions, providing recommendations to the government. Additionally, the Council assesses state strategies or action plans related to climate change and raises issues for governmental decision-making. Following the Council's recommendations, the Ministry of Environmental Protection and Agriculture of Georgia presented the Nationally Determined Contributions (NDC), the Climate Change Strategy and Action Plan, and the Long-term Concept of Low-Emission Development during a government session.

The Ministry of Environmental Protection and Agriculture serves as the primary governmental body responsible for formulating and executing climate change policies in the country. It represents Georgia in international climate forums and facilitates communication and reporting in accordance with the Convention and the Paris Agreement. The Ministry also prepares proposals for high-level discussions on climate change policy and develops pertinent legislative measures.

The involvement of sectoral ministries, which contribute based on their areas of expertise, is crucial in the formulation of climate change policy. The ministries engaged in the planning of the country's socio-economic sectors include the Ministry of Economy and Sustainable Development, the Ministry of Regional Development and Infrastructure, the Ministry of Finance, the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health and Social Protection, and the Ministry of Education and Science. Notably, the Ministry of Economy and Sustainable Development plays a significant role, as it oversees three essential sectors related to climate change: energy, transport, and industry. During the reporting period, this ministry was instrumental in creating the vital document titled "National Integrated Energy and Climate Plan of Georgia for 2021-2030."

The National Statistics Service of Georgia holds a vital position in the processes of climate change reporting, as it is instrumental in the collection and processing of greenhouse gas inventory data.

1.3.2 INSTITUTIONAL ARRANGEMENTS FOR THE REPORTING PROCESS TO THE CLIMATE CHANGE CONVENTION

Since 1999, Georgia has consistently prepared national communications and greenhouse gas inventory reports in accordance with Decision 17/CP.8 of the Conference of the Parties to the Convention. Following Decision 1/CP.16, Georgia, classified as a non-Annex I country, commenced the preparation of biennial updated reports in 2016. As of 2023, Georgia has fulfilled its reporting obligations under the Convention by producing the following documents:

- National Communications in the years 1999, 2009, 2016, and 2021
- Biennial Updated Reports in 2016 and 2019

In the context of its national communications and biennial updated reports to the Convention, Georgia has conducted greenhouse gas inventories on seven occasions from 1999 to 2024. These inventories encompassed the following periods: 1997-1999, 1997-2006, 2007-2011, 2012-2013, 2014-2015, 2016-2017, 1999-2017, and 2018-2022.

Georgia, in line with Decision 18/CMA.1 from the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement, is set to report for the first time under the expanded transparency framework by the year 2024. Additionally, the country will submit its Fifth National Communication, adhering to Decision 17/CP.8 from the Conference of the Parties to the Convention.

The Government of Georgia is the designated authority responsible for reporting to the United Nations Framework Convention on Climate Change, with the Ministry of Environmental Protection and Agriculture overseeing the coordination of related activities. Within the Ministry, the Department of Environment and Climate Change, particularly its Climate Change Division, is tasked with various responsibilities, including the coordination of regular report preparation for the Convention, verification processes, and the organization of submissions to the Convention Secretariat. Furthermore, the Environmental

Information and Education Centre, a non-profit legal entity of public law under the Ministry of Environmental Protection and Agriculture, offers administrative, logistical, and other forms of support for the report preparation process, while also ensuring the transparency of these reports. The involvement of line ministries, the National Statistics Service, and the Government of the Ajara Autonomous Region in report preparation is primarily limited to providing pertinent information, such as data on emissions, financial support received under climate initiatives, and gender-related issues.

Georgia primarily relies on resources obtained through international funding to carry out its reporting process. The assistance from the Global Environment Facility (GEF) is particularly vital for fulfilling obligations under the Convention. Until 2022, the national reporting process associated with GEF was managed by the United Nations Development Programme Georgia Office (UNDP Georgia). However, starting in 2023, there has been a partial shift in the management structure. UNDP Georgia now serves as the project implementing organization with a supervisory role, while the Environmental Information and Education Centre takes the lead in preparing reports, including the greenhouse gas inventory, national communication, and biennial transparency reports. This involves conducting expert analyses and ensuring inter-agency coordination in close collaboration with the Climate Change Division.[43] This reorganization represents a significant advancement in enhancing the capabilities of public

1.4 PUBLIC PARTICIPATION IN THE CREATION AND IMPLEMENTATION OF CLIMATE POLICY AND THE LEVEL OF AWARENESS REGARDING CLIMATE CHANGE

1.4.1 PUBLIC PARTICIPATION IN THE CREATION AND IMPLEMENTATION OF CLIMATE POLICY

The formulation of climate change policies and action plans in Georgia is being conducted with active public participation. This initiative is primarily led by organizations dedicated to environmental and climate change matters. These organizations have played a significant role in the development of various key documents, including the Nationally Determined Contributions (NDC) document, the Georgia's Climate Change Strategy for 2030 along with its Action Plans for 2021-2023 and 2024-2025, the Long-Term Low Emission Development Strategy (LT-LEDS), and the Fourth National Environmental Action Program for 2022-2026, which addresses climate change among other topics. Additionally, the Integrated National Energy and Climate Plan of Georgia has also been shaped through this collaborative effort.

Similarly, the preparation of the Biennial Transparency Report and the Fifth National Communication has been structured to allow participation from various stakeholders, including organizations focused on climate change and environmental issues, academic institutions (universities and research centers), consulting firms with relevant expertise, independent experts, and other interested parties, ensuring a comprehensive approach to document development.

Participation is facilitated through the distribution of both working and final documents,

43 The Environmental Education and Information Centre also prepares a greenhouse gas inventory report. The previous inventory report, for the years 1990-2017, was also prepared by the Center.

as well as the organization of discussions involving the public or stakeholders regarding these documents. This includes the submission of written opinions and comments, the consideration of feedback received, and the subsequent availability of the final documents to the public.

Currently, efforts are being made to formulate a Climate Change Law. This initiative commenced with the development of the Green and White Papers, which were made accessible to the public, accompanied by several public meetings aimed at reviewing these documents and discussing the formulation of the Climate Change Law. The development of the law will similarly adhere to a participatory approach, with public hearings scheduled to evaluate the draft law, in accordance with national legislation.

Legal mechanisms for participation

In Georgia, the legal framework facilitates public engagement in climate policymaking through various mechanisms:

1. ***Policy Planning Monitoring and Evaluation Rules -*** The guidelines associated with the Policy Planning, Monitoring and Evaluation Rules advocate for public participation at every stage of the policy cycle. To effectively implement this process, it is essential to identify and notify all relevant individuals and legal entities with an interest in the matter.
2. ***Environmental Assessment Code -*** Strategic documents related to economic sectors must undergo a Strategic Environmental Assessment (SEA) prior to their approval. The Environmental Assessment Code mandates the public disclosure and discussion of the SEA report, serving as a means for public engagement. For instance, the Integrated National Energy and Climate Plan of Georgia underwent a public review process during the SEA preparation. Additionally, public consultations were held during the scoping report phase, even though such a requirement is not legally mandated. The SEA report was subject to public review on two occasions..
3. ***Electronic Petition -*** Georgian law allows the public to propose specific issues for discussion at government meetings, including those related to climate change. Since 2017, if a petition garners 10,000 signatures through an electronic platform, citizens can present it to the government, requesting that the issue be addressed. However, it is important to note that this mechanism has not yet been utilized in relation to climate or environmental matters.
4. ***Access to information as ensured by the General Administrative Code -*** A crucial element for fostering public engagement is the availability of information, which is assured by the General Administrative Code. The Environmental Information and Education Centre plays a significant role in providing access to information regarding climate change. Its main functions include ensuring access to environmental and agricultural information, organizing public hearings and public involvement in the environmental decision-making process, promoting environmental and agricultural education of the public, and raising awareness.

The Climate Change Division conducts public meetings aimed at individuals and organizations interested in climate change matters, including representatives from the non-governmental sector, independent experts, and academia. These meetings serve to provide information and report on the results of the Conference of the Parties to the Convention.

An essential resource for the public regarding the current status of climate change is the National Report on the State of the Environment of Georgia, which is prepared by the government on a regular basis every four years. The most recent report, published in 2023, encompasses the years 2018 to 2022 and includes a dedicated chapter on climate change. Additionally, it examines the interplay between four sectors—energy, transport, industry, and agriculture—and their relationship with climate change. This document is readily accessible to the public.

Public engagement is further supported by the presence of relevant national platforms. One such platform focused on climate change was established in 2021, led by the non-governmental organization Caucasus Environmental NGO Network (CENN), as part of an ongoing project funded by the European Union. The objective of this climate platform is to enhance the active participation of stakeholders in the formulation and execution of climate change policies. The necessity of this platform was particularly underscored in light of the development and adoption of the NDC document, the 2030 Climate Change Strategy, and the 2021-2023 Action Plan, as obtaining feedback and ensuring coordinated efforts are vital for meeting the established commitments. The platform comprises seven thematic working groups, with participation from over 40 organizations, including non-governmental organizations operating at both the national and regional levels.

TABLE 1.4: LEGAL FRAMEWORK FOR PUBLIC PARTICIPATION IN CLIMATE-RELATED DECISION-MAKING IN GEORGIA[44]

Topic	Participation form	Procedures	Relevant legislation
The formulation of policy initiatives and programs addressing climate change.	Written feedback Public forums and conferences Collaborative working groups Additional formats.	A comprehensive framework for public engagement in the formulation of strategies, plans, and programs associated with national policy documents.	Policy Planning, Monitoring and Evaluation Manual (2019)
The formulation of policy strategies and initiatives that can influence climate change, including the spatial organization of urban areas and neighborhoods.	Written comments Public hearings, conferences	Strategic Environmental Assessment	Environmental Assessment Code (2017) Law of Georgia on Environmental Protection (1996) Code of Spatial Planning, Architectural and Construction Activities of Georgia (2018) Procedures for the Development of Spatial and Urban Plans (2019)

44 Civic Space for Climate Policy Participation in Georgia, 2021. Independent Institute for Environmental Studies - UfU e.V.

Topic	Participation form	Procedures	Relevant legislation
Making choices regarding particular projects that could have considerable effects on the environment and climate.	Written comments Public hearings, conferences	Environmental Impact Assessment	Environmental Assessment Code (2017) Procedures (Regulations) for Public Hearings (2018) Guidelines for Proactive Disclosure of Public Information (Public Records), Requests for Public Information in Electronic Format, and Access to Environmental Information (2017).

1.4.2 LEVEL OF PUBLIC AWARENESS AND INFORMATION REGARDING CLIMATE CHANGE

The degree of public understanding and knowledge regarding climate change serves as a crucial foundation for fostering climate-conscious behaviors within society, as well as for cultivating a culture of participation in the development and execution of climate policies. At the national level, this matter constitutes a significant aspect of the initiatives undertaken by the Environmental Information and Education Centre. In 2022, the Centre, with the assistance of the United Nations Development Program (UNDP) and Swedish partners, carried out a study[45], designed to evaluate the level and quality of the population's knowledge, awareness, and education concerning environmental and ecological issues in the country, with the aim of informing future actions.

This study presents a novel approach compared to prior research by evaluating the behavioral practices of the Georgian population in relation to environmental education and awareness. The findings indicate that 62% of Georgians acknowledge that the impacts of climate change are already being experienced in the country; however, 27% consider these consequences to be a distant concern. Notably, a part of the population, specifically 21%, perceives climate change as a fabricated concept aimed at hindering the hydrocarbon industry. Conversely, 66% of respondents recognize climate change as a genuine phenomenon that poses a threat. Furthermore, 48% believe that human actions can mitigate the risks associated with climate change, while a slightly higher percentage, 53%, is of the opinion that these changes can be alleviated through human intervention[46]. An additional finding from the study is that the population indicates a need for increased information dissemination. The population also appears to struggle with understanding the link between individual behaviors and global climate change.

The public awareness survey conducted in 2022 as part of the EU4Climate project, funded by the European Union, yielded intriguing insights. Focus group discussions revealed that society views the consequences of climate change as a significant everyday and socio-economic issue. Residents of urban areas tend to regard climate change as a relatively minor challenge compared to those living in rural regions. When discussing natural hazards, the public is less inclined to associate them with climate change. The study highlights that

45 Assessment of Environmental Education and Awareness Levels at the National Level (Research Analytical Report), 2022. ISSA. Commissioned by UNDP.

46 The research also showed that the higher the level of education of the respondents, the more the share of correctly informed respondents increases (for example, the share of correctly informed respondents is 62.6% in the case of incomplete and complete secondary education and 70.3% in the case of complete higher education).

television and online resources serve as the primary sources of information regarding climate change. While there is a sense of danger associated with climate change, it does not lead to despair, as individuals believe that these challenges can be addressed through collective human efforts.

A public opinion survey focusing on knowledge, perceptions, attitudes, behaviors, and preferred policies regarding environmental and climate issues was carried out in 2023, funded by the Westminster Democracy Foundation. The findings revealed that a significant portion of the population has become increasingly aware of the adverse effects of climate change in recent years. Over 90% of respondents identified natural disasters, declining health, and reduced agricultural yields as the most pressing concerns. The survey further highlighted that the impact of climate change is more acutely felt by individuals in rural areas, particularly those engaged in agriculture, compared to residents of major urban centers. There has been a notable decrease in the percentage of individuals who view climate change as an unrealistic phenomenon, now standing at 13%. Additionally, 12% of respondents believe that climate change does not affect regions like Georgia or similar countries. With job creation consistently ranking among the top three issues in sociological surveys conducted in Georgia, this study found that 38% of participants disagreed with the notion that "job creation is far more important, even if it negatively impacts the environment." The research also indicates strong public backing for alternative energy development, with 84% in favor. Among these, 34% prioritize solar energy development, while 20% advocate for the implementation of wind energy and related technologies. Furthermore, 32% emphasize the importance of establishing early warning systems. A significant 87% of the population supports the enactment of climate change legislation and associated regulations.

1.4.3 EXISTING POLICIES AND MECHANISMS FOR RAISING CLIMATE EDUCATION AND AWARENESS

The state policy regarding education and awareness on climate change in Georgia is executed by the Environmental Information and Education Centre, which provides annual support for both formal and non-formal education in environmental and agricultural sectors. The Centre primarily targets various groups, including pupils and students, teachers, educators in preschool institutions, farmers, media representatives, NGOs, local self-governments, penitentiary institutions, and both private and public sectors.

From 2019 to 2023, the Centre focused on key thematic areas such as disaster risk reduction related to climate change and climate-smart agriculture. In this context, the Centre engages with preschool, general education, vocational, and higher education levels.

Since 2016, the Environmental Information and Education Centre has been implementing the "Preschool Environmental Education" program and providing retraining for preschool teachers in Georgia. To enhance the program in 2022, an evaluation study was conducted, leading to the incorporation of a new comprehensive textbook on climate change and an eco-package into the preschool environmental education curriculum. By 2022, over 2,600 preschool teachers had undergone retraining, and the program continues to be implemented nationwide.

In 2020, the Environmental Information and Education Centre created a series of supplementary textbooks aimed at primary school educators in general education institutions, titled “Environmental and Agricultural Education at School.” This collection includes the textbook “Climate Change and Natural Hazard Reduction.” In 2021, to facilitate the effective incorporation of these topics into the school curriculum, a retraining program for primary school teachers was initiated. By the conclusion of 2022, approximately 3,800 teachers had completed the training. It is projected that by 2026, the number of trained educators will increase to 8,000, with an enhancement of the capacity of around 20,000 teachers, representing 31.4% of the total teaching workforce in the country. Presently, thousands of students are engaged in learning about environmental issues and climate change, as well as natural hazard reduction, covering topics such as sustainable development, biodiversity conservation, water resource management, ambient air quality protection, waste management, land use planning, combating desertification, sustainable agriculture, and food safety and quality.

Additionally, significant advancements have been made in vocational and higher education institutions. In 2022, the Centre successfully developed and secured approval for three vocational training and retraining programs: “Forest Inventory and Taxation,” “Environmental Management,” and “Climate-Smart Planning of Agricultural Activities.” These programs are designed to foster the growth of green enterprises and promote the adoption of climate-smart methodologies.

It is important to highlight that relevant modules have been established to incorporate climate-smart agriculture topics into vocational and higher education curricula. As part of this initiative, the Center has organized training sessions and workshops for educators in vocational schools.

Agricultural training sessions were conducted with a focus on climate-smart agriculture, covering topics such as beekeeping, potato farming, and pasture management. The primary participants in these training sessions included farmers, cooperative representatives, and extension service personnel.

In 2021, the Center developed a Climate-Smart Agriculture Support Manual tailored for vocational and higher education students in Georgia, addressing the specific challenges posed by climate change.

To address the shortage of professionals in environmental fields, the “Green Scholarships” initiative was launched in higher education institutions. This program will provide scholarships to 32 outstanding master’s students in areas experiencing shortages, including ecology, hydrology, geology, environmental protection, ecological engineering, structural geography, environmental management and policy, physical geography, and sustainable development. Between 2016 and 2022, various educational programs were created and executed to promote environmental and agricultural careers, such as the “School of Ecoleaders,” “Agroschool,” “Forestry School,” “Green Camp - Climate Ambassadors,” and the “Young Volunteer Network.” Each year, over 200 young individuals participate in these initiatives.

1.4.4 ACTIVITIES OF PUBLIC ORGANIZATIONS TO IMPROVE THE AWARENESS LEVEL ON CLIMATE CHANGE

The non-governmental sector plays a crucial role in educating and raising awareness among various societal segments and stakeholders regarding climate change issues. While most organizations are based in Tbilisi, there are also entities in major Georgian cities such as Rustavi, Kutaisi, and Batumi that address environmental concerns, including climate change and related topics such as water resource management, agriculture, forest conservation, waste management, and land cover protection. A significant aspect of their efforts involves public awareness initiatives, which include information campaigns, collaborations with schools, the creation and distribution of brochures, training sessions, and school competitions. These activities are fully backed by donor support. However, this heavy reliance on international funding renders the process less sustainable, particularly as alternative funding sources for public organizations remain limited, aside from some involvement from the business sector in specific projects.

In recent years, the proactive use of social media by engaged community members to inform and mobilize the public has gained prominence. Individuals with shared interests in environmental matters convene in various thematic groups, where they discuss pressing environmental issues, including the impacts of climate change. These groups facilitate discussions. The membership in some of these groups reaches into the tens of thousands, reflecting a significant societal interest in environmental matters.

1.5 GENDER AND CLIMATE CHANGE

The connection between gender and climate change is a relatively recent development within the Georgian context, resulting in a limited understanding of these issues among stakeholders. Additionally, obtaining information on these topics proves challenging, as such data is not systematically gathered or analyzed. To conduct a comprehensive analysis aimed at identifying gender-specific needs and planning relevant activities, the availability of gender-disaggregated data across various sectors is essential, yet remains a significant challenge. Consequently, the following analysis relies on secondary data and existing documentation, concentrating on three key areas: agriculture, water supply and sanitation, and health.

A study conducted in 2023 examined the susceptibility of various groups of women to the impacts of climate change.[47] The findings indicated that women perceive the severe effects of climate change as being reflected in heightened occurrences of drought, soil degradation, intense winds, heat waves, an increase in the frequency of hailstorms, and a reduction in the duration of spring and autumn seasons. The reduction in snowfall and the diminishing intensity of frosts have been identified as clear indicators of climate change. It is important to highlight that the research reveals women residing in rural regions are disproportionately impacted by climate change, resulting in a heightened concern for these matters. Furthermore, the study indicates that over 50% of women report residing in areas prone to natural disasters, which frequently results in the destruction and damage

47 M. Devidze, et.al. 2023. Climate Change Impact on Women's Vulnerability in Georgia, Study report – DRAFT. Westminster Foundation

of homes, infrastructure, agricultural land, crops, and other assets.

1.5.1 WOMEN'S NEEDS IDENTIFIED IN THE RESULTS OF NEGATIVE CLIMATE IMPACTS

Individuals of different genders participate in public life in different ways and at different levels, resulting in their roles assigned by society consequently, measures aimed at mitigating the impact of climate change must consider these disparities. This chapter examines three critical sectors—agriculture, water and sanitation, and health—that are especially susceptible to the repercussions of climate change. Simultaneously, these sectors highlight the diverse needs and varying impacts of climate change most prominently.

Agriculture[48], [49]

Agriculture represents the most significant employment sector in low and middle-income countries. For instance, data from Geostat in 2022 indicates that 20.3 percent of men and 14.8 percent of women are engaged in agriculture, forestry, and fisheries, marking the highest employment rate for men in comparison to other sectors (with the highest employment rate for women, at 22 percent, found in education). However, a study conducted in 2023 highlights that women's employment security in agriculture is notably low due to several factors: insufficient resources and knowledge to address climate change and adapt agricultural practices, inadequate preparedness for hazards, and a lack of protective systems. These issues have enduring effects on women's mental and physical well-being, as well as on their natural and living environments.

A more comprehensive examination of this sector uncovers additional significant trends. Geostat reports that the proportion of farms managed by women has remained stable at approximately 32 percent over recent years, while the land area utilized by these farms has varied between 19 and 21 percent. This suggests that the majority of larger landholdings are controlled by men. Consequently, women working in this sector face heightened vulnerability to the challenges posed by climate change, as smaller farms typically possess fewer financial and human resources to mitigate these risks. This assertion is further supported by existing statistics. In 2020, Geostat revealed that the average annual profit of male-headed small farms surpassed that of female-headed small farms by 51 percent, and by 43 percent for medium and large farms. Additionally, a 2023 study found that nearly 25 percent of women lack a stable income, and among those who do have a stable income, approximately half earn no more than 400 GEL per month.

The agricultural sector holds significance beyond its economic contributions, particularly when examining the gender implications of climate-related challenges. The outdoor nature of agricultural activities heightens women's susceptibility to climate risks. Official statistics indicate that women predominantly engage in small-scale farming, earning lower incomes, and undertaking more demanding tasks compared to their male counterparts. Data from Geostat reveals that in 2021, the number of men employed in agriculture surpassed that of women by 14%. However, the total man-days worked by male employees was only 4.6% greater than that of female workers, suggesting that, on average, women in agriculture contribute more labor than men.

48 Statistical publication "Women and Men in Georgia", 2022. Geostat

49 M. Devidze, et.al. 2023. Climate Change Impact on Women's Vulnerability in Georgia, Study report – DRAFT. Westminster Foundation

These statistics underscore the distinct gender needs within the agricultural sector, highlighting the necessity for climate policy to reflect these differences. Nevertheless, document analysis indicates a lack of systematic approaches to integrating gender considerations in this domain. Furthermore, there is an absence of standardized guidelines at the state level. Although the Ministry of Environmental Protection and Agriculture of Georgia has designated a gender focal point, the effectiveness of this role is compromised by the absence of clearly defined responsibilities and adequate resources to support its functions.

Access to water and sanitation

Water and sanitation challenges represent a critical concern, particularly for rural communities, where the impacts of climate change are felt more intensely. Limited water resources lead to unirrigated fields, resulting in diminished agricultural yields, while simultaneously hindering the execution of essential household tasks. Furthermore, access to clean water and adequate sanitation is fundamental for promoting overall well-being. Water and sanitation concerns are regarded as critical factors in the realization of girls' right to education. The 2018 report from the Public Defender presents findings from the monitoring of 108 general educational institutions. The assessment indicated that the physical infrastructure and sanitary conditions of schools are inadequately aligned with the needs of students. The most pressing issues include access to water in schools, the proper operation of toilets and water supply facilities, as well as adherence to and enhancement of hygiene standards[50]. These issues also represent a significant problem in adult women.

Women exhibit lower levels of participation in the labor market compared to men. Over the past decade, the labor force participation rate has ranged from 62% to 67% for men, while for women, it has varied between 40% and 46%. This discrepancy can be attributed to the definition of unemployment, which includes individuals who are actively seeking employment and are prepared to commence work almost immediately[51]. This situation primarily arises from the reality that women have limited opportunities to engage in the labor market due to the unpaid caregiving responsibilities they undertake. According to the OECD, unpaid care work encompasses activities such as caring for children, the elderly, and the sick, as well as domestic tasks like washing, cooking, shopping, cleaning, and gathering essential resources such as food, fuel, and water, along with agricultural work performed for the family. In 2020-2021, the National Statistics Office of Georgia, with the assistance of UN Women, conducted the time use survey for the first time in Georgia. The findings revealed that women dedicate 4.8 times more time than men to unpaid care and household responsibilities. These indicates are further intensified by various socio-demographic factors. The study indicated that in Tbilisi, the gender ratio of time allocated to unpaid care and household work is 4.6, while in other cities it is 5.1, and in rural areas, it stands at 4.5. This disparity is particularly pronounced among women aged 25 to 44[52].

The significant level of engagement in domestic services and the socio-cultural responsibilities assigned to women by society contribute to their heightened interest in

50 Access to Water and Sanitation Rights in Public Schools in Georgia, Special Report. (2018) Office of the Public Defender of Georgia.

51 Geostat. Statistical publication "Women and Men in Georgia", 2022.

52 For women, this is 17.8% of the time, and for men - 3.7%.

issues related to water supply and sanitation. In light of climate change, water resources are among the most susceptible. Furthermore, it is noteworthy that the proportion of the population in Georgia connected to the water supply system remains relatively low at 71%. This indicates that as water supply and sanitation services improve, the demand on water resources will likely increase (in 2015, only 59.5% of the population was connected to the water supply system). This effect will be particularly pronounced in the context of climate change impacts.[53] Water supply problems were also identified in the 2023 survey, especially in the case of women living in rural areas, where they speak of water supply problems that become even more acute during the summer.[54]

The involvement of women is crucial in the management of water resources, particularly in the execution of adaptation strategies such as minimizing water wastage during usage and promoting awareness regarding sanitation. This significance arises from the fact that women are often responsible for addressing these matters on a daily basis, making the implications of these issues more immediate and relevant to their lives.

Healthcare

Climate change affects women and men in distinct ways. The health of women and girls is jeopardized by climate change and related disasters, which lead to diminished access to essential services and healthcare, as well as heightened risks to maternal and child health. Research indicates that extreme heat events, such as heat waves, are associated with higher stillbirth rates, while climate change also contributes to the proliferation of communicable diseases.

Maternal and infant mortality: Over the past 15 years, substantial state investments in healthcare and the establishment of a universal health coverage program have resulted in notable enhancements in essential health metrics. In comparison to the early 2000s, the infant mortality rate (defined as the number of deaths per 1,000 live births) has experienced a fourfold reduction. According to Geostat data from 2022, the infant mortality rate stands at 7.6 per 1,000 live births for both genders, with rates of 7.9 for boys and 7.3 for girls. A similar trends are observed in the mortality rate of children under-5 years of age, which has nearly halved over the last decade for both girls and boys. Currently, there are no studies conducted in Georgia that examine the trends in mortality rates in relation to heat waves, nor are there any forecasts regarding potential improvements or declines in these statistics. Nevertheless, the experiences of other countries indicate that it is crucial to consider these factors when evaluating the effects of climate change, and such considerations should be incorporated into policy documents, presenting a significant challenge at this time.

Causes of disease and mortality: Climate change is a significant factor contributing to the emergence of new diseases and exacerbating the progression of existing ones. In certain instances, it may even result in increased mortality rates. Current statistics indicate that the primary causes of illness and death differ between men and women, suggesting that the effects of climate change on the progression of diseases may manifest differently across genders. However, the scarcity of research in this area complicates the ability to draw definitive conclusions. Data analysis reveals that the incidence of tuberculosis, HIV

53 By 2015, only 59% of the population was connected to the water supply system.

54 M. Devidze, et.al. 2023. Climate Change Impact on Women's Vulnerability in Georgia, Study report – DRAFT. Westminster Foundation

infections, and mental health disorders is higher among men compared to women, while women experience a greater number of newly diagnosed malignant tumors than men. Furthermore, an examination of mortality causes indicates that diseases of the circulatory system remain the leading contributors, accounting for 39% of female mortality and 35% of male mortality[55]. It is important to highlight that, at this juncture, the available data does not facilitate an assessment of the connection between climate change and health outcomes, including from a gender perspective, necessitating further comprehensive research.

To effectively understand the interplay between climate change and health issues, as well as to conduct gender analyses and develop relevant policies, there is a pressing need to enhance existing statistical frameworks and evidence-based policy processes, which presents a significant challenge at this time.

1.5.2 HARM REDUCTION MEASURES, STATE POLICY AND GENDER MAINSTREAMING

The Fourth National Communication, released in 2021, did not address the connection between gender and climate issues. However, progress has been made since then, as the updated Nationally Determined Contributions (NDC) document of Georgia now includes a dedicated sub-chapter on gender and climate change. This development aligns with Article 11 of the Constitution of Georgia, which guarantees the right to equality, as well as the Law of Georgia on gender equality, Decision 21/CP.22 from the Conference of the Parties regarding gender and climate change, the Enhanced Lima Programme of Work on Gender, and the relevant Gender Action Plan.

Georgia has made commitments, both domestically and internationally, to promote gender equality across various sectors. Key international obligations include the Convention on the Elimination of All Forms of Discrimination against Women and its additional protocols, the general recommendations from the Committee on the Elimination of Discrimination against Women, the European Convention for the Protection of Human Rights and Fundamental Freedoms, the Istanbul Convention on Preventing and Combating Violence against Women and Domestic Violence, the 1995 UN Beijing Declaration and Platform for Action, UN Security Council Resolution 1325 and its related resolutions, as well as the UN Sustainable Development Goals. In addition to these international commitments, significant domestic legal frameworks exist that mandate the state to uphold gender equality, including the Constitution of Georgia, the Law on Gender Equality, the Law on the Elimination of All Forms of Discrimination, and the Law on the Prevention of Violence against Women and Domestic Violence, which also encompasses provisions for the protection and assistance of victims of violence. Furthermore, strategic documents such as the National Strategy for the Protection of Human Rights (2022-2030) and its associated action plans are also noteworthy.

Georgia is not only dedicated to promoting gender equality but also actively engages in efforts to address climate change, which incorporates gender mainstreaming. These commitments are articulated in key documents such as the Paris Agreement on Climate Change and the Lima Gender Action Plan, adopted in 2014. These agreements mandate that the parties involved and the Convention Secretariat develop and implement climate

55 Statistical publication "Women and men in Georgia", 2022. Geostat

policies that are sensitive to gender issues. The Lima Gender Action Plan outlines the general responsibilities of the parties across five key areas: capacity development, knowledge management and communication; participation and leadership of women; coherence; gender-sensitive implementation processes and means of implementation; as well as monitoring and reporting.

Furthermore, the Nationally Determined Contributions (NDC) document incorporates a gender perspective. It acknowledges the nationalization of targets 5.1-5.6, 5.a, and 5.b of Sustainable Development Goal 5, which focus on achieving gender equality and empowering women. The document also recognizes women as pivotal agents of change in raising awareness, enhancing capacities and skills, and disseminating knowledge regarding climate change. Additionally, it highlights the importance of women's involvement in decision-making processes related to improving energy efficiency in residential buildings and optimizing water resource usage. Lastly, the NDC document underscores the country's intention to gather gender-disaggregated data, conduct gender analysis, and foster capacity development within the context of climate change initiatives.

The country has established a Climate Change Strategy for 2030, accompanied by an Action Plan for the years 2021-2023 and Action Plan for 2024-2025. It is important to highlight that this document largely lacks a gender mainstreaming element, with the exception of certain provisions in the forestry sector.

Based on the analysis of the documents, we can conclude that:

- Currently, the integration of gender considerations within existing international and national climate commitment documents is limited;
- Advancements in gender mainstreaming are evident in certain strategic documents (NDC, LT-LEDS), which highlight the relationship between gender and climate and emphasize the necessity for action;
- At this point, issues related to gender mainstreaming in the climate sector are primarily confined to commitments, with substantial progress in this area being less apparent at the implementation stage.

CHAPTER 2 ON NATIONAL GREENHOUSE GAS INVENTORY

This chapter provides an overview of Georgia's greenhouse gas inventory for the years 2018 to 2022. Emission and removal data are organized in tables, categorized by sector and by type of greenhouse gas, with separate considerations for the Land Use, Land-Use Change and Forestry (LULUCF) sector.

The greenhouse gas inventory for Georgia during the 2018-2022 period encompasses five distinct sectors. In the energy sector, emissions rose from 11,326 Gg CO2-eq to 13,218 Gg CO2-eq, reflecting an increase of approximately 14%. Conversely, emissions in the agricultural sector saw a decline from 2,411 Gg CO2-eq to 2,310 Gg CO2-eq, indicating a reduction of about 4%. The Industrial Processes and Product Use (IPPU) sector experienced a slight increase in emissions, rising from 2,019 Gg CO2-eq to 2,571 Gg CO2-eq, which corresponds to an increase of roughly 21%. In the waste sector, emissions grew from 1,900 Gg CO2-eq to 1,996 Gg CO2-eq, marking an overall increase of approximately 5.1%. The LULUCF sector showed a minor improvement in removals, with emissions shifting from -5,884 Gg CO2-eq to -5,801 Gg CO2-eq, representing a reduction in removal potential of about 1.4%. Throughout the 2018-2022 timeframe, the IPPU sector is anticipated to experience the most significant rise in greenhouse gas emissions, while the agricultural sector recorded the most substantial decrease. Additionally, the removal capacity of the LULUCF sector exhibited a slight decline during this period.

TABLE 2.1. GEORGIA'S GREENHOUSE GAS INVENTORY DATA FOR 2018-2022, BY SECTOR (GG CO2-EQ)

Sector	2018	2019	2020	2021	2022
Energy	11,326	11,462	11,351	11,984	13,218
Agriculture	2,411	2,377	2,541	2,530	2,310
Industrial Processes and Product Use	2,019	2,236	2,452	2,305	2,571
Waste	1,900	1,926	1,951	1,978	1,996
LULUCF	-5,884	-5,784	-5,901	-6,011	-5,801

Table 2.2 illustrates the greenhouse gas emissions in Georgia categorized by gas type from 2018 to 2022, measured in Gg CO2 equivalent. The analysis encompasses emissions from nine different greenhouse gases over the five-year span.

Carbon dioxide (CO_2) emissions exhibit a distinct upward trajectory, rising from 10,455 Gg in 2018 to 12,829 Gg in 2022, which corresponds to a 22% increase. In contrast, emissions of methane (CH_4) and nitrous oxide (N_2O) have experienced a slight decline relative to their levels in 2018.

Additionally, the table details emissions of fluorinated gases (HFCs). Notably, emissions of HFC-125 rose by 54.62 Gg CO2-eq from 2018 to 2022, marking an 82% increase for this specific gas. Other HFC gases also demonstrated considerable increases during the same timeframe. Furthermore, emissions of sulfur hexafluoride (SF_6) experienced a modest rise from 0.93 Gg CO2-eq in 2018 to 1.14 Gg CO2-eq in 2022, with HFC emissions showing the most pronounced growth between 2018 and 2022.

TABLE 2.2. GEORGIA'S GREENHOUSE GAS INVENTORY DATA FOR 2018-2022, BY GAS (GG CO2-EQ).

Year	CO_2	CH_4	N_2O	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-227ea	SF_6
2018	10,455	6,048	905	10.40	66.44	95.40	72.38	0.31	0.93
2019	11,171	5,639	892	11.96	79.43	115.42	92.56	0.10	1.00
2020	11,050	5,859	943	14.45	122.91	153.60	152.04	0.61	1.06
2021	11,545	5,943	924	16.59	117.49	126.94	122.14	0.39	1.12
2022	12,829	5,906	879	14.82	121.06	207.04	136.20	0.47	1.14

Table 2.3 illustrates the findings of the greenhouse gas inventory for the years 2022 and 1990, highlighting the variations in emissions between these two years. Notably, there has been a considerable reduction in greenhouse gas emissions within the energy and agriculture sectors. Conversely, the LULUCF/IPPU and waste sectors have experienced an increase in emissions.

TABLE 2.3. VARIATION IN GHG EMISSIONS IN 2022 RELATIVE TO 1990.

Sector	GHG emissions, Gg CO2-eq		Change in 2022 compared to 1990
	1990	2022	
Energy	39,464	13,218	-66.5%
Agriculture	1,549	2,571	66.0%
Industrial processes and product use	4,284	2,310	-46.1%
Waste	1,185	1,996	68.4%
Total, excluding **LULUCF**	**46,482**	**20,095**	-56.8%
LULUCF	-8,180	-5,801	-29.1%
Total, including **LULUCF**	**38,302**	**14,294**	-62.7%

The national greenhouse gas inventory is described in detail in the “National Inventory Document”.

2.1 ENERGY (SECTOR 1)

2.1.1 GENERAL INFORMATION

In 2022, greenhouse gas (GHG) emissions from the energy sector in Georgia reached 13,218 Gg CO2-equivalent, representing approximately 67% of the country’s total GHG emissions. The distribution of emissions within the energy sector is as follows: energy industry accounts for 11.5%, mining and construction for 13.5%, transport for 34%, other sectors for 25%, and fugitive emissions for 16%.

The energy sector’s GHG emissions are categorized into two main types: fuel combustion and fugitive emissions. Fuel combustion emissions stem from the burning of fossil fuels, including coal, oil, oil products, and natural gas. Fugitive emissions are associated with activities involving coal, oil, and natural gas, such as extraction, processing, and distribution.

In Georgia, fossil fuels are utilized across nearly all economic sectors, including industry and transport, for energy production. The combustion process generates and releases various gases into the atmosphere, including CO2 (carbon dioxide), CH4 (methane), N2O (nitrous oxide), NOX (nitrogen oxides), CO (carbon monoxide), and NMVOC (non-methane volatile organic compounds).

2.1.2 GHG EMISSIONS TREND

Table 2.4 illustrates the greenhouse gas emissions originating from the energy sector for the years 1990 to 2022. The notable reduction in emissions during the 1990s can be attributed to substantial transformations within the country’s economy following the dissolution of the Soviet Union.

TABLE 2.4. GHG EMISSIONS FROM THE ENERGY SECTOR (GG CO2-EQ).

Year	Emissions from fuel combustion	Volatile emissions	Total from the sector
1990	31,330	8,134	**39,464**
1991	23,755	7,897	**31,652**
1992	19,712	6,865	**26,577**
1993	15,845	5,751	**21,596**
1994	10,285	2,065	**12,350**
1995	7,350	1,704	**9,054**
1996	7,406	2,262	**9,668**
1997	6,398	2,070	**8,468**
1998	5,469	2,075	**7,544**
1999	4,684	1,136	**5,820**
2000	4,895	1,493	**6,388**
2001	3,599	1,102	**4,701**
2002	3,177	2,837	**6,014**
2003	3,326	3,556	**6,882**
2004	3,658	3,614	**7,272**
2005	4,373	1,717	**6,090**
2006	4,737	3,485	**8,222**
2007	5,317	3,126	**8,443**
2008	5,084	1,944	**7,028**
2009	5,509	1,497	**7,006**
2010	5,928	2,273	**8,201**
2011	7,193	2,916	**10,109**
2012	7,499	3,156	**10,655**
2013	7,761	2,112	**9,873**
2014	8,414	1,963	**10,377**
2015	9,092	2,681	**11,773**
2016	9,390	2,773	**12,163**
2017	9,291	2,030	**11,321**
2018	9,101	2,225	**11,326**
2019	9,663	1,799	**11,462**
2020	9,444	1,908	**11,352**
2021	10,014	1,970	**11,984**
2022	11,148	2,070	**13,218**

Table 2.5 presents emissions by greenhouse gas. The dominant gas is carbon dioxide, whose share in the sector's emissions varies from year to year and is within the range of

44.3-82.9 percent, while in recent years it has exceeded 80%. The share of nitrous oxide is insignificant.

TABLE 2.5. GHG EMISSIONS FROM THE ENERGY SECTOR BY GAS

Year	Gg CO_2	%	Gg CH_4	CH_4 Gg CO_2-eq	%	Gg N_2O	N_2O Gg CO_2-eq	%	Total Gg CO2-eq	%
1990	31,028	78.6	297	8,313	21.1	0.465	123	0.3	**39,464**	100.0
1991	23,475	74.2	289	8,084	25.5	0.349	92	0.3	**31,652**	100.0
1992	19,346	72.8	255	7,143	26.9	0.33	88	0.3	**26,577**	100.0
1993	15,351	71.1	220	6,152	28.5	0.349	92	0.4	**21,595**	100.0
1994	10,110	81.9	78	2,194	17.8	0.174	46	0.4	**12,350**	100.0
1995	7,052	77.9	70	1,951	21.5	0.192	51	0.6	**9,054**	100.0
1996	6,961	72.0	94	2,626	27.2	0.305	81	0.8	**9,668**	100.0
1997	6,041	71.3	84	2,361	27.9	0.251	67	0.8	**8,469**	100.0
1998	5,162	68.4	83	2,328	30.9	0.202	53	0.7	**7,544**	100.0
1999	4,392	75.5	49	1,378	23.7	0.186	49	0.8	**5,820**	100.0
2000	4,624	72.4	61	1,719	26.9	0.171	45	0.7	**6,388**	100.0
2001	3,326	70.8	47	1,329	28.3	0.172	45	1.0	**4,701**	100.0
2002	2,901	48.2	110	3,067	51.0	0.174	46	0.8	**6,014**	100.0
2003	3,051	44.3	135	3,784	55.0	0.177	47	0.7	**6,881**	100.0
2004	3,378	46.5	137	3,846	52.9	0.179	47	0.6	**7,272**	100.0
2005	4,196	68.9	66	1,856	30.5	0.144	38	0.6	**6,090**	100.0
2006	4,550	55.3	130	3,633	44.2	0.152	40	0.5	**8,222**	100.0
2007	5,108	60.5	117	3,288	38.9	0.179	47	0.6	**8,443**	100.0
2008	4,885	69.5	75	2,099	29.9	0.164	44	0.6	**7,028**	100.0
2009	5,304	75.7	59	1,652	23.6	0.19	50	0.7	**7,006**	100.0
2010	5,723	69.8	87	2,425	29.6	0.197	52	0.6	**8,200**	100.0
2011	7,013	69.4	109	3,043	30.1	0.198	53	0.5	**10,108**	100.0
2012	7,325	68.7	117	3,277	30.8	0.204	54	0.5	**10,656**	100.0
2013	7,490	75.9	83	2,314	23.4	0.264	70	0.7	**9,874**	100.0
2014	8,131	78.4	78	2,172	20.9	0.28	74	0.7	**10,377**	100.0
2015	8,829	75.0	102	2,869	24.4	0.282	75	0.6	**11,773**	100.0
2016	9,125	75.0	106	2,957	24.3	0.305	81	0.7	**12,162**	100.0
2017	9,043	79.9	79	2,203	19.5	0.281	74	0.7	**11,321**	100.0
2018	8,890	78.5	85	2,369	20.9	0.257	68	0.6	**11,326**	100.0
2019	9,457	82.5	69	1,936	16.9	0.264	70	0.6	**11,462**	100.0
2020	9,258	81.6	73	2,031	17.9	0.237	63	0.6	**11,352**	100.0

Year	Gg CO_2	%	Gg CH_4	CH_4 Gg CO_2-eq	%	Gg N_2O	N_2O Gg CO_2-eq	%	Total Gg CO2-eq	%
2021	9,821	82.0	75	2,097	17.5	0.251	66	0.6	**11,984**	100.0
2022	10,955	82.9	78	2,196	16.6	0.253	67	0.5	**13,218**	100.0

2.1.3 METHODOLOGICAL ISSUES

Greenhouse gas emissions were determined utilizing the methodologies outlined in the 2006 IPCC Guidlines, specifically employing the Level 1 and Level 2 approaches. Furthermore, both national emission factors and standard values of emission factors from the 2006 IPCC were incorporated. The details regarding the methodological levels and types of emission factors applied in the energy sector are illustrated in Table 2.6.

TABLE 2.6. METHODOLOGICAL LEVELS AND TYPES OF EMISSION FACTORS USED IN THE ENERGY SECTOR.

Categories	CO_2		CH_4		N_2O	
	Method	Emission factor	Method	Emission factor	Method	Emission factor
1.A - Fuel combustion	T1	D	T1	D	T1	D
1.A.1 - Energy industry	T1, T2	D	T1, T2	D	T1, T2	D
1.A.2 - Manufacturing and construction	T1	D	T1	D	T1	D
1.A.3 - Transport	T1	D	T1	D	T1	D
1.A.4 - Other sectors	T1	D	T1	D	T1	D
1.A.4.a - Commercial/Public	*T1*	*D*	*T1*	*D*	*T1*	*D*
1.A.4.b - Domestic	*T1*	*D*	*T1*	*D*	*T1*	*D*
1.A.4.c -Agriculture/Forestry/Fisheries	*T1*	*D*	*T1*	*D*	*T1*	*D*
1.A.5 Unspecified	T1	D	T1	D	T1	D
1.B - Fugitive emissions from fuels	T1	D	T1, T2	D, CS	T1	D
1.B.1 - Solid fuels	T1	D	T1	D	NA	NA
1.B.2 - Oil and natural gas	T1	D	T1, T2	D, CS	T1	D
1.B.2.a - Oil	*T1*	*D*	*T1*	*D*	*T1*	*D*
1.B.2.b - Natural gas	*T1*	*D*	*T2*	*CS*	*T1*	*D*
1.C. CO2 transport and storage	NA	NA				

EF – emission factor, T1 – level 1; T2 – level 2; CS – national EF; D – typical EF

2.2 INDUSTRIAL PROCESSES AND PRODUCT USE (SECTOR 2)

2.2.1 GENERAL INFORMATION

The industrial processes and product use sector encompasses the following categories: the production of mineral materials (2.A), the chemical industry (2.B), metal production (2.C), non-energy products derived from the use of fuels and solvents (2.D), products designed to replace ozone-depleting substances (2.F), and the production and utilization of various other products (2.G).

2.2.2 GHG EMISSIONS TREND

Greenhouse gas emissions originating from the industrial processes and product use sector were assessed for the period from 2018 to 2022. To maintain the consistency of the time series, emissions for the earlier years, specifically from 1990 to 2017, were recalculated. The findings are detailed in Table 2.7.

TABLE 2.7. GREENHOUSE GAS EMISSIONS FROM THE INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR CATEGORIZED BY TYPE (IN GG CO2-EQ) FOR THE YEARS 1990-2022.

Year	Category						Total
	2.A Production of mineral materials	2.B Chemical industry	2.C Metal production	2.D Non-energy products	2.F Product used to replace ozone-depleting substances	2.G Production and use of other products	
1990	576.0	C	254.7	C	-	NA	**1,548.5**
1991	360.6	C	179.3	C	-	NA	**1,271.5**
1992	221.7	C	85.9	C	-	NA	**814.9**
1993	117.1	C	65.1	C	-	NA	**639.7**
1994	48.0	C	45.2	C	-	NA	**378.8**
1995	33.5	C	46.6	C	-	NA	**399.1**
1996	49.5	C	36.3	C	-	NA	**492.0**
1997	43.2	C	49.6	C	-	NA	**441.4**
1998	84.7	C	80.7	C	-	NA	**467.7**
1999	138.3	C	58.2	C	-	NA	**693.0**
2000	142.5	C	46.5	C	-	NA	**708.8**
2001	146.0	C	71.1	C	0.2	NA	**433.4**
2002	160.6	C	60.7	C	0.9	NA	**576.4**
2003	163.2	C	111.0	C	2.9	NA	**685.7**
2004	190.1	C	186.9	C	5.2	NA	**835.0**
2005	228.3	C	200.4	C	9.4	NA	**941.6**
2006	378.8	C	213.9	C	9.2	NA	**1,165.7**
2007	489.5	C	207.1	C	9.7	NA	**1,266.8**
2008	643.3	C	235.3	C	14.9	NA	**1,424.8**
2009	339.8	C	223.8	C	22.3	NA	**1,090.6**

Year	Category						Total
	2.A Production of mineral materials	2.B Chemical industry	2.C Metal production	2.D Non-energy products	2.F Product used to replace ozone-depleting substances	2.G Production and use of other products	
2010	437.3	C	361.0	C	59.4	0.55	**1,445.5**
2011	622.2	C	437.7	C	70.1	0.62	**1,768.7**
2012	648.2	C	472.6	C	98.8	0.68	**1,876.0**
2013	662.8	C	465.3	C	109.1	0.68	**1,885.5**
2014	776.1	C	475.4	C	125.3	0.74	**2,021.9**
2015	775.0	C	425.2	C	144.8	0.79	**2,029.2**
2016	718.0	C	367.5	C	154.2	0.83	**1,917.6**
2017	728.4	C	436.2	C	192.1	0.87	**2,070.3**
2018	632.7	C	391.9	C	244.6	0.93	**2,018.8**
2019	718.5	C	418.1	C	299.4	1.00	**2,235.7**
2020	778.5	C	443.7	C	443.0	1.06	**2,451.8**
2021	727.6	C	468.9	C	383.2	1.12	**2,304.4**
2022	819.2	C	493.7	C	479.1	1.14	**2,571.0**

2.2.3 METHODOLOGICAL ISSUES

GHG emissions were calculated using the methodologies presented in the 2006 IPCC Guidelines using the Level 1, Level 2 and Level 3 approaches of accuracy/complexity. In addition, both national emission factors and typical values of emission factors from the 2006 IPCC were used. Table 2.8 presents the methodological levels and types of emission factors used in the energy sector.

TABLE 2.8 METHODOLOGICAL LEVELS AND TYPES OF EMISSION FACTORS USED IN THE ENERGY SECTOR

2A		Mineral industry	Chemical industry	Metal production	Non-energy products from fuel and solvent consumption	Electronics manufacturing	Products used to replace ozone-depleting substances	Production and use of other products	Other industrial processes, such as paper, beverage, and food manufacturing
		2B	2C	2D	2E	2F	2G	2H	
CO_2	Method used	T2,T3	T3	T1,T2	T1	NA		NA,NO	NO
	Emission factor	D,CS	D,CS	D	D	NA		NA,NO	NO
CH_4	Method used			T1	NA,NO	NA		NA,NO	NO
	Emission factor			D	NA,NO	NA		NA,NO	NO
N_2O	Method used		T2	NA,NO	NA,NO	NA		NA,NO	NO
	Emission factor		D	NA,NO	NA,NO	NA		NA,NO	NO
HFC-32	Method used					NA	T1	NA,NO	NO
	Emission factor					NA	D	NA,NO	NO
HFC-125	Method used					NA	T1	NA,NO	NO
	Emission factor					NA	D	NA,NO	NO
HFC-134a	Method used					NA	T1	NA,NO	NO
	Emission factor					NA	D	NA,NO	NO
HFC-143a	Method used					NA	T1	NA,NO	NO
	Emission factor					NA	D	NA,NO	NO
HFC-227ea	Method used					NA	NE	T1	NO
	Emission factor					NA	NE	D	NO
SF_6	Method used					NA		T1	NO
	Emission factor					NA		D	NO

2.3 AGRICULTURE (SECTOR 3)

2.3.1 GENERAL INFORMATION

Agriculture has historically been a prominent sector within the Georgian economy.

Currently, 40% of the population resides in rural regions and is involved in agricultural activities. This sector is vital to the economic framework of Georgia, making it a focal point in all national strategic documents. Georgian farmers must play a key role in ensuring the supply of a fundamental need of society - safe and affordable food.

In terms of greenhouse gas emissions, Georgia's agricultural sector encompasses several categories, including enteric fermentation, manure management, both direct and indirect emissions of N2O from cultivated soils, the burning of agricultural waste, and the application of urea.

2.3.2 GHG EMISSIONS TREND

GHG emissions from the agricultural sector were calculated for the years 2018-2022 and, to ensure consistency of the time series, were recalculated for the previous years, 1990-2017. The results are presented in Table 2.9.

TABLE 2.9. GHG EMISSIONS FROM THE AGRICULTURAL SECTOR (GG CO2-EQ) 1990-2022

Year	CH_4				N2O						CO2		Total Gg CO_2 eq
	3.A.1 Enteric fermentation	3.A.2 Manure management	3.C.1.b On arable land Biomass burning	Total GG CH_4	3.A.2 N_2O direct Emissions from manure management	3.C.6 N_2O indirect Emissions from manure management	3.C.4 Direct emissions From managed soils	3.C.5 Indirect emissions From managed soils	3.C.1.b On arable land Biomass burning	Total GG N_2O	3.C.3 Urea consumption	Total CO_2	
1990	2,980	344	2	**3,326**	111	70	606	171	1	**958**	0	0	**4,284**
1991	2,706	304	2	**3,012**	98	63	530	150	1	**841**	0	0	**3,853**
1992	2,166	222	2	**2,390**	74	48	413	116	0	**651**	0	0	**3,041**
1993	1,916	185	1	**2,102**	64	44	361	102	0	**571**	0	0	**2,674**
1994	1,851	171	1	**2,023**	63	45	335	92	0	**535**	0	0	**2,558**
1995	1,820	159	1	**1,979**	62	46	352	96	0	**556**	0	0	**2,536**
1996	1,790	144	1	**1,935**	61	47	436	119	0	**664**	0	0	**2,599**
1997	1,788	143	1	**1,932**	61	48	471	126	0	**705**	0	0	**2,637**
1998	1,803	140	1	**1,944**	62	44	412	110	0	**628**	0	0	**2,572**
1999	1,899	147	2	**2,047**	66	47	481	127	0	**721**	0	0	**2,769**
2000	1,956	151	1	**2,107**	68	48	444	119	0	**679**	0	0	**2,787**
2001	1,947	150	2	**2,099**	68	48	477	124	1	**718**	0	0	**2,817**
2002	1,991	152	1	**2,145**	69	50	511	136	0	**766**	0	0	**2,911**

Year	CH 4				N2O						CO2		Total Gg CO2 eq
	3.A.1 Enteric fermentation	3.A.2 Manure management	3.C.1.b On arable land Biomass burning	Total GG CH_4	3.A.2 N_2O direct Emissions from manure management	3.C.6 N_2O indirect Emissions from manure management	3.C.4 Direct emissions From managed soils	3.C.5 Indirect emissions From managed soils	3.C.1.b On arable land Biomass burning	Total GG N_2O	3.C.3 Urea consumption	Total CO_2	
2003	2,022	157	2	**2,180**	71	50	532	141	0	**795**	0	0	**2,976**
2004	1,922	152	1	**2,075**	69	49	458	122	0	**698**	0	0	**2,773**
2005	1,928	149	2	**2,078**	68	47	463	121	0	**699**	0.1	0.1	**2,777**
2006	1,741	128	1	**1,870**	59	41	410	115	0	**625**	0.1	0.1	**2,494**
2007	1,679	106	1	**1,786**	49	38	360	98	0	**545**	0.1	0.1	**2,331**
2008	1,654	103	1	**1,759**	48	38	365	99	0	**549**	0.1	0.1	**2,308**
2009	1,591	105	2	**1,698**	47	37	352	97	0	**533**	0.3	0.3	**2,231**
2010	1,621	104	1	**1,726**	47	37	341	95	0	**520**	0.8	0.8	**2,246**
2011	1,658	106	2	**1,766**	48	38	351	94	0	**530**	0.2	0.2	**2,296**
2012	1,723	118	1	**1,842**	52	39	384	105	0	**581**	0.4	0.4	**2,424**
2013	1,863	125	1	**1,989**	55	42	458	125	0	**681**	0.5	0.5	**2,670**
2014	1,925	127	1	**2,053**	56	43	454	123	0	**677**	1.7	1.7	**2,731**
2015	1,981	132	2	**2,115**	57	45	473	128	1	**704**	2.7	2.7	**2,822**
2016	1,906	129	2	**2,037**	55	43	450	123	1	**671**	1.7	1.7	**2,709**
2017	1,791	122	2	**1,915**	52	41	393	108	0	**595**	1.9	1.9	**2,512**
2018	1,715	117	2	**1,834**	51	39	379	104	1	**574**	2.5	2.5	**2,411**
2019	1,709	121	2	**1,832**	50	39	356	97	1	**542**	2.7	2.7	**2,377**
2020	1,803	128	2	**1,934**	53	41	400	109	0	**603**	4.8	4.8	**2,541**
2021	1,797	127	2	**1,926**	52	40	399	109	1	**601**	3.1	3.1	**2,530**
2022	1,649	118	2	**1,770**	48	37	354	96	1	**537**	3.9	3.9	**2,310**

2.3.3. METHODOLOGICAL ISSUES

Emissions originating from the agricultural sector were assessed utilizing both the Tier 1 methodological framework alongside standard values of emission factors. For significant categories, the Tier 2 methodological framework and country-specific emission factors were employed. A concise overview of the methodologies applied for estimating emissions by category is presented in Table 2.10.

TABLE 2.10. METHODOLOGIES AND EMISSION FACTORS UTILIZED FOR THE CALCULATION OF GHG EMISSIONS FROM THE AGRICULTURAL SECTOR.

<table>
<tr><th rowspan="2">Source category</th><th colspan="2">CO2</th><th colspan="2">CH $_4$</th><th colspan="2">N2O</th></tr>
<tr><th>Method</th><th>EF</th><th>Method</th><th>EF</th><th>Method</th><th>EF</th></tr>
<tr><td>3.A.1 Enteric fermentation</td><td colspan="2" rowspan="3">T2
CS
T1
D
T1</td><td>T1, T2</td><td>CS, D</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>3.A.2 Manure management</td><td></td><td></td></tr>
<tr><td>3.C.1.b Burning of biomass on arable land</td><td>D</td><td></td><td></td><td></td></tr>
<tr><td>3.A.2 Direct N2O emissions from manure management</td><td colspan="4" rowspan="11">T1, T2
D, CS
T1
D
T1
D
T1
D
T1
D
T1
D
T1
D
T1
D
T1
D</td><td>T2</td><td>CS</td></tr>
<tr><td>3.C.6 Indirect N2O emissions from manure management</td><td></td><td></td></tr>
<tr><td>3.C.4 Direct N2O emissions from managed soils</td><td></td><td></td></tr>
<tr><td>Synthetic N fertilizers</td><td></td><td></td></tr>
<tr><td>Organic N fertilizer applied to the soil</td><td></td><td></td></tr>
<tr><td>Emissions from animal manure on pastures</td><td></td><td></td></tr>
<tr><td>Rotting of crop residues</td><td></td><td></td></tr>
<tr><td>3.C.5 Indirect N2O emissions from managed soils</td><td></td><td></td></tr>
<tr><td>N2O emissions from managed soils from the application of aerated nitrogen</td><td></td><td></td></tr>
<tr><td>N2O emissions from nitrogen leaching and flushing</td><td></td><td></td></tr>
<tr><td>3.C.3 Urea consumption</td><td>T1</td><td>D</td><td colspan="4"></td></tr>
</table>

EF – emission factor, T1 – level 1; T2 – level 2; CS – national EF; D – typical EF

2.4 LAND USE, LAND USE CHANGE AND FORESTRY (SECTOR 4)

2.4.1 GENERAL INFORMATION

The greenhouse gas (GHG) inventory for the Land Use, Land-Use Change, and Forestry (LULUCF) sector was prepared in accordance with the 2006 IPCC Guidelines, covering the years 1990 to 2022. Specifically, the emissions and removals data for the earlier period of 1990 to 2017 were revised, and new calculations were performed for the years 2018 to 2022.

This sector encompasses six sub-sectors: Forestry (3B1), Cropland (3B2), Grasslands (3B3), Wetlands (3B4), Settlements (3B5), and Other Land (3B6).

2.4.2 GHG EMISSIONS TREND

The greenhouse gas (GHG) inventory within the Land Use, Land-Use Change, and Forestry (LULUCF) sector was carried out across four sub-sectors, specifically focusing on three primary source categories: forest land, cropland, grassland, and wetlands. The carbon dioxide emissions for each sub-sector, along with the total emissions for the entire sector from 1990 to 2022, are detailed in Table 2.28. The methodology for calculations, the activity data utilized, and the emission factors are thoroughly explained in the subsequent chapters. In the tables presented in the report, CO2 emissions are denoted with a (+) sign, while CO2 removals from the atmosphere are marked with a (-) sign.

According to Table 2.11, the most significant change in emissions since 1990 has occurred in arable land, particularly in areas cultivated with perennial crops. Notably, carbon dioxide emissions were recorded at -1,041 Gg CO2 in 1990, whereas by 2022, emissions had risen to 757.5 Gg CO2.

TABLE 2.11. GHG INVENTORY RESULTS FOR THE LULUCF SECTOR FROM 1990 TO 2022.

Year	Forest lands		Arable land				Meadows		Wetlands		Clean emission/ Absorption	
			Perennial crops		Arable land							
	Thousand tons C	GG CO2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2
1990	1,883	-6,904	284	-1,041	188	-689	-120	439	4	16	**2,239**	**-8,180**
1991	1,894	-6,943	269	-986	132	-483	-223	816	4	16	**2,076**	**-7,580**
1992	1,929	-7,074	254	-932	136	-499	-223	816	4	16	**2,101**	**-7,672**
1993	1,899	-6,964	239	-877	123	-450	-223	816	4	16	**2,043**	**-7,459**
1994	1,894	-6,943	224	-822	60	-221	-223	816	4	16	**1,960**	**-7,154**
1995	1,915	-7,020	209	-768	76	-277	-223	816	4	16	**1,981**	**-7,233**
1996	1,897	-6,956	195	-713	71	-262	-223	816	4	16	**1,945**	**-7,099**
1997	1,950	-7,150	180	-659	82	-302	-223	816	4	16	**1,994**	**-7,278**
1998	1,837	-6,737	165	-604	77	-282	-217	796	4	16	**1,866**	**-6,810**
1999	1,852	-6,791	150	-549	92	-337	-217	796	4	16	**1,881**	**-6,865**
2000	1,837	-6,735	135	-494	88	-321	-217	796	4	16	**1,846**	**-6,739**
2001	1,869	-6,854	120	-440	123	-451	-217	796	4	16	**1,899**	**-6,933**
2002	1,818	-6,666	105	-385	128	-471	-217	796	4	16	**1,839**	**-6,710**
2003	1,780	-6,526	90	-330	148	-543	-217	796	4	16	**1,805**	**-6,588**
2004	1,742	-6,388	75	-276	162	-595	-209	765	4	16	**1,775**	**-6,478**
2005	1,633	-5,986	60	-221	159	-585	-209	765	4	16	**1,648**	**-6,011**
2006	1,777	-6,515	45	-167	243	-893	-209	765	4	16	**1,861**	**-6,793**
2007	1,616	-5,927	31	-112	258	-947	-209	765	4	16	**1,701**	**-6,205**
2008	1,649	-6,047	16	-57	284	-1,042	-209	765	4	16	**1,745**	**-6,366**
2009	1,709	-6,266	1	-2	262	-959	-209	765	4	16	**1,767**	**-6,446**
2010	1,654	-6,066	-14	52	160	-588	-209	765	4	16	**1,596**	**-5,821**
2011	1,775	-6,508	-29	107	158	-579	-209	765	4	16	**1,699**	**-6,199**
2012	1,854	-6,796	-44	162	159	-583	-209	765	4	16	**1,764**	**-6,437**
2013	1,720	-6,306	-59	216	136	-499	-209	765	4	16	**1,593**	**-5,808**
2014	1,716	-6,290	-74	271	134	-490	-209	765	4	16	**1,571**	**-5,728**
2015	1,705	-6,252	-89	326	157	-577	-209	765	4	16	**1,569**	**-5,722**
2016	1,747	-6,404	-104	380	168	-616	-209	765	4	16	**1,607**	**-5,859**
2017	1,741	-6,385	-119	435	177	-648	-209	765	5	20	**1,596**	**-5,813**
2018	1,771	-6,493	-134	490	183	-670	-209	765	7	24	**1,618**	**-5,884**
2019	1,760	-6,452	-149	545	185	-677	-209	765	10	35	**1,597**	**-5,784**
2020	1,823	-6,686	-176	645	182	-667	-209	765	11	39	**1,631**	**-5,903**

Year	Forest lands		Arable land				Meadows		Wetlands		Clean emission/ Absorption	
		Perennial crops		Arable land								
	Thousand tons C	GG CO2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2	Thousand tons of C	GG CO_2
2021	1,869	-6,853	-191	701	181	-663	-209	765	10	38	**1,660**	**-6,011**
2022	1,826	-6,694	-207	758	179	-656	-209	765	7	26	**1,596**	**-5,801**

2.4.3. METHODOLOGICAL ISSUES

The methodology employed for the inventory of the Geographic Information System (GIS) is grounded in the principles of "best practice." This approach emphasizes the advancement towards a high standard of calculations, which necessitates an enhancement of research capabilities in the pertinent fields. Additionally, it requires the engagement of agencies capable of systematically gathering the data essential for these calculations, as well as providing statistical indicators to the inventory team. Most critically, it involves the supply of relevant information. At this juncture, the acquisition of data continues to pose challenges; often, data is not organized, hindering the transition from the initial to the subsequent level of calculations (refer to Table 2.12).

TABLE 2.12. METHODOLOGICAL LEVELS UTILIZED IN THE LAND USE, LAND USE CHANGE, AND FORESTRY SECTOR.

Category	CO2		CH_4		N2O		NOx		CO	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
5.A Forestry Lands	D, T2	D, PS	D,T1	D	D, T1	D	D, T1	D	D, T1	D
5.B Arable - Sowing lands	D, T1	D ,P.S.	NE	NE	NE	NE	NE	NE	NE	NE
5.C Meadows	D, T1	D, P.S.	NE	NE	NE	NE	NE	NE	NE	NE
5.D Wetland Lands	D,T1	D	NE	NE	NE	NE	NE	NE	NE	NE
5.E Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
5.F Other lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

EF – emission factor, T1 – level 1; T2 – level 2; D – typical EF; PS: plant specific).

2.5 WASTE (SECTOR 5)

2.5.1. GENERAL INFORMATION

The waste sector encompasses greenhouse gas emissions, specifically CO2, CH4, and N2O, resulting from various activities such as the disposal of solid waste, biological processing of solid waste, incineration of waste, and open burning. Additionally, it includes emissions generated from the treatment and discharge of both domestic and industrial wastewater.

2.5.2 GHG EMISSIONS TREND

Greenhouse gas emissions originating from the waste sector were assessed for the period from 2018 to 2022. To maintain consistency across the time series, these emissions were also recalculated for the earlier years, spanning from 1990 to 2017. The findings are detailed in Table 2.13. During the years 2018 to 2022, methane emissions from solid waste disposal sites represented roughly 84% of the total emissions attributed to the waste sector.

TABLE 2.13. GHG EMISSIONS FROM THE WASTE SECTOR IN 1990-2022

Year	CH_4, GG CO_2-th sq.					N_2O, GG CO_2-th sq.			CO2	Gg CO_2-eq
	Solid waste Placement (4.A)	Household Wastewater (4.D.1)	Industrial Wastewater Waters (4.D.2)	Composting (4.B.1)	Total	Household Wastewater (4.D.1)	Composting (4.B.1)	Total	Incineration (4.C.1)	
1990	787.4	284.0	63.1	0.0	**1,134.4**	50.8	0.0	**50.8**	0	**1,185.2**
1991	845.3	285.2	11.8	0.0	**1,142.3**	51.1	0.0	**51.1**	0	**1,193.3**
1992	901.1	284.9	6.6	0.0	**1,192.7**	51.2	0.0	**51.2**	0	**1,243.9**
1993	954.6	278.5	8.1	0.0	**1,241.3**	53.6	0.0	**53.6**	0	**1,294.9**
1994	1,004.8	255.8	2.3	0.0	**1,262.8**	53.6	0.0	**53.6**	0	**1,316.4**
1995	1,053.4	248.3	1.2	0.0	**1,303.0**	55.3	0.0	**55.3**	0	**1,358.3**
1996	1,097.9	241.5	1.4	0.0	**1,340.8**	53.9	0.0	**53.9**	0	**1,394.7**
1997	1,138.3	235.3	2.5	0.0	**1,376.0**	52.6	0.0	**52.6**	0	**1,428.6**
1998	1,175.2	231.9	1.6	0.0	**1,408.6**	52.7	0.0	**52.7**	0	**1,461.4**
1999	1,209.6	229.8	3.5	0.0	**1,442.9**	53.1	0.0	**53.1**	0	**1,496.0**
2000	1,245.7	227.6	3.7	0.0	**1,477.1**	53.4	0.0	**53.4**	0	**1,530.4**
2001	1,280.1	225.8	4.2	0.0	**1,510.0**	52.9	0.0	**52.9**	0	**1,562.9**
2002	1,311.3	223.9	2.2	0.0	**1,537.4**	52.4	0.0	**52.4**	0	**1,589.8**
2003	1,335.5	220.5	2.2	0.0	**1,558.3**	52.8	0.0	**52.8**	0	**1,611.1**

Year	CH_4, GG CO_2-th sq.					N_2O, GG CO_2-th sq.			CO2	Gg CO_2-eq
	Solid waste Placement (4.A)	Household Wastewater (4.D.1)	Industrial Wastewater Waters (4.D.2)	Composting (4.B.1)	Total	Household Wastewater (4.D.1)	Composting (4.B.1)	Total	Incineration (4.C.1)	
2004	1,357.4	217.2	4.7	0.0	**1,579.2**	53.2	0.0	**53.2**	0	**1,632.4**
2005	1,379.8	213.8	6.2	0.0	**1,599.7**	52.8	0.0	**52.8**	0	**1,652.5**
2006	1,402.7	210.4	8.5	0.0	**1,621.6**	51.7	0.0	**51.7**	0	**1,673.3**
2007	1,425.1	207.0	9.5	0.0	**1,641.6**	50.6	0.0	**50.6**	0	**1,692.2**
2008	1,446.3	203.7	8.9	0.0	**1,658.8**	50.2	0.0	**50.2**	0	**1,709.0**
2009	1,466.1	202.7	15.4	0.0	**1,684.1**	50.6	0.0	**50.6**	0	**1,734.7**
2010	1,484.3	201.1	16.4	0.0	**1,701.8**	50.8	0.0	**50.8**	0	**1,752.6**
2011	1,519.9	199.7	20.3	0.0	**1,739.9**	51.1	0.0	**51.1**	0	**1,791.1**
2012	1,543.3	197.9	21.4	0.1	**1,762.6**	51.3	0.0	**51.3**	0	**1,813.9**
2013	1,562.7	196.8	19.4	0.3	**1,779.3**	51.6	0.2	**51.8**	0	**1,831.2**
2014	1,579.2	196.7	21.7	0.7	**1,798.2**	52.2	0.5	**52.7**	0	**1,850.9**
2015	1,591.3	197.0	18.7	1.0	**1,808.0**	51.6	0.7	**52.4**	0	**1,860.4**
2016	1,601.2	197.4	18.6	1.3	**1,818.5**	51.9	0.9	**52.8**	0	**1,871.3**
2017	1,609.1	197.2	20.2	1.6	**1,828.1**	52.4	1.1	**53.5**	0.73	**1,882.4**
2018	1,611.9	209.4	21.8	1.7	**1,844.8**	52.7	1.2	**53.9**	0.85	**1,899.6**
2019	1,626.7	220.2	22.2	1.8	**1,870.9**	53.2	1.3	**54.5**	1.01	**1,926.4**
2020	1,639.5	231.2	21.7	1.8	**1,894.2**	53.6	1.3	**54.9**	1.51	**1,950.6**
2021	1,651.4	243.4	23.4	1.8	**1,920.0**	54.4	1.3	**55.6**	2.14	**1,977.8**
2022	1,662.3	252.0	24.1	1.8	**1,940.3**	52.2	1.3	**53.5**	2.02	**1,995.9**

2.5.3 METHODOLOGICAL ISSUES

Emissions associated with the categories of Solid Waste Disposal (4.A), Biological Treatment of Solid Waste (4.B), Waste Incineration and Open Burning (4.C), Domestic Wastewater Treatment and Discharge (4.D.1), and Industrial Wastewater Treatment and Discharge (4.D.2) were assessed utilizing both the Tier 1 methodological framework, which incorporates standard emission factor values, and the Tier 2 methodological framework, which employs country-specific emission factors for significant categories. The methodologies applied for estimating emissions across these categories are detailed in Table 2.14.

TABLE 2.14. METHODS AND EMISSION FACTORS UTILIZED FOR CALCULATING GHG EMISSIONS FROM THE WASTE SECTOR.

<table>
<tr><th rowspan="2">Category</th><th colspan="2">CO2</th><th colspan="2">CH4</th><th colspan="2">N2O</th></tr>
<tr><th>Method</th><th>EF</th><th>Method</th><th>EF</th><th>Method</th><th>EF</th></tr>
<tr><td>4.A Solid waste disposal</td><td colspan="2" rowspan="2">T1</td><td>T2</td><td>CS, D</td><td colspan="2"></td></tr>
<tr><td>4.B Biological treatment of solid waste</td><td>D</td><td>T1</td><td>D</td><td></td></tr>
<tr><td>4.C Incineration and open burning of waste</td><td>T1</td><td>D</td><td colspan="4"></td></tr>
<tr><td>4.D.1 Treatment and discharge of domestic wastewater</td><td colspan="2" rowspan="2">T1</td><td>T1</td><td>D</td><td>T1</td><td>D</td></tr>
<tr><td>4.D.2 Treatment and discharge of industrial wastewater</td><td>D</td><td colspan="2"></td><td></td></tr>
</table>

EF – emission factor, T1 – level 1; T2 – level 2; CS – national EF; D – typical EF

The national inventory of greenhouse gas emissions is described in detail in the “National Inventory Document”.

CHAPTER 3. MITIGATION

POLICIES, MEASURES, ACTIVITIES, AND PLANS, ALONG WITH THE CO-BENEFITS OF MITIGATION DERIVED FROM ADAPTATION INITIATIVES AND ECONOMIC DIVERSIFICATION STRATEGIES, ASSOCIATED WITH THE EXECUTION AND ACHIEVEMENT OF THE NATIONALLY DETERMINED CONTRIBUTION.

In 2021, Georgia formulated and presented an updated Nationally Determined Contribution (NDC) document to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). This document outlines the country's voluntary commitment to achieve a 35% reduction in greenhouse gas emissions by 2030, unconditionally, and an additional reduction of 15-22% with international assistance, relative to 1990 levels, contingent upon global emissions adhering to the 2°C and 1.5°C scenarios, respectively.

The Ministry of Environmental Protection and Agriculture of Georgia, with the support of the German Society for International Cooperation (GIZ), has developed the Climate Change Strategy 2030 along with Action Plans for the periods 2021-2023 and 2024-2025, which serve as the frameworks for executing the NDC. The Climate Action Plan for 2024-2025 encompasses various sectors, including energy production and transmission, transportation, buildings, industry, agriculture, forestry, and waste management.

In 2023, Georgia also prepared and submitted the Long-term Low Emission Development Strategy of Georgia (LT-LEDS) to the Secretariat of the Framework Convention on Climate Change. This long-term strategy was developed as part of the EU4Climate project, which is funded by the European Union. The EU4Climate project aims to facilitate the implementation of commitments under the Paris Agreement and to foster climate-related policies that promote low-emission and climate-resilient development in Eastern Partnership countries, including Georgia.

As of 2023, a total of 32 municipalities in Georgia have become participants in the EU initiative known as the Covenant of Mayors. This development carries significant implications for the execution of national climate change policies, given that the signatory municipalities account for roughly 65% of Georgia's population and an even greater proportion of its Gross Domestic Product (GDP). The municipalities that have signed the covenant pledge to achieve a 40 percent reduction in greenhouse gas emissions within their jurisdictions by the year 2030, relative to levels recorded in 1990.

3.1. AGREEMENTS CONCLUDED WITHIN THE FRAMEWORK OF INTERNATIONAL MARKET MECHANISMS

Georgia is currently exploring the possibility of establishing bilateral agreements with advanced and industrialized countries to address climate change mitigation, thereby supporting the fulfillment of international commitments made by various countries. This initiative is primarily motivated by the opportunity to engage in the trading of reduced greenhouse gas emissions among nations, as permitted under the United Nations Framework Convention on Climate Change.

In the last five years, Georgia has strengthened its collaboration with Japan, Switzerland, and South Korea regarding greenhouse gas emissions trading. Agreements have already been finalized with Japan and the Swiss Confederation, while discussions are ongoing with the Republic of South Korea.

Agreement between the Swiss Confederation and Georgia on the implementation of the Paris Agreement

The Agreement established between Georgia and the Swiss Confederation on 18 October 2021 is designed to create [56]a legal framework for the transfer of Internationally Transferred Mitigation Outcomes (ITMOs) to facilitate the attainment of Nationally Determined Contributions (NDCs) or other mitigation objectives. In this context, both Parties commit to fostering sustainable development while ensuring environmental integrity and transparency. Furthermore, the Parties concur on the necessity of precise accounting practices, which include the prevention of double counting.

Mitigation outcomes will be realized through actions that:

a. do not result in an increase in greenhouse gas emissions;

b. align with each Party's low-emission development strategy;

c. contribute to the low-emission development strategy aimed at achieving carbon neutrality by 2050;

d. exclude nuclear-based initiatives;

e. bolster enhanced climate action;

56 Agreement on the Implementation of the Paris Agreement between Georgia and the Swiss Confederation, 2021

f. mitigate the risks of carbon leakage;

g. establish baselines based on conservative data;

h. consider all existing and planned national policies, including relevant legislation;

i. take into account additional factors that may enhance climate action by the transmitter;

j. utilize the linking of mitigation results to financing sources, where appropriate and feasible;

k. avoid any negative environmental and social consequences.

In terms of environmental integrity, Georgia and Switzerland, as part of this Agreement, have concurred that the outcomes of climate change mitigation must be genuine, verifiable, and supplementary to other results.

The Parties have also committed to the creation and verification of a monitoring report for each mitigation initiative. Furthermore, it is imperative that each Party guarantees public access to information and publishes a report on verification and monitoring.

Each Party is required to submit quantitative data to the Paris Agreement Secretariat regarding the mitigation results that have been transferred, acquired, seized, retired, and utilized on an annual basis. These reports must detail the purpose of use, the identifier, including the organizations involved in the transfer and receipt, as well as the origin and year of acquisition of the results, along with references to the pertinent monitoring and verification reports.

The designated authorities responsible for the implementation of this Agreement are the Ministry of Environmental Protection and Agriculture/MEPA for Georgia and the Federal Department of Environment, Transport, Energy and Communications for Switzerland.

Memorandum of Understanding between the Government of Japan and the Government of Georgia on the Joint Credit Mechanism (JCM)

The Joint Lending Facility is designed to promote the adoption of advanced decarbonization technologies, products, systems, services, and infrastructure, alongside the execution of mitigation strategies aimed at reducing or eliminating greenhouse gas emissions. This initiative will support sustainable development in Georgia and assist in meeting the Nationally Determined Contributions of both Georgia and Japan. The memorandum will enable Japan to meet its commitments under the Paris Agreement while providing Georgia with opportunities to attract climate-friendly technologies and investments.

Additionally, this memorandum will foster collaboration between Georgian and Japanese companies in the development and execution of joint projects in sectors such as renewable energy, waste management, transportation, and energy efficiency.

Thus, the primary goals of the Joint Credit Facility between Georgia and Japan include the decarbonization of various sectoral technologies, products, services, systems, and infrastructure, as well as the implementation of mitigation measures that facilitate greenhouse gas sequestration or emission reductions, all contributing to sustainable development.

To facilitate these efforts, Georgia and Japan have established a Joint Committee within the framework of the Joint Credit Facility, tasked with formulating rules and guidelines for the project cycle, encompassing development, methodologies, project design, documentation, monitoring, verification, and other aspects of project management.

3.2 SECTORAL ISSUES

A significant aspect of Georgia's climate change policy focuses on the reduction of greenhouse gas emissions and the enhancement of absorption capabilities. The strategy to limit emissions to designated target levels is informed by an analysis of six key sectors within the national economy. These sectors include transport, buildings, energy generation and transmission, agriculture, industry, and waste management. Additionally, Georgia is exploring ways to improve the carbon absorption potential of its land use and forestry sector.

3.2.1 TRANSPORT SECTOR

Georgia's economic development is significantly influenced by the efficient utilization of its capabilities as a transit nation. The transportation infrastructure of the country encompasses five modes of transport: road, rail, maritime, aviation, and pipelines[57]. As per the most recent greenhouse gas inventory, emissions from the transportation sector represent 22.4% of the country's overall emissions.

The transport sector in Georgia, particularly in the realm of road passenger transport, is experiencing significant growth.[58] Road transport is responsible for over 85% of greenhouse gas emissions within the entire sector.[59] Therefore, substantial efforts are necessary to mitigate these emissions, particularly in the development of road transport and its related subsectors.

The trend in registered motor vehicles in Georgia is on the rise. In 2023, the number of motor vehicles increased by 30% compared to 2018, with current data indicating that there are 1.68 million registered vehicles in the country.[60]

The excess emissions from the road transport subsector can be attributed to an aging fleet of used cars. Efforts to modernize this fleet have commenced; as of 2023, approximately 82% of the registered motor vehicle fleet in Georgia was over ten years old[61], a decrease from 87% in 2018. Overall, the transition to clean energy within the road transport sector is showing positive trends. Between 2018 and 2023, [62]there has been an increase in the number of low-emission vehicles, primarily due to a rise in hybrid vehicle imports[63].

57 Long-term concept of low-emission development of Georgia. p. 46. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

58 Long-term concept of low-emission development of Georgia. p. 44. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

59 Long-term concept of low-emission development of Georgia. p. 44. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

60 Automobile statistics, National Statistics Service of Georgia https://automobile.geostat.ge/ka/automobiles/general-info

61 Automobile statistics, National Statistics Service of Georgia https://automobile.geostat.ge/ka/automobiles/general-info

62 The reporting period of the document (2018-2023) includes the reporting period (2021-2023) of the Action Plan of the 2030 Strategy of Climate Change of Georgia.

63 Automobile statistics, National Statistics Service of Georgia https://automobile.geostat.ge/ka/automobiles/general-info

However, the market share of electric vehicles remains minimal, accounting for less than 1% of total passenger cars.

By 2030, the transport sector aims to enhance the proportion of low- and zero-emission vehicles in the fleet, decrease reliance on fossil fuels, promote the use of biofuels, develop electric vehicle charging infrastructure, support non-motorized mobility and public transport, and implement innovative, evidence-based initiatives within the transport sector.[64]

As GDP and overall well-being improve, it is anticipated that the share of comfortable, low-emission vehicles will rise significantly by the mid-21st century, leading to a notable reduction in greenhouse gas emissions from road transport.

Additional long-term priorities in the transport sector include:

- The comprehensive utilization of Georgia's transit capabilities;
- Advancement of transportation infrastructure;
- Establishment of logistics hubs and enhanced value-added services;
- Enhancement of safety measures and service quality;
- Upgrading pedestrian and cycling pathways;
- Boosting the effectiveness of rail passenger transport;
- Promoting the production of biodiesel[65].

By the year 2030, it is anticipated that the transportation sector in Georgia will evolve to achieve a reduction in greenhouse gas emissions by 15% compared to the baseline projections[66].

According to the 2021-2023 Action Plan of the 2020-2030 Climate Strategy of Georgia, the following activities were planned to be implemented in the transport sector in 2021-2023:

1. Revision of the current regulations governing the technical inspection of vehicles;
2. Enhanced enforcement of penalties stipulated in the Code of Administrative Offenses of Georgia related to vehicle technical inspections;
3. Monitoring of vehicle emissions on public roads;
4. Exploration of additional optimal tax incentive options to promote the adoption of electric vehicles through a cost-benefit analysis;
5. Enhancement of electric vehicle infrastructure in Tbilisi;
6. Evaluation of the potential for increasing import taxes on older light vehicles based on an economic feasibility assessment;
7. Establishment of emission standards for imported vehicles informed by a cost-effectiveness analysis (EUR4 / EUR5 engines);

64 Climate change strategy of Georgia for 2030, p.30

65 Long-term concept of low-emission development of Georgia. p. 84. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

66 Nationally Determined Contribution (NDC) of Georgia, p.30. https://mepa.gov.ge/Ge/Files/ViewFile/50125

8. Examination of the potential for raising fuel taxes;
9. Encouragement and promotion of biodiesel production;
10. Execution of initiatives outlined in the Tbilisi Transport Policy;
11. Implementation of strategies proposed in the Batumi Sustainable Urban Mobility Plan;
12. Development of proposals for international climate financing aimed at improving public, intercity, and non-motorized transport;
13. Conducting a cost-benefit analysis and feasibility study to determine optimal opportunities for transferring road freight to rail transport.[67]

Of the 13 activities in the transport sector, 7 have been implemented, 5 are ongoing,[68] and 1 is planned.

Greenhouse gas emissions from the transport sector were reduced by 260.41 Gg CO2-eq during the period from 2021 to 2023, as a result of the activities undertaken. Should all 13 proposed activities be fully executed, it is anticipated that the annual reduction in greenhouse gas emissions by the year 2030 will reach 249.89 Gg CO2-eq, culminating in a total reduction of 2,009.7 Gg CO2-eq.

Specifically, the following measures have been implemented: (1) the establishment of a unified electronic database for Periodic Technical Inspection (PTI) centers, aimed at minimizing the likelihood of inspection evasion; (2) the installation of 559 license plate recognition cameras to enhance the enforcement of fines, alongside amendments to regulations concerning vehicles that have not undergone inspection, which now classify repeated offenses as aggravating circumstances and impose corresponding fines; (3) the introduction of vehicle emission controls on public roads; (4) the completion of an economic feasibility study regarding an increase in import taxes on older light vehicles; (5) the publication of a cost-benefit analysis on vehicle emission standards, along with the approval of technical regulations for the implementation of the Euro 5 standard for vehicle emissions at the national level; (6) a study on the potential increase of fuel taxes; (7) the execution of initiatives outlined in the Batumi Sustainable Urban Mobility Plan.

Currently ongoing initiatives include: (1) a cost-benefit analysis aimed at identifying optimal tax incentives to promote the use of electric vehicles; (2) enhancements to the electric vehicle infrastructure in Tbilisi; (3) support for the production of biodiesel; (4) the implementation of measures specified in the Tbilisi Transport Policy; and (5) the preparation of proposals for international climate financing to improve public transport, intercity transport, and non-motorized transport options.

Additionally, it is planned to conduct a cost-benefit analysis and feasibility study to explore the most effective opportunities for transferring road freight to rail transport.

67 2021-2023 action plan of the 2030 climate change strategy of Georgia

68 The term “ongoing” corresponds to the term “approved” in the relevant chapter of the Biennial Transparency Report (BTR).

TABLE 3.1. IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE TRANSPORT SECTOR OF GEORGIA

Activity	Description	Objectives	Instrument type	Status	Greenhouse gas	Reduced emissions (Gg CO2 eq) (2021-2023)	Expected emission reductions, (Gg CO2-eq.) (2024-2030)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
1. Amendments to the existing regulations regarding technical inspection of vehicles	**Actions undertaken prior to the reporting period:** As of April 2021, it has become a requirement to incorporate Periodic Technical Inspection (PTI) centers into a centralized electronic database. This initiative aims to enhance the transparency of the PTI process and diminish the likelihood of evading inspections[69].	Implementing legislative and administrative measures to reduce the tendency to bypass technical inspections.	Regulatory instrument	Implemented	CO2	-37.82	- 96.25	See BTR	2021	Ministry of Economy and Sustainable Development	Administrative expenses	Reduced number of administrative violations	NO
2. More effective enforcement of fines provided for in the Code of Administrative Offenses of Georgia regarding technical inspections of vehicles	**Actions taken before the reporting period:** For the effective enforcement of fines, 559 license plate recognition video cameras were installed. On March 22, 2023, with the active participation of the Ministry of Internal Affairs and the initiative of members of the Parliament of Georgia, amendments were made to Article 118 of the Administrative Offenses Code of Georgia, which concerns driving a vehicle that has not undergone periodic technical inspection. The second, third, and fourth commission of the same act were defined as aggravating circumstances. The amendment also determined the corresponding fines. Legislative amendments have improved the legislative regulations for periodic technical inspections of vehicles.	The goal of the activity is to increase the frequency of technical inspections, remove the least efficient vehicles from the market, and renew the vehicle fleet, which will increase the average efficiency of technical inspection visits.	Regulator and instrument	Implemented	CO2	NA	NA	See BTR	2021	Ministry of Internal Affairs	Administrative expenses	Establishment of a safe transportation system, reduced number of administrative violations	Link to Activity 1: The effectiveness of license plate recognition video cameras has increased by including centers in a unified electronic database.
3. Control of vehicle emissions on the roads	**Actions taken before the reporting period:** With the active participation of the Ministry of Internal Affairs and the initiative of the Ministry of Environmental Protection and Agriculture of Georgia, the Resolution No. 348 of the Government of Georgia of September 1, 2023 approved the "Rules for Checking Vehicle Emission Norms and Vehicle Emissions on the Road with Visible Emissions", which entered into force on September 4, 2023 and began to determine the compliance of vehicle emissions with the established norms. In addition, amendments to the Code of Administrative Offenses established a fine for driving a vehicle with visible emissions.	the level of emissions from vehicles on the street in real time .	Regulatory instrument	Implemented	CO2	- 0.00005	- 0.00084	See BTR	2021	Ministry of Environmental Protection and Agriculture	Administrative expenses	Reduction of air pollution, well-maintained car park	NO

69 Technical Regulations approved by the Resolution No. 511 of the Government of Georgia dated December 1, 2017 (change - Resolution No. 113 of the Government of Georgia dated March 19, 2021).

Activity	Description	Objectives	Instrument type	Status	Greenhouse gas	Reduced emissions (Gg CO2 eq) (2021-2023)	Expected emission reductions, (Gg CO2-eq.) (2024-2030)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
4.Identifying additional optimal tax incentive alternatives to encourage the use of electric vehicles based on a cost-benefit analysis	**The following activities are planned:** a cost-effectiveness analysis to determine the extent to which introducing additional tax incentives for electric vehicles (in addition to excise tax) would increase the market penetration of electric vehicles in order to gradually replace the existing fleet and determine the fiscal impact. **Actions taken before the reporting period:** In the second half of 2023, the Ministry of Finance of Georgia became aware that it was not possible to find donor funding for the deficit activities of the CS AP by the NDC Partnership , within the framework of which the research envisaged in the said activity was to be carried out. Accordingly, in the second half of 2023, the Ministry of Finance of Georgia began to search for alternative sources to conduct the research envisaged in the said activity and in October 2023, USAID was sought, within the framework of whose economic governance program the said research was to be conducted.	Conduct a cost-effectiveness analysis to determine the extent to which introducing additional tax incentives for electric vehicles (in addition to excise tax) would increase the market penetration of electric vehicles in order to gradually replace the existing fleet and determine the fiscal impact.	Research instrument	Approved	CO_2	NA	NA	See BTR	2021	Ministry of Finance	Administrative expenses	Infrastructure development, determination of fiscal impact.	NO
5.Improving infrastructure for electric vehicles in Tbilisi	**The following activities are planned:** Creation of charging points, parking lanes, and other supporting infrastructure for electric vehicles. **Actions taken before the reporting period:** 28 spaces from zonal parking spaces have been allocated for charging electric vehicles. And 37 spaces from municipal parking spaces have been allocated for charging electric vehicles. A total of 65 spaces. As of December 31, 2023, 1,809 spaces have been designated within the framework of the zonal-hourly parking system across Tbilisi, which provides for a zero tariff for electric vehicles. Another 1,691 spaces are to be designated.	The goal of the activity is to create charging points, parking lanes, and other supporting infrastructure for electric vehicles.	Planning tool	Approved	CO_2	NA	NA	See BTR	2021	Tbilisi City Hall	Administrative expenses	Developing environmentally sustainable behavior among the population, encouraging the purchase of electric vehicles	NO

Activity	Description	Objectives	Instrument type	Status	Greenhouse gas	Reduced emissions (Gg CO2 eq) (2021-2023)	Expected emission reductions, (Gg CO2-eq.) (2024-2030)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
6.Discussion of the possibility of increasing import duties on old light vehicles based on an economic feasibility study	**Actions taken before the reporting period:** The above research was conducted within the framework of GIZ projects (CDCPIII and Mobility4Cities). The research has been completed.	The study will examine the economic feasibility of imposing a progressive import tax on imported vehicles aged 5 years and under, 6 to 10 years, and 10 years and older .	Research instrument	Implemented	CO2	NE[70]	NE	See BTR	2021	Ministry of Finance	300,000.0 GEL	Establishing a modern, safe transportation system	NO
7.Introduction of emission standards for imported vehicles based on cost-effectiveness analysis (EUR4 / EUR5 engines)	**Actions taken before the reporting period:** With the support of the United Nations Environment Programme (UNEP) and the Caucasus Environmental Non-Governmental Organizations Network (CENN), a cost-benefit analysis document on vehicle emission standards was prepared, presented to stakeholders, and published.[71] A technical regulation was developed and approved by the Resolution of the Government of Georgia No. 238 of June 28, 2023 - " On the introduction of maximum permissible norms for emissions (emissions) from various types of transport and other mobile-mechanical means of atmospheric air pollution with harmful substances, provided for by the legislation of the European Union, in the territory of Georgia". The technical regulation provides for the introduction of the Euro 5 vehicle emission standard at the national level. The restrictions provided for by the regulation for passenger cars and minibuses will enter into force from January 1, 2024, and for buses and trucks - from January 1, 2025.	A cost-effectiveness analysis document will be published by 2024; regulations corresponding to the (engine) EUR4 / EUR5 Euro standard will be introduced and implemented.	Regulatory instrument	Implemented	CO2	NE[72]	NE	See BTR	2021	Ministry of Environmental Protection and Agriculture	1,203,840.0 GEL	Reducing air pollution, boosting the economy	NO

70 Greenhouse gas emissions will not be significantly reduced by increasing import taxes

71 http://environment.cenn.org/downloads/cost-benefit-analysis-of-applying-a-euro-5a-emissions-policy-on-imports-of-car/

72 Euro 3, 4 and 5 car engines do not cover energy efficiency, therefore the impact on emissions is negligible.

Activity	Description	Objectives	Instrument type	Status	Greenhouse gas	Reduced emissions (Gg CO2 eq) (2021-2023)	Expected emission reductions, (Gg CO2-eq.) (2024-2030)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
8.Discussion of the possibility of increasing fuel taxes	**Actions taken before the reporting period:** The above research was conducted within the framework of GIZ projects (CDCPIII and Mobility4Cities). The research has been completed.	Discuss and prepare options for increasing fuel taxes to reduce the activity of gasoline and diesel-powered vehicles so that a specific portion of drivers switch to using public transportation as their primary means of transportation.	Fiscal instrument Research instrument	Implemented	CO2	NE[73]	NE	See. BTR	2021	Ministry of Finance	300,000.0 GEL	Increasing the use of public transport, reducing the use of unsustainable and inefficient vehicles, improving air quality	NO
9.Promoting and encouraging biodiesel production	**The following activities will be carried out within the scope of the activity:** As part of the activity, a database on biodiesel production and sales will be created. **Actions taken before the reporting period:** A brochure and informational video about biodiesel have been prepared. No separate database has been created within the scope of the activity, and information on biodiesel can only be found in the oil producer's database.	The activity involves promoting biodiesel production to reduce carbon dioxide emissions, collecting data on biodiesel production and sales, and monitoring trends. It also involves preparing an information brochure on biodiesel to encourage its consumption.	Economic instrument Information tool Research instrument	Approved	CO2	N O	-32	See BTR	2021	Ministry of Environmental Protection and Agriculture	Administrative expenses	Waste recycling, increased recycling, reduced environmental pollution, enhanced national energy security, reduced dependence on imported fossil fuels	NO
10.Implementation of measures envisaged within the framework of Tbilisi's transport policy	**The following activities will be carried out within the framework of the activity:** A Sustainable Urban Mobility Plan (SUMP) will be developed; the bus fleet will be renovated; at least 3,500 parking spaces will be added to the zonal-hourly parking system; and streets will be rehabilitated to meet multimodal planning principles. **Actions taken before the reporting period:** Work on the SUMP document has been completed. Tbilisi's bus fleet has been completely renewed. In 2021, 180 units of 8-meter ISUZU buses were purchased. Based on the agreement signed in 2023, 50 units of 18-meter MAN buses were added to the capital's bus fleet. It is planned to purchase additional buses of the same brand and volume during 2024-2025. In order to encourage the use of public transportation in the capital, 9 streets were designed in accordance with multimodal planning principles. As for zonal-hourly parking, it has been implemented by 52%. 1809 spaces have been identified within the zonal-hourly parking system, which provides for a zero tariff for electric vehicles.	The aim of the activity is to develop a Sustainable Urban Mobility Plan (SUMP); upgrade the bus fleet; add parking spaces to the zonal-hourly parking system; modernize the metro and increase its capacity; construct a cable car; implement an intelligent transportation system; implement zonal-hourly parking; and rehabilitate streets in accordance with multimodal planning principles.	Other	Approved	CO2	-222.59	- 1,559.04	See BTR	2021	Tbilisi Municipality City Hall	1,762,200,000.0 GEL	Urban development, economic stimulation, transportation system development, infrastructure development	NO

73 The study does not include information on emissions reduction (feasibility study on introducing a progressive taxation system on the import of light vehicles and increasing fuel taxes)

Activity	Description	Objectives	Instrument type	Status	Greenhouse gas	Reduced emissions (Gg CO2 eq) (2021-2023)	Expected emission reductions, (Gg CO2-eq.) (2024-2030)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
11.Implementation of measures envisaged by the Batumi Sustainable Urban Mobility Plan	**Actions taken before the reporting period:** More than 20% of the measures envisaged in the Batumi Integrated Sustainable Urban Mobility Plan have been implemented during the reporting period. Within the framework of the Batumi Bus Project (Phase 2), 8 electric buses were purchased in 2020. Within the framework of the United Nations Development Program (UNDP) project - “Green Cities: Development of Integrated Sustainable Transport Systems for the City of Batumi and the Adjara Region”, hourly parking lots have been established and are already operating at 7 locations in Batumi.	The aim of the activity is to improve the efficiency of bus routes; increase bus capacity and passenger numbers; introduce zonal and hourly parking in central districts; plan and implement reduced vehicle activity; purchase modern standard diesel (euro 5) and fully electric buses, renew/replenish the municipal transport company’s fleet with new adapted buses, which will contribute to environmental protection and the smooth operation of the municipal transport system.	Other	Implemented	CO2	NE	NE	See BTR	2021	Batumi City Hall	8,800,000.0 GEL	Economic growth, transportation system development, urban development, infrastructure development	NO
12.proposals for international climate finance to improve public, intercity and non-motorized transportation	**The following activities will be carried out within the scope of the activity:** A project proposal must be submitted to 3 potential funders. **Actions taken before the reporting period:** 1 project proposal was prepared. The project proposal “Intermunicipal Road Transport in Georgia” was submitted to the NAMA Facility in 2021. The project proposal was not selected for funding, and an additional donor is being sought.	Mobilizing financial resources to implement specific new policies and measures within the next version of the Climate Action Plan.	Planning tool	Approved	CO2	NO	-62	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change)	178,200.0 GEL	Development of a sustainable urban transport system, promotion of social inclusion, improved air quality, convergence with international standards	NO
13.Preparing a cost-benefit analysis and feasibility study to identify the best options for shifting road freight to rail	**The following activities will be carried out within the scope of the activity:** At least one technical analysis document will be developed within the framework of the activity . The donor and implementing organization have been selected, and the project terms of reference have been prepared.	The aim of the activity is to prepare a cost-benefit analysis that can help identify the most attractive measures for inclusion in the next version of the Climate Action Plan.	Research tool	Planned	CO2	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change)	257,400.0 GEL	foreign investment , developing infrastructure, reducing air pollution	NO

3.2.1.1 Low-emission development of the transport sector

In Georgia, the municipalities of Kvareli, Sagarejo, Bagdati, Poti, Lanchkhuti, Ozurgeti, and Chokhatauri are set to transition their municipal vehicle fleets from diesel to biodiesel, from gasoline to natural gas, and from gasoline and natural gas to electric power. These initiatives, which will also encompass the promotion of non-fossil fuel vehicles alongside the renewal of the fleet, are expected to lead to a reduction of approximately 201 tonnes of CO2-equivalent

TABLE 3.2. CHANGES IN EXPECTED ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS BY 2030 FROM PLANNED ACTIVITIES IN THE MUNICIPAL CAR PARKS OF KVARELI, SAGAREJO, BAGHDATI, POTI, LANCHKHUTI, OZURGETI AND CHOKHATAURI

	Activity	Completion date	Activity budget, GEL		Change in energy consumption, MWh	Greenhouse gases Emissions change , tons CO2 _eq.
			Mobilized amount	Deficit		
1	Municipally owned vehicles will be upgraded to low-emission alternatives, including the replacement of 22 diesel vehicles with electric vehicles, 51 gasoline vehicles with electric vehicles, and 20 gasoline vehicles with natural gas vehicles.	31.12.2029	5,000,000	3,550,000	0	- 201
2	Construction of bicycle paths in Kvareli, Baghdati, Ozurgeti and Poti municipalities	31. 12.2028	The budget for 2024-2028 was determined based on needs.	500,000	NA	NA
3	electric vehicles in Poti Municipality [74]	22. 12.2028	0	250,000	0	0
Total			5,000,000	4,300,000	0	-201

3.2.2 BUILDING SECTOR

The building sector represents one of the largest and most rapidly expanding segments of the national economy. This sector encompasses commercial, public, and residential structures. According to the greenhouse gas inventory, emissions from the buildings sector contribute to 21.1% of the country's total greenhouse gas emissions.[75]

Most of the buildings in Georgia were constructed during the Soviet era, spanning from 1921 to 1990. The aging of these structures has led to a notable decline in their energy

74 Within the framework of this activity, the expected change in energy consumption can be calculated according to the load of the new charging points.

75 National Inventory Report

efficiency. In contrast, the buildings erected in the three decades following independence predominantly exhibit low energy efficiency.

The buildings sector is marked by significant energy usage and substantial emissions of greenhouse gases.[76]

The transition from fossil fuels to clean energy sources is significantly hindered by the limited capacities of households and individuals. This situation is closely linked to their low income levels and the substantial energy demands stemming from inefficient residential buildings and appliances. To tackle these issues, strategies outlined in the Energy Performance of Buildings Directive (EPBD) are being progressively implemented in Georgia.[77]

In 2020, Georgia enacted the Law on Energy Efficiency of Buildings, which established a framework for enhancing the energy efficiency of both new and existing structures. This initiative seeks to tackle the issues prevalent in the building sector, including the inadequate energy efficiency of current buildings, limited awareness of contemporary renewable energy and energy-efficient technologies among households, and the absence of favorable credit or co-financing options for energy-efficient and renewable energy projects.[78] In 2024, the law was revised to align with the updated directive.

The demonstration projects focused on building energy efficiency, supported by technical assistance in the country, have played a significant role in enhancing public awareness regarding this issue. It is essential to maintain these initiatives to achieve a substantial reduction in greenhouse gas emissions.

According to the current legislation in Georgia, after 2023 it is mandated to achieve minimum energy efficiency in newly constructed buildings. These requirements will be applicable to all new constructions, and following a transitional phase, they will also extend to buildings undergoing major renovations.[79]

The Georgian government, being the principal owner of buildings, is committed to the energy-efficient management of its properties. Annually, 3% of public buildings are required to undergo renovations to meet updated energy efficiency standards[80]. To align with the recent amendments to the Law on Energy Efficiency, a target of 1% renovation is established by the end of 2025, followed by a requirement of 3% starting in 2025.

- The long-term goals for promoting low-emission development within the building sector include the following:
- Achieving optimal thermal insulation in buildings;
- Implementing renewable energy solutions such as photovoltaics (PV), domestic hot water (DHW) systems, and ground source heat pumps;

76 Long-term concept of low-emission development of Georgia, p.83. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
77 Long-term concept of low-emission development of Georgia, p.83. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
78 Long-term concept of low-emission development of Georgia, p.83. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
79 Long-term concept of low-emission development of Georgia, p.83. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
80 Long-term concept of low-emission development of Georgia, p.83. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

Encouraging a shift in citizen behavior towards climate-friendly practices.[81]

1. It is important to highlight that the 2021-2023 Action Plan, part of the 2020-2030 Climate Strategy of Georgia, outlines several initiatives planned by the Ministry of Economy and Sustainable Development of Georgia for the period from 2021 to 2023. These initiatives include:
2. 1. Development of a methodology necessary for building certification;
3. Development, approval, and execution of normative by-laws concerning the energy efficiency of buildings;
4. Establishment of standards, norms, and labeling schemes for various devices;
5. Implementation of programs to raise public awareness regarding energy efficiency;
6. Launching an information campaign focused on incandescent light bulbs;
7. Conducting information campaigns related to solar water heating;
8. Introduction of tax regulations pertaining to incandescent light bulbs;
9. Installation of energy-efficient lighting in buildings utilized by public institutions;
10. Development of information systems to assess the energy efficiency of public buildings;
11. Enhancement of external structures in school buildings, installation of energy-efficient lighting in schools, and upgrading or replacing solid fuel heaters;
12. Creation of a financial incentive mechanism to encourage the installation of solar water heating systems in buildings;
13. Promotion of energy-efficient wood stoves;
14. Development of qualification, accreditation, and certification frameworks for energy sector professionals;

Creation of educational and training programs for energy consultants[82].

In the buildings sector, out of 14 activities, 3 have been completed, 7 are currently in progress, and 4 are in the planning stage.

According to the Climate Action Plan for 2021-2023, there has been no reduction in greenhouse gas emissions from the buildings sector, even with the implementation of 3 activities. The activities numbered 9, 12, and 13, as detailed in the table, focus on informational and educational initiatives. Consequently, the impact of these activities on greenhouse gas reduction extends beyond the designated reporting period. Should all 14 activities be executed, it is projected that the annual reduction in emissions by 2030 will amount to 1,334.35 Gg CO2-eq, culminating in a total reduction of 5,366.95 Gg CO2-eq.

Specifically, (1) a register of operational buildings has been initiated by an administrative body in accordance with the Law of Georgia on Energy Efficiency, (2) efforts have been made

81 Long-term concept of low-emission development of Georgia, p.84. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

82 2021-2023 action plan of the 2030 climate change strategy of Georgia

to promote the use of energy-efficient wood stoves, and (3) frameworks for the qualification, accreditation, and certification of energy sector experts have been established. Currently, (1) a methodology to enhance energy efficiency in buildings is under development, (2) subsidiary normative acts related to energy efficiency in buildings are being formulated, approved, and implemented, (3) standards, norms, and labels for equipment are being created, (4) tax regulations concerning incandescent light bulbs are being introduced, (5) energy-efficient lighting is being installed in public institution buildings, (6) improvements are being made to external enclosing structures in school buildings, including the installation of energy-efficient lamps and upgrades or replacements of solid fuel heaters, and (7) educational and training programs for energy consultants are being developed.

Future plans include (1) launching programs to enhance public awareness of energy efficiency, (2) conducting an information campaign focused on incandescent light bulbs, (3) implementing information campaigns regarding solar water heating, and (4) developing a financial incentive mechanism for the installation of solar water heating systems in buildings.

A comprehensive overview of the mitigation measures that have been implemented, are currently in progress, and are planned for the buildings sector is provided in the table below.

TABLE 3.3 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE GEORGIAN BUILDINGS SECTOR

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
1.Development of a methodology for building certification	**The following activities will be implemented within the scope of the activity:** A methodology aimed at enhancing the energy efficiency of buildings will be formulated as part of this initiative. This methodology will be coordinated with environmental and energy non-governmental organizations, as well as construction firms, ensuring full compliance with the 2010/31/EU European Directive. **Actions taken before the reporting period:** The minimum energy performance [83]standards for buildings, their components, and elements have been established, along with the national methodology for assessing the energy performance of buildings[84]. This framework is essential for developing the certification methodology for buildings. A pilot version of the energy performance calculation program has been initiated, which produces the necessary declarations of conformity to verify adherence to the minimum standards. Additionally, a draft of the "Regulations for the Certification of Energy Performance of Buildings" has been created and is scheduled for submission to the government for approval in 2024. The creation of a certification methodology for buildings is essential, allowing the government to formulate model construction projects focused on the thermal insulation of external building envelopes tailored to various climatic conditions and regions. This initiative will align with energy efficiency standards and ensure that the outcomes are accessible to the general public.		Regulatory instrument	Implemented	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	88,715,880 GEL	Adherence to European energy efficiency regulations, heightened involvement of stakeholders, improved energy efficiency, and a robust legislative framework.	Link to Activity 2: To establish the methodology necessary for the certification of buildings, the minimum energy efficiency standards were outlined in the subordinate normative regulations pertaining to the energy efficiency of buildings.

83 Resolution N354 of the Government of Georgia of July 13, 2021.

84 Resolution N449 of the Government of Georgia of September 7, 2021.

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
2.Creation, approval and implementation of subordinate normative acts on the energy efficiency of buildings.	**The following activities will be implemented within the scope of the activity:** Within the framework of the activity, relevant subordinate normative acts will be developed and approved. **Actions taken before the reporting period:** The national methodology for assessing the energy efficiency of buildings was approved in 2021. Minimum energy performance standards for buildings, their components, or elements were also approved in 2021, with the regulation taking effect on July 1, 2023. A draft version of the comparative methodology for determining cost-optimal levels of minimum energy efficiency requirements has been prepared. Additionally, the procedure for developing one or more programs aimed at calculating energy efficiency and their implementation was approved in 2023. A draft version of the regulations governing overall energy efficiency, as well as the selection, installation, regulation, and management of technical systems in both existing and new buildings, has also been prepared.	Creation and approval of relevant subordinate normative acts.	Regulator Bell Tool	Approved	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	33,264,000 GEL	Reduction of energy consumption and, consequently, costs, effective regulatory acts, compliance with European energy efficiency standards	N O
3.Creation of standards, norms and markings (labeling) of the necessary circuits for devices.	**The following activities will be implemented within the scope of the activity:** Practical frameworks aimed at enhancing the energy efficiency of household appliances will be developed, incorporating the perspectives of non-governmental organizations and private enterprises, while ensuring full compliance with the 2010/30/EU European Directive. Under the established framework for energy efficiency, it is anticipated that by 2024, all products available in the market will carry energy labels, achieving a 100% compliance rate. Additionally, by September 30, 2021, a total of 16 technical regulations will receive approval. **Actions taken before the reporting period:** 51% of the current schemes for the energy efficiency of household appliances have been designed, taking into account the opinions of non-governmental organizations and private companies and fully comply with the 2010/30/EU European Directive. According to the scheme created for the energy efficiency of household appliances, the percentage of labeled products on the market amounted to 100% of all products. 14 technical regulations instead of 16 are to be approved. Currently, draft technical regulations have been fully prepared for 9 regulations. 3 regulations have already been approved.	The objective of this initiative is to translate and implement pertinent European standards, specifically those set by the European Committee for Standardization (CEN), as well as international standards for assessing the energy efficiency of designated household appliances. Additionally, the rollout of the energy labelling regulatory framework should be supported by an informational campaign regarding energy labelling.	Regulatory instrument Informative Tool	Approved	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	411,840 .0 GEL	Reduced risk of malfunctions and accidents related to electrical circuits, improved quality in products	NO

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
4.Implementing programs to raise public awareness about energy efficiency.	**The following activities will be implemented within the scope of the activity:** Disseminating information to the public regarding financially viable and easily implementable modifications in energy consumption practices, as well as promoting awareness of energy efficiency initiatives, will enhance the target audience's understanding by a minimum of 50%. The development and execution of this campaign are scheduled as part of the ongoing technical assistance project titled "Implementation of the Energy Efficiency Legislative Framework," which is funded by the European Union and KfW.	1. Disseminating information to the public regarding financially beneficial and easily implementable modifications in energy consumption, as well as promoting awareness of energy-efficient practices, enables consumers to make informed decisions about energy-efficient household appliances.	Educational tool Information tool Research tool	Planned	CO2	NA	NA	See BTR	2021	Annual Report of the Ministry of Economy and Sustainable Development	299,376 .0 GEL	Encouraging energy-efficient behavior in society, stimulating the economy	Link to Activities 2 and 3: Familiarization with the normative acts on the energy efficiency of buildings, standards, norms and markings of the necessary schemes for devices within the framework of the awareness-raising program
5.Conducting an information campaign regarding the "Incandescent light bulbs"	**The following activities will be implemented within the scope of the activity:** The initiative aims to enhance the target audience's awareness of energy-efficient light bulbs by a minimum of 30%. The planning and execution of this campaign are organized as part of the ongoing technical assistance project titled "Implementation of the Energy Efficiency Legislative Framework," which is funded by the European Union and KfW.	Conducting an information campaign regarding the incandescent light bulbs, the goal of which will be, after the launch of the measure, to include them in new residential and commercial buildings purchased by 2023 Increasing the share of energy-efficient light bulbs to 100%.	Educational tool Information tool Research tool	Planned	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	Administrative expenses	Promoting the transition to energy-efficient lighting options, raising awareness, encouraging energy efficiency	Link to Activity 3: Familiarization with standards, norms and markings of circuits required for devices within the framework of the awareness-raising program
6.Implementation of information campaigns on solar water heating.	**The following activities will be implemented within the scope of the activity:** The initiative aims to enhance the target audience's understanding of solar water heating by a minimum of 50%. This campaign's preparation and execution are organized as part of the ongoing technical assistance project titled "Implementation of the Energy Efficiency Legislative Framework," which is funded by the European Union and KfW.	Implementing information campaigns on solar water heating and energy efficiency, which will raise consumer awareness.	Educational tool Information tool Research tool	Planned	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	Administrative expenses	Promoting the transition to energy-efficient energy device options, raising awareness, encouraging energy efficiency	Link to Activity 3: Familiarization with standards, norms and markings of circuits required for devices within the framework of the awareness-raising program

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
7.Introducing tax regulations regarding incandescent light bulbs .	**The following activities will be implemented within the scope of the activity:** As part of the activity, tax regulations will be introduced regarding incandescent light bulbs, the aim of which will be to introduce a tax on new lamps purchased for residential and commercial buildings by 2023, after the launch of the measure. Increasing the share of energy-efficient light bulbs to 100%. **Actions taken before the reporting period:** The protocol for the upkeep of the register of operational buildings managed by an administrative entity, as stipulated by the Law of Georgia on Energy Efficiency, was developed under the auspices of the EU/KfW Technical Assistance Project and received approval through Order No. 1-1/335 from the Minister of Economy and Sustainable Development of Georgia. Following this protocol, the register has been initiated, currently encompassing data on at least 70% of public buildings, which has been made accessible on the Ministry's website. While this initiative has been successfully executed, it is important to highlight that the register is intended to undergo annual updates, ensuring that the information is regularly revised and supplemented.	The introduction of tax regulations concerning incandescent light bulbs is intended to impose a tax on the purchase of new lamps for both residential and commercial properties by the year 2023, following the implementation of this measure. The objective is to achieve a complete transition to energy-efficient light bulbs, reaching a 100% share.	Regulatory instrument Fiscal instrument	Approved	CO2	N A	-68.95	See BTR	2021	of Economy and Sustainable Development	Administrative expenses	Reduced use of inefficient lighting, Stimulating the economy	Link to Activity 5: Demonstrate the feasibility of introducing tax regulations regarding incandescent light bulbs by conducting an information campaign.
8.Installation of energy-efficient lighting in buildings owned/occupied by a public institution.	**The following activities will be implemented within the scope of the activity:** new materials purchased for all public buildings by 2023 The share of energy-efficient light bulbs in light bulbs will increase to 100% . **Actions taken before the reporting period:** Discussions regarding the draft Ecodesign Technical Regulation with stakeholders commenced in the first half of 2023. Currently, the final phase of agreement with the donor concerning the preparation of the Regulatory Impact Assessment (RIA) is in progress.	The activity involves purchasing new furniture for all public buildings with a long-term perspective by 2023, after the launch of the measure. Increasing the share of energy-efficient light bulbs to 100%.	Other	Approved	CO2	NA	NA	See BTR	2021	of Economy and Sustainable Development ;	621,720.0 GEL	to energy-efficient energy device options , encouraging energy efficiency	Link to Activity 7: "Incandescent light " Natures Within the Scope of the Introduction of Tax Regulation on New Materials Purchased for Public Buildings Increase the share of energy-efficient light bulbs in light bulbs .
9.Creation of information systems on the energy efficiency of public buildings.	**Actions taken before the reporting period:** The process for establishing a register of buildings utilized by an administrative entity, as stipulated by the Law of Georgia on Energy Efficiency, was developed under the EU/KfW technical assistance initiative and has received final approval. [85]Consequently, the registry has been initiated.	Collection of information on building characteristics and energy consumption/ utilization for national and municipal public sector buildings, excluding schools and kindergartens.	Information tool	Implemented	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	178,200.0 GEL	Increased transparency, increased access to information, establishment of a common system	Link to Activity 7: Based on the rule, a registry has been launched, which already reflects information on at least 70% of public buildings.

85 Order No. 1-1/335 of the Minister of Economy and Sustainable Development of Georgia.

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
10.improvement/ replacement of solid fuel heating systems	**The following activities will be implemented within the scope of the activity:** As part of the activity, it is planned that 10% of schools will implement at least one of three energy efficiency initiatives each year - improving the external enclosing structure, installing energy-efficient light bulbs, and replacing solid fuel heaters. **Actions taken before the reporting period:** In 2021-2022, 237 public schools underwent full or partial rehabilitation. Since 2019, the construction and rehabilitation of 106 public schools in the regions has been completed. This amounts to a total of 337 rehabilitated schools where the external enclosing structures have been improved.	Improving the external enclosing structure of school buildings, installing energy-efficient light bulbs, improving/ replacing solid fuel heaters.	Other	Approved	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	9,808,920.0 GEL	Encouraging energy efficiency	Link to Activity 7: Installation of energy-efficient lamps within the framework of the introduction of tax regulations regarding incandescent light bulbs.
11.Development of a financial incentive mechanism for the installation of solar water heating systems in buildings	**The following activities will be implemented within the scope of the activity:** as part of the activity . The ongoing technical assistance project - “Implementation of the Energy Efficiency Legislative Framework” funded by the European Union and KfW envisages the development of various schemes to encourage the development of energy efficiency. To implement this activity, the donor needs to find additional experts and conduct research, which requires more time.	Developing financial incentive mechanisms for the use of solar energy for water heating, which will reduce pressure on forests and represent a more energy-efficient alternative.	Voluntary agreement	Planned	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	178,200.0 GEL	sustainable energy consumption, promotion of renewable energy, long-term financial benefits	Link to Activity 3: Develop various schemes to encourage the development of energy efficiency for equipment.
12Encouraging the use of energy-efficient wood stoves	**Actions taken before the reporting period:** The voucher program was initiated in 2023. To disseminate information regarding energy-efficient stoves and financial assistance programs, five informational meetings were conducted across the Guria, Kakheti, and Mtskheta-Mtianeti regions. Throughout the year, from January 1 to December 31, 2023, two information campaigns were executed. An event focused on the voucher program took place in Guria, attracting 250 participants. Furthermore, demonstration sites for energy-efficient stoves were established in eight targeted municipalities, drawing the interest and participation of 5,000 individuals.	By the year 2027, the government and financial institutions will establish and execute a financial incentive mechanism, accompanied by information campaigns aimed at promoting the adoption of energy-efficient stoves. This initiative is expected to alleviate the strain on forest resources and enhance the utilization of residual biomass.	Educational tool Information tool	Implemented	CO2	NA	-5,298	See BTR	2021	Ministry of Environmental Protection and Agriculture	33,660,000.0 GEL	Encouraging energy efficiency, reducing air pollution, improved use of waste biomass, reduced pressure on forests	NO

Activity	Description	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 equivalent)	Admissions And methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
13.Development of qualification, accreditation and certification schemes for experts in the energy sector	**Actions taken before the reporting period:** In the fall of 2021, accreditation was granted to the Georgian Technical University, which announced admission to the certification training course in November 2022. Interested individuals successfully completed the first and second semesters of the course.	Development of a certification system for service providers, auditors, managers and developers in the energy sector who work on the installation of energy devices in the buildings sector.	Educational tool	Implemented	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	1,073,160.0 GEL	Developed certification system, trained personnel, development of the energy sector	Link to Activity 14: Development of qualification, accreditation and certification schemes for experts in the energy sector within the framework of the development of educational and training programs for energy consultants
14.Development of educational and training programs for energy consultants	**The following activities will be implemented within the scope of the activity:** At least two educational and vocational training programs will be created and sanctioned with the participation of stakeholders in Tbilisi and the surrounding region as part of this initiative. **Actions taken before the reporting period:** A draft program was prepared within the framework of a technical assistance project funded by the EU/KfW.[86] In addition, “Rules for the certification of energy auditors, independent experts issuing energy performance certificates for buildings and inspecting heating and air conditioning systems in buildings, and for the verification and verification of energy performance certificates for buildings and inspection reports for heating and air conditioning systems” have been developed.[87]	Developing programs to improve the skills and competencies of engineers, energy audit companies, and service providers in the energy sector.	Educational tool Regulatory instrument	Approved	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	Administrative expenses	Improving the skills and competence of engineers, energy audit companies and service providers in the energy sector	NO

86 "On Energy Efficiency" Law, Article 14.

87 “On Energy Efficiency” Law.

The Ministry of Regional Development and Infrastructure of Georgia, the Ministry of Economy and Sustainable Development of Georgia, and the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health, and Social Protection of Georgia have outlined a series of initiatives to be funded by the state budget for the years 2020-2022, specifically targeting the buildings sector. These initiatives include:

- Rehabilitation of regional and municipal infrastructure;
- Projects to be executed by the Municipal Development Fund of Georgia;
- Regional and Municipal Infrastructure Development Project II (World Bank, World Bank Trust Fund);
- Urban Reconstruction and Development Project of Georgia (European Investment Bank);
- Construction and rehabilitation of general education facilities;
- Construction and rehabilitation of public schools;
- Tbilisi Public Schools Rehabilitation and Energy Efficiency Improvement Project (Council of Europe Development Bank, E5P);
- Rehabilitation and equipping of medical facilities;
- Establishment of social and living conditions for the resettlement of internally displaced persons;
- Promotion of entrepreneurship.

A comprehensive overview of the mitigation measures undertaken from the 2020-2022 state budget within the buildings sector is provided in the table below.

TABLE 3.4 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE GEORGIAN BUILDINGS SECTOR (ACCORDING TO THE STATE BUDGET)

Activity	Description[88]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
25 03 Rehabilitation of regional and municipal infrastructure	The restoration and rehabilitation of residential and other facilities are underway. Additionally, spatial planning is being addressed, and discussions regarding development regulation plans in the context of urban development have taken place in the years 2020, 2021, and 2022.	In municipalities Developed and rehabilitated infrastructure ; Increased investment attractiveness; Improved living conditions for the poor; Increased Tourist Potential: Improved urban and tourist infrastructure, modern Cultural and historical heritage preserved in accordance with standards; Renewable energy implemented on public buildings and Alternative energy sources.	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	1,161,892,600 Gel
25 03 01 Projects to be implemented by the Municipal Development Fund of Georgia	In Dedoplistskaro Municipality, in the village of Khornabuji, a kindergarten for 50 children has been rehabilitated (2020); In the cities of Gori and Gurjaani, regional shelters for companion animals have been built (2020); In the Gardabani Municipality, in the village of Gamjarveg (for 110 children) and in the village of Kumisi (for 90 children), kindergartens have been built (2020); In the village of Lakham, in the Chuberi community of Mestia Municipality, kindergartens (for 50 children) have been built in the Chuberi community center and in the village of Mulakhi (for 2022)	In municipalities Developed and rehabilitated infrastructure;	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	44,556,800 Gel
25 03 04 Regional and Municipal Infrastructure Development Project II (WB, WB-TF)		In municipalities Developed and rehabilitated infrastructure; Increased investment attractiveness	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	26,516,900 Gel
25 03 05 Georgia Urban Reconstruction and Development Project (EIB)	A kindergarten for 180 children has been built in Gori Municipality; A kindergarten for 180 children has been built in Akhaltsikhe Municipality; Gori A kindergarten for 75 children has been built in the village of Meghvrekisi-Ergneti in the municipality;	Improved living conditions for the population;	Social tool	Implemented	2020	Ministry of Regional Development and Infrastructure	89,594,200 Gel
25 07 Construction and rehabilitation of general education infrastructure	Municipalities were carrying out rehabilitation and construction work and increasing energy efficiency of public schools, and preparing detailed design and cost accounting documentation required for rehabilitation and construction (2022).	Developed infrastructure in general education institutions; Public schools built and rehabilitated in municipalities.	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	395,362,000 Gel
25 07 01 Construction-rehabilitation of public schools	In the Zugdidi Municipality, the public school located in the village of Jikhashkari has undergone rehabilitation. Similarly, in Martvili, public school No. 1 has also been rehabilitated. Additionally, within Martvili Municipality, the public schools situated in the villages of Didi Chkoni, Salkhino, and Doshake have been rehabilitated as well (2021).	in general education institutions ; Public schools built and rehabilitated in municipalities.	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	248,993,000 Gel

88 The first year indicated in the description column corresponds to the original deadline determined by the Climate Action Plan (2021-2023), and the year indicated in parentheses is the updated information about the deadline for the completion of the work.

Activity	Description[88]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
25 07 02 Rehabilitation and Energy Efficiency Improvement Project (CEB, E5P)	Reconstruction-rehabilitation and energy efficiency improvement works were underway at Tbilisi Public Schools No. 36, No. 43, No. 85, No. 165, No. 169 and No. 181 (2021, 2022)	infrastructure in general education institutions ; Public schools built and rehabilitated in the municipality of Tebe.	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	13,657,800 Gel
27 04 Rehabilitation and equipment of medical institutions	The installation of the heating, cooling and ventilation systems of the Dedoplistskaro Multidisciplinary Hospital has been completed (2021);	Rehabilitated and equipped medical facilities.	Other	Implemented	2020	the Occupied Territories ¬, Labor, Health and Social Protection	121,382,300 Gel
27 06 03 Internally Displaced Persons Social and accommodation Creating living conditions	Works on connecting and installing electricity, external sewage, natural gas, water, drainage and ventilation systems and roofing were underway in IDP accommodation facilities and newly constructed buildings (2020,2021)	Eco-migrants in a safe environment; IDP population provided with decent living conditions;	Social tool	Implemented	2020	the Occupied Territories ¬, Labor, Health and Social Protection	220,070,600 Gel
24 07 Entrepreneurship development	The Ministry of Economy and Sustainable Development of Georgia has allocated funds amounting to GEL, equivalent to 11 million USD, to facilitate the construction of a specialized facility for the JSC "Scientific and Practical Center for Infectious Diseases, AIDS and Clinical Immunology" as part of its initiatives to enhance the management of infectious diseases.	Competitive local production, Increased export potential; Increased foreign direct investment and jobs.	Economic instrument	Implemented	2020	Ministry of Economy and Sustainable Development	963,590,200 Gel

3.2.2.1 Rehabilitation of municipal buildings using energy-efficient approaches

In addition to the initiatives outlined in the Climate Change Plan and the budgets allocated by the ministries of Georgia, various municipalities are actively pursuing mitigation strategies within the building sector as part of the Covenant of Mayors[89]. To decrease energy consumption in municipal buildings, these municipalities are exploring rehabilitation projects that aim to lower greenhouse gas emissions and promote efficient energy use for heating, cooling, and lighting.

The rehabilitation efforts for municipal buildings primarily involve the replacement of doors and windows, the thermal insulation of roofs, walls, and floors, and, in certain instances, the installation of solar water heating systems (solar collectors). The objective of these initiatives is to minimize the loss of heat or cool air generated by the energy utilized in buildings, thereby ensuring that the indoor environment remains conducive to human activity over extended periods. Furthermore, these efforts will enhance awareness and encourage climate-smart practices among local authorities.

By the year 2030, it is anticipated that greenhouse gas emissions from municipal buildings in Georgia, particularly in the municipalities of Kvareli, Sagarejo, Bagdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti, will be reduced by 227 tons of CO2 equivalent annually, alongside an estimated energy savings of approximately 1,404 MWh.

The table below illustrates the expected changes in energy consumption and greenhouse gas emissions resulting from the planned activities in these municipal buildings by 2030.

89 https://www.eecgeo.org/ge/como.htm

TABLE 3.5. CHANGES IN EXPECTED ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS FROM PLANNED ACTIVITIES IN THE MUNICIPAL BUILDING OF KVARELI, SAGAREJO, BAGHDATI, POTI , CHOKHATAURI, LANCHKHUTI AND OZURGETI BY 2030

#	Activity	Completion date	Activity budget (GEL)		Change in energy consumption (MWh)	Change in greenhouse gas emissions, tons CO2-eq.
			Mobilized amount	Deficit		
	Rehabilitation and repair of administrative buildings, including city halls and district administrations, in the municipalities of Kvareli, Baghdati, Poti, Chokhatauri, and Lanchkhuti will involve the replacement of doors and windows, thermal insulation of roofs and attics, and the installation of solar water heating systems.	31.12.2029	9,879,256	7,147,310	-779.57	-119.95
	The rehabilitation of kindergartens in the municipalities of Baghdati, Lanchkhuti, and Ozurgeti will encompass the replacement of doors and windows, thermal insulation of roofs and attics, wall thermal insulation, basement and floor thermal insulation, as well as the installation of solar water heating systems.	30.12.2029	11,350,620	11,185,000	-469.62	-79.75
	The rehabilitation of schools in the municipalities of Baghdati, Lanchkhuti, and Chokhatauri will include the replacement of doors and windows, thermal insulation of roofs and attics, wall thermal insulation, basement and floor thermal insulation, along with the installation of solar water heating systems.	12.31.2029	1,616,700	1,686,900	-91.54	-18.12
	Rehabilitation of sports facilities, such as swimming pools, chess houses, and sports complexes, will take place in the municipalities of Lanchkhuti and Chokhatauri.	12.31.2029	155,000	380,000	-12.35	-1.67

#	Activity	Completion date	Activity budget (GEL)		Change in energy consumption (MWh)	Change in greenhouse gas emissions, tons CO2-eq.
			Mobilized amount	Deficit		
	Rehabilitation efforts will be undertaken for cultural and educational facilities, including a cinema, library, youth center, and former club, located in the municipalities of Lanchkhuti, Kvareli, Poti, Sagarejo, and Chokhatauri. This initiative encompasses the replacement of doors and windows, thermal insulation of roofs and attics, wall thermal insulation, basement and floor thermal insulation, as well as the installation of a solar water heating system.	12.31.2029	1,727,006	6,015,000	-49.19	-7.55
	Rehabilitation of additional municipal structures in Baghdati and Chokhatauri, including the replacement of doors and windows, thermal insulation of roofs and attics, as well as wall thermal insulation.	31.12.2024	997,000	75,000	-2.31	-0.42
Total			25,725,582	26,489,210	-1,404.58	-227.46

3.2.2.2 Rehabilitation of non-municipal and residential buildings using energy-efficient approaches

Municipalities are not only focusing on their own buildings but are also undertaking energy-efficient and climate-smart renovations of non-municipal and residential structures. To promote the conservation of natural gas and the efficient use of energy, various initiatives are being organized to enhance local interest in new energy-efficient heating solutions and central heating systems. Furthermore, in collaboration with the private sector, efforts are underway to promote building insulation through targeted promotional activities. A crucial aspect of these awareness campaigns involves the collection and analysis of gender-disaggregated data. By utilizing gender-sensitive information, municipalities will be able to discern the differing needs of women and men, their resource usage, and the distribution of roles and responsibilities, thereby tailoring their activities accordingly.

By the year 2030, it is anticipated that energy consumption in non-municipal and residential buildings across Georgia, particularly in Kvareli, Sagarejo, Bagdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti, will decrease by 61,445 MWh, resulting in a reduction of greenhouse gas emissions by 12,412 tCO2-eq. The total budget earmarked for achieving this reduction amounts to GEL 1,025,000, which represents approximately 5.5% of the anticipated expenses to be borne by the private sector. For further details, please refer to Table 3.6, which outlines the mitigation activities.

TABLE 3.6. PROJECTED CHANGES IN ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS RESULTING FROM PLANNED INITIATIVES IN NON-MUNICIPAL AND RESIDENTIAL BUILDINGS WITHIN THE MUNICIPALITIES OF KVARELI, SAGAREJO, BAGDATI, POTI, CHOKHATAURI, LANCHKHUTI, AND OZURGETI BY 2030.

#	Activity	Performance Date	Activity Budget (GEL)		Energy consumption Change (MWh)	Greenhouse Gases Emissions Change (tons of CO2 - $_{eq}$.)
			On mobile Amount	Deficit		
11	Central Heating Consumption Encouragement Campaign *	31.12.2029	0	165,000	-12,971	−2,620
22	Building Denaturation Events Promotion Campaign *	31.12.2029	0	285,000	−14,269.	−2.882
33	Outdated Heaters With new Replacement Campaign *	31.12.2029	0	420,000	−17,515	- 3,538
44	Energy efficient Skills Development Campaign *	31.12.2029	0	155,000	−16,689	−3.371
Total			**0**	**1,025,000**	**-61,445**	**-12,412**

In 2022, the Municipal Development Fund undertook the renovation of six multi-apartment residential buildings as part of the “Renewed Regions Program.” This initiative encompassed the thermal insulation of the structures, the replacement of existing doors and windows with high-quality double-glazed options, and the enhancement of the surrounding yards. Additionally, the mayors of Sagarejo and Bagdati executed a residential building rehabilitation project during the same year. This project resulted in the renovation of twelve multi-apartment residential buildings in Sagarejo and Bagdati, along with five privately owned structures in Bagdati, significantly improving the energy efficiency of these buildings.

Poti Municipality consistently implements the "Construction Infrastructure and Improvement Works" program, aimed at enhancing living conditions in multi-storey and multi-apartment residential buildings. This program includes the rehabilitation of common areas within housing associations, yard improvements, and the upgrading of utility systems, all funded entirely by the Poti Municipality budget

In Ozurgeti, the budgeted condominium support program facilitated repair works in multi-apartment buildings, leading to the rehabilitation of a twelve-storey building and the repair of roofs and facades of two additional multi-apartment buildings in 2022.

3.2.2.3 Illumination of street and building facades with energy-efficient lamps

The outdoor lighting network within municipalities encompasses a diverse array of elements, including building facades, streets, squares, fountains, and various public facilities. Over the past decade, there has been a remarkable enhancement in the quality and efficiency of municipal outdoor lighting. However, there exists a compelling vision to further advance this initiative through the adoption of low-emission approaches. The modernisation and progressive development of outdoor lighting systems in municipalities are primarily focused on reducing operational costs. This objective is being realised through the strategic replacement of conventional lighting with energy-efficient diode LED lamps. In pursuit of minimising emissions associated with outdoor lighting, there is also a concerted effort to harness solar energy. This is achieved by installing solar photovoltaic systems on the lighting fixtures, thereby integrating sustainable energy solutions.

In 2022, significant advancements in outdoor lighting infrastructure were realised across various municipalities, including Kvareli, Sagarejo, Baghdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti. This initiative involved the strategic installation of new outdoor lighting points as well as the retrofitting of existing ones with energy-efficient lamps. The implementation of these energy-efficient solutions also led to a notable reduction in electricity consumption. To accurately assess the impact of these improvements on electricity consumption and associated greenhouse gas emissions from outdoor lighting, it is essential to consider the adjustments in the network emission factor alongside the above mentioned measures.

By 2030, it is projected that energy consumption associated with outdoor lighting across the municipalities of Kvareli, Sagarejo, Baghdati, Poti, Chokhatauri, Lanchkhuti, and Ozurgeti will experience a significant decrease of 1,918.57 MWh in absolute terms. Correspondingly, greenhouse gas emissions are expected to be reduced by 237.26 tonnes of CO_2 equivalent. This reduction is primarily attributed to the implementation of new LED lighting systems, which will further diminish greenhouse gas emissions by an additional 151.33 tonnes of CO_2 equivalent when contrasted with the traditional business-as-usual scenario. When considering the comprehensive set of activities outlined in the accompanying table, it is estimated that total greenhouse gas emissions will ultimately be lowered by 1,277.45 tonnes of CO2 equivalent by 2030. The detailed changes in anticipated energy consumption and greenhouse gas emissions resulting from outdoor lighting initiatives in the abovementioned municipalities are presented in Table 3.7 below.

TABLE 3.7. CHANGES IN EXPECTED ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS FROM OUTDOOR LIGHTING ACTIVITIES IN THE MUNICIPALITIES OF KVARELI, SAGAREJO, BAGHDATI, POTI, CHOKHATAURI, LANCHKHUTI, AND OZURGETI BY 2030.

#	Activity	Completion date	Activity budget (GEL)		Change in energy consumption (MWh)	Change in greenhouse gas emissions (tonnes CO2 eq)
			Mobilized amount	Deficit		
	Installation of new outdoor lighting points with LED lights in the territories of municipalities	31.12.2029	2,414,708	0	+1,340	-155
	Upgrading municipal lighting systems with energy-efficient devices	31.12.2029	6,895,785	1,050,000	-2,808	-354
	In municipalities Maintenance of the outdoor lighting network (providing appropriate services to outdoor lighting points , replacing broken lamps in the outdoor lighting network on the territory of the municipality, repairing worn-out and damaged lighting poles, replacing them with new ones, restoring and repairing damaged sections of the network, etc.)	31.12.202 9	3,740,300	0	NA	NA

3.2.3 ENERGY PRODUCTION AND TRANSMISSION SECTOR

The advancement of economic activities and the overall welfare of the population in Georgia are heavily reliant on the energy production and transmission sector. This sector encompasses the energy industry as well as the fluctuating emissions resulting from fuel usage. As indicated by the greenhouse gas inventory, emissions from the energy production and transmission sector represent 20% of the country's total emissions.

To leverage the country's low-emission, clean, safe, and affordable energy resources while enhancing energy security, a comprehensive reform of the energy sector is ongoing. This reform aims to promote free market dynamics by separating energy activities—specifically transmission and distribution—from production, trading, and supply functions.[90]

At present, Georgia's electricity demand is satisfied through both domestically produced and imported electricity. The existing deficit in the electricity system, along with future projections, indicates a clear necessity for energy facilities that will reduce reliance on imports and bolster energy security.[91]

Consequently, significant emphasis is placed on the optimal use of available renewable energy sources. This approach enables the country to fulfill its electricity needs through technologies that address global challenges related to environmental protection and climate change, as well as to adhere to international commitments in this area.[92]

The advancement of the energy generation and transmission sector faces numerous challenges, including: 1) delays and failures in executing significant energy projects[93] 2) suboptimal performance of aging thermal power plants.

In recent years, the system has incorporated two combined cycle power plants, and there were intentions to replace the inefficient older facilities with modern alternatives. However, due to the increasing electricity demand and setbacks in the development of new hydropower projects, the older plants remain operational. It is important to highlight that the majority of production is now conducted in the new plants, with the older facilities not operating at full capacity. Plans are still in place to introduce two additional combined cycle power plants and to decommission the older plants entirely, which is expected to positively influence emissions within the energy generation and transmission sector.[94]

Since July 1, 2017, Georgia has been a contracted party of the European Energy Community, necessitating the alignment of the country's national legislation with the energy regulations of the European Union within specified timeframes.[95]

Georgia places significant emphasis on meeting its commitments related to the promotion and advancement of energy efficiency and renewable energy sources as part of its climate change mitigation efforts. To this end, several key pieces of legislation have been enacted,

90 Fourth National Communication of Georgia, p. 137
91 Development Strategy of Georgia - Vision 2030, p. 137. https://www.gov.ge/files/428_85680_321942_khedva-2030-saqarthvelos-ganvitharebis-strategia-1.pdf
92 Development Strategy of Georgia - Vision 2030, p. 138. https://www.gov.ge/files/428_85680_321942_khedva-2030-saqarthvelos-ganvitharebis-strategia-1.pdf
93 Long-term concept of low-emission development of Georgia, p.81. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
94 Fourth National Communication of Georgia, p. 137-138.
95 Fourth National Communication of Georgia, p. 136. https://www.undp.org/ka/georgia/publications/sakartvelos-meotkhe-erovnuli-shetqobineba-klimatis-tsvlilebis-shesakheb-gaeros-charcho-konventsiisadmi

including the “On Energy and Water Supply,” “On Energy Efficiency,” “On Energy Efficiency of Buildings,” and “On Encouraging the Production and Use of Energy from Renewable Sources.”

According to Article 7, Paragraph 3 of the Law “On Energy and Water Supply,” the energy policy encompasses a National Integrated Energy and Climate Plan (National Energy and Climate Plan-NECP). The formulation of the National Energy and Climate Plan was conducted concurrently with the development of the Climate Action Plan and the Nationally Determined Contribution Document, receiving approval from the Parliament of Georgia on June 27, 2024.[96] The long-term vision for the country in this domain aims to achieve decarbonization of the sector by maximizing the utilization of renewable energy and enhancing energy efficiency across all economic sectors.[97]

Long-term objectives within the energy sector encompass:

- The establishment and advancement of facilities for renewable energy generation;
- A substantial enhancement in the proportion of renewable energy within the overall energy mix;
- The execution of extensive energy efficiency initiatives in the construction industry;
- The pursuit of supplementary investments aimed at the adoption of low-carbon technologies.

The Long-term Low-Emission Development Concept of Georgia encompasses the transportation, building, and energy generation and transmission sectors, collectively referred to as the energy sector. It outlines emission reduction scenarios in a consolidated manner. Consequently, by the year 2050, the anticipated greenhouse gas emissions from the energy sector are projected to reach 5.191 Gg CO_2-eq.[98]

It is important to highlight that the 2021-2023 Action Plan, part of the 2020-2030 Climate Strategy of Georgia, outlines several initiatives planned by the Ministry of Economy and Sustainable Development of Georgia for the years 2021 to 2023. These initiatives include:

1. Providing technical and procedural support for wind energy electricity generation;
2. Offering technical and procedural support for solar energy electricity generation;
3. Facilitating technical and procedural support for hydroelectric power plants;
4. Executing technical works at thermal power plants;
5. Carrying out the Ten-Year Development Plan for the Georgian Transmission Network aimed at electricity transmission companies;
6. Creating a comprehensive long-term multi-sector strategy document for Georgia’s energy policy.[99]

96 Fourth National Communication of Georgia, p. 138.
97 Long-term concept of low-emission development of Georgia, p.80. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
98 Long-term concept of low-emission development of Georgia, p.81; p.72 https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
99 2021-2023 action plan of the 2030 climate change strategy of Georgia

Out of the six activities within the energy production and transmission sector, four are currently in progress while two are in the planning stage.

As a result of the activities undertaken, greenhouse gas emissions from this sector were decreased by 2.89 Gg CO2-eq during the period from 2021 to 2023. Should all six activities be fully implemented, it is projected that annual emissions will be reduced by 0.79liv Gg CO2-eq by the year 2030, culminating in a total reduction of 8.42 Gg CO2-eq. Specifically, the construction of nine wind power plants, seven solar power plants, and ten hydro power plants is underway, alongside the development of approximately 1650 MW of substations and around 490 kilometers of power transmission lines. Additionally, approximately 435 MW of total installed capacity from wind and solar power plants will be integrated into the electrical grid.

A comprehensive overview of the implemented, ongoing, and planned mitigation strategies in the energy generation and transmission sector is provided in the table below.

TABLE 3.8 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE ENERGY GENERATION AND TRANSMISSION SECTOR OF GEORGIA

Activity	Description[100]	Goals	Instrument type	Status	Greenhouse gas[101]	Reduced emissions (2021-2023) (Gg CO2 eq.)	in emissions , Gg CO_2 -eq (2024-2030)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Technical and procedural support works for electricity generation from wind energy	**The following will be built as part of the activity:** Imereti 104 MW; Rikoti-Fona 20 MW; Tbilisi 54 MW; Dirbula - 21 MW; Ruisi 12.6 MW; Samgori 8 MW; Zestaponi 50 MW; Nigoza 50 MW[102]; Kaspi 54 MW. **Actions taken before the reporting period:** At the stations: Imereti 1, Rikoti , Tbilisi, Kaspi and Nigoza, basic studies have been completed and construction contracts are being signed. Samgori, a construction contract has been signed and construction works are underway . The Dirbula wind power station project has been canceled, after which an agreement was signed with another company on the same territories for the development of one large combined Ruisi wind power station (206 MW). A feasibility study is being carried out on the Ruisi wind power station.	9 wind power plants have been built by 2024.	Other Research tool	Approved	CO2	N A	NA	See BTR	2021	Ministry of Economy and Sustainable Development	2,178,000,000.0 GEL	Infrastructure development, local economy stimulation, job creation, development/creation of renewable energy sources	NO
Technical and procedural support works for electricity generation from solar energy	**The following will be built as part of the activity:** Desert 5 MW; Unspecified solar power station 1 MW; Flavi 7 MW; Gardabani 50 MW (EBRD); Marneuli 20 MW; Geosolar 9 MW; Sagarejo 25 MW. **Actions taken before the reporting period:** The projects are at various stages of development: Desert - installed capacity increased to 6.1 MW. Contract signed (stage - study); Feasibility study underway; Flavi - project cancelled. Gardabani (EBRD) - project prepared, contract negotiations underway for joint New Samgori Solar Power Plant (96 MW) project. Marneuli - basic studies completed and construction contracts underway. Installed capacity increased to 68 MW. Geosolar - contract negotiations underway; Sagarejo - project suspended.	7 solar power plants have been built by 2024.	Other	Approved	CO2	N A	NA	See BTR	2021	Ministry of Economy and Sustainable Development	209,880,000.0 GEL	Infrastructure development, local economy stimulation, job creation, development/creation of renewable energy sources	NO

100 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

101 Emissions of CH4 and N2O are insignificant and therefore not taken into account.

102 An environmental decision has not yet been issued for the Nigoza station (Status: 24.02.2021)

Activity	Description[100]	Goals	Instrument type	Status	Greenhouse gas[101]	Reduced emissions (2021-2023) (Gg CO2 eq.)	in emissions , Gg CO_2 -eq (2024-2030)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Technical and procedural support works for hydroelectric power plants	**The following will be built within the scope of the activity (with a capacity of more than 13 MW):** Kirnath 51.3 MW. Khobi 46.7 MW. Mtkvari 53 MW. Mestiachala1 20.0 MW. Story 1 20.0 MW. Samkuristskali2 26.3 MW. Metekhi1 36.7 MW. Ghebi 14.3 MW. Chiora 14.2 MW. Zotye 44.3 MW. **Actions taken before the reporting period:** Kirnati - Construction is complete, additional work is underway. Khobi 2 - under construction. Mtkvari - under construction. Installed capacity increased to 54.1 MW. Mestiachala 1 - put into operation. Story 1 - Under construction. Installed capacity increased to 33.6 MW. Samkuristskali2 - Construction has been suspended. Metekhi 1 - under construction. Ghebi - under construction. Chiora (26.1 MW) is under construction. Zoti - construction has been suspended.	10 hydroelectric power stations have been built by 2024. (Due to changes to the Ten-Year Transmission Network Development Plan of Georgia, the project's commissioning deadline has been extended to December 31, 2025.)	Other	Approved	CO2	-2.89	-5.53	See BTR	2021	Ministry of Economy and Sustainable Development	1,980,000,000.0 GEL	Infrastructure development, local economy stimulation, job creation, development/creation of renewable energy sources	NO

Activity	Description[100]	Goals	Instrument type	Status	Greenhouse gas[101]	Reduced emissions (2021-2023) (Gg CO2 eq.)	in emissions , Gg CO_2 -eq (2024-2030)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Carrying out maintenance work at thermal power plants	**The following activities will be implemented within the scope of the activity:** All existing thermal power plants will be upgraded to increase efficiency, and new combined cycle thermal power plants will be equipped with new technologies to double their energy efficiency. Gardabani 3 - a combined cycle gas thermal power plant - will be built by 2023.	In order to double energy efficiency, all existing Work will be carried out at the thermal power plant to increase efficiency, and new combined cycle thermal power plants will be equipped with new technologies.	Other	Planned	CO2	N A	NA	See BTR	2021	Ministry of Economy and Sustainable Development	531,200,000.0 GEL	Increased energy efficiency, cost savings, environmental benefits, technological innovations	NO
Implementation of the Ten-Year Georgian Transmission Network Development Plan for Electricity Transmission Companies	**The following activities are planned:** By 2024, approximately 1,650 MW of substations will be constructed and/or renovated, approximately 490 km of power transmission lines will be constructed and/or renovated, and approximately 435 MW of wind and solar power plants will be integrated into the grid. **Actions taken before the reporting period:** Construction work on the 220/110 kV Lajanuri substation is underway, construction work on the 220/110 kV Ozurgeti substation is underway, and a detailed project for the expansion of the Akhaltsikhe substation with 500 kV and 400 kV wings is being prepared. Construction work on the 500 kV substation in Tskaltubo is underway. Work on the 330/220 kV, 400 MGVA substation in Gardabani has been completed. Completed: - 500 kV overhead line “Kavkasioni” in the substation “Jvari 500/220” - 16 km (2x8 km); 220 kV overhead line “Jvari-Khorga” - 2x56.5 km; - 220 kV overhead line “Alaverdi” in the substation Marneuli - 2x16.7 km and arrangement of two 220 kV cells - Rehabilitation of part of the 220 kV overhead line “Alaverdi” (Alaverdi 3) (from thermal power plant 2 to the Alaverdi crossing point) - 7.5 km; 330 kV overhead line Gardabani-Aghstapa double-circuiting - 2x18.5 km (to the border); Rehabilitation of the 220 kV overhead line “Kolkhida-1” - 66 km - 83%, awaiting construction permit; * 220 kV Aragvi double-circuit - 34 km - 30% work has begun on the substation penetration, on the line. Construction permit is awaited .	The aim of the activity is to strengthen the infrastructure of the national electricity transmission systems, address existing problems, respond to future challenges, and realize the potential of the network, including the integration of renewable energy sources into the network.	Other	Approved	CO2	NA	NA	See BTR	2021	Ministry of Economy and Sustainable Development	771,804,000.0 GEL	Infrastructure development, local economy stimulation, development of renewable energy sources	Link to Activities 1, 2 and 3: The activities carried out within the scope of the activity enable the integration of renewable energy sources into the grid.

Activity	Description[100]	Goals	Instrument type	Status	Greenhouse gas[101]	Reduced emissions (2021-2023) (Gg CO2 eq.)	in emissions , Gg CO_2 -eq (2024-2030)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Development of a unified long-term multi-sectoral strategy document for Georgia's energy policy	**The activity plans include:** developing a long-term (up to 2030) and comprehensive state energy policy strategy document, which will serve as the basis for developing short-term, medium-term and long-term strategies, with a specific focus on Georgia's use of renewable energy resources. **Actions taken before the reporting period** The National Integrated Energy and Climate Plan was approved by the Parliament of Georgia on June 27, 2024.	a long-term (by 2030) and comprehensive state energy policy strategy document, which will serve as the basis for developing short-term, medium-term and long-term strategies, with a specific focus on Georgia's use of renewable energy resources.	Regulatory instrument	Planned	CO2	N A	N A	See BTR	2021	Ministry of Economy and Sustainable Development	198,000.0 GEL (Grant)	Development of the legislative framework and approximation to international standards	NO

The Ministry of Economy and Sustainable Development of Georgia, along with the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health, and Social Protection of Georgia, has outlined a series of initiatives for the energy sector funded by the state budget for the years 2020 to 2022. These initiatives include:

1. Compensation for the expenses related to the provision of natural gas to residents of Kazbegi Municipality and Dusheti Municipality in the highland areas;

- Rehabilitation initiative for the Vardnili and Enguri hydroelectric power stations;
- Technical support initiative for the Georgian Energy Sector Reform Program (GESRP) funded by the EU-NIF;
- Development of a crucial electricity transmission infrastructure;
- Project aimed at enhancing the electricity transmission network;
- Open initiative for the expansion of the electricity transmission infrastructure in Georgia;
- Project focused on improving regional electricity transmission
- Enhancement of electricity and natural gas services for the local population;
- Social welfare measures for the community;
- Provision of social benefits for residents in mountainous regions.

A comprehensive overview of the mitigation measures undertaken in the energy sector, as financed by the state budget from 2020 to 2022, is detailed in the table below.

TABLE 3.9 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE ENERGY GENERATION AND TRANSMISSION SECTOR OF GEORGIA (ACCORDING TO THE STATE BUDGET)

Activity	Description[103]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
24 11 Measures to compensate the population of the high-mountainous villages of Kazbegi Municipality and Dusheti Municipality for the cost of natural gas supplied	Kazbegi Municipality and Dusheti Municipality Highlander In the villages, Implemented for the permanently resident population Natural gas supplied during the period Gas cost reimbursement (2020); Dusheti Municipality Highlander In the villages, Implemented for the permanently resident population Natural gas supplied during the period Gas cost reimbursement - 10.1 million GEL, amount of natural gas consumed - 17.7 million m3 (2021); consumed The cost of natural gas is 11.3 million GEL. Amount of natural gas consumed - 19.9 million m3 (2022);	Socio-economic status of the population permanently residing in Kazbegi and Dusheti municipalities Improvement.	Social tool	Implemented	2020	Ministry of Economy and Sustainable Development	30,359,000 Gel
24 13 Vardnili and Enguri Hydropower Plants Rehabilitation Project (EBRD, EIB, EU)	In accordance with the contracts signed within the framework of the project, all rehabilitation works have been started. 10% of the works have been completed (2020); “Construction works on the Enguri pressure tunnel and other construction works” - the works have been successfully completed according to the plan (2021); “Cleaning works of the Enguri reservoir from silt” - the contractor replaced the damaged equipment. Installation - commissioning and testing of the equipment has been completed (2022); “Electromechanical and hydromechanical works” - all major works have been completed (2022); “Rehabilitation of the 14 km road leading to the Enguri HPP” and “Construction works on the Enguri pressure tunnel and other construction works” have been completed (2022).	the electricity system and increased export potential;	Economic instrument	Implemented	2020	Ministry of Economy and Sustainable Development	100,322,800 GEL
24 13 Technical Assistance Project Georgia’s energy sector Reform Program (GESRP) To support (EU-NIF)	Approved: 11 by-laws based on the Law “On Energy Efficiency” ; 2 by-laws based on the Law “On Energy Efficiency of Buildings”; 7 by-laws based on the Law “On the Promotion of the Production and Use of Energy from Renewable Sources” (2022).	the electricity system and increased export potential;	Regulatory instrument	Implemented	2022	Ministry of Economy and Sustainable Development	2,651,700 Gel

103 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

Activity	Description[103]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
24 14 Development of a system-critical power transmission network	The following were in progress: Construction of the 220 kV “Akhaltsikhe-Batumi” line; Scada/EMS program update; Correction of deficiencies remaining after the construction of the 500 kV overhead line “Ksani-Stepantsminda” (2020); Within the framework of the “Construction of the 500 kV overhead line “Ksani-Stepantsminda” (EBRD, EC, KfW)” project, the contractor company eliminated the deficiencies remaining after the construction of the completed 500 kV power transmission line “Ksani-Stepantsminda” (2021); Works began in the Adigeni-Beshumi area; Construction works of “Jvari-Khorga” were completed and the Take-over Certificate was signed by the customer (2022); Detailed design of the Tskaltubo substation was completed and construction works began.	System sustainability and increased export potential; Increased electricity transmission capacity with neighboring countries; Increasing the reliability of electricity supply in Abkhazia, Samegrelo, Adjara and Guria ;	Economic instrument	Implemented	2020	Ministry of Economy and Sustainable Development	234,649,800 GEL
24 14 01 Power Transmission Network Strengthening Project	Within the framework of the first phase of the contract, work was underway on the design of reinforcement and stabilization of 20 towers located in the bed of the Adjaristskali River. Works were completed on tower No. 296 (2020); within the framework of the 220 kV “Akhaltsikhe-Batumi” line project, work was underway on detailed design and pre-construction studies. In July 2022, the contractor was added to the work in the Adigeni-Beshumi area, on which work began in August 2022.	Increasing the reliability of electricity supply.	Other	Implemented	2020	Ministry of Economy and Sustainable Development	37,555,800 Gel
24 14 02 Open Program for the Expansion of the Georgian Electricity Transmission Network	Stepantsminda” 500 kV power transmission line , which was completed by the end of 2019 , the contractor company was carrying out works to eliminate the remaining shortcomings; The existing shortcomings have been eliminated, the line is switched on and energy transmission is underway (2021); Construction works on the “Jvari-Khorga” power transmission line (underway within the framework of the EBRD, EU, KfW” project. A large part of the construction has been completed, a cable has been laid on 48 km of the line from 55 km and an optical fiber cable on 44 km (2021); The construction of the 500 kV “Ksani- Ste Phantsminda” power transmission line has been completed and energy transmission is underway (2022); The works within the framework of the “Jvari-Khorga” project have been fully completed (2022).	System sustainability and increased export potential; Increased electricity transmission capacity with neighboring countries;	Economic instrument	Implemented	2020	Ministry of Economy and Sustainable Development	16,318,200 Gel
24 14 03 Regional Power Transmission Improvement Project	The following were underway: Construction of the 500-kilovolt, single-circuit power transmission line “Jvari - Tskaltubo” ; Construction of the 110 kV power transmission line “Ozurgeti - Zoti HPP - Chokhatauri”; Construction of the “Akhmeta - Telavi - Tsinandali - Mukuzani - Gurjaani” power transmission lines; Construction of the 220 kV double-circuit “Kheledula-Lajanuri-Oni” power transmission line (2021);	Increasing the reliability of electricity supply.	Other	Implemented	2020	Ministry of Economy and Sustainable Development	180,775,700 Gel

Activity	Description[103]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
24 15 Improving the supply of electricity and natural gas to the population	In 2020, an additional 31,801 subscribers were connected to the natural gas network; In 2020, 36,693 subscribers were gasified across the country; 13,881 subscribers in 69 settlements were given the opportunity to be connected to the natural gas network (in total, 235 settlements were gasified in accordance with the 2020 plan, which includes 45,612 potential subscribers); During the reporting period, the construction of gas pipelines was completed in 84 settlements (22,345 potential subscribers were given the opportunity to be connected to the natural gas network) and construction work continued in 21 settlements.	Increasing the reliability of electricity supply.	Social tool	Implemented	2020	Ministry of Economy and Sustainable Development	259,827,800 GEL
27 02 Social protection of the population	For subscribers living in mountainous settlements (household) for consumers) consumed in a highland settlement Electricity Monthly fee 50% (no more than 100 kWh consumed Electricity (fee) Salary 2020, 2021, 2022) ;	Socio-economic rights guaranteed and realized by law for citizens; Improving the socio-economic situation of vulnerable groups , deinstitutionalization, prevention of abandonment, reintegration; reimbursement of electricity consumption fees for the population living in high-mountainous regions.	Social tool	Implemented	2020	Occupied displaced persons from the territories, labor, Health and Social Security Ministry	11,855,526,400 GEL
27 02 04 Social benefits in mountainous settlements	Pensions and social benefits in mountainous regions; Electricity discounts were extended to more than 77.0 thousand subscribers in January-March (2020),	Reimbursement of electricity consumption fees for residents living in mountainous regions.	Social tool	Implemented	2020	Occupied Displaced persons from the territories , labor, Ministry of Health and Social Welfare	211,690,800 GEL

3.2.4 AGRICULTURE SECTOR

As of 2023, 16.5% of the workforce is engaged in agriculture, which contributes approximately 7.0% to the country's GDP[104] the Agriculture and Rural Development Strategy for Georgia, covering the period from 2021 to 2027, designates agriculture as a key sector vital for the country's GDP and overall economic advancement.[105]

The National Statistics Office of Georgia (Geostat) indicates a consistent increase in agricultural output over the years. In 2022, livestock farming and crop production each represented 47% of the total agricultural output, while agricultural services contributed 6%.[106]

The 2014 Agricultural Census revealed that agricultural land constitutes about 11% of Georgia's total land area. This includes 377,445 hectares of arable land, 109,567 hectares dedicated to perennial crops, and 300,004 hectares of hayfields and pastures.[107] Notably, 68.9% of the 642,209 agricultural holdings possess agricultural land. Among these holdings, 19.1% manage between 1 and 5 hectares, while 1.3% exceed 5 hectares. The figures for the remaining 77.1% are derived solely from holdings with agricultural land, totaling 574,077 as per the 2014 census.[108]

In terms of environmental impact, greenhouse gas emissions from the agricultural sector represent 11.8% of the country's total emissions. The most recent report from the National Greenhouse Gas Inventory identifies three primary subcategories within Georgia's agricultural sector that contribute to these emissions: enteric fermentation, manure management, and agricultural soils. Other categories, such as rice cultivation and established savanna burning, are not applicable to Georgia and are therefore excluded from consideration.[109]

The agricultural sector is essential in ensuring that society has access to safe, secure, and affordable food[110]. Recent developments in the global agri-food market have highlighted the significance of enhancing the agricultural value chain in Georgia.[111]

To advance this value chain, particular emphasis is placed on encouraging the utilization of agricultural land and establishing greenhouse farms within the agri-food sector.[112] The agricultural sector faces considerable challenges, including insufficient capital, land fragmentation, outdated technologies, and poverty in rural communities. Addressing

104 National Statistical Service of Georgia. Distribution of employees according to types of economic activity (Nace rev. 2). https://www.geostat.ge/ka/modules/categories/683/dasakmeba-umushevroba

105 Agriculture and rural development strategy of Georgia, 2021-2027. p. https://mepa.gov.ge/Ge/PublicInformation/20395

106 National Statistical Service of Georgia. Agriculture of Georgia 2022. Statistical publication. GG. 19-20. https://www.geostat.ge/media/54292/soflis_meurneoba_2022.pdf

107 National Statistical Service of Georgia. Agricultural census 2014. https://www.geostat.ge/ka/single-news/803/sasoflo-sameurneo-aghtsera-2014

108 National Statistical Service of Georgia. Agricultural census 2014. https://www.geostat.ge/ka/single-news/803/sasoflo-sameurneo-aghtsera-2014

109 National Inventory Report. p. 117. https://www.undp.org/ka/georgia/publications/sakartvelos-erovnuli-satburis-gazebis-inventarizatsiis-angarishi-1990-2017

110 Long-term concept of low-emission development of Georgia, p. 87 https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

111 Agriculture and rural development strategy of Georgia. 2021-2027. p. 24. https://mepa.gov.ge/Ge/PublicInformation/20395

112 Vision 2030. Development Strategy of Georgia. p. 155. https://faolex.fao.org/docs/pdf/geo215987.pdf

these issues is vital for improving agricultural productivity and minimizing greenhouse gas emissions.[113]

It is important to recognize that the execution of agricultural programs and projects aimed at boosting production may inadvertently result in increased emissions.[114] Consequently, there is a growing necessity and opportunity for the advancement of high technologies within the agricultural sector. Ongoing support for entrepreneurs is enhancing access to these high-tech solutions and streamlining production processes. Furthermore, there is a notable improvement in farmers' understanding of climate-smart agriculture and the impacts of climate change.

The long-term objective of the country is to achieve a technological transformation within the agricultural sector, focusing on the advancement of technologies and innovations that target the following areas:

- Halting the degradation of agricultural lands, restoring them, and enhancing their productivity;
- Boosting the yield of agricultural crops, intensifying their processing, and attaining market and export standards;
- Implementing modern technologies for manure processing;
- Increasing the production of dairy and beef cattle;
- Expanding and technologically upgrading the processing and production of dairy and meat products.[115]

In line with Georgia's long-term low-emission development strategy, it is projected that by 2050, the non-energy greenhouse gas emissions from the agricultural sector will reach 1,868 Gg CO2-eq.[116]

Georgia's revised Nationally Determined Contribution (NDC) does not establish an emissions target for the agricultural sector by 2030. Nevertheless, the initiatives outlined in Georgia's Climate Action Plan are designed to mitigate emissions from this sector.[117]

To tackle the challenges faced in agriculture, Georgia, as per the updated NDC, advocates for the adoption of low-carbon strategies by fostering climate-smart agricultural practices and promoting agritourism.[118]

It is important to highlight that the Ministry of Environmental Protection and Agriculture of Georgia has outlined several initiatives in its 2021-2023 Action Plan, which is part of the 2030 Climate Change Strategy. The planned activities include:

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113 Fourth National Communication of Georgia, p. 32

114 Fourth National Communication of Georgia to the United Nations Framework Convention on Climate Change. 2021. p. 166. https://www.undp.org/ka/georgia/publications/sakartvelos-meotkhe-erovnuli-shetqobineba-klimatis-tsvlilebis-shesakheb-gaeros-charcho-konventsiisadmi

115 Long-term concept of low-emission development of Georgia p. 97-88. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

116 Long-term concept of low-emission development of Georgia p. 72. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

117 2030 Climate Change Strategy of Georgia. p. 26. https://mepa.gov.ge/Ge/PublicInformation/32027

118 Nationally Determined Contribution (NDC) of Georgia. p. 30. https://mepa.gov.ge/Ge/Files/ViewFile/50125

1. Creating a methodology for altering feed for domestic cattle and launching a recommendation campaign aimed at reducing emissions from enteric fermentation in cattle.
2. Formulating legislation and preparing a project proposal to enhance the quality of livestock nutrition while preserving pasture biodiversity.
3. Restoring and transforming windbreaks to mitigate land degradation resulting from climate change.
4. Conducting a cost-benefit analysis and feasibility study for the forthcoming Climate Action Plan focused on improving livestock nutrition.
5. Performing cost-benefit and feasibility studies to determine the most effective methods for implementing manure management systems within the Georgian context.
6. Assisting both existing and new cooperatives in adopting sustainable pasture management practices and disseminating the successful strategies of effective cooperatives to others.
7. Engaging in research and consultation processes to pinpoint economically and socially significant climate-smart agricultural practices suitable for Georgia.
8. Promoting the adoption of climate-smart agricultural methods through extension services and awareness-raising initiatives.

Out of the eight activities within the agricultural sector, five have been successfully implemented, one is currently in progress, and two are in the planning stages.

As outlined in the Climate Action Plan for 2021-2023, there has been no reduction in greenhouse gas emissions from the agricultural sector, despite the implementation of five activities. The activities numbered 4, 5, and 8 in the accompanying table focus on informational, research, and educational initiatives. Consequently, the impact of these activities on greenhouse gas reduction extends beyond the designated reporting period. Furthermore, activities 2 and 3 are regulatory in nature; however, the legislative measures associated with them have yet to be enacted. Should all eight activities be fully executed, it is projected that annual emissions will decrease by 195.47liv Gg CO2-eq by 2030, culminating in a total reduction of 1,368.32 Gg CO2-eq.

Specifically, the following actions have been taken: (1) legislation has been drafted and a project proposal has been developed to enhance livestock nutrition and preserve pasture biodiversity; (2) a legislative framework concerning windbreaks has been prepared and/or adopted; (3) a cost-benefit analysis and feasibility study aimed at improving livestock nutrition for the subsequent Climate Action Plan have been completed; (4) a cost-benefit and feasibility study has been conducted to determine optimal manure management systems suitable for the Georgian context; (5) initiatives have been undertaken to promote the adoption of climate-smart agricultural practices through extension services and awareness campaigns.

Additionally, (1) guidelines and documents are currently being developed to identify economically and socially significant climate-smart agricultural activities for Georgia.

A comprehensive overview of the implemented, ongoing, and planned mitigation measures in the agricultural sector is provided in the table below.

TABLE 3.10. IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE GEORGIAN AGRICULTURAL SECTOR

Activity	Description[119]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected slow reduction in emissions (2024-2030) (Gg CO2 _eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Methodology development and recommendation campaign implementation to reduce emissions from enteric fermentation in cattle	**The following activities will be implemented within the scope of the activity:** Within the scope of the activity It is planned to: Maximize the improvement of feed quality for 20% of cattle, which will lead to a reduction in greenhouse gas emissions caused by enteric fermentation.	Developing a methodology agreed with stakeholders; Conduct at least one advocacy campaign in all regions, with at least 50 farmers participating in each.	Research instrument Information tool	Planned	CH4	NO	-101.8	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change; Department of Agriculture, Food and Rural Development;)	574,200.0 GEL	Increasing farmers' income and welfare , promoting sustainable agriculture, developing technologies	N O
improve the quality of livestock nutrition and maintain the biodiversity of pastures	**Actions taken before the reporting period:** A draft law on pasture management has been developed. A project proposal on sustainable pasture management was prepared and submitted to an international donor.	Developing a project concept and requesting international funding for its implementation; Development of pasture management legislation.	Regulatory Instrument	Implemented	CO2	NO	-15.6	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Hydro-Amelioration and Land Management , Department of Environment and Climate Change , and Department of Agriculture, Food and Rural Development)	237,600.0 GEL	Conserving and promoting biodiversity (genetic resources), increasing farmers' income and improving their well-being	NO
Rehabilitation and transformation of windbreaks to minimize land degradation caused by climate change	**Actions taken before the reporting period:** Work is underway on a project proposal with IFAD and GCF. The Law on Legislative Regulation on Windbreaks was adopted in 2022.	Submitting a project proposal for the rehabilitation of windbreaks to the donor for funding; Preparation/adoption of legislative regulation on windbreaks.	Regulatory Instrument	Implemented	CO2	NO	-10.92	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Hydromelioration and Land Management)	498,000.0 GEL	Protection of soil from degradation (wind erosion), protection of biodiversity (genetic resources), increase in production, increase in farmers' income and welfare	NO

119 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

Activity	Description[119]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected slow reduction in emissions (2024-2030) (Gg CO2 _eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Cost-benefit analysis and feasibility study for improving pet nutrition for the next Climate Action Plan	**Actions taken before the reporting period:** An analytical document has been prepared and published - "Climate-Smart Agriculture Practices in the Georgian Context", which includes information on the analysis and potential costs of implementing animal nutrition optimization.	Preparation of a technical analysis report that will analyze at least two new alternatives for improving nutrition.	Information tool Research tool	Implemented	CH4	NO	IE[120]	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change; Department of Agriculture, Food and Rural Development)	237,600.0 GEL	Increase in production, increase in farmers' income and welfare , optimization of costs	NO
Cost-benefit and feasibility study to identify the best ways to strengthen manure management systems in the Georgian context.	**Actions taken before the reporting period:** The project "Climate Policy Capacity Building in the South East, Eastern Europe, South Caucasus and Central Asia, Phase III", implemented by the German Agency for International Cooperation (GIZ), has developed and published a document on manure management practices and cost-benefit analysis.	Preparation of a technical analysis report that will analyze at least two new manure management alternatives.	Research tool	Implemented	CH4	NO	-1,240	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change; of Agriculture, Food and Rural Development;)	237,600.0 GEL	Conservation and promotion of biodiversity (genetic resources) , cost optimization	NO
Supporting existing and emerging cooperatives to implement sustainable pasture management practices and replicating the success factors of successful cooperatives for other cooperatives	**The following activities will be implemented within the scope of the activity:** As part of the activity, a project proposal will be prepared that will include the introduction of sustainable pasture management principles for farmers.	The activity includes the preparation of a project proposal on the implementation of sustainable pasture management principles.	Research tool	Planned	CO2	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture (A(A)I Rural Development Agency)	996,000.0 GEL	Soil protection from degradation (water and wind erosion) , protection of biodiversity (genetic resources) , rehabilitation of pastures for the local population and increase in production	Link to Activity 2: Developing legislation to preserve pasture biodiversity will facilitate the introduction of sustainable pasture management practices.

120 See Activity 1.

Activity	Description[19]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected slow reduction in emissions (2024-2030) (Gg CO2 _eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Research and consultation processes to identify economically and socially relevant climate-smart agriculture activities (CSA) for Georgia	**The following activities will be implemented within the scope of the activity:** As part of the activity, good agricultural practice guidelines will be prepared for at least 5 agricultural crops by 2024. "FAO and the World Bank have developed a vision document for the country's climate-resilient agriculture." **Actions taken before the reporting period:** An analytical document has been prepared - "Climate-Smart Agriculture Practices in the Georgian Context" which contains recommendations on the most promising measures for implementing Climate-Smart Agriculture (CSA) practices; Two meetings were held in 2023;	Research on economically and socially relevant climate-smart agriculture activities for Georgia to implement Climate-Smart Agriculture (CSA) practices.	Educational tool	Approved	CO_2, CH_4, N_2O	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture (Department of Environment and Climate Change; Department of Agriculture, Food and Rural Development)	356,400.0 GEL	Improving soil and ecosystem , producing higher quality products, increasing food safety, increasing the nutritional value of products	NO
Promoting the adoption of climate-smart agricultural practices through extension and awareness-raising campaigns	**Actions taken before the reporting period:** 10 practical trainings were conducted to raise awareness about climate-smart agriculture practices and implement them in practice; The Environmental Information and Education Centre held workshops with agricultural colleges (12 colleges).	Conduct at least 12 awareness-raising events.	Educational tool Information tool	Implemented	CO_2, CH_4, N_2O	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture	356,400.0 GEL	Improving soil and ecosystem , producing higher quality products, increasing food safety, increasing the nutritional value of products	NO

The Ministry of Environmental Protection and Agriculture of Georgia outlined a series of initiatives for the agricultural sector, funded by the state budget for the years 2020-2022. These initiatives include:

- Conducting scientific and research activities related to agriculture;
- Establishing a unified agricultural project;
- Overseeing the management of agricultural projects;
- Implementing a co-financing program for enterprises;
- Modernizing land reclamation systems;
- Restoring land reclamation systems and acquiring necessary equipment;
- Ensuring the ongoing technical operation of land reclamation infrastructure; - Enhancing irrigation and drainage systems;
- Promoting access to information regarding environmental protection and agriculture, along with a focus on "Education for Sustainable" development;
- Launching a state program aimed at sustainable land management and monitoring land use.

A comprehensive overview of the mitigation measures executed in the agricultural sector, as funded by the 2020-2022 state budget, is provided in the table below.

TABLE 3.11. IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE AGRICULTURAL SECTOR OF GEORGIA (ACCORDING TO THE STATE BUDGET)

Activity	Description[121]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
31 04 Implementation of scientific and research activities in the field of agriculture	An expeditionary study of Caucasian chestnut herds was conducted, quantitative indicators of productivity of Caucasian chestnut herds were studied, growth was recorded, feed rations were monitored, as well as agricultural and biological indicators of chestnut herds were studied (2020); seeds treated with bio preparations were sown in seedling cassettes (2021)	One-year-old sister On modern technologies for the care and cultivation of perennial crops Developed Recommendations; Raw fruits and vegetables Optimally established storage, drying and quick freezing regimes	Research tool	Implemented	2020	Ministry of Environmental Protection and Agriculture	18,645,600 GEL
31 05 Unified Agricultural Project	Development of bio and organic tea production; Creation of modern standards of processing and storage capacities for agricultural products (2020, 2021, 2022)	Management and effective implementation of ongoing projects in the field of agriculture are ensured	Other	Implemented	2020	Ministry of Environmental Protection and Agriculture	892,210,600 GEL
31 05 01 Agricultural Project Management	Support for the establishment of nurseries and perennial crop gardens (2020, 2021); Co-financing of agricultural product processing and storage enterprises (2021)	Unhindered implementation of planned projects	Other	Implemented	2020	Ministry of Environmental Protection and Agriculture	43,579,100 GEL
31 05 06 Enterprise Co-financing Project	During the reporting period, 10 projects were approved in the Saving Enterprises component, with a total value of 11.7 million GEL, of which the co-financing volume is 5.7 million GEL. Within the Processing Enterprises component, 6 projects were approved, with a total value of 7.7 million GEL, of which the co-financing volume is 3.3 million GEL (2020); During the reporting period, 51 projects were approved in the Saving Enterprises component, with a total value of 69.6 million GEL, of which the co-financing volume is 23.9 million GEL (2021); Within the Processing Enterprises component, 14 projects were approved, with a total investment value of 14.7 million GEL (2022)	Creation of modern standards for processing and storing agricultural products	Economic instrument	Implemented	2020	Ministry of Environmental Protection and Agriculture	46,420,900 GEL
31 06 Modernization of land reclamation systems	Additional electricity was purchased to increase the capacity of pumping stations (2021);	Dissemination of climate-smart, modern technologies ; Development of irrigation and drainage infrastructure; Increase in the area of regularly irrigated land	Economic instrument	Implemented	2020	Ministry of Environmental Protection and Agriculture	222,842,500 GEL
31 06 01 Rehabilitation of land reclamation systems and purchase of equipment	New pumping stations were constructed and existing pumping stations were rehabilitated/modernized, and electrical and mechanical equipment was restored and replaced with new ones (2021);	Development of irrigation and drainage infrastructure	Economic instrument	Implemented	2020	Ministry of Environmental Protection and Agriculture	82,850,000 GEL
31 06 02 Current technical operation of land reclamation infrastructure	During the reporting period, the company reimbursed the technical operation of the land reclamation infrastructure, electricity used for the operation of mechanical pumping stations and other hydropower plants, maintenance and upkeep of land reclamation equipment, vehicles and other machinery and mechanisms, and current expenses (2020, 2021, 2022);	Development of irrigation and drainage infrastructure	Economic instrument	Implemented	2020	Ministry of Environmental Protection and Agriculture	74,875,000 GEL

121 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

Activity	Description[121]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
31 06 03 Improvement of irrigation and drainage systems	A detailed engineering design was prepared for the rehabilitation works for the safety of the Sioni and Algeti reservoirs. A tender was announced. The company Sakhydroenergomsheni was selected. Rehabilitation works began (2020);	Improving the reclamation condition of irrigated lands	Economic instrument	Implemented	2020	Ministry of Environmental Protection and Agriculture	65,117,500 GEL
Program for Promoting Access to Information and " Education for Sustainable Development " in the Field of Environmental Protection and Agriculture	3,610 people participated in events held in the field of environmental protection and agriculture (2020); 5,344 people participated in events held in the field of environmental protection and agriculture; 751 pupils and students attended lectures and seminars; 3,328 participants underwent trainings (2021); 6,391 people participated in educational and awareness-raising events in the field of environmental protection and agriculture, as well as in public discussions, information and workshops held by the Centre (2022);	Increased awareness and level of education in society regarding environmental protection and agriculture, public Changed behavior towards environmental and agricultural issues, informal and unofficial Through educational programs that include sustainable development issues; An informed society and increased involvement in environmental decision-making; Created and developed information technologies and Electronic systems	Educational tool	Implemented	2020	Ministry of Environmental Protection and Agriculture	13,164,300 GEL
State Program for Sustainable Land Management and Land Use Monitoring	The "State Program for Access to State-Owned Pastures" has been launched. 368 applications have been received under the program, of which 221 participants have been identified as being in compliance with the program;	Creation and establishment of the National Agency for Sustainable Land Management and Land Use Monitoring. Preparation of appropriate proposals and carrying out relevant work on compiling a land balance, agricultural land use For the purpose of recording resources and creating a unified database	Other	Implemented	2020	Ministry of Environmental Protection and Agriculture	

3.2.5 INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR

The industrial sector significantly contributes to the value added within the Georgian economy, outpacing numerous other sectors. In 2022, the industrial sector's added value amounted to 11% of the country's GDP[122]. Additionally, industrial products rank among the foremost export commodities, with ferroalloys and fertilizers being the top five exported goods from Georgia in 2022.[123]

This sector encompasses various activities, including industrial processes, product consumption, manufacturing, and construction. As per the greenhouse gas inventory, emissions from the industrial sector constitute 20.2% of the total emissions in the country.

Despite the minimal production levels experienced during the initial decade of Georgia's independence, primarily due to an economic crisis, a consistent upward trend has been noted over the last twenty years.[124] Between 2012 and 2018, Georgia's industrial competitiveness index improved by four points, positioning the country at 96th among other developing economies worldwide.[125]

It is important to highlight that the chemical and physical processing of raw materials in this sector results in the release of considerable quantities of carbon dioxide and other greenhouse gases into the atmosphere. Currently, non-energy-related greenhouse gas emissions can be mitigated in three key areas: cement manufacturing, ammonia synthesis, and nitric acid production.

The industrial sector faces challenges related to limited competitiveness, further exacerbated by a shortage of adequately trained personnel. This deficiency poses a significant barrier to the low-carbon development of foreign direct investment within the industrial domain. Consequently, there exists a substantial risk that greenhouse gas emissions may rise in tandem with the sector's economic growth.

To address these challenges and reduce risks, various measures and initiatives aimed at supporting the industrial sector are being considered. These include enhancing competitive market practices, fostering the growth of small and medium-sized enterprises (SMEs), creating favorable conditions for access to international markets, and attracting foreign investments.[126]

The long-term priorities for the advancement of Georgian industry encompass:[127]

- Adoption of energy-efficient technologies and equipment;
- Utilization of alternative energy sources;
- Transfer of innovative technologies and expertise, particularly in identifying low-carbon alternatives.

122 https://www.geostat.ge/ka/modules/categories/23/mtliani-shida-produkti-mshp Status: 08.03.2024
123 https://www.geostat.ge/ka/modules/categories/637/eksporti Status: 08.03.2024
124 Greenhouse gas inventory, report of Georgia 1990-2017, p.4-79 https://eiec.gov.ge/Ge/Documents/ViewFile/519
125 Competitive Industrial Performance Report 2020, გვ.24 https://stat.unido.org/content/publications/competitive-industrial-performance-report-2020
126 Long-term concept of low-emission development of Georgia, p. 85 https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf
127 Long-term concept of low-emission development of Georgia, p. 86 https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

In line with Georgia's long-term low-emission development strategy, it is projected that by 2050, the non-energy greenhouse gas emissions from the industrial sector will reach 2,140 Gg CO2-eq.[128]

Georgia aims to achieve a 5% reduction in greenhouse gas emissions from the industrial sector by 2030, relative to the baseline forecast.[129]

As outlined in the 2021-2023 Action Plan of the Georgian Climate Change Strategy 2030, the following initiatives were scheduled for implementation in the industrial sector during the years 2021-2023:

- Transitioning from the wet method to the dry method of cement production;
- Encouraging the production of nitric acid with reduced greenhouse gas emissions;
- Establishing specific emission factors based on production processes.

Out of three activities within the industrial sector, two have been successfully implemented, while one is currently in the planning stage.

As a result of the implemented activities, greenhouse gas emissions from the industrial sector were reduced by 868.46 Gg CO2-eq during the period from 2021 to 2023. Should all three activities be executed, it is anticipated that the annual reduction in emissions by 2030 will reach 852.21liv Gg CO2-eq, culminating in a total reduction of 6,833.97 Gg CO2-eq.

Specifically, the following measures have been taken: (1) the wet method of cement production has been replaced with the dry method, and (2) individual emission factors corresponding to production processes have been established.

Additionally, it is planned to (1) promote the production of nitric acid with reduced greenhouse gas emissions.[130]

A comprehensive overview of the implemented, ongoing, and planned mitigation measures in the industrial sector is provided in the table below.

128 Long-term concept of low-emission development of Georgia, p. 70

129 Nationally Determined Contribution (NDC) of Georgia. p. 20. https://mepa.gov.ge/Ge/Files/ViewFile/50125

130 Preliminary work has begun.

TABLE 3.12 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE GEORGIAN INDUSTRIAL PROCESSES AND PRODUCTS CONSUMPTION SECTOR

Activity	Description[131]	Goals	Instrument type	Status	Greenhouse gas	Reduced evaporation (2021-2023) (Gg CO2 eq.)	Expected emission reduction (2024-2030) (Gg CO2 eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Replacing the wet method of cement production with the dry method	**Actions taken before the reporting period:** New technology has been implemented that has reduced energy use by 20%. 100% of cement production is carried out using new technology.	Replacing the cement production method with the dry method.	Other	Implemented	CO2	-478.44	-1.674.54	See BTR	2021	Heidelberg LLC	15,687,936 GEL	Waste reduction, technological development, increased energy efficiency	NO
Promoting nitric acid production with low greenhouse gas emissions	**The following activities will be implemented within the scope of the activity:** Within the scope of the activity Planned: Starting in 2020, Georgia, in cooperation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic of Germany, has joined an initiative aimed at equipping nitric acid producing companies in the member countries of this initiative with technology to absorb climate change-causing nitrogen oxide. In cooperation with JSC "Rustavi Azot", the project will begin in the near future.	Equipping the enterprise with new technology that emits at least 95% less N2O; Production of 100% nitric acid with new equipment.	Voluntary agreement	Planned	CO2	NO	- 1.5 60.79	See BTR	2021	LLC "Rustavi Nitrogen"	17,820,000 GEL	Technological development, increased market competitiveness	NO
Establishing individual emission factors according to production	**Actions taken before the reporting period:** In order to calculate and determine the sector's emissions and mitigation potential, individual emission factors were established for two major productions (JSC HeidelbergCement, JSC Rustavi Nitrogen).	Establishing specific emission factors for at least two major industries.	Research tool	Implemented	CO2	-390.02	-2,730.1 8	See BTR	2021	Ministry of Environmental Protection Protection and Agriculture (Climate Change Division)	99,600 GEL	Increasing the quality of public reporting	Link to Activities 1 and 2: The results of the above activities are taken into account in the development of individual emission factors according to production.

The Ministry of Economy and Sustainable Development of Georgia has outlined a series of initiatives for the industrial sector, funded by the state budget for the years 2020 to 2022.

- Encouraging the advancement of entrepreneurship.

A comprehensive overview of the mitigation measures executed within the industrial sector, as derived from the state budget for the

131 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

period 2020-2022, is provided in the table below.

TABLE 3.13 MITIGATION MEASURES THAT HAVE BEEN IMPLEMENTED, APPROVED, AND PLANNED IN THE INDUSTRIAL AND PRODUCT CONSUMPTION SECTOR OF GEORGIA (AS PER THE STATE BUDGET).

Activity	Description[132]	Goals	Instrument type	Status	Year of implementation	Implement the label.	Expenses
24 07 02 Entrepreneurship Development Promotion	In 2020, 19 new or existing enterprises were supported for expansion/re-equipment/modernization	Competitive Local Production , Increased Export Potential ; Increased Direct Foreign Investments And Work Places .	Economic instrument	Implemented	2020	Ministry of Economy and Sustainable Development	326,034,600 GEL

3.2.6 WASTE SECTOR

In 2021, Georgia generated a total of 1,104,952 tons of municipal waste, with 69% originating from urban areas and 31% from rural regions. Despite legislative mandates, illegal landfills persist in the country, and littering remains a significant issue. These illegal sites not only contribute to environmental degradation but also pose serious risks to public health.[133]

The waste management sector encompasses both solid waste and wastewater. According to the greenhouse gas inventory, emissions from this sector represent 9.9% of the country's overall greenhouse gas emissions.

Georgia is currently undergoing a comprehensive reform of its waste management sector, emphasizing waste prevention and recycling.[134] This development incorporates waste separation practices and adheres to the principles of a circular economy, while also promoting innovative low-carbon technologies and services.[135]

Nevertheless, despite these reforms, greenhouse gas emissions from the waste sector continue to rise. Emissions from solid waste constitute 84% of the total greenhouse gas emissions, with the remaining 16% attributed to domestic and industrial wastewater. To effectively transform the waste sector, it is essential to draw lessons from the most advanced waste management systems globally. The sector faces ongoing challenges due to outdated landfill practices and the substantial disposal of municipal waste in landfills.[136]

In response, Georgia is in the process of closing old official and informal landfills while constructing eight new regional landfills. Plans include the installation of a gas recovery system at the existing Tbilisi landfill, the recovery of methane gas from five new

132 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

133 On the approval of the 2016-2030 national waste management strategy and the national waste management action plan of Georgia https://matsne.gov.ge/ka/document/view/3242506?publication=0

134 2016-2030 National Waste Management Strategy and 2022-2026 National Action Plan, p.21. https://rec-caucasus.org/wp-content/uploads/2022/12/PRINT-narchenebis-marthvis-erovnuli-strategia-6.pdf

135 Updated Nationally Determined Contribution of Georgia, p. 31 https://mepa.gov.ge/Ge/Files/ViewFile/50125

136 2016-2030 National Waste Management Strategy and 2016-2020 National Action Plan, p.18. https://mepa.gov.ge/Ge/Files/Download/1358

regional landfills, the construction of seven new wastewater treatment facilities, and the implementation of gas removal systems at these new plants by 2030[137]. According to the National Waste Management Strategy and Action Plan, all existing landfills in the country are scheduled to be closed by the end of 2030, coinciding with the establishment of new waste disposal facilities.

This enables the nation to advance its waste management sector by employing technologies that align with environmental standards and international obligations.

The long-term objectives for the low-emission advancement of the waste sector include:

- Enhancing the capacity for methane extraction from landfills;
- Boosting the recycling rates of municipal solid waste components;
- Expanding the composting of organic materials within municipal solid waste;
- Extracting nitrogen from wastewater sludge;
- Utilizing solid waste as an alternative energy source in cement manufacturing.[138]

According to Georgia's Long-term Low-Emission Development Strategy, the anticipated greenhouse gas emissions from the waste sector by the year 2050 are projected to reach 740 Gg CO2-eq.[139] The updated Nationally Determined Contributions (NDC) document for Georgia does not specify a target for emissions from the waste sector for 2030. Nevertheless, the Climate Action Plan of Georgia outlines measures aimed at reducing emissions in this sector.

The Action Plan for the Climate Change Strategy of Georgia for the period 2021-2023 includes several planned initiatives for the waste sector, which are as follows:

- 1. Closure of unauthorized non-hazardous landfills;
- 2. Closure of natural landfills;
- 3. Establishment of regional non-hazardous waste disposal facilities;
- 4. Renovation and enhancement of the Tbilisi landfill;
- 5. Implementation of a gas management system at the Kutaisi non-hazardous waste landfill;
- 6. Implementation of a gas management system at the Batumi non-hazardous waste landfill;
- 7. Introduction of source separation for paper waste by municipalities and promotion of paper recycling;
- 8. Recycling of biodegradable (organic and garden) waste by municipalities;
- 9. Increasing knowledge and awareness regarding waste management;

137 Long-term concept of low-emission development of Georgia, p. 192. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

138 Long-term concept of low-emission development of Georgia, p. 227. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

139 Long-term concept of low-emission development of Georgia, p. 72. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

- 10. Construction of urban wastewater treatment plants;
- 11. Collecting and recycling of greenhouse gases at the Tbilisi urban wastewater treatment plants;
- 12. Collection and treatment of greenhouse gases at the Batumi Urban Wastewater Treatment Plant;
- 13. Collection and treatment of greenhouse gases at the Kobuleti Wastewater Treatment Plant;
- 14. Establishment of a consolidated process for data collection and updating within the waste sector.

Out of the 14 proposed activities in the waste sector, 2 have been completed, 7 are currently in progress, 4 are planned for future implementation, and 1 activity has been canceled.

Greenhouse gas emissions from the waste sector were reduced by 0.023 Gg CO2-eq during the period of 2021-2023, as a result of the activities undertaken. If all 14 proposed activities are executed, it is anticipated that the annual reduction in emissions by 2030 will reach 46.96liv Gg CO2-eq, culminating in a total reduction of 328.76 Gg CO2-eq.

Specifically, the following initiatives were implemented: (1) programs aimed at enhancing knowledge and awareness regarding waste management, and (2) the initiation of waste statistics production, which included the publication of municipal waste data on the National Statistics Office of Georgia's website. The National Greenhouse Gas Emissions and Removals Inventory document relies on the sources and data provided by this service.

The activities include: (1) the closure of unauthorized non-hazardous landfills, (2) the closure of natural landfills, (3) the establishment of regional non-hazardous landfills, (4) the renovation and enhancement of the Tbilisi landfill, (5) initiatives to promote source separation of paper waste by municipalities and to encourage paper recycling,[140] (6) the recycling of biodegradable (organic and garden) waste by municipalities, and (7) the construction of urban wastewater treatment facilities.

Plans are in place to install a greenhouse gas collection and treatment system at (1) non-hazardous waste landfills in Batumi, (2) Tbilisi, and (3) urban wastewater treatment plants in Batumi and Kobuleti.

It is important to note that one planned measure was canceled as per the final report of the 2021-2023 Action Plan of the Georgia Climate Change Strategy 2030: 6.1.5 Installation of a gas management system at the Kutaisi non-hazardous waste landfill.[141]

A comprehensive overview of the implemented, ongoing, and planned mitigation measures in the waste sector is provided in the table below.

140 Source separation of waste is the segregation of different types of solid waste at the location where they are generated (e.g., a household or business facility).

141 Implementation report of the 2021-2023 action plan of the 2030 climate change strategy of Georgia. https://mepa.gov.ge/Ge/Files/ViewFile/54001

TABLE 3.14 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE WASTE SECTOR OF GEORGIA

Activity	Description[142]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected emission reductions (2024-2030) (Gg CO2 eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Closure of official (unauthorized) non-hazardous landfills	**The following activities will be implemented within the scope of the activity:** Closing at least 4 unauthorized landfills by 2024. **Actions taken before the reporting period:** A plan for the closure of 2 landfills (Rustavi and Tianeti) has been prepared, agreed with MEPA, construction works will be carried out in 2024; have been prepared and agreed with the donor - EBRD, and after agreement with MEPA, the closure activities will begin in 2026-2027.	Closing at least 4 unauthorized landfills by 2024.	Other	Approved	CH4	N A	- 70	See BTR	2021	Regional Development and Infrastructure Government of the Autonomous Republic of Adjara	6,520,000.0 GEL	Reduced environmental pollution	NO
Closure of natural landfills	**The following activities will be implemented within the scope of the activity:** By 2024, 100% of natural landfills will be closed. **Actions taken before the reporting period:** Within the framework of the “Let’s Clean Up Georgia” project, 1,315 natural landfills were identified, of which about 1,000 were cleaned.	Closing 100% of natural landfills by 2024.	Other	Approved	CH4	NA	- 29	See BTR	2021	Municipalities’ mayors	2,800,000.0 GEL	Reduced environmental pollution	NO
Establishment of regional non-hazardous landfills	**The following activities will be implemented within the scope of the activity:** Within the framework of the activity, it is planned that - by the end of 2030, 7 regional non-hazardous landfills meeting the standards will be established (Adjara, Kvemo Kartli, Samegrelo, Imereti, Kakheti, Central, Georgia - 2). **Actions taken before the reporting period:** A new landfill has been constructed in Adjara, and construction works in Samegrelo-Zemo Svaneti and Kvemo Kartli will begin in 2024 due to the extension of the environmental decision-making process.	Construction of 3 new landfills (Adjara, Kvemo Kartli, Samegrelo) by 2024.	Other	Approved	CH4	NA	- 22 9	See BTR	2021	Ministry of Regional Development and Infrastructure	47,520,000.0 GEL	Technological development, Development of the remaining will management , establishment of an effective management system	Link to Activities 1 and 2: Closure of official (unauthorized) non-hazardous and illegal landfills is a prerequisite for the establishment of regional non-hazardous landfills .

142 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

Activity	Description[142]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected emission reductions (2024-2030) (Gg CO2 eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Renovation and improvement of Tbilisi landfill	**The following activities will be implemented within the scope of the activity:** The activity plans include the purchase of waste collection trucks to renew the existing fleet of garbage trucks, modernization of existing solid waste transfer stations, improvement of the leachate management system of the Tbilisi landfill, and installation of a gas collection and capture system at the Tbilisi landfill; In the 1st quarter of 2024, it is planned to present the most beneficial scenarios for the city, after which, with the assistance of the EBRD, a consultant will be selected to assist in the implementation of the project and a tender request will be developed; A tender for the improvement of the landfill leachate treatment system is planned for the end of the first quarter of 2024. **Actions taken before the reporting period:** A technical and economic study was conducted on the arrangement of a gas gathering system;	Installation of a gas collection and leachate management system at the Tbilisi landfill, which is fully compliant with the Technical Regulations on the Establishment, Operation, Closure and After-care of Landfills approved by the Government of Georgia.	Regulatory instruments Research tool Other	Approved	CH4	NA	NA	See BTR	2021	Tbilisi Municipality City Hall	4,000,000.0 GEL	Technological development, Development of waste management, reduced environmental pollution	NO
Installation of a gas management system at the Batumi non-hazardous waste landfill	**The following activities are planned:** Arrangement of a gas collection and processing system at the Batumi landfill. At the landfill in Batumi, the international consulting company ICT, with the support of the EBRD, is currently conducting research work, based on which measures will be developed to close the landfill and install air intake systems that comply with European standards.	Arrangement of a gas collection and processing system at the Batumi landfill, which is fully compliant with the Technical Regulations on the Establishment, Operation, Closure and After-care of Landfills approved by the Government of Georgia.	Regulatory instrument Research tool Other	Planned	CH4	NA	NA	See BTR	2021	Relevant municipality	4,000,000.0 GEL	Technological development, Development of waste management, reduced environmental pollution	NO
Implementing source separation practices for paper waste by municipalities and encouraging paper recycling	**The following activities are planned:** In order to achieve the separation of one of the biodegradable municipal waste streams at source by municipalities and the paper recycling rate, collecting information on paper recycling and preparing an information brochure; **Actions taken before the reporting period:** Paper separation at the source has partially begun in Kutaisi, Tbilisi, Zugdidi and Batumi. No information is available on quantities, despite the existence of a waste database; There are no plans to start preparing an information brochure.	The amount of paper waste recycled annually must be at least 30% of the paper waste generated; Implementation of the practice of paper separation at source in at least 2 municipalities; Preparation of an information brochure.	Information tool Other	Approved	CH4	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture	Administrative expenses	Increased awareness, technological development, economic stimulation, new jobs	Link to Activity 9: Raising knowledge and awareness about waste management by introducing source separation practices for paper waste by municipalities and encouraging paper recycling

Activity	Description[142]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected emission reductions (2024-2030) (Gg CO2 eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Recycling of biodegradable (organic and garden) waste by municipalities	**The following activities are planned:** Composting of organic and garden waste in Kutaisi and Marneuli municipalities by municipal composting enterprises. **Actions taken before the reporting period:** As of 2023, the total amount of biodegradable organic and garden waste recycled in Kutaisi Municipality is 132 tons. As of 2023, the total amount of compost received in Kutaisi Municipality is 12.50 tons.	The amount of biodegradable organic and garden waste recycled annually should be 600 tons; The amount of compost obtained should be 40 tons.	Other	Approved	CH4 N20	-0.023	- 0.74	See BTR	2021	Relevant municipalities	1,188,000.0 GEL	Technological development, economic stimulation, new jobs	NO
Raising knowledge and awareness about waste management	**Actions taken before the reporting period:** Within the framework of 5 information campaigns, an awareness-raising meeting was held with 10 schools, a brochure on extended producer responsibility was printed, and a manual on waste management was printed. An information campaign on extended producer responsibility was carried out in social media, 2 training courses were held and 1800 teachers were retrained.	Conduct at least 5 awareness-raising campaigns.	Educational tool	Implemented	CH4	NA	NA	See BTR	2021	Municipalities	118,800.0 GEL	Increased awareness	NO
Construction of urban wastewater treatment plants	**The following activities are planned:** Completion of construction of 7 urban wastewater treatment plants. Ongoing construction works: Poti; Marneuli; Gudauri; Mestia; Abastumani; Planned construction works: Kutaisi; Khashuri; Kvareli; Mukhrani; Martvili; Dusheti; Zhinvali; Pasanauri; **Actions taken before the reporting period:** Construction progress on the Abastumani wastewater treatment plant is 100% complete; Poti wastewater treatment plant is 80% complete, Gudauri wastewater treatment plant is 61% complete, and Marneuli wastewater treatment plant is 62% complete. Design has been completed for the following wastewater treatment plants: Mukhrani, Dusheti, Pasanauri, Zhinvali, Kvareli and Martvili. Construction is currently planned for the Kvareli and Martvili wastewater treatment plants.	Construction of nine urban wastewater treatment plants by 2024; Announcement of project procurement for the construction of 6 stations by 2024.	Other	Approved	CH4	NA	NA	See BTR	2021	LLC “United Water Supply Company of Georgia”	183,120,618.0 GEL	Technological development, urban development, infrastructure development, promoting sustainable development, improving the ecosystem	NO
Greenhouse gas collection at Tbilisi urban wastewater treatment plants and recycling	**The following activities are planned:** Installation of a gas collection and processing system at Tbilisi urban wastewater treatment plants.	Installation of gas collection and recycling systems at the Tbilisi Urban Wastewater Treatment Plant, which are fully compliant with the European Council Directive 91/271/EEC.	Other	Planned	CH4	NA	NA	See BTR	2021	Georgian Water and Power LLC	21,000.0 GEL	Technological development, infrastructure development, economic stimulation	NO

Activity	Description[42]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2 eq.)	Expected emission reductions (2024-2030) (Gg CO2 eq.)	Assumptions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
gas collection and recycling at the Batumi Urban Wastewater Treatment Plant	**The following activities are planned:** Installation of a gas collection and processing system at the Batumi Urban Wastewater Treatment Plant. Within the framework of the V and VI phases of the new KfW investment program, wastewater treatment measures will be implemented, in particular wastewater collection and municipal wastewater treatment, in full compliance with the EU directive. Biofilters are envisaged for gas and odor removal, the implementation of which is planned for 2026-27.	Installation of gas collection and processing systems at the Batumi Urban Wastewater Treatment Plant, which are fully compliant with the European Council Directive 91/271/EEC.	Other	Planned	CH_4	NA	NA	See BTR	2021	Batumi Water LLC	17,500.0 GEL	Technological development, infrastructure development, economic stimulation	NO
Collection and recycling of greenhouse gases at the Kobuleti wastewater treatment plant	**The following activities are planned:** Installation of gas collection and processing systems at the Kobuleti wastewater treatment plant.	Installation of gas collection and processing systems at the Kobuleti Wastewater Treatment Plant , which are fully compliant with the European Council Directive 91/271/EEC	Other	Planned	CH_4	NA	NA	See BTR	2021	Kobuleti Water LLC	17,500.0 GEL	Technological development, infrastructure development, economic stimulation	NO
Establish a consolidated process for collecting and updating data for the waste sector	**Actions taken before the reporting period:** Waste statistics have been started, municipal waste data is published on the website. Work is underway to determine the possibility of producing additional waste indicators. The National Greenhouse Gas Emissions and Removals Inventory document is based on sources and data published by the National Statistics Office.	Start of production of waste statistics by the National Statistics Office of Georgia; Emissions reports should be based on sources and data (including incineration and composting).	Information tool	Implemented	CH_4	NA	NA	See BTR	2021	National Statistical Service of Georgia (Geostat)	62,500.0 GEL	Transparent reporting process	NO

The Ministry of Regional Development and Infrastructure of Georgia outlined a series of initiatives for the waste sector, funded by the state budget for the years 2020 to 2022. These initiatives include:

- Solid Waste Management Program;
- Solid Waste Management in Georgia;
- Kutaisi Integrated Solid Waste Management Project (EU, KfW).

A comprehensive overview of the mitigation measures executed in the waste sector during the 2020-2022 budget period is provided in the table below.

TABLE 3.15 IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE WASTE SECTOR OF GEORGIA (ACCORDING TO THE STATE BUDGET)

Activity	Description[143]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
25 05 Solid Waste Management Program	New landfills complying with European standards have been built, transfer stations have been established, and existing old landfills have been closed; public awareness has been raised about the sanitary treatment of solid waste (2020); maintenance, rehabilitation, improvement and management of existing landfills and waste transfer stations in municipalities (except for Tbilisi City Municipality and the Autonomous Republic of Adjara) has been carried out (2022)	New landfills complying with European standards have been built, transfer stations have been established, and existing ones have been closed. Old Landfills; Reduced environmental impact, improved ecological conditions, living conditions and solid Waste management system (in municipalities); Sublime Public awareness on sanitary treatment of solid waste	Other	Implemented	2020	Ministry of Regional Development and Infrastructure	80,686,900 GEL
25 05 01 Solid Waste Management in Georgia	in Samtredia, Sachkhere, Khashuri, Lagodekhi, Terjola , Dusheti, Sagarejo, Tkibuli, Marneuli and Kaspi (2020); The landfill in Dmanisi is closed (2021); Rehabilitated-improved landfills in Kutaisi, Khashuri, Samtredia, Telavi, Ninotsminda, Gori , Aspindza, Akhaltsikhe, Bolnisi, Chokhatauri and Zugdidi (2021); Rehabilitated-improved waste transfer station in Ureki town (2022); The Tsnori landfill is closed (2022)	Reduced environmental impact, Improved ecological conditions, living conditions and solid Waste management system (in municipalities)	Social tool Other	Implemented	2020	Ministry of Regional Development and Infrastructure	40,100,000 GEL
25 05 02 Kutaisi Integrated Solid Waste Management Project (EU, KfW)	Construction of a regional non-hazardous waste disposal facility (landfill) has been completed. Under construction Site Selection Report (2020, 2021)	Reduced environmental impact, improved ecological conditions, living conditions and solid Waste management system (in municipalities)	Social tool Other	Implemented	2020	Ministry of Regional Development and Infrastructure	4,800,200 GEL

143 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

3.2.7 LAND USE, LAND USE CHANGE AND FORESTRY SECTOR

Forests represent a vital natural resource for the country, serving as a crucial foundation for its ecological, social, and economic advancement. The management of Georgian forests is guided by a framework established in alignment with sustainable development principles. This framework aims to enhance both the quantitative and qualitative aspects of forests, safeguard their biodiversity, and promote the judicious utilization of their economic potential while recognizing their ecological significance. It also emphasizes public involvement in forest management and ensures that forest resources remain accessible to the populace.[144]

In Georgia, forests play a pivotal role in carbon dioxide absorption. Recent greenhouse gas inventories indicate that this sector contributes to 28.9% of the country's total emissions absorption.

However, the land use and forestry sector faces significant challenges, including a lack of sufficient human resources for forest management and oversight, the absence of modern technologies essential for effective monitoring and supervision, outdated or malfunctioning equipment, and underdeveloped forest infrastructure such as roads and business yards. Additionally, the adverse effects of climate change and natural disasters persist, and despite the growing prevalence of gasification, firewood remains the primary heating source in rural areas, leading to excessive logging and the degradation of forest resources.[145]

To address these challenges, Georgia aims to enhance the carbon sequestration capacity of its forest sector by 10% by the year 2030, relative to the levels recorded in 2015.[146]

The Fourth National Environmental Action Program of Georgia for the period 2022-2026 establishes the legal framework for forest management through the "Forest Code of Georgia," which became effective on January 1, 2021. This legislation is founded on internationally accepted principles of sustainable forest management and contemporary methodologies, which not only promote ecological sustainability but also enhance the contribution of forests to the social and economic advancement of the nation.[147]

By the year 2030, comprehensive management plans will be formulated for all forest areas overseen by the National Forestry Agency. To preserve the ecological integrity of forests, initiatives for restoration and cultivation will be undertaken, focusing primarily on developing forest ecosystems that closely resemble natural conditions in degraded regions. Additionally, by 2030, reforestation and planting efforts are projected to cover up to 2,000 hectares of forested land.[148]

Long-term priorities for the development of the forest sector include:

- The introduction of sustainable forest management principles nationwide;
- The preservation and enhancement of both quantitative and qualitative forest

144 Law of Georgia, Forest Code of Georgia https://matsne.gov.ge/ka/document/view/4874066?publication=6
145 Fourth National Environmental Protection Action Program of Georgia for 2022-2026, 2022. p. 95, 98-99, 110.
146 Nationally Determined Contribution (NDC) of Georgia, p.31. https://mepa.gov.ge/Ge/Files/ViewFile/50125
147 Fourth National Environmental Protection Action Program of Georgia for 2022-2026, p. 93, https://mepa.gov.ge/Ge/PublicInformation/34047
148 Vision 2030. Development Strategy of Georgia. p. 168-169. https://faolex.fao.org/docs/pdf/geo215987.pdf

indicators;

- The rehabilitation of degraded soils;
- The adoption of sustainable practices for pasture management.[149]

As outlined in the Long-term Concept of Low-Emission Development for Georgia, the anticipated absorption of greenhouse gases by the land use and forestry sector by the year 2050 is projected to be -10,740 Gg CO2 equivalent.[150]

The forestry sector plays a significant role in Georgia's 2030 Climate Change Strategy, which aims to fulfill the country's obligations under its Nationally Determined Contribution (NDC). A key objective of this strategy is to boost the carbon absorption capacity of the forestry sector by 10% by 2030, relative to the levels recorded in 2015.

In accordance with the 2021-2023 Action Plan of the 2030 Climate Strategy for Georgia, the Ministry of Environmental Protection and Agriculture has outlined specific activities to be undertaken during the years 2021 to 2023.

1. Restoration of 625 hectares of degraded forest land, including areas affected by fire, through afforestation efforts;

2. Rehabilitation of degraded forests by facilitating natural regeneration processes;

3. Implementation of sustainable forest management practices through the development of comprehensive management plans;

4. Advancement of sustainable forest management practices through oversight and capacity-building initiatives;

5. Enhancement of sustainable forest management by fostering the multifunctional role of forests, increasing public awareness, and encouraging community participation in forest reform initiatives;

6. Development of management plans for the Emerald Network in the forest regions of Georgia, as designated within the approved Emerald Network area;

7. Conservation and/or sustainable management of forest regions designated as new protected areas;

8. Incorporation of climate change considerations, including mitigation strategies, into the management plans for protected areas.

Out of 8 forestry sector activities, 3 have been implemented and 5 activities are ongoing.

Carbon dioxide absorption from the forestry sector has seen an increase of 176.4 Gg CO2 during the period from 2021 to 2023, and should all eight proposed activities be executed, it is projected that the annual carbon dioxide absorption will reach 414.2liv Gg CO2 by the year 2030, culminating in a total of 3,075.8 Gg CO2.

In particular, (1) initiatives aimed at fostering natural forest regeneration have been carried out over an area of 3,153.9 hectares within the country, (2) business yards have been

149 Long-term concept of low-emission development of Georgia, p.89. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

150 Long-term concept of low-emission development of Georgia, p.72. https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

established, and oversight activities adhering to sustainable forest management principles have been conducted across 270,000 hectares of land. Necessary equipment, techniques, and personnel have been acquired to facilitate this supervision, (3) management plans for the Emerald network have been developed.

Furthermore, (1) efforts are underway to restore 625 hectares of degraded forest, including areas affected by fire, through afforestation, (2) sustainable forest management practices are being implemented in line with established management plans, (3) the promotion of sustainable forest management is being advanced by enhancing the multifunctionality of forests, increasing public awareness, and encouraging community involvement in forest reform initiatives, (4) the protection and/or sustainable management of forest areas designated as new protected zones, and (5) the incorporation of climate change considerations, including mitigation strategies, into the management plans for protected areas.

A comprehensive overview of the implemented, ongoing, and planned mitigation strategies within the land use and forestry sector is provided in the table below.

TABLE 3.16. IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN GEORGIA'S LAND USE, LAND USE CHANGE AND FOREST SECTORS

Activity	Description[151]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2-eq.)	Reduce the amount of spray mist (2024-2030) (Gg CO2-eq.)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Restoration of 625 ha of degraded forest area (including fire-damaged area) through afforestation	**The following activities will be implemented within the scope of the activity:** Within the activity 250 ha [152] and 375 ha of degraded forest areas (including forest affected by fires) will be restored through afforestation in 2021-2023 (125 ha per year); the exact areas will be selected at the end of each year. **Actions taken before the reporting period:** Forest restoration measures have been completed on 150.2 ha. 144 ha of fire-damaged territory has been restored in the Samtskhe-Javakheti region, 4.9 ha of forest plantations were also carried out in the same region, and 1.3 ha of forest crops were planted in the Samegrelo-Zemo Svaneti region.	The goal of the activity is to restore degraded forest areas through afforestation.	Other	Approved	CO2	- 3.6	- 26.6	See BTR	2021	Ministry of Environmental Protection and Agriculture	6,585,000 Gel	Economic growth, ecosystem improvement, sustainable forest development	NO
Restoration of degraded forests through the promotion of natural regeneration	**Actions taken before the reporting period:** As of 2022, measures to promote natural regeneration have been implemented on 3153.9 ha, of which in 2022 the National Forestry Agency implemented 1472.9 ha, and the Adjara Forestry Agency implemented 100 ha. The activities were carried out on an area of 1714.6 ha.	Various management bodies responsible for forest sector management will restore degraded areas by promoting natural regeneration.	Other	Implemented	CO2	- 31.5	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture	4,758,260 Gel	Economic growth, ecosystem improvement, sustainable forest development	NO

151 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

152 Of this, 125 ha are within the scope of the Rural Development Action Plan.

Activity	Description[51]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2-eq.)	Reduce the amount of spray mist (2024-2030) (Gg CO2-eq.)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Introduction of sustainable forest management practices through the implementation of sustainable forest management plans	**The following will be implemented within the scope of the activity:** Sustainable Forest Management Plan for at least 7 municipalities (Lanchkhuti, Chokhatauri, Dedoplistskaro-Sighnaghi, Adigeni, Lentekhi, Lagodekhi, Akhmeta) will be developed and approved. A total of 269,954 ha of forest area will be sustainably managed in the municipality . **Actions taken before the reporting period:** In 2022, the Lanchkhuti, Chokhatauri, and Lagodekhi forest management plans were approved. In 2023, the Lentekhi forest management plan was approved. A forest inventory was conducted and field work has been completed in the Akhmeta, Dedoplistskaro-Sighnaghi and Adigeni forests. At this stage, the program is in testing mode, technical parameters are being specified/ adjusted, and forest management plans will be developed within this program.	The aim of the activity is to introduce sustainable forest management practices through the implementation of sustainable forest management plans.	Planning tool	Approved	CO_2	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture	12,512,960 Gel	Economic growth, ecosystem improvement, sustainable forest development	NO
Implementing sustainable forest management practices through oversight and capacity building	**Actions taken before the reporting period:** From January 1 to December 31, 2023, 23 (twenty-three) business yards were organized. A total of 54 business yards have been organized in Georgia. According to data from January 1 to December 31, 2023, the National Forestry Agency completed work in the villages of Shekhomdi, Chokhatauri, Ozurgeti, and Kvenobani, Lanchkhuti. Business yards were organized in Kakheti: Akhmeta villages Khodasheni, Telavi-Kavtiskhevi, Pshaveli, Eniseli. In Mtskheta Mtianeti municipality: Tianeti-Kanatia, Khevsurtsopeli, Kudro. Construction of business yards is currently underway in the village of Chikaani, Kvareli. Based on the principles of sustainable forest management practices, surveillance activities were carried out over the entire area (270,000 ha). To ensure surveillance, appropriate equipment and techniques (high-altitude vehicles, camera traps, drones, etc.) were purchased, and personnel (rapid response officers, forest inspectors, etc.) were trained.	Establishment and staffing of 14 business yards; Supervision of 270,807 ha of forest area based on the principles of sustainable forest management practices.	Planning instrument	Implemented	CO_2	NA	- 1,324.4	See BTR	2021	Ministry of Environmental Protection and Agriculture	411,123 GEL	Raising awareness , improving the ecological environment, sustainable forest development, economic growth	NO

Activity	Description[51]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2-eq.)	Reduce the amount of spray mist (2024-2030) (Gg CO2-eq.)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Promoting sustainable forest management by supporting the multifunctionality of forests, raising public awareness, and supporting public involvement in forest reform processes	**The following activities will be implemented within the scope of the activity:** Reducing cases of illegal logging and use of forest timber by the population in target areas ; Issuance of at least 10 permits for the use of non-timber resources by 2024; Issuance of at least 3 permits for recreational use of non-timber resources. **Actions taken before the reporting period:** As of 2022, a total of 14 recreational use permits have been issued, and 27 permits have been issued for the use of non-timber resources, including 4 by the Ajara Forestry Agency and 23 by the LEPL National Forestry Agency for the production of non-timber forest resources. No recreational use permits were issued during the reporting period. The LEPL Ajara Forestry Agency issued 16 recreational permits and 8 permits for the use of non-timber products. A public awareness campaign plan has been developed by the LEPL Environmental Information and Education Centre. The annual number of cases of illegal logging and use of forest timber by the population in the target areas is to be reduced by 30%.	illegal logging and use of forest timber as material by the population in the target areas will be reduced by 30%; By 2024, at least 10 permits will be issued for the use of non-renewable resources, and at least 3 permits will be issued for recreational use; A plan for a public awareness campaign will be developed.	Regulatory Instrument Educational tool	Approved	CO_2	NA	- 889	See BTR	2021	Ministry of Environmental Protection and Agriculture	1,445,400 GEL	Awareness raising, sustainable forest management, economic growth , increased community engagement	NO
Preparation of Emerald Network Management Plans for Georgian forests within the approved Emerald Network area	**Actions taken before the reporting period:** As of Q4 2023, 19 management plans have been developed for the Emerald Network areas located outside the protected areas, covering more than 200,000 ha of Georgia's forest area.	By 2024, Emerald Network Management Plans will be developed for at least 100,000 hectares of the Emerald Network Forest area.	Planning tool	Implemented	CO_2	-141.3	- 329.7	See BTR	2021	Ministry of Environmental Protection and Agriculture	60,000 GEL	Promoting sustainable forest management	NO
Protection and/or sustainable management of forest areas included in new protected areas	**The following activities are planned:** By 2030, 162,895 ha of forest area included in new protected areas will be protected and/or sustainably managed; **Actions taken before the reporting period:** The following protected areas have been established and are sustainably managed, covering a total of 107,462 ha of forest area - Erusheti National Park 7,216 ha (forest); Racha National Park 16,684 ha (forest); Tana Reserve 10,926.9 ha (forest); Kvereti Reserve 14,711.5 ha (forest); Aragvi Protected Landscape 41,736.00 ha (forest); Machakhela Protected Landscape 3,326.00 ha (forest); Tana Tedzami Protected Landscape 12,862.00 ha (forest).	The newly designated areas will include a minimum of 150,000 ha of protected/sustainably managed forest.	Other	Approved	CO_2	NA	- 329.7	See BTR	2021	LEPL "Agency of Protected Areas"	185,845.0 GEL	Promoting sustainable forest management	NO

Activity	Description[51]	Goals	Instrument type	Status	Greenhouse gas	Reduced emissions (2021-2023) (Gg CO2-eq.)	Reduce the amount of spray mist (2024-2030) (Gg CO2-eq.)	Admissions and methodology	Year of implementation	Implementer	Expenses	Other benefits besides mitigation	Interrelationship between mitigation activities
Integrating climate change issues, including mitigation, into protected area management plans	**The following activities are planned:** protected areas, consider, develop and gradually integrate climate change issues and mitigation into protected area management plans. **Actions taken before the reporting period:** As of 2023, 12 protected area management plans from a total of 26 administrations have addressed climate change issues in their new and revised approved management plans. The 12 management plans represent 42% of the total management plans. Two new protected landscapes were created in 2023, and the number of management bodies increased, but the indicator result did not increase.	By 2024, climate change mitigation issues will be integrated into more than 50% of protected area management plans.	Planning tool	Approved	CO2	NA	NA	See BTR	2021	Ministry of Environmental Protection and Agriculture	Administrative expenses	Promoting sustainable forest management	Link to Activity 7: Ensure protection and sustainable management of forest areas included in new protected areas

The Ministry of Environmental Protection and Agriculture of Georgia outlined a series of initiatives for the land use and forestry sector, funded by the state budget for the years 2020 to 2022. These initiatives include:

- The creation and administration of a protected areas system;
- The development and oversight of a forest management system;
- The formation and governance of a National Wildlife Agency system.

A comprehensive overview of the mitigation measures executed in the land use and forestry sector during the 2020-2022 budget period is provided in the table below.

TABLE 3.17. IMPLEMENTED, APPROVED AND PLANNED MITIGATION MEASURES IN THE LAND USE, LAND USE CHANGE AND FOREST SECTORS OF GEORGIA (ACCORDING TO THE STATE BUDGET)

Activity	Description[153]	Goals	Instrument type	Status	Year of implementation	Implementer	Expenses
31 08 Establishment and management of a system of protected areas	212 lecture-seminars were held on the topic of environmental protection and protected areas, 7 weeks, 15 green and 46 cleaning campaigns were organized. 78 eco-tours, 1 eco-lesson and 5 eco-camps were organized in protected areas (2020); During the reporting period, 850 different types of activities were carried out on the topic of environmental protection and protected areas: 276 lecture-seminars were held, 5 environmental weeks, 237 meetings with local population, 196 eco-tours, 8 eco-camps, 22 green and 66 cleaning campaigns (2021); 448 eco-educational lectures-seminars, 187 meetings with the local population, 16 greening and 105 cleaning actions were held. 808 ecotours were carried out in protected areas, 21 weeks, 29 ecocamps were organized (2022)	Protected and restored natural ecosystems, landscapes and living organisms; Developed traditional agricultural activities, maximum involvement of the local population in environmental protection activities, their increased incomes and improved socio-economic status.	Educational tool	Implemented	2020	Ministry of Environmental Protection and Agriculture	74,140,500 GEL
31 09 Forest system development and management	Planning of forest maintenance and restoration measures, spring and autumn works (including forest restoration and renewal, establishment of nurseries, promotion of natural renewal, planting and maintenance of plantations) were carried out in 7 regions. Planning of pest control and fire prevention measures was underway (2020); 281.0 thousand cubic meters of timber were issued with timber production tickets, and according to the origin documents, 252.9 thousand cubic meters were issued within the framework of social felling. Timber resource (2021); Measures to maintain restored and cultivated forest areas were carried out on an area of 114.8 ha (2022); Finished Infrastructure projects: Construction works of business yards in Samtskhe-Javakheti 5 business yards ; Kakheti 5 business yards Yard ; Imereti 1 Business Yard ; Mtskheta-Mtianeti 5 Business Yard ; Shida Kartli 1 facility (2020); 6 business yards completed : 4 facilities in Mtskheta-Mtianeti ; 1 business yard - in Racha and 1 business yard - in Kakheti (2021); Construction of 9 business yards completed (2022);	Ecological values of preserved Georgian forests, including biological Diversity; Regenerated forest Ecosystems, increased Forested areas; Updated information on forest resources, their Qualitative and About quantitative indicators, planned forestry use of forest resources (including timber) .	Other	Implemented	2020	Ministry of Environmental Protection and Agriculture	38,467,600 GEL
31 10 Establishment and management of the National Wildlife Agency system	6,000 pieces of field maple were sown in containers; 4,000 pieces of acacia, 5,000 pieces of cedar and 1,760 pieces of almond seedlings were transplanted from containers into 1-liter pots. 3,450 pieces of seedlings of various species were transplanted into 20 and 10-liter pots. 20,100 pieces of almond seedlings were removed from the open ground and transplanted into 1-liter containers (2020); The following were sown in containers: 62,000 pieces of spruce, 3,000 pieces of birch, 3,000 pieces of willow, 3,000 pieces of barberry, 2,500 pieces of Caucasian acacia, 20,000 pieces of field maple, 10,000 pieces of common ash, 2,000 pieces of rabbit's broom, 6,000 pieces of Georgian oak, 300 pieces of stone oak, 2,500 pieces of Himalayan cedar, 3,000 pieces of red tkemali, 300 pieces of hawthorn, 2,000 pieces of oleaster, 500 pieces of rowan and 3,000 pieces of maples were sown in containers (2021); 1,000 holm oak and 416 Eldar pine seedlings were planted in the Krtsanisi Forest Park. Their maintenance and pruning work has been ongoing (2021)	The number of wildlife species identified, which will allow us to estimate their reproduction by population Implementation based on priority; Through the addition of artificially propagated species, populations in the wild are replenished and thus wild populations are Reduced pressure on nature;	Other	Implemented	2020	Ministry of Environmental Protection and Agriculture	4,558,500 GEL

153 The first year indicated in the description column corresponds to the original deadline set by the Climate Action Plan (2021-2023), while the year indicated in brackets is the updated information on the completion date of the work.

3.3 NATIONALLY DETERMINED CONTRIBUTION FROM A GENDER PERSPECTIVE

Georgia's 2030 Climate Change Strategy (CSAP) is essential for the execution of the country's Nationally Determined Contributions (NDC). It is important to highlight the growing potential for incorporating gender commitments into these policy frameworks. Acknowledging gender equality as a fundamental aspect of sustainable development allows Georgia to formulate a holistic strategy for realizing the gender commitments outlined in the NDC through various mitigation initiatives.

Gender considerations are actively incorporated within the two primary objectives of the Climate Action Plan of Georgia (CAP). Firstly, sustainable forest management plans are crafted with attention to gender dynamics, recognizing the distinct roles and requirements of both women and men in the utilization and stewardship of forest resources. Secondly, Sustainable Development Goal (SDG) 5, which underscores the importance of gender equality, is woven into the objective of enhancing consumer awareness regarding energy efficiency. While progress has been made, these initiatives also reveal the potential for further advancing gender mainstreaming within the Climate Action Plan.

This section of the document outlines the current state of gender mainstreaming in the Climate Action Plan, pinpoints areas needing enhancement, and provides recommendations. The aim of this section is to evaluate the gender alignment of the Climate Action Plan with the LWPG, ensuring that gender considerations are integrated across all sectors of the Action Plan. This approach will enhance the inclusivity and effectiveness of Georgia's climate change policy.

3.3.1 GENDER COHERENCE OF THE CLIMATE ACTION PLAN (CAP) WITH THE ENHANCED LIMA WORK PROGRAMME ON GENDER (ELWPG)

Goal 1: Reduce greenhouse gas emissions in the energy generation and transmission sector

By the year 2030, achieving a 15% reduction in greenhouse gas emissions from the energy generation and transmission sector, relative to the baseline scenario, presents a substantial opportunity to advance gender equality within this field. Currently, women are significantly underrepresented in the energy sector; however, through proactive measures, this trend can be reversed, fostering a more inclusive atmosphere. Comprehensive educational initiatives can play a crucial role in dismantling stereotypes and motivating women to pursue careers in the energy sector, particularly in leadership roles, in accordance with Priority Area B of the Enhanced Lima Agenda on Gender.

Georgia's Long-Term Low Emission Development Strategy highlights the necessity of inclusive mitigation strategies that guarantee equal involvement of women in the workforce. By implementing training programs, offering flexible work arrangements, and establishing targeted recruitment initiatives, the sector can enhance support for women's career progression and create pathways for their leadership. Synchronizing these efforts with Georgia's National Gender Strategy and international commitments will further promote gender equality across all sectors.

These initiatives within the energy sector, through continuous assessment and modification, will bolster advancements toward gender equality. By fostering an environment of inclusion and equity, Georgia can cultivate a diverse workforce, drive innovation, and achieve sustainable growth in the energy sector.

Goal 2: Reduce greenhouse gas emissions in the transport sector

The objective of achieving a 15% reduction in greenhouse gas emissions from the transportation sector by 2030, relative to the baseline scenario, is a crucial element of Georgia's climate change strategy and presents a valuable opportunity to enhance gender inclusivity. At present, women encounter more significant obstacles than men in accessing low-emission vehicles, primarily due to wage disparities and limited financial resources. By establishing subsidies that ensure equal access to clean technologies for both genders and effectively promoting programs that highlight the advantages and affordability of these technologies, Georgia can foster a more equitable utilization of sustainable transportation.

Recognizing the distinct needs of women and men in public transport planning further reinforces this initiative. Women who rely on public transport often emphasize the importance of safety, accessibility, and comfort. For instance, the availability of easily accessible buses and sidewalks is vital for parents and individuals with disabilities. Addressing these specific needs in transport planning will greatly enhance the inclusivity and quality of services within the transportation sector.

Additionally, it is essential to gather gender-disaggregated data regarding the needs and behaviors of tourists. This information serves as the foundation for gender-sensitive planning, implementation, monitoring, and evaluation in alignment with the priorities of the ELWPG. By incorporating gender considerations into transport policy, Georgia can establish a more just and effective strategy for reducing emissions while developing a sustainable and inclusive transportation system.

Goal 3: Promote the development of low-carbon approaches in the buildings sector

Supporting low-carbon development within the building sector is essential for meeting climate change objectives, particularly through the advancement of climate-smart and energy-efficient technologies and services. Women are pivotal in this sector, as they are the primary energy consumers in households and possess the potential to become energy producers. This dual capacity underscores the necessity of incorporating gender considerations into energy policy and practice.

Donor-funded rural energy projects have illustrated the transformative effects of engaging women in energy initiatives, establishing new benchmarks for best practices. These initiatives reveal that empowering women in energy management leads to more efficient energy utilization and accelerates the adoption of sustainable technologies. To amplify this positive impact, it is imperative to integrate gender considerations into all activities within the building sector.

To build upon the progress achieved, it is vital to mainstream gender issues in all household energy-related endeavors by acknowledging women's contributions and unique insights in energy management. The active participation of women is not merely beneficial; it is vital to reach the long-term, sustainable change and ensuring the low-carbon development.

Georgia has made progress in integrating gender issues within the energy sector, yet there remains significant room for enhancement. This includes the implementation of policies that directly tackle gender disparities, the provision of training and resources to support women's involvement in energy initiatives, and the creation of an inclusive environment that fosters women's leadership in energy-related decision-making. These measures will empower Georgia to fully harness the potential of its population, ensure gender equality, and more effectively meet climate change objectives.

Goal 4: Promote the development of low-carbon approaches in the industrial sector

By the year 2030, it is imperative to foster the advancement of low-carbon strategies within the industrial sector through the promotion of climate-smart and energy-efficient technologies and services, aiming for a 5% reduction in greenhouse gas emissions. This ambitious goal encompasses the implementation of climate-smart technologies and services, which are vital for transitioning to a more sustainable industrial framework. Furthermore, ensuring equal representation and empowerment of women in the industrial sector, historically dominated by men, is a fundamental aspect of this transition.

To address gender disparities, it is essential to adopt proactive measures that promote gender equality, enabling women to fully engage in and benefit from the shift towards a low-carbon economy. Establishing accessible pathways for women to enter and progress within the industrial sector is crucial, facilitated by education and training programs focused on green skills, as well as mentoring and networking opportunities that help women build confidence and connections in this domain.

The Long-Term Low Emission Development Strategies (LT-LEDS) framework incorporates the WAM scenario, which prioritizes gender equality as a central theme. By enacting policies that actively promote the employment and advancement of women, especially in leadership and decision-making roles, this initiative seeks to cultivate a genuinely inclusive sector. Setting gender-specific targets and monitoring progress will enhance accountability and contribute to a more equitable, innovative, and sustainable future for the industrial sector.

Moreover, fostering inclusive working conditions that appreciate diversity and combat gender discrimination is vital for creating an environment where women can excel. This includes the implementation of family-friendly policies, such as flexible working hours and parental leave, which can assist in balancing professional and familial responsibilities.

Through the implementation of these extensive measures, the industrial sector can successfully meet its objectives for reducing greenhouse gas emissions while simultaneously advancing the wider social aims of gender equality and economic empowerment. This strategy aligns with global commitments to sustainable development and guarantees that the advantages of low-carbon economic growth are equitably distributed throughout society.

Goal 5: Ensure low-carbon development of the agricultural sector by promoting climate-smart and energy-efficient technologies and services

Despite the fact that women in Georgia currently possess less land than men, they play a crucial role in smallholder agriculture and significantly contribute to the advancement of this sector. The participation of women, particularly in low-income agricultural settings, underscores their resilience and adaptability, while also emphasizing the necessity of supporting them amid market fluctuations and the effects of climate change.

To mitigate this vulnerability, it is essential to adopt gender-sensitive strategies in all agricultural initiatives. This entails acknowledging the distinct challenges that women encounter in agriculture and ensuring they have equal access to resources, training, and technologies that can enhance their resilience and productivity. Climate-smart agricultural innovations, including improved irrigation systems, drought-resistant crops, and sustainable waste management practices, should be customized to meet the specific requirements of women farmers.

Furthermore, it is vital to incorporate gender considerations into agricultural policies and programs to achieve fair outcomes. This involves engaging women in decision-making processes at all levels, from local community planning to national policy formulation. Such involvement can help ensure that women's voices and perspectives are integrated into strategies aimed at alleviating the impacts of climate change and fostering sustainable agricultural practices.

Agricultural activities must align with all LWPG priority areas, highlighting the significance of a gender-responsive implementation process and the empowerment of women in sectors related to climate change.

Goal 6: Foster the advancement of low-carbon practices within the waste sector by encouraging the adoption of climate-friendly and energy-efficient technologies and services.

There exists a significant opportunity to enhance the incorporation of gender considerations within the waste management initiatives outlined in the Climate Action Plan. By addressing these considerations, the nation can markedly improve the efficacy of its waste management strategies, recognizing that men and women frequently assume distinct roles and responsibilities within households.

To foster a more inclusive approach, it is essential to implement a gender-sensitive framework across all waste management activities and plans. This entails comprehending the differing perspectives of women and men regarding waste management issues and formulating suitable communication strategies that acknowledge these variations in practice. Women, in particular, are pivotal in household waste management and can greatly contribute to waste segregation and recycling efforts. Consequently, it is imperative to actively engage women in communication campaigns to ensure they receive the necessary information and resources to participate effectively in waste management initiatives.

Moreover, gender-sensitive communication should extend beyond mere information dissemination. It should promote participatory methods that empower both women and men to engage in decision-making processes concerning waste management. Community meetings, focus groups, and other interactive platforms can foster dialogue and collaboration, ensuring that all voices are acknowledged and valued in the formulation of waste management strategies.

Target 7: By 2030, increase the carbon sequestration capacity of the forest sector by 10% compared to 2015 levels

It is essential to comprehend the distinct ways in which women and men utilize land and forest resources. Women frequently gather non-timber forest products, including berries and medicinal plants, which are crucial for household sustenance and the local economy. Conversely, men generally collect firewood, a primary source of heating for their residences.

To successfully incorporate these varied roles and interests, forest management strategies and protected area governance must be inclusive and responsive to gender considerations. Women's grassroots organizations often play a significant role in the management of protected areas. This necessitates the integration of both women's and men's viewpoints in decision-making processes, thereby fostering equitable resource management. The equal representation of women and men in forest management, as emphasized in Priority D of the LWPG, is vital for achieving the objectives of the forest sector outlined in the Climate Action Plan. Furthermore, effective communication strategies are critical for promoting collaboration and understanding among stakeholders. This involves creating platforms for dialogue and knowledge sharing, enabling both women and men to exchange their experiences and insights.

Incorporating gender considerations into forest management not only supports low-carbon development but also aligns with the broader objectives of gender equality.

TABLE 3 18. ANALYSIS OF MITIGATION MEASURES / NDC ACTIVITIES RELATED TO THE LIMA WORK PROGRAMME ON GENDER (LWPG) AND ITS ACTION PLAN

Activity	Description	LWPG's Category	LWPG's Sub-category	Comment
2.3.1. Implementation of measures envisaged within the framework of Tbilisi's transport policy.	Tbilisi Transport Company LLC is provided with consulting services on gender equality issues by the international consulting company AETS apave. Within the framework of this cooperation, Tbilisi Transport Company has carried out various events: Action Plan and Application An action plan for the implementation of the equal opportunities policy was created; A statement and slogan about the equal opportunities policy were developed. Trainings and employment More than 50 female bus drivers were trained; 42 women have been employed as bus drivers in Tbilisi. Hiring and work policies A gender-neutral job application form was developed; Newly designed work uniforms were created for bus drivers, conductors, and controllers, taking into account the equal opportunities policy. Employee engagement: A questionnaire was developed for employees in order to properly develop equal opportunities, create a better working environment, and raise awareness. Tbilisi Transport Company LLC is focused on creating a diverse work environment that provides equal opportunities for all employees, regardless of age, gender, ethnicity, or religious affiliation, to maximize their potential.	A	A1	Tbilisi Transport Company: https://ttc.com.ge/ka/equal-abilities https://ttc.com.ge/ka/news/528
2.3.2. Implementation of measures envisaged by the Batumi Sustainable Urban Mobility Plan	Weak integration of gender issues in the initial planning phase: According to the evaluation report, the Integrated Sustainable Urban Mobility Plan (ISUMP) includes gender, but lacked gender-related considerations in its initial design phase. Opportunities for mainstreaming: The plan recognizes the benefits of improved public transport for improving women's mobility, but its potential to improve living conditions for women and other vulnerable groups has not been fully exploited. Household Mobility Survey Results: " Green City – Integrated Sustainable Transport for Batumi and Adjara Region " The ISTBAR project provided relevant information on social and gender issues through tools such as household surveys. The ISUMP plan did not address actions or recommendations on vulnerable groups. Root cause of ISUMP weaknesses: The weak implementation of gender aspects was due to the incomplete review of gender and vulnerability issues by the Batumi ISUMP. Although general gender data was provided, it was not translated into actionable measures.	D	D7	Green City – Integrated Sustainable Transport for Batumi and Adjara Region (ISTBAR): https://www.gefieo.org/sites/default/files/documents/projects/tes/5468-terminal-evaluation.pdf

Activity	Description	LWPG's Category	LWPG's Sub-category	Comment
3.1.1. Development of a methodology for building certification	Gender is not mentioned, but the donors of the activity have a gender and community engagement policy.			EBRD Gender Insights: https://www.ebrd.com/gender-tools-publications.html
3.1.2. Creation, approval and implementation of subordinate normative acts on the energy efficiency of buildings.	Gender is not mentioned, but civil society was actively involved in the development of the law on energy efficiency.			
3.2.2. Implementation of public awareness programs on energy efficiency.	Gender is not mentioned.			GOPA Intec, within the framework of the EU-supported project "Georgian Energy Sector Reform Program (GESRP)", announces a competition for Tbilisi schools to participate in the international campaign. https://www.economy.ge/?page=news&nw=2212&s=romeo-miqautadzem-kampaniis-gaxade-sheni-skola-energoefeqturi-gaxsnit-gonisdziebashi-miigo-monawileoba-
3.2.4. Implementation of information campaigns on solar water heating.	Gender is not mentioned in the CAP, although it is addressed in gender-sensitive Nationally Acceptable Mitigation Actions (NAMAs) that address sustainable energy development in rural areas.			CENN communication campaign with the support of UNDP and the European Union: https://www.undp.org/sites/g/files/zskgke326/files/migration/ge/undp_ge_enpard_simple-solar-water-heater_brochure_geo.pdf WECF has developed a gender-sensitive solar water heater project that was not funded. Discussions are currently underway with KLIK to support the promotion of solar water heaters in a gender-sensitive manner, implemented by WECF.
3.4.2. Encourage the use of energy-efficient wood stoves.	One of the main target groups of the activity is women, as they are the main caregivers in the family and the main consumers of fuel wood. Assessing the gender impact of stove financing schemes to ensure that loans and microloans are accessible to women, especially female-headed households and single parents; Strengthening financial literacy in target regions and municipalities by integrating relevant activities into the municipalities' action plans (e.g. financial literacy workshops within the framework of International Women's Day) using the powers and functions of Gender Equality Councils and Gender Focal Points ; " women's rooms " in municipalities for relevant activities.	Priority areas: A and D	Activities: A1 (emphasis on municipalities) A5 D1, D2, D3, D5 (emphasis on municipalities)	The Gender Action Plan is available at: https://www.giz.de/en/downloads/giz2022-en-gender-action-plan-GA.pdf

Activity	Description	LWPG's Category	LWPG's Sub-category	Comment
5.2.3 Support existing and emerging cooperatives to implement sustainable pasture management practices and replicate the success factors of successful cooperatives for other cooperatives.	The document highlights the existence of gender inequality in decision-making, access to property and resources, especially in the livestock sector; The document notes that despite women's active participation, their contributions are often not valued, which affects both their social status and their inclusion in the decision-making process; The document emphasizes the importance of inclusive policies and proposes initiatives such as the establishment of pasture user associations, where women would be significantly represented, gender-sensitive infrastructure planning, and revised pasture lease criteria to improve women's access to credit resources; Taking into account the aforementioned gender dynamics is essential for the successful implementation of sustainable and equitable management practices for pastures and meadows in the country.	A	A1, A4, D3	National Policy Concept for Sustainable Pasture Management: https://mepa.gov.ge/Ge/Files/ViewFile/53687
7.2.1 Implement sustainable forest management practices through the implementation of sustainable forest management plans.	By 2027, 100% gender-sensitive forest management plans will be created that meet the needs of women and men; The inclusion of women in planning and decision-making processes and the consideration of gender issues in forest management training will be ensured; Gender-segregated information will be collected.	A, D	A1, A4, D5, D7	https://www.giz.de/en/worldwide/100952.html See projects GAP and GA .
7.2.2. Implement sustainable forest management practices through oversight and capacity building.	Ongoing work with municipal gender equality councils: The Department of Environmental Supervision (DES) training system includes a training component for DES employees on gender equality and the specifics of the forestry sector; A gender expert reviews standard operating procedures (SOPs) and training modules to ensure their compliance with gender-sensitive language and content; DES trainers will be trained in gender-equal and sensitive management; the DES is encouraged .	A	A1	
7.2.3. Promoting sustainable forest management by supporting the multifunctionality of forests, raising public awareness, and supporting public involvement in forest reform processes.	Local Forest Sector Reform Focal Points and municipal Gender Focal Points should collaborate to ensure that the flow of information is ensured and accessible to women. Advocacy and information campaigns organized and led by women to increase women's visibility and knowledge about the role women play in the successful implementation of Energy Efficiency and Adaptation Fund (EE-AF) solutions. Household advisory services for EE-AF should be particularly focused on female-headed and vulnerable households. Within the scope of the activity: All knowledge and information materials on gender It is edited with mainstreaming in mind. National campaigns on gender It is designed with mainstreaming in mind.	A, D	A1, A5, D2, D3 (partly)	

3.3.2 GENDER IN GEORGIA'S CLIMATE CHANGE POLICIES, STRATEGIES AND ACTIONS

Preface

The fight against climate change is inherently influenced by gender, as men and women bear distinct responsibilities and have varying access to the advantages of mitigation strategies (LT-LEDS, 2030). The impacts of climate change mitigation efforts are experienced differently by women and men, particularly in Georgia, where this disparity is evident in the division of labor (LT-LEDS). Women in Georgia are significantly underrepresented in leadership roles, a situation exacerbated by a substantial wage gap, prevalent negative perceptions, and a scarcity of role models, which collectively deter young girls from pursuing careers in science, technology, engineering, and mathematics (STEM). According to LT-LEDS, it is anticipated that the employment opportunities generated in a low-carbon economy scenario will predominantly benefit men.

An intersectional approach is vital for analyzing access to resources, decision-making processes, and the resultant impacts. This approach considers various factors that affect access and outcomes related to gender, including ethnicity, disability, socioeconomic status, language, migration status, and whether one resides in an urban or rural area[154]. Consequently, it is imperative that climate change policies are designed with a gender-sensitive lens.

This chapter evaluates existing climate change policies, identifies existing gaps and exemplary practices, and examines pertinent documents in the context of the LWPG and its Gender Action Plan.

3.3.2.1. Gender in Georgia's Climate Change Policy - Overview

This paragraph examines the integration of gender considerations within Georgia's primary policies and strategies concerning climate change mitigation and the National Contribution.

Georgia's National Contribution features a section dedicated to gender and climate change, with the objective of mainstreaming gender, fostering equal participation, empowering women, enhancing capacity, and formulating gender-responsive climate change policies. Additionally, it incorporates Sustainable Development Goal 5, which focuses on eradicating gender inequality and discrimination against women and girls through their economic, political, and social empowerment. Nevertheless, after the nationalization of the Sustainable Development Goals, the National Contribution fails to address SDG 5 indicator 5c, which emphasizes the necessity of implementing legislative measures to attain gender equality. The National Contribution also underscores the significance of women as educators, decision-makers, and agents of change, highlighting their active roles within the education system and their unique positions in households to promote energy efficiency. Furthermore, the document acknowledges women as a demographic particularly vulnerable to the impacts of climate change.

Nonetheless, there is a need for further dialogue regarding the empowerment of women through their involvement in decision-making processes and the implementation of

154 https://unfccc.int/sites/default/files/resource/Background%20note%20-%20Gender-responsive%20JT.pdf

measures to achieve gender-related objectives. Additionally, it is essential to establish measurable gender targets, indicators, and budgets. The International Labour Organization (ILO) Guidelines on a Just Transition to Sustainable Economies and Societies urge Parties to incorporate similar strategies into their National Contributions, and it is important to note that some countries have already heeded this recommendation.[155]

The Nationally Determined Contributions (NDCs) include a dedicated chapter addressing gender; however, it is essential to incorporate gender considerations throughout the entire document. Additionally, the current framework adopts a binary perspective of gender, overlooking other significant factors that shape individuals' experiences. For instance, disparities between rural and urban communities, as well as the unique challenges faced by ethnic minorities, play a crucial role in shaping perceptions of climate change mitigation efforts and the ability of both women and men to engage in climate action.

The Climate Strategy and Action Plan (CSAP) seeks to operationalize the Nationally Determined Contributions (NDCs), yet gender considerations are not adequately woven into its framework. A comprehensive strategy outlining gender commitments related to NDC mitigation actions has yet to be established.

The Long-Term Low Emission Development Strategy (LT-LEDS)[156], which received approval in 2023, acknowledges the presence of gender considerations within Georgian legislation and emphasizes the prevailing inequalities in employment, wage parity, and the underrepresentation of women in leadership roles. Gender-related issues encompass:

- Encourage the equal engagement of women across all sectors, particularly in agriculture and other fields that have historically been male-dominated.
- Enhance the participation of women in conducting needs assessments, as well as in the formulation of climate change policies and action plans.
- Acknowledge that within the technology sector, which has traditionally been male-dominated, the WAM scenario predicts the creation of 200,000 jobs by the year 2050. This development poses a significant challenge to the Just Transition process, as it is projected that, without additional interventions, only 17% of these new positions will be filled by women by 2050.

Georgia's Biennial Update Report (BUR)[157] and and Fourth National Communication[158] address gender issues comprehensively. Specifically, the BUR highlights gender-related Nationally Appropriate Mitigation Actions (NAMAs) that focus on sustainable rural energy development. By employing a transformative and intersectional framework, these initiatives ensure that gender considerations are embedded at every level of implementation.

The White Paper on Climate Change Law[159] adopts a comprehensive perspective on gender issues. It not only explicitly addresses gender justice but also incorporates an intersectional gender lens into climate change objectives, governance, adaptation strategies, just

155 https://ndcpartnership.org/sites/default/files/2024-02/supporting-gender-responsive-ndcsinsight-brief-feb-2022.pdf
156 For detailed information, see DGGC/LT-LEDS, p. 77
157 https://unfccc.int/sites/default/files/resource/2019.06.13_BUR2_2019_Eng.pdf
158 https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf
159 https://web-api.parliament.ge/storage/files/shares/Komitetebi/garemo/White-Paper-WDF-geo.pdf?fbclid=IwAR1KVsxosoTuSSU2o_OaE4y460QLj8-oTU_ofNouq8Rp4UmJV6e8E3jTtXI

transition, and community engagement. This approach acknowledges the diverse impacts of climate change on different genders, underscoring the necessity for gender-responsive strategies throughout the climate change response process. Notably, in the adaptation section, the White Paper emphasizes the need for national contributions and mitigation strategies to be inclusive and sensitive to the needs, challenges, and priorities of vulnerable groups, including women, adolescents, internally displaced persons, and ethnic minorities. By promoting the participation of marginalized communities and civil society organizations, the White Paper seeks to empower these groups and enhance their resilience. This strategy aligns with global initiatives, such as the Paris Agreement, and reflects Georgia's dedication to integrating social justice and gender equality into its mitigation efforts.

The National Energy Efficiency Action Plan[160] encompasses issues related to gender:

- Women are identified as a vulnerable group.
- Enhancing women's access to sustainable energy sources.
- Incorporation of Sustainable Development Goals and gender-sensitive indicators.
- The significance of empowering women for sustainable development and the role of energy access in facilitating this empowerment.
- In the context of household energy management, the document employs the term "housewife," which lacks gender sensitivity. It is advisable to utilize terminology that reflects gender inclusivity, such as "women," "caregivers," or "women as energy managers in households."

The "Medium-Term Action Plan (2023-2026) - Development and Management of Regional and Infrastructure Development Policies" presents a holistic strategy for advancing regional, infrastructure, and tourism development, with a particular emphasis on the incorporation of gender considerations into various initiatives and sub-initiatives.

Under the priority area of "Development and Management of Regional and Infrastructure Development Policies (Program Code 25 01)," the document underscores "gender equality" as a core tenet of the decentralization strategy. The program seeks to engage both women and men in the decentralization and self-governance processes, which is anticipated to influence the formulation of regional development policies that prioritize gender issues. Furthermore, the plan emphasizes the importance of gender-sensitive policies within the "Restoration and Rehabilitation of Water Supply Infrastructure (Program Code 25 04)" and the "Solid Waste Management (Program Code 25 05)" initiatives. These efforts aim to establish gender-sensitive infrastructure that fosters equal employment opportunities within the waste management sector.

Moreover, the plan reaffirms its dedication to promoting gender inclusivity in the construction and rehabilitation of general education and preschool facilities (Program Code 25 07), which includes enhancing educational opportunities for girls, fostering social inclusion, and improving accessibility for individuals with disabilities. The sub-program "Tourism Infrastructure Improvement Measures" (Program Code 25 08) also emphasizes the significance of urban renewal and development, particularly through the lens of

160 https://unece.org/fileadmin/DAM/project-monitoring/unda/16_17X/E2_A2.3/NSEAP_Georgia.pdf

gender mainstreaming in the creation of alternative spaces and the restoration of various structures. Ultimately, the Medium-Term Action Plan illustrates a proactive commitment to embedding gender considerations across multiple sectors, thereby reflecting a dedication to inclusive and equitable development.

1. The significance of incorporating a gender perspective into climate change policies, strategies, and action plans cannot be overstated. However, the annual budgets assessed by MEPA, MOESD, and MRDI currently lack provisions that specifically address gender issues within the broader framework of climate change. This gap presents an opportunity to enhance both the inclusivity and effectiveness of the budget concerning climate change and gender-related initiatives.

The 11th Sustainable Energy and Climate Action Plan (SECAP) highlights gender as "a crucial component of the awareness-raising campaign focused on the collection and analysis of gender-sensitive data." Such data is essential for recognizing the differing needs of women and men, understanding resource utilization, defining roles and responsibilities, and planning activities accordingly.

The Tbilisi Green City Action Plan (2017-2030)[161] emphasizes the significance and necessity of incorporating gender stratification in the data collection process of household surveys.

The reviewed documents presently lack an intersectional perspective, presenting an opportunity to adopt a more holistic approach that considers the effects of climate change on gender and associated matters.

3.3.2.2 Lima Work Programme on Gender and its Action Plan – Analysis

Georgia's climate change policy and initiatives address the relevant priority areas: A, B, and D, as areas C and E fall solely under the jurisdiction of the UNFCCC. It is important to highlight that 9 out of 15 activities in each of these areas are partially integrated into the current projects.

Priority Area A. Capacity Development, Knowledge Management and Communication

A1. Enhancing Capacity Development for Gender Mainstreaming

There exists a deficiency in the capacity for integrating gender considerations into climate change policy. Training sessions for gender stakeholders were held during the formulation of current documents. It is important to highlight that gender issues were also included in the training offered to municipalities.

Various non-governmental organizations, including the Westminster Democracy Foundation (WDF), Women for a Common Future (WECF), and Green Alternative, are actively engaged in capacity development initiatives aimed at promoting gender mainstreaming within climate change policy. Furthermore, the Regional Environmental Center for the Caucasus (The REC Caucasus) convened a conference on this subject in 2022.

161 https://www.ebrdgreencities.com/assets/Uploads/PDF/GCAP_Tblisi.pdf

A3. Enhancing Capacity for Gender-Disaggregated Data

The National Statistics Office of Georgia gathers sex-disaggregated data, albeit with limited contextual information.

It is important to highlight that data regarding employment and earnings is collected based on gender.

A4. Advancing Evidence and Research on Differential Impacts and Women's Contributions

The LT-LEDS incorporates an examination of how low-carbon development models will affect gender balance in future employment opportunities. For comprehensive details, please refer to the Adaptation chapter.

A5. Promoting Communication on LWPG and GAP

On December 2, 2022, the Ministry of Environmental Protection and Agriculture of Georgia, in partnership with GIZ (Developing Capacity for Climate Change Policy in South-East, Eastern Europe, South Caucasus, and Central Asia, Phase III (CDCPIII)) and The REC Caucasus, organized a conference titled Tbilisi Climate Change and Gender Conference: 'Bridging the Gender Gap in Climate Change in Georgia.' Additionally, WECF, with the backing of BMZ, is executing the project Mainstreaming Gender in Climate Policy in Georgia (2023-2025), which includes stakeholder interviews and communication efforts.

WECF, with the assistance of BMZ, is executing the project titled Gender Mainstreaming in Climate Policy in Georgia (2023-2025), during which stakeholder interviews and communication efforts have been carried out.

Caucasus Digest also released an article[162], examining the influence of gender on climate change policy in Georgia.

Additionally, another piece[163] highlighted gender-sensitive energy cooperatives that advocate for environmentally sustainable technologies.

Priority Area B. Gender Balance, Participation and Women's Leadership

B1. Promoting women's leadership and enhancing their skills in negotiations

The gender representation within the Georgian government delegation has been notably preserved, ranging from 33% to 67% during the UNFCCC Conferences of the Parties (COP) and interim meetings from 2017 to 2023. In 6 out of 10 meetings, a woman has taken the lead of the delegation.

B2. Providing financial support for travel expenses for female delegates and civil society participants engaged in negotiations

Georgian delegations tend to be relatively small, with a commendable gender balance. On

162 https://css.ethz.ch/content/dam/ethz/special-interest/gess/cis/center-for-securities-studies/pdfs/CAD124.pdf#page=11

163 https://energy-democracy.net/cooperatives-promote-gender-equality-and-combat-energy-poverty-in-rural-georgia/index.html

multiple occasions, civil society representatives have received funding from international NGOs, including WECF and Climate Action Network (CAN), although comprehensive details remain unavailable.

B3. Collaboration with local communities and the Indigenous Peoples Platform Facilitation Working Group

N/A

Priority Area D. Implementation of Gender-Sensitive Approaches and Means of Implementation

D1. Capacity building for gender budgeting

Civil society organizations are enhancing their skills in gender budgeting; however, these initiatives do not specifically address climate change or related programs.

Since 2020, training sessions have been consistently held for both ministries and municipalities, with all entities participating in these training efforts. Furthermore, a gender budgeting program has been established at the LEPL - Academy of the Ministry of Finance, and training activities are currently in progress.

Training has been carried out with selected ministries on distinct links (Tag), and all ministries are now incorporating these links into their budgets, which is documented in the annex to the program budget.

D2. Enhance understanding of the financial and technical assistance available that aids in promoting gender mainstreaming within the context of climate change.

NA

D3. Facilitate the development and implementation of technologies that are responsive to gender considerations.

Many SECAPs and the Climate Action Plan advocate for the adoption of solar water heaters and energy-efficient stoves, which are typically recognized as gender-sensitive technologies due to the distinct advantages they offer to both women and men. These technologies contribute to a decrease in unpaid labor, enhance health, and improve comfort and indoor air quality within residential spaces.

D4. Gather information regarding gender and expertise related to climate change.

NA

D5. Engage women's organizations in the formulation and implementation of climate change policies and initiatives.

NA

D6. Share insights on the activities of the Parties concerning gender and climate change.

NA

D7. Release data that is disaggregated by sex.

All publicly available data can be accessed on the Geostat website.

3.4 BRIEF INFORMATION ON GREENHOUSE GAS EMISSIONS AND REMOVALS

(Paragraph 91 MPGs)

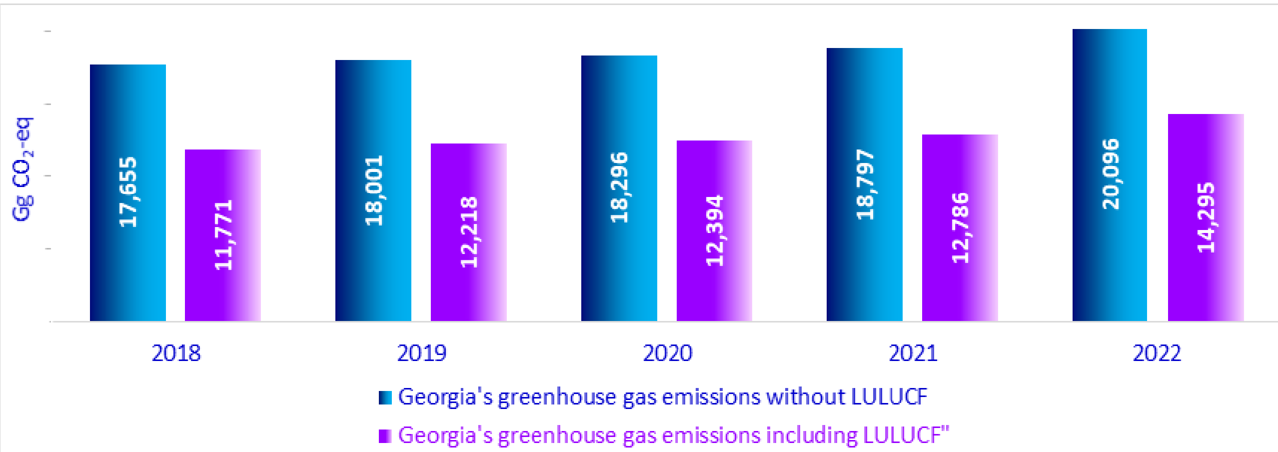
This chapter presents an overview of Georgia's inventory of greenhouse gas emissions and removals for the years 2018 to 2022. The data is organized in tabular form, detailing emissions and removals for Georgia's greenhouse gases, both with and without the inclusion of Land Use, Land Use Change, and Forestry (LULUCF), as well as categorized by sector and specific greenhouse gases.

Between 2018 and 2022, Georgia's greenhouse gas emissions, excluding LULUCF, rose from 17,655 to 20,096 Gg CO_2-eq, reflecting an increase of approximately 13.8%. When including the LULUCF sector, emissions grew from 11,771 to 14,295 Gg CO_2-eq, indicating a rise of about 21.4%. Thus, during the period from 2018 to 2022, there was an increase in greenhouse gas emissions in both scenarios. Notably, the percentage increase in emissions that includes the LULUCF sector is slightly higher than that of emissions calculated without it.

TABLE 3.19 GEORGIA'S GREENHOUSE GAS EMISSIONS IN 2018-2022 (GG CO2-EQ)

	2018	2019	2020	2021	2022
Georgia's greenhouse gas emissions excluding LULUCF	17,655	18,001	18,296	18,797	20,096
Georgia's greenhouse gas emissions including LULUCF	11,771	12,218	12,394	12,786	14,295

FIGURE 3.4.1. GEORGIA'S GREENHOUSE GAS EMISSIONS IN 2018-2022



Georgia has carried out a comprehensive assessment of greenhouse gas emissions and removals for the years 2018 to 2022 across five distinct sectors. In the energy sector, emissions rose from 11,326 to 13,218 Gg CO2-eq, marking an increase of approximately 14%. Conversely, the agriculture sector saw a reduction in emissions, decreasing from 2,411 to 2,310 Gg CO2-eq, which equates to a decline of around 4%. The industrial processes and product use (IPPU) sector experienced a slight uptick in emissions, rising from 2,019 to 2,571 Gg CO2-eq, reflecting an increase of about 21%. In the waste sector, emissions grew from 1,900 to 1,996 Gg CO2-eq, indicating an overall increase of roughly 5.1%. The land use, land-use change, and forestry (LULUCF) sector showed a minor improvement in removals, with emissions shifting from -5,884 Gg CO2-eq to -5,801 Gg CO2-eq, representing a reduction in removal capacity of approximately 1.4%. During the period from 2018 to 2022, the IPPU sector recorded the most significant rise in greenhouse gas emissions, while the agriculture sector achieved the most substantial decrease. Additionally, the removal potential in the LULUCF sector experienced a slight decline over the same timeframe.

TABLE 3.20 PRESENTS THE INVENTORY DATA ON GREENHOUSE GAS EMISSIONS AND REMOVALS IN GEORGIA FOR THE YEARS 2018-2022, CATEGORIZED BY SECTOR (GG CO2-EQ).

	2018	2019	2020	2021	2022
Energy	11,326	11,462	11,351	11,984	13,218
Industrial processes and product consumption	2,019	2,236	2,452	2,305	2,571
Agriculture	2,411	2,377	2,541	2,530	2,310
Waste	1,900	1,926	1,951	1,978	1,996
LULUCF	-5,884	-5,784	-5,901	-6,011	-5,801

FIGURE 3.4.2. INVENTORY DATA ON GREENHOUSE GAS EMISSIONS AND REMOVALS OF GEORGIA IN 2018-2022, BY SECTOR (GG CO2-EQ)

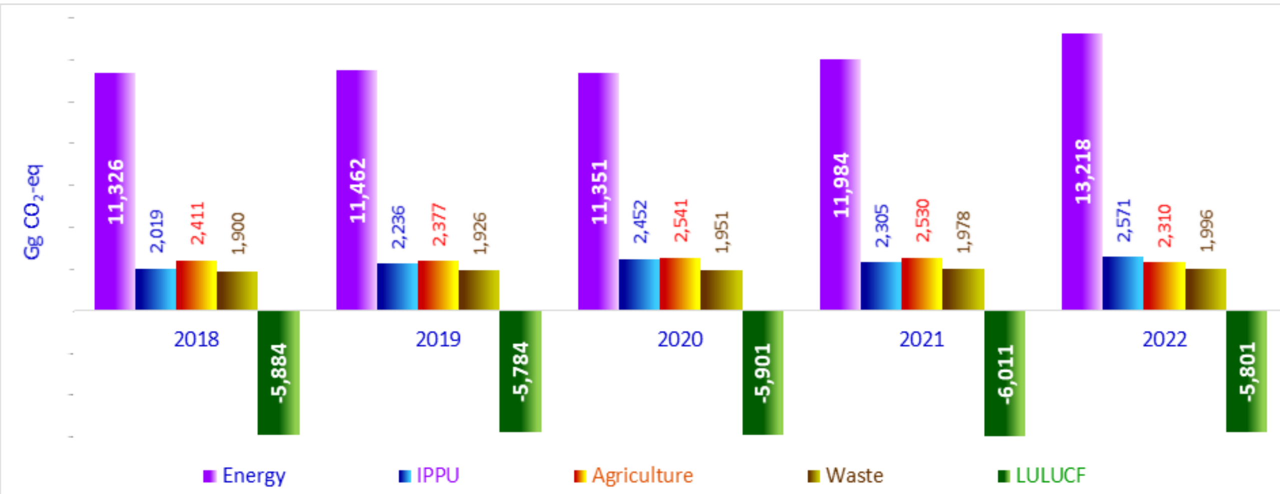


TABLE 3.21 PRESENTS THE EMISSIONS OF VARIOUS GREENHOUSE GASES (MEASURED IN GG CO2-EQ) FOR THE YEARS 2018 TO 2022. THE DATA FOR THE NINE GREENHOUSE GASES ANALYZED REFLECTS THE TOTAL EMISSIONS AND REMOVALS OF EACH GAS OVER THIS FIVE-YEAR SPAN.

Carbon dioxide (CO_2) emissions have shown a notable increase of 22%, rising from 10,455

Gg CO2-eq in 2018 to 12,829 Gg CO2-eq in 2022. In contrast, emissions of methane (CH_4) and nitrous oxide (N_2O) have experienced a slight decline compared to their levels in 2018.

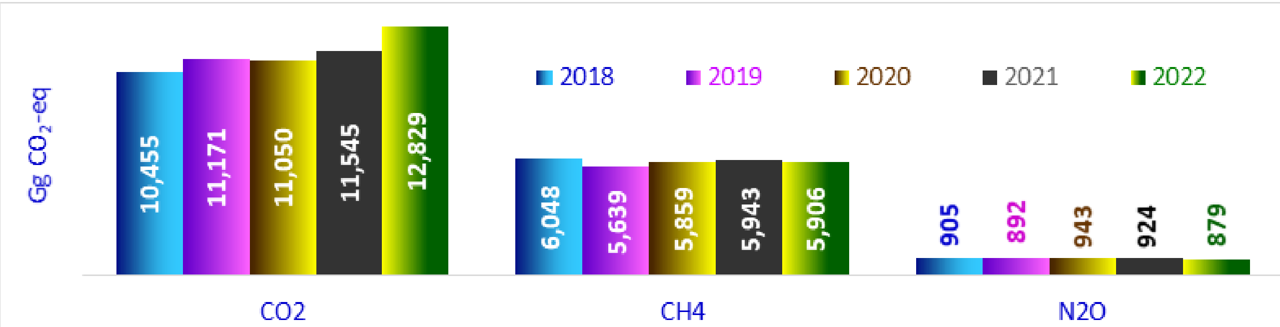
Additionally, the table includes figures for hydrofluorocarbon (HFC) emissions. Specifically, emissions of HFC-125 surged by 82%, reaching 54.62 Gg CO2-eq between 2018 and 2022. Emissions of sulfur hexafluoride (SF_6) rose from 0.93 Gg CO2-eq to 1.14 Gg CO2-eq. While CH_4 and N_2O emissions decreased, HFC emissions exhibited the most significant increase during the same period.

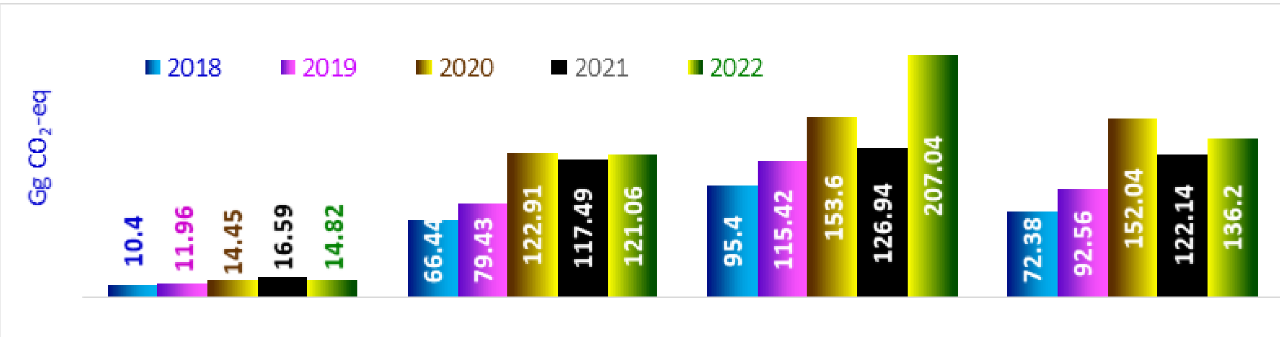
Inventory data categorized by gas, excluding HFC-227ea and SF6, is also illustrated in Figure 3.

TABLE 3.22 PRESENTS THE INVENTORY DATA CONCERNING GREENHOUSE GAS EMISSIONS AND REMOVALS IN GEORGIA FOR THE YEARS 2018 TO 2022, ORGANIZED BY GAS (GG CO2-EQ).

Year	CO2	CH4	N2O	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-227ea	SF6
2018	10,455	6,048	905	10.40	66.44	95.40	72.38	0.31	0.93
2019	11,171	5,639	892	11.96	79.43	115.42	92.56	0.10	1.00
2020	11,050	5,859	943	14.45	122.91	153.60	152.04	0.61	1.06
2021	11,545	5,943	924	16.59	117.49	126.94	122.14	0.39	1.12
2022	12,829	5,906	879	14.82	121.06	207.04	136.20	0.47	1.14

FIGURE 3.4.3. DISPLAYS THE INVENTORY DATA RELATED TO GREENHOUSE GAS EMISSIONS AND REMOVALS IN GEORGIA FROM 2018 TO 2022, CLASSIFIED BY GAS (GG CO2-EQ).





3.4.1 BRIEF INFORMATION ON GREENHOUSE GAS EMISSIONS AND REMOVALS BY SCENARIOS

(Paragraphs 92-102 MPGs)

This chapter outlines the projected reduction of greenhouse gas emissions and the enhancement of removals by the year 2040 across three distinct scenarios:

Scenario: Without measures;

Scenario: With measures;

Scenario: With additional measures.

In alignment with paragraph 98 of the MPG, these scenarios utilize the same measurement units as those outlined in the National Greenhouse Gas Inventory of Georgia. Furthermore, as stipulated in paragraph 99 of the MPG, the scenarios are accompanied by the relevant inventory data.

In accordance with paragraphs 100 and 101 of the MPG, the scenarios detailing the reduction of greenhouse gas emissions and the increase of removals by 2040 are illustrated in both graphical and tabular formats, encompassing both the inclusion and exclusion of the land use sector.

The information outlined in the national-scale projection scenario, as stipulated in paragraph 93 of the MPG, illustrates the effects of national and municipal mitigation policies, strategies, action plans, and other measures on greenhouse gas emissions or removals. However, it should be noted that this information is not intended for evaluating progress towards the nationally determined contribution.

The Long-Term Concept for Low-Emission Development outlines the scenarios for greenhouse gas emissions and removals, having been prepared by the Government of Georgia as a foundational document for a long-term strategy aligned with the Paris Agreement. This document was officially enacted on April 24, 2023.[164]

The LT-LEDS delineates the anticipated range of national greenhouse gas emissions and removals while articulating a vision for the year 2050. This vision is grounded in projections created for sectors involved in greenhouse gas emissions and removals, which are summarized as aggregated national emissions.[165]

The LT-LEDS outlines several economic sectors, which encompass buildings, industry, transportation, energy, agriculture, waste management, and land use, land-use change, and forestry (LULUCF)[166]. The primary objective of this initiative is to achieve climate neutrality for Georgia by the year 2050.

According to the existing and prospective policy documents, such as the Climate Change Strategy 2030 and the Action Plan 2021-2023, two mitigation scenarios have been established: "With Existing Measures (WEM)" and "With Additional Measures (WAM)." Additionally, a

164 Long-term concept of low-emission development of Georgia, p. 11.
165 Long-term concept of low-emission development of Georgia, p. 11.
166 Land use, land use change and forestry

scenario termed "Without Measures (WOM)" was created. Ultimately, six scenarios were formulated, encompassing both pessimistic and optimistic projections for WOM, WEM, and WAM, which delineated the anticipated ranges of greenhouse gas emissions by the year 2050.[167]

3.4.1.1 Scenario without events (VAT/WOM scenario)

Under the WOM scenario, carbon dioxide (CO2) emissions from the land use, land-use change, and forestry (LULUCF) sector, encompassing both projected emissions and removals, are anticipated to rise by 10,230.01 Gg CO2 by the year 2040 in comparison to the last inventory year (2022). Excluding LULUCF, the increase is projected to be 9,967.17 Gg CO2.

Methane (CH4) emissions from the LULUCF sector are expected to grow by 1,761 Gg CO2-equivalent by 2040 relative to 2022. Additionally, nitrous oxide (N2O) emissions from the same sector are projected to increase by 216 Gg CO2-equivalent compared to 2022. For both methane and nitrous oxide, the anticipated emissions, whether including or excluding the LULUCF sector, are expected to remain relatively stable when compared to 2022.

In terms of sectoral contributions, the energy sector is projected to experience the most significant rise in emissions, with an increase of 5,367 Gg CO2-equivalent by 2040 compared to the last inventory year.

According to the WOM scenario, CO2 is expected to exhibit the most substantial increase in greenhouse gas emissions by 2040, both in terms of percentage and absolute values.

TABLE 3.23. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER BUSINESS-AS-USUAL SCENARIOS A,B [168]

	Last year of inventory c	Projected greenhouse gas emissions and removals c			
Sector d	2022	2025	2030	2035	2040
Energy	8,718.34	9,843.79	11,924.19	13,104.68	14,085.86
Transport	4,499.50	5,080.34	6,154.02	6,763.27	7,269.65
Industrial processes and product use	2,571.47	2,844.87	3,276.14	3,647.55	3,934.7
Agriculture	2,310.10	2,316.28	2,326.57	2,426.43	2,525.26
Land use	-5,800.73	-5,771.38	-5,693.55	-5,615.72	-5,537.89
Waste	1,995.90	2,029.15	2,086.15	2,157.08	2,247.01
Other	NA	NA	NA	NA	NA
Gases					
CO2 emissions including net CO2 from land use (LULUCF)	7,028.17	8,670.21	11,675.58	13,506.79	15,026.36

167 The pessimistic scenarios for WOM, WEM, and WAM are discussed below.
168 Long-term concept of low-emission development of Georgia, p. 68.

	Last year of inventory c	Projected greenhouse gas emissions and removals c			
CO2 emissions minus net CO2 emissions from land use (LULUCF)	12,828.84	14,441.65	17,369.08	19,122.45	20,564.19
CH4 emissions including net CH4 emissions from land use (LULUCF)	5,906.27	6,226.97	6,814.23	7,257.07	7,667.38
CH4 emissions minus net CH4 emissions from land use (LULUCF)	5,906.32	6,226.9	6,814.27	7,257.12	7,667.43
N2O emissions including net N2O from land use (LULUCF)	879.41	914.03	971.23	1,037.52	1,095.26
N2O emissions minus net N2O emissions from land use	879.42	914.04	971.24	1,037.53	1,095.27
HFCs	479.59	530.58	611.02	680.29	733.84
PFCs	NA	NA	NA	NA	NA
SF6	1.14	1.26	1.46	1.62	1.75
NF3	NA	NA	NA	NA	NA
Other	NA	NA	NA	NA	NA
Total land use (LULUCF) including	14,294.58	16,343.05	20,073.52	22,483.29	24,524.59
Total excluding land use (LULUCF)	20,095.31	22,114.43	25,767.07	28,099.01	30,062.48

Each Party is obligated to provide projections as outlined in paragraphs 93-101 of the MPGs. Developing countries that require flexibility based on their capacities are encouraged to submit these projections, as stated in paragraph 92 of the MPGs.

Developing countries that seek flexibility in accordance with their capabilities, in relation to paragraphs 93-101 of the MPGs, may adopt a less detailed methodology or narrower scope of coverage, as indicated in paragraph 102 of the MPGs.

Projections should commence from the most recent year presented in the latest national communication and must extend at least 15 years beyond the nearest year that ends in zero or five. Developing countries that require flexibility based on their capacities may submit projections that align with the target period of their nationally determined contributions as specified in Chapter 4 of the Paris Agreement, according to paragraph 95 of the MPGs.

FIGURE 3.4.4. TOTAL GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WOM SCENARIO

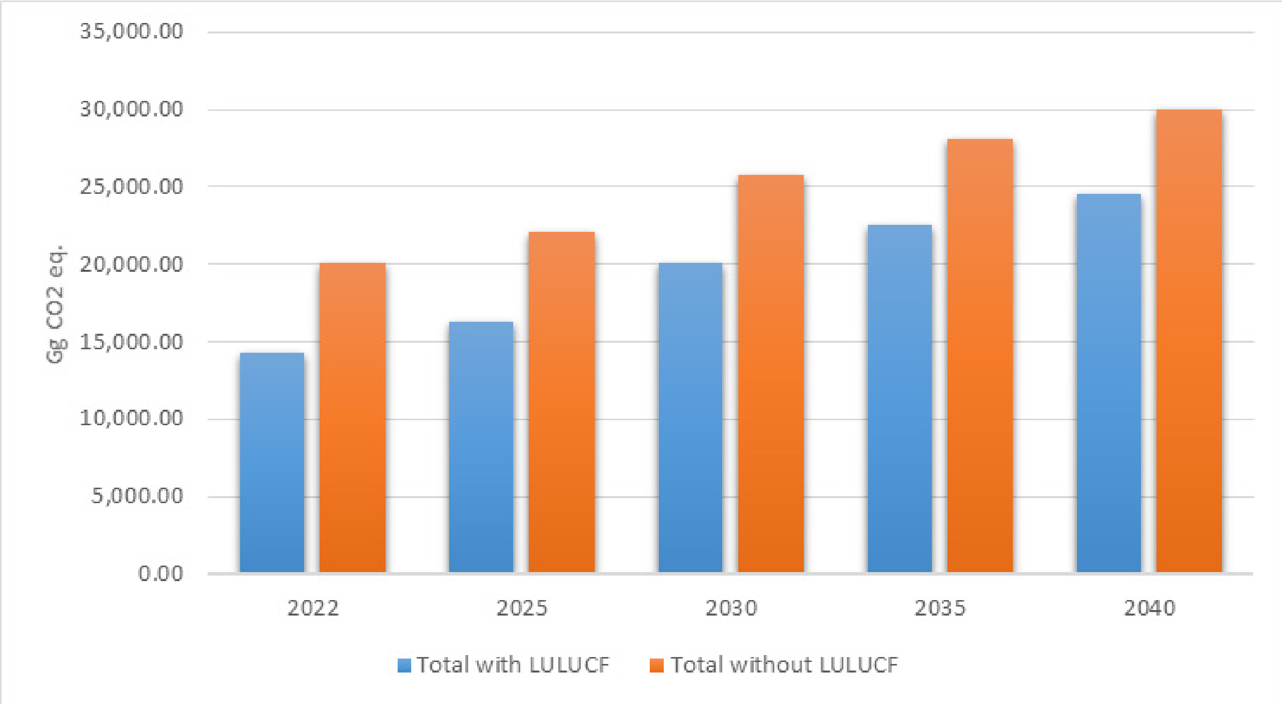
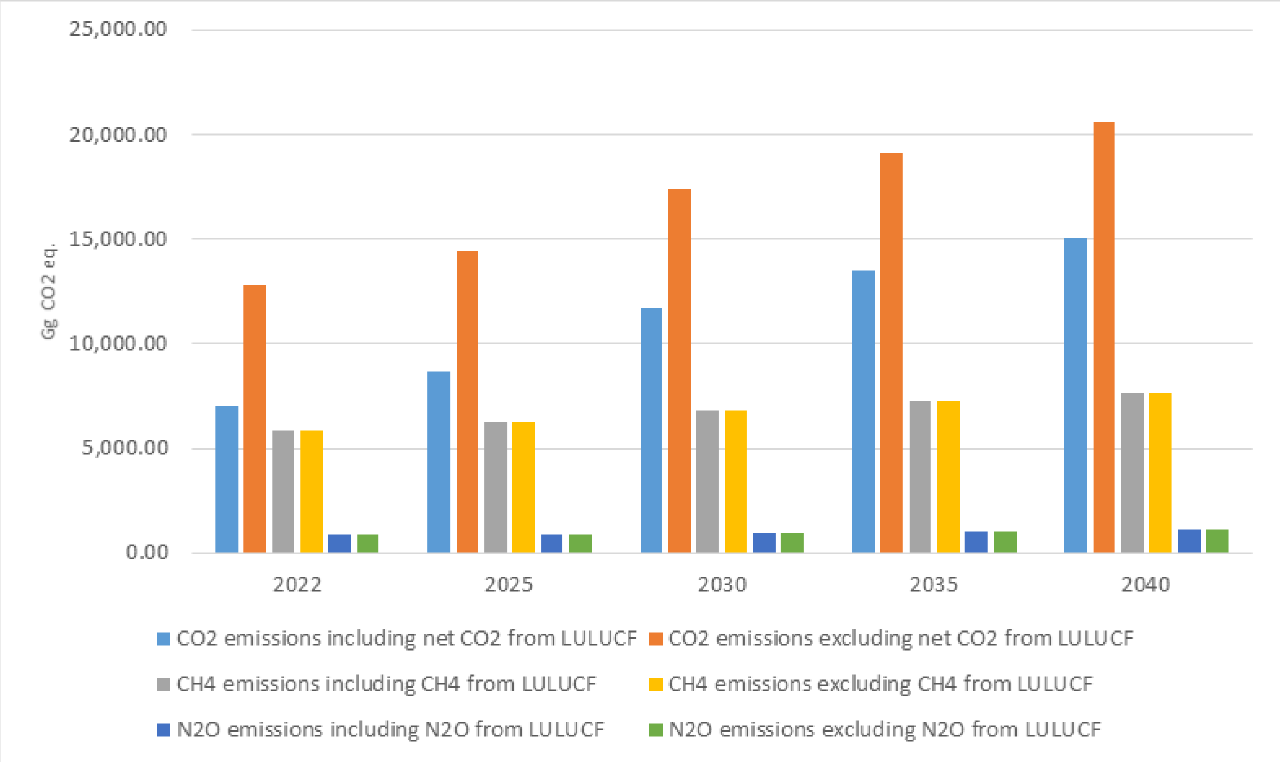


FIGURE 3.4.5. SECTORAL INDICATORS OF GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WOM SCENARIO

FIGURE 3.4.6. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WOM SCENARIO



WOM by sector

A sectoral examination of anticipated greenhouse gas emissions and removals under the WOM scenario indicates that by the year 2040, emissions across all sectors are projected to rise, while removals in the Land Use, Land Use Change, and Forestry (LULUCF) sector are expected to decline.

In the energy sector, emissions are forecasted to reach 14,086 Gg CO2-eq under the WOM scenario, representing an increase of 61.5% compared to the levels recorded in 2022.

The transport sector is projected to emit 7,270 Gg CO2-eq under the same scenario, which translates to a 61.5% increase in greenhouse gas emissions relative to 2022.

Similarly, the IPPU sector is anticipated to see an increase in emissions of 3,935Gg CO2-eq under the GHG/WOM scenario, marking a rise of 9.3% compared to 2022.

Emissions from the waste sector are expected to grow by 2,247 Gg CO2-eq under the GHG/WOM scenario, indicating a 12.5% increase compared to the figures from 2022.

By the year 2040, the agriculture sector is projected to emit 2,525 Gg CO2-equivalent greenhouse gases under the WOM scenario, representing an increase of 9.3% compared to the levels recorded in 2022.

In the same timeframe, greenhouse gas removals from the land use, land use change, and forestry sector are anticipated to reach -5,538 Gg CO2-equivalent under the WOM scenario. Consequently, this indicates a reduction of 4.6% in carbon dioxide removals from the land use, land use change, and forestry sector relative to 2022.

3.4.1.2 Scenario with existing measures (WEM scenario)

Under the current WEM scenario, carbon dioxide emissions, inclusive of the LULUCF sector, are anticipated to rise by 2,506.42 Gg CO2-eq by the year 2040 in comparison to 2022 levels. When excluding the LULUCF sector, the increase in CO2 emissions is projected to be 4,291.9 Gg CO2-eq.

Methane emissions, including the LULUCF sector, are expected to grow by 594.4Gg CO2-eq by 2040 relative to 2022. Similarly, nitrous oxide emissions, also including the LULUCF sector, are forecasted to rise by 119.1 Gg CO2-eq by 2040 compared to 2022. For both methane and nitrous oxide, the projected emissions, whether including or excluding the LULUCF sector, remain largely unchanged from 2022 figures.

In terms of sectoral contributions, the energy sector is projected to experience the most significant increase in emissions, with an expected rise of 2,161 Gg CO2-eq by 2040 compared to the last year of the inventory.

According to the WEM scenario, carbon dioxide is expected to exhibit the most substantial increase in greenhouse gas emissions by 2040, both in terms of percentage and absolute values.

TABLE 3.24. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE A/WEM SCENARIO [169]

	Inventory Last Year	**Greenhouse Gases Spraying And Absorption Forecast Indicators**			
Sector	2022	2025	2030	2035	2040
Energy	8,718.34	8,299.96	9,116.49	10,245.17	10,880.18
Transport	4,499.50	4,283.58	4,704.98	5,287.49	5,615.21
Industry	2,571.47	2,722.8	3,106.86	3,362.51	3,514.99
Rural Farming	2,310.10	2,292.69	2,263.67	2,333.11	2,402.55
Land use	-5,800.73	-5,949.63	-6,316.58	-6,951.4	-7,586.21
Waste	1,995.90	2,023.04	2,052.74	1,989.97	1,974.28
Other	NA	NA	NA	NA	NA
Gases					
CO2 emission Land use Net CO2 emissions including	7,028.17	6,463.52	7,401.54	8,370.7	8,644.67
CO2 emission Land use Net CO2 emissions With the exception of	12,828.84	12,413.09	13,718.06	15,322.04	16,230.81
CH4 emission Land use Net CH4 amount including	5,906.27	5,813.92	6,026.26	6,302.77	6,500.68
CH4 emission Land use Net CH4 amount With the exception of	5,906.32	5,813.97	6,026.32	6,302.83	6,500.74
N2O spraying Land use Net N2O quantity including	879.41	885.97	919.53	964.76	998.53

169 Long-term concept of low-emission development of Georgia, p. 70

	Inventory Last Year	Greenhouse Gases Spraying And Absorption Forecast Indicators			
N2O spraying Land use Net N2O quantity With the exception of	879.42	885.98	919.53	964.76	998.54
HFCs	479.59	507.82	579.45	627.13	655.56
PFCs	NA	NA	NA	NA	NA
SF6	1.14	1.21	1.38	1.49	1.56
NF3	NA	NA	NA	NA	NA
Other	NA	NA	NA	NA	NA
Total Land use including	14,294.58	13,672.44	14,928.16	16,266.85	16,801.00
Total Land use With the exception of	20,095.31	19,622.07	21,244.74	23,218.25	24,387.21

FIGURE 3.4.7. TOTAL GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WEM SCENARIO

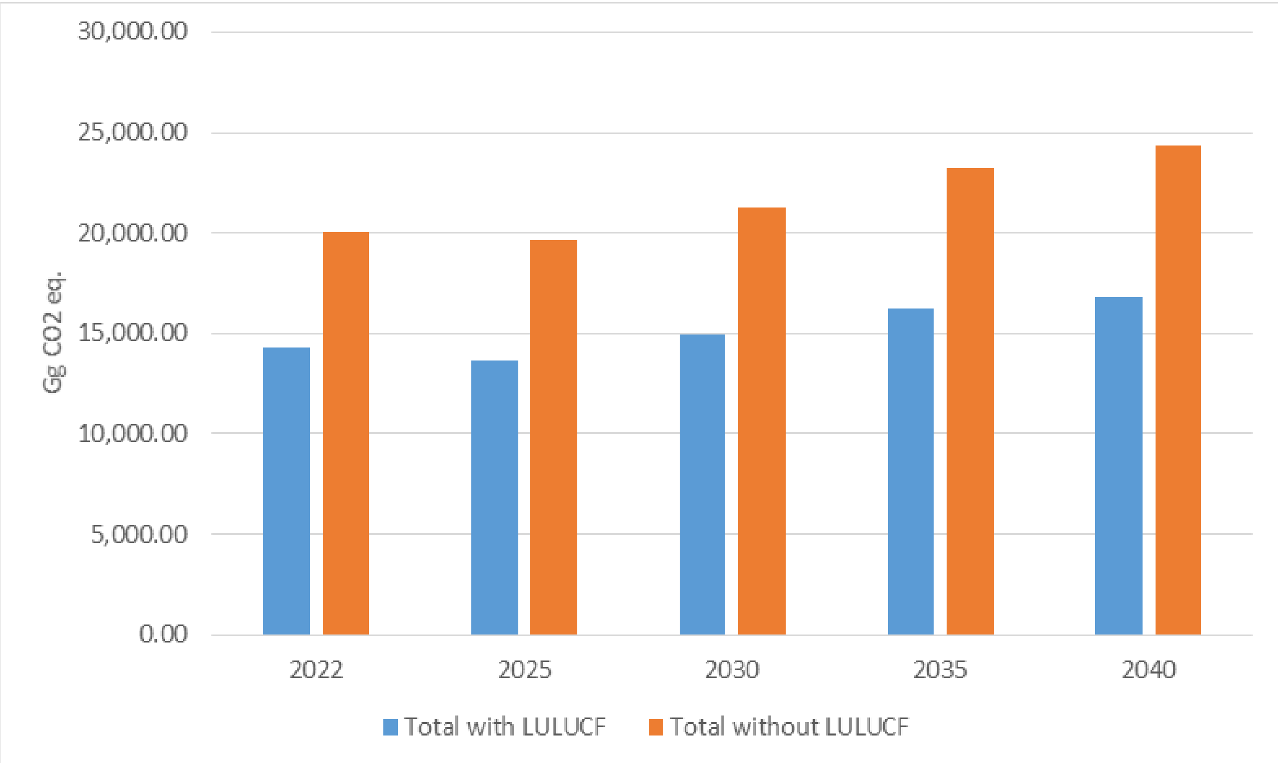


FIGURE 3.4.8. SECTORAL GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WEM SCENARIO

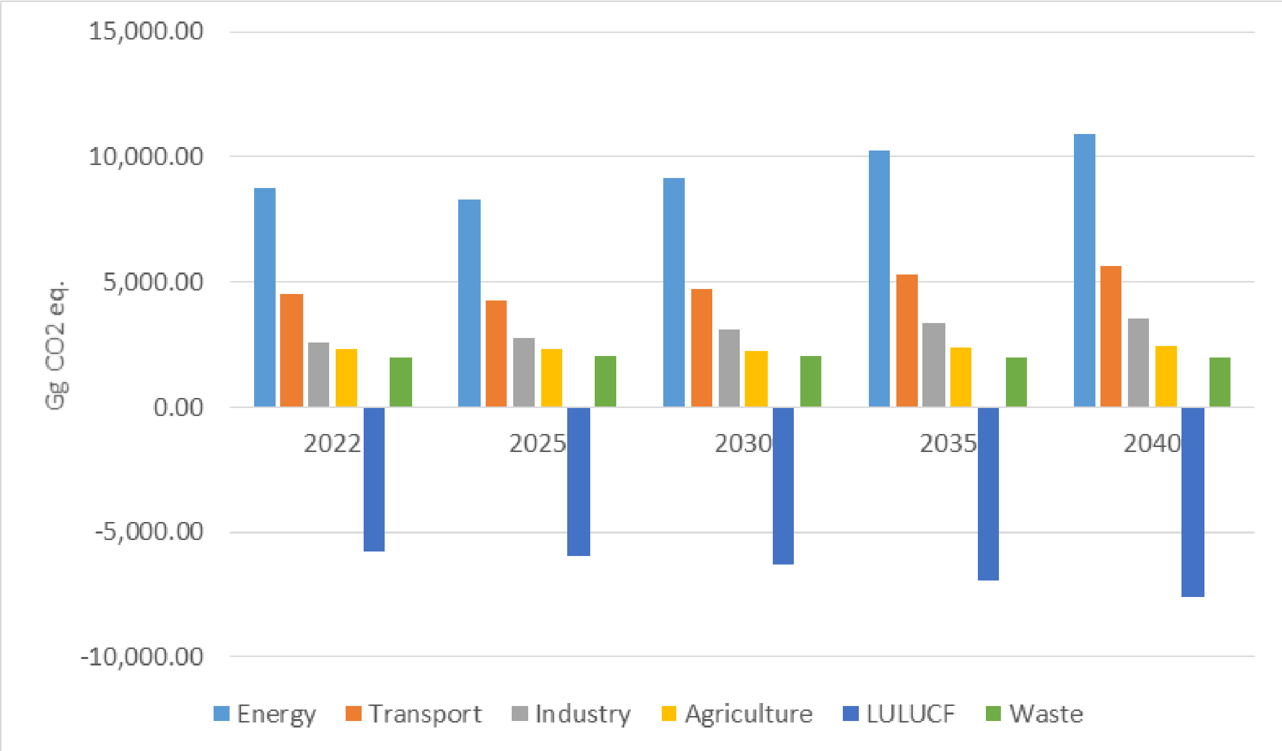
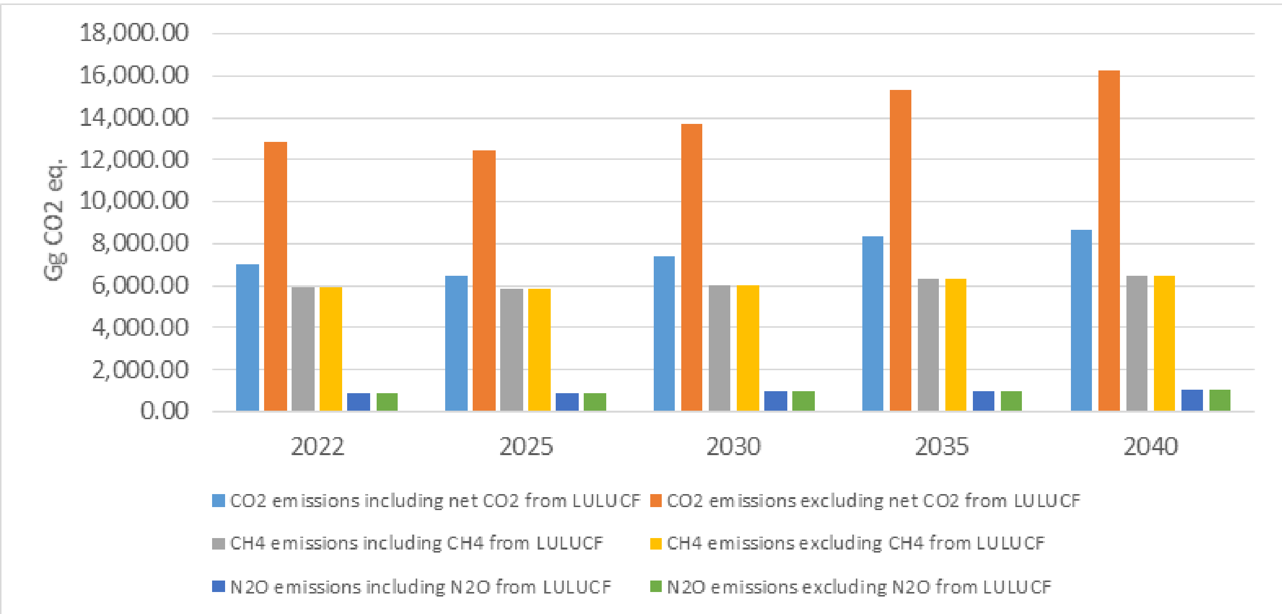


FIGURE 3.4.9. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WAM SCENARIO



WEM by sector

A sectoral examination of anticipated greenhouse gas emissions and removals within the WEM scenario indicates that by the year 2040, there will be an increase in greenhouse gas emissions and removals across all sectors, excluding the waste sector

In the context of the WEM scenario, emissions from the energy sector are projected to reach 10,880 Gg CO_2-eq, representing a 24.7% rise compared to the levels recorded in 2022.

Similarly, emissions from the transport sector are forecasted to amount to 5,615 Gg CO2-eq under the WEM scenario, which signifies a 24.7% increase relative to the figures from 2022.

In the WEM scenario, it is anticipated that greenhouse gas emissions from the IPPU sector will rise by 3,515 Gg CO2-eq, representing an increase of 36.6% relative to the levels recorded in 2022.

The waste sector is projected to see a decrease in greenhouse gas emissions of 2,403 Gg CO2-eq, which corresponds to a 1.1% decline compared to the figures from 2022.

By the year 2040, emissions from the agricultural sector in the WEM scenario are expected to reach 2,403 Gg CO2-eq, marking a 4% increase from the 2022 baseline.

Furthermore, by 2040, the land use, land use change, and forestry sector is projected to achieve greenhouse gas removals of -7,586 Gg CO2-eq under the WEM scenario, indicating a 30.7% increase in carbon dioxide removals compared to 2022.

3.4.1.3 Scenario with additional measures (WAM scenario)

Under the Additional Measures for Projected Greenhouse Gas Emissions and Removals (WAM) scenario, CO2 emissions, inclusive of the LULUCF sector, are anticipated to decline by 5,984.72 Gg CO2-eq by the year 2040 in comparison to 2022. Conversely, carbon dioxide emissions, excluding the LULUCF sector, are projected to decrease by 3,075.35 Gg CO2-eq.

Methane emissions, including the LULUCF sector, are expected to decrease by 792.33 Gg CO2-eq by 2040 relative to the final year of the inventory. Nitrous oxide emissions, also including the LULUCF sector, are forecasted to diminish by 12.67 Gg CO2-eq compared to 2022. For both methane and nitrous oxide, the projected emissions, whether including or excluding the LULUCF sector, remain nearly constant when compared to 2022.

In terms of sector-specific reductions, the Energy sector is projected to experience the most significant decrease in emissions, with a reduction of 1,960 Gg CO2-eq by 2040 compared to the last year of the inventory.

TABLE 3.25. GREENHOUSE GAS EMISSIONS AND REMOVALS BY SCENARIO WITH ADDITIONAL MEASURES. [170]

	Inventory Last Year	Greenhouse Gases Spraying and Absorption Forecast Indicators			
Sector	2022	2025	2030	2035	2040
Energy	8,718.34	8,312.81	8,313.58	8,467.12	6,758.11
Transport	4,499.50	4,290.21	4,290.6	4,369.85	3,487.83
Industry	2,571.47	2,692.82	2,895.07	2,897.38	2,782.96
Rural Farming	2,310.10	2,268.77	2,199.9	2,236.42	2,272.95
Land use	-5,800.73	-6,145.4	-7,000.3	-7,855.2	-8,710.1
Waste	1,995.90	2,020.62	2,007.05	1,868.64	1,718.11
Other	NA	NA	NA	NA	NA

170 Long-term concept of low-emission development of Georgia, p. 73

	Inventory Last Year	Greenhouse Gases Spraying and Absorption Forecast Indicators			
Gases					
CO2 emission Land use Net CO2 emissions including	7,028.17	6,261.95	5,554.81	4,894.56	1,808.9
CO2 emission Land use Net CO2 emissions with the exception of	12,828.84	12,407.4	12,555.16	12,749.69	10,519.08
CH4 emission Land use Net CH4 amount including	5,906.27	5,796.6	5,730.85	5,662.82	5,113.94
CH4 emission Land use Net CH4 amount with the exception of	5,906.32	5,796.54	5,730.79	5,662.89	5,114.01
N2O spraying Land use Net N2O quantity including	879.41	877.86	879	885.16	866.74
N2O spraying Land use Net N2O quantity with the exception of	879.42	877.87	879.01	885.16	866.59
HFCs	479.59	502.22	539.95	540.38	519.04
PFCs	NA	NA	NA	NA	NA
SF6	1.14	1.2	1.29	1.29	1.24
NF3	NA	NA	NA	NA	NA
Other	NA	NA	NA	NA	NA
Total Land use including	14,294.58	13,439.83	12,705.90	11,984.21	8,309.86
Total Land use with the exception of	20,095.31	19,585.23	19,706.20	19,839.41	17,019.96

FIGURE 3.4.10. TOTAL GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WAM SCENARIO

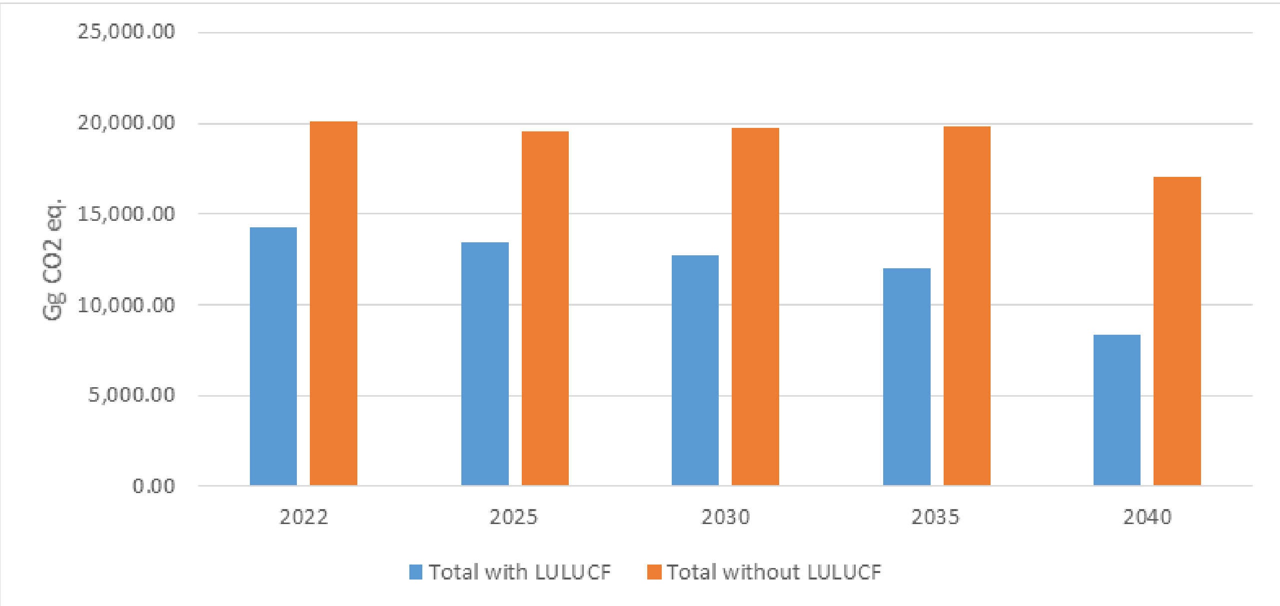


FIGURE 3.4.11. SECTORAL GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WAM SCENARIO

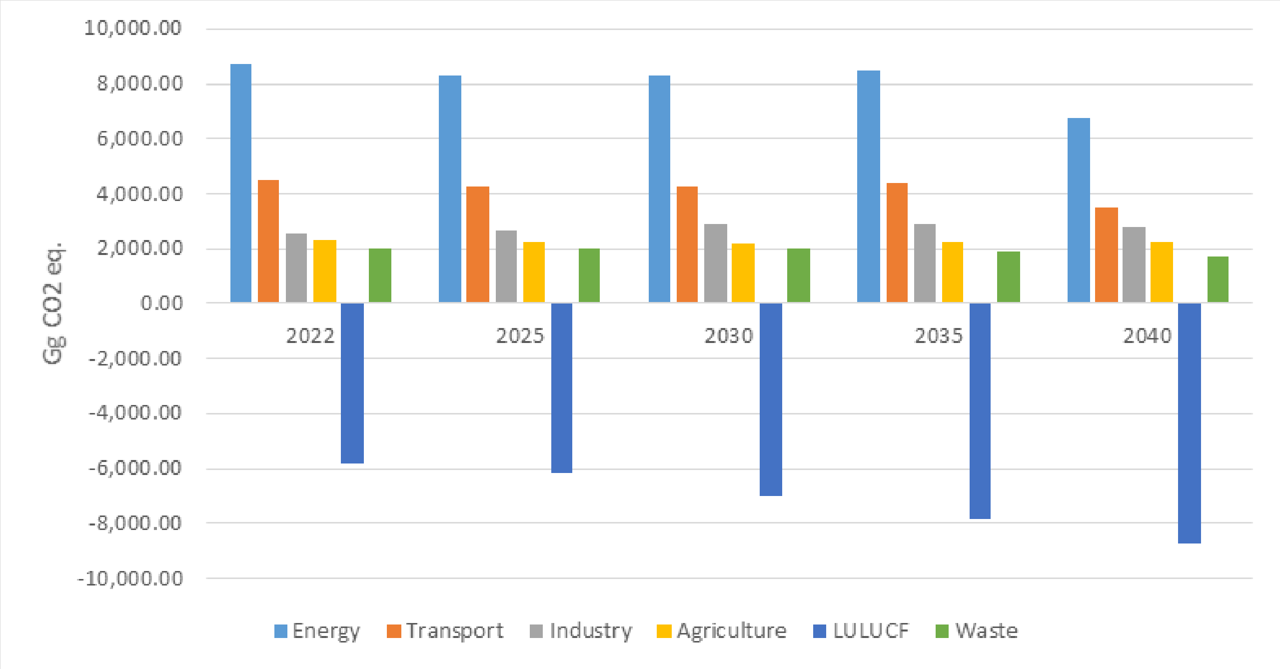
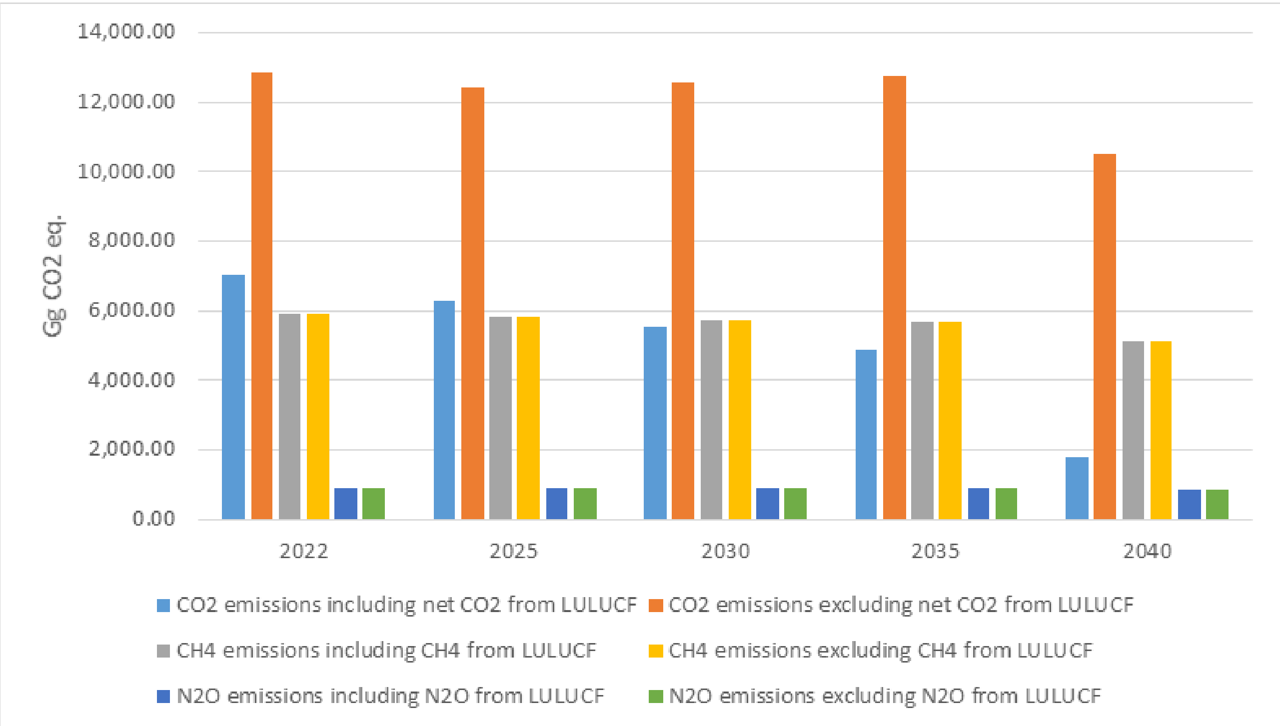


FIGURE 3.4.12. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WAM SCENARIO



WAM by sector

A sectoral examination of anticipated greenhouse gas emissions and removals under the WAM scenario indicates that by the year 2040, emissions from all sectors, except the Industry sector, will decline. Absorptions from LULUCF sector are expected to increase.

In the context of the WAM scenario, greenhouse gas emissions from the energy sector are anticipated to reach 6,758 Gg CO2-eq, representing a 22.4 % decrease compared to the levels recorded in 2022.

For the transport sector, emissions are projected to be 3,488 Gg CO2-eq under the WAM scenario, reflecting a decrease of 22.4% relative to 2022.

Under the WAM scenario, emissions from the industry sector are expected to rise, with an increase of 2,783 Gg CO2-eq. Consequently, emissions from the industry sector are projected to grow by 8.2% compared to 2022.

The waste sector is projected to achieve a reduction in greenhouse gas emissions to 1,718 Gg CO2-eq in the WAM scenario. Consequently, emissions from this sector are anticipated to decline by 13.9% relative to the levels recorded in 2022.

In the agriculture sector, greenhouse gas emissions are expected to reach 2,273 Gg CO2-eq by 2040 under the WAM scenario, representing a decrease of 1.6% compared to the figures from 2022.

By the year 2040, the land use, land use change, and forestry sector is forecasted to achieve greenhouse gas removals of -8,710 Gg CO2-eq under the WAM scenario. This indicates a 50.1% increase in carbon dioxide removals from this sector when compared to the 2022 data.[171]

Forecast of key indicators

The following table presents the projected greenhouse gas emissions (measured in Gg CO2-eq.) for key indicators during the period from 2022 to 2040. This data illustrates the long-term trends in emissions across the primary sectors.

The main indicator of the Nationally Determined Contributions (NDC) is the total greenhouse gas emissions of Georgia, excluding the Land Use, Land Use Change, and Forestry (LULUCF) sector. According to the 2030 With Existing Measures (WEM) scenario for climate change in Georgia, it is anticipated that by 2030, the greenhouse gas emissions for this indicator will reach 21,244 Gg CO2-eq. Furthermore, by 2040, emissions are projected to decline by 24,387 Gg CO2-eq under the same WEM scenario.

Additionally, the sectoral indicators of the NDC include (1) greenhouse gas emissions from the power generation and transmission sector, (2) emissions from the transport sector, (3) emissions from the industrial sector, and (4) the carbon sequestration potential of the forestry sector.

A notable increase of 25% in greenhouse gas emissions is expected from Georgia's Energy generation and transmission sector, rising from 3,594 Gg CO_2-eq in 2022 to 4,485 Gg CO_2-eq by 2040. Similarly, emissions in the transport sector are projected to rise from 4,500 Gg CO_2-eq in 2022 to 5,615 Gg CO_2-eq in 2040, indicating a growth in transport activities.

It is important to highlight that projections indicate a 32% rise in greenhouse gas emissions within the industry sector, increasing from 4,366 Gg CO_2-eq in 2022 to 5,755 Gg CO_2-eq by 2040. The data shown in the table reveals that the carbon sequestration capacity of the forest sector is on the rise, expected to grow from -6,694 Gg CO_2-eq to -8,753 Gg CO_2-eq.

171 Data for the year 2040 are presented according to the AGH/WEM scenario.

TABLE 3.26. FORECASTS OF KEY INDICATORS

Key assumptions and indicators	Unit of measurement	Last year of inventory	Forecasted greenhouse gas emissions and removals (Gg CO2-eq)			
		2022	2025	2030	2035	2040
Georgia's greenhouse gas emissions excluding the LULUCF sector	Gg CO2-eq	20,096	19,622	21,244	23,218	24,387
Greenhouse gas emissions from the energy generation and transmission sector	Gg CO2-eq	3,594	3,422	3,758	4,223	4,485
Amount of greenhouse gas emissions from the transport sector	Gg CO2-eq	4,500	4,284	4,705	5,287	5,615
Amount of greenhouse gas emissions from the industrial sector	Gg CO2-eq	4,366	4,432	4,984	5,472	5,755
Carbon sequestration potential of the forest sector	Gg CO2-eq	-6,694	-6,865	-7,289	-8,021	-8,753

Note: Parties are permitted to add additional rows for each key indicator as necessary.

a Each Party must provide projections in line with paragraphs 93-101 of the Modalities, Procedures, and Guidelines (MPGs); developing nations that need flexibility according to their capacities are encouraged to submit these projections as outlined in paragraph 92 of the MPGs.

b Developing countries that seek flexibility in accordance with paragraphs 93-101 of the MPGs may adopt a less comprehensive methodology or narrower scope of coverage, as stated in paragraph 102 of the MPGs.

c Each Party is obligated to submit projections for essential indicators to assess progress towards its nationally determined contribution as specified in Article 4 of the Paris Agreement, as indicated in paragraph 97 of the MPGs.

d Projections from countries should extend for a minimum of 15 years beyond the nearest year that ends in zero or five. Developing countries that require flexibility based on their capabilities may submit projections that align with the target period of their nationally determined contributions as detailed in Chapter 4 of the Paris Agreement, as referenced in paragraph 95 of the MPGs.

3.4.2 METHODOLOGY USED FOR SCENARIOS

This subsection, in alignment with paragraph 96 of the MPGs, provides details regarding the model, essential assumptions, and forecast parameters utilized in the forecast scenarios. It also outlines the assumptions applied within the context of the strategies and activities encompassed in both the measures and additional measures. Furthermore, this subsection includes information pertaining to the sensitivity analysis of the forecast scenarios.

3.4.2.1 Methodology for key scenarios and parameters

Various methods and models for forecasting greenhouse gas emissions have been employed to create long-term scenarios for low-emission development, tailored to specific sectors.[172]

172 Long-term concept of low-emission development of Georgia, pp. 105-106

The TIMES-Georgia model serves as a tool for predicting emissions within the energy sector, encompassing energy consumption across various domains, including the energy industry (generation and transmission), residential and commercial buildings, industrial processes, agriculture, and transportation, along with their associated emissions. Tailored specifically for Georgia, the model utilized initial data from 2016 regarding energy, economic, and other relevant parameters. It was based on general statistical information such as population, GDP, and daylight hours, and it generated forecasts by analyzing existing policy documents to establish both optimistic and pessimistic baseline scenarios (without interventions). These scenarios were derived from projections related to general (population, GDP) and sector-specific drivers, as well as greenhouse gas (GHG) emission reduction scenarios that considered both existing and proposed sector-specific measures. Additionally, the model incorporates available technologies within the sector and evaluates economic criteria, including costs.

The Ex-ACT (Ex-Ante Carbon-balance Tool) is a carbon balance instrument that evaluates emissions originating from the forestry sector and assesses the effectiveness of proposed interventions in both forestry and agriculture in mitigating these emissions.

Developed by the Food and Agriculture Organization of the United Nations (FAO), the EX-ACT system aims to analyze the effects of agricultural and forestry development initiatives, programs, and policies on the overall carbon balance.

The assessment employs the C Stock Changes method, which involves monitoring variations in carbon stocks over different timeframes. EX-ACT adheres to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. In line with these guidelines, the calculations within the forestry sector encompass five carbon pools: aboveground biomass, belowground biomass, dead root mass, dry woody biomass, and soil organic carbon.

EX-ACT employs geographical, climatic, and agro-ecological variables to analyze information related to land use and agricultural practices. Its computational framework is founded on the comparison of the anticipated impacts of proposed measures against the outcomes of the WOM scenario concerning carbon stocks.

In alignment with the IPCC methodology, EX-ACT utilizes standardized emission factors for initial computational assessments. Data pertaining to the agricultural sector is assigned a specific emission factor that corresponds to the national inventory report of each country.

The improved version of the IPCC Waste Model (IPCC WASTE model) is designed to estimate methane emissions from solid waste deposited in landfills, taking into account the waste composition. This model is grounded in the methodology established by the Food and Agriculture Organization of the United Nations (FAO), specifically the First Order Decomposition (FOD) methodology, which is endorsed by the 2006 IPCC Guidelines. The IPCC model facilitates the simulation of landfill gas, or methane emissions, based on various parameters such as climate type, waste volume, composition, and landfill management practices.

3.4.2.2 Key assumptions, including those in the WEM and WAM scenarios

According to existing and prospective policy documents, such as the 2030 Climate Change Strategy and the 2021-2023 Action Plan, two scenarios for mitigation actions have been identified: WEM and WAM.

The WEM scenario is established by considering the impact of the country's current and proposed mitigation policies and measures on greenhouse gas reduction.[173]

The WAM scenario is based on the WEM scenario and incorporates the impacts of further mitigation strategies, reflecting both existing and anticipated policies and initiatives. This definition indicates that all technologies featured in the WEM scenarios are also accounted for in the WAM, in addition to other technologies.[174]

Population and GDP data indicate a pattern of weak and fluctuating growth over recent decades. Regardless of the underlying factors, the country's long-term development strategy seeks to counteract this trend, aspiring for substantial growth and advancement by the mid-century. In light of this perspective, rather than formulating a singular development scenario, a variety of both pessimistic and optimistic development pathways has been identified.[175]

The pessimistic scenario anticipates a gradual increase in both population and GDP, aligning closely with existing statistical trends. In contrast, the optimistic scenario reflects the most favorable projections regarding economic and demographic expansion. Consequently, two scenarios—pessimistic and optimistic—were formulated, incorporating forecast data series for specific drivers that were pre-calculated, along with the relevant annual growth rates that were computed and utilized for the forecasting process.

TABLE 3.27. DRIVERS' FORECASTS FOR THE OPTIMISTIC SCENARIO[176]

Driver	Unit	2020	2025	2030	2040	2050
GDP (convergence) without)	million Gel, 2015 Prices	33,754.7	43,614.7	56,618.1	95,448.5	160,896.9
GDP Growth	%	-6.3	5.2	3.8	4	4.05
Population	thousand	3,716.8	3,721.6	3,727.5	3,739.5	3,751.5
Population Growth	%	-0.17	0.032	0.032	0.032	0.032

TABLE 3.28. DRIVERS' FORECASTS FOR THE PESSIMISTIC SCENARIO[177]

Driver	Unit	2020	2025	2030	2040	2050
GDP (with convergence)	million Gel, 2015 Prices	33,754.7	43,614.7	55,284.6	82,718.5	115,977.3
GDP Growth	%	-6.3	5.2	4.6	3.7	3.3
Population	thousand	3,716.8	3,722.7	3,722.7	3,722.7	3,722.7
Population Growth	%	-0.17	0.031	0	0	0

173 Long-term concept of low-emission development of Georgia, pp. 129
174 Long-term concept of low-emission development of Georgia, pp. 134.
175 Long-term concept of low-emission development of Georgia, pp. 190.
176 Long-term concept of low-emission development of Georgia, pp. 107.
177 Long-term concept of low-emission development of Georgia, pp. 108.

TABLE 3.29. KEY ASSUMPTIONS AND PARAMETERS FORECAST INDICATORS

Footprint Admissions And Options	Measuring Unit	Inventory Last Year (Gg CO2-eq)	Basic Admission And Settings Forecast Indicators (Gg CO2-eq)			
		2020	2025	2030	2040	2050
GDP (with convergence)	million Gel , 2015 Prices	33,754.7	43,614.7	55,284.6	82,718.5	115,977.3
GDP Growth	%	-6.1	5.2	4.6	3.7	3.3
Population	thousand	3,716.8	3,722.7	3,722.7	3,722.7	3,722.7
Population Growth	%	-0.17	0.031	0	0	0

Note: parties are permitted to include additional rows for key assumptions and parameters.

a Each Party must submit projections in accordance with paragraphs 93-101 of the MPGs. Developing countries that seek flexibility due to their capabilities are encouraged to provide such projections as outlined in paragraph 92 of the MPGs.

b Developing countries that require flexibility concerning their capabilities, in relation to paragraphs 93-101 of the MPGs, may adopt a less detailed methodology or narrower scope of coverage as specified in paragraph 102 of the MPGs.

c Each Party's submission detailing the methodology employed in the projections should encompass the key assumptions and projection parameters, such as gross domestic product rates/levels and population rates/levels, as indicated in paragraph 96(a) of the MPGs.

d Projections for countries should extend for a minimum of 15 years beyond the nearest year that ends in zero or five. Developing countries that require flexibility based on their capabilities may submit projections that align with the target period of their nationally determined contributions as outlined in Chapter 4 of the Paris Agreement, as stated in paragraph 95 of the MPGs.

The following assumptions are considered for the mitigation measures defined in the AW/WEM and WAM scenarios, which are given below by sector:

Transport sector assumptions in the WEM and WAM scenarios:[178]

- The South Caucasus Pipeline is projected to convey 18 billion cubic meters of gas by the year 2030, with an anticipated increase to 25 billion cubic meters by 2040.
- By 2030, the estimated daily distance traveled by vehicles is expected to reach 28 kilometers.

Agricultural sector assumptions in the WEM and WAM scenarios:[179]

- The fuel consumption associated with field operations, including traditional plowing, harrowing, fertilizer application, herbicide treatment, sowing, and harvesting, ranges from 80 to 100 kg per hectare, with an average of 90 kg/ha.
- In instances of minimum plowing, fuel consumption is recorded at 47 kg/ha, while zero plowing results in a consumption of 34 kg/ha.

178 Long-term concept of low-emission development of Georgia, pp. 139.
179 Long-term concept of low-emission development of Georgia, pp. 172.

- Diesel serves as the primary fuel for agricultural machinery.
- Natural gas is predominantly utilized for heating farm structures and greenhouses.
- Electricity is primarily employed for water pumping in irrigation systems and for lighting purposes.

Energy sector assumptions in the WEM and WAM scenarios:[180]

- Electricity is sourced from external suppliers;
- Methane is derived from coal reserves;
- Losses associated with natural gas are minimized and conform to established normative standards;
- Transportation losses of natural gas have decreased and correspond to the methane emission factor for transportation systems as outlined in the 2006 IPCC Guidelines.

Industry sector assumptions in the WEM and WAM scenarios:[181]

- Cement and steel production is changing;
- Greenhouse gas emissions from the use of fluorinated gases are decreasing.

Land use, land use change and forestry sector assumptions in the WEM and WAM scenarios[182]

- Change in the use of wood resources;
- Changes in the use of arable land will be implemented;
- The areas covered by perennial crops on agricultural land will change.

It is worth noting that the model does not use common drivers (population, GDP) for forecasting; therefore, "pessimistic" and "optimistic" scenarios are not considered for this sector.

Waste sector assumptions in the WEM and WAM scenarios[183]

- The sector is unlikely to see any new technologies introduced;
- "Removing" compostable paper and paper fractions from municipal solid waste and recycling them.

3.4.2.3 Changes in scenario methodology

This subsection outlines the information regarding modifications to the scenario methodology in relation to the previous biennial transparency report, as stipulated in paragraph 98(b) of the Modalities Procedures and Guidelines. Since this biennial transparency report is the inaugural one, details in this subsection will be included in future reports as deemed necessary.

180 Long-term concept of low-emission development of Georgia, pp. 111.
181 Long-term concept of low-emission development of Georgia, pp. 147.
182 Long-term concept of low-emission development of Georgia, pp. 176, 189.
183 Long-term concept of low-emission development of Georgia, pp. 190, 192, 194.

3.4.2.4 Sensitivity analysis

The sensitivity analysis presented herein evaluates mitigation forecast scenarios that incorporate macroeconomic projections developed as part of the Georgian Long-Term Low Emission Development Strategy (LT-LEDS141). This analysis seeks to elucidate the relationships between greenhouse gas emissions (the dependent variable) and real GDP along with population metrics (the independent variables). Additionally, it investigates the correlation between international financial flows and the trends in greenhouse gas emissions.

During the sensitivity analysis, time series data spanning from 2016 to 2050 were analyzed at both national and sectoral levels. The analysis focused on seven sectors pertinent to climate change: energy, buildings, transport, industry, agriculture, waste management, and land use, land use change, and forestry (LULUCF). The study employed simple linear regression analysis to assess elasticity and correlation relationships.

The fluctuations in greenhouse gas emissions in Georgia are influenced by a variety of events and factors. Both the gross domestic product (GDP) and the size of the population play a crucial role in determining these emissions. The analysis has identified correlations between optimistic and pessimistic development strategies and the variations in greenhouse gas emissions across all three scenarios: WOM, WEM, and WAM. Consequently, the sensitivity analysis evaluates how changes in these scenarios affect the country's emissions and examines the responsiveness of Georgia's national emissions to the primary drivers, namely GDP and population.

The WOM scenario encompasses two potential development pathways—optimistic and pessimistic. The optimistic pathway is marked by a projected population increase over the long term (2016-2040) at an average growth rate of 0.02%, alongside a relatively robust economic growth rate averaging 3.94%. Conversely, the pessimistic long-term development pathway anticipates a slight decline in population and a lower rate of economic growth.[184]

In the WOM scenario, there exists a significant connection between real GDP and greenhouse gas emissions. The correlation coefficient between the optimistic and pessimistic projections of real GDP and the associated greenhouse gas indicators is 0.99. The total greenhouse gas emissions of the country exhibit an inelastic response to real GDP, with an elasticity of 0.85. Consequently, over the long term, a 1% rise in GDP is expected to result in a 0.85% increase in greenhouse gas emissions. Furthermore, the absolute dependence of greenhouse gas emissions on GDP is quantified at 0.19. Thus, in the long run, an increase of 1 million GEL in GDP will correspond to an increase of 0.19 Gg CO2-eq in national greenhouse gas emissions (refer to Table 3.30).

It is important to highlight that similar patterns are evident when examining sectoral emissions. These emissions also demonstrate inelasticity in relation to GDP, with an elasticity value of less than 1 (see Table 3.30).

184 Long-term concept of low-emission development of Georgia

TABLE 3.30. RESULTS OF SENSITIVITY ANALYSIS OF NATIONAL AND SECTORAL GREENHOUSE GAS EMISSIONS OF GEORGIA CONCERNING GDP AND THE NUMBER OF HOUSEHOLDS, BASELINE SCENARIO (WOM).[185-186]

Sector	Elasticity % change in relation to GDP	Elasticity towards population, % change	Attitude towards GDP, change Gg CO2-eq	Damok Regulation for the Population, Amendment Gg CO2-eq
Energy and buildings	0.83	1.88	0.15	198.6
Transport	0.59	1.66	0.08	103.5
Industry	0.63	1.54	0.02	28.7
Agriculture	0.58	1.09	0.004	7.6
Waste management	0.57	1.25	0.017	20.0
Forestry (LULUCF)	NA	NA	NA	NA
Total national greenhouse gas emissions	0.85	1.82	0.19	254.9

The responsiveness of greenhouse gas emissions to changes in population size is significant, with an elasticity coefficient of 1.82. Furthermore, the elasticity across all sectors exceeds 1, as indicated in Table 3.30.

The population dependency coefficient stands at approximately 255, suggesting that a long-term increase of 1,000 individuals will result in an elevation of greenhouse gas emissions by 255 Gg CO2-eq. This value is notably high for both the energy and buildings sectors, as detailed in Table 3.30.

In the A/WEM scenario, there exists a strong correlation between real GDP and greenhouse gas emissions. The correlation coefficient between the variations in optimistic and pessimistic real GDP scenarios and the corresponding greenhouse gas emissions is 0.97. The total greenhouse gas emissions of the country exhibit inelasticity concerning real GDP, with a coefficient of 0.56. Thus, a 1% rise in GDP is expected to produce a 0.56% increase in greenhouse gas emissions over the long term. Additionally, the relationship between greenhouse gas emissions and GDP in absolute terms is quantified at 0.14. Consequently, a long-term increase of 1 million GEL in GDP will correspond to an increase of 0.14 Gg CO2-eq in national greenhouse gas emissions, as shown in Table 3.31.

Comparable patterns are also observable in the sectoral distribution. Emissions across sectors exhibit inelasticity in relation to GDP, with elasticities falling below 1. Consequently, the sensitivity remains minimal (refer to Table 3.31).

185 Note: Total national GHG emissions are analyzed without LULUCF
186 Long-term concept of low-emission development of Georgia, author's calculations.

TABLE 3.31. OUTCOMES OF THE SENSITIVITY ANALYSIS CONCERNING GEORGIA'S NATIONAL AND SECTORAL GREENHOUSE GAS EMISSIONS IN RELATION TO GDP AND POPULATION SIZE, UNDER THE BUSINESS AS USUAL SCENARIO (WEM).[187-188]

Sector	Elasticity to GDP, % change	Elasticity to shrinkage, % change	Attitude to GDP, change in GG CO2-eq.	Attitude towards population, change in GG CO2-eq
Energy and buildings	0.79	1.73	0.1	130.3
Transport	0.66	1.85	0.12	154.1
Industry	0.53	1.12	0.02	23.8
Agriculture	0.35	0.66	0.003	6.25
Waste management	0.44	1.03	0.017	20.1
Forestry (LULUCF)	NA	NA	NA	NA
Total national greenhouse gas emissions	0.56	1.21	0.14	180.2

The responsiveness of greenhouse gas emissions to population size in the WEM scenario is significant, indicated by an elasticity coefficient of 1.21 concerning population. Notably, all sectors, with the exception of agriculture, exhibit an elasticity greater than 1 (refer to Table 3.31).

In contrast to the VAT/WOM scenario, the elasticity coefficients for all sectors in the WEM scenario are comparatively lower (see Table 3.31).

The population sensitivity coefficient is estimated at approximately 180, suggesting that an increase of 1,000 individuals will result in a long-term rise in greenhouse gas emissions by 180 Gg CO2-eq. This value is also considerable for the energy, buildings, and transport sectors (see Table 3.31).

In the WAM scenario, a significant relationship exists between real GDP and greenhouse gas emissions. The correlation coefficient between the disparity of the optimistic and pessimistic real GDP scenarios and the corresponding greenhouse gas emissions indicator is 0.49. The total greenhouse gas emissions of the country exhibit inelasticity concerning real GDP, with a value of 0.07. Consequently, over the long term, a 1% rise in GDP is expected to result in a 0.07% increase in greenhouse gas emissions. Furthermore, the absolute dependence of greenhouse gas emissions on GDP is quantified at 0.01. Thus, under the development of the aforementioned scenario, a long-term increase in GDP by 1 million GEL will correspond to an increase in national greenhouse gas emissions by 0.01 Gg CO2-eq (refer to Table 3.32).

It is important to highlight that analogous relationships are also evident in the sectoral analysis. Sectoral emissions exhibit inelasticity in relation to GDP, with an elasticity coefficient of less than 1 (refer to Table 3.32).

187 Long-term concept of low-emission development of Georgia, author's calculations.
188 Note: Total national GHG emissions are analyzed without LULUCF

TABLE 3.32. OUTCOMES OF THE SENSITIVITY ANALYSIS CONCERNING NATIONAL AND SECTORAL GREENHOUSE GAS EMISSIONS IN GEORGIA, IN RELATION TO GDP AND POPULATION SIZE, UNDER THE SCENARIO INCORPORATING ADDITIONAL MEASURES (D/WAM). [189]-[190]

Sector	Elasticity to GDP, % change	Elasticity to shrinkage, % change	Attitude to GDP, change in GG CO2-eq.	Attitude towards population, change in GG CO2-eq.
Energy and buildings	0.005	0.08	0.008	0.001
Transport	0.09	0.14	0.007	0.001
Industry	0.58	1.41	0.012	15.9
Agriculture	0.33	0.63	0.002	4.87
Waste management	0.16	0.32	0.004	0.4
Forestry (LULUCF)	NA	NA	NA	NA
Total national greenhouse gas emissions	0.07	0.24	0.01	10.2

The relationship between greenhouse gas emissions and population size exhibits low sensitivity, as indicated by an elasticity coefficient of 0.24 concerning population. Furthermore, the elasticity values for all sectors, with the exception of industry, are below 1 (refer to Table 3.32).

The dependence coefficient on population size is approximately 10, suggesting that a population increase of 1,000 individuals will result in a long-term rise in greenhouse gas emissions by 10 Gg CO2-eq. This metric is notably higher for the industrial sector, which shows an increase of 15.9 Gg CO2-eq (see Table 3.32).

In the WOM, WEM, and WAM scenarios, the greenhouse gas emissions from the land use, land use change, and forestry (LULUCF) sector remain constant regardless of the optimistic and pessimistic scenarios. Consequently, it is not possible to evaluate the sensitivity of this sector to real GDP and population changes.

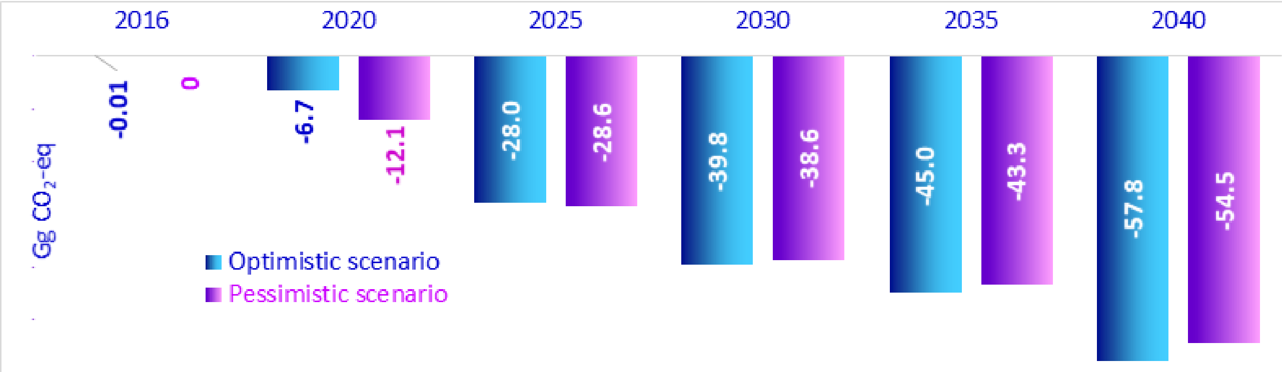
Figure 20 illustrates the responsiveness of national greenhouse gas emissions to international financial assistance. This matter is particularly significant as Georgia remains a developing nation, reliant on collaboration with donors and international organizations to effectively implement climate change strategies. It is also crucial to highlight that the climate change mitigation initiatives outlined in the WAM scenario are heavily contingent upon international backing and donor funding.

The graph indicates that the percentage deviation from the WOM scenario in both optimistic and pessimistic scenarios is projected to increase over the long term, surpassing 50% by the year 2040. This trend suggests a substantial opportunity for reducing greenhouse gas emissions, contingent upon the availability of international financial support.

189 Long-term concept of low-emission development of Georgia, author's calculations.

190 Note: Total national greenhouse gas emissions are analyzed without LULUCF

FIGURE 3.4.13. GREENHOUSE GAS EMISSIONS AND REMOVALS UNDER THE WAM SCENARIO.[191]-[192]



Thus, Georgia's national greenhouse gas emissions are highly sensitive to variables such as population size and international finance. The country's real GDP also has some impact on greenhouse gas emissions, although relatively low. It is also important to note that in the case of the development of the scenario (Dg/WAM) with additional measures, there will be a significant decrease in the sensitivity of greenhouse gas emissions to economic variables, which will lead to the separation of their development dynamics from economic and social events (so-called decoupling).

191 Long-term concept of low-emission development of Georgia.
192 Long-term concept of low-emission development of Georgia.

CHAPTER 4. CLIMATE CHANGE
IMPACTS AND ADAPTATION

Preface

The adverse effects of climate change on Georgia's ecosystems and economy represent a significant challenge to the country's development. The country's distinctive geographical position, intricate and rugged landscape, varied land cover, and unique climate—which encompasses nearly all climatic zones—create conditions conducive to a broad spectrum of detrimental impacts from climate change in Georgia.

Georgia is committed to further exploring the potential for adapting to the adverse effects of climate change and to implementing suitable measures by mobilizing both domestic and international resources for sectors that are particularly susceptible to these negative impacts (Nationally Determined Contribution).

4.1 NATIONAL CLIMATE POLICY, INSTITUTIONAL ARRANGEMENTS AND LEGISLATIVE FRAMEWORK

4.1.1. NATIONAL CIRCUMSTANCES IN RELATION TO ADAPTATION MEASURES

The geographical positioning of Georgia, along with its unique climatic features, significantly influences the nature, extent, and characteristics of climate change impacts. Key geographical elements include the Greater Caucasus Range to the north, the Black Sea to the west, and the Likhi Range, which serves as a natural divider between the eastern and western regions.

Approximately two-thirds of Georgia's land area is mountainous, with over half of the territory situated at elevations exceeding 1,000 meters. The terrain is complex, showcasing a wide variety of ecosystems. The country boasts abundant freshwater resources, including lakes and rivers, as well as numerous types of mineral waters, thermal springs, and groundwater.

The Likhi Range acts as a natural boundary between Western and Eastern Georgia, leading to distinct climatic variations. Western Georgia experiences a subtropical climate, while Eastern Georgia has a dry temperate continental climate. The country's location within a temperate latitude, combined with the protective barrier of the Caucasus Mountains that prevents the influx of cold air masses, results in a predominantly warm climate characterized by mild winters and extended daylight hours (with an average annual sunshine duration ranging from 1,350 to 2,520 hours). Although the average annual temperatures in both western and eastern Georgia are relatively similar, there is a significant disparity in precipitation levels due to the proximity of the Black Sea, which leads to heavy rainfall in western Georgia, contrasting with the predominantly arid conditions found in the eastern region.

Climate Change Impacts: Georgia's unique ecosystems and complex geological terrain render it particularly vulnerable to the effects of climate change.

Recent research and observations indicate that the processes associated with climate change have markedly intensified in Georgia, leading to a variety of detrimental outcomes. Over the last quarter-century, the average annual temperature in the country has risen by 1 degree Celsius. In Western Georgia, there is an increase in annual precipitation, while certain areas in Eastern Georgia are experiencing a decline. A notable rise in precipitation is evident across much of Western Georgia, linked to a higher frequency of heavy rainfall events. Conversely, many regions in Eastern Georgia have seen a reduction in precipitation of up to 15% over the past three decades, primarily due to prolonged dry spells.

In this context, extreme weather events such as floods, landslides, mudslides, droughts, heatwaves, forest fires, and severe storms are occurring with greater frequency, resulting in damage to infrastructure and significant economic and human losses.

Among the gradual changes, the rapid melting of glaciers in the Caucasus Mountains and the erosion of the Black Sea coastline are particularly concerning, alongside the desertification occurring in the semi-arid regions of Northern Georgia and land degradation due to frequent extreme weather events, including floods and droughts. There is also a noticeable decline in forest and water ecosystems, as well as shifts in seasonal patterns and alterations in precipitation distribution.

These developments adversely affect vital resources such as water, land, and forests, as well as the economy—impacting sectors like agriculture, energy, and trade—along with infrastructure, including roads and pipelines, and the physical and mental well-being of the population.

Demographics, Infrastructure, and Economy: As of January 1, 2023, Georgia's population stood at 3,736.4, with a significant majority residing in urban areas. The ongoing enhancement of road infrastructure not only leads to a rise in the number of vehicles, including privately owned cars, but also improves mobility. On another hand, enhances the population's capacity to cope with the adverse effects of climate change and extreme weather events. Nevertheless, the increasing frequency of such extreme events poses a considerable threat to infrastructure, particularly older structures, thereby raising serious concerns regarding public safety. Notably, the number of bridges rendered unusable due to floods and flash floods has risen, which considerably hampers the implementation of necessary adaptation measures.

Georgia's GDP, as reported by Geostat, demonstrates a positive growth trajectory, increasing from 6.1% in 2018 to 11% in 2022, notwithstanding the economic downturn experienced in 2020 due to the Covid-19 pandemic. This growth enhances the country's capacity to effectively address the impacts of climate change by implementing suitable, timely, and well-prioritized adaptation strategies. However, it is important to highlight the disparities in economic development between urban and rural areas, which positions them differently in relation to climate change threats. Additionally, the unequal distribution of economic resources among various population segments raises security concerns for low-income groups in the context of climate change.

The mountainous regions of Georgia warrant particular attention regarding their adaptation to the adverse effects of climate change. The population density in these highland areas is considerably lower than in the lowlands, resulting in a scarcity of human resources. Furthermore, these highland communities often experience low levels of economic development and inadequate infrastructure, largely due to their inaccessibility. Some settlements still lack access to essential services such as natural gas and electricity. These factors contribute to the heightened vulnerability of the population in these areas to the detrimental impacts of climate change. The current economic advantages available to highland settlements do not sufficiently support the adaptation of their residents to the ongoing changes in climate.

4.1.2 INSTITUTIONAL ARRANGEMENT AND MANAGEMENT

The Ministry of Environmental Protection and Agriculture of Georgia is responsible for formulating and executing state policy regarding climate change adaptation and the broader context of climate change, in alignment with the Government of Georgia's commitments to the United Nations Framework Convention on Climate Change. The Climate Change Division, part of the Environment and Climate Change Department, is tasked with coordinating and submitting Georgia's national reports to the Convention. In fulfilling its obligations under the Convention, Georgia has included information on planned and executed activities related to climate change adaptation in four national communications submitted to date (1999, 2009, 2016, and 2021).

Within the Ministry of Environmental Protection and Agriculture of Georgia, a public law entity known as the Environmental Information and Education Centre operates, which is responsible for establishing a comprehensive database of environmental information and enhancing its accessibility. Additionally, another public law entity within the Ministry, the LEPL National Environmental Agency, is engaged in gathering climate-related data nationwide and plays a significant role in the development of climate change policy documents, particularly concerning adaptation strategies.

The primary source of the necessary data is the National Statistical Office of Georgia (Geostat) and the National Environmental Agency. Since 2014, a Memorandum of Cooperation has been signed between the Ministry of Environment and Natural Resources Protection of Georgia and Geostat, which stipulates that Geostat supplies statistical data to the Ministry. In accordance with Government Resolution No. 502, dated August 18, 2014, and the General Administrative Code of Georgia, the National Environmental Agency is obligated to provide the Ministry with all available information at no cost. The integrity of the data is ensured by local independent experts.

The evaluation of climate change impacts and vulnerabilities is conducted periodically, typically within the framework of relevant projects overseen by the Ministry. This process usually coincides with the preparation of national communications, which may be incorporated into the biennial transparency report starting in 2024. The assessment relies on information obtained from the National Environmental Agency and Geostat, as well as findings from other pertinent studies or projects, if available. Following the assessment of impacts and vulnerabilities, suitable adaptation measures are identified. The evaluation of climate change impacts, the formulation of adaptation measures at the national level, and the development of the associated plan involve contributions from representatives of relevant sectors, local independent experts, non-governmental organizations, and academic professionals. The final plan is subject to government approval following consultations and public discussions that engage a wide audience.

Climate change impact assessments, along with the development and execution of appropriate adaptation strategies and plans, can be conducted at both sectoral and municipal levels through various projects and organizations. Specifically, adaptation strategies are essential elements of the Sustainable Energy and Climate Action Plans adopted by municipalities participating in the European Covenant of Mayors initiative, which actively engages these municipalities. The Ministry of Agriculture has developed the Roadmap for the Action Plan for Adaptation to Climate Change in Agriculture to facilitate the sector's adaptation to climate change. Numerous non-governmental organizations play a significant role in identifying 'local adaptation' measures and formulating plans for different regions and communities as part of various initiatives.

The evaluation of climate change impacts, along with the planning, prioritization, and execution of adaptation measures at the sectoral or regional/municipal level, is undertaken by the appropriate ministries or governmental bodies at the relevant levels (such as autonomous republics and municipalities). This is done within the context of various projects and involves collaboration with multiple organizations. These processes are characterized by extensive stakeholder engagement, public consultations, and necessary modifications.

To facilitate the coordination of initiatives aimed at mitigating greenhouse gas emissions that contribute to climate change and to address the associated risks, the Climate Change Council[193] was established in the country in 2020 (Resolution of the Government of Georgia No. 54, January 23, 2020). This Council encompasses a focus on adaptation strategies. It is composed of senior officials from climate-related ministries, leaders from the Autonomous Republics of Abkhazia and Adjara, the Chairman of the Coordination Group of Municipalities that are signatories to the Covenant of Mayors, and the Executive Director of the National Statistics Service of Georgia, who is invited to participate in its activities. The Minister of Environmental Protection and Agriculture of Georgia serves as the Chairman of the Climate Change Council. Additionally, the Council includes a Coordination Group that acts as an advisory body, addressing the coordination between state and local government entities regarding climate change. This group comprises the mayors of municipalities that have signed the Covenant of Mayors, the Deputy Mayor of Tbilisi Municipality, and representatives

193 https://www.matsne.gov.ge/ka/document/view/4780380?publication=0

from the state. Furthermore, there exists a working group that advises the Council on specific climate change policy issues within the economic and social sectors, consisting of public officials, experts, and members of the scientific community. The Climate Change Council is responsible for discussing the implementation of the country's international commitments, target indicators, reports, strategies, and other policy documents, as well as evaluating projects submitted to various funding sources, which, upon approval, are then forwarded to the government for consideration.

4.1.3 LEGISLATIVE AND POLICY FRAMEWORKS AND REGULATIONS

Georgia currently lacks specific legislation to regulate the field of climate change and, hence, climate change adaptation. Efforts are presently underway, involving extensive public participation, to draft a climate law that will establish a comprehensive framework for the legislative oversight of all aspects of climate change, including adaptation measures.

Additionally, there is an absence of a political document addressing climate change adaptation. The existing Climate Change Strategy for 2021-2030 and the Action Plan for 2021-2023 do not adequately address adaptation initiatives. The Covid-19 pandemic has caused delays in the development of a National Action Plan for Climate Change Adaptation, which is now in progress. This plan aims to identify priorities and direct activities at the national level, while also establishing a framework for such initiatives at regional (autonomous republics), municipal, and community levels.

Georgia's continuous efforts in climate change adaptation are regulated by its international commitments to the Framework Convention on Climate Change and the Paris Agreement. Under this framework, the country regularly prepares and submits national communications to the Convention, detailing the effects of climate change within its borders, its susceptibility to these impacts, and its adaptation requirements, along with the adaptation measures that are currently in place or have been implemented. Up to now, the country has submitted four national communications to the Convention, specifically in the years 1999, 2009, 2016, and 2021. The latest updates regarding climate change adaptation are encapsulated in Georgia's fifth national communication, which is presented to the Convention alongside the inaugural biennial transparency report, adhering to the structure and stipulations outlined in Article 13 of the Paris Agreement (Decision 18/CMA.1)[194]

4.1.4 PRIORITIES, BARRIERS, CHALLENGES AND GAPS

Climate change adaptation policy, reflected in relevant strategies and action plans, is based on the identification of the county's requirements in this direction. This involves the development, prioritization, and execution of suitable measures within specified timeframes. The determination of climate change adaptation needs is based on an evaluation of vulnerability to impacts and associated risks. The success of policy implementation is significantly influenced by the appropriate prioritization of adaptation measures, which in turn guides the effective allocation of efforts and resources

National and sectoral priorities for climate change adaptation

194 FCCC/PA/CMA/2018/3/Add.2

The identification of national requirements for adapting to climate change relies on an evaluation of the sensitivity and risks associated with a specific area, sector, or system in relation to climate change. The prioritization of suitable adaptation strategies is conducted by considering the severity of the impact, the level of vulnerability, the urgency of the response, and the significance of the affected entity.

The severity of climate change impacts, along with their consequences and associated risks, is established through research on climate parameters. The prioritization of the affected entity is influenced by various factors, including economic, social, and political considerations. Nevertheless, in the context of climate change adaptation, the primary determinants of priority are vulnerability and the urgency of the situation.

Vulnerability assessments generally utilize national data on key climate parameters, such as temperature and precipitation, along with their trends. For the current reporting period, this data encompasses monthly, seasonal, and annual values for parameters including air temperature, precipitation, wind, humidity, snow cover, and sunlight.

Data pertaining to these parameters for the years 1961 to 2020 were sourced from a database[195] established through the analysis of observations from the hydrometeorological network. To assess the trend of climate change effects, average and extreme values for two distinct 30-year intervals (1961-1990 and 1991-2020) were compared.

Analysis of the results shows an increase in the intensity of climate change and confirms the trends identified in previous reports:

- The average temperatures are rising in both Western and Eastern Georgia;
- There is a notable increase in extreme temperature occurrences, particularly in certain areas;
- Western Georgia is experiencing a rise in precipitation, while Eastern Georgia is witnessing a decline overall;
- The precipitation patterns across the nation are shifting, characterized by a higher frequency of intense rainfall and an extended duration of dry periods;
- Wind speeds are generally increasing, with some regions experiencing more significant changes;
- Moreover, there is a growing frequency and severity of extreme weather phenomena, including floods, landslides, mudslides, droughts, heat waves, forest fires, heavy rainfall, strong winds, and maritime storms.

In addition to the aforementioned areas, the escalation of various manifestations of climate change has become increasingly evident, including droughts, heat waves, land degradation (such as erosion and salinization), as well as floods and landslides.

Among the gradual phenomena, the acceleration of glacier melting is particularly significant, often resulting in severe consequences, as seen in the collapses of the Devdoraki glacier in 2014 and 2016, and the Shovi landslide in 2023. The current data regarding glacier melting is concerning, indicating a rapid retreat and reduction in the volume of major glaciers, alongside the disappearance of smaller ones. It is important to recognize that in

195 https://www.ecad.eu/

the natural context of Georgia, glacier melting not only threatens water resources but also increases the risk of floods, mudslides, and landslides.

Other gradual changes include the degradation of forest and aquatic ecosystems, as well as shifts in seasonal patterns.

Both extreme weather events and slow-moving processes have profound effects on various economic sectors, contributing to trends such as resource depletion, loss of biodiversity, and ecosystem degradation. These impacts ultimately affect the economy as a whole and lead to a decline in quality of life, including health-related issues.

TABLE 4.1.: CLIMATE CHANGE MANIFESTATIONS AND THEIR CONSEQUENCES

Climate disasters	Slow events of nature	Results
Floods - flash floods, mudslides, landslides Droughts, heat waves Heavy rains Strong winds, hurricanes, storms Forest fires	Changing seasons Sea level rise Melting glaciers	Degradation of ecosystems (lands, lakes, rivers, forests, coastlines) Resource depletion (water, biodiversity) Decline in productivity

The findings indicate that there is a pressing national requirement for climate change adaptation, particularly aimed at enhancing the resilience of climate-sensitive regions against both sudden climate disasters and gradual changes.

When examining specific sectors, the most significant needs are identified in agriculture, where issues such as land degradation and the depletion of natural resources are prevalent, compounded by an increase in extreme weather events and seasonal variations that ultimately threaten productivity and food security. The energy sector faces challenges due to heightened demands resulting from the intensification of extreme events. Infrastructure is frequently compromised by these extreme occurrences, while tourism development is adversely affected for similar reasons. Additionally, healthcare emerges as a particularly vulnerable sector in the context of climate change. Evidence from the National Center for Disease Control and Public Health highlights a rise in diseases associated with climate change, including infectious, respiratory, and cardiovascular conditions, alongside injuries and fatalities linked to extreme events and climate-related disasters. Furthermore, the deterioration of mental health is a significant concern, stemming from both the immediate effects of extreme situations and the challenges posed by gradual changes. It is also important to recognize the detrimental effects of food security issues and resource depletion on overall human health.

To enhance resilience against the adverse effects of climate change, the country's policy priorities focus on safeguarding human health, minimizing resource depletion, and implementing adaptation strategies in vulnerable sectors and ecosystems. In identifying priority areas, the criteria considered included the significance, vulnerability, and urgency of the entities affected by climate change (such as regions, fields, sectors, systems, and ecosystems). Due to the intricate nature of these impacts, those entities facing the most immediate threats were deemed more critical, as their adaptation could yield beneficial effects on other areas as well.

Consequently, the prevention and mitigation of climate-related disasters is of paramount importance, influencing all aspects of life, including health, ecosystems, infrastructure, tourism, agriculture, and resources.

In this context, plans are underway to establish a nationwide early warning system, which aims to significantly reduce the occurrence of disasters stemming from floods, flash floods, heavy rainfall, and windstorms. This initiative is expected to positively affect all economic sectors, ecosystems, resources, and public health.

To enhance the resilience of various sectors, it is crucial to incorporate the climate change aspect into sectoral development strategies. This is particularly significant for agriculture, which is the sector most affected by climate change. In this context, adapting vulnerable regions, such as those with degraded soils, and implementing climate-smart agricultural practices are essential. Additionally, the introduction of innovative practices is equally important. These strategic directions and pertinent studies regarding the adoption of new practices are documented in key sector policy frameworks, including the Agricultural Development Strategy of Georgia 2015-2020 (2015), the National Climate Change Adaptation Plan for the Agricultural Sector (2017), and the Agricultural and Rural Development Strategy of Georgia 2021-2027 (2019).

The resilience of the energy sector to climate change is significantly influenced by the effective utilization of available resources. The Energy Efficiency Development Strategy (2019) and the National Integrated Energy and Climate Program (2023, draft version) focus on enhancing energy efficiency. Overall, the predicted increase in energy generation during this decade, coupled with improved energy efficiency, will play a vital role in adapting the sector to the heightened demands imposed by climate change.

In certain domains pertinent to climate change, there exist adaptation strategies tailored to specific sectors, reflecting their unique needs and priorities. For instance, the National Biodiversity Strategy and Action Plan for 2014-2020, the updated Forest Code of 2023, and the Law of Georgia on Water Resources Management enacted in 2023 are designed to promote sustainable resource management while addressing the risks associated with climate change..

Barriers, challenges and gaps related to adaptation planning and implementation

The main challenges in the field of climate change adaptation remain:

- Lack of comprehensive national adaptation strategy;
- Challenges in incorporating adaptation measures into national development frameworks;
- Obstacles in the adoption of new technologies;
- Issues related to implementation (financial and technical);
- Lack of system for monitoring implementation progress.

Barriers to enhancing adaptation policies are varied, encompassing technical, organizational, financial challenges, as well as lack of awareness and capacity.

Georgia is actively undertaking preventive, mitigation, and rehabilitation measures to address the adverse effects and repercussions of climate change, in accordance with its priorities and capacities. Nevertheless, the lack of a cohesive national climate change adaptation policy, which should be incorporated into the country's long-term development strategy and plans, obstructs a systematic approach. The establishment of the national climate change adaptation strategy, initially scheduled for 2020, which aims to consolidate related activities in a coherent manner over time and space, has been postponed.

Technical barriers are associated with both the insufficient technical capabilities, such as personnel, qualifications, and technologies, and the intricate, multi-layered nature of the adaptation process, which stems from the complex, multi-sectoral aspects of climate change itself. The diverse needs for adaptation across various scales—national, regional, and local—introduce further organizational challenges. National policies must integrate regional and local levels, as well as pertinent sectors, to establish the cause-and-effect relationships among different impacts. This approach should aim to devise an optimal framework that effectively addresses current issues while avoiding the creation of new challenges in the future. Additional obstacles include the general lack of awareness among the population and authorities regarding climate change and adaptation, coupled with financial constraints, as adaptation measures tend to be expensive and the inherently localized nature of adaptation limits the availability of external support.

Moreover, the absence of a monitoring system to oversee the implementation of adaptation strategies presents an additional hurdle.

A critical challenge lies in the technological gap across nearly all sectors, including climate technologies, which necessitates urgent technological upgrades and the development of relevant technical skills and knowledge. The complexity of this undertaking represents a significant barrier to the formulation of a comprehensive national adaptation policy.

4.1.5 PROGRESS IN IMPLEMENTING CLIMATE CHANGE ADAPTATION

Georgia adheres to its commitments under the Convention and the Paris Agreement, executing all climate change initiatives in alignment with the principles established by the Convention. Systematic implementation of adaptation measures is carried out through various projects, with an increasing scale of activities.

Considering the pronounced escalation of adverse impacts from climate change across nearly all aspects of the country's socio-economic landscape, there is a growing urgency to enhance resilience and intensify adaptation efforts. Consequently, Georgia is undertaking specific adaptation measures across different sectors and levels (regional and local), prioritizing them accordingly. Simultaneously, the country aims to formulate and implement a cohesive policy designed to prevent and mitigate the detrimental effects of climate change while bolstering national resilience.

In recent years, there has been a significant focus on large-scale prevention measures with national coverage, as well as the formulation of national policy documents aimed at establishing a technical and legal framework for the implementation of more targeted adaptation strategies.

Georgia, a small nation characterized by a rich diversity of ecosystems and vulnerability to climate change, acknowledges the critical importance of adaptation efforts. This recognition is evident in the Nationally Determined Contribution document, as well as in the 2030 Climate Change Strategy and the 2021-2023 Action Plan, which, along with the 2024-2025 Action Plan outlined in the Paris Agreement, primarily address mitigation efforts. To enhance the emphasis on adaptation, the development of a National Adaptation Plan was initially scheduled to commence in 2020. However, this initiative faced delays due to the pandemic and a shortage of technical resources. Now it has been resolved that the preparation of a National Climate Change Adaptation Plan is intended commence in 2025, which will outline the national strategy for the current decade and the corresponding action plan, thereby complementing the mitigation aspects of the 2030 Climate Change Strategy.

The National Adaptation Plan outlines the requirements, priorities, and strategies for addressing, mitigating, and enhancing resilience to the impacts of climate change at the national level. It will consider the challenges present in specific regions, sectors, and various levels, and will integrate actions to be executed at the national, sectoral, and regional/local tiers.

During the reporting period, the Fourth National Environmental Action Program of Georgia (2022-2026) was developed, which addresses various issues, including climate change, natural hazards and risks, land and water resources, forests, the Black Sea, and biodiversity conservation, while also establishing specific goals and objectives.

At the sectoral level, several strategic documents have been created focusing on climate change adaptation or incorporating its aspects. Notably, significant efforts have been made in the agricultural sector, which is particularly vulnerable to the negative impacts of climate change.

The Georgian Agricultural Development Strategy 2015-2020 (2015) marks a significant milestone by recognizing the integration of climate-smart technologies as a key focus for the sector's advancement. The National Climate Change Adaptation Plan for the Agricultural Sector (2017), formulated based on a pertinent roadmap, addresses the adaptation requirements and potential actions for the country's vital agricultural sectors in response to climate change. Additionally, the Rural Development Strategy 2021-2027 (2019) has been established in recent years, outlining plans and initiatives for the adoption of climate-smart practices, with a particular emphasis on adaptation.

Efforts are underway to revise the "National Biodiversity Strategy and Action Plan 2014-2020 (2014)." The newly enacted Forest Code (2023), the Law of Georgia on Water Resources Management (2023), and the Tourism Strategy of Georgia (2025) have been developed, which, while indirectly, acknowledge the significance of climate change impacts on these sectors and incorporate adaptation strategies within their frameworks.

Significant progress has been made in the protection and management of protected areas and landscapes, as well as the establishment of new areas, all of which are closely linked to the challenges posed by climate change adaptation.

Numerous initiatives are currently underway in Georgia that are either directly or indirectly associated with climate change adaptation. The outcomes of these initiatives significantly influence the formulation and execution of future policies.

Given that climate change adaptation is a key focus for the nation, it is incorporated within the Nationally Determined Contribution (NDC) document. This document outlines the strategic directions that are subsequently detailed in the National Adaptation Plan. These strategic directions include: evaluating the effects of climate change on the Black Sea coastline, forest ecosystems, and ecosystem management; assessing the impact on water resources, agricultural productivity, and public health; investigating the repercussions of climate change on glaciers, particularly in vulnerable forest ecosystems; enhancing the adaptive capacity of resorts situated in coastal and mountainous regions; and advocating for measures aimed at minimizing losses and damages resulting from extreme weather events. In alignment with these priorities, a variety of adaptation projects have been initiated and are currently being executed in Georgia.

Adaptation projects/measures can be aimed at:

- To enhance the adaptive ability or resilience of regions that are susceptible or sensitive to climate change;
- To adjust to or bolster resilience against current or anticipated impacts;
- To avert anticipated hazards;
- To reduce expected consequences, including losses and damages.

These initiatives, in conjunction with technical and material efforts, encompass research, forecasting, awareness-raising, the development of suitable infrastructure, and the overall establishment of a supportive environment aimed at halting, reducing, and/or preventing the ongoing impacts.

In alignment with its priorities, Georgia places significant emphasis on the prevention and mitigation of climate-related disasters. A key initiative in this regard is the extensive project currently being implemented with the support of the Green Climate Fund, which aims to equip all river basins in Georgia with early warning systems. This initiative is expected to greatly enhance preparedness and resilience against floods and flash floods, which are among the most pronounced effects of climate change in the region.

Additionally, the project titled 'Training in Hydraulic Modeling for Floods' also addressed this area, with its second phase—'Promoting the Capacity and Preparedness of Georgian Institutions'—being carried out in 2016 and 2017.

In the agricultural sector, the initiative titled "Implementation of Sustainable Management of Landscape and Land Resources in Rural Areas to Mitigate Land Degradation and Poverty" was executed from 2016 to 2019. This project sought to combat land degradation, a consequence of climate change, particularly in the eastern regions of Georgia, by promoting sustainable land management practices.

The issue of water resource depletion and its governance is a significant concern in Georgia. To address this, the country is enhancing its water management systems by aligning with pertinent EU directives. The activities undertaken from 2016 to 2020 as part of the EU Water Initiative Plus for Eastern Partnership countries (EUWI+) aimed to harmonize national policy documents and strategies related to water resources with the EU Framework Directive, Integrated Water Resources Management, and relevant multilateral environmental agreements. In order to fulfill these requirements a new water law was adopted, known as the Law of Georgia on Water Resources Management[196] (2023), with the

196 Preview (matsne.gov.ge)

associated sub-legislative regulations currently under development.

Georgian forest ecosystem is notably vulnerable to the impacts of climate change, including increased forest fires, pest proliferation, and overall forest degradation. Consequently, the forest is experiencing a decline in its diverse functions—recreational, economic, environmental, and social—as well as its capacity to sequester greenhouse gases. In light of these findings and Georgia's commitments under the Paris Agreement, which include reducing greenhouse gas emissions as outlined in nationally determined contributions and achieving climate neutrality by mid-century, the forest's role as a greenhouse gas sink becomes particularly significant. Therefore, the implementation of sustainable forest management practices is crucial. A comprehensive project, supported by the Green Climate Fund, the German International Cooperation Agency (GIZ), and the Swiss Agency for Development and Cooperation (SDC), titled "Support to the Implementation of Forest Sector Reform in Georgia" (2021-2028), is currently underway to establish a sustainable management framework for the country's forests. The primary objective of the first component of this initiative is to introduce a sustainable forest management system at the national level.

Additionally, the role of public awareness, especially through media engagement, is vital in promoting climate change adaptation strategies. This can be achieved through localized adaptation measures that involve community participation. Under the European initiative "Covenant of Mayors," which is actively progressing in the country, municipalities that have signed the covenant are becoming increasingly aware of the climate-related threats in their regions and are developing local adaptation strategies as part of their sustainable energy and climate development plans.

The ongoing and planned legislative and project initiatives related to climate change adaptation in the country are anticipated to enhance Georgia's ability to bolster its resilience against climate change. Furthermore, these efforts will facilitate the execution of the "Nationally Determined Contribution" regarding adaptation and aid in aligning with EU legislation.

4.1.6 MONITORING AND EVALUATION OF ADAPTATION MEASURES AND PROCESSES

Georgia is actively engaged in the systematic implementation of climate change adaptation measures through a variety of projects, which are expanding in both number and scale due to the increasing diversity and intensity of climate change impacts.

In addition to the careful planning of these adaptation measures, it is crucial to monitor the implementation process. This monitoring is essential for the timely identification and rectification of errors, thereby ensuring that adaptation efforts are effective and that the associated threats are fully mitigated, leaving no opportunity for recurrence of the issues.

At present, Georgia lacks a cohesive system for monitoring activities related to climate change. The monitoring of adaptation measures is conducted through various methods, tailored to the specific nature of each adaptation initiative: a) planned and ongoing monitoring within project frameworks, which focuses on addressing identified vulnerabilities, enhancing adaptive capacity, and bolstering resilience; b) monitoring aimed at preventing and mitigating the impacts of anticipated extreme events; and c) monitoring conducted as part of general climate observations to detect, track, and forecast emerging threats.

Throughout adaptation projects, monitoring is integrated into the project management process, relying on specific data, parameters, and indicators established by the project. This is supported by relevant interim reports and oversight from the project management board. The findings from this monitoring inform necessary responses and adjustments throughout the project's lifecycle..

Adaptation project-related activities may encompass various elements such as material and technical support, research initiatives, capacity building and technical assistance, awareness-raising efforts, and other components designed to enhance the capacity to adapt to climate change and bolster resilience. These activities aim to reduce vulnerability, avert anticipated threats, and mitigate losses and damage. The monitoring of adaptation measures necessitates a tailored approach, contingent upon the specific nature of the measures implemented.

Typically, any climate change adaptation initiative undertaken within the country is conducted under the auspices of the Ministry of Environmental Protection and Agriculture of Georgia. This ministry, in collaboration with other relevant sectoral ministries or independently, is accountable for overseeing the project's progress and outcomes. Regrettably, monitoring is limited to the duration of the project, and the responsibility for ensuring the sustainability of the results post-completion rests with a designated beneficiary—namely, the owner of the project area or the entity where the project activities are executed. This situation underscores the need for heightened attention during the project planning phase, particularly in accurately defining the scope of activities and identifying the beneficiary, as well as in ensuring the long-term sustainability of the achieved results.

Monitoring plays a crucial role in the implementation of adaptation measures concerning disasters induced by climate change. In recent years, Georgia has experienced a notable increase in extreme weather events, particularly floods, mudslides, and landslides, which have resulted in significant damage and loss of life. The climatic conditions in the country foster an environment conducive to these events, characterized by fluctuations in temperature, precipitation, and wind patterns, alongside a diverse ecosystem that includes coastal areas, high mountains, and glaciers, as well as a complex geological landscape. Adaptation strategies for climate-related disasters focus on two main objectives: mitigating the impacts of recurring events through infrastructure such as river dams and sea wave barriers, and preventing future occurrences by establishing and effectively operating early warning systems. The monitoring of these adaptation measures encompasses not only the oversight of project implementation but also the ongoing observation of various parameters in disaster-prone areas, enabling timely responses to anticipated disasters and efforts to minimize potential losses.

The assessment of potential disasters relies on information derived from previously identified threats, which is informed by systematic surveys conducted by the National Environmental Agency across various regions of the country, along with the data collected. This information serves as the foundation for developing suitable measures aimed at preventing and/or mitigating the identified potential threats. The effectiveness of these measures is monitored through performance evaluations, taking into account any changes in the status of actions during their implementation. In such instances, well-planned and timely interventions are crucial, guided by the significance of the potential threat and the urgency of the response required. The monitoring of these measures is vital for ensuring both the quality of execution and adherence to timelines.

Continuous monitoring aimed at identifying, observing, and predicting new threats is conducted through the ongoing observation of key climatic parameters and the collection of time series data. This monitoring utilizes information from the national network of meteorological stations and observatories, augmented by satellite climate data from EUMETSAT[197]. The data collected is used to calculate various indicators and climate indices. The continuously monitored parameters include temperature, precipitation, wind, snow cover, and sunlight, along with the indices derived from these factors. Through comprehensive analysis and forecasting of these indicators, in conjunction with the findings from planned field surveys, including geological assessments, informed conclusions are drawn regarding anticipated climate threats, and specific locations are identified that necessitate appropriate adaptation measures.

The early warning system will greatly enhance the existing continuous monitoring framework by encompassing the entire national territory and providing ongoing information regarding the probability of extreme climate events. The finalization of this system is currently underway, and its integration into the forthcoming national climate change monitoring, reporting, and verification framework will substantially elevate the quality of climate change adaptation monitoring within the country.

At present, the monitoring of adaptation measures in Georgia is limited to assessing their progress. **The indicators** employed for this monitoring consist of project performance metrics, which include general indicators (such as the percentage of activities completed by the reporting date, funds utilized, and timelines for completed activities) as well as project-specific indicators that reflect the extent of work accomplished in particular areas relevant to each adaptation measure (for instance, the number and types of trees planted on a mountain slope as part of a flood prevention initiative).

A crucial factor for the successful adaptation of the country to climate change is the sustainability of the outcomes from the adaptation measures implemented. This sustainability is essential for ensuring the coherence and mutual coordination of various adaptation initiatives, which should be interdependent. Regrettably, the lack of monitoring regarding the sustainability of these adaptation outcomes represents a significant flaw in the country’s adaptation process. This issue arises primarily because adaptation measures in Georgia are largely funded by donor support, leading to the cessation of financial assistance once a project concludes. Consequently, the responsibility for maintaining and developing the results falls to the project beneficiaries, who typically lack the necessary technical and financial resources. This challenge is particularly pronounced for local community adaptation initiatives and the municipalities that benefit from them. To address this gap, it is important to consider the capabilities of beneficiary owners during the planning of activities and to incorporate capacity-building components into projects. Additionally, fostering their interest in these initiatives is vital. Furthermore, increasing funding for climate change adaptation from both domestic (budgetary) and international

197 https://www.eumetsat.int/cm-saf

(bilateral and multilateral donor) sources, along with the implementation of flexible financial and regulatory frameworks, and the involvement of the private sector, will be beneficial. This process will gain momentum as the country integrates with the European Union and aligns with its legislative framework.

4.1.7 PREVENT, MINIMIZE AND ADDRESS LOSS AND DAMAGE ASSOCIATED WITH THE ADVERSE IMPACTS OF CLIMATE CHANGE

Georgia is a nation characterized by its diverse ecosystems, which are increasingly affected by the various manifestations of climate change. The impacts of climate change range from those that are impossible or exceedingly difficult to adapt to, to those that can only be mitigated through a rapid and concerted effort to reduce greenhouse gas emissions. Both gradual and extreme climate-related events serve as examples of these detrimental effects, and Georgia is currently facing the repercussions of both.

The notable rise in temperatures, significant alterations in precipitation patterns, and the shifting of seasonal cycles are becoming increasingly apparent each year, leading to slow yet severe changes across nearly all ecosystems. The ongoing melting of glaciers, the rise in sea levels, and the degradation of both terrestrial and aquatic ecosystems are slow-moving phenomena that are already in progress and cannot be halted. These changes manifest in various forms of damage and loss.

The melting of glaciers represents a significant slow-moving phenomenon that has emerged and evolved due to climate change. Observations of the glaciers in the Greater Caucasus indicate a marked increase in their melting rates over the decades, with smaller glaciers vanishing and larger ones retreating. The rate of retreat has approximately doubled since 2000 compared to earlier decades. This occurrence has far-reaching implications for Georgia's natural resources, economy, and human life. Primarily, these effects manifest in the depletion of water resources. Although Georgia is endowed with abundant water resources, including lakes, reservoirs, groundwater, and rivers, climate change exerts a detrimental influence on them. Furthermore, all forms of water resources—rivers, lakes, reservoirs, groundwater, and precipitation—are affected by climate change. Elevated temperatures, along with associated droughts and heat waves, heighten the demand for water, particularly in agriculture. Alterations in precipitation patterns and glacier melting result in changes to the hydrological regimes of rivers, which in turn affect the lakes and reservoirs that depend on them. The drying and pollution of rivers and lakes, stemming from shifts in precipitation and other nutritional sources, along with changes in biodiversity, are increasingly harming the quality of life for people and the economy.

The susceptibility of the Black Sea coastal zone to rising sea levels was highlighted in Georgia's 2nd National Communication in 2010. This trend persists and is exacerbated by the growing frequency and intensity of storms, leading to the complete erosion of the coastline and gradual encroachment by the sea. Such developments are anticipated to inflict significant damage on resort infrastructure, resulting in both economic and non-economic losses.

The degradation of land, particularly agricultural soils, is extensive. This phenomenon is driven by various factors, including temperature fluctuations, seasonal variations, alterations in precipitation patterns, and biodiversity loss. Additionally, increased flooding—linked to changes in precipitation and the melting of glaciers—exacerbates the situation. The widespread degradation of agricultural lands, manifested through different forms of erosion, salinization, and desertification, diminishes productivity and contributes to food insecurity.

In North Georgia, the desertification process is most evident in Dedoplistskaro, the hottest and driest area of the country. The 2nd National Communication has highlighted this issue, noting the vulnerability of semi-desert regions to climate change. The situation is worsening, with frequent droughts and reduced rainfall leading to a significant decline in the productivity of these once-fertile arable lands. This decline adversely affects the living conditions of the local population and threatens food security.

Moreover, the degradation of pastures has also occurred, resulting in a notable decrease in livestock productivity.

Restoring degraded agricultural lands and adapting to climate change presents a formidable challenge, particularly given the scale of the issue. Addressing this problem requires prioritization and the implementation of new technologies, which unfortunately do not progress at a pace that matches the rate of degradation.

In Georgia, forests represent a vital natural resource, serving a multitude of functions, including those that are not economically driven. As early as 2010, concerns regarding the susceptibility of the forest massif to climate change in the Upper Svaneti region were raised. Since that time, the degradation of forest ecosystems has intensified, evidenced by the rise in pest populations and a decline in forest quality, leading to significant losses. Recently, several proactive measures have been implemented to promote sustainable forest management, including the development of a new Forest Code and the initiation of a comprehensive forest inventory. Through sustainable management practices, it is possible to mitigate the losses and damages associated with this vital ecosystem.

These ongoing and gradually evolving processes have also contributed to natural disasters and extreme weather phenomena, the frequency and severity of which have become increasingly apparent in recent years. Incidents of flooding, mudslides, and landslides have surged, with new affected areas emerging that were previously unreported.

The geographical features of Georgia, particularly its proximity to the sea and highlands, play a crucial role in these dynamics. Continuous warming leads to increased evaporation, and the resulting vapor condenses and accumulates as snow in the high mountains. During the spring and summer thaw, this snow melts, forming temporary lakes between the mountains. Following significant rainfall, these lakes can overflow, resulting in destructive mudslides or floods.

The melting of glaciers has led not only to a reduction in water resources but also to the occurrence of landslides and mudslides as glaciers collapse. New landslide-prone areas have emerged in regions previously considered safe. A notable incident occurred several years ago when the Devdoraki glacier in the Caucasus Mountains collapsed, obstructing the Aragvi River and posing a significant threat to the entire valley. On August 3, 2023, a severe landslide and mudslide resulted from the interaction of a rock fall with a glacier at the Shovi resort, tragically resulting in the loss of over 30 lives. Additionally, in February 2024, a sudden mountain slope collapse in the village of Nergeti, located in the Baghdati district, led to a catastrophic landslide that destroyed three homes and resulted in eight fatalities.

In response to these challenges, Georgia is committed to implementing early warning systems across the nation, which are expected to be fully operational soon. This initiative aims to facilitate timely interventions to mitigate risks to individuals and property, thereby reducing potential losses and damages. However, the National Environmental Agency (NEA) has noted that even with early warning systems in place, their effectiveness is limited during rapid events like the one in Shovi, due to insufficient response time.

Given the current circumstances, Georgia intends to enhance the frequency and depth of research efforts to identify potential hazards, provide timely information, formulate appropriate recommendations, and implement preventive measures to avert losses and damages associated with climate-related disasters.

The National Environmental Agency of Georgia is responsible for collecting meteorological and general environmental data, analyzing this information, drawing relevant conclusions, and offering recommendations to the appropriate ministries. The agency is staffed by highly qualified professionals who consistently gather data from meteorological stations and observation posts across the nation. Additionally, they organize field expeditions and conduct research in various regions. This comprehensive effort has led to the development of maps that highlight areas susceptible to floods, mudslides, landslides, and other natural events, which are regularly updated. The agency has also identified regions with geological issues, as Georgia's complex geological landscape often exacerbates the impact of climatic disasters.

In Georgia, the management of emergency situations, including the risks associated with natural disasters, is overseen by a state sub-agency under the Ministry of Internal Affairs, known as the Emergency Situations Management Service. This service continuously receives information from the National Environmental Agency. According to the Regulation of the Emergency Situations Management Service (Order No. 24 of the Minister of Internal Affairs), the Service is responsible for organizing fire and rescue units to effectively respond to emergencies.

Given the current circumstances, where the adverse impacts of climate change are leading to a rapid escalation of natural disasters in the country, it is imperative for Georgia to enhance the material and technical capacities of its entire emergency management framework. This includes both the National Environmental Agency and the Emergency Management Service of the Ministry of Internal Affairs, enabling them to effectively address the increasing severity of natural disasters.

While it is not feasible to completely prevent either gradual processes or sudden extreme events resulting from climate change, the associated risks, losses, and damages can be significantly reduced. This can be achieved through the improvement of climate policy and enforcement mechanisms, the advancement of technological resources, the enhancement of technical capabilities, the coordination of efforts, and the establishment of a robust system for resource mobilization and management.

4.2 CURRENT CLIMATE CHANGE

4.2.1 DATA USED AND DATA SOURCES

4.2.1.1 Ground observations

To assess the ongoing climate change, a certain number of meteorological stations were selected with the aim of covering the entire territory of the country as completely as possible from a climate-related point of view, and the data from each station were reliable and long-term, with a time series of observations of at least 60 years.

Based on the data of the last 60-year period (1961-2020) of 38 stations of the Georgian meteorological network, the nature of the change in the intensity and repeatability of the average and extreme values of meteorological elements was studied. The aforementioned 38 stations were selected in order to optimally take into account the climatic features of the territory of Georgia, as well as on the basis of the administrative-territorial division of the country.

- Adjara: Batumi, Kobuleti, Keda, Khulo;
- Guria: Lanchkhuti, Chokhatauri, Ozurgeti;
- Samegrelo-Zemo Svaneti: Poti, Zugdidi, Senaki, Mestia;
- Racha-Lechkhumi and Kvemo Svaneti: Ambrolauri, Shovi;
- Imereti: Kutaisi, Zestaponi, Sachkhere, Sairme, Mta-Sabueti;
- Samtskhe-Javakheti: Akhaltsikhe, Akhalkalaki, Borjomi, Bakuriani;
- Shida Kartli: Gori, Khashuri;
- Kvemo Kartli: Tbilisi, Bolnisi, Tsalka, Marneuli;
- Mtskheta-Mtianeti: Dusheti, Pasanauri, Tianeti, Stepantsminda, Gudauri;
- Kakheti: Akhmeta, Telavi, Sagarejo, Lagodekhi, Dedoplistskaro;

The utilized database was developed through the analysis of observational materials from the hydrometeorological network. During the creation of this database, a procedure for data quality control and assurance was implemented, adhering to the guidelines established by the World Meteorological Organization, as practiced by national hydrometeorological services.[198]

Furthermore, to eliminate any artificial alterations in the data series, a statistical uniformity check was conducted.

Both statistical and dynamic approaches to studying climate change are significantly influenced by the homogeneity of the time series being analyzed. This matter is particularly pertinent, as changes induced by the aforementioned factors may mimic actual climate change, thereby distorting the long-term trends and dynamic characteristics. To ensure the data's homogenization for each climate station or observatory under review, the metadata associated with each station was scrutinized, and all artificial discontinuities

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in the dataset—resulting from changes in station location, measurement instruments, or methodologies, including transitions to automated stations—were thoroughly verified.

4.2.1.2 E-OBS Interpolating Gridded Data

The study incorporated the pan-European gridded dataset from the European Climate Assessment & Dataset project (ECA&D)[199] of the World Meteorological Organization (WMO), known as E-OBS, to address the gaps in the observational series. This dataset, which is managed by the Copernicus Climate Change Service (C3S)[200], is derived from observational data supplied by national meteorological services, including that of Georgia. E-OBS is an ensemble dataset and is accessible on a consistent grid with resolutions of 0.10 and 0.25 degrees.[201]

4.2.2 METHODOLOGICAL ISSUES

Trends in the alterations of primary climatic parameters, including temperature, precipitation, humidity, and wind, were evaluated.

A methodology was employed to analyze climate change within the country, focusing on the characterization of climatic impact drivers (CID) and the examination of lowprobability, high-impact events. These events, while having a low probability of occurence or being poorly understood, possess the potential for significant repercussions on both society and ecosystems.

To facilitate this analysis, various climatic indices were utilized, which serve to illustrate the characteristics of relevant climatic impacts across different sectors or applications, as well as the surpassing of established threshold values (refer to Appendix: Table A1 – Selected climatic indices).

In the scientific discourse surrounding climate, numerous indices are employed to describe and quantify one or more dimensions of climate phenomena resulting from natural variability or long-term systemic changes.

Additionally, indices are used to delineate aspects of climate forcing mechanisms that are crucial for evaluating impacts and risks to society and ecosystems. Climate forcing indices are defined as numerically derived indices that combine one or more climate variables, aimed at measuring the intensity of a climate forcing mechanism or the likelihood of exceeding a specified threshold.

The trends of change for both average parameters and extreme climate indices (up to 50 indices) were analyzed for the 38 specified locations, focusing on annual values, monthly data, and seasonal variations throughout the year.

To enhance the reliability of the findings, changes in the aforementioned parameters were evaluated using two approaches: first, by identifying trends for each parameter from 1961 to 2020, and second, by assessing the statistical significance of these trends through the Mann-Kendall non-parametric test, which is employed to examine spatial variations and

199 WMO, 2017b; WMO, 2019
200 https://www.ecad.eu/
201 https://www.ecad.eu/download/ensembles/ensembles.php

temporal trends in hydroclimatic series.[202] Additionally, a comparison of the average and extreme values across two 30-year periods (1961-1990 and 1991-2020) was conducted.

4.2.3 ASSESSMENT OF CLIMATE IMPACT MECHANISMS

Warming and cooling

(i) Surface air temperature - temperature and diurnal and seasonal temperature cycles

The average daily temperature has shown a consistent increase across the entire country when comparing the two 30-year periods of 1961-1990 and 1991-2020. The annual mean surface air temperature has risen by nearly 1 degree, with an overall average increase of 0.79 [0.33 to 1.24]°C across the region. This rise is 0.30°C greater than the temperature increase reported in the Fourth National Communication, which analyzed the changes between the periods of 1956-1985 and 1986-2015 (refer to Figures 4.2.1 and 4.2.2).

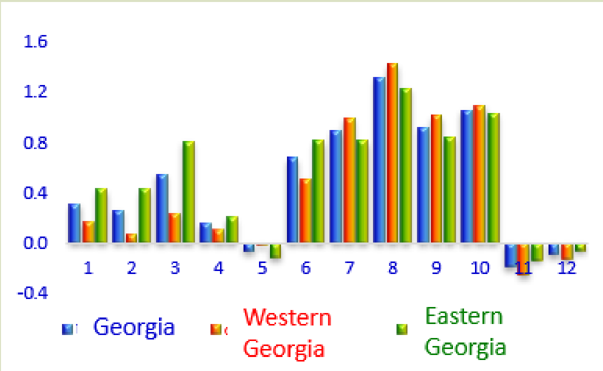


FIGURE 4.2.1. ANOMALIES OF AVERAGE ANNUAL AIR TEMPERATURE RELATIVE TO BASE PERIODS (4NC)

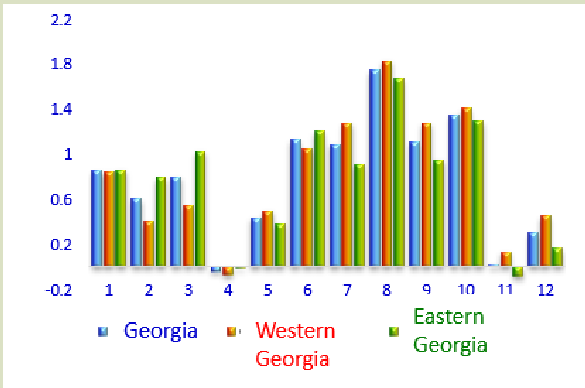


FIGURE 4.2.2. ANOMALIES OF AVERAGE ANNUAL AIR TEMPERATURE RELATIVE TO BASE PERIODS (5NC)

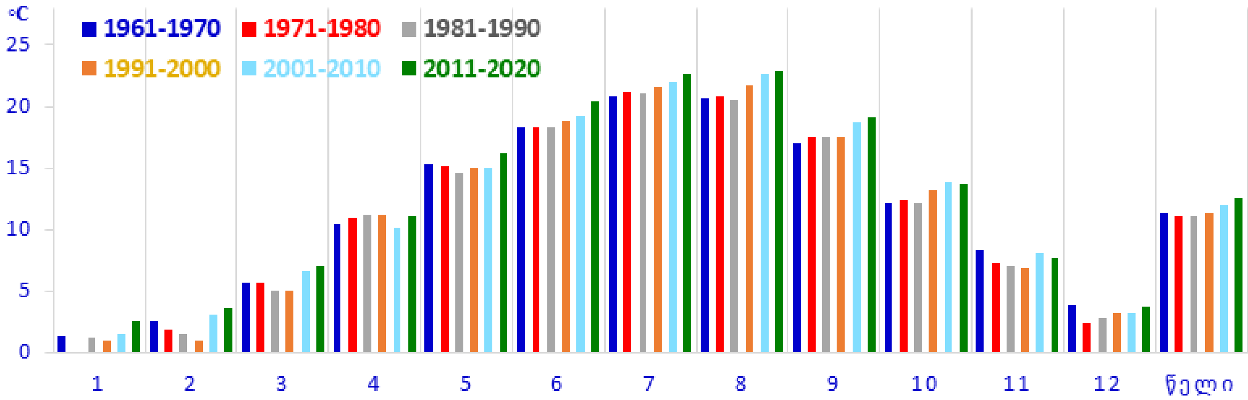
The warming trend is notably pronounced in the regions of Samegrelo-Zemo Svaneti, Racha-Lechkhumi, Kvemo Svaneti, and Samtskhe-Javakheti. The most substantial increase in temperature has been recorded in the central areas of the country. Specifically, the highest rise between the two observed periods is found in the highland region of Samtskhe-Javakheti (Bakuriani), with an annual increase of +1.240°C. Meanwhile, the steepest trend slope and rate of change in average annual temperature are evident in Shida Kartli (Khashuri), where the increase is +0.400°C per decade, indicating a yearly rise of 0.040°C, which translates to a total increase of 4.00°C over a century. It is important to highlight that the trends in average annual temperatures remain consistent across nearly the entire country, as supported by the data presented in Tables 4.2.1 and 4.2.2.

Regarding decadal variations, the surface air temperature across the country was 1.33 [0.05 to 2.63]°C higher during the period from 2011 to 2020 compared to 1961 to 1990, with more pronounced increases observed in the eastern regions (1.37 [0.77 to 1.86]°C) than in the western regions (1.31 [0.05 to 2.63]°C). The surface temperatures recorded in the first two decades of the 21st century (2001–2020) were 1.06 [0.39 to 1.83]°C warmer than those from 1961 to 1990. Furthermore, it is noted with high confidence that the rate of temperature increase since 1990 has outpaced that of any other decade in the past 60 years (Figure

202 https://vsp.pnnl.gov/help/vsample/design_trend_mann_kendall.htm

4.2.3).

FIGURE 4.2.3. SURFACE AIR TEMPERATURE CHANGES (°C) BY DECADE



The analysis of monthly data reveals intra-annual changes, indicating that warming is primarily attributed to rising temperatures during the summer-autumn period (June to October). During this timeframe, all examined locations experienced an average temperature increase of 1.29 [ranging from 0.45 to 2.45]°C. The observed trends in temperature growth are consistent and are corroborated by data from nearly the entire region during the specified months, as well as by annual averages. However, the changes are less reliable in the mountainous areas of Adjara.

Seasonal temperature variations exhibit a clear pattern: both autumn and summer are warmer across the board, with a more pronounced increase in summer temperatures. The most significant rise in seasonal temperatures was recorded in Poti, where summer temperatures increased by +1.93°C, while Dedoplistskaro showed the highest rate of increase in average summer temperature at +0.69°C per decade.

August experiences the most significant warming throughout the year, with an increase of 1.75 [ranging from 1.15 to 2.45]°C, as a consistent rise in temperature is noted across all examined locations. Furthermore, the rate of temperature change in August is the highest for the entire year across most of the territory.

In winter and spring, average temperatures have risen, although these changes are generally unstable. Notably, March exhibited a reliable warming trend, particularly in eastern Georgia and along the Black Sea coast, with an increase of 0.80 [ranging from -0.18 to 1.94]°C, translating to a temperature change rate of 0.03 to 0.52°C per decade. It is important to highlight that cooling trends were also recorded in certain months of these seasons, specifically in April and November to December. The most significant negative deviations, reaching up to one degree, were observed in April in the Adjara-Guria region (ranging from 0.6 to 1.1°C) and in November in Kakheti (ranging from 0.4 to 0.5°C).

Average daytime temperatures are on the rise, with annual average maximum values consistently increasing across nearly all regions. The mountainous Adjara area remains a notable exception.

The most significant changes in average maximum temperatures have been observed in western Georgia, particularly along the Black Sea coast and in areas adjacent to the Colchis Lowland, such as Poti, which has experienced an increase of 0.40°C per decade. In eastern Georgia, particularly in the mountainous regions of southern Georgia like Bakuriani, the increase is even more pronounced at 0.48°C per decade. Over two 30-year periods, certain regions have seen average maximum temperature increases exceeding 1.5 degrees. The eastern part of the country, especially the mountainous areas of southern Georgia, is experiencing relatively rapid warming. Samtskhe-Javakheti shows the most significant increases in both annual and seasonal temperatures, with Bakuriani recording an annual rise of +1.71°C, a summer increase of +2.75°C, and an August increase of +3.67°C. The sharpest seasonal and monthly temperature increases are noted in the Racha-Lechkhumi and Kveda Svaneti regions, particularly on the slopes of the Western Caucasus, where the increase is 0.91°C per year.

Similar to the overall temperature trends, the rise in average maximum temperatures is primarily attributed to increases during the summer and autumn months. The most substantial increases occur from June to October, with August showing the highest daytime temperature rise. Reliable trends indicating summer warming have been identified across all monitored locations in Georgia. In autumn, the trends are less pronounced, likely due to cooling in November. In the lowland and plain areas of Georgia, including Kutaisi, Zestaponi, Tbilisi, Marneuli, and Sagarejo, as well as parts of Mtskheta-Mtianeti, the trends are not consistently confirmed, although positive increases are observed between the two 30-year periods.

TABLE 4.2. AVERAGE SURFACE AIR TEMPERATURE (^{o}C) IN 1991–2020

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Adjara	Batumi	7.9	23.7	8.6	13.5	23.1	17.4	15.7
	Kobuleti	6.7	23.7	7.3	12.9	23.0	16.5	14.9
	Ridge	5.6	23.5	6.2	13.0	22.9	16.1	14.6
	Khulo	0.8	19.7	1.7	9.3	19.2	12.4	10.7
Guria	Lanchkhuti	6.6	24.3	7.2	13.6	23.7	16.9	15.3
	Chokhatauri	6.5	24.1	7.2	14.0	23.6	16.9	15.4
	Ozurgeti	6.8	23.7	7.5	13.3	23.1	16.7	15.1
Samegrelo-Zemo Svaneti	Poti	7.4	24.6	8.1	14.2	24.0	17.3	15.9
	Zugdidi	6.2	24.4	7.2	14.3	23.9	16.6	15.5
	Senaki	6.9	24.7	7.8	14.8	24.2	17.4	16.0
	Mestia	-3.4	18.2	-2.4	6.9	17.4	9.0	7.7
Racha-Lechkhumi and Qv. Svaneti	Ambrolauri	1.2	23.4	2.3	12.1	22.7	13.8	12.7
	Shovi	-3.4	18.2	-2.4	6.7	17.3	8.9	7.6
Imereti	Kutaisi	6.7	24.9	7.5	14.8	24.4	17.6	16.1
	Zestaponi	5.4	25.4	6.4	14.5	24.8	17.2	15.7
	Sachkhere	2.7	24.0	3.5	12.6	23.2	14.5	13.4
	Sairme	1.9	19.6	2.7	9.9	19.0	12.5	11.0
	Mta-Sabueti	-2.2	17.8	-1.5	6.6	17.1	9.3	7.9

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Samtskhe-Javakheti	Akhaltsikhe	-1.6	22.0	-0.5	10.0	21.0	11.5	10.5
	Akhalkalaki	-6.1	16.9	-5.0	5.3	15.9	8.1	6.1
	Borjomi	0.4	22.2	1.2	10.7	21.3	12.2	11.4
	Bakuriani	-4.1	16.4	-3.2	5.4	15.9	7.8	6.5
Shida Kartli	Gori	1.1	23.2	1.8	11.3	22.2	12.9	12.1
	Khashuri	0.4	22.7	1.1	10.7	21.8	12.5	11.5
Kvemo Kartli	Tbilisi	3.4	25.9	4.2	13.5	24.9	15.2	14.4
	Bolnisi	2.7	25.3	3.5	12.6	24.2	14.4	13.7
	Tsalka	-3.2	17.2	-2.3	6.2	16.4	8.3	7.2
	Marneuli	2.3	25.5	3.1	12.9	24.4	14.5	13.7
Mtskheta-Mtianeti	Dusheti	0.3	21.6	1.3	10.3	20.8	12.1	11.1
	Pasanauri	-2.0	20.3	-0.8	9.0	19.3	10.6	9.5
	Tianeti	-2.3	20.3	-1.2	8.5	19.4	10.2	9.2
	Stepantsminda	-3.7	16.0	-2.7	5.3	15.5	7.9	6.5
	Gudauri	-5.7	14.1	-4.8	2.7	13.2	5.5	4.2
Kakheti	Akhmeta	3.0	24.6	3.7	12.7	23.7	14.5	13.7
	Telavi	2.3	24.5	3.3	12.6	23.6	14.2	13.4
	Sagarejo	2.4	23.5	3.1	11.7	22.6	13.4	12.7
	Lagodekhi	3.3	25.7	4.2	13.6	24.9	15.3	14.5
	Dedoplistskaro	1.1	24.1	2.0	10.8	23.1	13.1	12.3

In the spring season, a notable rise in daytime temperatures is primarily observed in March, with some exceptions. However, during April and May, the temperature fluctuations tend to be inconsistent, particularly in several regions, especially in the western part of the country, where negative trends have been noted. Additionally, a decline in temperatures has been recorded in Adjara-Guria, corroborated by data indicating a trend of -0.47°C per decade in Keda.

In winter, significant changes in maximum temperatures have been predominantly identified in the central regions of the country. The most pronounced warming is evident in Samtskhe-Javakheti and Kartli, particularly in Akhaltsikhe, where an increase of +0.54°C per decade has been observed. During this season, the warming trends noted in January and February are somewhat offset by cooler temperatures in December. A slight reduction in daytime temperatures, ranging from 0.1 to 0.3°C, is particularly noticeable in Eastern Georgia, with the most significant negative deviations occurring in December within the Mtskheta-Mtianeti and Kvemo Kartli regions.

Regarding **average night temperatures**, annual values of the average minimums have risen across most of the country, although some regions exhibit unreliable warming trends. The increase in night temperatures, when compared to the period from 1961 to 1990, is relatively modest in comparison to other average temperature metrics, amounting to +0.70°C (ranging from 0.08 to 1.20°C). The most significant warming has been recorded in Western Georgia, specifically in Samegrelo-Imereti, the Kolkheti Plain, and the elevated areas near the Likhi Range, where an increase of +0.99°C (from 0.66 to 1.20°C) has been noted. Additionally, the extreme southeastern regions of Kakheti have shown the highest annual rates of increase in average minimum temperatures, with Lagodekhi reporting +0.38°C per decade.

The rise in average and average maximum temperatures is accompanied by a notable increase in average minimum temperatures, particularly during the summer-autumn months (June to October). Consistent upward trends have been observed across the entire region during the summer, with a marked rise in nighttime temperatures during autumn primarily noted in western Georgia. Within the annual temperature cycle, October exhibits a warming trend alongside August. Furthermore, the increase in nighttime temperatures in August is particularly pronounced along the coastal areas of Adjara and in Kakheti, where Lagodekhi has recorded an increase of +2.10°C. In October, the most significant warming is observed in the western regions, especially in Imereti, where Zestafoni has experienced a rise of +1.91°C.

Similar to the maximum temperatures, a consistent warming trend in minimum temperatures is evident during the spring, particularly in March. However, in April, especially in eastern Georgia, there are prevailing trends of decreasing nighttime temperatures. A cooling trend is also noted in November and December, with temperature reductions ranging from 0.6 to 0.8 degrees.

Overall, the warming trend across the country appears to be primarily driven by increases in daytime temperatures during the warmer months. The most significant nighttime warming is observed in western Georgia, particularly in the autumn season. Throughout the year, cooling trends are most prominent in November and April. The temperature decline in the eastern regions is largely attributed to reductions in nighttime temperatures, while in the west, it is due to decreases in daytime temperatures. Conversely, warming in the east is mainly associated with rising maximum temperatures, whereas in the west, it is linked to increasing minimum temperatures.

TABLE 4.3. CHANGE IN AVERAGE SURFACE AIR TEMPERATURE (^0C) BETWEEN TWO THIRTY-YEAR PERIODS (1961–1990 AND 1991–2020)

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Adjara	Batumi	0.52	1.17	0.21	0.48	1.31	0.78	0.69
Adjara	Kobuleti	0.60	1.41	0.36	0.53	1.52	0.96	0.84
Adjara	Keda	1.46	1.57	0.96	-0.39	1.55	1.32	0.86
Adjara	Khulo	0.31	0.83	0.13	-0.23	0.91	0.53	0.33
Guria	Lanchkhuti	1.04	1.04	0.56	-0.33	1.06	0.80	0.53
Guria	Chokhatauri	0.82	1.47	0.56	0.37	1.48	1.05	0.87
Guria	Ozurgeti	0.78	1.44	0.47	-0.09	1.43	0.74	0.64
Samegrelo-Zemo Svaneti	Poti	1.07	1.85	0.84	0.89	1.93	1.17	1.21
Samegrelo-Zemo Svaneti	Zugdidi	0.72	1.61	0.57	0.66	1.76	1.10	1.02
Samegrelo-Zemo Svaneti	Senaki	0.64	1.32	0.45	0.41	1.32	0.74	0.73
Samegrelo-Zemo Svaneti	Mestia	1.51	0.58	1.19	0.41	0.97	0.93	0.87
Racha-Lechkhumi And Kvemo Svaneti	Ambrolauri	0.75	0.84	0.45	0.05	1.06	0.79	0.59
Racha-Lechkhumi And Kvemo Svaneti	Shovi	0.73	1.58	0.62	1.07	1.84	1.31	1.21
Imereti	Kutaisi	0.77	1.38	0.46	0.36	1.34	0.83	0.75
Imereti	Zestaponi	0.54	1.42	0.37	0.16	1.45	0.95	0.73
Imereti	Sachkhere	1.25	1.36	0.82	0.47	1.44	0.96	0.92
Imereti	Sairme	1.05	1.33	0.84	0.84	1.54	1.30	1.13
Imereti	Mta-Sabueti	0.73	0.86	0.38	0.17	1.09	0.68	0.58
Samtskhe-Javakheti	Akhaltsikhe	1.32	1.17	0.98	0.62	1.44	0.92	0.99
Samtskhe-Javakheti	Akhalkalaki	0.47	0.65	0.21	0.54	0.88	0.79	0.60
Samtskhe-Javakheti	Borjomi	0.76	1.28	0.45	0.79	1.59	0.76	0.90
Samtskhe-Javakheti	Bakuriani	1.22	1.19	1.01	0.96	1.85	1.14	1.24
Shida Kartli	Gori	1.18	0.73	0.77	0.11	0.95	0.66	0.62
Shida Kartli	Khashuri	1.45	1.50	1.02	0.50	1.74	1.05	1.07
Kvemo Kartli	Tbilisi	0.89	0.78	0.62	0.40	1.15	0.60	0.69
Kvemo Kartli	Bolnisi	0.82	0.94	0.52	0.37	1.26	0.59	0.68
Kvemo Kartli	Tsalka	0.81	0.58	0.61	0.57	0.97	0.67	0.71
Kvemo Kartli	Marneuli	0.75	1.09	0.44	0.55	1.40	0.70	0.77

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Mtskheta-Mtianeti	Dusheti	0.39	0.59	0.25	0.36	0.89	0.40	0.47
	Pasanauri	0.60	0.78	0.34	0.41	1.00	0.43	0.55
	Tianeti	0.44	1.05	0.24	0.40	1.35	0.52	0.63
	Stepantsminda	0.83	0.91	0.76	0.52	1.39	0.89	0.89
	Gudauri	0.72	0.95	0.60	0.18	1.20	0.83	0.70
Kakheti	Akhmeta	0.98	0.72	0.59	0.32	1.05	0.46	0.61
	Telavi	0.70	0.71	0.50	0.40	1.15	0.63	0.67
	Sagarejo	1.06	0.53	0.74	0.55	0.96	0.43	0.67
	Lagodekhi	1.04	0.62	0.82	0.36	1.21	0.90	0.82
	Dedoplistskaro	0.81	1.53	0.67	0.46	1.91	1.06	1.02
Georgia		0.86	1.09	0.59	0.40	1.32	0.83	0.79
Western Georgia		0.85	1.28	0.57	0.32	1.39	0.94	0.81
Eastern Georgia		0.86	0.91	0.61	0.47	1.27	0.72	0.77

The observed trends in temperature parameters are notably significant for indices associated with maximum temperatures, indicating a shift in the daily temperature distribution towards higher values. This phenomenon is particularly evident across the region during the summer and early autumn months, especially in August. The rise in temperatures, characterized by a more pronounced increase in minimum temperatures, is most apparent during the winter-spring seasons, particularly in Western Georgia in March. Consequently, the average daily temperature amplitude has experienced a slight increase across the territory, measuring 0.18°C (ranging from -0.56 to +1.05°C), with the most substantial deviations occurring in March in the west (-0.59°C) and in August in the east (+0.95°C). The warming trend, primarily driven by rising minimum temperatures, is most pronounced in the eastern Colchis Lowland and the southeastern regions of the country. Additionally, the increase in daytime temperatures is particularly significant in the mountainous areas of Samtskhe-Javakheti and Racha-Lechkhumi.

Throughout the annual cycle, the peak temperature has shifted from July to August in certain areas of the country. In the earlier period, August was the warmest month in terms of both average and daytime temperatures for most regions in Western Georgia, while July held this distinction in the east. In the subsequent period, the annual average temperature maximum has transitioned to August in most regions, with the highest daytime temperatures now consistently recorded in August across the territory. Regarding minimum temperatures, July was the warmest month in both periods; however, in the later period, August has become the month with the warmest nights in most regions of Western Georgia, excluding Racha-Lechkhumi and Zemo Imereti. January remains the coldest month across all temperature metrics in both periods, although in some western regions, there has been a shift of the coldest month from January to February based on nighttime temperatures.

The following trends have been identified concerning the extreme characteristics of temperature.

(ii) Extreme heat - episodic events with high surface air temperatures

- Positive trends in annual absolute maximum temperatures have primarily been observed in Eastern Georgia, whereas in the Western region, significant warming is noted only in the lowland area of Samegrelo and certain high-altitude locations such as Shovi and Mestia. Similar to other temperature metrics, this parameter is experiencing an increase due to rising absolute maximums during the summer and autumn months, particularly from July to October. Notably, upward trends have also been identified in February and March. Conversely, a decline in absolute maximums is evident during November, December, and April. The most pronounced changes in annual absolute maxima were recorded in the West at 0.86°C per decade (Shovi) and in the East at 0.90°C per decade (Dedoplistskaro). The significance of positive trends is most pronounced in August. The observed cooling trends in warm extremes are largely insignificant, with only a few negative trends noted in April and December, exhibiting a nearly equivalent rate of decrease at -0.5°C per decade.
- During the two 30-year intervals, instances of exceeding maximum temperature thresholds were observed at nearly all monitored locations in September and October. Additionally, in many regions, maximums were also surpassed during the spring and the months of July and August. The extent of these exceedances ranges from 4 to 6 degrees, with some high-altitude areas recording increases of up to 7 to 8 degrees. Furthermore, in recent times, maximum temperatures in the lowland and plain regions of the country have surpassed 40°C. The highest temperature recorded throughout the entire observation period occurred in Poti, reaching 45.2°C on July 31, 2000. In the second interval, absolute maximums predominantly occurred in August.
- The prevalence of warm days and nights is on the rise nationwide, with an average increase of 6-7%. The most significant rise in warm nights has been observed along the Black Sea coast and the Colchis Plain, as well as in the southeastern regions, where the increase is approximately 8-9% annually. Warm days have predominantly increased in coastal and mountainous areas, with an annual rise of 10-13%. These trends are consistent and corroborated by data from most regions. Additionally, there is a notable increase in the frequency of hot days (maximum daytime temperature exceeding 30°C) and extremely hot days (maximum daytime temperature exceeding 35°C), as well as tropical nights (minimum night temperature exceeding 20°C). On average, the number of hot summer days has risen by about 10-15 days across the country, with certain areas in the Colchis Plain experiencing an increase of 20-25 days. The rise in extremely hot days is most pronounced in Kvemo Kartli and Zemo Imereti, where the increase ranges from 7-12 days per year, while the national average is 2-4 days. In the lowland and foothill regions, particularly along the Black Sea coast and in the eastern Kolkheti Lowland, the occurrence of tropical nights has surged significantly, with an increase of 24-29 days per year. Overall, the frequency of such nights has risen by a factor of 8-9. Similar to other warming indicators, the frequency of hot days and tropical nights, along with the percentage of warm days and nights, has also escalated throughout August. Furthermore, unusually high

daytime and nighttime temperatures have been recorded in certain mountainous areas (such as Fasanauri and Tianeti) during the recent period (1991-2020), which were not observed in the earlier period (1961-1990).

- An examination of climatic characteristics reveals that the rise in average temperatures during the warm season (May-September) can be attributed to a higher frequency of heat waves, as well as a notable extension of their duration. This trend is particularly evident in the coastal region of the Black Sea, the surrounding lowland areas, and the eastern Iori Plateau. In this region, the maximum duration of heat waves has increased by nearly one month over the two observed periods, with an additional 3 to 4 heat waves occurring each season. Furthermore, the duration of these heat waves is increasing at a rate of approximately 3 days per decade.
- Sustainable positive changes have also been noted in the occurrence of warm episodes throughout the year. The duration of these episodes has seen the most significant increase, ranging from 25 to 30 days, particularly in the regions of Samtskhe-Javakheti, the Black Sea coast, and Dedoplistskaro. On average, the duration is increasing by 5 to 6 days every decade (Figure 4.2.5)..

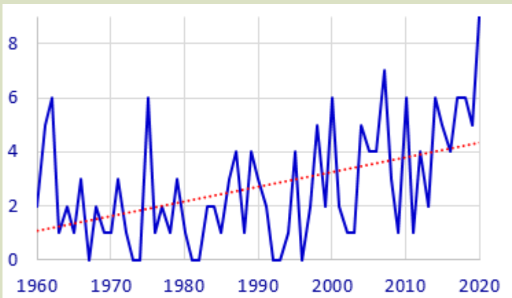


FIGURE 4.2.4. DYNAMICS OF THE NUMBER OF HEAT WAVES IN 1961-2020 (TBILISI)

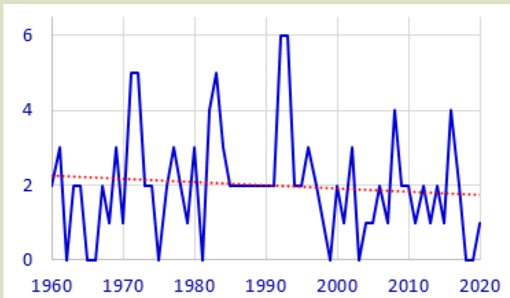


FIGURE 4.2.5. DYNAMICS OF THE NUMBER OF COLD WAVES IN 1961-2020 (TBILISI)

(iii) Cold episodes - episodic events with low surface air temperatures

- Annual absolute minimum temperatures are consistently rising in select regions: in the western area of Imereti, particularly in Sachkhere, where the increase is recorded at 1.22°C per decade, and in the eastern regions of Shida Kartli and Kakheti, with Gori experiencing a maximum rise of 1.00°C per decade. Seasonal analysis indicates that the warming of cold extremes is most pronounced during the spring months. In autumn, positive trends are observed solely in the west, although these changes lack robust confirmation through trends. Throughout the year, the most significant rise in absolute minimum temperatures occurs in October, while a decline is noted in April. During the warmer months, the steepest upward trends are found in Imereti and Racha-Lechkhumi, as well as in the eastern regions of Mtskheta-Mtianeti and Kakheti. Conversely, cooling trends for cold extremes are primarily observed in April and November, predominantly affecting the southern and eastern parts of the country. Notable decreases in nighttime temperatures are consistently recorded in April in Kvemo Kartli (Marneuli at -0.49°C per decade) and in November in Samtskhe-Javakheti (Borjomi at -0.39°C per decade).
- The overlap of minimum temperatures (in the context of cooling) between two

30-year intervals was predominantly noted in December. The extent of the excess ranges from 2 to 3 degrees, with certain areas experiencing increases of up to 4 to 5 degrees. It is important to highlight that instances of absolute minimum temperature excess were rarely observed during the winter and spring months, while the overlap of annual values reached between 1 and 3 degrees. Within the annual cycle, there has been a shift in absolute minimum temperatures. Specifically, in the initial 30-year period, the lowest temperatures were primarily recorded in January and, to some extent, in February. However, from 1991 to 2020, the lowest temperatures throughout the year were mainly observed in February, with some regions also experiencing low temperatures in December. Recently, minimum temperatures in mountainous and highland areas of the country have dropped below -25°C. The record low temperature for the entire observation period was noted in Tsalka, reaching -33.4°C on February 4, 2014.

- The incidence of frosty days and nights is diminishing nationwide, with an average reduction of 2 days for nights and 5 days for days. The regions experiencing the most significant decline in frosty nights are Imereti and Kakheti, with a decrease of 8 to 9 days annually, while Samtskhe-Javakheti and Mtskheta-Mtianeti are seeing a reduction of 5 to 6 frosty days per year. Overall, the occurrence of cold days and nights is declining by approximately 2 to 3% each year. Notably, the frequency of frosty nights is on the rise in November across most areas, whereas frosty days are becoming more common in December. Additionally, cold nights are increasingly prevalent in April, particularly inKartli region. In December, certain areas, including Tbilisi, are witnessing a rise in the number of cold days.
- The incidence and frequency of cold waves are on the decline. The trends indicating a reduction in the duration of these cold waves are becoming increasingly apparent, averaging a decrease of 0.5 to 1 day per decade. Furthermore, in certain areas, such as Shida Kartli and Mtskheta-Mtianeti lowland zone, the intensity of cold waves is actually rising, with Khashuri experiencing an increase of 1.7°C per decade. This phenomenon contributes to the erratic nature of warming during the colder months, specifically from November to April.
- While some regions have experienced a reduction in the length of cold episodes, these trends are largely inconsistent. Additionally, similar to the patterns observed with cold waves, there is a notable increase in the duration of cold episodes in mountainous areas, such as Mtskheta-Mtianeti and Racha-Lechkhumi, where an extension of 1 to 4 days is anticipated.

The following trends were identified for other sectoral climate indices of the temperature regime:

- The length of the growing season (defined as temperatures exceeding 5°C) has expanded in comparison to the initial 30-year period. However, many of these changes exhibit instability across various regions, as the warming noted in early autumn is somewhat offset by cooler temperatures in April. Notably, the most significant increases in the duration of the growing season have been observed primarily in the central areas of the country, particularly in Shida Kartli and neighboring Borjomi-Bakuriani regions, where the rate of increase is approximately

3 to 4 days per decade. (Table 4.6, Index gsl).

- The most significant increase across the country was observed in the warm period for accumulated temperature sums, the so-called degree-day indices. Namely:
- October has led to an increase in the number of days with temperatures exceeding 10°C across the region, particularly in the mountainous areas, which experience an additional 10 to 20 days annually. Consequently, the data from all examined locations indicate a rise in the total accumulated active temperatures (above 10°C). The most significant changes are observed along the Black Sea coast, in Kolkheti lowland, and in Kakheti region, specifically in Dedoplistskaro district, where the accumulated temperatures above 10°C have risen by 250 to 300 grams per day. The highest increase, ranging from 300 to 400 grams per day, has been noted in the coastal and lowland regions of Samegrelo.

The examination of heating and cooling degree-days, a metric utilized to evaluate energy consumption in buildings, indicates that the most significant changes are evident in the temperature indices during the warm season. However, alterations in the characteristics of the heating (cold) season are also substantiated by trends observed across the region. Notably, the most considerable reduction in heating degree-days (90-120 g.days) is recorded in mountainous and high-altitude areas such as Bakuriani, Gudauri, Sairme, and Shovi. Conversely, the average increase in cooling degree-days during the cooling season is approximately 130 g.days, with certain areas, including Samegrelo Sea coast and lowland zones, experiencing increases of 230-270 g.days. Based on the identified trends, the number of cooling degree-days in major urban centers of the country rises by 50-70 every decade.

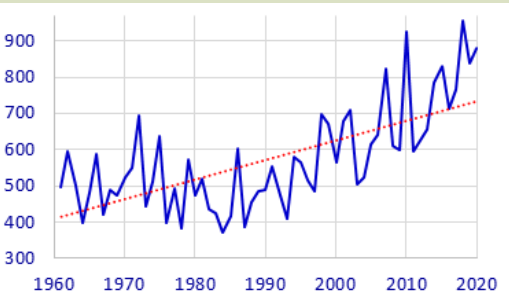


FIGURE 4.2.6. DYNAMICS OF THE NUMBER OF AIR CONDITIONING DEGREE DAYS IN 1961-2020 (BATUMI)

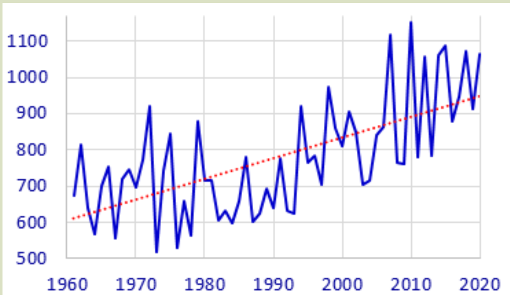


FIGURE 4.2.7. DYNAMICS OF THE NUMBER OF AIR CONDITIONING DEGREE DAYS, 1961-2020 (KUTAISI)

Humidity and dryness

(i) Precipitation - Precipitation and diurnal and seasonal cycles of precipitation

Changes in the precipitation patterns across the nation exhibit temporal instability and spatial heterogeneity, yet they still display certain consistent trends. Overall, there has been a noticeable decline in precipitation levels across the region in recent years. Specifically, during the timeframe analyzed in the Fourth National Communication (1956-2015), an increase in precipitation was primarily noted in Western Georgia, while Eastern Georgia experienced predominantly decreasing trends. However, the analysis of data from

1961 to 2020 indicates that recent trends show a decline in precipitation across most of the country. Despite this, similar to previous periods, the variability in annual precipitation totals remains largely unreliable, with no definitive trends emerging. Across the majority of the region (with some exceptions), fluctuations in annual precipitation are generally within the range of ±10-15%..

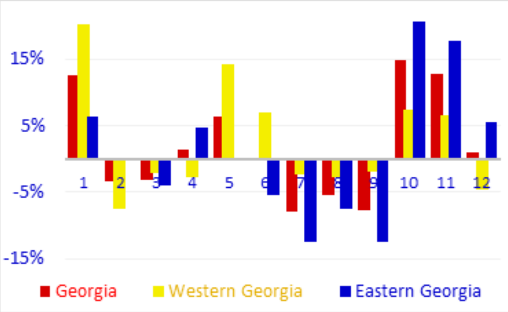


FIGURE 4.2.8. ANNUAL PRECIPITATION ANOMALIES RELATIVE TO BASE PERIODS (4NC)

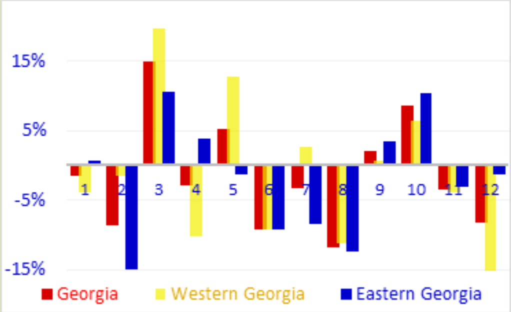


FIGURE 4.2.9. ANNUAL PRECIPITATION ANOMALIES RELATIVE TO BASELINE PERIODS (5NC)

In terms of decadal variations, the most recent decade was the second driest observed in the past 60 years regarding precipitation levels. Specifically, the average precipitation from 2011 to 2020 was 3% lower, with a range of -15 to +20%, compared to the period from 1961 to 1990. This decline was nearly uniform across regions, with the eastern area experiencing a 4% decrease (ranging from -24 to +15%) and the western area a 3% decrease (ranging from -16 to +29%). The driest decade within 1961-2020 timeframe was identified as 1991-2000, during which annual precipitation totals were, on average, 7-8% lower (with a range of -28 to +13%) than those recorded from 1961 to 1990. The decade from 2001 to 2010 was noted as the wettest for the country as a whole and specifically for its eastern regions, while the western part experienced its wettest conditions during 1981-1990. Furthermore, it is suggested, albeit with low confidence, that precipitation patterns have shifted more significantly since 1990 compared to any other decade within the last 60 years.

FIGURE 4.2.10. CHANGES IN MONTHLY PRECIPITATION TOTALS (MM) BY DECADE

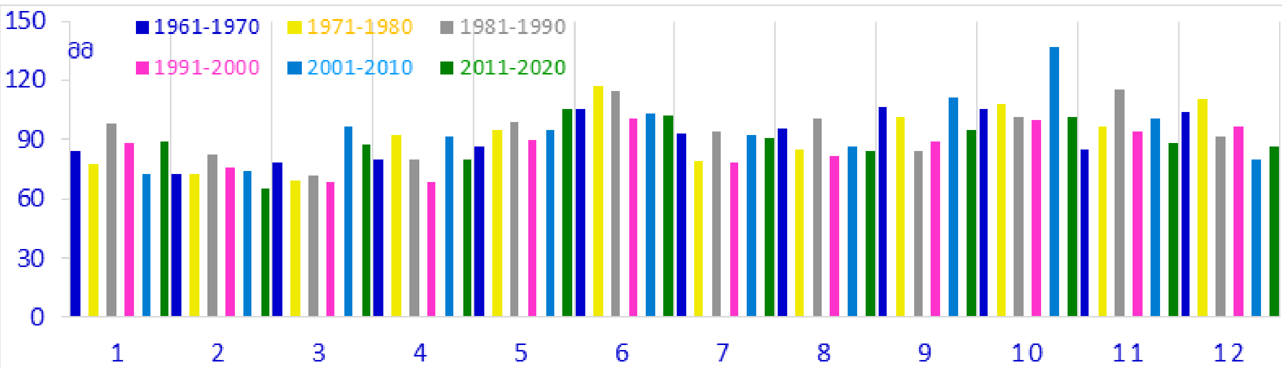
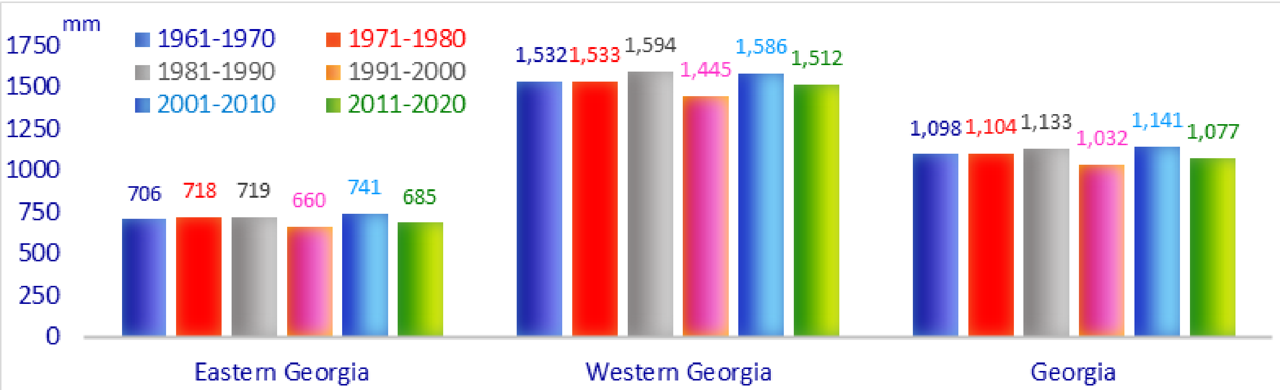


FIGURE 4.2.11. CHANGES IN ANNUAL PRECIPITATION (MM) BY DECADE



Sustainable trends in precipitation time series were observed solely at specific stations. In the western region, positive trends in the average annual precipitation are evident in the Black Sea coastal area and the mountainous region of Adjara, while in the eastern region, such trends are limited to the southern slopes of Kakheti Caucasus, particularly in Lagodekhi. The most significant deviation between the two periods, reaching up to 30%, along with the most pronounced growth trend, was recorded in Lagodekhi, with an increase of 83 mm over a decade. In Adjara and Poti, annual precipitation totals have risen by an average of 10-12%, with trend inclination angles ranging from 50 to 60 mm per decade. Conversely, notable decreases in precipitation were identified in Batumi and the lower part of Guria, with reductions between 45 and 80 mm per decade. In the eastern region, the most substantial decline in precipitation occurs in Mtskheta-Mtianeti, particularly in Tianeti, where a decrease of 25% equates to 60 mm per decade.

Regarding seasonal changes in precipitation amounts, winter predominantly exhibits a decrease, averaging 7% (ranging from -24% to +32%). The most significant reductions are found in the western region, particularly in Guria, with an average decrease of up to 20%, and in the eastern region, specifically in Shida Kartli, with an average decrease of up to 15%. Only a few trends were identified, all indicating negative changes, with the most pronounced downward trend in winter precipitation occurring in Batumi and the lower part of Guria, amounting to 35-40 mm per decade.

Similar to winter, reliable decreasing trends in precipitation are also observed in summer, with reductions of a comparable magnitude to those in winter. However, a more pronounced decrease during this season is noted in the eastern part of the country, especially in Kakheti (excluding Lagodekhi), where reductions can reach up to 20% on average.

Increasing trends in precipitation were recorded only during the transitional seasons, particularly in spring. During these periods, the average increase in precipitation (ranging from 2-5% across the territory) partially offsets the declines observed in winter and summer.

In the spring season, all trend indicators, with the exception of Tianeti, exhibit a positive trend. Additionally, trends have been observed in the eastern regions, specifically in Kartli and Kakheti during this time. The rate of increase in seasonal precipitation totals is highest in the western region, particularly in mountainous Adjara, where it reaches 16 mm over a decade, while in the east, Lagodekhi shows an increase of 26 mm over the same period.

On average, the variation in seasonal precipitation totals across the area ranges from 5% to 10%. The most significant decline in precipitation occurs in the western region during winter, whereas in the eastern region, the decrease is most pronounced in summer. The rise in spring precipitation is notably more significant in the west, especially in the mountainous areas of Adjara.

TABLE 4.4. AMOUNT OF ATMOSPHERIC PRECIPITATION (MM) IN 1991–2020

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Adjara	Batumi	211	158	630	309	500	846	2285
	Kobuleti	238	192	683	351	598	882	2513
	Keda	179	84	500	324	274	561	1659
	Khulo	157	77	443	297	243	480	1463
Guria	Lanchkhuti	147	124	422	274	355	520	1571
	Chokhatauri	155	103	446	289	314	562	1611
	Ozurgeti	199	182	575	349	507	691	2123
Samegrelo - Upper Svaneti	Poti	154	226	437	305	643	674	2059
	Zugdidi	141	165	407	448	495	471	1821
	Senaki	129	133	381	327	415	426	1549
	Mestia	70	73	196	234	218	208	856
Racha-Lechkhumi And Svaneti	Ambrolauri	83	83	235	267	248	297	1047
	Shovi	71	97	204	282	294	268	1048
Imereti	Kutaisi	138	86	407	303	263	390	1363
	Zestaponi	141	63	396	298	208	356	1256
	Sachkhere	74	73	225	254	234	270	983
	Sairme	74	74	214	237	221	248	920
	Mta-Sabueti	150	54	402	290	187	281	1159
Samtskhe - Javakheti	Akhaltsikhe	21	57	68	157	181	110	515
	Akhalkalaki	31	63	87	172	189	107	555
	Borjomi	36	43	108	192	148	170	618
	Bakuriani	54	68	154	257	223	171	805
Internal Kartli	Gori	27	40	87	151	134	122	493
	Khashuri	45	37	130	155	134	153	572
Lower Kartli	Tbilisi	16	41	53	173	162	113	501
	Bolnisi	18	37	61	180	132	125	498
	Tsalka	26	53	68	215	221	121	626
	Marneuli	17	35	54	144	118	98	413

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Mtskheta-Mtianeti	Dusheti	24	53	87	214	185	136	622
	Pasanauri	45	93	138	302	296	202	939
	Tianeti	25	58	84	201	198	143	626
	Stepantsminda	23	100	75	234	310	151	769
	Gudauri	88	143	259	453	424	296	1432
Kakheti	Akhmeta	29	57	86	222	196	157	662
	Telavi	27	66	82	258	227	175	743
	Sagarejo	25	59	86	252	194	186	719
	Lagodekhi	50	115	161	375	350	329	1214
	Dedoplistskaro	29	51	77	201	161	145	583

TABLE 4.5. CHANGE IN THE AMOUNT OF ATMOSPHERIC PRECIPITATION (%) BETWEEN TWO THIRTY-YEAR PERIODS (1961–1990 AND 1991–2020)

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Adjara	Batumi	-14%	-4%	-14%	-12%	-7%	-6%	-9%
	Kobuleti	19%	16%	12%	4%	9%	15%	11%
	Keda	-3%	8%	-12%	12%	-4%	2%	-2%
	Khulo	0%	34%	-4%	13%	13%	21%	9%
Guria	Lanchkhuti	-19%	13%	-22%	7%	-12%	-14%	-13%
	Chokhatauri	-23%	12%	-24%	-2%	-10%	-3%	-11%
	Ozurgeti	-1%	45%	-10%	9%	18%	-3%	1%
Samegrelo-Zemo Svaneti	Poti	3%	12%	1%	23%	10%	11%	10%
	Zugdidi	1%	-8%	-8%	15%	-11%	2%	-2%
	Senaki	-13%	-7%	-15%	4%	-14%	-12%	-10%
	Mestia	8%	-23%	3%	2%	-26%	-16%	-11%
Racha-Lechkhumi and Qv. Svaneti	Ambrolauri	-7%	7%	-14%	13%	-4%	6%	0%
	Shovi	-13%	-13%	-11%	-8%	-17%	-5%	-11%
Imereti	Kutaisi	-9%	8%	-8%	8%	-10%	1%	-3%
	Zestaponi	-4%	-15%	-10%	11%	-14%	7%	-2%
	Sachkhere	-2%	-9%	-2%	16%	-3%	13%	6%
	Sairme	-6%	0%	-9%	8%	-8%	8%	0%
	Mta-Sabueti	12%	-31%	1%	-2%	-28%	-8%	-8%

Side	Point	Month		Season				Year
		I	VII	Winter	Spring	Summer	Autumn	
Samtskhe-Javakheti	Akhaltsikhe	-2%	4%	-11%	1%	-4%	5%	-2%
	Akhalkalaki	55%	21%	23%	9%	-2%	1%	5%
	Borjomi	-7%	-17%	-15%	5%	-21%	5%	-6%
	Bakuriani	15%	-6%	-2%	1%	-10%	-6%	-4%
Shida Kartli	Gori	-12%	-13%	-11%	10%	-10%	0%	-2%
	Khashuri	-18%	-20%	-22%	5%	-13%	-1%	-8%
Kvemo Kartli	Tbilisi	-14%	-5%	-13%	11%	2%	12%	5%
	Bolnisi	-17%	-9%	-12%	4%	-13%	18%	0%
	Tsalka	27%	-27%	-3%	-4%	-13%	-8%	-8%
	Marneuli	-7%	-1%	-12%	3%	-9%	-3%	-4%
Mtskheta-Mtianeti	Dusheti	-12%	-21%	-5%	-5%	-16%	-5%	-9%
	Pasanauri	-9%	-15%	-13%	0%	-7%	3%	-4%
	Tianeti	-22%	-29%	-23%	-27%	-30%	-15%	-25%
	Stepantsminda	-8%	-7%	-6%	3%	1%	8%	2%
	Gudauri	-1%	-3%	-4%	1%	-4%	1%	-1%
Kakheti	Akhmeta	-5%	-17%	-14%	-4%	-20%	-5%	-11%
	Telavi	3%	-12%	-10%	8%	-15%	7%	-2%
	Sagarejo	-17%	-18%	-14%	-1%	-21%	6%	-7%
	Lagodekhi	34%	28%	32%	28%	21%	32%	28%
	Dedoplistskaro	29%	-1%	3%	6%	-19%	12%	-1%
Georgia		-2%	-3%	-7%	5%	-9%	2%	-3%
Western Georgia		-4%	3%	-8%	7%	-7%	1%	-2%
Eastern Georgia		1%	-8%	-7%	3%	-10%	3%	-3%

By month, the increase in precipitation is observed almost everywhere during March and October, averaging up to 15%. In early spring, the rise in precipitation is significantly more pronounced in the western areas, while in October, it is notably evident in the eastern regions of the country. Conversely, a decline in precipitation occurs across all areas during the summer and winter months, with the most significant reductions observed in the west at the onset of winter and in the east towards the end of the winter season. The decrease in precipitation during August is relatively uniform across the country, ranging from 10% to 12%. Between these two periods, the most substantial increase in monthly precipitation totals was recorded in Lagodekhi in December, with a rise of 60%, whereas Upper Svaneti experienced a decrease of 38% in August.

Throughout the annual cycle, the monthly peaks of precipitation have shifted in many regions of Eastern Georgia. In the earlier period, the wettest months were identified as May and June, with December being the wettest in certain areas of Western Georgia. In the most recent period, the highest precipitation in the East again occurs at the end of spring, while in most western regions, the annual peak is now observed in October. In many areas of Western Georgia, May was previously the driest month; currently, the lowest precipitation levels are recorded in the lowland regions during April and May, in mountainous Adjara during the summer months, and in other mountainous areas at the end of winter. In the East, January consistently remains the least wet month throughout the entire period analyzed.

(ii) High intensity precipitation

The characteristics of extreme precipitation, including the frequency of heavy precipitation days, the maximum precipitation recorded over one or more consecutive days, and the contribution of heavy and extremely heavy precipitation days to the annual total, are significant factors in the occurrence and intensification of hazardous natural events. The following trends have been observed:

Similar to the average precipitation levels, the changes in extreme precipitation characteristics exhibit instability and variability across the region, with only a few consistent trends identified. Notably, an increase in the number of days with heavy precipitation (defined as daily totals exceeding 30 or 50 mm) is primarily evident in the Black Sea coastal area (excluding Batumi), the mountainous regions of Adjara and Mtskheta-Mtianeti, as well as Upper Imereti, the southern slopes of the Kakheti Caucasus (Lagodekhi), and Tbilisi. In the second period, the increase in heavy precipitation days ranges from 2 to 4 days in Adjara, the Samegrelo Coast, and Lagodekhi, while other regions experience an increase of 1 to 2 days per year. The observed trends suggest a rise in such occurrences by 0.4 to 1.1 days every decade. Conversely, the most significant decline in heavy precipitation days between the two 30-year periods is noted in the mountainous areas of the Western Caucasus, particularly in Ambrolauri, Shovi, and Mestia.

In the context of maximum precipitation over one and five days, the second 30-year period reveals instances where both metrics were surpassed during specific months across the country. Notably, record levels of precipitation for both daily and five-day maximums were observed at the designated locations during this period. The historical daily maximums from the past 60 years, particularly in the western and eastern regions, were documented post-2000 (Kobuleti: 261 mm, observed on 15/08/2001; Lagodekhi: 210 mm, observed on 21/08/2011). The majority of trends identified for both one- and five-day maximum precipitation exhibit a decreasing pattern. However, annual trends indicate an increase in daily maximums, attributed to heightened precipitation levels in spring and early summer, particularly in the western mountainous region of Adjara (Khulo, 3 mm/10 years) and in the eastern region of Kvemo Kartli (Tbilisi, 2 mm/10 years). The most significant increase in five-day precipitation is consistently noted on the southern slopes of the Kakheti Caucasus (Lagodekhi, 6 mm/10 years).

TABLE 4.6. CHANGES IN SOME CLIMATE INDICES (INDICES ARE GIVEN IN THE APPENDIX) BETWEEN TWO THIRTY-YEAR PERIODS (1961–1990 AND 1991–2020)

Side	Point	cdd	cwd	r95p	r95ptot	r99p	r99ptot	SDII	cddcold18	csdi	gddgrow10	gsl	hddheat18	wsdi	HWN	HWD	CWN	CWD
Adjara	Batumi	-6	3	-63	-0.5	32	2.1	-2.0	170	-1.9	199	1.4	-79	17.6	2.8	28	-0.6	5
	Kobuleti	-2	1	220	6.0	142	4.7	2.4	197	-0.6	268	3.0	-117	27.0	3.5	23	-0.2	4
	Keda	-3	1	16	1.5	8	0.7	-0.7	188	-0.7	218	13.6	-128	14.6	2.5	21	-1.3	1
	Khulo	-13	-11	71	3.1	53	3.3	0.7	70	0.1	116	4.2	-56	4.8	0.8	12	-0.1	-6
Guria	Lanchkhuti	4	4	-148	-6.4	-52	-2.4	-1.4	136	-1.2	146	5.8	-61	13.1	1.6	17	-0.7	-4
	Chokhatauri	1	-2	-79	-1.8	-38	-1.3	-0.4	199	-0.7	255	1.9	-123	13.7	3.2	19	-0.5	6
	Ozurgeti	1	3	-150	-7.7	-17	-1.0	-1.9	164	1.0	158	5.8	-74	14.0	2.1	31	-1.5	22
Samegrelo-Zemo Svaneti	Poti	-14	3	109	1.8	104	3.3	1.1	268	-1.4	385	6.3	-210	32.0	3.2	30	-0.9	4
	Zugdidi	-10	-5	-6	0.1	-17	-0.4	0.3	231	-1.3	317	4.0	-142	12.6	2.4	19	-0.8	-5
	Senaki	-6	-2	-126	-6.1	-60	-2.7	-1.3	177	-3.8	226	2.7	-95	11.7	1.9	12	-0.3	11
	Mestia	3	-1	-108	-11.1	-43	-4.4	-1.5	45	2.5	156	5.5	-272	13.1	2.4	8	-1.0	-13
Racha-Lechkhumi and Svaneti	Ambrolauri	1	-4	33	3.3	22	1.9	0.1	115	1.6	160	5.3	-117	12.3	1.4	17	-0.5	-5
	Shovi	-2	1	-59	-3.6	-7	0.0	-0.1	65	1.8	233	9.7	-273	22.2	3.3	29	-0.7	16
Imereti	Kutaisi	8	18	40	4.4	9	1.1	0.2	187	-1.7	238	-0.5	-88	6.4	2.0	18	0.0	10
	Zestaponi	0	-2	2	-0.2	5	0.0	0.3	198	-2.6	243	0.4	-89	7.7	1.5	16	-0.5	-7
	Sachkhere	-9	-1	18	0.9	23	1.8	0.0	207	1.0	274	5.2	-182	10.6	2.2	18	-0.9	-1
	Sairme	-3	-1	-48	-5.4	-14	-2.2	-0.3	107	0.8	262	20.4	-308	15.8	2.1	88	-1.0	6
	Mta-Sabueti	-9	-1	-110	-7.5	-48	-3.3	-0.5	46	-1.2	153	1.8	-167	11.6	1.7	8	-0.2	-5
Samtskhe-Javakheti	Akhaltsikhe	2	-3	-6	-0.2	-1	0.3	0.0	128	-1.6	215	10.6	-235	14.4	2.5	15	-0.4	-4
	Akhalkalaki	-5	0	17	1.7	6	1.0	0.5	20	1.2	130	2.5	-216	14.9	1.4	2	-0.4	-5
	Borjomi	-4	0	10	2.8	-7	-0.7	0.2	147	2.3	256	9.8	-210	20.0	2.4	18	-0.9	2
	Bakuriani	-11	-1	3	1.4	-9	-0.9	0.0	35	0.2	244	11.7	-507	30.1	3.6	14	-0.6	-12
Shida Kartli	Gori	-1	2	2	1.4	3	1.0	0.1	111	-0.2	146	7.2	-141	19.1	1.5	4	-0.8	-12
	Khashuri	-5	-2	-15	-0.7	7	1.7	0.1	178	-0.8	261	11.2	-215	21.6	2.6	25	-0.7	-12

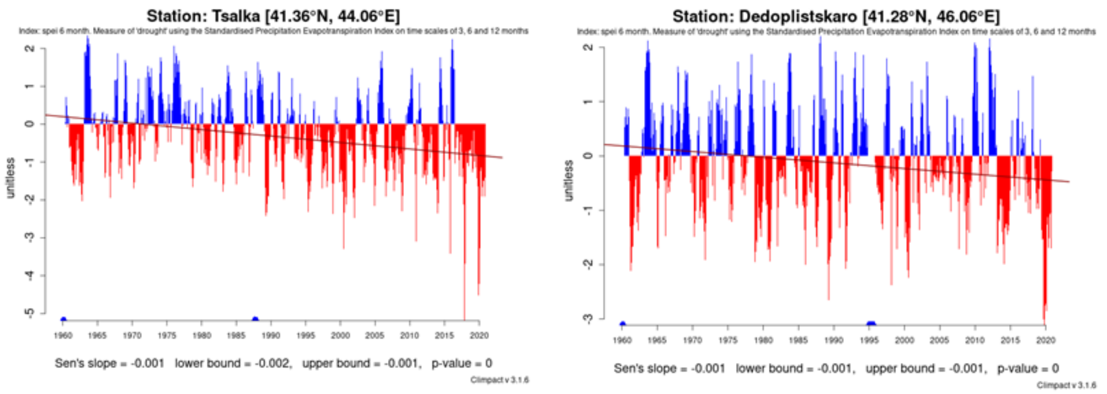
Side	Point	cdd	cwd	r95p	r95ptot	r99p	r99ptot	SDII	cddcold18	csdi	gddgrow10	gsl	hddheat18	wsdi	HWN	HWD	CWN	CWD
Kvemo Kartli	Tbilisi	-7	-2	4	0.7	9	2.3	0.4	146	-0.7	181	9.8	-108	13.8	1.5	19	-0.2	-8
	Bolnisi	0	0	-11	-1.1	-5	-0.4	0.1	168	0.0	208	-7.7	-122	17.5	2.0	19	-0.5	-6
	Tsalka	-14	0	-35	-3.8	-11	-1.2	-0.3	19	0.2	139	2.4	-235	13.3	1.6	5	-0.6	-6
	Marneuli	-29	-3	-12	-2.0	7	2.3	-0.4	163	-2.9	213	-3.7	-117	10.6	2.4	15	-0.2	-6
Mtskheta-Mtianeti	Dusheti	1	3	-150	-7.7	-17	-1.0	-1.9	164	1.0	158	1.7	-74	14.0	2.1	31	-1.5	22
	Pasanauri	-2	4	-15	-0.8	-1	-0.1	-0.4	69	1.1	143	5.7	-139	11.8	1.4	21	-0.6	1
	Tianeti	11	-1	-84	-6.9	-26	-2.4	-0.7	96	1.7	188	1.3	-138	10.7	1.8	20	-0.3	-7
	Stepantsminda	7	-1	88	8.4	43	4.5	0.8	19	1.1	151	6.2	-334	8.0	1.2	2	-0.6	-2
	Gudauri	14	1	86	6.2	56	3.8	0.4	5	3.9	128	4.6	-264	24.5	2.0	37	-0.1	24
Kakheti	Akhmeta	-8	2	-89	-9.8	-37	-4.2	-1.2	126	1.7	151	-0.4	-97	16.3	0.7	5	-0.7	-4
	Telavi	2	0	3	1.5	-3	-0.4	-0.1	141	1.1	189	-1.4	-123	15.2	1.2	6	-0.5	-4
	Sagarejo	2	-2	-45	-3.6	-18	-2.1	-0.1	104	0.2	159	1.6	-143	8.7	1.3	13	-0.8	-13
	Lagodekhi	16	-4	161	7.1	47	1.9	4.4	184	-2.0	240	1.2	-157	15.7	2.2	22	-0.4	-5
	Dedoplistskaro	6	0	-8	-1.3	-1	-0.1	0.2	209	-1.1	284	6.4	-178	24.7	2.6	33	-0.5	-13

- Maximum peaks will be evident across nearly the entire territory during the summer months, while five-day maxima will predominantly occur in the western regions during autumn.
- The alterations in the characteristics of extreme precipitation suggest that nearly all areas are experiencing an upward trend in precipitation, primarily attributed to an increase in the frequency of heavy rainfall events. Notably, along the coast of Adjara and in Mtskheta-Mtianeti, the share of heavy precipitation in the annual total has risen by 6-8%, with extremely heavy precipitation contributing an additional 3-5%. This quantitatively translates to an increase of 100-200 mm in heavy precipitation and 40-140 mm in extreme precipitation. Significant trends indicating a rise in the proportion of heavy precipitation relative to total precipitation have been observed exclusively in high mountainous regions, such as Khulo and Stepantsminda, where the increase is measured at a rate of 20-30 mm per decade.

(iii) Precipitation deficit - drought

- In the southern and eastern regions of the country, extreme precipitation indices suggest that, although there is a noticeable change in the annual precipitation totals, the frequency of dry spells is increasing in nearly all areas, particularly in Kvemo Kartli, Mtskheta-Mtianeti, and to some extent in Kakheti. Nevertheless, many of the observed trends regarding this parameter lack statistical reliability and are not substantiated by consistent patterns. Only Tianeti and Gudauri have upward trends in the maximum duration of dry spells identified, with Tianeti experiencing an increase of 1.9 days per decade. Furthermore, in light of the detected warming, the rise in temperatures and, consequently, the increase in evaporation contribute to what is termed a negative climate balance. This situation has led to a more frequent occurrence of droughts and significant precipitation deficits in the aforementioned regions, particularly during the summer months, when a notable decline in precipitation is recorded
- Concurrently, in the southern slopes of the Kakheti Caucasus (Lagodekhi) and the high-altitude areas of Mtskheta-Mtianeti (Gudauri, Stepantsminda), as well as in Kvemo Kartli (Tbilisi), there has been an uptick in the frequency of heavy precipitation events. This trend indicates a likely increase in the occurrence of both droughts and floods, along with other hazardous natural phenomena in these areas..

FIGURE 4.2.12. DYNAMICS OF DROUGHT INDICES ON A 6-MONTH TIME SCALE IN 1961-2020 (TSALKA, DEDOPLISTSKARO)



(iv) Air humidity - relative humidity and daily and seasonal cycles of humidity

Over the past six decades, there has been a notable increase in relative air humidity across most regions of the territory. On average, the annual variation in values between two 30-year periods is +1 [-3 to +10]%. This rise in humidity appears to be primarily attributed to significant increases during the winter and spring months, particularly in January and February, when positive trends were recorded nearly nationwide. The most pronounced increase in humidity was observed in the western region during December, specifically in Poti (2.2% per decade), while in the eastern region, the most significant rise occurred in November, particularly in Akhalkalaki (2.8% per decade). The annual trends are statistically significant, with the most substantial changes occurring in the mountainous areas of Adjara, as well as in the lowland regions of Samegrelo, Samtskhe-Javakheti, and Shida Kartli.

Conversely, during the summer and early autumn months, a majority of the notable downward trends were identified. During this period, a decrease in humidity is evident across most of the territory, with the exception of the lowland areas of Samegrelo and the East Georgian Plain. The most significant negative deviations (ranging from 3-5%) were recorded in Upper Imereti and the elevated zones of Mtskheta-Mtianeti. These declining trends are prevalent throughout the country, particularly intense in August, where the decrease is estimated at 1.5-2% per decade.

Monthly observations indicate that the highest increases in humidity (up to 10-12%) occur in January, while the most frequent instances of decreasing humidity are noted in August, with the largest negative deviations reaching up to 7-10%.

Changes are also evident in the intra annual cycle. Specifically, during the second 30-year period, the driest months are more pronounced, with April being the driest in the west and August in the east. Regarding the seasons with the highest humidity, while the first period saw summer as the peak in the west and late autumn to early winter in the east, the current trend indicates that the highest humidity levels are now predominantly recorded in December and partially in January across most regions. An exception to this pattern is found in the Guria-Samegrelo areas situated on the Colchis Plain, where the peak humidity throughout the entire period occurs in July and August.

(v) Humidity extremes - humid and dry days

To evaluate the changes in extreme humidity values, the frequency of humid (midday relative humidity ≥80%) and dry (minimum relative humidity ≤30%) days was analyzed.

The data indicates an increase in the number of humid days across most regions of Georgia over the two examined 30-year periods. Furthermore, these upward trends are generally consistent and corroborated by annual values and seasonal transitions. The most pronounced rise in humid days is observed in the western part of the country, particularly in Poti and Adjara (excluding Batumi), as well as in the eastern region of Samtskhe-Javakheti. During the two periods, Poti experienced the largest annual increase, reaching up to 70 additional humid days, while other areas saw increases that did not exceed 10-15 days. The most significant rise occurred in August in Poti, with an increase of 9 days, while the largest decline was noted in November in Mestia, with a reduction of 4 days. The overall increase in humid days is the most prominent in June, whereas the decrease is observed in August.

No substantial alterations are noted in the annual cycle. In both the initial and subsequent 30-year periods, the peak number of humid days occurs at the onset of winter, specifically in December and partially in January.

Regarding extremely dry days, a decline is evident across nearly the entire territory, primarily attributed to a notable reduction in dry days during the spring season. The average annual decrease between the two periods is approximately 4-5 days. This reduction is the most significant in Imereti and Samtskhe-Javakheti, as well as in Tbilisi, where the occurrence of dry days has diminished by around 20 days. Conversely, an increase in dry days has been recorded mainly during the summer and early autumn months, particularly in the mountainous regions such as Mestia, Ambrolauri, and Pasanauri, where the annual increase ranges from 12 to 14 days, with a summer rise of 5 to 6 days.

There have been notable alterations in the intraannual cycle. In the initial period, the highest number of dry days throughout the year was recorded in April. However, during the subsequent 30-year period, several western regions experienced a shift, with the peak frequency of dry days moving to March, while in the eastern regions, this peak now occurs in August.

The examination of humidity extremes corroborates and elucidates the observed patterns in average relative humidity. Specifically, the rise in humidity during the spring season can be attributed to a reduction in the frequency of dry days, particularly in the central regions of the country. Conversely, the increase in humidity during January and February is linked to a rise in the occurrence of wet days during these months, a trend that is notably more pronounced in western Georgia..

Wind

(i) Average wind speed - wind regime and diurnal and seasonal wind cycles

The average annual wind speed across the country has experienced a decline of 0.6 m/s, shifting from -1.3 to +0.4 m/s, over the two 30-year periods. Monthly fluctuations range from -2.3 to +2.7 m/s, with the most significant negative deviation recorded in Poti, while Mestia and Tbilisi have shown positive increases. Furthermore, the trend in wind speed for nearly all monitored stations indicates a consistent decrease in both annual and monthly, as well as seasonal measurements. Notably, a few stations exhibit sporadic positive trends, where average wind speeds increase, particularly during certain seasons, with Tbilisi showing the most instances of such trends, especially in winter and summer. The most pronounced decline in average wind speed has been observed in Poti, Kutaisi, and Gori, where speeds decrease by 0.4 m/s every decade. The rate of decline is the most significant in the western regions during winter (February) and in the eastern regions during spring (March). Among the locations assessed, the highest wind speeds continue to be recorded along the Black Sea coast of Adjara (3-4 m/s) and in the eastern section of the Kolkheti lowland extending to the western slopes of the Likhi ridge (5-6 m/s).

Changes in the intra annual cycle are also evident. In the first 30-year period, the average wind speed was generally highest in the west at the end of winter (February) and in the east at the onset of spring (March-April). However, in the subsequent period, March emerged as the windiest month across most regions. Additionally, the least windy month in the eastern part of the country has been identified as December, marking a shift in wind patterns.

(ii) Strong winds - episodic strong winds, gusts of wind

To assess the frequency of strong winds within the country, the criteria of strong wind days (defined as maximum wind speeds of 15 m/s or greater) and wind gusts (the daily maximum wind speed) were utilized. Wind gust data has been recorded since 1970, allowing for the analysis of trends from 1970 to 2020, while the number of strong wind days was compared between the periods of 1970-1990 and 1990-2020.

The distribution of strong wind days (≥15 m/s) exhibits significant variation across the country. The most notable decrease in the frequency of these days occurs in the central region, particularly on the western slopes of the Likhi Range (Mt. Sabueti) and in Samtskhe-Javakheti, where occurrences diminish throughout the year, especially during the autumn and winter months (averaging 2-4 days per month). Conversely, an increase in the frequency of strong wind days has been recorded along the Black Sea coast (Kobuleti, Poti) and in the eastern Mtkvari Gorge (Gori, Tbilisi), where such occurrences have risen across all seasons, with the most significant increase noted in spring (averaging 6-10 days per season).

Regarding maximum wind speeds, a prevailing trend of decline is observed across the territory for annual values, likely attributed to a reduction in the intensity of wind gusts during winter and spring in western Georgia, as well as in summer in the eastern regions. Persistent downward trends are evident for both annual and most seasonal maxima in the central part of the country, particularly in the middle mountainous areas of Mtskheta-Mtianeti and the high mountainous region of Adjara. Additionally, certain areas (Kobuleti, Gori, Telavi) have experienced an increase in maximum wind speeds throughout the year, with the most significant rate of change recorded at 2 m/s per decade in Telavi during March. The intensity of gusts has also shown an upward trend in Samegrelo-Zemo Svaneti, although this is primarily noticeable in specific months (August, November). Overall, the increase in wind gust intensity is particularly prominent in late autumn, especially in November.

In the annual cycle, wind speeds throughout the entire period analyzed peak in early spring (March-April). While the lowest intensity of wind gusts was recorded in the west during August and in the east during July in the initial period, August has emerged as the month with the lowest gust intensity across most regions in the latter period. Additionally, the highest frequency of strong wind days is noted in the second 30-year period, predominantly in spring, particularly in March.

It appears that alongside a reduction in average wind speed, there is a corresponding decline in the intensity of wind gusts across the majority of the country's regions, with a decrease in the number of strong wind days observed in several areas. Nevertheless, contrasting trends have also been detected, most notably the significant rise in the frequency of such days within the intermountain region of the country (Poti-Kutaisi-Gori-Tbilisi).

4.2.4. LOW PROBABILITY HIGH IMPACT EVENTS

Threshold values play a significant role in various fields such as hydrology, wind engineering, the insurance sector, and risk assessment within financial markets. For instance, severe river floods are frequently triggered by extreme precipitation events that may occur after a waiting period of several decades or even centuries. Consequently, the effective design of flood protection measures depends on accurate estimations of these critical threshold values.[203]

Low probability precipitation extremes were analyzed by calculating the 1- and 5-day precipitation maxima anticipated to occur once every 20, 50, and 100 years, with changes assessed relative to the baseline period of 1961-1990.

The results of the analysis indicated that daily precipitation maxima at various return periods (1%, 2%, 5%) exhibited upward trends in regions such as Adjara (Kobuleti, Keda), Zemo Imereti, Shida Kartli, the high mountainous areas of Mtskheta-Mtianeti, and most parts of Kakheti, with increases reaching between 80 and 100 mm. Conversely, the most significant decreases were observed in Kvemo Kartli (Tbilisi, Bolnisi) as illustrated in Figure 4.2.13.

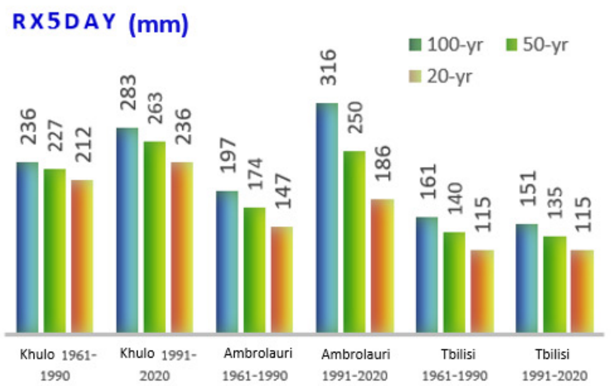
Regarding the 5-day maxima, the increases are more widespread compared to the daily maxima, with increments ranging from 150 to 200 mm. Notably, in most mountainous regions (excluding Samtskhe-Javakheti), areas adjacent to the Likhi Range, and much of Kakheti, an increase of up to 50% in the 5-day maxima values expected once every 20 years is projected, while the maxima for the 100-year return period may nearly double. The percentage decreases for the 5-day maxima are approximately 10% lower than those for the daily maxima.

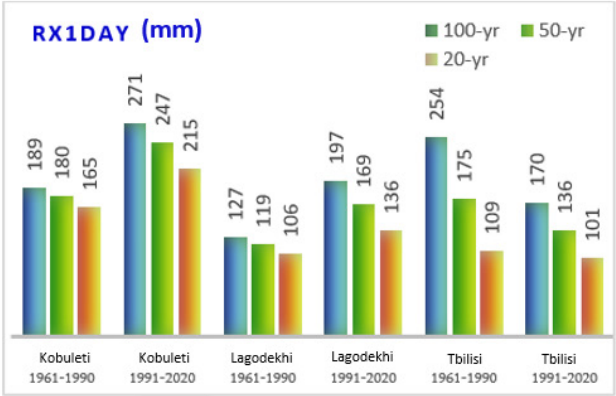
Furthermore, an increase in the frequency of heavy precipitation events is anticipated even in regions where total precipitation trends are observed, such as Kvemo Kartli, Mtskheta-Mtianeti, and certain areas of Kakheti, in addition to the high mountainous regions of Zemo Svaneti.

The trend of heightened extreme precipitation intensifies with an extended waiting period, indicating that the precipitation levels observed between two periods for a 100-year waiting period (1% assurance) are roughly 15-20% greater than those for a 20-year waiting period (5% assurance).

203 The analysis of extreme values is carried out by fitting the annual extreme value series for each station to Generalized Extreme Value (GEV) distribution curves using the Maximum Likelihood Estimation (MLE) method. To assess the compatibility of the empirical distributions of annual extremes with the GEV distribution, various goodness-of-fit (GOF) tests (e.g., PP and QQ plots) are used. The P-year return level is defined as the value that exceeds the annual extreme value at least once in P years. A 100-year return period corresponds to a 1% (1/100) probability level.

FIGURE 4.2.13. CHANGES IN DAILY PRECIPITATION AMOUNTS FOR DIFFERENT (20-, 50- AND 100-YEAR) WAITING PERIODS





(ii) Low probability of warm temperature extremes

The occurrence of extreme temperature events significantly affects both society and ecosystems. Projections for annual absolute maximum air temperatures, anticipated to occur once every 20, 50, and 100 years, have been calculated, and their variations from the baseline period of 1961-1990 have been assessed.

Throughout the nation, nearly all analyzed locations show an increase in temperature maximums across all specified waiting periods, indicating a reduction in the duration of these waiting periods alongside an increase in temperature provision. The sole exception is the coastal region of Adjara, where absolute maximum temperatures are expected to decrease by approximately 1°C. In the remaining areas, the increases for the 20-year waiting period average 1.9°C (ranging from 0.6 to 4.5°C), with the most significant rises observed in the mountainous regions of Racha-Lechkhumi and Mtskheta-Mtianeti (Shovi, Tianeti).

Similar to the trends observed in precipitation extremes, the intensity of warm temperature extremes escalates with longer waiting periods. The increments between the two periods for the 100-year waiting period (with a 1% probability) are estimated to be about 0.5-1°C higher than those for the 20-year waiting period (with a 5% probability). Consequently, the increments for the 100-year waiting period are projected to be 2.4°C (ranging from 0.1 to 7.1°C), with the most pronounced increases again occurring in the mountainous regions of Racha-Lechkhumi and Mtskheta-Mtianeti (Shovi, Tianeti).

It is also important to highlight that a slight cooling of warm extremes is anticipated in the coastal areas of the country, while warming is expected to be more pronounced in the mountainous regions).

Recent analyses indicate a heightened likelihood of experiencing warm extremes in comparison to historical data. Specifically, during the initial period (1961-1990), the maximum temperature in the region fluctuated between 25-41°C with a 5% certainty. In contrast, the subsequent period (1991-2020) anticipates annual maximum temperatures ranging from 28-43°C, expected to occur once every 20 years, which aligns with the 1% certainty observed in the first period (a 100-year return interval). For the latter period, the maximum temperature at the 1% certainty level is projected to reach between 30-46°C, contingent upon the geographical location.

(iii) Low probability of cold temperature extremes

The annual absolute minimum air temperatures, anticipated to occur once every 20, 50, and 100 years, have been calculated, and their variations in relation to the baseline period of 1961-1990 have been assessed.

Regarding the absolute maximum temperatures, it has been observed that across the nation, nearly all examined locations show a warming trend in the temperature minimums associated with all specified waiting periods, indicating an increase in the duration of these periods while the provision diminishes. Notably, the mountainous areas of Adjara and Mtskheta-Mtianeti exhibit a slight decrease in absolute minimum temperatures, with reductions of up to 0.5°C. In contrast, the remaining regions experience increases for the 20-year waiting period averaging 2.0°C (ranging from -0.2 to +5.2°C), with the most significant rises occurring in the lowland areas of Guria-Samegrelo and the southeastern part of the country.

Similar to the absolute maximums, the intensity of cold temperature extremes escalates with longer waiting periods. The increments observed between the two periods for a 100-year waiting period (with a 1% probability) are approximately 0.5-1°C greater than those for a 20-year waiting period (with a 5% probability). Consequently, the increments for the 100-year waiting period are recorded at 2.8°C (ranging from -0.4 to +8.7°C), with the most pronounced increases again found in the lowland regions of Guria-Samegrelo and the southeastern part of the country.

FIGURE 4.2.14. CHANGES IN TEMPERATURE EXTREMES - TXX - MAXIMA FOR DIFFERENT (20-, 50- AND 100-YEAR) WAITING PERIODS

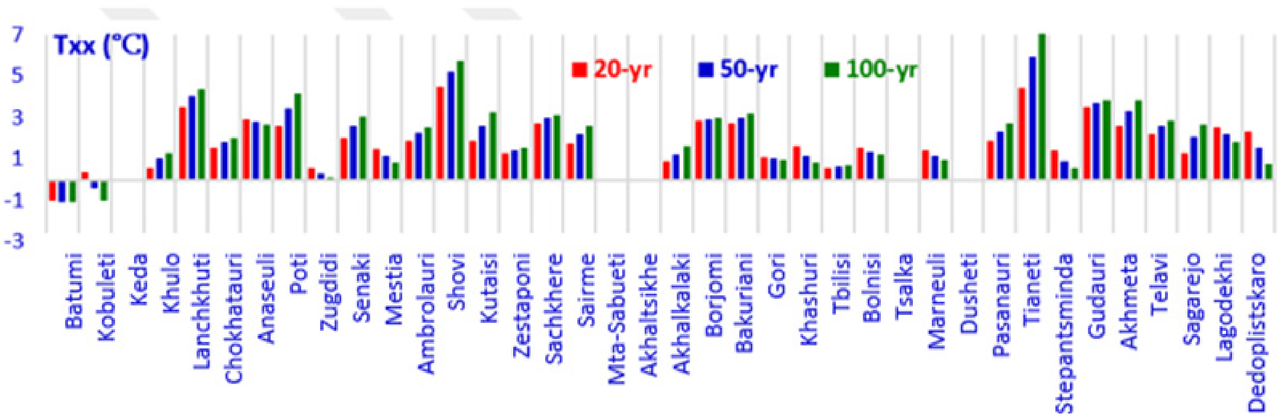
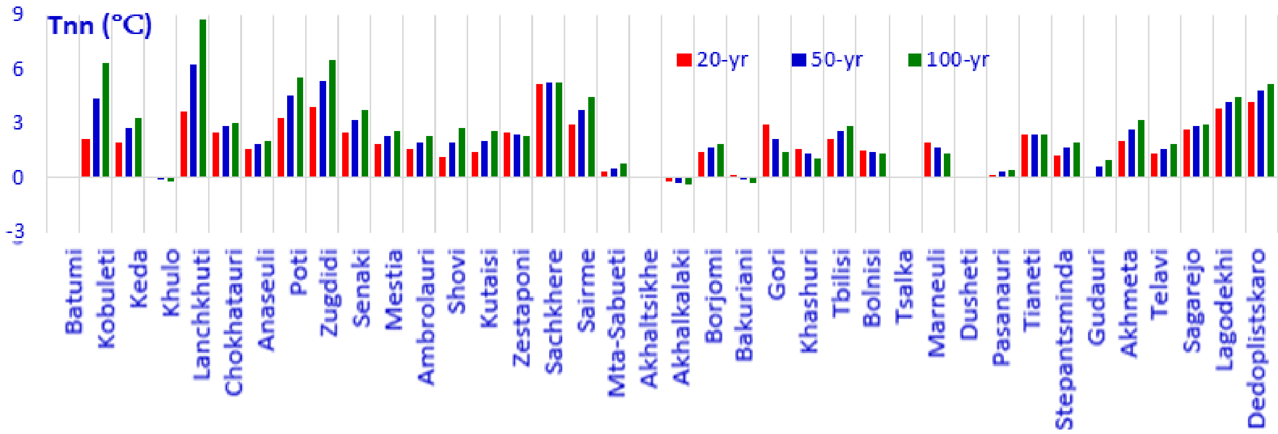


FIGURE 4.2.15. CHANGES IN MINIMUM TEMPERATURE EXTREMES - TNN - FOR DIFFERENT (20-, 50- AND 100-YEAR) WAITING PERIODS



It is important to highlight that a minor reduction in cold extremes is anticipated in mountainous regions (Fig. 4.2.14), whereas an increase in temperatures is expected in the lowlands and plains of the nation (Fig. 4.2.15).

Recent data indicates a diminished likelihood of cold extremes occurring when compared to earlier periods. Specifically, during the first period (1961-1990), the temperature minima within the region were observed to range from -(7-33)°C with a 2% probability. In contrast, during the second period (1991-2020), it is projected that annual minima will range from -(6-32)°C, which is expected to occur once every 50 years, aligning with the 5% probability observed in the first period (20-year waiting period). Furthermore, recent findings suggest that, on a centennial scale (1% probability), absolute temperature minima in the western part of the country may reach -26°C, while in the eastern region, they could drop to -33°C..

(iv) Low probability of strong winds

The anticipated maximum wind speeds for the next 20, 50, and 100 years were computed, and their variations from the baseline period (1961-1990) were assessed using data from ten stations, selected based on data availability and the outcomes of compatibility tests between empirical and theoretical distributions.

The analysis indicates that maximum wind speeds have notably diminished at nearly all the stations examined, with a few exceptions where minor increases were observed.

In conclusion, the investigation into current climate change trends substantiates that the previously noted warming patterns in the country are intensifying and continue to persist in most regions, accompanied by rising air humidity and declining wind speeds. Additionally, alterations in the precipitation patterns have been noted, primarily characterized by a reduction in overall precipitation, although certain areas are experiencing an uptick in the frequency of heavy precipitation days and the intensity of rainfall.

In summary, it can be asserted that the following indicators of climate change are evident within the country and/or its specific regions:

- Increase in surface air temperature;
- Increase in the frequency of hot days and warm nights, decrease in the frequency of cold days and nights;
- Decrease in the number of frosty days and nights;
- Increase in the frequency and duration of warm episodes/heat waves;
- Increase in the probability and magnitude of low-probability warm extremes;
- Decrease in the probability and magnitude of low-probability cold extremes;
- Increase in air humidity (over most of the territory);
- Changes in the precipitation regime;
- Increase in the intensity of precipitation and the share of days with heavy precipitation in the total amount of precipitation (in separate regions);
- Increase in the probability and intensity of low-probability heavy precipitation (in separate regions);

- Increased frequency of windy days and increased intensity of wind gusts (in some regions);
- Increased frequency and severity of droughts (in some regions).

4.3 CLIMATE CHANGE SCENARIOS

4.3.1. IPCC[204] SIXTH ASSESSMENT REPORT (AR6)[205]

After the completion of Georgia's Fourth National Communication, the Intergovernmental Panel on Climate Change (IPCC) released its Sixth Assessment Report (AR6). This report, grounded in over 14,000 scientific studies, presents new insights regarding ongoing alterations in the climate system, potential future changes across various scenarios, as well as strategies and technologies for mitigation and adaptation.

CMIP6[206] Models and "Shared Socio-Economic Scenarios" (SSPs)

These investigations are managed by the working groups of the IPCC through a variety of programs and initiatives. A crucial aspect of evaluating future climate change involves the enhancement of climate models. In this context, the Coupled Model Intercomparison Project Phase 6 (CMIP6)[207] This initiative is spearheaded by the World Climate Research Programme[208] and is aligned with the IPCC Working Group 1 (WG1), which is tasked with providing the scientific foundation for the assessment reports. The outcomes of the Phase 6 models were incorporated into the Sixth Assessment Report (AR6), similar to how the models from Phase 5 were included in the Fifth Assessment Report (AR5). The primary focus of the advancements in the models participating in CMIP6 is to improve the representation of climatic, biological, and chemical processes, as well as large-scale indicators of climate change, while also generating results with higher resolution.

In advance of the preparation of the IPCC AR6, a new array of emission scenarios was created, based on various socio-economic assumptions, referred to as "shared socio-economic scenarios" (SSPs). Several of these SSP scenarios were chosen for implementation in CMIP6 to forecast future climate conditions. Specifically, a selection of scenarios was made to encompass a spectrum of climate change projections by the century's end. The IPCC AR5 utilized four representative concentration pathways (RCPs) that examined different potential future greenhouse gas emissions. These pathways—RCP2.6, RCP4.5, RCP6.0, and RCP8.5—have been updated in CMIP6. The revised scenarios are designated as SSP1-2.6, SSP2-4.5, SSP4-6.0, and SSP5-8.5, each achieving the same radiative forcing by 2100 as their AR5 counterparts.

One of the key objectives of the CMIP6 scenarios is to enhance the understanding of the "no climate policy" framework within potential baseline scenarios. The preceding generation of climate models, represented in CMIP5, featured only a single very high baseline scenario (RCP8.5) and a relatively minor mitigation scenario that influenced the baseline results

204 https://www.ipcc.ch/
205 https://www.ipcc.ch/report/ar6/wg1/
206 https://www.wcrp-climate.org/wgcm-cmip
207 https://www.wcrp-climate.org/wgcm-cmip
208 https://www.wcrp-climate.org/

(RCP6.0). The RCP8.5 scenario is subsequently designated as the sole “no climate policy” baseline scenario, or referred to as “business as usual,” despite its projection of the most severe outcomes among the “no climate policy” scenarios.

While both the SSP and RCP scenarios forecast the same level of forcing on the climate system by the century’s end, the contributions from CO2 and non-CO2 emissions to these scenarios differ.

Several factors contribute to these discrepancies. The new SSP scenarios commence in 2014, whereas the earlier RCPs begin in 2007. The low-end SSP1-2.6 scenario indicates a more gradual decrease in emissions compared to RCP2.6, starting from a higher baseline, which partially reflects the emissions from 2007 to 2014 that were considerably elevated compared to those projected in the original RCP2.6 scenario. Additionally, it incorporates significantly more negative emissions in the latter part of the century to offset the higher initial levels and the slower rate of decline.

Global results

The climate projections for the future, as outlined in report, are derived from the findings of multi-model ensembles.

The observed trends in land surface air temperature indicate a notable increase in warming during the periods of 2041–2060 and 2081–2100 when compared to the baseline of 1995–2014, across all Shared Socioeconomic Pathways (SSP) scenarios. The extent of the area experiencing warming is expected to rise in accordance with the degree of global average temperature increase. As the global mean surface air temperature (GSAT) continues to rise, it is highly probable that the majority of land and ocean regions will exhibit warmer conditions in the mid- to late 21st century relative to the period of 1995–2014, with a high level of confidence in this projection.

The Fifth Assessment Report (AR5) projected that changes in average precipitation resulting from warming will exhibit considerable spatial variability. Furthermore, the disparity in average precipitation between arid and humid regions, as well as between dry and wet seasons, is anticipated to intensify across much of the globe as temperatures escalate. The overarching trend suggests that in high-latitude land areas, an increase in precipitation is likely due to heightened specific humidity in the warmer troposphere, along with enhanced transport of water vapor from tropical regions by the end of this century under the RCP8.5 scenario. Conversely, many mid-latitude and subtropical arid and semi-arid regions are expected to see a reduction in precipitation, while numerous humid mid-latitude areas are projected to experience an increase in precipitation by the century’s end under the same RCP8.5 scenario.

In the same report, the thermodynamic response to global warming is linked to a “wet to wetter” mechanism, where increased moisture fluxes lead to drier conditions in subtropical dry regions and wetter conditions in tropical and mid-latitude wet areas. Recent studies indicate that this mechanism does not apply to subtropical land, revealing inconsistencies among models in this aspect. Additionally, in Arctic regions, a weakening of circulation processes is anticipated, resulting in a shift from wet to dry conditions and vice versa.

Climate models forecast that the intensity and frequency of extreme precipitation events observed globally, as well as in most regions, are comparable to those predicted by the

Coupled Model Intercomparison Project Phase 6 (CMIP6) models, which aligns with the findings of the CMIP5 models (high confidence). An increase in horizontal model resolution enhances the spatial accuracy of certain extreme events, such as heavy precipitation, particularly in areas with diverse topography (high confidence).

Since the Fifth Assessment Report (AR5), the ability to describe and predict extreme weather and climate has improved markedly, as these phenomena have become more comprehensively understood. Climate models effectively identify trends in extreme temperature changes (direction), although the magnitude of these trends may differ (high confidence). Furthermore, models accurately depict the large-scale spatial distribution of extreme precipitation over land (high confidence). There is no discernible difference between the CMIP5 and CMIP6 models regarding the simulation of the intensity and frequency of extreme precipitation (high confidence).

The occurrence and severity of hot extremes are projected to rise, alongside an increase in the frequency of cold extremes, affecting both global and continental scales as well as all populated areas. This trend is expected to persist even if global warming is capped at 1.5°C. In comparison to the present conditions, extreme weather events are anticipated to double with a 2°C increase and quadruple with a 3°C rise relative to a 1.5°C scenario. The incidence of hot days and nights, along with the duration, frequency, and intensity of warm spells or heat waves, is likely to escalate across the majority of terrestrial regions.

Regional results

Multiple methodologies were employed in the 6th Assessment Report to adapt global-scale findings to regional contexts. A significant contribution came from CORDEX data[209] with some of its findings also featured in the 5th Assessment Report. The CORDEX initiative utilized the complete CMIP5 global and regional climate model framework, which downscaled global models to 14 pre-defined regions, thereby encompassing the entire planet. At the project's request, historical and future periods, scales, variables, and results were established and made accessible through the Earth System Grid Federation (ESGF) and the Copernicus Climate Change Service (C3S), ensuring open access. In the AR6, these regional findings were comprehensively gathered and analyzed, acknowledging that enhancements in the global models involved in the project could not directly influence the regional outcomes, as simulations were conducted solely with CMIP5 models. Furthermore, the available datasets for each region were inconsistent. Two strategies were implemented to evaluate climate change at the regional level: grand ensemble modeling and mosaic ensemble modeling.

In each calculation box, all potential simulations are aggregated. In this context, the number of ensemble members at various spatial points (ensemble size) differs across regions within the "grand ensemble" framework. Nonetheless, a significant limitation of this method is that the indication of change in a region is influenced more by the combination of models included in the ensemble (GCM–RCM pair) rather than by the inherent trends within the region itself.

The "mosaic ensemble" is constructed based on the principle that results derived from different regions, contingent upon the calculation areas, exhibit a certain degree of overlap. Particular emphasis was placed on regions where the calculation areas of multiple regions

209 https://cordex.org/

intersect. In the AR6 report, the findings from both methodologies are aligned with the sustainable trends present in the regions.

The geographical area of Georgia is situated at the convergence of three CORDEX calculation regions, which has led to its classification within the West Central Asia (WCA) region.

Based on the analysis of 30 CMIP6 models, it is anticipated that the average annual temperature will rise between 1.6°C and 5.4°C relative to the 1981–2010 average (WCA) under the SSP1-2.6 and SSP5-8.5 scenarios for the timeframe of 2070–2099.

The projected changes in total annual precipitation for the period 2070–2099, when compared to the 1981–2010 period, range from 3% to 29% under the SSP1-2.6 scenario, and from 12% to 107% under the SSP5-8.5 scenario, with a medium level of confidence. It is expected that the decrease in total precipitation within the region will exhibit significant spatial and temporal variability, showing an inclination towards increased precipitation in winter and decreased amounts in summer (medium confidence level).

While the climate projections provided in this report are comprehensive, there are inherent limitations that necessitate further customization and detail to effectively evaluate climate pressures and formulate adaptation strategies in Georgia.

4.3.2. REFINEMENT OF A HIGH-RESOLUTION CLIMATE SCENARIO FOR GEORGIA

To delineate the high-resolution climate scenario for Georgia, an assessment of the results derived from the primary models featured in the AR6 report, which serve as updated climate projections, was conducted. It is important to highlight that data pertaining to the territory of Georgia was accessible through open databases.

In this analysis, three simulations from two CORDEX calculation regions were utilized to construct a comprehensive overview. The scenario in question is also based on rcp4.5, with the global and regional models comprising CMCC-ESM2, CCSM4, ALARO-0, and RegCMv4. The global model and scenario employed in the development of the Fourth National Communication were regarded as the most plausible representation for that timeframe, although recent evaluations suggest that this outcome reflects a relatively lower warming trend concerning temperature variations.

Monthly parameter data were derived from daily gridded datasets. These were categorized into three distinct periods, with the historical timeframe of 1971-2000 utilized for calibration, while two future 30-year periods were selected for averaging. To assess growth, the average of the baseline period was subtracted from the average of the future period.

Trends in the variations of average air temperature and total precipitation were analyzed for the two future 30-year periods (2041-2071 and 2071-2100) in comparison to the average values from 1971-2000.

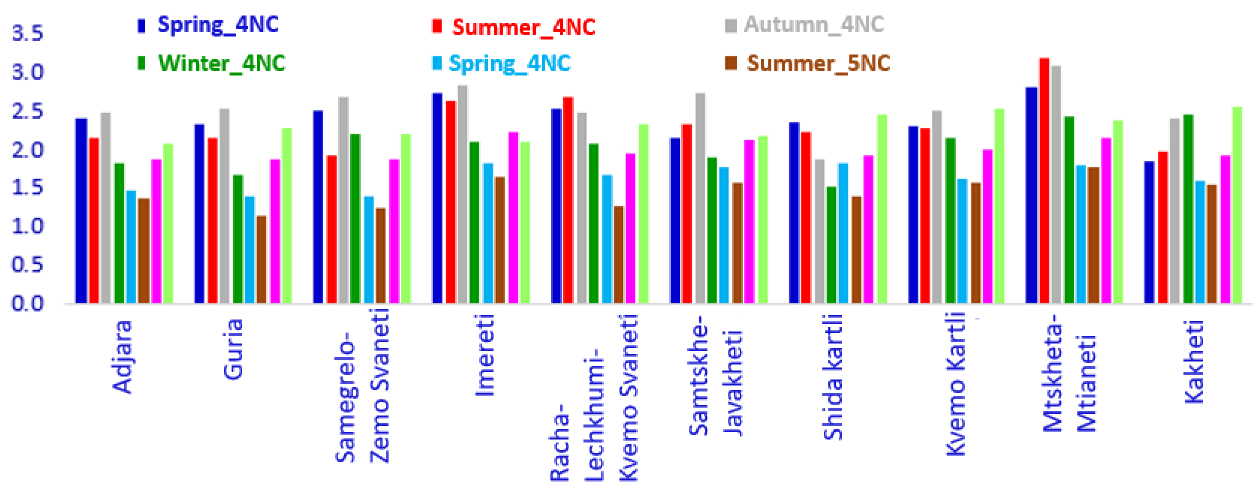
Climate parameters can be accessed at any stage of the calculation process; however, these gridded data have also been converted to point values corresponding to climate stations. This conversion allows for the establishment of a statistical correlation between long-term observations spanning 50 to 60 years and the outcomes of model calculations.

4.3.3. CLIMATE CHANGE PARAMETERS FOR THE PERIOD 2041-2070

The average temperature. The variation in the average surface air temperature across the country during the two examined 30-year periods (2041-2070 and 1971-2000) is detailed in Table 4.7., while the relative changes between the scenarios outlined in the fourth and fifth reports are illustrated in Figure 4.3.1.

According to the new scenario, the increase in the average annual temperature during this timeframe is projected to be between 1.6 and 2.0°C nationwide, which represents a decrease of 0.3°C compared to the previous scenario. The figure indicates that the annual temperature distribution varies significantly by region. Notably, the new scenario predicts the most substantial warming during the winter months, contrasting with the previous scenario where winter experienced the least warming. This change is particularly pronounced in the Kartli region, where winter temperatures are expected to rise by approximately 1 degree. Variations in other seasons are also observed, though they remain within a range of about 0.9°C depending on the specific region.

FIGURE 4.3.1. AVERAGE TEMPERATURE CHANGE IN THE PERIOD 2041-2070 (4NC AND 5NC)



The average monthly temperature across the country experiences an increase ranging from 0.5 to 2.9 degrees Celsius, varying by month. The least amount of warming is observed during the summer months, particularly in June. In eastern Georgia, the rise in temperatures during summer is notably significant, whereas the western regions experience higher temperatures during the winter season. The anticipated warming during the summer months is relatively modest, falling between 1.3 and 1.9 degrees. In autumn, the warming trend is expected to be more pronounced nationwide, with average temperatures exceeding 2 degrees in the majority of the country. However, a smaller increase in temperatures is projected for the areas bordering the Black Sea during this season. As previously noted, the most substantial temperature rise is anticipated in winter, with a comparatively smaller increase expected in the western regions of Georgia, including Adjara, Guria, and Samegrelo-Zemo Svaneti (around 2 degrees). In contrast, a more significant increase, reaching up to 2.5 degrees, is expected in Imereti, Racha-Lechkhumi, Kvemo Svaneti, and Samtskhe-Javakheti. The highest winter temperature increases are projected for Shida Kartli, Kvemo Kartli, and Kakheti, with some stations potentially reaching nearly 3 degrees.

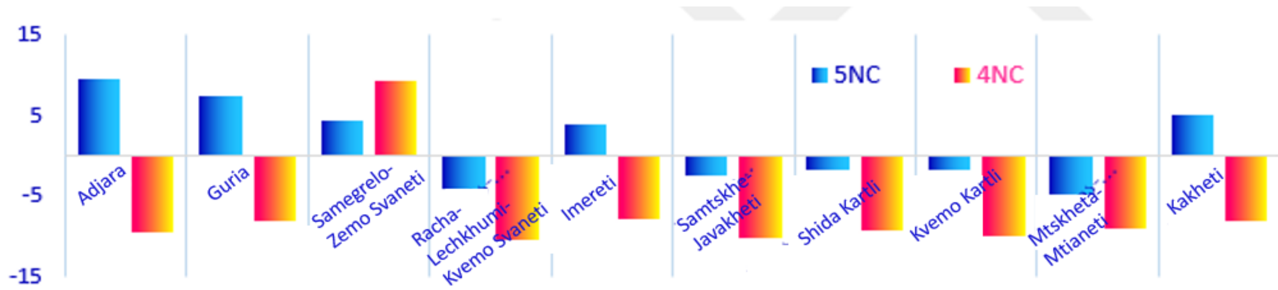
TABLE 4.7. CHANGE IN AVERAGE AIR TEMPERATURE (0C) BETWEEN TWO THIRTY-YEAR PERIODS (1971–2000 AND 2041–2070)

Side	Point	1	2	3	4	5	6	7	8	9	10	11	12	Year
Adjara	Batumi	2.0	2.2	1.2	1.5	1.1	0.7	1.4	1.6	1.8	1.7	1.9	2.1	1.6
	Keda	1.9	2.2	1.3	1.7	1.2	0.5	1.2	1.6	1.8	1.9	2.1	2.3	1.6
	Khulo	1.8	1.9	1.3	2.1	1.7	0.8	2.5	2.0	1.9	1.6	2.1	2.2	1.8
Guria	Lanchkhuti	2.2	2.3	1.3	1.7	1.2	0.6	1.3	1.7	1.8	1.8	2.0	2.3	1.7
	Chokhatauri	2.1	2.4	1.2	1.7	1.3	0.5	1.2	1.6	1.8	1.8	2.1	2.3	1.7
Samegrelo-Zemo Svaneti	Poti	2.1	2.2	1.3	1.6	1.2	1.0	1.5	1.7	1.9	1.8	2.0	2.2	1.7
	Zugdidi	2.1	2.4	1.2	1.7	1.2	0.6	1.3	1.6	1.8	1.8	2.0	2.0	1.6
	Senaki	2.3	2.3	1.3	1.7	1.3	0.6	1.3	1.6	1.8	1.8	2.0	2.3	1.7
Racha-Lechkhumi and kvemo Svaneti	Ambrolauri	1.8	1.9	1.3	2.3	1.7	0.7	1.6	1.8	1.7	2.0	2.4	2.2	1.8
	Shovi	2.1	2.3	1.1	2.0	2.5	1.6	1.9	2.2	2.0	2.4	2.8	2.3	2.1
Imereti	Kutaisi	2.4	2.6	1.5	1.8	1.4	0.5	1.3	1.7	1.8	1.9	2.1	2.5	1.8
	Zestaponi	2.2	2.5	1.7	1.9	1.5	0.5	1.4	1.8	1.8	1.9	2.2	2.6	1.8
	Sachkhere	2.0	2.1	1.6	2.1	1.7	0.6	1.5	1.8	1.7	2.0	2.2	2.4	1.8
	Sairme	1.9	2.2	1.2	1.8	1.6	0.6	1.4	1.8	1.7	2.0	2.2	2.2	1.7
	Mta - Sabueti	2.2	2.4	1.7	2.0	1.6	0.6	1.5	1.8	1.8	1.9	2.2	2.6	1.9
Samtskhe-Javakheti	Akhaltsikhe	1.9	2.0	1.6	2.0	1.7	0.9	1.7	2.0	1.9	2.2	2.3	2.4	1.9
	Akhalkalaki	2.1	2.2	1.4	2.4	2.0	1.4	1.9	2.1	2.1	2.3	2.4	2.4	2.1
	Borjomi	2.0	2.3	1.4	1.9	1.6	0.8	1.6	1.8	1.8	1.9	2.3	2.5	1.8
	Bakuriani	1.9	2.1	1.5	2.1	1.7	1.0	1.7	2.0	1.9	2.1	2.4	2.4	1.9
Shida Kartli	Gori	2.4	2.4	1.7	2.0	1.6	0.8	1.7	1.8	1.6	1.9	2.3	2.7	1.9
	Khashuri	2.3	2.3	1.7	2.3	1.6	0.7	1.6	1.8	1.6	1.9	2.3	2.6	1.9
Kvemo Kartli	Tbilisi	2.6	2.5	1.3	1.8	1.6	1.1	1.8	1.8	1.6	2.0	2.3	2.6	1.9
	Bolnisi	2.6	2.5	1.5	1.8	1.6	1.2	1.7	1.8	1.5	2.0	2.4	2.6	1.9
	Tsalka	2.4	2.4	1.4	2.2	1.6	1.1	1.8	1.8	1.6	2.0	2.6	2.6	2.0
	Marneuli	2.6	2.5	1.3	1.7	1.6	1.1	1.7	1.9	1.6	2.0	2.3	2.5	1.9
Mtskheta-Mtianeti	Pasanauri	2.1	2.3	1.4	2.3	1.7	1.4	1.8	1.9	1.6	2.0	2.6	2.6	2.0
	Tianeti	2.3	2.6	1.6	1.9	1.7	1.2	1.7	1.9	1.4	1.9	2.5	2.7	2.0
	Stepantsminda	2.2	2.2	1.2	2.1	2.2	1.6	1.9	2.2	1.9	2.3	2.7	2.5	2.1
	Gudauri	2.2	2.2	1.2	2.1	2.2	1.6	1.9	2.2	1.9	2.3	2.7	2.5	2.1
Kakheti	Akhmeta	2.4	2.6	1.7	1.9	1.7	1.3	1.7	1.8	1.4	1.9	2.6	2.8	2.0
	Telavi	2.5	2.5	1.4	1.7	1.6	1.1	1.6	1.8	1.3	1.9	2.5	2.7	1.9
	Sagarejo	2.6	2.6	1.3	1.7	1.6	1.1	1.8	1.8	1.5	2.0	2.3	2.6	1.9
	Lagodekhi	2.1	2.4	1.6	1.9	1.7	1.3	1.7	1.8	1.4	1.9	2.6	2.9	1.9
	Dedoplistskaro	2.3	2.7	1.2	1.5	1.5	0.9	1.6	1.8	1.4	1.9	2.3	2.5	1.8

The volume of atmospheric precipitation is analyzed, with the percentage variation in monthly precipitation totals relative to the baseline period presented in Table 4.8. Additionally, Figure 4.3.2 illustrates the difference when compared to the annual precipitation totals from the Fourth National Communication (NC4).

Regarding annual totals, both scenarios fall within the range of predictions made by global models for our region, indicating a potential change of ±5-10%. This scenario suggests that an increase in annual totals is predominantly observed in Western Georgia, excluding the regions of Racha-Lechkhumi and Kveda Svaneti, where a decrease is anticipated in the eastern part of the country, with the exception of Kakheti. Notably, there is significant alignment between these two scenarios; in Eastern Georgia, the annual total is projected to decline by as much as 10%, while the new scenario indicates a decrease of up to 5%.

FIGURE 4.3.2. ANOMALIES OF ANNUAL PRECIPITATION TOTALS (IN PERCENT) RELATIVE TO THE BASE PERIODS (4NC & 5NC)



The variation in precipitation levels throughout the year is more pronounced on a monthly basis. The percentage values indicated in the table reveal that, with certain exceptions, there is a general increase in precipitation during the colder months across nearly the entire region. Notably, in the first four months, the increase is less significant in western Georgia, while the eastern areas, such as Marneuli and Bolnisi, may experience an increase of up to 45%. In May, there is a widespread decline in precipitation, which continues in July and August, although the Kvemo Kartli and Kakheti regions are exceptions, experiencing an increase. Additionally, June sees a rise in precipitation in most parts of western Georgia, contrasted by a decrease in the eastern and southern regions.

TABLE 4.8. CHANGE IN ATMOSPHERIC PRECIPITATION (0C) BETWEEN TWO THIRTY-YEAR PERIODS (1971–2000 AND 2041–2070)

Side	Point	1	2	3	4	5	6	7	8	9	10	11	12	Year
Adjara	Batumi	18.4	11.5	24.3	10	-16.1	53.6	-10.3	-8.7	19.7	1.1	3.7	17.8	10.4
	Keda	9.4	7.3	20.2	7.2	-15.7	17.7	-22.5	-16.3	21.3	2.6	4.5	12.9	4.1
	Khulo	13.9	9.4	22.25	8.6	-15.9	35.65	-16.4	-12.5	20.5	1.85	4.1	15.35	7.2
Guria	Lanchkhuti	22.1	4.9	20.3	10.3	-16.7	23.8	-8.6	4.6	25.6	-3.9	-5.6	11	7.3
	Chokhatauri	11.1	6.6	18.6	9.8	-14.2	8.4	-9.1	-13.2	30.5	0.1	-0.6	10.4	4.9

Side	Point	1	2	3	4	5	6	7	8	9	10	11	12	Year
Samegrelo-Zemo Svaneti	Poti	32.3	8.2	30.9	10.4	-20.8	20.8	-3.4	25.5	17.9	-3.4	-1	14.6	11.0
	Zugdidi	23	15	1.2	2.6	-12.5	-53.5	-34.8	-43.1	4.6	-13.6	-13.1	7.4	-9.7
	Senaki	22.2	4.9	27.5	2.1	-15.3	45.4	0.7	39.9	12.9	-7.4	1.7	14.3	12.4
Racha-Lechkhumi and kvemo Svaneti	Ambrolauri	-1.3	4.2	2	3	-13.4	-10.2	-14.2	20.3	14.8	-2	-3.9	8.7	0.7
	Shovi	-6.6	6.3	-15.2	0.9	-1.5	-28.5	1.2	-29.5	8.4	-14.9	-14.6	2.3	-7.6
Imereti	Kutaisi	15.8	6.3	22.3	2.1	-18.1	42.1	-6.8	21	8.5	-9.2	2.1	13.3	8.3
	Zestaponi	12.7	3.8	20.1	7.7	-20.2	11.3	-26.2	-23.8	35.8	-8	-1.6	11.2	1.9
	Sachkhere	3.8	1.5	10.3	1.2	-15.9	-6.7	-16.7	24.4	10.1	-7.4	0	11.8	1.4
	Sairme	7.4	5.2	14.9	11	-18.1	-12.5	-22.9	-25.4	44.9	-2.8	-4.2	8.1	0.5
	Mta-Sabueti	8	1	19.1	4.1	-15.5	-20.9	-6.1	-22.9	18	-6.2	2.2	12.6	-0.6
Samtskhe-Javakheti	Akhaltsikhe	15	6.2	14.9	8.1	-17.9	-33.1	-10	-39.3	15.9	-4.1	-3.9	6.1	-3.5
	Akhalkalaki	18.2	2.6	12.2	0.7	-21.7	-36.5	-28.9	-50.1	0.1	-5.7	6	7.2	-8.0
	Borjomi	11.4	2.3	17.8	4.9	-20.9	-37	-15.8	-44.8	21.4	3	0.8	10.5	-3.9
	Bakuriani	17.7	3.8	14.4	3.9	-20.5	-41.3	-19.2	-42.4	5.3	-0.1	2.7	7	-5.7
Shida Kartli	Gori	12.9	6.3	7.5	2.5	-15	-46.3	-22.9	-36.2	16.8	-13.2	-7.4	7.6	-7.3
	Khashuri	7	0.1	13.8	4.9	-11.1	-38.3	21.4	-18.2	5.4	-1.5	-1.1	8.5	-0.8
Kvemo Kartli	Tbilisi	40.9	30.8	13.7	20.4	-8.5	-51.7	36.9	12.2	-2.2	-9.6	-8.2	19.7	7.9
	Bolnisi	44.9	26.2	7.1	4.8	-12.4	-47.6	40.1	-2.5	0.6	-12.1	-18.3	16	3.9
	Tsalka	23	15	1.2	2.6	-12.5	-53.5	-34.8	-43.1	4.6	-13.6	-13.1	7.4	-9.7
	Marneuli	45.5	29.4	17.8	16.9	-10.3	-47.1	67.5	72.9	-1.7	-11.2	-10.4	22.2	16.0
Mtskheta-Mtianeti	Pasanauri	9.4	11.8	-7.1	4.7	-2.4	-35.6	-7.8	-25	5.1	-9.8	-15.9	4	-5.7
	Tianeti	17	16.5	0.3	8.9	8.1	-38.7	4.6	-24.7	3.8	0.3	-13.4	7.6	-0.8
	Stepantsminda	12.7	12.3	-7.6	5	-2.7	-25.1	-6.8	-32.3	2.6	-16	-12.8	-3.3	-6.2
	Gudauri	12.7	12.3	-7.6	5	-2.7	-25.1	-6.8	-32.3	2.6	-16	-12.8	-3.3	-6.2
Kakheti	Akhmeta	16.3	11.1	0.4	7.1	7.6	-32.9	27.7	-10.9	0.5	3.4	-13.2	8.4	2.1
	Telavi	24.7	12.8	3.3	18.7	-5.4	-21.5	57.3	22.7	1.8	18.5	-7.6	15.4	11.7
	Sagarejo	42	23.1	17.5	24	-6.2	-35.1	44.4	55.3	-3.2	-1.5	-2.4	24.4	15.2
	Lagodekhi	15.6	5.9	8.1	9.5	6.9	-14.5	-14.1	-18.4	17.9	11.6	7	8.3	3.7
	Dedoplistskaro	37.5	9.7	29.2	13.1	1.8	-19.5	-46.4	-26.8	-5.2	4.2	7.1	30.5	2.9

Considering the alterations in surface air temperature and total precipitation, it can be inferred that winter is likely to be warmer and more humid across nearly the entire country, whereas summer is expected to be hot and comparatively dry. A notable trend of significant temperature rise and reduced precipitation has also been detected in various mountainous areas, including Shovi, Stepantsminda, and Gudauri. Nevertheless, a more comprehensive understanding of the changes in temperature and humidity patterns will emerge from the analysis of the relevant indices.

Future trends in climate indices

In addition to analyzing trends in average air temperature and total precipitation, the study also evaluated variations in specialized sectoral indices derived from maximum and minimum air temperatures, as well as daily precipitation amounts, over two 30-year periods (2041-2071 and 2071-2100) in comparison to the baseline period (1971-2000).

These indices were computed for 38 carefully selected stations across Georgia, which effectively represent the climatic characteristics of the region and align with the country's administrative divisions.

While the indices and key climatic parameters are calculated and examined on a monthly basis for each station, the report primarily focuses on seasonal and annual trends across different regions of Georgia due to the extensive number of stations involved.

The primary objective of calculating these indices is to evaluate the impact of climate change on specific sectors; however, the report also details the changes in these indices based on their principal influencing factors, including maximum and minimum temperatures and total daily precipitation.

The trends in change are presented consistently for both future periods.

Change in sectoral climate indices for the period 2041-2070

An evaluation of the changes in average temperature necessitates a closer look at the daily and seasonal patterns of these variations. This analysis begins with an examination of the average, absolute maximum, and minimum temperatures, as well as the frequency of cold and hot days and their respective proportions.

Over the two analyzed 30-year periods (2041-2070 and 1971-2000), **the annual average maximum and minimum temperatures** in the country have risen by approximately 2 degrees, with regional variations ranging from 1.5 to 2.3 degrees Celsius. The increase in temperature is comparatively less pronounced in the Black Sea region, while it is more significant in Kakheti and Kvemo Kartli. Seasonal changes are illustrated in Figures 4.3.3 and 4.3.4, where the regions of Georgia are numbered from 1 to 10 as follows: Adjara (1), Guria (2), Samegrelo-Zemo Svaneti (3), Racha-Lechkhumi and Kvemo Svaneti (4), Imereti (5), Samtskhe-Javakheti (6), Shida Kartli (7), Kvemo Kartli (8), Mtskheta-Mtianeti (9), and Kakheti (10)..

FIGURE 4.3.3. CHANGE IN AVERAGE MAXIMUM TEMPERATURES (0C) DURING THE PERIOD 2041-2070

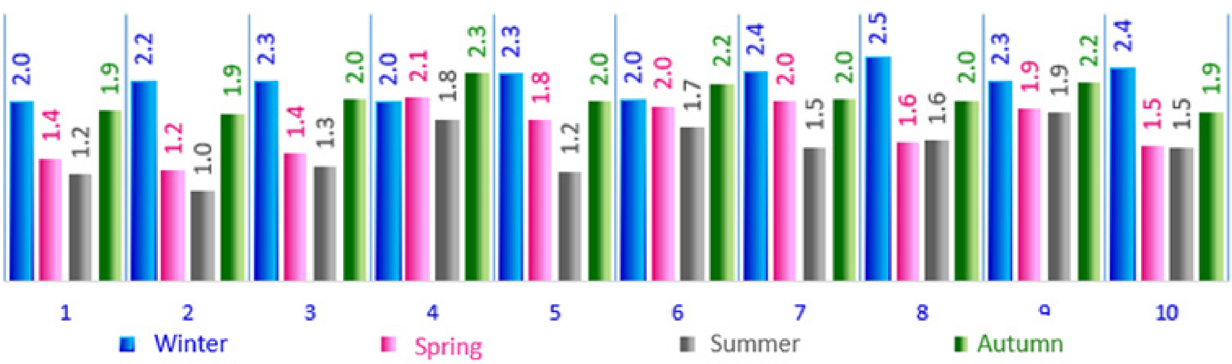
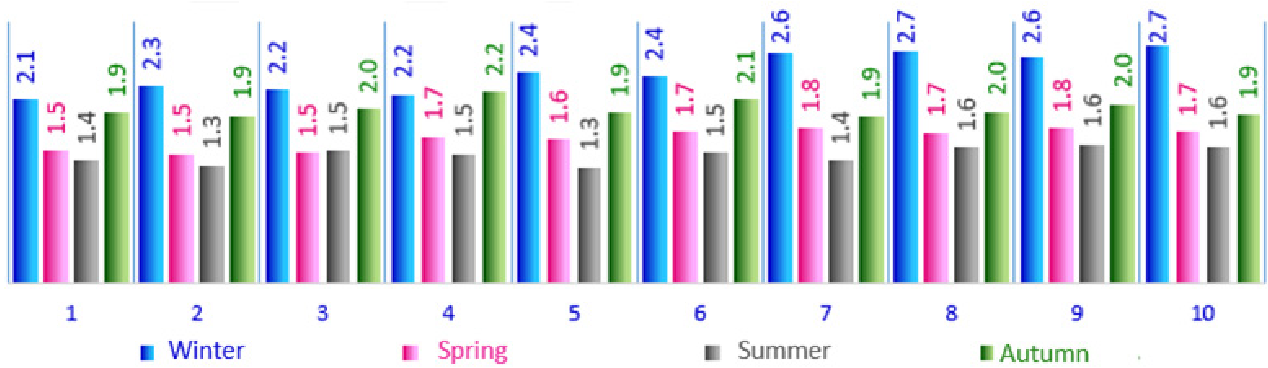


FIGURE 4.3.4. CHANGE IN AVERAGE MINIMUM TEMPERATURES DURING THE PERIOD 2041-2070



The figure illustrates that both temperature metrics experience the most significant increase during winter, with the rise in minimum temperature being notably higher by 0.5°C, particularly in eastern Georgia. Following winter, both parameters continue to warm during the autumn season; however, the maximum temperatures see an average increase of 0.2°C in this period. In contrast, the warming observed in spring and summer is relatively modest. The least increase in maximum temperatures during spring and summer occurs in the Adjara-Guria region, where it rises by 1.2 degrees, while the highest increase is noted in high-altitude areas such as Racha-Lechkhumi, Samtskhe-Javakheti, and Mtskheta-Mtianeti, which experience a rise of 1.8 degrees.

In comparison to their average values, **the absolute maximum and minimum temperatures** exhibit an increase of 11-12 degrees at specific stations, predominantly during the winter months and in mountainous regions. This significant rise in multi-annual extremes suggests that summer maximum temperatures in Western Georgia may reach 50 degrees, while minimum temperatures are expected to decrease (by up to one degree) across most areas. This pattern is particularly evident in January, although it generally applies to the winter months as a whole. The seasonal variations of these parameters are detailed in Table 5.3.3, which clearly demonstrates a wide range of variability in daily maximums and minimums. It is important to reiterate that the figures presented in the table pertain to multi-annual extremes, with regional and seasonal values derived from the selection of the highest and lowest monthly and point-specific temperatures for both maximum and minimum readings.

The least amount of warming is recorded during the peak of the summer season, with temperature increases of up to 2.5 degrees in the Kartli region, while Adjara-Guria experiences a significantly higher rise of 7.5 degrees. The most substantial increases in maximum temperatures occur during the winter and spring months. Conversely, in autumn, the rise in absolute minimum temperatures is more pronounced than that of maximum temperatures. The escalation of extreme temperature values is a critical factor for adaptation; however, the evaluation of the impacts of such changes is of greater significance, which can be further informed by examining variations in other temperature indices.

TABLE 4.9. CHANGE IN ABSOLUTE MAXIMUM AND MINIMUM TEMPERATURES IN THE PERIOD 2041-2070.

Side	Winter		Spring		Summer		Autumn		Year	
	T_{max}	T_{min}	T_{max}	min	T_{max}	min	T_{max}	min	T_{max}	min
Adjara	9.6	3.4	6.3	12.5	7.5	3.0	6.1	7.8	9.6	12.5
Guria	6.6	5.2	9.4	8.0	7.9	3.3	5.5	8.2	9.4	8.2
Samegrelo-Zemo Svaneti	6.6	7.5	9.2	5.8	5.3	6.7	6.9	8.3	9.2	8.3
Racha-Lechkhumi and Kvemo Svaneti	8.6	3.4	7.2	4.7	5.5	3.6	6.8	7.6	8.6	7.6
Imereti	8.8	5.5	7.8	5.7	4.4	2.7	5.9	5.1	8.8	5.7
Samtskhe-Javakheti	8.6	4.4	11.2	6.1	5.1	2.3	5.6	9.6	11.2	9.6
Shida Kartli	9.9	3.7	8.6	4.6	2.5	2.4	5.3	6.5	9.9	6.5
Kvemo Kartli	10.3	5.3	7.0	4.6	2.5	3.2	4.1	6.7	10.3	6.7
Mtskheta-Mtianeti	10.4	7.9	7.7	3.3	4.1	4.0	5.4	8.5	10.4	8.5
Kakheti	7.2	6.3	6.8	4.2	4.3	4.5	5.9	11.4	7.2	11.4

Number of hot and cold days and nights

The assessment of various temperature parameters and indices not only facilitates a clearer understanding of their societal and sectoral impacts but also enhances the diagnosis of the warming process itself. This includes analyzing the conditions under which warming or cooling occurs, the number of days characterized by maximum or minimum temperatures within a specified timeframe, and the sequence of these occurrences.

To begin with, we will evaluate the number of days with daily maximum temperatures of 30°C and above (SU30) and those exceeding 35°C (SU35). The annual count of days with maximum temperatures above 30°C is projected to rise by 11 to 47 days compared to the baseline period, varying by region. The smallest increase is observed in Racha-Lekchkhumi and Kvemo Svaneti, while other areas, particularly Shida Kartli, may see an increase of over 35 days. Days with maximum temperatures exceeding 35°C are expected to rise by 3.3 to 12 days, with the least increase again in Racha-Lekchkhumi and Kvemo Svaneti, and the most significant rise in Adjara.

Seasonal variations in these parameters are noteworthy: during winter, no days with maximum temperatures above 30°C were recorded in any of the analyzed locations during the baseline period. However, forecasts suggest that Imereti, Samegrelo, Guria, and Mtskheta Mtianeti may experience an average of 1.3 days with maximum temperatures exceeding 30°C over the next 30 years. The most substantial increases are anticipated in summer, with an average rise of 2 to 5.5 days per year for SU30, while SU35 is expected to increase by only 3 days over a decade in Racha-Lekchkhumi and Kveda Svaneti, and by 13 days in Adjara. In transitional seasons, the increase in SU30 is nearly double in autumn (4-17 days per decade) compared to spring (1-7 days per decade). For SU35, the occurrence of such days remains minimal, not exceeding single instances in both transitional seasons throughout the entire period.

High minimum temperature indicators play a crucial role in determining the frequency of warm or hot nights. There is a positive annual trend in the occurrence of tropical nights across the country, with an average increase of approximately 50 nights in most regions. However, Samtskhe-Javakheti stands out as an exception, experiencing a minimal rise of only 5 days. Throughout the winter and future seasons, such nights are absent, but their prevalence during the summer months is notably high. In several areas, this increase reaches triple digits. Additionally, during the transitional seasons, the rise in hot nights is more pronounced in spring compared to autumn. Overall, the trend of increasing hot nights is evident across the board, with the exception of winter.

The SU30 and SU35 indices are classified as fixed threshold indices, with thresholds of 30 and 35 degrees, respectively. However, these thresholds do not uniformly apply across different locations in Georgia. Therefore, it is essential to examine percentage indices that reflect the number of the hottest and coldest days specific to each area. The Tx90p and Tn90p indices represent the percentage of days and nights that fall within the hottest 10% (90-100%) of maximum and minimum temperatures, while Tx10p and Tn10p indicate the percentage of days and nights within the coolest 10% (0-10%). During the baseline period, Tx90p and Tn90p indices range from 9% to 12% across all examined stations, with Gudauri recording the highest figure. In the initial forecast period, the annual increase in Tx90p will vary significantly, ranging from 18.5% to 36%, with Guria experiencing the least increase and Mtskheta-Mtianeti the most. Similarly, Tn90p is expected to change within a range of 18.5% to 40% annually, again showing the highest increase in Mtskheta-Mtianeti and the lowest in Shida Kartli.

During the winter and spring seasons, the proportion of high minimum temperatures (Tn90p) rises significantly, ranging from 16% to 57%, surpassing the increase in maximum temperatures, which ranges from 13% to 40%. Conversely, in autumn, this pattern reverses, with maximum temperatures increasing by 22% to 42%, while minimum temperatures rise by only 5% to 20%. In summer, both maximum and minimum temperatures exhibit a roughly proportional increase, averaging between 20% and 40%.

The Tx10p index experiences an annual decline of 7%, whereas the Tn10p index shows an increase of 1% to 4% in regions such as Adjara, Guria, Imereti, and Kvemo Kartli. Similar to the previously mentioned indices, these figures also fall within the range of 9% to 11% annually during the baseline period. Under these circumstances, the percentage of days classified as particularly cold for the respective season will be between 3% and 9%, with nights increasing to 14% in the specified areas.

In winter, both indices decline by approximately 9%. In spring, Tn10p experiences a more pronounced decrease, dropping to 8%, while Tx10p fluctuates between +1.1% and 5.5%. Consequently, in Samegrelo-Zemo Svaneti, Racha Lechkhumi, and Kvemo Svaneti, the number of cold days typical for the season is projected to rise by 1% to 1.3%. Throughout summer and autumn, the frequency of cold days diminishes across all regions, whereas the number of cold nights in spring is expected to increase by up to 9% in Adjara, Guria, Imereti, Samtskhe-Javakheti, and Kvemo Kartli. This increase is particularly pronounced in autumn, affecting nearly the entire country, with Adjara anticipating the highest rise of 15%.

Let us examine the annual indices that are specifically associated with various sectors.

These include heating and cooling degree days (energy), the cumulative active temperatures (agriculture), and the frequency of heat waves (health). The variation in heating and cooling degree days presents a paradoxical trend. During this forecasting period, there will be a need for cooling for an additional 70 to 404 degree days, while the demand for heating will decrease by 85 to 1193 g/day. The cumulative active temperatures are also on the rise across all regions, with a significant increase observed in Mtskheta-Mtianeti, although this index is rising by at least 190 g/day in all areas. Regarding the frequency of heat waves, the maximum annual increase is projected to be between 9 and 10 across all regions. The average increase in this metric is relatively consistent, expected to range from 4.4 to 6.1.

Precipitation-related indices

The previous report addressed the alterations in monthly precipitation totals; however, a significant challenge posed by climate change lies in the temporal distribution of precipitation. In numerous instances, even when annual and seasonal totals remain stable, the maxima for daily, three-day, and five-day periods can increase substantially, while dry spells may extend. This phenomenon is particularly pertinent to the conditions in Georgia, where various hydrometeorological hazards, such as floods, flash floods, mudslides, and landslides, are linked to heightened precipitation intensity.

Throughout the year, all monitored stations exhibit an increase in the maximum precipitation recorded in a single day, with particularly pronounced increases observed in Adjara and Samegrelo-Zemo Svaneti, reaching 75 mm and 79 mm, respectively. Additionally, the maximum precipitation over a five-day period is expected to rise across all regions. In the western Georgia, this increase exceeds 100 mm compared to the annual maximum of the baseline period; however, the frequency of such events is also crucial for risk assessment. Generally, both maxima show seasonal increases, with a few exceptions primarily occurring during the summer and autumn months.

Notably, the five-day winter maximum experiences a significant rise in Racha-Lechkhumi and Kveda Svaneti during the winter season, reaching 141 mm. Furthermore, an increase in the summer maximum is also observed in Samegrelo-Zemo Svaneti, amounting to 79 mm.

The calculation of days with precipitation surpassing 10, 20, 50, and 90 mm has been conducted. The frequency of days with precipitation exceeding 10 and 20 mm remains largely stable in the coastal areas, while it shows a decline in regions such as Imereti, Shida Kartli, and Samtskhe-Javakheti. Conversely, there is an increase during the winter months in Kvemo Kartli and Mtskheta Mtianeti, along with a slight rise in Kakheti, except during the summer season. The pattern for days with precipitation exceeding 50 mm mirrors that of the 10 mm threshold.

Annually, the number of days with precipitation over 50 mm is on the rise solely in Adjara and Samegrelo, although winter months witness an increase across nearly all regions, with the exception of Guria and Rachalechkhumi. Notably, there is a significant rise in the winter and spring months in Adjara, as well as in spring across Western Georgia, which may exacerbate the aforementioned risks. Additionally, a decline in this metric is observed in nearly all areas during spring, a trend that also applies to days with precipitation exceeding 90 mm. While the overall number of such days will increase, the relative frequency will be lower in winter and spring, thereby heightening the risk indicators in Western Georgia. In Eastern Georgia, the frequency of both categories of days remains stable or decreases, with the exception of the winter season.

These precipitation metrics help quantify the percentage of rainy (95%) and extremely rainy (99%) days within the total annual precipitation, along with the corresponding millimeter values. Variations in these four indices provide insight into the increasing intensity and frequency of extreme precipitation events.

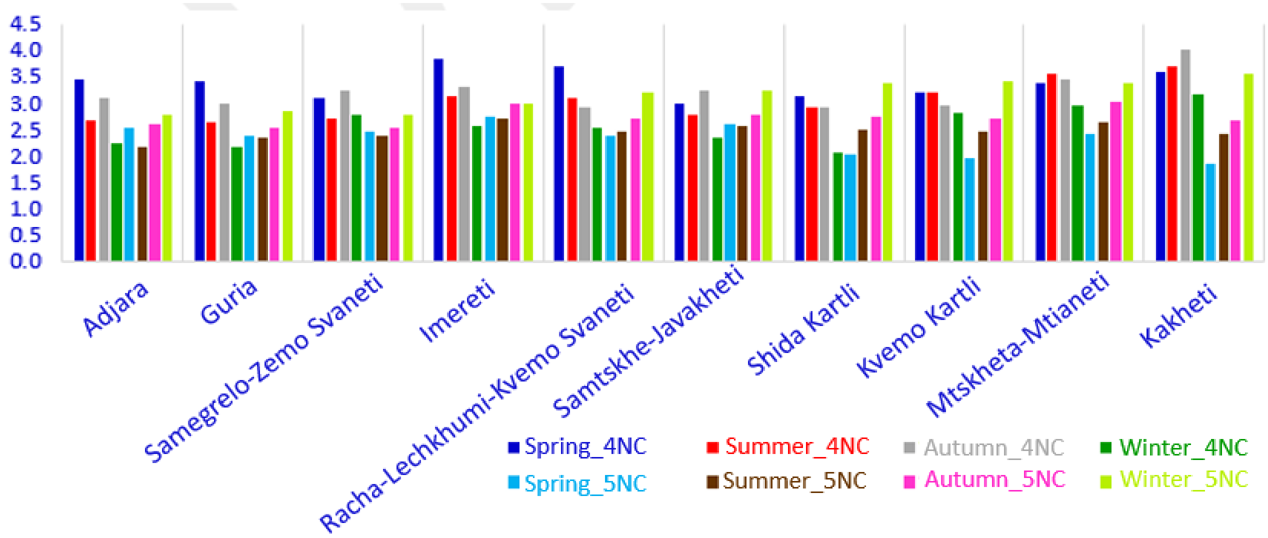
During the baseline period, the proportion of very rainy days (r95ptot) varied between 19% and 23% across the region, while the proportion of extremely rainy days (r99ptot) was around 5%. The volume of precipitation (r95, r99) recorded on these days, however, differs significantly by area. In the initial forecast period, r95ptot is projected to rise by 5% in Western Georgia, with the exception of Racha-Lechkhumi and Kveda Svaneti, where a decrease of 1.3% is anticipated. This increase will correspond to a rise in precipitation amounts from 36 mm to 192 mm. For extremely rainy days, a similar increase is expected in the same region, ranging from 1% to 3%. The associated increase in precipitation amounts will be between 19 mm and 80 mm. Conversely, in Eastern Georgia, all these metrics are expected to decline, with the exception of Kakheti.

4.3.4. CHANGE IN CLIMATE PARAMETERS FOR THE PERIOD 2071-2100

The average temperature. The variation in the average surface air temperature across the country between the two analyzed 30-year periods (2071-2100 and 1971-2000) is detailed in Table 4.10., while the relative changes between the scenarios outlined in the fourth and fifth reports are illustrated in Figure 4.3.5.

According to the new scenario, the increase in the average annual temperature during this timeframe ranges from 2 to 3 degrees Celsius throughout the country, which is approximately 0.3 degrees lower than the previous scenario. The figure indicates that the annual temperature distribution varies significantly by region. Similar to the earlier forecast period, the most substantial seasonal increases are observed in winter, with notable warming also occurring in spring. In the Black Sea regions, winter temperatures rise by 3 degrees Celsius, whereas in other areas, the increase is 3.5 degrees Celsius, often falling 0.6 to 1.3 degrees below the warming projected in the earlier scenario. The difference in spring temperatures is smaller, approximately 1 degree, and in other seasons, the increases are less pronounced than in the previous scenario, not exceeding about 0.7 degrees Celsius depending on the region.

FIGURE 4.3.5. AVERAGE TEMPERATURE CHANGE IN THE PERIOD 2071-2100 FOR 4NC AND 5NC



The monthly variations in average temperature exhibit patterns akin to those observed in the preceding period, with the winter months experiencing the most significant warming. Notably, eastern Georgia is anticipated to witness more pronounced temperature increases, particularly in December. Conversely, the Adjara-Guria and Samegrelo-Zemo Svaneti regions are expected to experience relatively modest temperature rises across nearly all months, except for September, which shows a more considerable increase (averaging 0.5 degrees) compared to Kartli and Kakheti. In July, the temperature rise was recorded at 1.7-2.3 degrees, marking it as the least increase among the months. It is important to highlight that in mountainous areas such as Shovi (4.1°C), Khulo (3.2°C), Akhalkalaki (3.5°C), Stepantsminda (3.6°C), and Gudauri (3.6°C), the temperature in May is projected to rise by 3.2-4 degrees.

TABLE 4.10. AVERAGE AIR TEMPERATURE FOR THE PERIOD 2071–2100 AND THE CHANGE IN AVERAGE TEMPERATURE (°C) BETWEEN THE TWO THIRTY-YEAR INTERVALS (1971–2000 AND 2071–2100).

Side	Point	T_{avg}., change in average air temperature (0 C)													$T_{avg.}$ (0 C), Year
		Month												Year	
		1	2	3	4	5	6	7	8	9	10	11	12		
Adjara	Batumi	3.1	3.4	2.6	1.8	2.1	1.7	2.2	2.1	2.3	2.2	2.5	2.7	2.4	17.2
	Keda	3.0	3.6	3.0	1.8	2.4	1.5	1.9	2.0	2.5	2.3	2.7	2.9	2.5	16.7
	Khulo	2.8	3.1	3.1	2.4	3.2	1.9	3.6	2.4	2.8	2.0	2.6	2.8	2.7	14.0
Guria	Lanchkhuti	3.1	3.2	2.7	1.8	2.3	1.7	2.2	2.2	2.4	2.4	2.5	2.9	2.5	17.4
	Chokhatauri	3.1	3.7	2.9	1.8	2.5	1.6	2.0	2.0	2.4	2.3	2.6	2.8	2.5	16.8

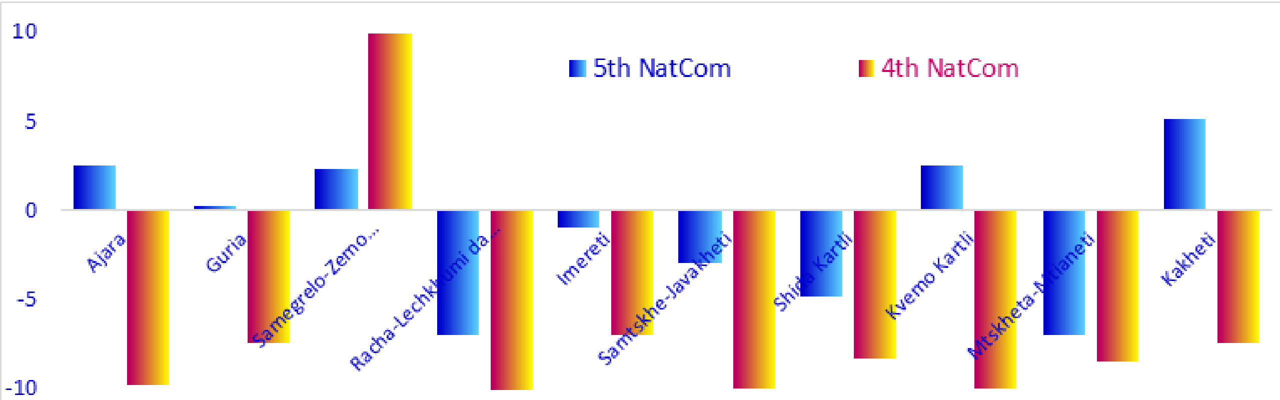
Side	Point	T avg., change in average air temperature (0 C)													T avg. (0 C),
		Month												Year	Year
		1	2	3	4	5	6	7	8	9	10	11	12		
Samegrelo-Zemo Svaneti	Poti	2.9	3.0	2.5	1.9	2.2	2.0	2.4	2.2	2.4	2.4	2.6	2.8	2.4	17.2
	Zugdidi	3.1	3.5	2.7	1.8	2.4	1.6	2.0	2.1	2.5	2.4	2.5	2.7	2.4	16.9
	Senaki	3.1	3.2	2.7	1.8	2.3	1.7	2.1	2.1	2.5	2.4	2.5	2.9	2.4	17.7
Racha-Lechkhumi and Kveda Svaneti	Ambrolauri	2.8	2.9	3.0	2.5	3.1	1.9	2.8	2.4	2.5	2.5	2.8	2.9	2.7	14.8
	Shovi	3.2	3.2	2.5	2.3	4.1	2.3	3.3	3.3	3.0	2.9	3.2	3.1	3.0	9.3
Imereti	Kutaisi	3.4	3.7	3.1	1.9	2.6	1.7	2.2	2.0	2.5	2.5	2.6	3.2	2.6	17.9
	Zestaponi	3.3	3.7	3.5	2.0	2.6	1.7	2.4	2.1	2.4	2.5	2.8	3.4	2.7	17.5
	Sachkhere	2.9	3.1	3.4	2.2	2.9	1.9	2.6	2.3	2.3	2.5	2.7	3.2	2.7	15.1
	Sairme	3.0	3.4	2.9	1.9	2.8	1.8	2.4	2.2	2.5	2.4	2.7	2.9	2.6	12.5
	Mta-Sabueti	3.1	3.5	3.4	2.1	2.8	1.9	2.6	2.3	2.3	2.5	2.7	3.4	2.7	10.0
Samtskhe-Javakheti	Akhaltsikhe	3.1	3.2	3.5	2.3	3.1	2.0	2.9	2.6	2.7	2.6	2.7	3.3	2.8	12.4
	Akhalkalaki	3.3	3.2	2.8	3.1	3.5	2.3	3.4	3.1	2.8	2.7	2.9	3.4	3.0	8.4
	Borjomi	2.9	3.3	3.1	2.1	2.8	1.9	2.7	2.4	2.3	2.5	2.7	3.1	2.7	13.1
	Bakuriani	3.1	3.3	3.2	2.3	3.1	2.0	3.0	2.6	2.6	2.5	2.8	3.2	2.8	7.9
Shida Kartli	Gori	3.3	3.4	3.2	2.2	2.8	1.9	2.8	2.5	2.0	2.5	2.7	3.4	2.7	14.1
	Khashuri	3.2	3.2	3.5	2.5	2.8	1.9	2.8	2.4	2.1	2.5	2.8	3.4	2.8	13.3
Kvemo Kartli	Tbilisi	3.3	3.2	2.6	2.0	2.7	2.0	3.0	2.6	2.0	2.5	2.6	3.4	2.7	16.4
	Bolnisi	3.4	3.3	2.7	2.0	2.7	2.0	3.0	2.7	1.9	2.4	2.7	3.5	2.7	15.6
	Tsalka	3.4	3.2	2.9	2.5	2.8	1.9	3.0	2.6	2.0	2.5	2.9	3.4	2.8	9.2
	Marneuli	3.3	3.1	2.6	1.9	2.7	2.0	3.0	2.7	2.0	2.5	2.6	3.4	2.7	15.7
Mtskheta-Mtianeti	Pasanauri	3.3	3.1	2.8	2.8	2.9	2.1	3.2	2.9	2.3	2.6	3.0	3.4	2.9	12.0
	Tianeti	3.6	3.7	3.1	2.3	2.9	2.0	3.1	2.8	2.0	2.4	2.8	3.5	2.9	11.5
	Stepantsminda	3.3	3.1	2.6	2.6	3.6	2.3	3.3	3.3	2.7	2.8	3.2	3.3	3.0	8.4
	Gudauri	3.3	3.1	2.6	2.6	3.6	2.3	3.3	3.3	2.7	2.8	3.2	3.3	3.0	6.2
Kakheti	Akhmeta	3.6	3.7	3.1	2.3	2.9	2.0	3.0	2.8	2.0	2.4	2.9	3.6	2.9	16.0
	Telavi	3.3	3.3	2.6	2.0	2.8	1.9	3.0	2.7	1.8	2.4	2.6	3.6	2.7	15.5
	Sagarejo	3.3	3.2	2.6	1.9	2.8	2.0	3.1	2.6	1.9	2.5	2.6	3.4	2.7	14.7
	Lagodekhi	3.3	3.3	3.0	2.3	2.9	1.8	2.8	2.7	1.9	2.4	2.9	3.8	2.8	16.4
	Dedoplistskaro	2.9	3.2	2.4	1.8	2.5	1.7	2.8	2.6	1.8	2.5	2.4	3.4	2.5	13.8

Amount of atmospheric precipitation

The variation in annual precipitation across different regions, as outlined in the scenarios presented in the Fourth and Fifth National Communications, is illustrated in Figure 4.3.6. Additionally, Table 4.11. provides the percentage change in total precipitation for the new scenario, categorized by month and station.

Figure 4.3.6 indicates that the total annual precipitation remains within ±7% of the baseline value for the period from 2071 to 2100. The scenario developed in the Fourth National Communication projected a reduction of up to 10% across the entire country during this timeframe, with the exception of Samegrelo-Zemo Svaneti. In contrast, the new scenario also predicts a decrease in precipitation over most of the country, albeit to a lesser extent, while the total precipitation in the Black Sea coastal regions, as well as in Sheda Kartli and Kakheti, is expected to increase by up to 5%.

FIGURE 4.3.6. ANOMALIES OF ANNUAL PRECIPITATION TOTALS (IN PERCENT) FOR THE PERIOD 2071-2100 RELATIVE TO THE BASE PERIODS (4NC AND 5NC))



The monthly variation in precipitation amounts exhibits a pattern similar to that observed in the preceding forecast period, albeit with a relatively minor decrease. Over the last three decades, there has been a slight increase in the total precipitation compared to the earlier timeframe.

As indicated in Table 4.11., a notable reduction in precipitation during February is evident across most regions of Western Georgia and the southern areas, a trend not present in the prior forecast period. However, there is a general increase in winter precipitation, primarily attributed to December and January. From May to September, a decline in precipitation is anticipated, with minor exceptions across various months and regions. The changes observed in September and October appear more erratic, yet they predominantly remain within a 10% variation. A nationwide decrease is expected in November. Significant increases in total annual precipitation are particularly evident in Batumi and Zugdidi, where levels have already surpassed previous records.

TABLE 4.11. AMOUNT OF ATMOSPHERIC PRECIPITATION (PR) IN 2071-2100 AND CHANGE IN ATMOSPHERIC PRECIPITATION (0C) BETWEEN TWO THIRTY-YEAR PERIODS (1971–2000 AND 2071–2100).

Side	Point	T_{avg}, , change in average air temperature (0 C)													T_{sash} (0 C), Year
		Month												Year	
		1	2	3	4	5	6	7	8	9	10	11	12		
Adjara	Batumi	3.1	3.4	2.6	1.8	2.1	1.7	2.2	2.1	2.3	2.2	2.5	2.7	2.4	17.2
	Keda	3.0	3.6	3.0	1.8	2.4	1.5	1.9	2.0	2.5	2.3	2.7	2.9	2.5	16.7
	Khulo	2.8	3.1	3.1	2.4	3.2	1.9	3.6	2.4	2.8	2.0	2.6	2.8	2.7	14.0

Side	Point	T_{avg}. , change in average air temperature (0 C)													T_{sash} (0 C), Year
		Month												Year	
		1	2	3	4	5	6	7	8	9	10	11	12		
Guria	Lanchkhuti	3.1	3.2	2.7	1.8	2.3	1.7	2.2	2.2	2.4	2.4	2.5	2.9	2.5	17.4
	Chokhatauri	3.1	3.7	2.9	1.8	2.5	1.6	2.0	2.0	2.4	2.3	2.6	2.8	2.5	16.8
Samegrelo-Zemo Svaneti	Poti	2.9	3.0	2.5	1.9	2.2	2.0	2.4	2.2	2.4	2.4	2.6	2.8	2.4	17.2
	Zugdidi	3.1	3.5	2.7	1.8	2.4	1.6	2.0	2.1	2.5	2.4	2.5	2.7	2.4	16.9
	Senaki	3.1	3.2	2.7	1.8	2.3	1.7	2.1	2.1	2.5	2.4	2.5	2.9	2.4	17.7
Racha-Lechkhumi and Kvemo Svaneti	Ambrolauri	2.8	2.9	3.0	2.5	3.1	1.9	2.8	2.4	2.5	2.5	2.8	2.9	2.7	14.8
	Shovi	3.2	3.2	2.5	2.3	4.1	2.3	3.3	3.3	3.0	2.9	3.2	3.1	3.0	9.3
Imereti	Kutaisi	3.4	3.7	3.1	1.9	2.6	1.7	2.2	2.0	2.5	2.5	2.6	3.2	2.6	17.9
	Zestaponi	3.3	3.7	3.5	2.0	2.6	1.7	2.4	2.1	2.4	2.5	2.8	3.4	2.7	17.5
	Sachkhere	2.9	3.1	3.4	2.2	2.9	1.9	2.6	2.3	2.3	2.5	2.7	3.2	2.7	15.1
	Sairme	3.0	3.4	2.9	1.9	2.8	1.8	2.4	2.2	2.5	2.4	2.7	2.9	2.6	12.5
	Mta-Sabueti	3.1	3.5	3.4	2.1	2.8	1.9	2.6	2.3	2.3	2.5	2.7	3.4	2.7	10.0
Samtskhe-Javakheti	Akhaltsikhe	3.1	3.2	3.5	2.3	3.1	2.0	2.9	2.6	2.7	2.6	2.7	3.3	2.8	12.4
	Akhalkalaki	3.3	3.2	2.8	3.1	3.5	2.3	3.4	3.1	2.8	2.7	2.9	3.4	3.0	8.4
	Borjomi	2.9	3.3	3.1	2.1	2.8	1.9	2.7	2.4	2.3	2.5	2.7	3.1	2.7	13.1
	Bakuriani	3.1	3.3	3.2	2.3	3.1	2.0	3.0	2.6	2.6	2.5	2.8	3.2	2.8	7.9
Shida Kartli	Gori	3.3	3.4	3.2	2.2	2.8	1.9	2.8	2.5	2.0	2.5	2.7	3.4	2.7	14.1
	Khashuri	3.2	3.2	3.5	2.5	2.8	1.9	2.8	2.4	2.1	2.5	2.8	3.4	2.8	13.3
Kvemo Kartli	Tbilisi	3.3	3.2	2.6	2.0	2.7	2.0	3.0	2.6	2.0	2.5	2.6	3.4	2.7	16.4
	Bolnisi	3.4	3.3	2.7	2.0	2.7	2.0	3.0	2.7	1.9	2.4	2.7	3.5	2.7	15.6
	Tsalka	3.4	3.2	2.9	2.5	2.8	1.9	3.0	2.6	2.0	2.5	2.9	3.4	2.8	9.2
	Marneuli	3.3	3.1	2.6	1.9	2.7	2.0	3.0	2.7	2.0	2.5	2.6	3.4	2.7	15.7
Mtskheta-Mtianeti	Pasanauri	3.3	3.1	2.8	2.8	2.9	2.1	3.2	2.9	2.3	2.6	3.0	3.4	2.9	12.0
	Tianeti	3.6	3.7	3.1	2.3	2.9	2.0	3.1	2.8	2.0	2.4	2.8	3.5	2.9	11.5
	Stepantsminda	3.3	3.1	2.6	2.6	3.6	2.3	3.3	3.3	2.7	2.8	3.2	3.3	3.0	8.4
	Gudauri	3.3	3.1	2.6	2.6	3.6	2.3	3.3	3.3	2.7	2.8	3.2	3.3	3.0	6.2
Kakheti	Akhmeta	3.6	3.7	3.1	2.3	2.9	2.0	3.0	2.8	2.0	2.4	2.9	3.6	2.9	16.0
	Telavi	3.3	3.3	2.6	2.0	2.8	1.9	3.0	2.7	1.8	2.4	2.6	3.6	2.7	15.5
	Sagarejo	3.3	3.2	2.6	1.9	2.8	2.0	3.1	2.6	1.9	2.5	2.6	3.4	2.7	14.7
	Lagodekhi	3.3	3.3	3.0	2.3	2.9	1.8	2.8	2.7	1.9	2.4	2.9	3.8	2.8	16.4
	Dedoplistskaro	2.9	3.2	2.4	1.8	2.5	1.7	2.8	2.6	1.8	2.5	2.4	3.4	2.5	13.8

The alterations observed in the summer and winter seasons during the period from 2071 to 2100 exhibit similarities to those noted between 2041 and 2070. Notably, winters are projected to be significantly warmer and to experience increased precipitation. Conversely, the rise in summer temperatures is somewhat mitigated by a relatively modest reduction in total precipitation during that season. However, the specific effects on various sectors will be clarified through an analysis of indices that more accurately reflect the distribution patterns of heat and moisture.

Change in sectoral climate indices for the period 2071-2100

The annual average maximum and minimum temperatures exhibit a consistent change throughout this period, averaging an increase of 2.7 degrees Celsius nationwide. The rise in maximum temperatures ranges from 2.3 to 3.3 degrees Celsius across various locations, while the average minimum temperatures show a more modest change, fluctuating between 2.5 and 3.0 degrees Celsius.

The seasonal and regional variations in these parameters are illustrated in Figures 5.3.7 and 5.3.8. Similar to the initial forecast period, the winter season continues to demonstrate the most significant rates of change, with both average maximum and minimum temperatures rising by 3 to 3.5 degrees Celsius compared to the baseline periods of 2071-2100 and 1971-2000. This indicates that, relative to the preceding 30-year period, winter daytime and nighttime temperatures are expected to increase by an average of 1 degree Celsius. The trend of greater warming in minimum temperatures persists, particularly in Eastern Georgia.

In spring, average maximum temperatures also show considerable variation, with some regions experiencing increases that surpass those observed in winter (notably Racha-Lechkhumi, Kvemo Svaneti, and Shida Kartli). Across much of the country, spring maximum temperatures are higher than those recorded in autumn. During this timeframe, the average summer extremes are the least elevated; however, in certain instances, the rise in summer maximum temperatures exceeds that of the transitional seasons (as seen in Kvemo Kartli, Mtskheta-Mtianeti, and Kakheti).

FIGURE 4.3.7. CHANGE IN AVERAGE MAXIMUM TEMPERATURE IN THE PERIOD 2071-2100

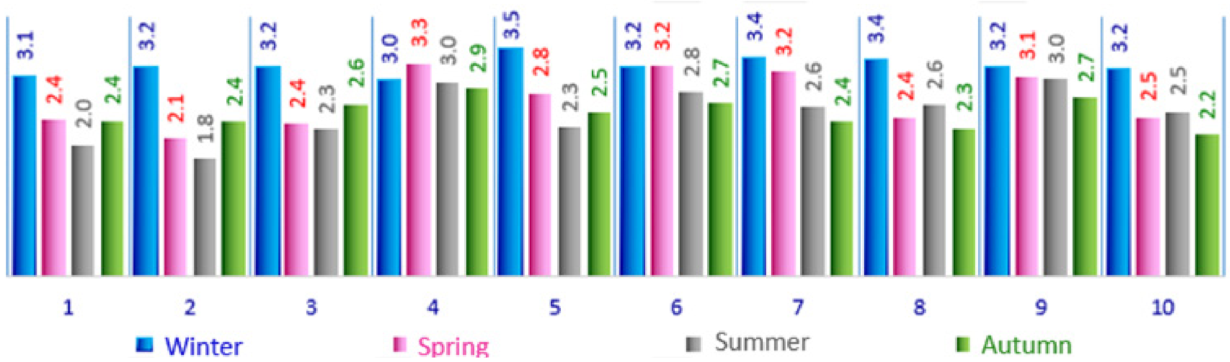
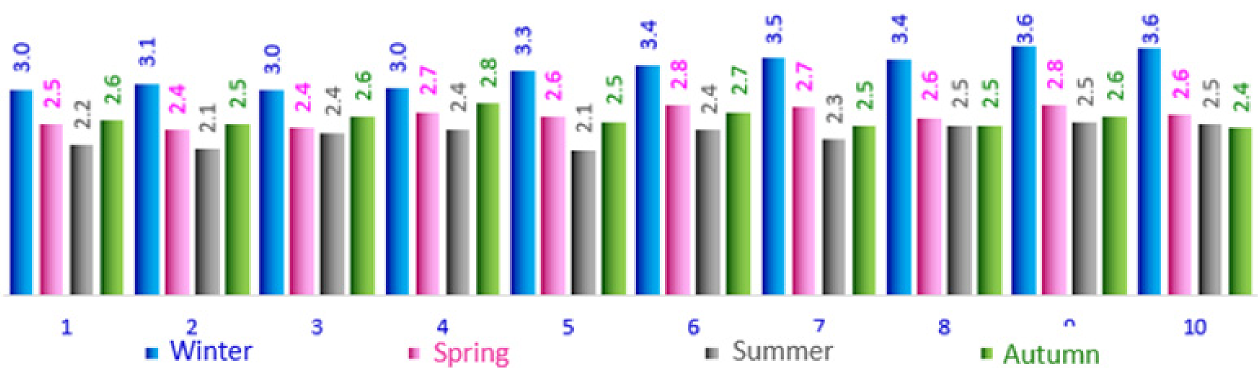


FIGURE 4.3.8. CHANGE IN AVERAGE MINIMUM TEMPERATURE IN THE PERIOD 2071-2100



While the average temperatures during both day and night are projected to rise further, the absolute maximum and minimum temperatures are not anticipated to undergo significant changes when compared to the previous forecast period. Additionally, the annual maximum temperature is expected to remain below 50 degrees Celsius throughout this timeframe. The annual minimum temperatures are likely to remain stable during the winter months, with the exception of certain high-altitude stations such as Fasanauri and Stepantsminda, where the values indicated in the table are primarily expected in December.

In the Adjara region, the absolute values for winter maximum and spring minimum temperatures are forecasted to increase by more than 13 degrees, resulting in a winter maximum of 29 degrees Celsius in Keda. However, the frequency of such warm days during the winter season will be clarified by other indices. In spring, there will also be days when maximum temperatures rise by 10-11 degrees, surpassing 25 degrees, particularly at stations like Akhalkalaki, Tsalka, and Khashuri, which typically experience colder conditions during this season.

During the summer months, changes in both parameters are expected to be relatively minor, similar to the previous period. Conversely, a more pronounced increase in minimum temperatures is anticipated in the autumn months.

TABLE 4.12. CHANGE IN ABSOLUTE MAXIMUM AND MINIMUM TEMPERATURES IN THE PERIOD 2071-2100.

Region	Winter		Spring		Summer		Autumn		Year	
	T_{max}	T_{min}	T_{max}	min	T_{max}	min	T_{max}	min	T_{max}	min
Adjara	13.7	6.7	7.9	13.4	5.2	3.6	4.4	8.4	13.7	13.4
Guria	8.3	6.6	8.4	9.2	5.8	3.9	4.4	8.1	8.4	9.2
Samegrelo-Zemo Svaneti	8.4	8.8	7.6	6.0	5.5	6.7	5.5	8.2	8.4	8.8
Racha-Lechkhumi and Kvemo Svaneti	11.2	8.8	8.2	8.1	3.9	5.7	5.2	7.2	11.2	8.8
Imereti	9.8	6.6	7.1	6.9	5.1	4.3	4.1	7.8	8.8	7.8
Samtskhe-Javakheti	13.1	6.8	11.2	7.2	5.1	3.1	4.6	10.7	13.1	10.7
Shida Kartli	12.5	6.0	10.2	3.0	5.6	4.5	3.5	6.0	12.5	6.0
Kvemo Kartli	10.0	7.9	9.4	7.3	4.2	3.3	2.6	6.5	10.0	7.9
Mtskheta-Mtianeti	8.8	12.9	10.7	5.0	4.3	4.4	4.6	8.0	10.7	12.9
Kakheti	8.3	8.5	9.9	8.2	4.3	4.0	4.6	11.6	9.9	11.6

During this timeframe, the average annual count of days exceeding 30°C is projected to rise from 22 to 74 days relative to the baseline period, varying by region. The lowest increase is anticipated in Racha-Lechkhumi and Kvemo Svaneti, while Shida Kartli is expected to experience the highest increase. Additionally, days with maximum temperatures surpassing 35°C are expected to rise significantly to between 8 and 24 days. Again, Racha-Lechkhumi and Svaneti will see the least increase, whereas Kakheti will record the highest.

The seasonal variations of these parameters are as follows: during winter, no days exceeding 30°C were recorded in the baseline period at any of the monitored locations. However, forecasts suggest that days with maximum temperatures above 30°C may occur across the country during the winter season, ranging from 0.3 to 3.2 days per period. Isolated instances of days reaching 35°C may also arise. In summer, both temperature indices are expected to rise significantly, with an average increase of 4 to 7 days for days exceeding 30°C, while days exceeding 35°C will see the most substantial rise in Kvemo Kartli and Kakheti, with an increase of 3 to 4.4 days. In autumn, the number of such days will increase more than in spring, although the difference is less pronounced compared to the previous period. Days exceeding 30°C will increase by 5 to 30 days in spring, with the most significant rise in Guria during autumn, reaching 73 days, while most other regions will see an increase of approximately 40 days. For days exceeding 35°C, the increase will be more pronounced in both seasons, with the highest occurrence in autumn being 11 days in Imereti for the entire period. In spring, the maximum recorded will be 8 days in western Georgia and 1 day in eastern Georgia.

- The annual variation in the occurrence of tropical nights across most regions of the country ranges from 60 to 90 days, while in other areas, this increase is considerably less pronounced. Seasonal fluctuations also lead to isolated instances of warm nights during the winter months. In the summer, the frequency of such occurrences rises significantly, reaching approximately 250 days in Samegrelo, with Guria, Kvemo Kartli, and Mtskheta-Mtianeti also experiencing high counts of over 200 days. In spring, a marked increase in this metric is observed in Adjara and Kvemo Kartli, whereas other regions exhibit a more modest rise. Notably, the escalation of hot nights is more pronounced in spring compared to autumn. The Tx90p and Tn90p indices show a relatively greater increase at most monitoring stations during this timeframe, although some stations report negligible changes. Specifically, the alteration in the Tx90p index surpasses that of the previous period by an additional 5%, while the Tn90p index experiences an increase of 6 to 10%.

During the winter and spring seasons, the proportion of high minimum temperatures (Tn90p) is projected to rise significantly, ranging from 25% to 65%, surpassing the increase in maximum temperatures (18% to 46%). Conversely, in autumn, this pattern is reversed, with maximum temperatures expected to rise by 22% to 42%, while minimum temperatures will only increase by 7% to 30%. In summer, the changes remain relatively stable compared to the previous period, with both indices showing an average increase of 20% to 40%.

The Tx10p index is anticipated to decline annually, reaching 8.5%, whereas the Tn10p index in the regions of Adjara and Imereti is expected to rise by 1% to 2% compared to the baseline period, albeit at a lower rate than previously observed. Consequently, the annual occurrence of such days during this timeframe will be less than in the prior period.

In winter, both indices are projected to decrease by approximately 9.5%. In spring, Tn10p is expected to experience a more pronounced decline, dropping to 9%, while Tx10p will see a slight increase of 0.5% in Samegrelo-Zemo Svaneti and Samtskhe-Javakheti; in other areas, this index will decrease to 7.5%. Throughout summer and autumn, the number of cold days is anticipated to diminish across the board by 0.2% to 9.7% in Gargly, while the number of cold nights will rise in spring by 9% in Adjara, Guria, Imereti, Samtskhe-Javakheti, and Kvemo Kartli. This increase will be more pronounced in autumn, affecting nearly the entire country, with Adjara expected to see the highest rise of 21%..

The variation in the number of heating and cooling degree days presents a contradictory trend. Throughout this forecast period, there will be an additional requirement for cooling by 131 to 352 degree days, while the need for heating will decrease by 115 to 1860 degree days. Additionally, the total of active temperatures is rising across all regions. Notably, Mtskheta-Mtianeti exhibits a significant increase, although this metric is rising by at least 350 degree days in all areas. Regarding the frequency of heat waves, the maximum annual increase is projected to be between 9 and 11 across all regions. The average increase in heat waves is relatively consistent, ranging from 4.6 to 6.6.

Precipitation-related indices

The highest recorded precipitation in a single day across all examined regions is projected to rise during this timeframe, with notable increases observed in Adjara and Guria, reaching 43 and 61 mm, respectively. Additionally, the maximum precipitation over a five-day span is expected to increase throughout all areas. When compared to the annual maximum from the baseline period in Western Georgia, this rise exceeds 150 mm in both Guria and Samegrelo-Zemo Svaneti. Generally, these maxima fluctuate with the seasons, although some exceptions are primarily noted during the summer and autumn months.

In the winter season, the five-day maximum is anticipated to see significant growth, particularly in Racha-Lechkhumi and Kvemo Svaneti, where it may reach 153 mm. Furthermore, an increase in the summer maximum is expected in Samegrelo-Zemo Svaneti and Adjara, amounting to 99 mm, along with a 150 mm rise in autumn precipitation in Guria.

The frequency of days with precipitation exceeding 10 mm in the coastal zone and Upper Svaneti is expected to remain stable during this period. Conversely, a decline in such occurrences is anticipated across the majority of the remaining regions, with the exception of Kartli and Kakheti, where an increase is primarily noted in winter, totaling no more than 2 additional days throughout the entire period.

Days with precipitation surpassing 20 mm are projected to increase more significantly in this period compared to the previous one, particularly during winter, although a decrease is also expected in other seasons, especially summer.

Annually, regions such as Adjara and Samegrelo experience days with precipitation exceeding 50 mm, while an increase in such occurrences is noted across most areas during the winter months. It is particularly significant that the frequency of these days rises in Adjara during winter and spring, thereby heightening the associated risks. Although the number of days with precipitation surpassing 90 mm remains relatively low, an increase is anticipated in Western Georgia, where the risks are already considerable. Conversely, in Eastern Georgia, the frequency of both types of precipitation days remains stable or declines, with the exception of the winter season.

In the subsequent forecast period, the r95ptot metric is projected to rise by up to 3% in Western Georgia, excluding Racha-Lechkhumi, Kvemo Svaneti, and Imereti, where a decrease of 0.3-1.6% is expected. This percentage increase will correspond to an additional 3 mm to 107 mm of precipitation. For extremely rainy days, a similar increase of approximately 1% is anticipated in the same regions, with precipitation levels rising between 15-30 mm. In Eastern Georgia, all related indices are expected to decline by 1-2%. Consequently, the overall number of rainy days (CWD) will increase across the entire territory. In this context, the duration of rainy episodes in the western regions, particularly in Guria and Adjara, will extend by an additional 9 days, further exacerbating the existing risks.

In summary, it can be concluded that throughout both forecast periods, despite the overall warming trend observed in all temperature metrics, the occurrence of cold days and nights with significantly low temperatures will persist during the winter and transitional seasons. Regarding precipitation, an increase in both abundance and intensity is anticipated in western Georgia, whereas the eastern and southern regions are expected to experience a predominantly decreasing trend.

4.4 ABOUT THE GREEN CLIMATE FUND PROJECT

UNDP, with financial backing from the Green Climate Fund, is executing the Government of Georgia's initiative titled "Enhancing Multi-Hazard Early Warning System and Utilization of Climate Information in Georgia." This initiative is supported by a grant of USD 27 million from the Green Climate Fund.

The primary objective of this project is to mitigate the direct effects of climate change-related disasters on the population, livelihoods, and infrastructure within Georgia.

In addition to this initiative, there are two other projects currently underway: "Strengthening Climate Change Adaptation Capacities in Georgia," which is funded by the Swiss Agency for Development and Cooperation with USD 5 million, and "Strengthening Community Resilience to Climate Change Risks," supported by the Swedish International Development Cooperation Agency with USD 4 million. Collectively, these three projects are regarded as components of a unified program.

Upon the program's completion, Georgia will gain access to essential tools that will aid in the development and implementation of a comprehensive climate change disaster risk management and early warning system.

- An enhanced hydrometeorological network has been established, comprising over 140 distinct types of observation instruments, 15 agro-meteorological stations, and 11 geological monitoring devices, along with advanced computing systems and pertinent information and communication technology for the National Environmental Agency.
- A comprehensive methodology for multi-hazard assessment, modeling, and mapping has been developed, adhering to the best international practices and the standards set by the European Union and the World Meteorological Organization.
- Seven hazard and risk maps related to climate change have been produced, covering floods, landslides, mudslides, avalanches, wind, hail, and drought across 11 river basins.
- An upgraded forecasting platform has been implemented for the seven identified hazards.
- A guide for hazard assessment and zoning standards, along with an operational protocol for early warning systems, has been established.
- Community-based disaster risk management strategies will be executed in the 100 most vulnerable communities identified through comprehensive risk assessments.

- Priority structural adaptation measures, including coastal protection initiatives, will be carried out in 15 locations deemed high-risk.
- Additionally, an information and advisory web platform tailored for farmers will be developed in two pilot regions, specifically Shida Kartli and Kakheti.
- The Environmental Information and Education Centre has conducted information campaigns and educational initiatives across 11 local municipalities in various regions of Georgia. Over 4,000 individuals have engaged in training sessions and other educational programs, while more than 110 youth have taken part in the Green Camp titled “Young Climate Ambassadors.”
- As part of this initiative, community forums addressing climate change issues are being organized, a Green Scholarship Program has been established in higher education institutions to encourage careers in environmental fields, and annual competitions are being held for media outlets, community organizations, and educational institutions.

The execution of the program will establish a robust foundation for developing a climate-smart and climate-resilient society in Georgia. This society will be equipped to effectively evaluate existing threats and risks, implement preventive and adaptive strategies, and respond swiftly and efficiently to disasters when necessary.

One of the primary objectives of the program is to create the technical and institutional capacity required for the establishment of an early warning system. The development of such systems is currently underway in the basins of 11 significant rivers in Georgia: Enguri, Chorokhi-Adjaristskali, Supsa, Natanebi, Khobi, Kintrishi, Mtkvari, Rioni, Khrami-Ktsia, Alazani, and Iori. Within these regions, enhancements will be made to address seven specific climate hazards, and suitable forecasting platforms will be developed for floods, mudslides, landslides, droughts, hail, avalanches, and strong winds. It is important to note that the program does not encompass monitoring glacier melt, as this necessitates specialized observations, equipment, and technology.

To date, the following key activities have been carried out:

- 154 units of hydrometeorological parameter observation stations/observatories were purchased. A total of 89 units were installed in the territory of Western Georgia during the period 2022-2023:
  - 11 meteorological stations;
  - 43 meteorological observatories;
  - 6 agrometeorological stations;
  - 29 hydrological stations.
- A high-performance computer (HPC) has been acquired and is operating effectively, resulting in enhancements to the high-resolution local weather forecasting system.
- Georgia has joined the European Centre for Medium-Range Weather Forecasts (ECMWF). The Agency utilizes the synoptic products offered by this organization to enhance its weather forecasting and warning preparation efforts. Furthermore, to advance their skills, the Agency’s personnel have the opportunity to engage in training courses organized by the ECMWF on a regular basis.

- A flood forecasting platform has been developed and is currently operating in a test mode, where it is undergoing calibration and verification processes. Efforts are being made to implement hydrological and hydraulic modeling. A flood modeling forecasting system has been established for the river basins in Western Georgia.
- Additionally, a drought monitoring system has been introduced.
- Monitoring systems have been installed on 11 significant landslide areas throughout the country.
- Utilizing the methodology for modeling and mapping natural hazards prepared by international experts, national-level maps have been created for strong winds, hail, drought, and avalanches. Efforts are ongoing to prepare mudslide hazard maps for 11 river basins, with completion anticipated in the first half of 2024.
- In 2024, there are plans to acquire and install an aerological station in Western Georgia.
- The continuation of a flood forecasting system for Eastern Georgia is scheduled for 2024.
- Additionally, a modern avalanche forecasting system is set to be implemented in a trial phase for Kazbegi Municipality in 2024..

4.5. IMPACT OF CLIMATE CHANGE ON GEORGIAN GLACIERS

4.5.1. IDENTIFICATION OF THE MAIN CHARACTERISTICS OF GEORGIAN GLACIERS

Introduction. The initial sporadic observations of the glaciers in the Caucasus, particularly in Georgia, commenced in the latter half of the 20th century. In the early twentieth century, a comprehensive inventory of all Caucasian glaciers was compiled based on extensive military topographic maps and a catalog from that era[210].

Since 1951, systematic glaciological observations have been conducted, primarily through fieldwork. Researchers and experts in this domain have made substantial contributions[211-212-213]. The findings from these studies have been documented in various editions of the Catalogue of Glaciers of the Former Soviet Union (hereinafter referred to as the Catalogue)[214-215]. The principal outcomes of the Catalogue have been incorporated into the World Glacier Inventory in a digital format[216].

210 Подозерский К.И. Ледники Кавказского хребта (Каталог ледников Кавказа). Зап. КОРГО, т. 29, в.1, Тифлис, 1911, 200 с.

211 Маруашвили Л. И. Оледенение Кавказа // Природа. № 5, М.: Академиздатцентр „Наука“, РАН, 1936. С. 52–61.

212 В. Ш., Дробышев О. А. Результаты гляциологических наблюдений на ледниках Кавказа//Труды ЗакНИГМИ, вып. 45 (51), 1970, с. 141–146.

213 Цомая В.Ш. (ред.). Ледники Кавказа 1963–1973 гг., Тбилиси, 1975, 322 с.

214 Маруашвили Л. И., Курдгелаидзе Г. М., Лашхи Т. А., Инашвили Ш. В., Цомая В.Ш. Каталог Ледников СССР. Т. 9, вып. 1, ч. 2-6, вып. 3, ч. 1. Закавказье и Дагестан, Л: Гидрометеоиздат, 1975. 181 с.

215 В.Ш. Цомая, О.А. Дробышев, В.Д. Панов, Э.С. Боровик. Каталог Ледников СССР, Т. 8, ч. 11 и 12. Северный Кавказ, Л.: Гидрометеоиздат, 1977, 122 с.

216 WGMS and NSIDC World glacier inventory. Compiled and made available by the World Glacier Monitoring Service, Zurich, Switzerland, and the National Snow and Ice Data Center, Boulder CO, USA. Digital media. 1989, updated 2012. www.wgms.ch .

As a result of these efforts, a series of temporal snapshots detailing glacier characteristics have been developed. During this timeframe, accessing glaciers, and particularly traversing them, was often challenging due to their considerable size. This posed difficulties in obtaining data with the necessary spatial resolution through ground observations. Consequently, aerial vehicles were employed for remote glacier studies, thereby mitigating the associated risks. The aerial photographs obtained served as a dependable resource for assessing glacier characteristics.

It is important to highlight that conducting field expeditions for glacier research entails significant financial investment. Furthermore, only a limited number of glacial basins can be surveyed each year based on field observations. Currently, over 400 glaciers are documented in Georgia. Therefore, it is evident that comprehensive ground observations of all glaciers will require several decades to complete.

To effectively address the effects of climate change on glaciers in a timely manner, it is essential to employ high-resolution satellite remote sensing technology (SRTS). This approach facilitates the examination of glaciers across extensive areas with the requisite resolution and precision, particularly in scenarios where material resources and time are constrained. A comprehensive methodology that integrates historical catalog data, existing field materials, and expert insights is utilized to ensure the quality of the results obtained.[217]

Research Area, Data, and Methodology: The glaciers in Georgia are situated in the southern part of the Caucasus Range and are distributed across 12 glacial basins: six located in Western Georgia (Bzifi, Kelasuri, Kodori, Enguri, Khobistskali, Rioni) and six in Eastern Georgia (Liakhvi, Aragvi, Tergi, Asa [Arhotistskali], Arghuni, and Pirikita Alazani).

To ascertain the characteristics of these glaciers, it is imperative to delineate their boundaries. The contours of the glaciers are established through manual digitization and the application of expert knowledge. The identification of the glaciers for study and the specification of their contours were accomplished using the ASTER satellite digital elevation model (DEM) and topographic maps from the 1960s (1:50,000) that were utilized in the creation of the catalog. The digital elevation model also enabled the 3D visualization of glaciers and terrain analysis, which facilitated the geographical linking of glaciers to their respective river basins. The contours were delineated by superimposing elevation contours derived from satellite imagery and the digital elevation model. High-precision definitions of watersheds were achieved through 3D imagery, which is vital for accurately determining glacier boundaries. Expert knowledge played a significant role throughout this process.

A comparative analysis of the glacier outlines in Georgia, derived from remote sensing data, against the glacier outlines presented in the topographic maps from the 1960s, revealed a significant reduction in the glacier area over the past six decades. The area measurements for specific glaciers listed in the catalog were found to be smaller than those determined by the TDS, indicating an error, as this would suggest an increase in glacier area since the 1960s. By examining the glacier outlines depicted on the topographic maps from that era (1:50,000 scale), the inaccurate data in the catalog were rectified, specifically for those

217 Kordzakhia G. I., Shengelia L. D., Tvauri G. A., Dzadzamia M. Sh. The climate change impact on the glaciers of Georgia. In Journal-World Science, vol. 1, № 4(44), Warsaw, Poland, 2019, pp. 29-34.

glaciers whose areas were reported as smaller than the TDS measurements.

The catalog's diagrams were utilized for glacier identification; however, an additional method was employed to verify the accuracy of this identification. The geographical coordinates of all glaciers were established using the Google Earth application, and these were compared with the coordinates listed in the World Catalog, as the USSR Glacier Catalog does not provide such coordinates. The World Catalog includes an identification code for each glacier adjacent to reference glaciers, which allows for the determination of their identification number and relevant characteristics in the USSR Glacier Catalog. The geographical coordinates obtained from Google Earth were found to be consistent with those in the World Glacier Catalog, thereby confirming the accuracy of the glacier identification..

The established methodology incorporates data from the National Geographic Society, various internet platforms, and multiple international databases to ensure the acquisition of highly reliable information pertaining to all glacial basins. The processing of the gathered information is also planned.

Google Earth serves as a valuable source of satellite imagery. For the majority of Georgia's territory, this application offers images with a spatial resolution ranging from 0.5 to 0.8 meters. Through Google Earth, data can be accessed from high-resolution satellites such as Spot, IKONOS, Quickbird, and RapidEye. However, for certain glaciers under investigation, the satellite data available in the Google Earth database is insufficient. Consequently, satellite images from Landsat 5, Landsat 7, and Landsat 8, which have a resolution of 15 to 30 meters, were utilized. Additionally, it is important to highlight that high-resolution data (1 to 1.5 meters) from the commercial satellite SPOT 6 has employed to comprehensively cover the final dataset for the year 2020.

To ensure the research's effectiveness, data from the databases of the US National Aeronautics and Space Administration (NASA) and the Global Land Ice Measurements from Space (GLIMS) project were utilized. These databases were established[218] using information from the ASTER sensor aboard the TERRA satellite, which has a spatial resolution of 15 meters. By employing the ASTER sensor in conjunction with multispectral satellite data, it is feasible to produce an ASTER Digital Elevation Model (DEM) with a resolution of 30 meters. Various technologies are employed for processing satellite data, including SAGA, GIS, and SNAP applications.[219_220_221]

The presence of cloud cover significantly hampers the use of satellite imagery. When monitoring glaciers, this limitation is compounded by the condition of the glacier surface itself. Ideally, the glacier surface should be largely devoid of snow cover, meaning that the topographic data survey (TDS) should be conducted from the end of the ablation season until the onset of the first snowfall. This timeframe varies based on the glacier's location, elevation, climate, and weather conditions. In Georgia, this interval typically spans from late June to early October.

218 Khalsa, S.J.S. Dyurgerov, M.B.; Khromova, T.; Raup, B.H.; and Barry R. G. Space-Based Mapping of Glacier Changes Using ASTER and GIS Tools, IEEE Transactions on geoscience and remote sensing, 2004, vol. 42, No. 10, 21-77.

219 Conrad, O., Bechtel, B., Bock, M., Dietrich, H., Fischer, E., Gerlitz, L., Wehberg, J., Wichmann, V., and Böhner, J. (2015): System for Automated Geoscientific Analyses (SAGA) v. 2.1.4, Geosci. Model Dev., 8, 1991-2007, doi:10.5194/gmd-8-1991-2015.

220 Gorelick N., Hancher M., Dixon M., Ilyushchenko S., Thau D., Moore R., 2017 Google Earth Engine: Planetary-scale geospatial analysis for everyone, Remote Sensing of Environment, ISSN 0034-4257

221 SNAP - ESA Sentinel Application Platform v2.0.2, Available from Webpage: http://step.esa.int.

Utilizing the aforementioned technology, various characteristics of the glacier are assessed, including area (in km²), morphological type, general exposure, maximum length (in km), and minimum and maximum elevations (in meters), as well as the height of the firn line (in meters) and the ablation area (in km²). Glaciers are categorized based on their area into three classifications: small (0.1 to 0.5 km²), medium (0.5 to 2.0 km²), and large (2.0 km² and above). It is important to note that glacier classification can frequently change due to fragmentation and melting.

Research indicates that assessing glacier characteristics and examining the dynamics of their degradation through high-resolution TDS is effective, as it incorporates global best practices[222]-[223] alongside methodologies developed in Georgia.[224]-[225]-[226]

It is beneficial to juxtapose the acquired data with the parameters outlined in the catalog. This comparison is of mutual significance, as the TDS can, in certain instances, enhance the accuracy of these catalogs, while the catalog data, in conjunction with expert insights regarding the study area, facilitates the validation of the TDS findings. The integration of satellite remote sensing data with ground observations enables a more precise assessment of glacier characteristics, which is essential for monitoring regional climate variations.

The alterations in the area and position of a glacier's tongue serve as indicators of the glacier's reaction to climatic influences. Consequently, it is pertinent to examine the changes in the area and tongues of the glaciers in Georgia over approximately 60 years by contrasting the numerical data derived from the TDS with the information from the glacier catalog.

The findings from the conducted studies are as follows. In Georgia's fourth national communication to the Convention[227], glacier data were obtained using the TDS for a specific observation period, namely 2015, or for adjacent dates if observations for that year were not feasible. For the fifth national communication, glacier data were expanded to include not only 2015 but also the years 2010 and 2020. It is noteworthy that the glacier data for 2020 were derived from high-resolution (1–1.5 m) imagery provided by the commercial satellite SPOT 6. Additionally, the range of characteristics assessed increased, with the morphological type of glaciers and their general exposure being included for all observation periods.

Consequently, the primary characteristics of glaciers were identified for six glacial basins in Western Georgia and six in Eastern Georgia, based on data from 2010 (designated as "TDZ 1"), 2015 (designated as "TDZ 2"), and 2020 (designated as "TDZ 3"). This information

222 Petri Pellikka, W. Gareth Rees - Remote Sensing of Glaciers Techniques for Topographic, Spatial and Thematic Mapping of Glaciers 2010, 330 p

223 Xiaofei Wang, Yue Huang, Tie Liu, Weibing Du. Impacts of climate change on glacial retreat during 1990-2021 in the Chinese Altay Mountains. CATENA Volume 228, July 2023, article id 107156, pp. 1-15.

224 Kordzakhia G. I., Shengelia L. D., Tvauri G. A., Dzadzamia M. Sh. The climate change impact on the glaciers of Georgia. In Journal-World Science, vol. 1, № 4(44), Warsaw, Poland, 2019, pp. 29-34.

225 George Kordzakhia. Fourth National Communication of Georgia, Under the United Nations Framework Convention on Climate Change. 4.4 Glaciers, Tbilisi, 2021, pp. 241-250. https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf

226 G. Kordzakhia, L. Shengelia, G. Tvauri. Impact of Climate Change on Glaciers of the Inguri River Basin (Georgia). Proceeding of WRFER International Conference. Barcelona, Spain, 23 September 2023, WRFER International Conference. Barcelona, Spain, 2023, pp. 1–4.

227 George Kordzakhia. Fourth National Communication of Georgia, Under the United Nations Framework Convention on Climate Change. 4.4 Glaciers, Tbilisi, 2021, pp. 241-250. https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf

was supplemented with catalog and topographic map data, leading to the compilation of relevant tables.

Table 4.13. lists the serial number of each glacier, along with its name and/or catalog number, and its ID according to the WGI. It presents various metrics for some of Georgia's larger glaciers based on the 2020 TDZ data, including area (km²), morphological type, general exposure, maximum length (km), minimum height (m), maximum height (m), firn line height (m), and ablation area (km²).

4.5.2. QUANTITATIVE ASSESSMENT OF CHANGES IN THE GREAT GLACIERS OF GEORGIA

Introduction. The issue of cryosphere change is a key focus of research for the Intergovernmental Panel on Climate Change (IPCC)[228]. The United Nations has adopted a specific resolution addressing high-mountain regions, emphasizing the significance of climate change effects on major glaciers and the associated risks stemming from their deterioration.

Investigating the effects of climate change on glaciers is crucial for formulating both adaptation strategies and long-term mitigation measures concerning glacier melting (which occurs over extended periods), as well as for recognizing the risks of rapid-onset natural disasters linked to glacial activity.

Mitigating the risks associated with glacial disasters is vital for ensuring the safety of communities, infrastructure, and transportation systems. Overall, the reduction of disaster risks is intrinsically connected to climate change adaptation, which is essential for the sustainable development of nations. A recent instance of a glacial disaster occurred on August 3, 2023, when the Buba glacier collapsed in the Bubistskali River gorge, located within the Shovi resort area, leading to the tragic loss of 33 lives, including children. The Shovi resort was inundated with a significant volume of rock and mud, resulting in near-total destruction of the facility[229]. This incident exemplified the interplay of glaciological, geological, and hydrometeorological factors. Such a natural event of this magnitude has not been witnessed in Georgia for the past century. The adverse effects of climate change on large glaciers have also led to glacial disasters in Mestia Municipality due to the degradation of the Murkvami Glacier in 2019 and in Kazbegi Municipality following the collapse of the Devdoraki Glacier in 2014[230].

Therefore, it is important to quantitatively assess the changes in the large glaciers of Georgia, for which it is necessary to solve the following sub-tasks, namely:

- Utilizing the TDS and any available ground observations, assess the alterations (including retreat, rate, and trend) of significant glaciers due to contemporary climate change from 1977 to 2020 across all glacial basins in Georgia that contain large glaciers.
- Additionally, analyze the characteristics of the retreat of these large glaciers.

228 M. Tignor et al. The Ocean and Cryosphere in a Changing Climate. A Special Working Group II Technical Report of the Intergovernmental Panel on Climate Change. IPCC Secretariat, Geneva, Switzerland. 2018. - 755 p

229 Disaster in Shovi Municipality. accessible from the website; nea.gov.ge/Ge/News/1178

230 G. Kordzakhia, L. Shengelia, G. Tvauri, M. Dzadzamia. Research of Devdoraki Glacier Based on Satellite Remote Sensing Data and Devdoraki Glacier Falls in Historical Context//American Journal of Environmental Protection, Volume 4, Issue 3-1, 2015, pp. 14–21.

Methodological Considerations. The significant glaciers in Georgia are situated within three glacial basins in Western Georgia (Kodori, Enguri, Rioni) and one in Eastern Georgia (Tergi). The retreat dynamics of these large glaciers are analyzed separately for the two regions, acknowledging the substantial climatic differences; Western Georgia experiences a maritime and humid climate, whereas Eastern Georgia has a continental climate.

The approximately 60-year gap between the TDS data and the catalog data facilitates an assessment of the retreat of large glaciers within these basins, proving effective for examining the effects of ongoing climate change on these glaciers. The procedures outlined in Table 4.13. were implemented to chronologically ascertain the coordinates of large glaciers by river basin utilizing the TDS. Variations in glacier area and the position of the glacier tongue's terminus serve as indicators of the glacier's response to climate change, with these parameters being derived from multispectral satellite imagery.

TABLE 4.13. CHARACTERISTICS OF SOME LARGE GLACIERS IN GEORGIA ACCORDING TO 2020 TDS

#	Glacier Name and / or Number ,	ID WGI According to	Glacier Area (km 2)	Morphological type	General Exposure	Maximum Length (km)	Minimum Height (m)	Maximum Height (m)	Firni Line Height (m)
1	Address : south Soprudzhu , 25	SU5T09104037	3.6	Door Valley	South	2.7	2742	3716	3056
2	Kharikhara , 143b	SU5T09105138	1.9	Valley	North / East	2.7	2483	3661	3132
3	Koruldashi , 318b	SU5T09106344	2.2	Valley	East	2.6	2873	4179	3324
4	Edena , 329	SU5T09106362	3.9	Valley	South / West	3.2	2827	3970	3364
5	Zophchito , 332b	SU5T09106366	2.0	Valley	South / East	3.9	2494	3971	3147
6	Laboda , 332	SU5T09106369	2.3	Valley	South / West	3.2	2486	4163	3252
7	Kirtisho, 350	SU5T09106382	4.0	Valley	West	4.2	2596	3688	3233
8	Boko , 359	SU5T09106394	3.7	Valley	South / West	4.1	2647	3985	3463
9	Tbilisi , 362	SU5T09106396	3.9	Valley	South / West	3.2	3020	4383	3525
10	Buba , 363	SU5T09106397	2.3	Valley	South / West	2.9	2980	4061	-
11	Chachi , 242	SU4G08011046	2.3	Hanging Valley	North / East	3.2	3239	4447	3665
12	Devdoraki , 241	SU4G08011048	6.2	Hanging Valley	North / East	6.9	2392	5038	3326

#	Glacier Name and / or Number ,	ID WGI According to	Glacier Area (km 2)	Morphological type	General Exposure	Maximum Length (km)	Minimum Height (m)	Maximum Height (m)	Firni Line Height (m)
13	Mna , 233	SU4G08011060	3.1	Hanging Valley	South / East	3.3	3036	4612	3568
14	232	SU4G08011061	2.7	Hanging	South .	4.3	3292	4586	3681
15	231 East Suatisi	SU4G08011062	7.9	Hanging Valley	South / West	4.5	3230	4532	3615
16	Middle Suatisi 230	SU4G08011063	2.1	Hanging Valley	South	4.0	2975	4734	3583

Quantitative evaluation of alterations in significant glaciers in Georgia is essential. The study of large glaciers is particularly important for the accurate determination of the exact location of the glacier's terminus, as this reference point directly influences the glacier's characteristics, including its length and minimum elevation. Expert knowledge becomes indispensable when the glacier tongue is obscured by moraines or debris.

For this study, glaciers with clearly defined and unobstructed tongue ends were selected. The methodology employed to assess the dynamics and rate of retreat of the glacier tongue's terminus for large glaciers is detailed in references [231–232].

In addition to the OA/OC procedures, the alignment of TDS data with ground observations from the National Environment Agency was utilized. The processed TDS data illustrates the glacier locations across various years, represented by contours in distinct colors. The extent of glacier retreat is determined by the white dashed line that intersects these contours. The acquisition date of satellite data and cloud cover conditions are considered, although images with significant cloud cover may still be useful if they do not obscure the glacier tongue's terminus.

The following standardized notations are applied to satellite imagery of glaciers.

- The blue line indicates the precise contour of the glacier;
- The green line indicates the rocky areas free from snow and ice;
- The light purple line indicates the firn line;
- An additional perpendicular line intersecting the contours is used to calculate the length of the glacier, which is marked in brown;
- The yellow line indicates the state border with the Russian Federation.

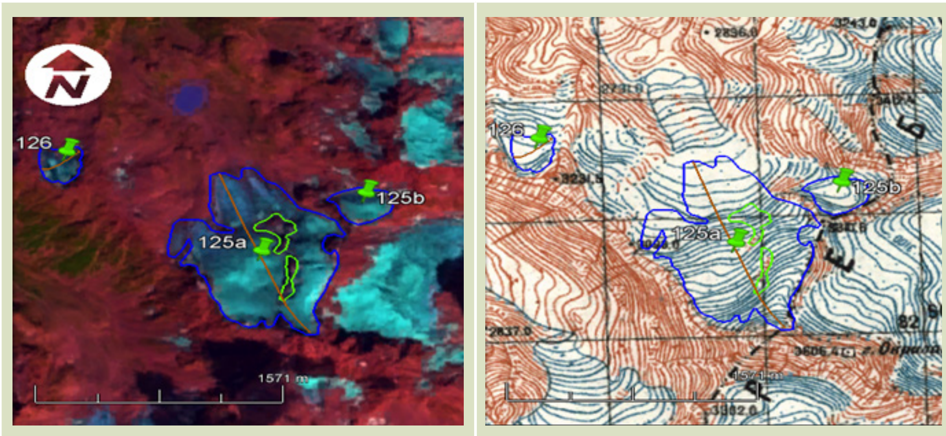
Large glaciers can be found in Western Georgia, specifically within the glacial basins of the Bzipi, Kelasuri, and Kodori rivers, which are situated in the Autonomous Republic of Abkhazia. In light of this information, the examination of the Chepara glacier referenced in question No. 125 is deemed pertinent. Figure 4.5.1 presents a satellite image along with the

231 Kordzakhia G. I., Shengelia L. D., Tvauri G. A., Dzadzamia M. Sh. The climate change impact on the glaciers of Georgia. In Journal-World Science, vol. 1, № 4(44), Warsaw, Poland, 2019, pp. 29-34.

232 George Kordzakhia. Fourth National Communication of Georgia, Under the United Nations Framework Convention on Climate Change. 4.4 Glaciers, Tbilisi, 2021, pp. 241-250. https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf

contours of the Chepara glacier, and it also includes a comparison of these contours with those depicted on the topographic map. According to the catalog, the area of the Chepara glacier is recorded as 1.6 km², while the satellite image indicates an area of 0.9 km².

FIGURE 4.5.1: GLACIERS NO. 121 – NO. 125 (CHEPARA): A – CONTOURS ACCORDING TO THE LANDSAT 7 ETM+ SENSOR IMAGE OF SEPTEMBER 6, 2015, B – COMPARISON OF THE REFINED CONTOURS OF THE GLACIERS WITH THE CONTOURS OF THE GLACIERS DEPICTED ON THE TOPOGRAPHIC MAP.



a	b

FIGURE 4.5.2: SCHEMATIC IMAGE OF THE RETREAT OF THE CHEPARA GLACIER.

Data obtained from multiple Landsat satellite sensors were utilized to analyze the dynamics of the Chepara Glacier's retreat. The contours marking the glacier's final position were established and enhanced using a high-resolution SPOT 6 satellite image taken on September 29, 2020, with a resolution of 1.5 meters. A schematic representation of the Chepara Glacier's retreat, derived from the TDS, is illustrated in Figure 5.4.2.

Table 4.14. presents various characteristics of the Chepara Glacier's retreat as determined from the TDS.

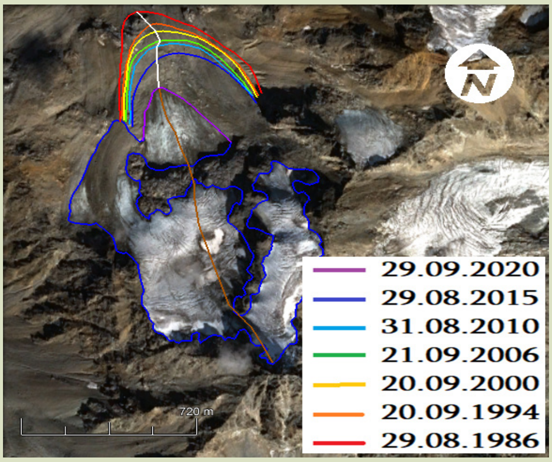
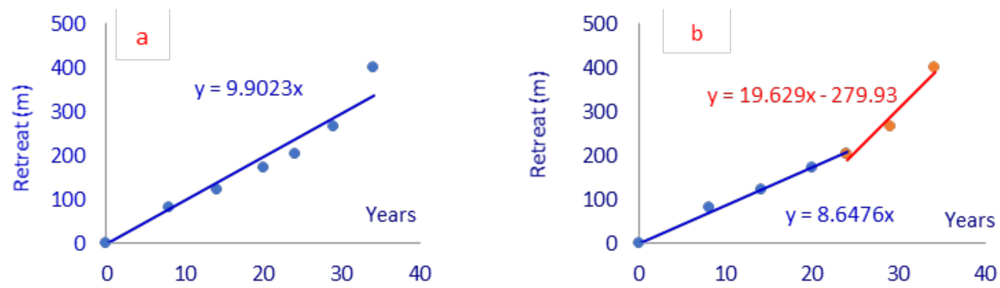


TABLE 4.14. LOCATION AND RETREAT DISTANCES OF THE END OF THE CHEPARA GLACIER TONGUE.

№	Satellite Type	Date	Coordinates (degrees)		Retreat (m)	Total Return (m)
			latitude	Longitude		
1	Landsat 5 TM	8/29/1986	43.15195	42.10432	0	0
2	Landsat 5 TM	9/20/1994	43.15134	42.10501	83.9	83.9
3	Landsat 7 +ETM	9/20/2000	43.15108	42.10529	40.6	124.5
4	Landsat 7 +ETM	9/21/2006	43.15065	42.10553	47	171.5
5	Landsat 8 OLI TIRS	31.08.2010	43.15042	42.1054	31.5	203.1
6	Landsat 8 OLI TIRS	29.08.2015	43.14987	42.10539	63.8	266.9
7	Spot 6	29.08.2020	43.14865	42.10552	134	400.9

Figure 4.5.3 illustrates a diagram depicting the shift in the position of the Chepara glacier tongue along with the associated trend, derived from the TDS data. The baseline state is representative of the year 1986. To elucidate the effects of persistent climate change on the Chepara glacier, a diagram has been created, segmenting the observation period into two distinct sub-periods: 1986–2010 and 2010–2020.

FIGURE 4.5.3: CHEPARA GLACIER RETREAT PATTERN AND TREND: A – FOR THE FULL OBSERVATION PERIOD, B – FOR TWO SUB-PERIODS OF OBSERVATION



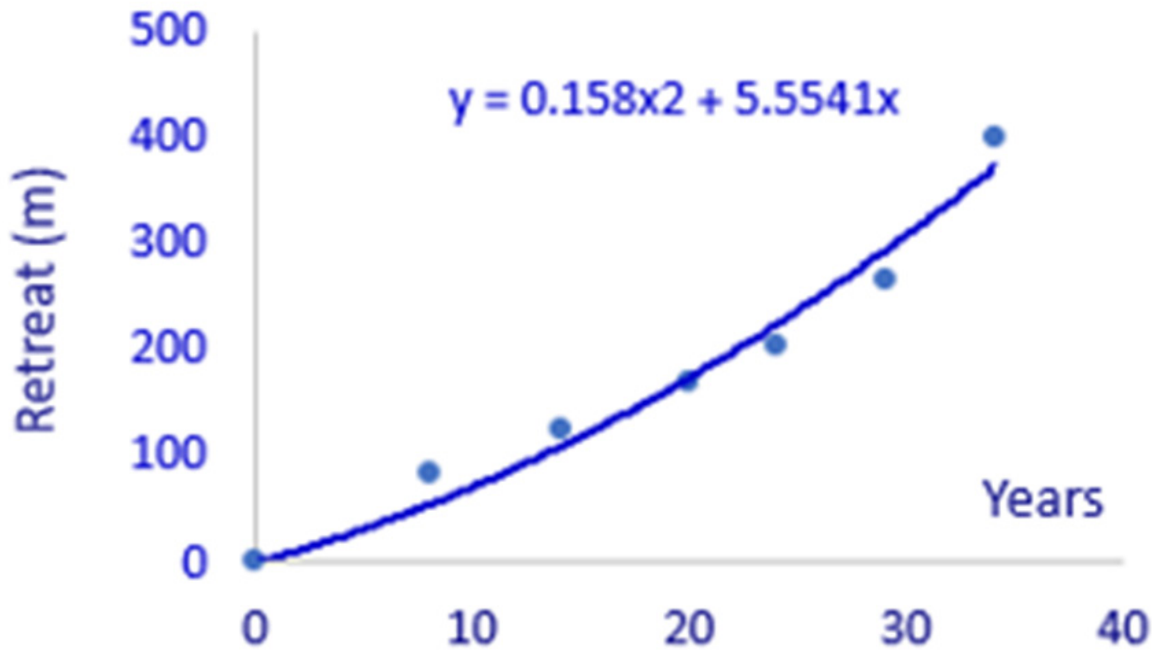
The analysis indicates that the Chepara Glacier has an overall retreat rate of approximately 9.9 meters per year. During the initial sub-period, this rate is around 8.6 meters per year, while in the subsequent sub-period, it escalates to approximately 19.6 meters per year. The significant increase in retreat during the second sub-period compared to the first suggests a nonlinear pattern of glacier retreat. These findings support the assertion that the accelerated degradation of the Chepara Glacier is attributable to contemporary climate change. Furthermore, the data on glacier retreat serve as a reliable indicator of the ongoing and intensifying effects of climate change over time. The calculations conducted reveal that the retreat of the Chepara Glacier can be accurately represented by a second-order parabolic curve.

The equation describing the retreat of the Chepara Glacier is:

$$y = 0.158\, x^2 + 5.5541\, x$$

Where x denotes time, and y denotes retreat.

FIGURE 4.5.4: DIAGRAM OF THE RETREAT OF THE CHEPARA GLACIER



The deterioration of significant glaciers in various glacial basins was similarly examined.

In the case of the **large glaciers within the Enguri River glacial basin**, the condition of No. 211 - **the North Liadeshti glacier** was analyzed using satellite data. The resulting contour was compared to the glacier outline presented on the topographic map. It was found that the area of the North Liadeshti glacier, according to the TDS, is 3.4 km², which aligns with the value provided in the catalog, suggesting a discrepancy in the catalog's accuracy. Adjustments made using the topographic map indicated that the actual area is 4.3 km².

The analysis of the North Liadeshti glacier's retreat revealed that its retreat can be characterized by a parabolic curve.

$$y=0.1321x^2+7.148x-12.027$$

The subsequent significant glacier in the Enguri basin, moving from west to east, that has been examined is Glacier No. 229, known as Kish. The issues related to its retreat were also addressed in the Fourth National Communication[233]. It is important to mention that data for the year 2020 were not accessible at that time; however, this absence did not notably alter the observed trend of glacier retreat.

The retreat of Glacier Kish is characterized by a parabolic curve.

$$y=0.513x^2+3.2826x$$

The subsequent significant glacier in the Enguri basin, progressing from west to east, that has been examined is Glacier No. 286, known as Adishi. The issues related to its retreat

233 George Kordzakhia. Fourth National Communication of Georgia, Under the United Nations Framework Convention on Climate Change. 4.4 Glaciers, Tbilisi, 2021, pp. 241-250. https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf

were addressed in the Fourth National Communication[234]. It is important to mention that data for the year 2020 were not accessible at that time; however, this absence did not notably alter the trend of glacier retreat. Mestia meteorological station, situated at an elevation of 1500 meters in proximity to the Adishi glacier, provides relevant data. Table 4.15. presents the average summer temperature Tmin for two distinct periods, along with the calculated difference Tmin derived from the station's data. An increase is observed in all three months, averaging 0.6 °C during the summer.

The information presented indicates that the deterioration of the Adishi glacier is attributable to contemporary climate change. Conversely, the data on glacier retreat serve as a significant indicator of the current climate change phenomenon and its intensification over time.

TABLE 4.15. ILLUSTRATES THE AVERAGE SUMMER AIR TEMPERATURE TMIN FOR TWO DISTINCT PERIODS, ALONG WITH THE DIFFERENCE BETWEEN THEM, TMIN, AS RECORDED BY THE MESTIA METEOROLOGICAL STATION.

Period	June	July	August	Summer
Tmin 1987–2001, 0C	13.7	17.5	16.7	16.0
Tmin 2001–2016, 0C	14.5	17.6	17.5	16.6
Tmin, 0C	0.8	0.1	0.8	0.6

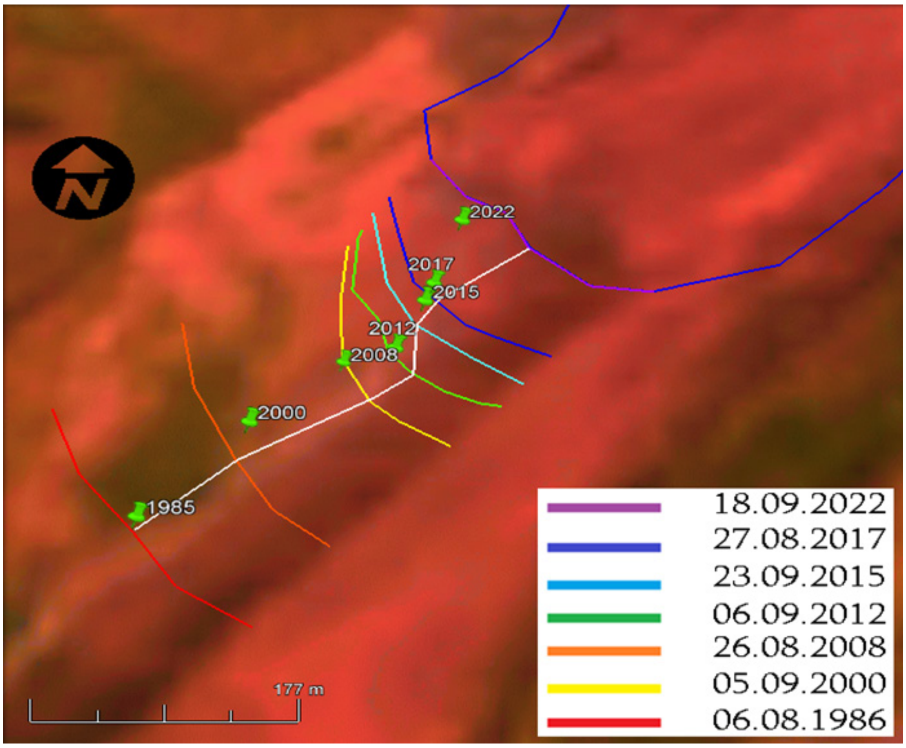
The retreat of the Adishi glacier is described by a parabolic curve.

$$y=0.317x^2-0.3186x-10.556$$

The Shkhara glacier, located in the Enguri basin, covers an area of 5.2 km² as per the catalog, while the TDS reports it to be 3.9 km². The catalog also indicates that the maximum elevation of the Shkhara glacier in western Georgia reaches 4,400 meters. Data collected from a retreat field expedition concerning the Shkhara glacier has been analyzed. The most recent satellite data from Landsat has been obtained, as illustrated in Figure 4.5.5.

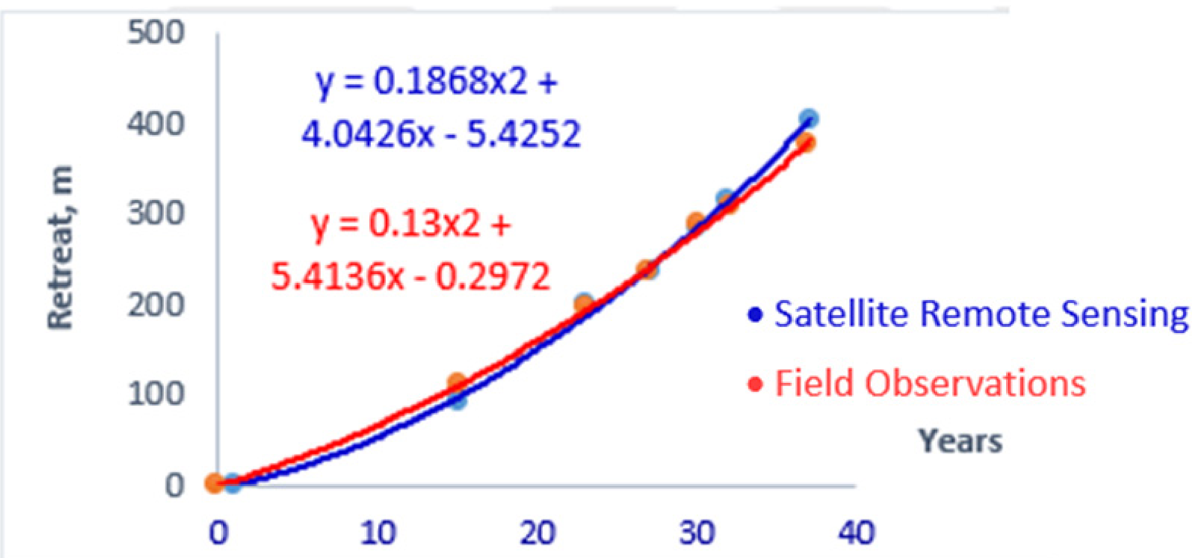
234 George Kordzakhia. Fourth National Communication of Georgia, Under the United Nations Framework Convention on Climate Change. 4.4 Glaciers, Tbilisi, 2021, pp. 241-250. https://unfccc.int/sites/default/files/resource/4%20Final%20Report%20-%20English%202020%2030.03_0.pdf

FIGURE 4.5.5: SCHEMATIC IMAGE OF THE RETREAT OF THE SHKHARA GLACIER AGAINST THE BACKGROUND OF THE LANDSAT 9 OLI TIRS SENSOR IMAGE OF SEPTEMBER 18, 2022. GREEN PINS SHOW DATA DETERMINED BY THE FIELD EXPEDITION.



The withdrawal of the Shkhara Glacier, along with the other significant glaciers mentioned, is characterized with considerable precision by a parabolic curve. The diagram illustrating the retreat of the Shkhara Glacier, developed based on data from field expeditions utilized for quality assessment and result verification, is similarly represented by a parabolic curve. As illustrated in Figure 5.4.6, there is a strong correlation between the Shkhara Glacier TDS and the field observation data.

FIGURE 4.5.6: SURFACE DATA FROM THE SHKHARA GLACIER TDS AND FIELD OBSERVATIONS



The retreat of the Shkhara glacier, based on field observations, is described by the equation:

$$y=0.13x^2+5.4136x-0.2972$$

And with satellite observations - with the equation:

$$y=0.1869x^2+4.0403x-5.4295$$

The area of the **Kirtisho Glacier**, No. 382, large glacier of the Rioni Basin, is 4.6 km2 according to the catalog, and 4.0 km2 according to the TDS. The calculations performed show that the nonlinear retreat of the Kirtisho Glacier is described with high accuracy by a second-order parabolic curve:

$$y=0.4756x^2-4.219x+11.112$$

The Boko Glacier, designated as No. 394 within the Rioni Basin, has an area of 4.6 km² as per the catalog, while the TDS reports it to be 3.7 km². The challenges associated with its retreat are thoroughly examined in the Fourth National Communication[235]. Although data for the year 2020 was not accessible at that time, this absence did not notably alter the concerns regarding the glacier's retreat. The retreat of the Boko Glacier, similar to that of other significant glaciers, exhibits a nonlinear pattern and is accurately represented by a parabolic curve.

$$y=0.0635x^2+13.576x$$

Large glaciers of East Georgia

In eastern Georgia, the Tergi River basin is home to the region's only significant glaciers. Among these, the Gergeti glacier stands out. Recent contour refinements have notably altered the shape of the Gergeti glacier. Analysis of a satellite image from September 1, 2010, alongside contours preserved in the GLIMS database, indicated that a large portion of the Mkinvartsveri plateau was classified as part of the Gergeti glacier. By employing a Digital Elevation Model (DEM) with 30-meter elevation increments to create hypsometric curves, the watershed boundaries were further delineated. This process revealed that a considerable section of the plateau is now associated with the Devdoraki glacier.

Adjacent to the Gergeti glacier is the Stepantsminda meteorological station. Table 4.16. presents the average summer air temperature (Tmin) for two distinct periods, along with the temperature difference (ΔTmin) recorded at this station. An increase in temperature is noted across all three summer months, averaging 1.1°C. These findings underscore that the rapid degradation of the Gergeti Glacier, similar to other glaciers, is primarily driven by climate change. Furthermore, the data on glacier retreat serves as a significant indicator of the ongoing and accelerating impacts of climate change over time.

235 Concept of protected and other conservation areas (working version, 2023);

TABLE 4.16. AVERAGE SUMMER AIR TEMPERATURE TMIN FOR THE TWO PERIODS AND THE DIFFERENCE BETWEEN THEM ΔTMIN ACCORDING TO THE STEPANTSMINDA METEOROLOGICAL STATION.

Period	June	July	August	Summer
Tmin 1987–2001, 0C	11.9	14.7	14.3	13.6
Tmin 2001–2016, 0C	13.1	15.2	15.7	14.7
Tmin, 0C	1.2	0.5	1.4	1.1

The calculations performed show that the nonlinear retreat of the Gergeti Glacier is described by a parabolic curve:

$$y=0.1966x^2+12.134x+8.0718$$

The second largest glacier of the Tergi glacial basin under consideration is the **Eastern Suatis**. The calculations performed show that the analytical form of its retreat is described by the following equation:

$$y=0.0874x^2+15.354x-9.6214$$

4.5.3. ESTIMATION OF THE ESTIMATED DATES OF COMPLETE MELTING OF GLACIAL BASINS

4.5.3.1 Estimation of the estimated dates of complete melting of large glaciers

It is essential to examine not only the present condition of glaciers but also to ascertain the projected timelines for their total melting. This matter can be addressed relatively straightforwardly, provided that climate change continues along its current trajectory. In climatological terms, this situation is referred to as the Business as Usual (BaU) scenario.

To estimate the dates for the complete melting of significant glaciers, the equations that describe the retreat of these glaciers, as outlined in section 4.4.2, are employed. For instance, to calculate the date for the total melting of the North-Eastern Liadeşti Glacier, one must first determine the length of retreat – y1 (over the entire observation period) and then add the remaining distance – y2, which indicates how much further the glacier must retreat to achieve complete melting from the last recorded observation.

$$y_1+y_2=y$$

The variable y represents the total length of the glacier from the onset of observation, or the distance the glacier would cover in the event of total melting. As per the data from 2022, the North Liadesti glacier measures 4,273 meters in length. Between 1986 and 2022, the glacier has receded by 392 meters. The sum of these two figures should correspond to the ordinate in the equation governing the retreat of the North Liadesti glacier, which can then be resolved into a quadratic equation.

$$0.1321x^2+7.148x-16.692=0$$

The positive solution derived from this equation is x=163, indicating that if the current rate of retreat persists, the North Liadesti glacier is likely to completely melt in approximately 163 years. Taking the initial year of 1986 into account, the projected year for the glacier's total melting is 2149 (1986+163). Table 4.17. presents the projected dates for the complete melting of other significant glaciers, calculated using a similar methodology.

TABLE 4.17. PROJECTED DATES FOR THE COMPLETE MELTING OF MAJOR GLACIERS IN GEORGIA BASED ON TDS DATA.

№	Glacier name, basin	Estimated date of complete melting, year
1	Chepara, Abkhazian glacial basin	2077
2	NE Liadeshti, Enguri basin	2149
3	Kvishi, Enguri basin	2095
4	Adishi, Enguri basin	2131
5	Shkhara, Enguri basin	2130
6	Kirtisho, Rioni basin	2087
7	Boko, Rioni basin	2161
8	NE Suatisi, Tergi basin.	2153
9	Gergeti glacier, Tergi basin.	2146

4.5.3.2 Determining the estimated dates of complete melting of glacial basins (where large glaciers exist)

Based on the projected dates for the total melting of the major glaciers presented in Table 4.17., a brief analysis was performed to ascertain the anticipated dates for the complete melting of each examined glacial basin. The findings indicate that the estimated date for the complete melting of the Abkhazian glacial basin is 2077; for the Enguri basin, it is 2149; for the Rioni basin, it is 2161; and for the East Georgian glacial basin, it is 2153.

4.5.3.3 Determining the estimated dates of complete melting of glacial basins (where there are no large glaciers)

To estimate the projected dates for the complete melting of glacial basins devoid of significant glaciers, regression equations were employed within the framework of the BaU climate change scenario.

In the context of eastern Georgia, the focus is on small and medium glaciers, utilizing data from Landsat satellites 4, 5, 7, and 8, covering the period from 1984 to 2022. Only six satellite images were deemed suitable for this analysis, a limitation attributed to both cloud cover and the extensive geographical range of these glacial basins, which extends from the Liakhvi Gorge to the Pirikita Alazani Gorge.

The satellite data processing involved multiple stages. Initially, the study area was delineated, followed by the identification of existing glaciers based on the basins of the Liakhvi, Aragvi, Asa (Arkhotis Tskal), Arghuni, and Pirikita Alazani rivers. To ascertain the glaciers' area, the satellite data underwent processing, which included assessing the reflectivity of the Earth's surface, applying topographic corrections to the results, and classifying the data using an unsupervised approach. Following classification, it became feasible to quantify the number of pixels in the raster image that were occupied by glaciers, thereby enabling the assessment of their chronological changes. This methodology allows for the determination of glacier areas, taking into account the spatial resolution of Landsat satellite imagery. The results of the area changes (reductions) in these glacial basins are presented in Table 4.18.

TABLE 4.18. DYNAMICS OF TOTAL AREA REDUCTION BY GLACIAL BASINS.

Date	Satellite	Time	Areas (km2) by glacial basins					
			Liakhvi	Aragvi	Khde	Asa	Arghuni	Pirikita Alazani
9/26/1984	Landsat 5	0	2.502	0.3969	5.1741	1.0431		6.903
8/31/1989	Landsat 4	4.931507	3.1356	-	-	0.8478	1.0638	-
9/6/1994	Landsat 5	9.950685	2.5029	-	3.1023	0.7416	0.9225	3.6261
8/28/2014	Landsat 8	29.93973	1.8009	0.2448	2.3427	0.765	0.5805	2.2518
9/5/2017	Landsat 8	32.96438	1.557	0.2484	1.6263	0.648	0.3303	1.2816
9/13/2022	Landsat 8	37.98904	0.6732	0.099	0.6075	0.2961	0.0765	0.3474

FIGURE 4.5.7 SHOWS THE DEPENDENCE OF THE TOTAL AREA OF GLACIERS IN THE GLACIAL BASINS OF EASTERN GEORGIA ON TIME BY YEAR.

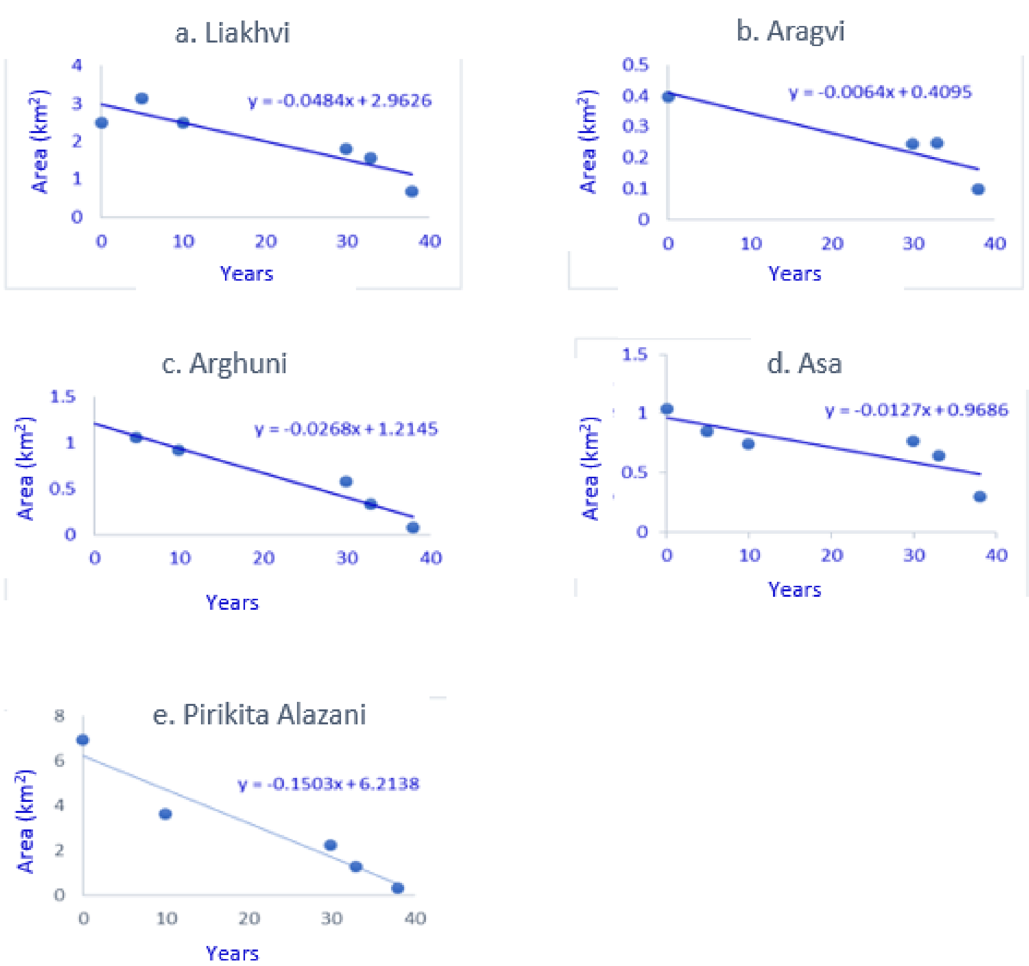


Figure 4.5.7: Time dependence of glacial basin areas

The determination of the ordinate at zero within the trend equations for the glacial basins of East Georgia allows for the calculation of the estimated time required for complete melting in each basin. Specifically, the projections indicate that the Liakhvi River will take approximately 61 years, the Aragvi River 64 years, the Arghuni River 45.3 years, the Asa River 76.3 years, and the Pirikita Alazani River 41.3 years to fully melt. By adding the initial observation year of 1984 to these estimates, the anticipated dates for complete melting of each glacial basin in East Georgia can be established, as detailed in Table 4.19.

TABLE 4.19. ESTIMATED DATES OF COMPLETE MELTING FOR GLACIAL BASINS OF EAST GEORGIA WHERE THERE ARE NO LARGE GLACIERS.

№	Glacial basin	Estimated date of complete melting (years)
1	River Liakhvi	2045
2	River Aragvi	2048
3	River Asa	2060
4	River Arguni	2029
5	River Pirikita Alazani	2025

Three of the six glacial basins located in Western Georgia, specifically the Bzipi, Kelasuri, and Khobistskali basins, lack significant glacier presence. It is important to highlight that within the Khobistskali basin, only three minor glaciers are documented in the catalog: No. 332, 333, and 334. By the year 2010, only glacier No. 334 persisted, which had fragmented into a single small glacier (covering an area of 0.1 km²) and six snowfields. By 2020, all of these features had diminished further. There is a strong possibility that this glacial basin will completely melt in the near future. The analysis of glacier dynamics in the Bzipi and Kelasuri basins utilized Landsat 5, 7, and 8 satellite data spanning from 1986 to 2023, with fourteen distinct dates of satellite imagery available during this timeframe. The total areas of glaciers, as determined by the TDS, are presented in Table 4.20. according to the respective dates.

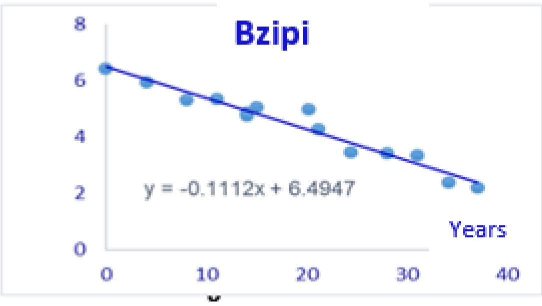
TABLE 4.20. TOTAL AREAS OF GLACIERS DETERMINED BY THE TDS IN THE BZIPI AND KELASURI RIVER BASINS BY DATE.

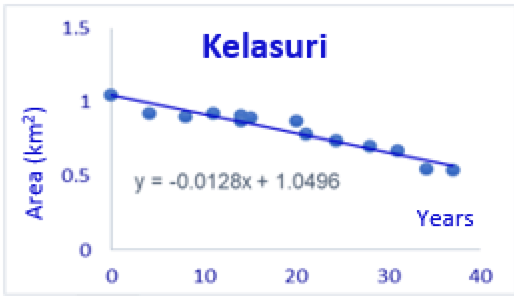
Date	Satellite	Time (year)	Areas by glacial basins (km2)	
			Bzipi	Kelasuri
8/29/1986	Landsat 5	0	6.4314	1.0503
9/25/1990	Landsat 5	4.076712	5.9553	0.9243
9/20/1994	Landsat 5	8.065753	5.3289	0.9
9/19/1997	Landsat 5	11.06575	5.3559	0.9225
9/12/2000	Landsat 7	14.04932	4.8609	0.9099
9/20/2000	Landsat 5	14.07123	4.7439	0.8721

Date	Satellite	Time (year)	Areas by glacial basins (km2)	
			Bzipi	Kelasuri
9/6/2001	Landsat 7	15.03288	5.0589	0.8973
10/7/2006	Landsat 5	20.12055	4.9896	0.8748
10/1/2007	Landsat 5	21.10411	4.2741	0.7821
1/19/2011	Landsat 5	24.40822	3.4506	0.738
9/2/2014	Landsat 8	28.03014	3.4119	0.7011
9/3/2017	Landsat 8	31.03562	3.3291	0.6714
10/13/2020	Landsat 8	34.14795	2.3796	0.5472
9/7/2023	Landsat 8	37.04932	2.1942	0.5454

Figure 4.5.8 shows graphs of changes in the total area of glaciers determined by the TDS in the glacial basins of the Bzipi and Kelasuri rivers.

FIGURE 4.5.8: GRAPHS OF CHANGES IN THE TOTAL AREA OF GLACIERS DETERMINED BY THE TDS IN THE BZIPI RIVER (LEFT GRAPH) AND KELASURI RIVER GLACIAL BASINS.





In the case of the BaU climate change scenario, glacier retreat equations were used to determine the estimated dates of complete melting of glaciers. For this, the ordinate in the trend equations was set to zero and the solution was determined. The estimated time of complete melting was determined for each glacial basin: for the Bzipi glacial basin this is 58 years, and for the Kelasuri glacial basin - 82 years. By adding the initial observation date (1986) to these values, the estimated date of complete melting of the Bzipi glacial basin is 2044 years, and for the Kelasuri basin - 2068 years.

4.5.4 ON THE DYNAMICS OF THE DEGRADATION OF GLACIAL BASINS IN GEORGIA

Glaciers are distributed unevenly around the world and within certain river basins. In Georgia, a significant concentration of glaciers is found in the glacial basins associated with the Enguri, Rioni, Kodori, Tergi, and other rivers, where elevations reach 3,500 meters and above.

The effects of ongoing climate change on glaciers and their accelerated deterioration are evident in the alterations observed in the characteristics of glacial basins, which serve as effective indicators of regional climate variations. To analyze the dynamics of glacial basin degradation, it is essential to gather data on the glaciers within these basins at various observation points, specifically at the baseline provided by the catalog and at three additional observation dates established by the TDS (refer to Chapter 4.4.1).

Utilizing this data, a numerical analysis was performed to assess changes in the area of glacial basins (a representative metric) and the number of glaciers (an unrepresentative metric) to identify trends in the degradation of these basins. The fluctuation in the number of glaciers within glacial basins is deemed unrepresentative, as intricate processes occur during glacier degradation, and the number of glaciers does not directly correlate with the effects of climate change. For instance, multiple smaller glaciers may form as larger and medium-sized glaciers deteriorate. Consequently, the alteration in the area of a glacial basin serves as a precise physical indicator of its degradation, while the variation in the number of glaciers can be regarded as an indirect, supplementary characteristic of this phenomenon. As previously noted, the analysis of the degradation dynamics of Georgia's glacial basins was conducted separately for the Western and Eastern regions due to the significant climatic differences between these areas.

In the Autonomous Republic of Abkhazia, located in Western Georgia, one can find the glacial basins associated with the Bzipi, Kelasuri, and Kodori rivers. Currently, the examination of these glaciers can only be conducted with the assistance of the TDS, primarily due to the ongoing occupation and the absence of a glaciological research institution within the Abkhazian region. The comprehensive distribution of glaciers in Abkhazia, categorized by both area and quantity within the glacial basins, is presented in Table 4.21.

TABLE 4.21. DISTRIBUTION OF GLACIER AREAS AND QUANTITIES IN THE ABKHAZIAN GLACIAL BASIN ACROSS VARIOUS OBSERVATION PERIODS.

Glacial basin			Glacier areas				Number of glaciers			
№	With the catalog of glaciers No.	Size	Catalog	TDS 1	TDS 2	TDS 3	Catalog	TDS 1	TDS 2	TDS 3
1	General characteristics of glacial basins of Abkhazia, 1–136	Small	23.9	25.9	22.2	18.8	92	138	116	104
		Medium	41.0	23.5	19.5	13.9	41	27	20	15
		Large	9.1	6.2	3.9	3.6	3	2	1	1
		Total	74.0	55.6	45.6	36.3	136	167	137	120

The catalog indicates that there are 92 small glaciers located within the glacial basins of Abkhazia. However, due to the fragmentation of these glaciers, the count rose to 138 by 2010. This number subsequently declined to 116 in 2015 and further to 104 by 2020. While the overall number of small glaciers increased throughout the observation period, a downward trend began in 2010. The average number of glaciers recorded in the catalog is 41, with figures of 27 in 2010, 20 in 2015, and 15 in 2020. Additionally, the average area of these glaciers has diminished from 41.0 km² to 13.9 km². The catalog lists 3 large glaciers, which decreased to 2 in 2010, and further to 1 in both 2015 and 2020. The area of these large glaciers has also contracted from 9.1 km² to 3.6 km². An examination of the overall changes in the area of the glacial basins in the Abkhaz region reveals a steady reduction over time, with the total area occupied by glaciers decreasing from 74 km² to 37.7 km², representing a decline of 50.1%.

The distribution of glaciers within the Rioni River basin is detailed in Table 4.22.

TABLE 4.22. DISTRIBUTION OF AREAS AND NUMBER OF GLACIERS IN THE RIONI RIVER BASIN BY OBSERVATION PERIOD.

Glacial Pool			Glaciers Area (km 2)				Glaciers Quantity			
No.	With the catalog of glaciers No.	Size	Cat .	TDS 1	TDS 2	TDS 3	Cat .	TDS 1	TDS 2	TDS 3
1	Rioni 335-409	Small	8.5	14.3	12.4	9.6	37	67	56	52
		Medium	26.8	13.9	12.6	11.5	28	15	13	13
		Big	35	29.0	20.7	20.2	10	9	8	8
		Total	70.3	57.2	45.7	41.3	75	91	77	73

The catalog indicates that the Rioni River basin is home to 37 small glaciers, 28 medium glaciers, and 10 large glaciers. By 2010, the count of small glaciers had risen by 30, representing an increase of 44.8%, bringing the total to 67. However, by 2015, this number had declined by 11, or 16.4%. A further decrease of 4 glaciers, equating to 7.1%, is anticipated by 2020. Overall, from the initial count to 2020, the number of small glaciers in the Rioni Gorge has increased by 15, or 28.8%, a change attributed to the fragmentation of glaciers.

In terms of the area of the glacial basin over time, there has been a noticeable decline. Initially, the catalog recorded 70.3 km² of glacier coverage in the Rioni Basin, but by 2020, the TDS recorded only 41.3 km². Consequently, the area occupied by glaciers has decreased by 29.0 km², which represents a reduction of 41.3%.

The distribution of glaciers in Eastern Georgia is detailed in Table 4.23.

TABLE 4.23. CHANGES IN THE NUMBER AND AREA OF GLACIERS IN EASTERN GEORGIA OVER THE OBSERVATION PERIODS.

Glacial Pools			Glaciers Area (km 2)				Glaciers Quantity			
No.	With the catalog of glaciers No.	Size	Cat .	TDS 1	TDS 2	TDS 3	Cat .	TDS 1	TDS 2	TDS 3
1	Rivers Liakhvi , Aragvi , Tergi , Asa , Arghun , Pirikita Alazani Glacial Pools Total Features	Small	23.5	13.4	9.9	4.4	99	67	53	25
		Medium	20.6	11.4	8.4	6.6	24	12	9	8
		Big	42.9	31.3	29.2	26.2	9	8	7	6
		Total	87	56.1	47.5	37.2	132	87	69	39

The catalog indicates that there were 132 glaciers located in eastern Georgia. Among these, 99 were classified as small glaciers, 24 as medium glaciers, and 9 as large glaciers. Over a span of 50 years, the number of small glaciers diminished by 32, representing a decrease of 32.3%, resulting in a total of 67. The medium glaciers saw a reduction of 12, or 50%, leaving 12 remaining, while the large glaciers decreased by 1, which is an 11.1% reduction, bringing their total to 8. Following an additional 5 years, the small glaciers further declined by 14, a 20.9% decrease, resulting in 53. The medium glaciers decreased by 3, or 25%, to 9, and the large glaciers also saw a reduction of 1, which is a 12.5% decrease, leaving 7.

By the year 2020, after another 5 years, the small glaciers had decreased by 28, amounting to a 52.8% reduction, resulting in a total of 25. The medium glaciers experienced a decrease of 1, or 11.1%, bringing their total to 8, while the large glaciers also decreased by 1, a 14.3% reduction, resulting in 6.

In summary, from the original 132 glaciers, after 50 years, the total number of glaciers had decreased by 45, or 34.1%, to 87. Following another 5 years, the number further declined by 18, or 20.7%, to 69. After an additional 5 years, the total decreased by 30, representing a 43.5% reduction. Due to the effects of ongoing climate change, only 39 glaciers remain, indicating a total decline of 70.5% in the number of glaciers in Eastern Georgia.

The area occupied by small glaciers was 23.5 km², while medium glaciers covered 20.6 km², and large glaciers encompassed 42.9 km². After 50 years, the area of small glaciers decreased by 10.1 km², or 43.0%, to 13.4 km²; the medium glaciers' area reduced by 9.2 km², or 44.7%, to 11.4 km²; and the area of large glaciers diminished by 11.6 km², or 27.0%,

The total area of glaciers in eastern Georgia has diminished by 57.3%.

An examination of the trends in glacier degradation in both western and eastern Georgia reveals that the eastern region is experiencing a more rapid retreat and melting of glaciers, attributed to notable climatic differences.

4.6 CLIMATE CHANGE IMPACTS AND ADAPTATION ON GEORGIAN FORESTS

4.6.1 ABOUT THE MAIN CHARACTERISTICS OF GEORGIAN FORESTS

The structural makeup of Georgian forests is intricate and varied, contributing to the resilience of these ecosystems and fostering favorable conditions for biodiversity. Primarily, forests serve essential functions such as soil protection, water conservation, water regulation, and various sanitary and hygienic benefits. They play a crucial role in providing forest resources to the population and economy of the country. Furthermore, the forest expanses found in the Greater and Lesser Caucasus hold significant global ecological value, as they are among the last remaining pristine forests within the temperate climate zone.

Forests cover 44.5% of Georgia's land area, totaling approximately 3,100,500 hectares. Of this forested land, 24.5% (759.2 thousand hectares) is situated in temporarily occupied territories, specifically: 547.6 thousand hectares in the Abkhazian region and 211.6 thousand hectares in the Tskhinvali region.

The distribution of forests across the country is uneven, influenced by climatic diversity. Notably, Adjara has a high proportion of forested area relative to its total land area, at 68.8%, whereas Kvemo Kartli has a significantly lower forest coverage of only 23.7%.

The distribution of forested areas by region is as follows:

1. Kvemo Kartli - 148.2 thousand ha (23.7%);
2. Samtskhe-Javakheti - 188.7 thousand ha (29.3%);
3. Kakheti - 352.2 thousand ha (31.1%);
4. Samegrelo-Zemo Svaneti - 301.6 thousand ha (39.9%);

5. Mtskheta-Mtianeti - 269.3 thousand ha (40.4%);
6. Shida Kartli - 259.5 thousand ha (45.5%);
7. Guria - 102.7 thousand ha (50.1%);
8. Imereti - 393.2 thousand ha (60.3%);
9. Abkhazia - 548.2 thousand ha (63.1%);
10. Racha-Lechkhumi Kvemo Svaneti - 325.9 thousand ha (64.3%);
11. Adjara - 199.4 thousand ha (68.8%).

The notable distinction between the climates of Eastern and Western Georgia significantly influences the variety of vegetation and the vertical stratification of forests. Western Georgia exhibits a straightforward profile of altitudinal zonation, lacking arid and semi-arid vegetation belts, and is categorized into five primary zones: forests (0-1900 m), subalpine (1900–2500 m), alpine (2500–3100 m), subnival (3100–3600 m), and nival (above 3600 m). In contrast, Eastern Georgia presents a more intricate altitudinal zonation, comprising six main zones: deserts, dry steppes, and arid light forests (150-600 m), forests (600-1900 m), subalpine (1900-2500 m), alpine (2500-3000 m), subnival (3000–3500 m), and nival (above 3500 m).

Over 60% of the forests are situated at elevations exceeding 1000 m above sea level, with more than 49% located on slopes with an inclination of 26 degrees or more. A substantial portion of these forests, amounting to 39.4%, is found on northern-facing slopes.

Natural forests account for over 98% of the total forest area. Among these, 93% are composed of groves that have originated from natural seeds, while 5.5% consist of natural deciduous forests. Additionally, a minor proportion of artificially planted groves, primarily of pine, constitutes 1.5% across various regions of Georgia.

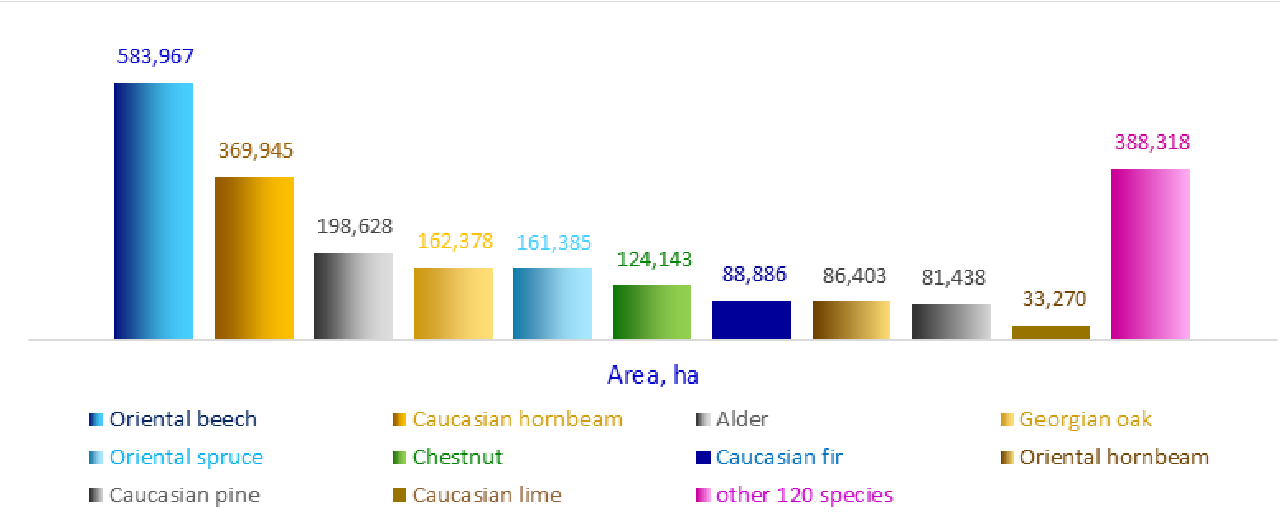
The composition, structure, growth, and development of these forests, along with other characteristics, contribute to their rich biodiversity. The extensive variety of dendroflora is evidenced by the presence of numerous endemic woody plants, with 61 species endemic to Georgia and 43 to the Caucasus region. Notably, 82.5% of the Georgian forest area is covered by forests formed from two or more woody species, which fosters a diverse habitat for various organisms and enhances resilience against adverse factors, including those associated with ongoing climate change. The majority of Georgian forests, approximately 83%, are deciduous species, while coniferous forests account for 17%.

The National Forest Inventory has identified 130 woody species, each exhibiting varying growth and development patterns based on their geographical location. When these species coexist with others, they contribute to a rich diversity of groves. The most prevalent species across the nation is beech, notable for its significant timber resources and extensive coverage. It predominantly serves as a dominant species, although it is classified as a sub-dominant in only two regions: Samtskhe-Javakheti, where spruce predominates at 38.1%, and Samegrelo-Zemo Svaneti, where it is nearly equally represented alongside Caucasian spruce at 25.8%.

TABLE 4.24. PRINCIPAL WOODY SPECIES CONSTITUTING THE FORESTS OF GEORGIA.

N	Species	Forested area %	Total timber stock %
1	Eastern beech	25.7	32.3
2	Caucasian hornbeam	16.2	12.1
3	Alder	8.7	5.0
4	Georgian oak	7.1	4.8
5	Oriental spruce	7.1	11.2
6	Common chestnut	5.4	5.4
7	Fir	3.9	9.8
8	Oriental hornbeam	3.8	1.0
9	Pine	3.6	4.3
10	Lime	1.5	2.7
11	Other	17.1	11.4

FIGURE 4.6.1: DISTRIBUTION OF MAIN WOODY FOREST SPECIES BY AREA



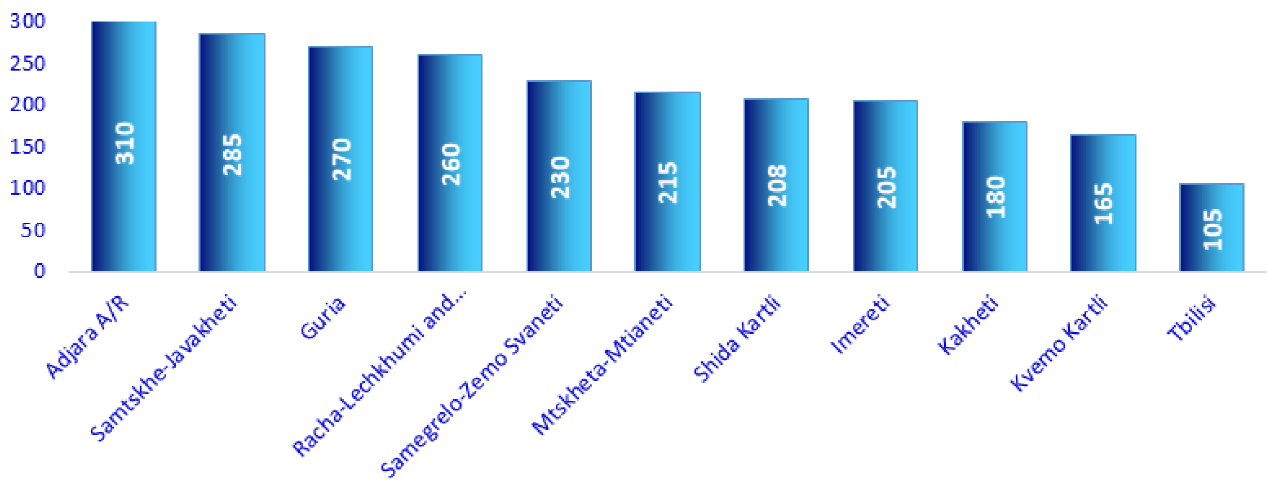
Georgian forests provide a wide array of ecosystem services. Beyond their vital ecological functions, which include soil protection, water conservation, water regulation, climate regulation, and various sanitary-hygienic benefits, these forests are essential for fulfilling the needs of the population and fostering the economic development of the country. Timber resources are utilized to satisfy the demand for both fuel and industrial timber. Additionally, non-timber resources, such as plant products, mushrooms, berries, and medicinal plants, along with recreational activities within the forest, enhance value chains and support the growth of multiple sectors.

The first national forest inventory indicates that Georgia's total forest timber stock amounts to 528.2 million m³. The average timber stock per hectare is recorded at 231.8 m³, which encompasses growing timber (217.6 m³/ha, including single trees, undergrowth, and sapling timber), dead timber (7 m³/ha), and felled timber (7.2 m³/ha). It is also important to highlight the current timber addition, which stands at 1 m^3/ha, while the overall forest addition is 13.7 million m^3.

A significant 61% of the total timber stock is found on slopes exceeding 260 degrees, with 73.3% located at altitudes above 1000 meters. The largest proportion of timber, amounting to 39.1%, is situated on northern-facing slopes.

Adjara is notable for its substantial timber reserves, averaging 311 m^3 per hectare. Other regions of interest include Samtskhe-Javakheti (292.4 m^3/ha), Guria (270.9 m^3/ha), and Racha-Lechkhumi-Kvemo Svaneti (260.9 m^3/ha).

FIGURE 4.6.2: DISTRIBUTION OF TIMBER BY REGION IN M3/HA



The eastern beech constitutes the largest portion of the timber stock, accounting for 32.5% of the total volume in the forests. Following it is the Caucasian hornbeam, which represents 12.1% of the total timber stock per hectare. Although the distribution of spruce and fir in eastern Georgia is somewhat limited, they collectively contribute a significant 20.9% to the timber resources.

It is important to highlight that the quality of timber in Georgian forests is generally low, with 70.9% of the total timber volume classified as having low economic value.

In addition to timber, Georgian forests are abundant in non-timber resources. They host a variety of mushrooms, berries, and medicinal plants, although a comprehensive assessment of these resources has yet to be conducted. Nonetheless, key species with economic potential have been identified, marking a significant advancement that will aid in promoting the sustainable and multipurpose utilization of forest resources in the future. Notable species include blueberries (Vaccinium myrtillus, V. arctostaphylos, V. vitis-idaea), ragwort (Senecio platyphylloides, S. rhombifolius), dog rose (Rosa canina, R. corymbifera), apple (Malus orientalis), sea buckthorn (Hippophae rhamnoides), yarrow (Achillea millefolium), primrose (Primula macrocalyx), horsetail (Leucojum aestivum), barberry (Berberis vulgaris), and hawthorn (Crataegus kyrtostyla, C. pentagyna, C. orientalis). These species, along with the Fir pine, are of significant interest to both local and export markets.

4.6.2. FOREST RESOURCE MANAGEMENT AND RESOURCE UTILIZATION PRACTICES

Over the years, Georgia's forestry sector has experienced numerous institutional shifts and inconsistent policies, which have adversely impacted both the quantitative and qualitative metrics of its forests. Research[236] indicates that a substantial portion of Georgia's forested areas is in a state of degradation, primarily due to reliance on wood resources for fuel and a decline in timber quality resulting from unregulated logging practices. This degradation contributes to a diminished capacity for carbon absorption, with Georgian forests playing a vital role in managing the country's greenhouse gas emissions.

According to the 2022 National Forest Inventory, a considerable portion of the forested land, amounting to 807,178 hectares (34.5%), is classified as degraded. This degradation is evidenced by the presence of low-frequency groves (unnaturally low, below 0.3 frequency), which constitute 38.8% of the total degradation, alongside a decline in forest quality attributed to unregulated logging (36.2%). The primary factors contributing to this degradation stem from past forest management errors and adverse natural influences, including the proliferation of pests and diseases that detrimentally affect forest health. Additionally, soil erosion is prevalent, with erosion processes affecting 643,678 hectares (28.2%) of forested land, while livestock grazing impacts 20% of the area occupied by forest-forming woody species, further compromising soil health and the natural regeneration processes of the forest..

To address the challenges faced in the forest sector, Georgia initiated a comprehensive reform in 2012. The following year, the Parliament ratified the National Forest Concept[237], the first document to outline the country's policy in this area. This concept served as a foundation for legislative amendments governing the forest sector and for establishing long-term strategic objectives. It, along with internationally recognized best practices in forest management, guided the development of a new Forest Code, which was fully updated in 2021. Currently, the "Forest Code," along with its subordinate regulations, facilitates the establishment of an ecologically sustainable, socially equitable, and economically viable forest management system within the nation.

Concurrently, a persistent challenge has been the reliance on inaccurate and outdated data regarding the country's forests, which has hindered effective forest management planning and decision-making. To enhance forest accounting and monitoring, the first national forest inventory was conducted in 2022, providing updated statistical data on both quantitative and qualitative forest indicators. Between 2017 and 2023, the scope of forest management increased, leading to the development of revised forest management plans. By the end of 2023, nearly half of the forest area will have updated 10-year management plans, with a goal of covering all forest districts by 2030. An active phase is underway to establish a forest information and monitoring system aimed at improving data organization, analysis, transparency, and public accessibility. Several modules, data analysis tools, and a data management portal have been created to support this initiative.

To regulate the utilization of timber and non-timber resources while ensuring their sustainable extraction, both legislative reforms and the establishment of appropriate infrastructure have been undertaken. Notably, since 2021, regulations concerning the

236 https://mepa.gov.ge/Ge/Page/NFI
237 https://matsne.gov.ge/ka/document/view/2157869

commercial use of forest residues and non-timber forest products have been enacted. The government is actively implementing targeted programs aimed at engaging the local community and the private sector in the production of energy-efficient alternative fuels derived from forest waste biomass, as well as in the processing of non-timber resources. The transition from traditional firewood collection methods to a system known as “social cutting” is currently in progress, which facilitates the organized supply of sustainably sourced resources to the local population and public institutions through designated business yards. As of 2023, over 40 business yards have been established, with ongoing efforts to equip and staff these facilities, as well as to create additional yards. This initiative aims to simplify access to timber resources for local residents and the private sector while simultaneously enhancing forest oversight and mitigating the risks of illegal resource use.

The scope and effectiveness of initiatives aimed at restoring degraded forests have markedly improved. In the course of forest restoration efforts, emphasis is placed on developing a forest ecosystem that closely resembles natural conditions and is resilient to adverse climate changes. Between 2021 and 2023, the average annual rate of forest restoration reached 1,500 hectares, nearly ten times greater than the figures recorded in previous years. Additionally, future objectives have been established, with a target of implementing forest restoration measures across a minimum area of 20,000 hectares by 2030.

Considerable emphasis is placed on combating forest pests and diseases, as well as managing forest fires. To facilitate the early detection of pests and diseases, the planning of preventive strategies, and the effective execution of control measures, a forest pathological monitoring system has been established. This system consists of a network of permanent observation plots and the systematic organization of data. Additionally, forest fire management plans have been developed, and efforts are ongoing to enhance the risk assessment methodology. This methodology is expected to incorporate climate change scenarios and evaluate the vulnerability of forests in relation to these scenarios.

Despite these advancements, the sector continues to face challenges. The long-term vision, priorities, and strategic directions for addressing these challenges are outlined in several strategic documents approved at the national level, including “The Fourth National Environmental Action Program of Georgia” (2022-2026) and the “Georgian Climate Change Strategy 2030.” The actions specified in these strategic documents are designed to meet national needs while also fulfilling the international commitments undertaken by the country. The primary objective is to sustain and enhance both the quantitative and qualitative metrics of forests, maximize the benefits derived from forest ecosystems, and develop a forest management system that is responsive to climate change. This includes improving forest management planning through the strengthening of institutional capacities, continuously updating and refining the interpretation of forest-related data, alleviating pressure on natural forests, implementing a new mechanism for fuelwood supply, promoting the use of alternative energy sources and energy-efficient technologies, expanding forest maintenance and restoration efforts for degraded areas, and enhancing the utilization of multipurpose forests.

4.6.3 ABOUT THE MOST VULNERABLE AREAS OF THE FOREST (DEVELOPMENT OF

VULNERABILITY CRITERIA AND SELECTION OF TARGET AREAS BASED ON THE CRITERIA)

Georgia's distinctive physical and geographical characteristics, along with its varied climatic conditions, contribute to a remarkable diversity of vegetation and tree species within its forests. The origins and species composition of these forests are critical factors influencing their stability and resilience against challenges posed by climate change. The majority of Georgia's forest area - 82.5% - is covered by forests formed from two or more woody species, while over 98% of the country's total timber reserves are found in naturally occurring groves, with artificially established groves making up only 1.5%[238]. Nevertheless, assessments highlighted in previous national communications indicate that climate change is already impacting Georgia's forests, and this adverse effect may result in a significant decline in both the quantity and quality of forest resources, as well as the ecosystem services they provide.

In light of the country's diverse forests, characterized by their complex structures and development, alongside the challenges posed by climate change that threaten biodiversity, it is crucial to evaluate the vulnerability of these forests and establish long-term monitoring systems. Such assessments are essential for determining appropriate management strategies and adaptation measures tailored to various forest ecosystems. A key priority outlined in the National Forest Concept, the principal strategic document guiding sector policy, is the categorization of forest stands based on their composition and susceptibility to climate change. The Fourth National Communication has recommended the creation of indicators to assess the vulnerability of forest resources to climate change, advocating for the collection of historical non-climatic data to support this analysis, including geo-information techniques. However, as of 2023, this process remains incomplete, and there is a lack of a standardized methodology or guidelines at the national level. It is important to note that in 2019, the Food and Agriculture Organization of the United Nations (FAO) released a Framework Methodology[239] for Assessing the Vulnerability of Forests and Forest-Dependent Communities to Climate Change, which serves as a practical guide for evaluating forest vulnerability and offers essential tools and methods for further analysis. This framework also outlines criteria for assessing both direct and indirect impacts of climate change on forests, which were utilized in the Fourth National Communication to evaluate the Kakheti, Guria, and Mtskheta-Mtianeti regions, while similar assessments were conducted for the forest areas of Adjara, Zemo Svaneti, and Borjomi-Bakuriani as part of the Third National Communication. It is often challenging to separate the impacts of climate change from other environmental stresses. However, the most reliable indicators for evaluating the direct and indirect effects of climate change on forests are the temporal and spatial patterns of temperature and precipitation. These factors are intrinsically linked to the establishment of species distribution areas and forest types, species turnover, growth dynamics, and the capacity for self-renewal. Furthermore, it is important to note that both species turnover and changes in forest area are closely associated with anthropogenic influences. This relationship has been particularly evident in Georgia over the past three decades, where pressures on forests and unsustainable resource exploitation have arisen from the population's heavy reliance on timber and internal migration. Assessing the impact of climate change on species composition within

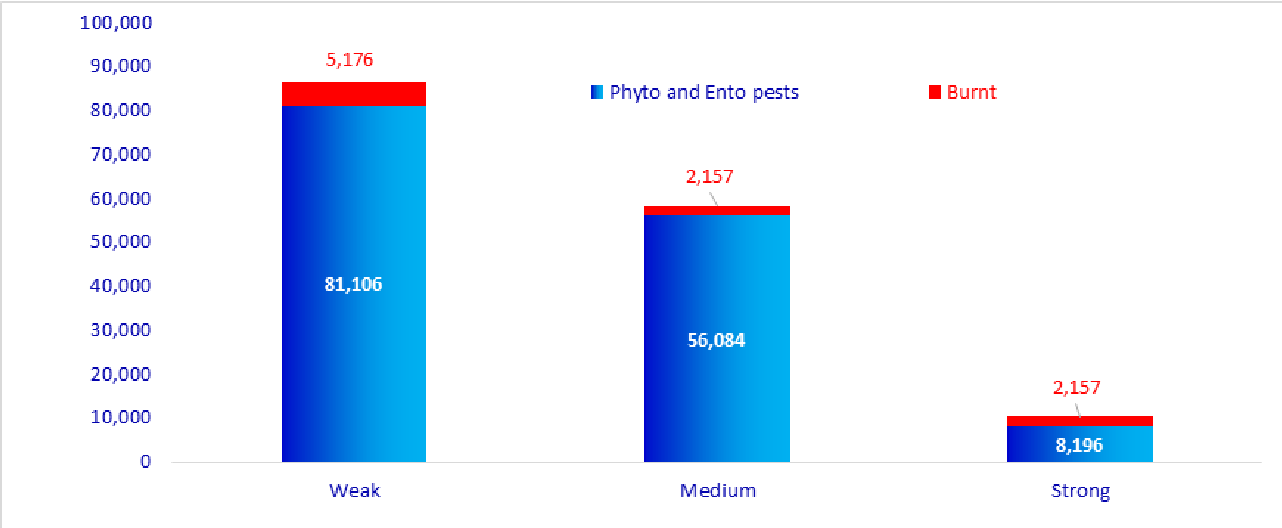
238 https://mepa.gov.ge/Ge/Reports

239 https://www.fao.org/documents/card/en?details=ca7064en%2f

a short timeframe poses significant challenges; thus, comprehensive studies, particularly phenological research, are essential for understanding indirect effects. Additionally, the proliferation of invasive species, forest fires, and the presence of pests and diseases serve as critical quantitative indicators. Consequently, the identification of the most vulnerable areas will be based on the frequency of forest fires, the extent of damage caused by these fires, and the spread of phytopathological pests and diseases.

According to the National Forest Inventory, which conducted fieldwork from 2019 to 2022, 807,178 hectares of Georgia's forest area (excluding occupied territories), representing 35.4% of the forest area assessed through field data, are classified as degraded. This includes 145,386 hectares that have suffered varying degrees of damage from phytophagous and entomological pests, as well as 9,490 hectares that have been affected by fires to different extents.

FIGURE 4.6.3. DEGRADED FOREST AREAS IN GEORGIA (HA) BY TYPE AND DEGREE OF DEGRADATION



In light of the ongoing climate change, the challenges posed by pests and diseases in forest ecosystems are becoming increasingly pressing. The growing vegetation period for pests is a direct result of more favorable climatic conditions. A national census has identified specific species that are experiencing significant adverse effects from environmental factors (both abiotic and biotic). The findings indicate that five species are particularly affected, as evidenced by the high number of dead trees.

The Buxus Colchica exhibits a concerning statistic, with 91.5% of its population consisting of dead individuals. The issue of box wilting has been problematic in the country since 2012, primarily initiated by a pathogenic fungus known as Cylindrocladium buxicola. Additionally, since 2014, the invasive boxworm (Cydalima perspectalis Walker) has proliferated in Colchian box groves. The rapid spread and escalation of boxworm infestations can be directly correlated with climate change. Although the boxwood alura is an invasive species believed to have originated from neighboring regions, its establishment, reproduction, and subsequent damage are heavily influenced by climatic conditions, as demonstrated by its geographical distribution.

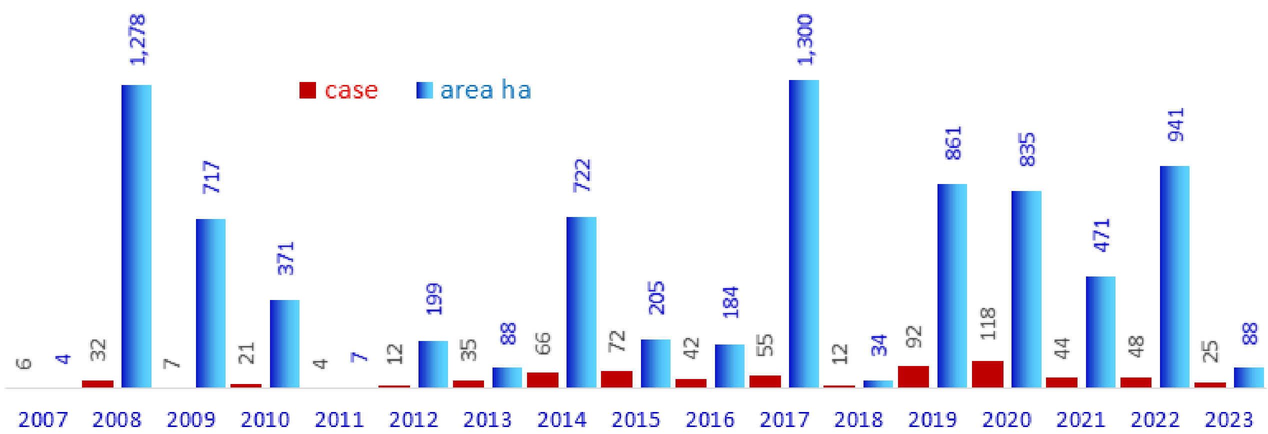
Among other species, 17.6% of the common chestnut population consists of dead individuals, while the pine species shows 8.7% of its population as dead. It is important to highlight that pine species are particularly vulnerable to climatic variations. In the case of oak, 8% of the total population is dead, and for spruce, the figure stands at 6.8%. The significance of spruce is underscored by discussions in the third and fourth national communications, which highlighted the direct correlation between the damage inflicted by the typographical bark beetle (Ips typographus) and climate change.

The analysis of forest fires was conducted using data from the National Forestry Agency, the primary and the largest forest management authority in the country. This agency meticulously documents fire incidents within its operational jurisdiction, which encompasses a state forest area of 1.8 million hectares. The records include details such as fire dates, scale, and extent of damage. Notably, the agency has maintained a consistent methodology for data collection and processing over the past 15 years, thereby enhancing the reliability of the information. In this instance, international electronic platforms for monitoring forest and field fires, as well as satellite data, were not utilized due to the frequent inaccuracies associated with the location and extent of fires, along with the varying methodologies employed in data collection and analysis.

Historically, forest fires were not regarded as a major issue in Georgia; however, an examination of the incidents recorded over the last 15 years indicates significant trends that warrant further investigation in relation to climatic factors. Prior to 2011, the majority of forest fire incidents occurred between May and September. Since 2012, there has been a notable shift, with an increase in incidents during early spring and winter months.

Since 2014, there has been a marked rise in the number of fire incidents, along with an increase in the areas affected and the severity of the damage.

FIGURE 4.6.4. NUMBER OF FOREST FIRES AND AREA COVERED BY FIRES (HA) IN 2007-2023



Alterations are also noted across various geographical regions. Forests are classified based on fire risk primarily according to their species composition. Naturally, coniferous forests located on south-facing slopes exhibit a significantly higher risk of fire and subsequent damage. In this context, Samtskhe-Javakheti, along with parts of Mtskheta-Mtianeti and Shida Kartli, has been identified as some of the most susceptible areas. However, the data collected from 2007 to 2023 presents a contrasting scenario.

FIGURE 4.6.5: NUMBER OF FOREST FIRES IN 2007-2023 BY REGION

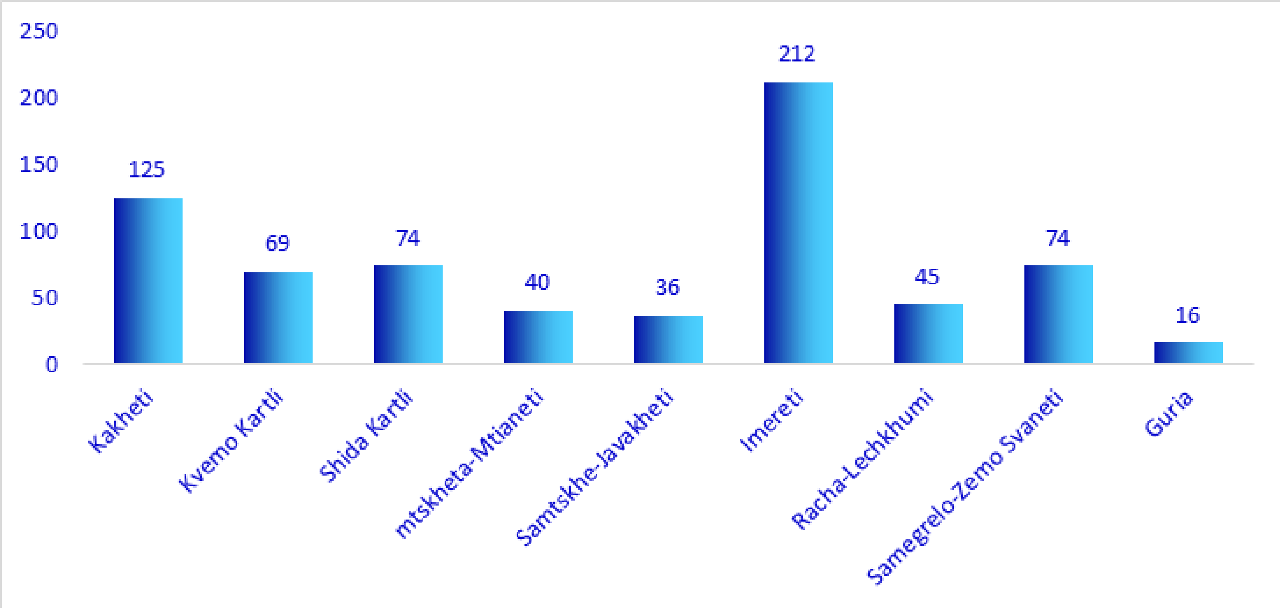
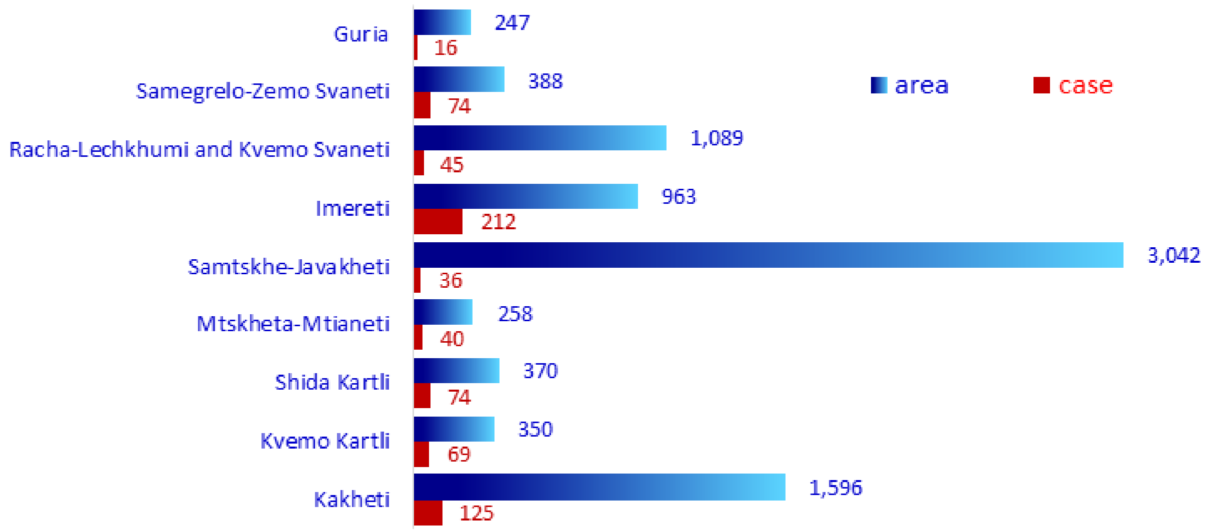


FIGURE 4.6.6. NUMBER AND AREA OF FOREST FIRES (HA) BY REGION IN 2007-2023



The analysis of these two primary indicators allows us to pinpoint the key target regions: more comprehensive evaluation is necessary for Imereti and Samtskhe-Javakheti areas. Furthermore, with the recent data obtained from the National Forest Inventory regarding the principal attributes of Georgian forests, it is possible to extrapolate the assessment across the nation by utilizing the identified climatic parameters.

4.6.4 FOREST SECTOR ADAPTATION MEASURES

Georgian forests, with their distinctive ecosystem services, are vital for fostering a healthy and secure environment at the national level. They contribute to ecological stability and address the needs of both the population and various economic sectors. Among their numerous functions, the most significant is their capacity for climate change mitigation and adaptation, achieved through the absorption of atmospheric carbon and its storage in forest biomass and soil.

Globally and within Georgia, the primary cause of declining forest biodiversity is the degradation and loss of forest ecosystems, which correlates with a reduction in habitat availability. The diversity of woody species in these forests is shaped by both natural elements, such as climatic and hydrological conditions and the phases of grove development, as well as historical and contemporary human activities, including forestry, agriculture, and livestock grazing. According to the initial national forest inventory in Georgia, a considerable portion of the forested area, approximately 35.4%, is classified as degraded. This degradation is primarily attributed to past mismanagement practices, increased timber extraction—particularly of firewood through unregulated logging—along with the proliferation of pests and diseases, heightened forest fire incidents, overgrazing, and anthropogenic pressures. These factors contribute to a decline in both the quantitative and qualitative metrics of forests, resulting in diminished carbon sequestration capabilities at a time when Georgian forests are essential for managing the country's greenhouse gas emissions.

Georgia's Fourth National Communication to the Convention highlights that climate change, alongside various challenges facing the sector, should be regarded as a significant issue. It emphasizes that strategies aimed at mitigating the effects of climate change on Georgian forests and adapting these forests to its impacts should serve as the foundation for planned actions in the sector's development.

Currently, adaptation strategies are outlined in several national strategic documents and action plans, including the Climate Strategy 2030 and its accompanying Action Plan. These documents prioritize enhancements in forest management planning, expansion of forest restoration efforts, and improvements in the quality and sustainability of data collection and analysis. This includes better monitoring of pests, diseases, and forest fires, as well as bolstering the capabilities of forest management agencies to ensure effective law enforcement. Similar initiatives are also incorporated in the Fourth National Environmental Action Program of Georgia (NEAP 4) for the period 2022-2026 and the Agriculture and Rural Development Strategy of Georgia for 2021-2027.

These actions align with the recommendations provided by Georgia in its third and fourth national communications to the Convention, demonstrating notable progress in various areas. For instance, the scale of forest restoration has increased nearly tenfold when comparing the two ten-year periods (2004-2014 and 2014-2023). In 2014, the total area of forest restoration activities was below 1,000 hectares; however, recent data indicates an average of 1,500 hectares restored annually. Significant advancements have also been made in forest management planning, which relies on continuously updated forest data. As of 2023, forest inventories have been conducted over more than 700,000 hectares, and comprehensive ten-year forest management plans have been developed for 17 municipalities. The inaugural national forest inventory in Georgia was completed in 2022, resulting in a report detailing both the quantitative and qualitative characteristics of the forests.

Nonetheless, a comprehensive assessment of the country's forests regarding their vulnerability to climate change, along with the establishment of appropriate categories, remains a challenge. This assessment is crucial for facilitating the planning of specific measures at regional or municipal levels. Currently, when planning initiatives—particularly those related to forest restoration—existing climate change conditions and future scenarios are not fully integrated or modeled. This oversight is essential to ensure the long-term viability and sustainability of forests, as well as their role in mitigating climate change..

The current data indicates that climate scenarios have evolved significantly since the last report. When comparing the two 30-year periods (2041-2070 and 1971-2000), the increase in average surface air temperature across the country is notably more pronounced. The latest projections suggest that the average temperature rise will range from 1.6 to 2.0 degrees Celsius, with seasonal variations; specifically, the most substantial warming is anticipated during the winter months, and regional differences will also play a role. Similar trends are observed in precipitation patterns, which are critical physical factors influencing ecological systems, particularly forests. In conjunction with this data, the systematic collection and analysis of historical non-climatic data are essential for developing indicators that assess the vulnerability of forest resources to climate change and for forecasting potential ecosystem alterations.

In light of these findings, it is imperative to categorize adaptation strategies within the forestry sector into two distinct levels: actions to be executed at the national level and those to be implemented at regional and municipal levels.

Drawing from an analysis of various studies, reports, action plans, and relevant information pertaining to the forestry sector from different timeframes, the following actions are proposed for national implementation:

- Categorizing forest stands based on their composition and susceptibility to climate change;
- Conducting research, particularly phenological studies, that utilize climate data to assess the vulnerability of specific species or shifts in species distribution;
- Implementing alternative methods for sourcing wood resources to alleviate pressure on natural forests, such as agroforestry and the cultivation of fast-growing plantations;
- Advancing energy-efficient technologies and alternative fuels, including those derived from forest by-products, to decrease the consumption of fuelwood;
- Establishing a forest health monitoring system to manage current pests and diseases while identifying and forecasting new pest threats at an early stage;
- Enhancing the forest fire management framework to address all four phases: preparedness, prevention, response, and recovery;
- Reinforcing forest monitoring and law enforcement efforts to curtail illegal logging activities.

Adaptation strategies to be executed at both regional and municipal levels must be grounded in forest management plans. Additionally, these strategies should incorporate specialized studies that assess vulnerability to climate change, along with modeling recommendations that reflect anticipated climate change scenarios. Within this framework, particular emphasis should be placed on:

Enhancing the scale of forest restoration initiatives necessitates prioritizing strategies that foster natural regeneration. In instances where forests are restored or established through planting, it is essential to utilize local species, ensuring that the species composition includes a minimum of 2-3 woody species in each scenario.

Conducting maintenance felling in accordance with forest management plans and relevant standards is vital for improving the sanitary condition of forests. This practice aims to augment biomass reserves while preserving and enhancing the ecological functions of forests, such as soil protection, water regulation, climate regulation, and other beneficial properties.

Implementing reconstruction fellings (including in evergreen sub-forest), to improve the species composition, structure, and productivity of forests.

It is imperative to undertake measures for the prevention and control of pests and diseases, which includes establishing a permanent monitoring network at the forest district level. Whenever feasible, biological control methods should be prioritized, particularly those utilizing bio-agents.

Assessing forest fire risks at the municipal unit level is essential, along with the implementation of preventive measures and the enhancement of monitoring systems, including advance warning mechanisms based on climatic parameters.

Developing optimal models for the use of timber and non-timber forest resources (ecotourism, non-timber forest products, etc.), taking into account the socio-economic and natural conditions of the municipality.

4.7 CLIMATE CHANGE IMPACT ON PROTECTED AREAS

4.7.1. BRIEF OVERVIEW OF PROTECTED AREAS

4.7.1.1 Coverage of Protected Areas

At present, there are 100 national category protected areas in Georgia, encompassing a total area of 912,908.40 hectares, which constitutes 13.1% of the country's land. This includes 14 state reserves, 14 national parks, 40 natural monuments, 26 protected areas, 5 protected landscapes, and 1 multipurpose use area. Beyond these national protected areas, there are regions recognized within international frameworks established by global agreements: 4 wetlands of international significance (Ramsar Sites), 1 UNESCO World Natural Heritage Site, 2 UNESCO Biosphere Reserves, and 66 sites within the Emerald Network. All four wetlands are situated within the existing national protected areas. The UNESCO World Heritage Site comprises four protected areas, while 13 protected areas are included in the two biosphere reserves. The Emerald Network, which spans a total of 1,306,748 hectares, overlaps with the national protected areas and, when combined with these areas, represents approximately 23% of the country's territory.

It is important to highlight that the number of protected areas has seen a substantial increase over the last three years, with the establishment of 13 new national category protected areas, including 2 national parks, 6 protected areas, 4 protected landscapes, and 1 multi-use area. During this timeframe, 2 UNESCO biosphere reserves have also been created, and the majority of the Emerald Network sites have received approval.

The proposed concept for protected and other conservation areas aims to identify and acknowledge additional effective area-based conservation mechanisms (OECMs), thereby enhancing the protection of vital areas for biodiversity. Furthermore, the concept seeks to expand the total area of protected and other conservation areas—including terrestrial, freshwater, and marine environments—to at least 30% by the year 2030[240].

4.7.1.2 Conservation values of protected areas

Georgia's protected areas are crucial for the conservation of the country's diverse biological heritage. These areas safeguard numerous distinctive habitats and species, including those that are endemic and at risk of extinction. In light of the global significance of biodiversity and the challenges it encounters, Georgia is recognized as part of two of the 36 designated "biodiversity hotspots" worldwide: the Caucasus and Irano-Anatolia hotspots.[241] Georgia, situated within the Caucasus region, is acknowledged as one of the 200 global priority ecoregions by the World Wide Fund for Nature (WWF)[242]. Consequently, the biodiversity of Georgia holds significant global relevance, and the establishment of protected and conservation areas serves as a crucial mechanism for its preservation.

4.7.1.3 Ecosystem services of protected areas

Georgia's protected areas are crucial not only for safeguarding the country's biodiversity but also for sustaining vital ecosystem services that enhance resilience to climate change and mitigate the impact on local livelihoods. These services are advantageous to both the local and national populations, contribute to the economy, and attract international visitors.

The healthy ecosystems within these protected areas are instrumental in sequestering carbon dioxide, maintaining substantial carbon reserves, and aiding in the reduction of greenhouse gas emissions. A study conducted in 2022[243] revealed that the carbon stocks in both aboveground and belowground biomass within these areas are estimated to reach approximately 23 million tons by that year. The economic value of these carbon stocks, reflecting the global advantages of carbon sequestration, was assessed at around 9.2 billion GEL.

Forest ecosystems offer a range of ecosystem services, including supporting, securing, regulating, and cultural benefits. They play a significant role in mitigating natural hazards such as erosion, landslides, avalanches, and floods. A primary objective of establishing the Tusheti protected areas is to prevent erosion and avalanches, while the Adjara protected

240 Concept of protected and other conservation areas (working version, 2023);

241 Conservation International. http://www.biodiversityhotspots.org

242 WWF, Global 200. https://www.worldwildlife.org/publications/global-200

243 van Zyl H., Kakabadze E., Goduadze I. (2023). Ecosystem Service Valuation and Cost-Benefit Analysis of Investment in Georgian Protected Areas. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia;

areas are vital for stabilizing the Black Sea coastline[244].

The significance of Georgia's protected areas in relation to water regulation and supply is substantial. The forest ecosystems found within these protected areas play a crucial role in mitigating surface runoff during periods of rainfall and in releasing water during drier seasons. Numerous communities situated near these protected areas rely on them for their drinking water needs. For instance, 22 villages within the municipalities of Kobuleti, Khelvachauri, and Keda are supplied with water from rivers that flow from the Mtirala National Park. Additionally, the city of Batumi obtains its water from the Chakvistavi River and the Korolistskali River, both of which have their sources in the Mtirala National Park.

The Alazani River, which flows from the Tusheti protected areas, is vital for irrigation across six regions in Kakheti, supporting the cultivation of grapes, wine production, wheat, corn, sunflowers, potatoes, and various other crops. Freshwater ecosystems located within and around several protected areas also offer local communities opportunities for fishing activities[245].

Moreover, numerous hydroelectric power plants utilize water resources derived from these protected areas or their surroundings. For example, two hydroelectric power plants in the Kakheti region depend on water sourced[246] from the Tusheti protected areas, while two others in Adjara are reliant on rivers that originate from the Machakhela and Kintrishi protected areas.[247]

Firewood sourced from the forests within protected areas is provided to the local communities residing in proximity. Timber intended for processing is allocated to residents in protected landscapes, including the Nedzvi reserve. As of 2021, data indicates that 15,500 cubic meters of timber were harvested from the administration of 12 protected areas, with a market value estimated at 1.4 million GEL. Additionally, non-timber forest products such as hay, mushrooms, berries, fruits, nuts, and medicinal plants are collected from 26 protected areas, involving approximately 4,583 families, with an annual total value of around 5.7 million GEL. Furthermore, about 900 families participate in beekeeping activities in and around these protected areas, managing approximately 26,500 hives. The role of bees and other pollinators is crucial for the pollination process[248].

Cattle and sheep farming relies on meadow ecosystems and is conducted in several protected areas, including Borjomi-Kharagauli, Tusheti, Vashlovani, and Javakheti. Some regions are leased, covering approximately 24,000 hectares at an annual cost of 330,000

244 Adeishvili, M. 2016. Assessment of the Ajara's Protected Areas' ecosystem service values and benefits and options for generation sustainable revenues for the targets PAs and local communities. Report prepared for the GEF and UNDP, Georgia;

245 Flores M. and Adeishvili M. (2012). Economic Valuation of the Contribution of Ecosystems in Protected Areas to Economic Growth and Human Well-Being in Georgia. Prepared by ECFDC/GCCW/AMECO, UNDP/GEF project Catalyzing Financial Sustainability of Georgia's Protected Areas System;

246 Flores M. and Adeishvili M. (2012). Economic Valuation of the Contribution of Ecosystems in Protected Areas to Economic Growth and Human Well-Being in Georgia. Prepared by ECFDC/GCCW/AMECO, UNDP/GEF project Catalyzing Financial Sustainability of Georgia's Protected Areas System;

247 Adeishvili, M. 2016. Assessment of the Ajara's Protected Areas' ecosystem service values and benefits and options for generation sustainable revenues for the targets PAs and local communities. Report prepared for the GEF and UNDP, Georgia;

248 van Zyl H., Kakabadze E., Goduadze I. (2023). Ecosystem Service Valuation and Cost-Benefit Analysis of Investment in Georgian Protected Areas. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia;

GEL, while others are accessible free of charge for traditional use by local residents.

The educational, aesthetic, spiritual, and cultural significance of protected areas is considerable, fostering the growth of ecotourism and, in turn, benefiting the local economy.

4.7.1.4 Steps taken towards climate change mitigation/adaptation and current challenges

Climate change poses a significant threat to biodiversity within protected areas, making it essential for these regions to effectively safeguard target species and their habitats. To achieve this, the establishment of a cohesive network of protected areas is crucial, as it will promote species migration and enhance the resilience of both flora and fauna in the face of climate change. Although new protected areas have been established in recent years, and their overall area has expanded, the objectives outlined in the "Georgian Biodiversity Strategy and Action Plan," the "Fourth National Environmental Action Program of Georgia," and the "Georgian Protected Areas System Development Strategy and Action Plan" to create a unified and effectively managed network of interconnected protected areas remain unfulfilled[249-250-251]. It is noteworthy that since 2015, the World Wide Fund for Nature (WWF) Caucasus Program Office has been actively working on the Western Lesser Caucasus Ecological Corridor Project,[252] which has initiated the development of the first eco-corridor linking Borjom-Kharaguli National Park with protected areas in the Adjara region, thereby connecting vital conservation zones in Georgia and Turkey.

Numerous strategies concerning protected areas have established specific objectives and actions pertaining to climate change. One of the responsibilities outlined in the "Georgian Biodiversity Strategy and Action Plan"[253] involves identifying the factors contributing to biodiversity loss due to climate change and formulating actions to address these issues. For protected areas, this includes evaluating the effects of climate change on biodiversity in vulnerable regions and developing appropriate recommendations. The "Strategy and Action Plan for the Development of the System of Protected Areas of Georgia"[254] (2018-2030) aims to identify deficiencies within the current network of protected areas, considering the anticipated impacts of climate change on species and habitats. It also emphasizes the identification of priority areas for future protection and the necessity for expanding existing protected areas, including the establishment of eco-corridors. The document prioritizes research into the projected effects of climate change on species and habitats, alongside the formulation of adaptation strategies. Furthermore, the draft[255] concept for protected and other conservation areas acknowledges the influence of climate change on these areas and their potential role in mitigating its effects. It highlights climate change

249 Biodiversity Strategy and Action Plan of Georgia 2014-2020 8.03.2014, Resolution of the Government of Georgia, # 343;

250 Fourth National Program of Environmental Actions of Georgia (2022-2026), 07.09.2022, Decree of the Government of Georgia N1629, https://matsne.gov.ge/document/view/5563250?publication=0);

251 Strategy and action plan for the development of the system of protected areas of Georgia (2018-2030), 04/01/2019, Order of the Minister of Environment Protection and Agriculture of Georgia #2-4. https://matsne.gov.ge/ka/document/view/4361355?publication=0.

252 WWF Caucasus. https://www.ecfcaucasus.org/georgia

253 Biodiversity Strategy and Action Plan of Georgia 2014-2020 8.03.2014, Resolution of the Government of Georgia, # 343;

254 Strategy and action plan for the development of the system of protected areas of Georgia (2018-2030), 04/01/2019, Order of the Minister of Environment Protection and Agriculture of Georgia #2-4. https://matsne.gov.ge/ka/document/view/4361355?publication=0.

255 Concept of protected and other conservation areas (working version, 2023);

as a significant challenge to biodiversity conservation, as it exacerbates threats that adversely affect the biodiversity values of protected areas.

In the management plans for protected areas developed over the last five years, climate change is recognized as a direct or indirect threat to the values of these areas. Most of these plans include the collection of meteorological and climatic data as part of their monitoring programs. Notably, automated continuous meteorological data collection commenced in 2022 at two meteorological stations situated within the Lagodekhi Protected Area.

Multiple management plans, both those that have received approval and those currently under development—specifically for the Tusheti Protected Areas, Tusheti Protected Landscape, Mtirala National Park, and Lagodekhi Protected Areas—incorporate the examination of anticipated climate change effects on existing species and habitats, alongside the formulation of adaptation strategies. Notably, the Kobuleti Protected Areas Management Plan includes explicit measures addressing these concerns.

In 2022, as part of the Global Environment Facility/United Nations Development Programme (GEF/UNDP) initiative titled "Promoting Financial Sustainability of the System of Protected Areas in Georgia," a vulnerability assessment regarding climate change and corresponding adaptation plans were developed for Kazbegi National Park, Tusheti Protected Areas, and Pshav-Khevsureti Protected Areas, commissioned by the Caucasus Fund for Nature (for further details, refer to section 4.6.3.). However, these documents have yet to be incorporated into the existing management frameworks of the respective protected areas and remain unimplemented.

Various initiatives undertaken across different protected areas are aimed at mitigating and adapting to climate change. For instance, a forest inventory has been conducted in several currently forested protected areas, which constitute 49% of the total area, and forest management plans[256] have been established for twelve protected areas. These plans address several issues, including forest protection strategies, such as conducting pathological studies to identify and document pests and diseases, assessing their spread and developmental trends, and offering recommendations for their management. Additionally, the protection strategies encompass the planning of forest fire prevention measures and categorizing forests based on fire hazard levels. Where necessary, the plans also outline forest restoration strategies. It is crucial to consider the potential impacts of anticipated climate change when developing forest management plans, a factor that is currently overlooked.

Guidance documents pertaining to pasture management, which include pertinent recommendations such as livestock capacity and, in certain instances, rotation schemes, have been established for eight protected areas. However, it is important to highlight that the majority of these documents are outdated and necessitate revision. Notably, the management practices implemented in accordance with the pasture plan for the Lagodekhi reserve during the period of 2012 to 2014 resulted in a significant enhancement of pasture conditions, as evidenced by an assessment conducted in 2022. Furthermore, between 2021 and 2023, the Scientific and Research Center for Species Conservation - Nakresi undertook a comprehensive inventory of pasture biodiversity across the Vashlovani, Lagodekhi, Borjomi-Kharagauli, Ktsia-Tabatskuri, Javakheti, and Kazbegi protected areas as part of

256 various data and materials provided by the Protected Areas Agency;

the Caucasus Nature Fund's Biodiversity Monitoring Program. This inventory is expected to provide a crucial foundation for the formulation of management plans for these pastures. It is essential that these management plans take into account the potential impacts of anticipated climate change.

Restoration initiatives have been undertaken in various protected regions. For instance, in the Ajameti reserve, forest restoration efforts have been supported by multiple donors, resulting in the planting of approximately 4 hectares of Imereti oak (Quercus imeretina) in recent years, with plans to continue these efforts in the future. In the Tusheti protected landscape, restoration activities have been facilitated by the German Society for International Cooperation (GIZ). To mitigate further erosion in a ravine caused by a landslide near the village of Jvarboseli, initial measures included the construction of concrete dams, followed by bioengineering techniques such as the creation of wooden dams covered with vegetation, smoothing of steep slope edges, and the establishment of palisade-type dams and shrubbery hedges. Additionally, electric fences were erected to deter animals from entering the area. Approximately 5,000 Caucasian pine (Pinus Cochiana) saplings were planted over an area of about 3 hectares above the landslide site. In the village of Shenako, electric fences were installed across two plots (totaling 28.7 hectares) to address initial erosion and enhance pasture quality. The Society for Nature Conservation - SABUKO is advancing the natural afforestation of floodplain forests in the Chachuna reserve by installing gabions, which have led to the flooding of the Iori floodplains. Given the positive outcomes, there are plans to install two additional gabions. Furthermore, protective fences have been established in certain areas to shield vegetation from trampling and grazing by livestock. Rotational grazing is being tested on specific pasture plots in the Chachuna nature reserve and its vicinity, in accordance with a developed pasture management plan. To alleviate compaction and overgrazing within the reserve, wells and cattle troughs have been installed in the pastures, alongside efforts to enrich the soil in degraded areas. Plans are in place to expand these implementations.

Forest pathology research is conducted during forest inventories in protected areas, providing essential baseline data for the management of these areas to facilitate future monitoring of pathogenic and harmful species. Distinct phytopathological investigations[257] have been carried out in the forests of Borjomi-Kharagauli National Park and Ajameti Reserve.

As part of the Caucasus Nature Fund's Biodiversity Monitoring Program, an evaluation of the ecological condition of forests has been undertaken in various protected areas in collaboration with Ilia State University. Additionally, monitoring efforts for non-native invasive plant species have commenced. Various studies have been performed, particularly during the formulation of management plans for regions such as Javakheti, Kolkheti, and Chachuna, as well as in the preparation of the UNESCO World Heritage Site nomination documentation, with data also collected on invasive animal species.

Protected area administrations regularly acquire and upgrade firefighting equipment, accompanied by relevant training sessions. Plans are underway to implement an early fire warning system in Borjomi-Kharagauli National Park..

257 ; various data and materials provided by the Protected Areas Agency;

4.7.2 CLIMATE CHANGE IMPACTS ON PROTECTED AREAS

4.7.2.1 Vulnerability of the Non-Living Environment

Ecosystems and biodiversity are intricately linked to the physical environment. Consequently, the effects of climate change on this environment—particularly concerning glaciers, rivers, and streams—as well as on protected areas and their associated biodiversity, represent a critical aspect of climate change's overall impact.

In the last century, the glacier coverage in the Greater Caucasus has experienced a significant reduction. This decline has accelerated between 2000 and 2020, and projections indicate that the trend of diminishing glacier area in the Caucasus will persist in the future due to ongoing climate change[258].

The rivers of Georgia are sustained by a combination of rainfall, groundwater, snowmelt, and glacial meltwater. A reduction in glacier size may result in alterations to glacial runoff, which could subsequently influence river flow. While it is anticipated that the contribution of glacial meltwater to the Tergi River will diminish, the overall river discharge will ultimately depend on precipitation levels[259]. An evaluation of the current and anticipated impacts of climate change on the Rioni basin suggests that the average annual river discharge (Qavg) is expected to experience a slight decline during the periods of 2041-2070 and 2071-2100, attributed to reduced precipitation and potentially the dynamics of glacier melting[260]. It is important to highlight that the Rioni River, along with several other rivers, holds significant ecological value and is crucial for the habitats within Kolkheti National Park.

Natural occurrences such as avalanches, landslides, mudslides, and rockfalls are integral components of natural dynamics and are typically not regarded as threats to biodiversity. Nevertheless, a rise in the frequency and severity of these events could present a considerable risk to habitats and species, leading to their classification as threatened. While it is impossible to prevent major natural disasters, it is feasible to implement strategies aimed at mitigating their effects on human populations, biodiversity, and infrastructure.[261]

4.7.2.2 Vulnerability of habitats and species

Climate change is anticipated to exert varying degrees of influence on all protected areas in Georgia, impacting their conservation values. The highlands, recognized as one of the most sensitive biomes, are expected to experience the most rapid and significant alterations due to climate change, which will consequently affect the vegetation cover in these regions.

258 Tielidze L.G., Nosenko G.A., Khromova T.E., Paul F. (2022) Strong acceleration of glacier area loss in the Greater Caucasus between 2000 and 2020. European Geoscience Union, The Cryosphere 16, issue 2, 489–504, 2022. https://doi.org/10.5194/tc-16-489-2022

259 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

260 UNDP (2021). Fourth National Communication of Georgia to the United Nations Framework Convention on Climate Change. UNDP

261 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

Research conducted in the Kazbegi area since 2001 as part of the GLORIA project indicates that there has not been a discernible impact of climate change on the flora and vegetation of the highlands; the distribution of dominant species remains unchanged, and endemic and cold-adapted species are not currently facing severe threats.[262] Nevertheless, the GLORIA project has documented the effects of climate change on highland vegetation in various temperate zones[263]. globally, suggesting that similar changes may occur in Georgia.

Forest ecosystems will also be influenced by climate change, with anticipated alterations in overall forest cover and species composition. It is expected that climate change will elevate the upper limit of forest distribution, thereby constricting the already limited sub-alpine and alpine zones. This shift poses a threat to the rare and endangered species inhabiting these areas, such as certain beetles, mountain ash, sedge, and grouse, along with their habitats. The GLORIA project has already observed a vertical upward shift in the upper limit of forest distribution in several countries. In certain highland regions of Georgia, including Kazbegi, Pshav-Khevsureti, Tusheti, and Racha, there has been an increase in forest cover on meadows, although it remains uncertain whether this phenomenon is a direct response to climate change or a consequence of reduced livestock grazing in these areas in the past. It is important to note that there is no direct evidence[264] indicating an increase in the upper limit of forest cover in the sample plots of the Kazbegi region.

Climate change is poised to impact protected species within designated areas, potentially resulting in their dispersal, the colonization of new habitats, or even local extinction. The migration of these species to new regions may be obstructed by fragmented or degraded habitats beyond the boundaries of protected areas, which are essential for their survival. The introduction of new species may replace existing ones, thereby facilitating the emergence of novel ecosystems. Concurrently, numerous protected areas may serve as climatic refugia for certain species, providing environments where favorable conditions can be sustained or established in response to climate change[265].

Trout represents a significant component of biodiversity in various protected regions of Georgia. As a cold-water species, it is highly sensitive to water temperature, which serves as a critical abiotic factor influencing its survival. Since 2021, the Caucasus Nature Fund has initiated a biodiversity monitoring program focusing on trout species in several rivers within protected areas of Georgia. Monitoring efforts for Salmo labrix in the Kintrishi and Chakvistskali rivers (located in the Kintrishi Protected Areas and Mtirala National Park) revealed water temperatures reaching 20°C in the lower sections of the river during peak summer months. The optimal upper limit for trout water temperature is 18°C; exceeding this threshold can induce stress and significantly increase mortality rates. Additionally, elevated temperatures heightened susceptibility to various diseases. Consequently, it is

262 Gigauri Kh., Abdaladze O., Asanidze Z., Bakhia A. (2023). The Results of the Three Cycle of Global Monitoring GLORIA Network of the Central Great Caucasus. 3rd World Conference on Climate Change and the Global Warming. 10-12 March 2023; Pragua, Czech Republic. https://www.dpublication.com/wp-content/uploads/2023/02/00-3135.pdf

263 GLORIA. https://gloria.ac.at/scope/background

264 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

265 Worboys G. L., Lockwood M., Kothari A., Feary S. and Pulsford I. (eds) (2015). Protected Area Governance and Management, ANU Press, Canberra. http://press-files.anu.edu.au/downloads/press/p312491/pdf/CHAPTER17.pdf

plausible that the upper reaches of the river function as a “refuge” for trout during the warmest periods of the year[266]. Looking ahead, as climate change progresses, high-altitude protected areas with river headwaters are expected to play a crucial role as refugia for trout species.

In light of the ongoing climate change, the protected areas located in the arid and semi-arid regions of Dedoplistskaro Municipality—including Vashlovani Nature Reserve, Vashlovani National Park, Samukhi Protected Landscape, Chachuna Preserve, and the natural monuments of Alazani Floodplain, Takhti-Tepa, and Artsivi Gorge—are particularly susceptible to its effects. Expert Aleksandre Bunikashvili suggests that the increasing presence of the hyena (Hystrix indica) in the Vashlovani and Chachuna protected areas may be attributed to rising temperatures.

While protected areas play a crucial role in moderating the local climate and mitigating the occurrence of natural disasters, the natural disasters induced by climate change can adversely affect these areas, the species inhabiting them, and their respective habitats. For instance, in late June and early July 2022, heavy rainfall along the Aragvistskali River in Akhieli (Arkhoti) resulted in flooding and multiple landslides, which severely impacted the trout population. It is important to note that the effects of flooding on trout are significantly more pronounced at higher elevations compared to lower elevations[267].

4.7.2.3 Spread of pests and diseases

Current climate change is facilitating the resurgence of previously identified diseases and their vectors, as well as the emergence and proliferation of novel diseases. The favorable climatic conditions are extending the growing season for pests, thereby intensifying the pressure on plant life.

The combined effects of several pests, including the pathogenic fungus responsible for leaf blight (Cylindrocladium buxicola), the boxwood moth (Cydalima perspectalis), and the soil-borne phytopathogen causing root rot (Phytophthora spp.), have led to significant damage to Colchian boxwood in numerous locations, with some areas experiencing complete loss of these groves.[268]

Chestnut trees in the protected regions of Adjara are also at risk, as the pathogen known as Chestnut Cancer (Cryphonectria parasitica) is prevalent in chestnut groves, alongside the Chestnut Borer (Cameraria ohridella Deschka & Dimic.), which emerged between 2006 and 2010[269]. Additionally, the chestnut pest Dryocosmus kuriphilus Yasumatsu, which has

266 Ninua L., Daraselia I., Devidze N. (2022). Monitoring of Brown Trout (Salmo trutta) in Selected Protected Areas in Georgia. Ilia State University. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project “Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

267 Ninua L., Daraselia I., Devidze N. (2022). Monitoring of Brown Trout (Salmo trutta) in Selected Protected Areas in Georgia. Ilia State University. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project “Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

268 UNDP (2021). Fourth National Communication of Georgia to the United Nations Framework Convention on Climate Change. UNDP

269 Mtirala National Park Management Plan (Draft, 2022)

been widespread in Turkey since 2014, has yet to be documented in Georgia[270].

In various protected areas, there is growing concern regarding multiple pests and diseases affecting conifers, particularly Caucasian pine and spruce, with their numbers having risen significantly over recent decades. Notably, the typographical bark beetle (Ips typographus), which previously produced one generation annually, has been observed to produce a second generation in the Borjomi region since 2015[271]. In Borjomi-Kharagauli National Park, the six-toothed bark beetle (Ips sextendatus Boern) poses a threat, characterized by low intensity but recognized as a dangerous pest, typically producing a single generation, although it may occasionally yield two generations in certain years.[272]

Since 2019, the common oak borer (Ocneria dispar, Lymantria dispar) has proliferated in the Chachuna reserve, inflicting significant damage on oak trees[273]. Additionally, various pests and diseases affecting Georgian oak have been identified in numerous protected areas, particularly within the Ajameti reserve.

4.7.2.4 Spread of invasive species

Non-native invasive species pose a considerable risk to protected areas. These species can outcompete native flora and fauna, thereby altering the structure and composition of local ecosystems. Invasive plant species, in particular, may provide inadequate nutrition for native herbivores. Additionally, they can influence fire dynamics and lead to shifts in vegetation cover. This issue is especially critical in light of climate change.[274]

The proliferation of non-native invasive plant species is most evident in western Georgia, specifically in the regions of Adjara and Samegrelo, as well as around Tbilisi and Kutaisi. As temperatures rise, the range of suitable habitats for these species is expected to expand both vertically with altitude and into eastern Georgia, although some invasive species may see a reduction in their suitable areas. A study projecting the potential spread of non-native invasive plant species by 2050 indicates that only the protected areas in the extreme southern region of the Lesser Caucasus and the northeastern part of the Greater Caucasus are likely to remain relatively unaffected. In contrast, the majority of other protected areas face a significant risk of increased suitability for invasive species. Furthermore, regions with high levels of plant endemism are at an even greater risk, yet protected areas encompass only a small fraction of these territories (9.4%), leaving them largely unprotected by conservation efforts[275].

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270 Çetġn G., Orman E., Zühtü Polat Z. (2014). First record of the Oriental chestnut gall wasp, Dryocosmus kuriphilus Yasumatsu (Hymenoptera: Cynipidae) in Turkey. Researchgate. https://www.researchgate.net/publication/273955215_First_record_of_the_Oriental_chestnut_gall_wasp_Dryocosmus_kuriphilus_Yasumatsu_Hymenoptera_Cynipidae_in_Turkey

271 UNDP (2021). Fourth National Communication of Georgia to the United Nations Framework Convention on Climate Change. UNDP

272 various data and materials provided by the Protected Areas Agency;

273 Regarding the approval of the technical regulation - Chachuni's prevention management plan. Resolution of the Government of Georgia #96, 10/03/2023. https://www.matsne.gov.ge/document/view/5747368?publication=0

274 Gross J.E., Woodley S., Welling L. A., and Watson J.E.M. (eds.) (2016). Adapting to Climate Change: Guidance for protected area managers and planners. Best Practice Protected Area Guidelines Series No. 24, Gland, Switzerland: IUCN. xviii + 129 pp. https://portals.iucn.org/library/sites/library/files/documents/PAG-024.pdf

275 Slodowicz D., Descombes P., Kikodze D., broennimann O., Müller-Schärer H. (2018). Areas of high conservation value at risk by plant invaders in Georgia under climate change. Ecology and Evolution. 2018 May; 8(9): 4431–4442. Published online 2018 Apr 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5938453/

Monitoring of non-native invasive plant species has been conducted across various protected areas as part of several projects. In 2014, baseline data collected from five protected areas—Lagodekhi Reserve, Babaneuri Reserve, Tbilisi National Park, Kobuleti Protected Areas, and Mtirala National Park—indicated that the distribution of invasive species within these areas was primarily along roadways, with their prevalence diminishing as the distance from the road increased, particularly within the shrub and tree layers. Notably, the number of invasive species varied by location, ranging from one species in Tbilisi National Park to thirteen species in Mtirala National Park.[276]

In the context of the Caucasus Nature Fund's biodiversity monitoring initiative, assessments carried out in 2021 across three protected regions in Adjara—namely, Kintrishi Protected Areas, Mtirala National Park, and Machakhela National Park—revealed the presence of 26 non-native species. Specifically, 14 species were identified in Mtirala National Park, 11 in Kintrishi Protected Areas, and 10 in Machakhela National Park, with 12 of these species classified as invasive. Furthermore, it was observed that the Colchian forest ecosystems within Mtirala National Park exhibit resilience against invasive species assemblages[277]. In 2022, monitoring efforts in Lagodekhi Protected Areas detected four invasive species, with Ailanthus altissima, known as Khemkral, being the primary focus of observation in areas categorized as having high to medium concern. Due to a lack of comprehensive data, the extent of resistance of native vegetation to invasive species assemblages remains uncertain.[278]

Additionally, the Georgian Agrarian University conducted an evaluation of the proliferation of non-native woody plants within the forest ecosystems of ten protected areas in Georgia. This assessment included predictive modeling of their potential spread from 2022 to 2042, taking into account critical climate variables, and resulted in the formulation of strategic management recommendations. The modeling indicated that lowland forest habitats are more susceptible to invasion compared to mountainous regions, thereby suggesting a higher likelihood of non-native woody plant proliferation in lowland areas[279].

The likelihood of colonization by non-native invasive plant species escalates in the event of habitat or soil degradation[280]. Factors such as climate change, an increase in visitor numbers to protected areas, improved access to remote locations, and soil disruption due to infrastructure development further facilitate the invasion and establishment of

276 Slodowicz D., Kikodze D., Khutsishvili M, Kalatozishvili L., Müller-Schärer H. (2018). Monitoring of Invasive Alien Plants in Protected Areas of Georgia. Builletin of the Georgian National Academy of Science, vol. 12, no.2, 2018. http://science.org.ge/bnas/t12-n2/16_Slodovich.pdf

277 Kikvidze Z., Kikodze C., Kolbaia S. (2022). Monitoring of Short-listed Invasive Alien Plant Species in Selected Protected Areas of Georgia. NACRES. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

278 Kikvidze Z., Kikodze C., Kolbaia S. (2022). Monitoring of Short-listed Species Indicators (mammals, pastures, invasive species) in 2022 in Selected Protected Areas in Georgia: Alien Invasive Plants in Lagodekhi Protected Areas. NACRES. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

279 Kavtaradze G., Basilidze L., Avoyani E., Manvelidze Z., Aptsiauri B., Goginashvili N., Bachilava M., Kobakhize N. (2024). Invasion of alien woody plants in forest habitats of protected areas of Georgia. Publishing House of Free and Agrarian Universities. https://www.researchgate.net/publication/378308723 Slodowicz D., Descombes P., Kikodze D., broennimann O., Müller-Schärer H. (2018). Areas of high conservation value at risk by plant invaders in Georgia under climate change. Ecology and Evolution. 2018 May; 8(9): 4431–4442. Published online 2018 Apr 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5938453/

280

non-native species[281].

Several management plans for protected areas, including those for Chachuna Protected Area and Javakheti Protected Areas, have documented the presence of various invasive fish species; however, there is a lack of data to ascertain trends related to climate change.

4.7.2.5 Vulnerability to the provision of ecosystem services

Climate change is poised to impact not only the natural attributes of protected areas but also the ecosystem services they provide, which are vital for local communities, the Georgian economy, and visitors. The following discussion addresses the effects of climate change on various ecosystem services.

Protected area forest ecosystems deliver a range of supporting, provisioning, regulating, and cultural ecosystem services. They play a crucial role in reducing and mitigating natural hazards such as avalanches, erosion, and landslides. These forests help to decrease surface runoff during periods of heavy rainfall and release water during drier seasons. This water is essential for drinking, irrigation, and electricity generation, benefiting both local and national economies, as well as communities situated downstream. Additionally, firewood, industrial timber (particularly in protected landscapes like the Nedzvi reserve), non-timber forest products, and medicinal plants are significant resources for the local populace. However, climate change, coupled with an increase in natural disasters and the proliferation of forest pests and diseases, poses a serious threat to the forest ecosystems within protected areas, thereby jeopardizing their ecosystem services[282].

In several protected areas, such as Tusheti National Park, Tusheti Protected Landscape, Kazbegi National Park, Pshav-Khevsureti Protected Areas, and Javakheti Protected Areas, livestock farming relies heavily on meadow ecosystems. The nomadic herding and traditional grazing practices in Tusheti are recognized as socio-economic assets in the management plans for Tushti Protected Areas and Tusheti Protected Landscape. In conjunction with climate change, there has been a noticeable rise in the (sub-)alpine meadow belt, along with a contraction of its lower section due to the upward shift of the forest boundary, a phenomenon already observed in various high-altitude regions globally[283-284-285].

281 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project “Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

282 van Zyl H., Kakabadze E., Goduadze I. (2023). Ecosystem Service Valuation and Cost-Benefit Analysis of Investment in Georgian Protected Areas. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project “Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia;

283 Gigauri Kh., Abdaladze O., Asanidze Z., Bakhia A. (2023). The Results of the Three Cycle of Global Monitoring GLORIA Network of the Central Great Caucasus. 3rd World Conference on Climate Change and the Global Warming. 10-12 March 2023; Pragua, Czech Republic. https://www.dpublication.com/wp-content/uploads/2023/02/00-3135.pdf

284 Vitasse Y., S. Ursenbacher G. Klein T. Bohnenstengel Y. Chittaro, A. Delestrade, C. Monnerat, M. Rebetez, C. Rixen, N. Strebel (2021). Phenological and elevational shifts of plants, animals and fungi under climate change in the European Alps. Biological Review 96(5): 1816-1835. Accessed on 26 March 2022 at: https://onlinelibrary.wiley.com/doi/full/10.1111/brv.12727

285 Cazzolla Gatti R., Callaghan T., Velichevskaya A., Dudko A. Fabbio L., Battipaglia G., Liang J. (2019). Accelerating upward treeline shift in the Altai Mountains under last-century climate change. Scientific Reports, 9. Accessed on 20 January 2022 at: https://www.nature.com/articles/s41598-019-44188-1

The anticipated rise in the upper limit of forest cover is likely to adversely affect meadow and shrub species, resulting in significant changes to the highland ecosystem. This transformation will lead to a decrease in the availability of pastures and hayfields, consequently heightening competition for food resources with domestic livestock and increasing the risk of disease transmission among animals.[286]

The trend of increasing visitor numbers to protected areas in Georgia is noteworthy. In 2007, only 7,714 visitors were recorded, whereas by 2019, this figure had surged to 1,119,011. The Covid-19 pandemic caused a sharp decline in visitor numbers in 2020; however, there was a resurgence in 2021, with 1,078,112 visitors recorded in 2023[287]. The peak visitation period for these areas spans from March to November, with August witnessing the highest attendance. An exception to this trend is the Vashlovani Protected Areas, which experience their peak visitor numbers in May, likely due to the region's appealing plant diversity and favorable climatic conditions during that time. Research conducted in protected areas in the United States and Canada suggests[288-289-290] that climate warming may lead to an increase in visitor numbers to these areas. Furthermore, some parks may see an extension of their tourist seasons. Conversely, in regions currently experiencing high temperatures, a decline in visitor numbers during the hotter months is anticipated[291]. Additionally, it is expected that visitor numbers to high-altitude protected areas may rise, potentially aligning with those of medium-altitude areas, while medium-altitude areas may see visitor numbers comparable to those in lowland protected areas. [47]. As protected areas become increasingly accessible, it is anticipated that interactions between humans and wildlife will rise, which may result in heightened human-wildlife conflicts. These conflicts could have various consequences, including adverse effects on animal populations, physical risks to visitors, damage to infrastructure, and a reduction in recreational opportunities. Similar patterns are expected to emerge in the protected areas of Georgia.

Climate change is expected to affect not only the accessibility of protected areas but also the natural and cultural values, as well as the tourism infrastructure[292], due to the rising frequency and severity of extreme weather events such as catastrophic fires, floods, and storms. Therefore, it is essential for the management structures of protected areas and the surrounding communities to consider these factors and formulate suitable adaptation

286 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

287 various data and materials provided by the Protected Areas Agency;

288 Scott D., Jones B., Konopek J. (2007). Implications of climate and environmental change for nature-based tourism in the canadian rocky mountains: A case study of Waterton Lakes National Park. Tourism Management. 2007;28: 570–579. https://www.researchgate.net/publication/236018564

289 Fisichelli N.A., Schuurman G.W., Monahan W.B., Ziesler P.S (2015). Protected Area Tourism in a Changing Climate: Will Visitation at US National Parks Warm Up or Overheat? https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0128226

290 Weststrate D.K., Chhen A., Mezzini S, Safford K., Noonan M.J. (2023). How climate change and population growth will shape attendance and human-wildlife interactions at British Columbia parks. BiorXyv : https://doi.org/10.1101/2023.07.11.548618

291 Fisichelli N.A., Schuurman G.W., Monahan W.B., Ziesler P.S (2015). Protected Area Tourism in a Changing Climate: Will Visitation at US National Parks Warm Up or Overheat? https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0128226

292 Leung Y., Spenceley A., Hvenegaard G, Buckley R.(eds.) (2018). Tourism and visitor management in protected areas: Guidelines for sustainability. Best Practice Protected Area Guidelines. Series No. 27, Gland, Switzerland: IUCN. xii + 120 pp. https://portals.iucn.org/library/sites/library/files/documents/PAG-027-En.pdf

strategies and plans. This approach will enable them to capitalize on potential opportunities while effectively addressing the associated challenges.

4.7.3. VULNERABILITY OF KAZBEGI, PSHAV-KHEVSURETI AND TUSHETI PROTECTED AREAS TO CLIMATE CHANGE AND ADAPTATION MEASURES

In the years 2021 to 2022, as part of the Global Environment Facility/United Nations Development Programme (UNDP/GEF) initiative, and with the assistance of the Caucasus Nature Fund, an evaluation of the vulnerability of key protected areas in the Central Caucasus—specifically Kazbegi, Pshav-Khevsureti, and Tusheti—was conducted in relation to climate change. Additionally, plans for adapting to climate change were developed. Below, information regarding the targeted protected areas, their vulnerability assessments, and the corresponding adaptation plans is provided[293].

4.7.3.1 Kazbegi, Pshav-Khevsureti and Tusheti Protected Areas

The designated region encompassing Kazbegi, Pshav-Khevsureti, and Tusheti protected areas is situated in the Central Caucasus along the Georgian-Russian frontier. To the east, Kazbegi National Park adjoins the Pshav-Khevsureti protected areas, which in turn are bordered by the Tusheti protected areas. These regions are part of the Caucasus, recognized as one of the global biodiversity hotspots, and are crucial for the preservation of endemic and globally threatened species.

Kazbegi National Park is found within the Mtskheta-Mtianeti region, specifically in the Kazbegi municipality, nestled in the Central Caucasus Mountains on the northern slopes of the Caucasus Range, while also encompassing the southern slopes. The Kazbegi Nature Reserve was established in 1976, covering an area of 3,841 hectares. In 2007, Kazbegi National Park was officially created, incorporating the Kazbegi Nature Reserve and five non-living nature monuments. The current expanse of the national park is 78,204 hectares. According to the draft management plan, the conservation values of Kazbegi National Park include high mountain ecosystems, spruce and pine forests, alpine and subalpine meadows, and glaciers, as well as various species such as the lynx (Lynx lynx), East Caucasian goat (Capra cylindricornis), roe deer (Rupicapra rupicapra), brown bear (Ursus arctos), and grouse (Lirurus mlokosiewiczi)[294].

The Pshav-Khevsureti Protected Areas are situated in the Mtskheta-Mtianeti region, specifically within the Dusheti municipality, encompassing both the northern and southern slopes of the Caucasus Mountains. Established in 2014, this protected area spans an impressive 79,908.4 hectares, which includes the Pshav-Khevsureti National Park (75,843 hectares), the Asa Reserve (3,943 hectares), and the Roshki Nature Monument (122.4 hectares). The management plan highlights several conservation values within the Pshav-Khevsureti Protected Areas, including diverse forest types such as deciduous, coniferous, and mixed forests; sub-alpine forests and high mountain shrubs; as well as high mountain and alpine

293 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project “Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

294 Kazbegi National Park Management Plan (draft, 2019);

meadows. Additionally, it encompasses rocky-shrubby habitats, floodplain forests, and various aquatic ecosystems, including rivers, springs, and lakes. Notable species found in this area include roe deer (Rupicapra rupicapra), ibex (Capra aegagrus), East Caucasian ibex (Capra cylindricornis), red deer (Cervus elaphus), brown bear (Ursus arctos), and lynx (Lynx lynx). The avian population features species such as the Caucasian black grouse (Tetraogallus caucasicus), Caucasian grouse (Lyrurus mlokosiewiczi), bearded vulture (Gypaetus barbatus), and Eurasian falcon (Neophron percnopterus). The herpetofauna includes Dinniki's viper (Vipera dinniki), Caucasian lizard (Darevskia caucasica), Georgian lizard (Darevskia rudis), and Artvin lizard (D. Georgian shemaya)[295].

Tusheti Protected Areas are situated in the Kakheti region, specifically within the Akhmeta municipality, in the historical and geographical region of Tusheti, along the northern slope of the Main Caucasus Range. The Tusheti Reserve was established in 1981, encompassing an area of 3,841 hectares. In 2003, the Tusheti Protected Areas were formally designated, which include a reserve of 10,275 hectares, a national park covering 71,341 hectares, and a protected landscape of 31,518 hectares, bringing the total area to 113,134 hectares. The conservation values outlined in the management plans for the Tusheti Protected Areas and the Tusheti Protected Landscape include high mountain and subalpine forests (comprising larch and pine), alpine and subalpine meadows, high mountain swamps, and freshwater ecosystems found within the protected landscapes. Notable species within this area include the lynx, leopard (Panthera pardus), East Caucasian ibex (Capra cylindricornis), carp (Carpa aegagrus), red deer (Cervus elaphus), roe deer (Rupicapra rupicapra), grouse (Lirurus mlokosiewiczi), Caucasian black grouse (Tetraogallus caucasicus), mountain eagle (Aquila chrysaetos), griffon vulture (Gyps fulvus), monk vulture (Aegypius monachus), bearded vulture (Gypaetus barbatus), Vipera dinniki, and Caucasian meadow viper (Vipera Lotievi)[296-297].

In the context of assessing climate change vulnerability in the target area, the geological monuments of Kazbegi National Park and the historical-cultural values identified within the Tusheti Protected Landscape were not included in the evaluation, as a different methodology was necessary for their assessment.

4.7.3.2 Observed climate change and climate change projections in the target area

The Fourth National Communication of Georgia indicates that the average annual surface air temperature in the country rose by 0.25–0.58°C between the periods of 1956–1985 and 1986–2015, with an overall average increase of 0.47°C during these intervals. In the specific region of interest, climate change data over the past century remain incomplete and fragmented, yet they align with the broader national trends. Data from the Stepantsminda Meteorological Station reveal a significant rise in average air temperature from 1986 to 2015, particularly evident during the summer months, when compared to the earlier period of 1956–1985. Additionally, the average annual temperature at Jvari Pass and Mt. Mkinvartsveri has also increased between 1907–1960 and 1961–2009, with a more substantial relative

295 Pshav-Khevsureti Management Plan (draft, 2019);

296 Regarding the approval of the technical regulation - Tusheti State Nature Reserve and Tusheti National Park management plan. Resolution of the Government of Georgia #547, 05/12/2022. https://matsne.gov.ge/document/view/5632677?publication=0

297 Tusheti protected landscape management plan (draft, 2022).

increase observed at the lower elevation of Jvari Pass compared to Mt. Mkinvartsveri. It remains uncertain whether this trend is representative of the entire target area[298].

Projections for climate change in the project area have been established based on anticipated monthly temperatures—both nighttime minimums and daytime maximums—as well as precipitation patterns for the near future (2021–2040) and the distant future (2061–2080).

1. Most forecasts suggest that in the near future (2021-2040), both minimum and maximum temperatures will rise throughout the year across all seasons when compared to the baseline period. The most significant increases in daytime maximum and nighttime minimum temperatures are anticipated during the summer months, with expected rises of 0.7 to 3.0°C and 0.4 to 2.8°C, respectively. Projections for winter temperatures indicate a range from no change to an increase of up to 2.3°C. Some predictions also suggest a potential decline in daytime temperatures during spring, with decreases ranging from -0.3°C to -2.7°C. Looking further ahead to the distant future (2061-2080), all projections indicate an increase in both minimum and maximum temperatures year-round. However, the rise in daytime maximum temperatures during winter is expected to be less significant, ranging from 0.6 to 4.7°C, while summer may see a more substantial increase of 1.7 to 7.1°C. The corresponding ranges for nighttime minimum temperatures are expected to be similarly elevated.

Projections regarding seasonal precipitation reveal considerable uncertainty regarding future trends for both timeframes. In the near future (2021-2040), the majority of forecasts indicate an increase in seasonal precipitation, although the potential trajectories vary widely. In winter, precipitation could either decrease by as much as 22% or increase by up to 42% compared to the baseline period, while summer precipitation may decrease by up to 35% or increase by as much as 34%. This uncertainty becomes even more pronounced in the projections for the distant future (2061-2080).

4.7.3.3 Climate change scenarios for the target area

Since near-term projections were more relevant for adaptation planning, near-term projections were considered for the vulnerability assessment of the target area. However, far-term projections were also considered to verify the results of near-term projections and to provide an idea of the potential strength of long-term trends.

For the vulnerability assessment, climate scenarios for all seasons were constructed – all projected trends were considered not for any specific season, but for all seasons together. Accordingly, four scenarios (descriptions of alternative climate scenarios) were adopted:

Sirimir: *Significantly humid, but only slightly warm*[299]*;*

Tropicana: *Significantly humid and much warmer;*

Oven: *Significantly dry and much warmer;*

298 Garstecki T., Kakabadze E. (2022). Climate Change Vulnerability Assessment and Preparation of Adaptation Plans for pilot target PAs in Georgia – Tusheti PAs, Kazbegi NP and Pshav-Khevsureti NP. Report to Caucasus Nature Fund and the Georgian Agency of Protected Areas forming part of the GEF/UNDP project "Enhancing financial sustainability of the Protected Areas system in Georgia. CNF, Georgia.

299 The name was derived from the gentle, refreshing rain that is typical of the spring and autumn seasons in the Basque Country.

Crispy: *Significantly dry, but slightly warmer.*

The four scenarios outlined illustrate the potential extremes of climate options anticipated in the designated region. For instance, it is conceivable that the average precipitation rate during the period from 2021 to 2040 may remain consistent with that of the baseline period. By examining these outer contours, we can establish a comprehensive perspective and, crucially, formulate effective adaptation strategies while steering clear of ineffective measures.

4.7.3.4 Vulnerability of conservation values of the target area to climate change

In order to formulate hypotheses regarding the possible effects of climate change on the conservation values of the designated protected areas across four scenarios, short-term weather variability observations conducted by the staff of these areas, along with relevant scientific literature pertaining to the Central Caucasus and other comparable high-altitude regions globally, were utilized. This literature provides insights into the vulnerability of ecosystems and biodiversity to climate change, drawing from more extensive research conducted in those areas.

The identified impacts of climate change on the ecosystems and biodiversity within the target area include:

Glacier retreat is anticipated to persist across all scenarios, particularly accelerating under the Guvuni and Tropicana scenarios.

The ongoing retreat of glaciers will ultimately result in the displacement of specialized peri-glacial and sub-nival flora and fauna, which will be supplanted by more generalist alpine species and plant communities. As a result, there will be insufficient space for the sub-nival and nival zones to migrate, leading to the irreversible loss of habitat for the associated biota.

A decrease in glacial runoff is expected to cause a reduction in river discharge and an earlier peak in seasonal maximum discharge, particularly within the Tergi catchment area of Kazbegi National Park.

The likelihood of geological disasters is projected to rise, reminiscent of the Kolka-Karmadon and Devdoraki events that occurred in 2002.

In most scenarios, particularly under Tropicana and Oven conditions, the (sub-)alpine grassland belt is likely to ascend, potentially resulting in the complete loss of (sub-)alpine grasslands. Additionally, the phenology of these grasslands will undergo changes, with spring arriving earlier and an extended growing season. This will likely lead to increased vegetation cover, productivity, and abundance, while the species composition will shift—rare and/or endemic, cold-adapted species will be replaced by more thermophilic species, and in the Oven and Crispy scenarios, by drought-resistant species.

Sub-alpine peatlands are expected to experience drying, particularly under the Guvuni scenario, with the Crispo scenario also contributing to this trend, albeit to a lesser degree. This drying may lead to a transition towards forest ecosystems as the forest boundary shifts upward.

The composition and distribution of forest species will vary across different scenarios.

In the Sirimir and Crispo scenarios, all forest types are anticipated to migrate to higher elevations. Conversely, the Tropicana and Guvuni scenarios suggest a decline in alpine pine forests, while deciduous forest types are expected to extend into higher altitudes. Additionally, the risk posed by invasive forest species is likely to rise, along with an increase in the frequency and intensity of certain insect pests and forest diseases.

Under the Sirimir scenario, river discharges may experience significant fluctuations, either increasing or decreasing sharply. With a reduction in glacial runoff, the peak seasonal discharge is likely to occur earlier, particularly in the Tergi catchment area.

The biota of streams and rivers will be impacted, with an anticipated expansion of trout populations.

Projected climate change is expected to have a notably adverse effect on endemic and threatened plant species, especially those found in (sub-)nival and (sub-)alpine environments. This impact is particularly severe under the Tropicana and Furnace scenarios.

Ungulates will experience varying impacts from climate change. Species such as the East Caucasian goat (Capra cylindricornis) and the mountain goat (Rupicapra rupicapra), along with the mountain goat (Capra aegagrus) to a lesser degree, that predominantly inhabit (sub-)alpine grasslands are particularly susceptible to habitat degradation. In the medium term, diminished access to these grasslands will heighten competition for food with livestock and increase the likelihood of disease transmission from domestic animals. Conversely, forest-dwelling ungulates, such as the red deer (Cervus elaphus), are expected to benefit from enhanced habitat availability, particularly under the Tropicana scenario. Beyond habitat alterations, ungulates may also face direct consequences from rising temperatures. Research indicates that East Caucasian goats in the Greater Caucasus favor cooler nighttime environments. Additionally, studies on red deer have highlighted the detrimental effects of heat stress on the growth rates and adaptability of their offspring. It is plausible that similar adverse effects may be observed in other ungulate species.

In addition to the effects of climate change on predatory mammals resulting from alterations in habitat and food resources, several other consequences are anticipated. For instance, the widespread distribution of the tsuro (Canis aureus) is projected to persist, particularly under the Tropicana and Guvuni scenarios. A pan-European modeling study indicates that the brown bear (Ursus arctos) is at risk due to rising winter temperatures, which may lead to a decline in its reproductive success. The anticipated reduction in snow cover at mid to high altitudes under the Guvuni scenario is expected to enhance habitat suitability for the jaguar (Panthera pardus saxicolor) in the Central Caucasus, although it will simultaneously diminish the availability of both habitat and food resources.

Modeling studies concerning the Caucasian grouse (Lyrurus mlokosiewiczi) and the Caucasian black grouse (Tetraogallus caucasicus) forecast a significant contraction of their distribution ranges.

Furthermore, literature from regions outside Georgia suggests that an upward shift in the distribution of herpetofauna and changes in seasonal patterns are likely to occur.

The analysis of vulnerability rankings indicates that ecosystems and habitats exhibit the greatest level of direct vulnerability, which further suggests a significant degree of indirect vulnerability for the species or groups that rely on them.

4.7.3.5 Adaptation plans for Kazbegi National Park, Pshav-Khevsureti Protected Areas and Tusheti Protected Areas

To determine appropriate adaptation strategies for the conservation values of the designated protected areas in response to climate change, an analysis was conducted of scientific literature, climate change adaptation guidelines, and various ongoing or completed projects relevant to ecosystems and species in high mountain regions. This review, which included stakeholder engagement, resulted in the identification of 35 specific strategies and 6 broader institutional adaptation measures tailored to address the vulnerabilities of the target area, thereby enhancing management capacities.

The identified strategies are categorized into four distinct groups: a) those aimed at mitigating additional threats unrelated to climate change that may be intensified by it, b) those focused on improving the adaptive capacity of conservation values or their sensitivity, c) those designed to reduce or alleviate the immediate effects of climate change, and d) those intended to prevent inappropriate or harmful adaptation measures. Notably, the majority of these strategies, which support the adaptation of biodiversity values, also yield significant advantages for resource users, local communities, and visitors.

The majority of the 35 specific adaptation strategies identified for addressing vulnerabilities pertain to (sub-)alpine meadows and mountain forests. The remaining strategies focus on the (sub-)nival zone, highland wetlands, rivers and streams, as well as particular species of flora and fauna.

These 35 adaptation strategies were evaluated based on several criteria, including practical applicability, feasibility, anticipated effectiveness, reliability of scenarios, and urgency. Consequently, up to 13 strategies were recommended for immediate full-scale implementation, while another 13 were suggested for further investigation, feasibility assessments, and pilot testing. Two strategies were deemed unfeasible or unreasonable, and the remaining seven were considered irrelevant at this time, although they should be reassessed in approximately ten years.

Distinct adaptation plans were formulated for Kazbegi National Park, Pshav-Khevsureti Protected Areas, and Tusheti Protected Areas. In each plan, in collaboration with the relevant authorities, appropriate strategies were selected from the 35 identified. The action plan outlined specific measures to be taken within each strategy, their interconnections with other strategies or measures, the organizations responsible for implementation, and the deadlines for execution. Detailed plans were developed for three priority strategies for each protected area, with one strategy—identifying local climate refugia and ensuring strict protection against climate-independent threats—designated as a priority across all three protected areas.

4.7.3.6 Recommendations for adaptation measures

1. The establishment of a cohesive ecological network comprising protected and other conservation zones, aimed at facilitating species adaptation to the effects of climate change.

2. In the process of modifying the boundaries of current protected areas and designating new ones, it is essential to consider regions characterized by significant

plant endemism, animal migration routes, connectivity corridors for populations, and critical plant habitats, particularly in relation to the potential impacts of climate change.

3. Enhancing cross-border collaboration in the planning and execution of climate change monitoring and adaptation strategies.
4. Evaluating the susceptibility to climate change and formulating adaptation strategies for each designated protected area.
5. Incorporating anticipated climate change factors into the development of management plans for protected areas, specifically:

    A. a. Use/consider local and regional climate scenarios;
    B. b. When determining conservation values, consider the most sensitive units to climate change;
    C. c. Identify adaptation needs when developing objectives and actions;
    D. d. Use the best available scientific evidence.

6. Incorporate the identified adaptation strategies into current management documents, including the management plan, forest management plan, pasture management plan, and tourism strategy.
7. Formulate a forest management plan for the designated protected area, considering the anticipated effects of climate change.
8. Create a pasture management plan for the designated protected area, taking into account the potential consequences of climate change
9. Restore degraded ecosystems within and surrounding protected areas in collaboration with relevant agencies
10. Monitor harmful, invasive, and disease-causing species, evaluate associated risks, and devise and implement suitable response and preventive strategies in partnership with relevant agencies.
11. Enhance fire monitoring efforts and execute preventive strategies in collaboration with relevant agencies.
12. Evaluate the potential effects of anticipated climate change on visitor patterns, tourism-friendly sites, pertinent infrastructure, as well as the timing and duration of visits, and the economic implications for tourism strategies in protected areas.
13. Establish a climate change monitoring framework within protected areas, which includes the installation of meteorological stations to gather essential climatic data, such as temperature and precipitation.

4.8 CLIMATE CHANGE IMPACT ON HUMAN HEALTH

4.8.1. IMPACT OF HEAT WAVES ON HUMAN HEALTH AND THE HEALTHCARE SYSTEM

The World Health Organization (WHO) defines heat waves as periods characterized by exceptionally high temperatures that lead to increased rates of illness and death. The World Meteorological Organization specifies that a heat wave occurs when the maximum daily temperature surpasses the average maximum temperature by 5°C or more for a minimum of five consecutive days.

To assess the severity of heat waves, various indicators are utilized, with the heat index being the most prevalent. This index combines air temperature and relative humidity to gauge how intensely the human body perceives heat. Consequently, the heat index serves as a key measure for evaluating the effects of heat waves on public health.

As climate change progresses, the frequency of extreme temperatures is anticipated to rise, thereby heightening health risks, particularly for vulnerable populations such as the elderly, children, pregnant women, individuals with chronic illnesses, and outdoor workers like farmers and construction laborers. Furthermore, a significant portion of the global population resides in urban areas, where the challenges posed by heat waves are exacerbated due to the 'urban heat island effect,' which results from the heating of air caused by buildings and land use. In response, numerous countries are developing heat-health action plans that include early warning systems for heat waves, which are crucial for safeguarding public health and ensuring the effective functioning of healthcare services.

Heat-related fatalities, while infrequent, have resulted in the loss of 150,000 lives globally over the last three decades. Notably, nine out of ten of these deaths have taken place since the year 2000. The World Health Organization anticipates that by 2030, heat waves will lead to a minimum of 92,000 deaths each year across the globe. Additionally, rising temperatures are expected to exacerbate mortality rates from cardiovascular and respiratory illnesses, which are already the primary causes of death in low- and middle-income nations.

4.8.2. VULNERABILITY TO HEAT WAVES

The assessment of heat wave impacts extends beyond their intensity to encompass various factors, including the susceptibility of the population and the capacity of the healthcare system to respond effectively. Vulnerable populations consist of: the elderly (individuals aged 65 and older); those with chronic health conditions (such as diabetes and heart disease) and/or those on specific medications like beta-blockers; individuals with disabilities; pregnant women; outdoor laborers and athletes; socially disadvantaged groups (including migrants, refugees, and the homeless); ethnic minorities facing language barriers in accessing and comprehending information; and tourists lacking comprehensive weather information and facing language obstacles.

Additionally, it is crucial to evaluate the living conditions that may heighten vulnerability. Factors such as the thickness and material of residential walls, the type of external wall cladding (some of which may be insulated), the roofing material (notably, metal roofs can be easily compromised), and the absence of cooling systems within homes are significant.

Furthermore, the presence of underground transportation systems, such as subways, exacerbates the effects of heat. The issue of underground climate change, recognized as a significant challenge in the United States, is becoming increasingly pertinent.

4.8.3 BRIEF OVERVIEW OF DISEASES ASSOCIATED WITH HEAT WAVES IN GEORGIA

Cardiovascular Disease Incidence: The occurrence of diseases related to the circulatory system accounts for 9.3% of newly reported cases within the nation. This category of diseases is marked by significant rates of morbidity and mortality, including hypertension (elevated blood pressure), ischemic conditions (such as myocardial infarction), and cerebrovascular diseases (affecting the blood vessels in the brain). In the year 2021, there were 103,293 newly documented cases, resulting in an incidence[300] rate of 2,785[301].

FIGURE 4.8.1. PREVALENCE OF CIRCULATORY SYSTEM DISEASES IN GEORGIA

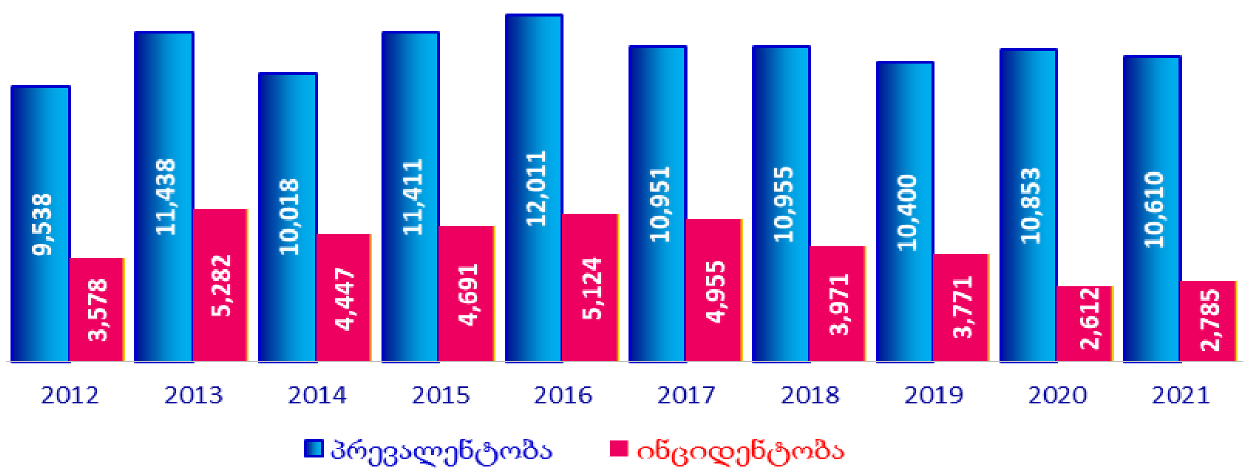
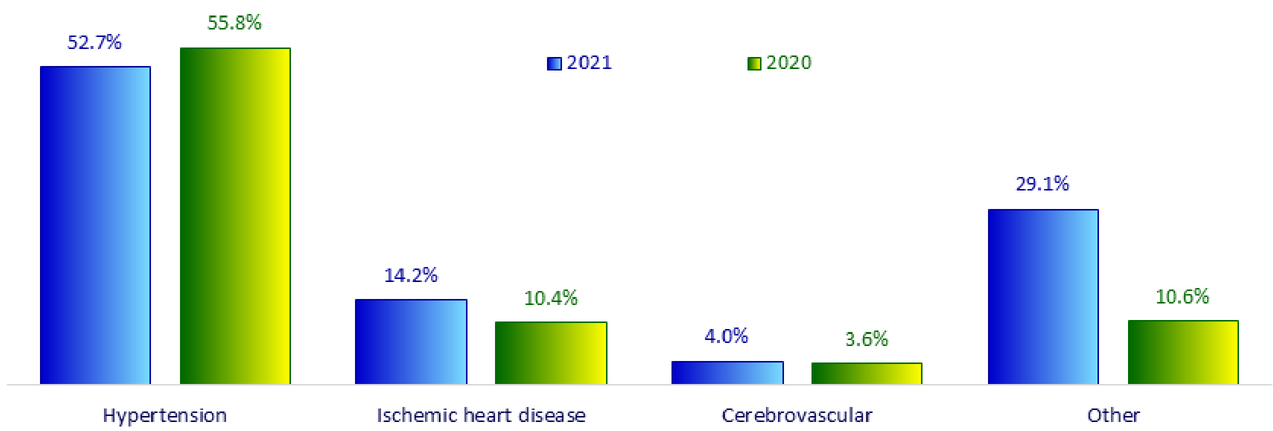


FIGURE 4.8.2. DISEASES OF THE CIRCULATORY SYSTEM, STRUCTURE OF NEW CASES



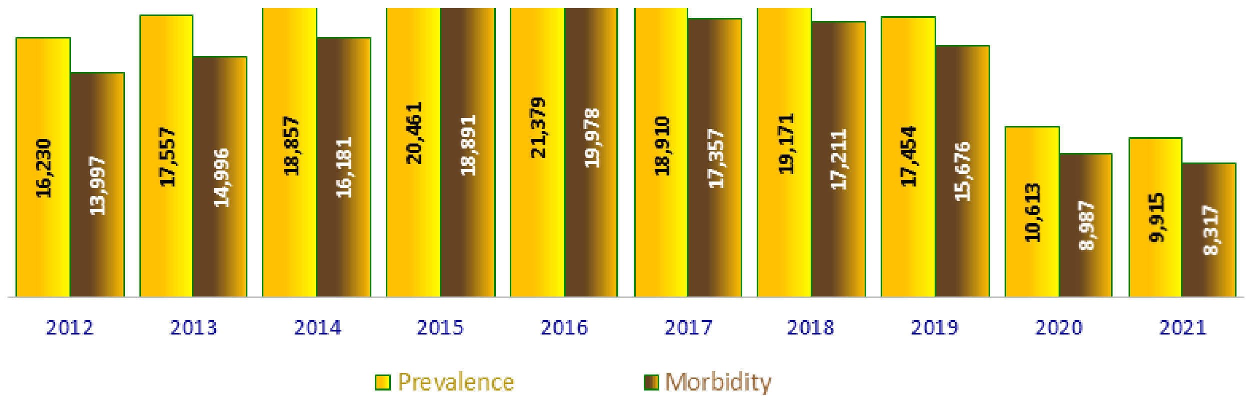
The rise in the prevalence of these diseases may be associated with the challenges posed by climate change, including heat waves. Prolonged exposure to elevated temperatures can exert considerable stress on the circulatory system, particularly affecting blood pressure, which is anticipated to rise during such heat events.

300 Incidence is the frequency of a disease per 100,000 population.

301 https://www.ncdc.ge/#/pages/file/ea1784b5-d3d0-4dd9-b29f-1369f5d6bbec

Regarding respiratory diseases, this category predominantly includes chronic conditions such as asthma, allergic respiratory disorders, and chronic obstructive pulmonary disease..

FIGURE 4.8.3. PREVALENCE OF RESPIRATORY DISEASES IN GEORGIA



One contributing factor to the emergence of this group of diseases is the influence of environmental conditions, particularly extreme heat. Elevated temperatures lead to excessive strain on the respiratory system. Concurrently, high temperatures facilitate the accumulation of solid particles in the atmosphere, which adversely impacts respiratory health, as these particles can settle in the lungs and cause tissue damage.

Beyond the chronic diseases previously mentioned, it is important to highlight the rising incidence of infectious diseases, especially those transmitted by vectors, in relation to air temperature. Typically, the number of reported cases tends to rise with increased temperatures and specific humidity levels. Furthermore, a rise in foodborne illnesses characterized by diarrhea is also anticipated during the warmer months.

4.8.4 HEALTHCARE SYSTEM DESIGN AND ROLE IN CLIMATE CHANGE ADAPTATION

Healthcare institutions are pivotal in tackling the challenges posed by climate change.

The Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health and Social Protection of Georgia operates within the executive branch of government and is tasked with formulating the country's healthcare policies. This responsibility is carried out by the Policy Department of the Ministry across all relevant sectors.

It is important to highlight that this Ministry is referenced in significant international documents as the designated authority. The roles of the Ministry and its affiliated agencies encompass not only the development of state policy but also the establishment, execution, and data collection necessary for monitoring mechanisms aimed at mitigating and preventing health risks associated with climate change.

Key sub-agencies of the Ministry that significantly contribute to understanding the health impacts of climate change include:

L. Sakvarelidze National Center for Disease Control and Public Health (NCDCPH), which engages in the formulation of public health policies. The Center's Department of Environmental Health specifically addresses climate change issues and is also capable of conducting relevant scientific research.

Additionally, the Department of Medical Statistics is tasked with gathering and analyzing statistical data regarding the medical and health status of the population, which is essential for monitoring current risks and outcomes, as well as for the prompt identification of emerging challenges.

The LEPL Emergency Coordination and Emergency Assistance Center is tasked with overseeing medical responses and is pivotal in the country's readiness for, as well as the mitigation of, the impacts of natural disasters, heat waves, and climate change-related incidents.

Additionally, the Emergency Management Service of the Ministry of Internal Affairs of Georgia significantly contributes to the response efforts for natural disasters. Data from 2019 indicates that 14% of the agency's interventions were in response to natural emergencies.

Furthermore, civil society organizations are instrumental in enhancing awareness regarding climate change, advocating for related issues, and educating the public on these matters..

Strategic documents: The National Environment and Health Action Plan (2018) was established by the National Environment and Health Action Plan (NEHAAP), which emphasizes the importance of close collaboration across various sectors to prioritize public health in all aspects of national policy (Health in All Policies). This initiative aims to uphold the constitutional right of the Georgian population to live in a health-promoting environment. The responsibility for executing the National Environment and Health Action Plan is shared among sectors such as economics, agriculture, education, finance, foreign affairs, local self-governance, as well as healthcare and environmental protection.

The management, coordination, and oversight of the National Environment and Health Action Plan will be conducted by the Coordination Council of the National Environment and Health Action Plan, which serves as an advisory entity to the Government of Georgia and is chaired by the Prime Minister. The National Center for Disease Control and Public Health will act as the secretariat for this Coordination Council. A key aspect of the Action Plan is its fifth point, which focuses on the "Surveillance of health status and risk factors associated with climate change."

Additionally, the "National Health Strategy of Georgia 2022-2030" highlights one of its strategic objectives as the "Prevention of morbidity, disability, and mortality resulting from climate change and environmental factors."[302].

4.8.5 PERCEPTION RESEARCH

Given the pivotal role that doctors and nurses play in identifying and treating diseases exacerbated or triggered by heat waves, it is essential to evaluate their perspectives and provide suitable recommendations. This approach aims to enhance the awareness and engagement of medical professionals in managing heat-related illnesses, thereby facilitating patient recovery. Furthermore, the active participation of healthcare providers is crucial should an early warning system for heat waves be implemented in the country.

302 https://matsne.gov.ge/ka/document/view/5453716?publication=0

Consequently, the preparedness of specialists in this regard is of significant importance.

A small-scale survey was conducted to gather insights from medical professionals concerning heat waves, utilizing a concise questionnaire designed for physicians across various specialties. The objective of the survey was to assess healthcare professionals' perceptions of climate change, particularly its effects on human health due to heat waves. The questionnaire was

informed by the model titled "Healthcare Professionals' Views on Climate Change and Health: A Multinational Study," published in the esteemed medical journal "The Lancet." Physicians from "Aversi Clinic" and "Academician Vakhtang Bochorishvili Clinic" participated in the interviews. A total of 148 doctors from diverse specialties took part in the study, including those essential for this research: general practitioners, cardiologists, and pediatricians.

The questionnaire comprised ten questions, yielding several noteworthy responses: 98% of participants acknowledged climate change as a genuine phenomenon, 98% recognized its detrimental effects on human health, 76% observed an increase in the frequency and duration of heat waves, 76% associated heat waves with climate change, 92% deemed heat waves harmful to health (attributing effects such as heat stress (38%), infectious diseases (46%), chronic conditions (82%), and mortality (18%)), and 68% emphasized the necessity of establishing an early warning system.

Research into the medical community's understanding of the challenges posed by climate change is crucial. Enhancing the awareness and knowledge of healthcare professionals is essential for developing and implementing an effective response system, which should include an early warning mechanism.

4.8.6 MULTI-CRITERIA VULNERABILITY ANALYSIS

Heat waves are recognized as a significant urban challenge, exemplified by the "heat island effect," which results in elevated temperatures in urban areas due to the extensive heat absorption by asphalt and buildings. Consequently, there has been a concerted effort to evaluate the vulnerability and adaptive capacity of several major cities. The analysis encompassed a broader selection of cities compared to the Fourth National Communication Report, which examined only six cities. The current report evaluated fifteen cities through a multi-criteria vulnerability analysis method, including: Batumi and Kobuleti from Adjara; Lanchkhuti from Guria; Kutaisi and Zestafoni from Imereti; Telavi and Dedoplistskaro from Kakheti; Poti and Zugdidi from Samegrelo-Zemo Svaneti; Tianeti from Mtskheta-Mtianeti; Oni (Shovi) from Racha-Lechkhumi; Akhaltsikhe from Samtskhe-Javakheti; and Tbilisi, Marneuli, and Khashuri from Kvemo Kartli and Shida Kartli, respectively.

The evaluation of these fifteen cities and municipalities in Georgia was conducted based on three primary components: (1) the capacity of the population to adapt; (2) the effects of heat waves; and (3) the sensitivity to heat waves.

The analysis relied on data sourced from strategic documents, reports, ministry databases, and contributions from experts.

Component	Selected Indicators
Population Adaptation Ability	
Social Capital	Subsistence Allowance % of recipients , pension % of recipients , socially % of vulnerable
Human Capital	Medium Education % of those with ,
Financial Capital	of employed , average Salary
Physical Capital	Emergency Medical Help Stations , qualified Medical Frame %
Heat Waves Influence	Heat Waves Quantity , heat Waves Duration
Heat To the waves Sensitivity	
Local Topics	of population over 65 Above , including % of women , population Density
Healthcare Sector / Human Health	Cardiovascular System % of diseases , respiratory System % of diseases

When selecting indicators, data was utilized up to and including December 2023. However, for certain indicators, such as healthcare personnel and the proportion of socially vulnerable individuals, the data pertains to earlier periods, specifically 2022. The trends in cardiovascular and respiratory diseases are based on data from 2009 to 2029, which encompasses the broader region rather than specific municipalities. Additionally, it is important to note that salary and employee data are exclusively derived from the business sector.

The indicators mentioned will be employed to evaluate the current situation, while the effects of heat waves will be assessed using contemporary climate data, specifically the differences between the periods of 1961-1990 and 1991-2020. The forecast periods for future projections are set for 2041-2070 and 2071-2100.

This assessment does have certain limitations: the data distinguishing the present from the future is solely based on impact, as all other data remains constant, with temperature data (including the frequency and duration of heat waves) varying according to present and future scenarios. Please refer to the accompanying Excel files in Annexes 2 and 3..

The most significant rise in the duration of heat waves between the periods of 1961-1990 and 1991-2020 was recorded in the municipalities of Poti, Batumi, Kobuleti, Khashuri, Dedoplistskaro, and Oni (Shovi). Similarly, the most pronounced increase in the number of days experiencing heat waves during the same timeframe was noted in Kobuleti, Poti, Oni (Shovi), Batumi, Dedoplistskaro, and Khashuri. Through a multi-criteria analysis of the current situation, the findings indicated that Batumi is the most vulnerable city, followed by Oni (Shovi), with Poti, Kobuleti, Kutaisi, and Khashuri also identified as vulnerable. The elevated vulnerability index is primarily influenced by the severe effects of heat waves, which are most intense in Kobuleti and Poti. However, when factoring in additional elements such as population adaptive capacity and sensitivity to heat waves, Batumi and Oni (Shovi) emerged as the most vulnerable locations.

The variation in the duration of heat waves is significantly less marked in the future periods of 2041-2070 and 2071-2100. Notably, the most substantial increase is recorded in Akhaltsikhe and Tianeti, while other municipalities exhibit a relatively modest rise, although increases are still noted in Kobuleti, Zestaponi, and Marneuli. Conversely, Pasanauri shows a decline. The notable rise in the number of days characterized by heat waves during the same timeframe is also less pronounced compared to the present; however, increases are observed in Zestaponi, Batumi, and Dedoplistskaro, while Zugdidi and Marneuli experience a decrease. A multi-criteria analysis of the current situation reveals that Kutaisi is the most vulnerable city, followed by Batumi, Zestaponi, Akhaltsikhe, and Lanchkhuti. Considering that the only variable changing in the future scenario is the effect of heat waves, it can be inferred that the shifts in vulnerability ratings are attributable to alterations in climate parameters. Kutaisi, previously identified as highly vulnerable, is projected to maintain this status in the future, while Batumi, although currently very vulnerable, is expected to become less so compared to Kutaisi. In the case of Oni (Shovi), the influence of heat waves is anticipated to diminish in the future, significantly lowering the municipality's vulnerability.

4.8.7 ACTION PLAN FOR THE MANAGEMENT OF PUBLIC HEALTH RISKS ASSOCIATED WITH HEAT WAVES 2024-2030

The Action Plan for Managing Public Health Risks Associated with Heat Waves for the years 2024-2030 is designed to enhance national capacities for climate change adaptation by establishing effective response mechanisms to heat waves. This document is both conceptually and strategically aligned with the United Nations Sustainable Development Goals for 2030, as well as the World Health Organization's guidelines for developing heat wave action plans.[303] The Action Plan also considers the recommendations presented in Georgia's Fourth National Communication to the United Nations Framework Convention on Climate Change. It aligns with the initiatives outlined in the National Health Strategy of Georgia for 2022–2030, aiming to prevent morbidity, disability, and mortality associated with climate change and environmental factors.

Furthermore, the Action Plan addresses national obligations under several international agreements, including the UNFCCC and its Paris Agreement, the Association Agreement with the European Union, and the Aarhus Convention. It incorporates commitments from the "Association Agreement between Georgia and the European Union, the European Atomic Energy Community, and their Member States." The obligations specified in the Association Agreement, such as planning for climate change mitigation and adaptation, epidemiological surveillance, management of communicable and non-communicable diseases, enhancement of information and knowledge, and environmental impact assessment and monitoring, are integral to the Action Plan's activities.

Additionally, the Action Plan is designed to fulfill Georgia's commitments to the Sustainable Development Goals (SDGs). The initiatives outlined within the Action Plan play a crucial role in advancing Sustainable Development Goals 3, 11, and 13, which focus on promoting healthy lives and well-being, ensuring sustainable cities and communities, mitigating negative environmental impacts, and addressing climate change.

At the national level, the Action Plan is founded upon the following legislative framework:

303 Heat-health action plans: guidance.WHO 2008. https://www.who.int/publications/i/item/9789289071918

the Constitution of Georgia; the Law of Georgia “On Health Protection”; the Law of Georgia “On Environmental Protection”; the Law of Georgia “On Environmental Assessment Code”; the Law of Georgia “On Public Health”; and the Law of Georgia “On Energy Efficiency of Buildings.”

The implementation of the Action Plan is anticipated to yield **two primary outcomes** by the year 2030.

1. Establishment of a real-time monitoring and evaluation system to address public health threats associated with heat waves.
2. Decrease in the rates of illness and fatalities linked to heat waves in Georgia.

The goal of the action plan will be achieved through the implementation of **four tasks:**

1. Create a public health risk management framework specifically addressing heat wave events;
2. Set up an early warning system to inform the public regarding impending heat waves;
3. Formulate and execute a communication strategy focused on heat wave awareness;
4. Introduce measures to mitigate damage in urban areas and ensure that long-term urban planning incorporates strategies for climate change adaptation.

The Action Plan is designed to address the needs of the entire population of Georgia. However, specific **priority groups** have been identified due to their heightened vulnerability to heat wave impacts. These groups include the elderly, particularly those suffering from multiple chronic conditions or residing in specialized care facilities, individuals with chronic illnesses such as heart failure, ischemic heart disease, cardiomyopathy, cerebrovascular diseases, hypertension, chronic obstructive pulmonary disease, kidney diseases, diabetes, obesity, Alzheimer’s disease, depression, and other mental health disorders, as well as those on long-term medication. Additionally, pregnant women, outdoor workers, medical personnel utilizing personal protective equipment, and individuals who are socially isolated or homeless are also prioritized.

The management of public health risks associated with heat waves will be approached through a multisectoral strategy. The key elements of this risk management framework include:

1. Mechanisms for coordination at both central and local government levels;
2. An early warning and notification system addressing the health effects of heat waves;
3. A surveillance framework to monitor health risks associated with heat waves;
4. A communication system aimed at informing the public and vulnerable populations;
5. Strategic long-term planning, supported by relevant legislation, to create an urban environment resilient to the effects of heat waves.

Responsibility for the successful execution of the Action Plan will be allocated among various governmental bodies, considering their respective mandates and areas of expertise. This includes the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health, and Social Protection of Georgia, as well as the Ministry of Environmental Protection and Agriculture of Georgia. A Coordination Council will be formed, tasked with overseeing the execution of the Action Plan, ensuring effective coordination at a high level, and reviewing and approving monitoring and evaluation reports. The Department of Health Policy within the Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health, and Social Protection of Georgia will serve as the primary coordinating entity for the implementation of the Action Plan. Additionally, other stakeholders, including non-governmental organizations, international entities, expert groups, the private sector, and academic circles, will be engaged in the execution of the Action Plan..

Recommendations

- Enhancing the understanding of the health implications associated with climate change among healthcare professionals and providing specialized training sessions is essential. This awareness is vital not only for clinical practitioners but also for the administrators of clinics and medical facilities. Furthermore, it is imperative to engage public health experts and encourage their participation in the policymaking process.
- The training topics should encompass fundamental information regarding climate change and its various challenges, such as heat waves, and their effects on human health. However, particular attention should be given to the subject of heat waves, as they pose a significant threat nationwide and adversely affect both individual health and the overall healthcare system.
- The implementation of early warning systems (EWS) for heat waves in cities that are at high risk is essential. The significance of these systems is emphasized in the Heat Wave Action Plan for 2024-2030. The National Center for Disease Control and Public Health should play a proactive role in both the establishment and ongoing evaluation of these EWS. Local disease control and public health centers will have a crucial function in the operation of these systems. In the development of an early warning system, it is vital to consider the outcomes of multi-criteria analysis, prioritizing cities that exhibit high levels of vulnerability.
- Furthermore, it is important to enhance collaboration between health and environmental protection agencies, advocate for a multisectoral approach, and, when necessary, encourage research that elucidates the relationship between climate change and health risks. Conducting studies to evaluate the economic impact of climate change on the healthcare system is also critical.
- In addition to addressing heat waves, it is necessary to identify and assess other climate change-related risks, such as cold waves, mental health issues stemming from climate change, and variations in air quality.

4.9 CLIMATE CHANGE IMPACT ON THE TOURISM SECTOR AND ADAPTATION

4.9.1. TOURISM SECTOR OVERVIEW

The tourism sector in Georgia plays a crucial role in the country's economy, underscoring the necessity to examine its susceptibility to various environmental influences, particularly climate change. This report aims to deliver an in-depth analysis of the sector, emphasizing marine and mountain tourism, which are notably the most vulnerable to the impacts of climate change.

Georgia, with its rich natural diversity, historical significance, and cultural heritage, has witnessed substantial growth in its tourism industry in recent years. This expansion has brought forth both opportunities and challenges, particularly concerning the heightened risk of natural disasters. Consequently, there is an urgent need for further research to assess the implications of climate change on tourism, which should inform the development of effective adaptation strategies. The present report evaluates current tourism trends, visitor distribution throughout the country, and the economic significance of the tourism sector..

The LEPL Georgian National Tourism Administration functions as a legal entity under public law, operating within the framework of the Ministry of Economy and Sustainable Development of Georgia. Its primary goals include the formulation and execution of state policies aimed at advancing tourism in Georgia, fostering sustainable tourism practices, enhancing export revenues, and generating new employment opportunities through tourism development. Additionally, the Administration seeks to attract international visitors to Georgia, promote domestic tourism, and enhance tourist destinations, infrastructure, and human resources within the tourism sector. In 2015, the Administration established a tourism strategy that outlined eight strategic goals and a vision prioritizing visitor quality over quantity. The following year, a marketing strategy was developed, linking specific tourism products to targeted markets. This strategy identified three primary tourism categories—wine and food, nature and adventure, and cultural heritage—alongside four supporting categories: health and wellness, marine tourism, MICE (Meetings, Incentives, Conferences, Exhibitions) tourism, and city tours. In 2023, the Parliament of Georgia enacted a new law titled "On Tourism."

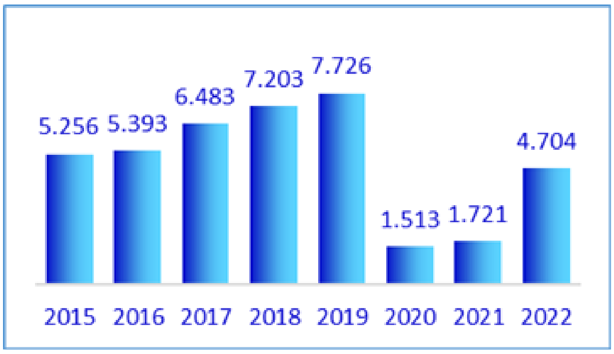
Additionally, Georgia has a Mountain Trails Agency responsible for the management and development of mountain trails and ski infrastructure in the country's ski resorts. Currently, the total length of marked trails in these resorts is 148 kilometers, complemented by 48 ski lifts. The Department of Tourism and Resorts of Adjara oversees the most sought-after marine tourism destinations, actively promoting the region's tourism potential..

The total number of visits to Georgia, encompassing both international and domestic travelers, reached 21 million. Of this total, international visits comprised 4.7 million, representing a 22% share, while domestic visits accounted for 16 million, or 78%. The period leading up to 2019 saw a significant rise in international visits, culminating in a record high of 7.7 million that year. However, the Covid-19 pandemic led to an 80% decline in international visitor numbers in 2020. By 2022, the reduction compared to 2019 had improved to 39% (refer to Figure 4.9.1). In that year, the majority of international visits (62%) originated from neighboring countries, with Russia leading at 23%, followed by

Turkey at 20% and Armenia at 16%. Among non-neighboring nations, Israel and Ukraine each contributed 4%, ranking fourth and fifth, respectively.

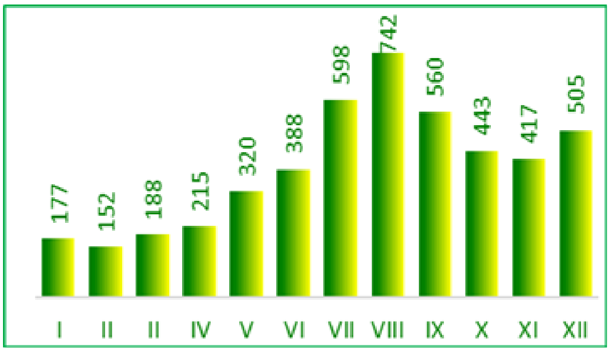
International visits exhibit notable seasonality. In 2022, the peak month for international arrivals was August, with 742 thousand visits (16% share), followed by July with 598 thousand (13% share) and September with 560 thousand (12% share). Conversely, the months with the fewest visits were January, with 177 thousand (4% share), February with 152 thousand (3%), and March with 188 thousand (4%) (see Figure 4.9.2).

FIGURE 4.9.1: NUMBER OF INTERNATIONAL VISITS IN 2015-2022 (MILLION).



https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

FIGURE 4.9.2: MONTHLY DISTRIBUTION OF INTERNATIONAL VISITS IN 2022 (THOUSANDS).



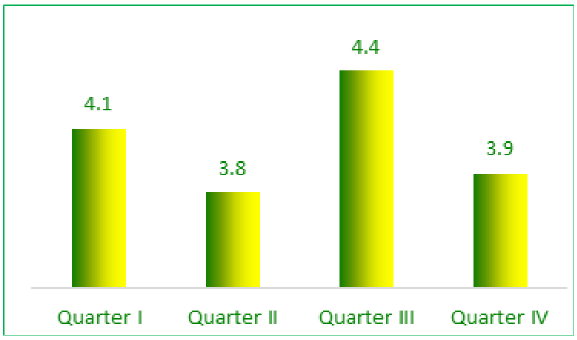
https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

The COVID-19 pandemic has influenced domestic visits, albeit to a lesser degree. In 2020, there was a 12% reduction, followed by a 19% rise in 2021 compared to 2019. In 2022, domestic visits experienced a slight decline of 4% relative to the previous year. The distribution of domestic visits is fairly consistent across the quarters, with the highest proportion occurring in the third quarter at 27.0%, while the second quarter recorded the lowest at 23.5%.

FIGURE 4.9.3: NUMBER OF LOCAL VISITS (MILLION) IN 2015-2022

https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

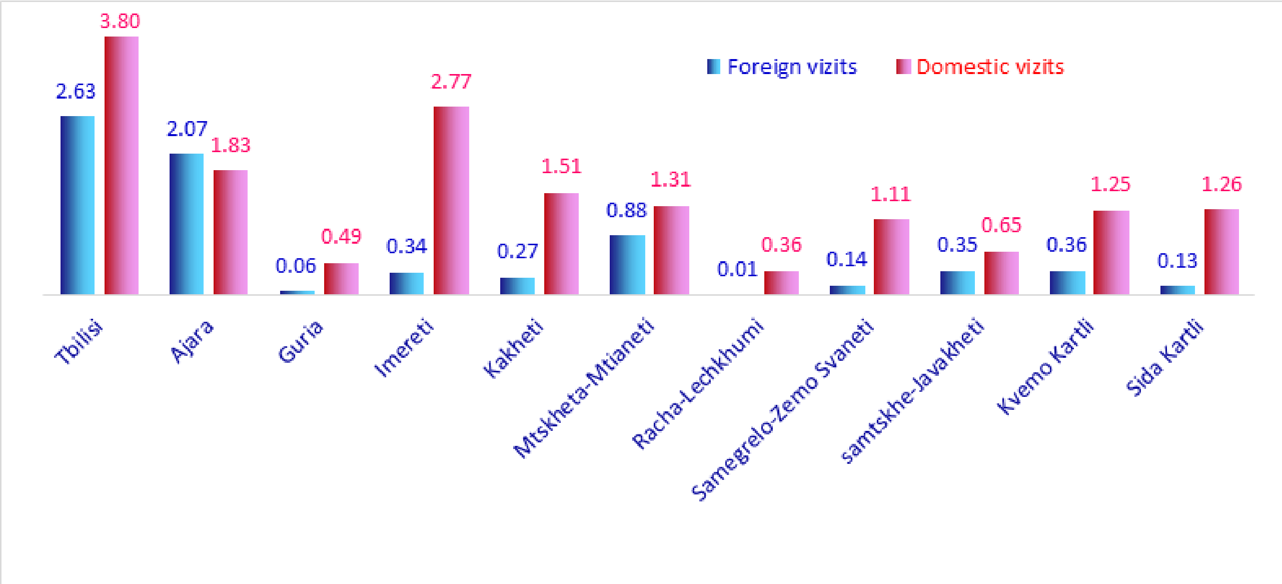
FIGURE 4.9.4: MONTHLY DISTRIBUTION OF LOCAL VISITS (MILLION) IN 2022



https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

The highest volume of both international and domestic tourism is recorded in Tbilisi. Data from 2022 indicates that international visitors are not evenly spread across regions, with Tbilisi and Adjara regions being the most prominent. In contrast, domestic tourism is more uniformly distributed. Notably, the Imereti region experienced a significant influx of visitors in 2022, alongside Tbilisi. Among coastal destinations, Batumi stands out as the most favored by international tourists, attracting 2 million visits, which accounts for 44% of the total. Other seaside resorts have considerably lower percentages: Kobuleti at 3.2%, Ureki at 1.2%, and Anaklia at 0.2%. In the mountain resort category, Kazbegi leads with 433 thousand international visits, representing a 9.4% share. The visitor distribution for other mountain resorts is as follows: Gudauri at 6.2%, Mestia and Ushguli at 1.7%, Bakuriani at 1.3%, Sairme at 0.3%, Shatili at 0.1%, and Shovi at 0.1%.

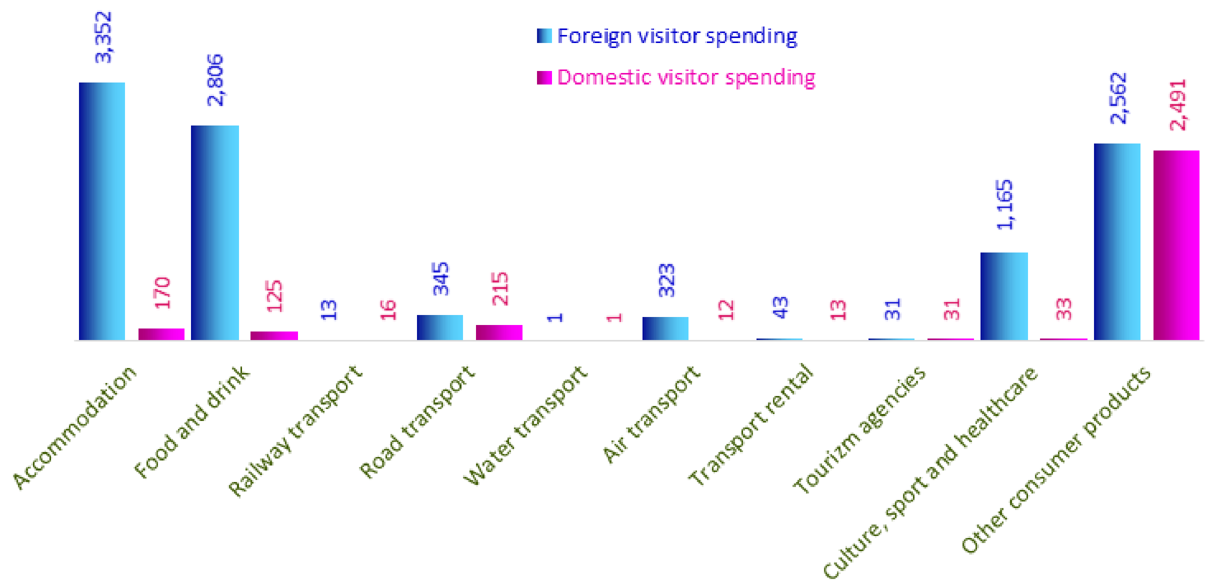
FIGURE 4.9.5: DISTRIBUTION OF INTERNATIONAL AND DOMESTIC VISITS BY REGION IN 2022.



https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

Domestic tourism expenditure in the country amounts to 3.0 million GEL, whereas spending by foreign tourists reaches 10.7 billion GEL, culminating in a total of 13.7 billion GEL. Although domestic visitors constitute a larger numerical presence, their contribution to overall spending is merely 23%. Figure 4.9.6 distinctly illustrates the minimal proportion of expenditure by domestic visitors across nearly all categories.

FIGURE 4.9.6: DOMESTIC TOURISM EXPENDITURE BY PRODUCT IN 2022 (THOUSAND GEL)



In conclusion, it can be stated that the growth of tourism in Georgia is currently generating significant revenue for the local population. Furthermore, anticipated reforms are likely to lead to an even greater influx of visitors in the future. Consequently, it is essential to prepare for the expected impacts of climate change by reducing potential harm to the community, which can only be achieved through effective planning.

4.9.2. CLIMATE CHANGE IMPACT ON THE TOURISM SECTOR

Climate change, characterized by rising average temperatures, poses significant challenges to the economy of the country. If nations worldwide fail to meet their obligations under the Paris Agreement, which appears likely given current trends, it is anticipated that social, economic, and environmental issues related to climate will intensify. For instance, higher temperatures may lead to decreased productivity, particularly in nations where agriculture is a key economic driver. This decline in productivity could adversely affect income growth for the population, subsequently impacting the development of both domestic and international tourism. Furthermore, the tourism industry may face additional threats from climate-related phenomena, such as reduced snow cover, which would increase the vulnerability of winter resorts, a shorter duration of snowfall leading to diminished winter seasons and associated revenues, rising sea levels that could erode recreational coastlines, and an increase in coastal storm activity.

The most evident effect of climate change is the rise in average temperatures. Climate projections indicate that Georgia will experience an increase in average temperatures throughout the year, albeit at varying rates. The anticipated rise in air temperature ranges from 0.2 to 0.7 degrees Celsius, with Mtskheta-Mtianeti recording the most significant increase. In Poti, the temperature rise is noted to be 0.6 degrees. The most substantial temperature increase in Mestia is projected for March, reaching +5.9 degrees Celsius, while Gudauri is expected to see its highest increase in October at +3.4 degrees Celsius. Conversely, the smallest changes in average temperatures for these regions are anticipated in April, with Mestia experiencing +1.6 degrees Celsius and Gudauri +2.1 degrees Celsius (Kartvelishvili L., Tatishvili A., 2023). A summary of the expected seasonal temperature variations in Mestia and Gudauri is presented in Table 4.26[304].

TABLE 4.26 CHANGE IN AVERAGE TEMPERATURES (°C) BY MONTH.

Station	Month						Season			Year
	X	XI	XII	II	III	IV	Spring	Autumn	Summer	
Mestia	4.4	2.1	2.8	2.4	5.9	1.6	3.5	3.3	2.5	2.9
Gudauri	3.4	3.1	2.9	2.7	2.8	2.1	2.9	3.0	2.9	3.0

It is important to highlight that, over the long term, there is a notable decline in precipitation across nearly all regions of Georgia. Consequently, in light of the rising average temperatures, a reduction in the duration of snow cover is anticipated in mountainous resort areas. A marked decrease in precipitation has been recorded in the high-altitude regions of the Caucasus, including the Gagra and Egrisi Ranges, as well as in the mountains of Guria and Adjara, and the Meskheti Range[305].

Additionally, an increase in precipitation has been observed along the coastal areas of the Kolkheti Plain and Adjara.

304 Kartvelishvili L., Tatishvili A., Amiranashvili A., Megrelidze L., Kutaladze N. Weather, climate and regularities of their changes in the conditions of Georgia, 2023. http://openlibrary.ge/handle/123456789/10319

305 Kartvelishvili L., Tatishvili A., Amiranashvili A., Megrelidze L., Kutaladze N. Weather, climate and regularities of their changes in the conditions of Georgia, 2023. http://openlibrary.ge/handle/123456789/10319

Given that mountain and ski tourism is particularly vulnerable to climate change, indicators of snow cover height have been closely monitored and analyzed. The ski tourism sector in Georgia encompasses the ski resorts of Bakuriani, Gudauri, Goderdzi, Tetnuldi, and Hatsvali (Upper Svaneti). However, due to insufficient data, an analysis of snow cover height for the winter resorts of Goderdzi (Adjara) and Svaneti could not be conducted.

For the Bakuriani resort, three distinct observation periods were selected based on the available data: 1961-1976, 1977-1992, and 2007-2020. The average snow cover level was assessed on a monthly basis as the key parameter for analysis. The findings are compiled in the tables presented below..

The data analysis revealed several notable trends. In the Bakuriani resort area, there was an increase in the average snow cover height from 1961 to 1992, followed by a decline from 2007 to 2020. During the months of May, June, July, August, September, and October, the average snow cover level in this region is nearly nonexistent, rendering any analysis of this parameter during these months ineffective. Between 1961 and 2020, an increase in average snow cover was noted in January and February, while a decrease was observed in March and November. February records the highest snow cover in Bakuriani. The observed decrease in snow cover primarily occurs during months with already low levels, which contributes to a shorter winter season. This trend poses a long-term threat to the growth of winter tourism in Bakuriani (refer to Table 4.27.).

TABLE 4.27. AVERAGE SNOW COVER HEIGHT IN BAKURIANI.

	Average snow cover, cm			Change, %		
Month/Period	**1961-1976 (1)**	**1977-1992 (2)**	**2007-2020 (3)**	**1 - 2**	**1 - 3**	**2 - 3**
January	31.7	32.1	35.3	1.2	11.4	10.1
February	39.8	45.1	46.3	13.3	16.3	2.7
March	35.3	30.1	28.4	-14.7	-19.5	-5.6
April	4.3	3.8	3.8	-11.1	-10.4	0.8
October	0.4	0.5	0.0	19.0	-88.9	-90.7
November	4.8	6.0	4.5	24.2	-6.1	-24.4
December	18.9	16.7	19.3	-11.8	2.0	15.8

The most notable alteration in the Bakuriani resort area occurred in March, where the average snow cover level experienced a decline of approximately 20% (from 35 cm to 28 cm) during the period from 1961 to 2020. Conversely, in January and February, the average snow cover increased by 11% and 16%, respectively, within the same timeframe. Additionally, the reduction in snow cover height for November from 2007 to 2020 is particularly noteworthy (refer to Table 4.28.).

For the Gudauri resort, two distinct observation periods were analyzed: 1961-1976 and 2002-2019. The average snow cover level was assessed on a monthly basis as the primary analytical parameter. The findings are compiled in the table below.

The analysis revealed several trends; specifically, an increase in the average snow cover height was noted in Gudauri during the 1961-1976 period, followed by a decrease in the

2002-2019 timeframe. The average snow cover levels in June, July, August, and September are nearly negligible, rendering the analysis of these months ineffective. Between 2002 and 2020, compared to the earlier period of 1961-1976, there was an increase in average snow cover in January (+17.5%) and February (+8.3%), while a decrease was observed in April (-5.6%) and December (-8.6%). March remains the month with the highest snow cover in Gudauri. A decline in average snow cover depth is also evident in April, May, and October, which may lead to a reduction in the winter season duration (see Table 4.28.).

Georgia is currently facing considerable challenges due to the rise in natural disasters, which are partly attributed to global warming. Given the country's geographical and climatic conditions, it is particularly susceptible to various natural disasters, including floods, droughts, storms, landslides, mudslides, and avalanches.

TABLE 4.28. AVERAGE DEPTH OF SNOW COVER IN GUDAURI.

	Average snow cover, cm		Change, %
Month/Period	**1961-1976 (1)**	**2002-2019 (2)**	**1 - 2**
January	79.5	93.4	17.50
February	105.6	114.4	8.33
March	127.4	126.6	-0.62
April	87.0	82.1	-5.64
May	12.9	12.5	-3.31
October	2.4	1.0	-58.13
November	15.6	16.0	2.69
December	52.4	47.9	-8.64

According to the National Statistics Service of Georgia, a total of 106 natural hydrometeorological events were recorded in 2021, marking a significant increase compared to similar data from previous years. Consequently, the damage inflicted by these natural disasters has also escalated.

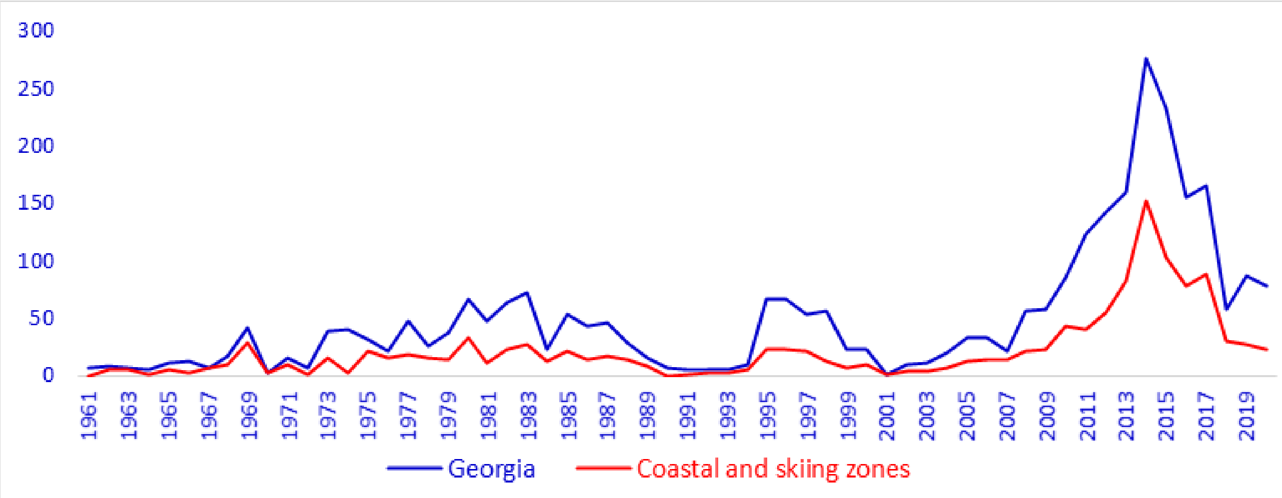
In terms of geological disasters, such as landslides and mudslides, there has been a notable rise in their occurrence, particularly with landslides. In 2021, Georgia experienced 1,107 landslides and 203 mudslides, figures that considerably surpass those from earlier periods (Geostat, 2021).

Figure 4.9.7 illustrates the statistics on natural disasters from 1961 to 2020. The coastal and mountain-skiing regions, which encompass Adjara, Guria, Abkhazia, Samegrelo-Zemo Svaneti, Mtskheta-Mtianeti, and Samtskhe-Javakheti, exhibit a clear upward trend in natural disasters. This increase has been particularly pronounced since 2001, although a decline has been noted since 2015. From 2003 to 2020, the average annual increase in natural disasters across the country was approximately 23%, a notably high statistic.

In the coastal and mountain-skiing areas (as shown in Figure 4.9.7), where tourism is the primary economic activity, similar trends are evident. The frequency of natural disasters in these regions accounts for about 44% of the total disasters nationwide, indicating that nearly half of all natural disasters occur in areas heavily reliant on tourism. This situation adversely impacts the tourism sector, leading to significant losses and damages. Given the anticipated intensification of the climate crisis in the long term, the tourism industry faces additional challenges and risks. The financial burden of adaptation measures is expected to rise, further straining the state budget.

It should also be noted that climate change will have certain impacts on marine (coastal) tourism (both negative and positive) in the long term. Among the positive ones, warming may create more comfort for beachgoers.

FIGURE 4.9.7: NATURAL DISASTER STATISTICS 1961-2020.



Among the adverse effects, it is important to highlight the increase in sea level along the entire coastline of the nation, which may intensify issues associated with coastal erosion. Between 1956 and 2007, the Black Sea experienced a rise of 0.7 meters. Additionally, the frequency of storms has significantly increased, with their annual occurrence rising by 50% during the same timeframe (Asian Development Bank, 2021). These trends are likely to adversely affect the tourism sector in the long run, thereby impeding economic development and the growth of household incomes. Furthermore, it is essential to recognize that, apart from global warming, other factors contribute to coastal erosion, including extensive infrastructure projects such as the beautification and expansion of ports and transport systems, as well as large hydropower installations.

As projections indicate that the Black Sea coastline may warm by 3 to 6 degrees Celsius, there exists a risk of rising sea surface temperatures, which could detrimentally affect both fishing and marine tourism. This may lead to the disappearance of certain fish species and render underwater excursions less appealing to visitors (Country Climate Risk Profile - Georgia, Asian Development Bank, 2021).

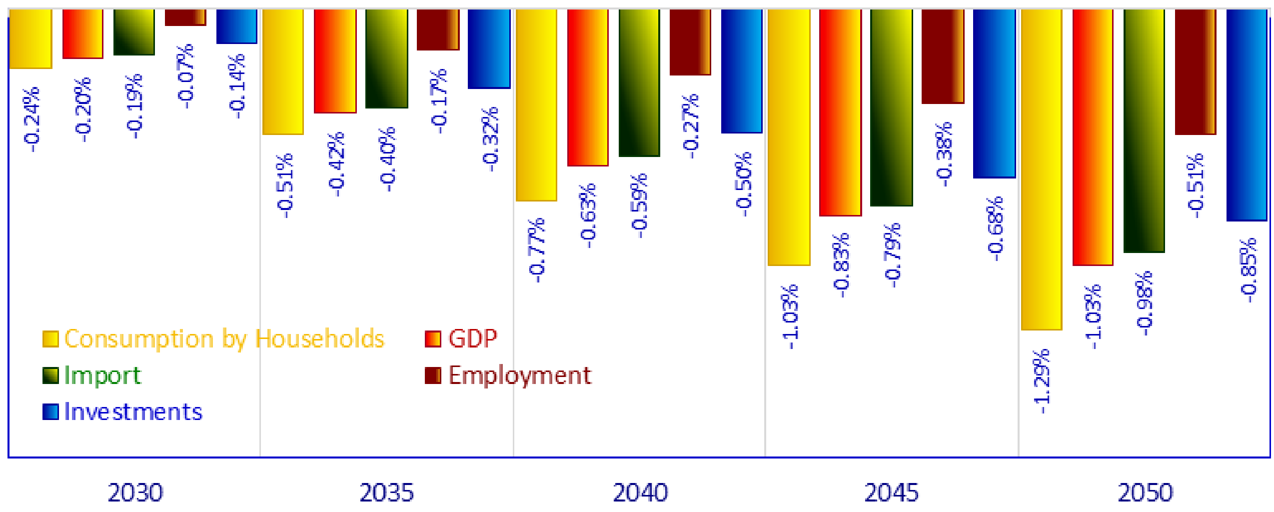
It is also noteworthy that approximately half a million individuals reside along the controlled Black Sea coastline, placing them in a category of high vulnerability to the impacts of global warming due to the aforementioned factors and potential threats. Therefore, it is imperative to incorporate climate change considerations into strategic planning for coastal development.

As previously mentioned, tourism constitutes a vital sector of the national economy, employing around 11% of the workforce. Approximately 70% of the country's service exports are linked to tourism, and the industry's contribution to the national GDP exceeds

10%. Given these factors, it is crucial to evaluate the implications of climate change on the country's macroeconomic indicators.

The E3.ge model was employed to evaluate the long-term economic consequences of climate change in Georgia. This model generates scenarios and examines the macroeconomic repercussions of climate change-related occurrences, including coastal erosion, rising sea levels, alterations in precipitation patterns, floods, landslides, and mudslides. Additionally, it assesses the potential economic impacts of measures aimed at adapting to climate change.

FIGURE 4.9.8: IMPACT OF CLIMATE CHANGE ON GEORGIA'S GROSS DOMESTIC PRODUCT AND ITS COMPONENTS[306].



The findings derived from the E3.ge model, which was employed to analyze the macroeconomic repercussions of climate change, indicate the following: Between 2025 and 2050, the effects of climate change on macroeconomic variables such as gross domestic product (GDP), consumption, investment, imports, and employment are projected to intensify and yield negative outcomes. Specifically, during this timeframe, the annual economic detriment to the tourism industry due to the adverse effects of climate change is anticipated to reach 1% of the country's GDP. Climate change is expected to influence economic metrics including consumption, investment, imports, and employment. The repercussions of climate change will exert the least influence on employment, with an estimated impact of approximately 0.5% of GDP by 2050 (refer to Figure 4.9.8).

Consequently, climate change emerges as a critical long-term factor affecting the growth of the tourism sector. Phenomena associated with global warming, such as rising temperatures, diminished snow cover, increased frequency of natural disasters, and rising sea levels, pose significant threats to this sector and may hinder its progress. It is essential to consider climatic factors when formulating a strategy for the advancement of the tourism sector, particularly for coastal and alpine tourism, to mitigate the adverse effects of global warming and the potential damages and losses that may arise in the future.

306 Georgia: Economic Effects of Adaptation in Tourism and Infrastructure Sectors, Policy Brief of the Ministry of Economy and Sustainable Development of Georgia and GIZ, 2021. https://www.giz.de/de/downloads/giz2021-en-georgia-sectoral-policy-brief-tourism-infrastructure.pdf

4.9.3 ON THE ADAPTATION OF THE TOURISM SECTOR TO CLIMATE CHANGE

The ongoing process of climate change is anticipated to persist in the future due to a variety of factors, including inadequate global efforts to mitigate greenhouse gas emissions responsible for global warming, the increasing global population and consumer demand, insufficient reforestation initiatives, the gradual transition from traditional fossil fuels to renewable energy sources, and the rapid expansion of transportation and shipping industries. Consequently, it is imperative for Georgia to focus on establishing a climate-resilient economy and ecosystems to mitigate the damages and losses associated with climate change. This necessitates the formulation and execution of effective adaptation policies across different economic sectors, particularly those that are highly susceptible to the impacts of global warming, such as winter tourism.

The tourism and recreation sector in Georgia is experiencing rapid development. Given the country's untapped tourism potential, it is anticipated that this sector will continue to expand and emerge as a significant source of revenue in the future. As climate change alters the environment, and considering that Georgia's tourism is predominantly nature-based, it is essential for policymakers and practitioners in the tourism sector to incorporate climate considerations into their planning and implementation processes. This approach will enable them to effectively address the long-term challenges posed by global warming. It is also important to recognize that climate change may yield both adverse and beneficial effects, warranting a thorough assessment and analysis of these impacts.

The tourism industry in Georgia is recognized as particularly vulnerable to the impacts of climate change. Research and observations indicate that long-term global warming may lead to alterations in the timing and length of tourist seasons, a reduction in snow cover, diminished comfort levels, and a decline in tourism demand, particularly affecting winter resorts. Additionally, issues such as water scarcity, increased risks from natural disasters, and the loss of recreational coastlines due to erosion and rising sea levels are also anticipated. Furthermore, climate change poses threats to urban infrastructure and coastal defense systems. Given these factors, the implications of global warming in Georgia could adversely influence both economic growth and social welfare over time.

The primary strategic framework guiding the tourism sector is the "Georgian Tourism Strategy 2025," which aims to foster sustainable tourism development, enhance revenue generation, and elevate the sector's significance. Notably, this document does not incorporate considerations related to climate change. In response to the Covid-19 pandemic, a recovery strategy for tourism has been established, highlighting climate adaptation and mitigation as key priorities within the agrotourism sector. It is important to mention that none of the current projects in the tourism sector focus on evaluating the sector's vulnerability to climate change or its necessary adaptations.

Regarding the country's climate adaptation policy, the draft National Adaptation Plan, which is intended to outline key priorities in this domain, is still under development. Nevertheless, several significant adaptation initiatives are currently in progress, supported by various donors, including the Green Climate Fund.

TABLE 4.29. BUDGETARY EXPENDITURES SPENT ON CLIMATE CHANGE ADAPTATION

Governmental Agency	Programs Quantity	Climate-friendly Adapt with Tatsia Busy Shire Program Quantity	Office Budgetary Programs Total Expenses , million Gel	With adaptation Busy Shire Program Expenses , million Gel
Environment Protection And Rural Farming Ministry	15	12	779.6	94.1
Regional Development And Infrastructure Ministry	8	8	3,469.3	867.9
Economy And Sustainable Development Ministry	26	3	958.4	1.14

It is important to recognize that certain government initiatives are partially associated with climate change adaptation, and as a result, their expenses have not been entirely accounted for within the overall costs of climate adaptation programs.

Additionally, it is noteworthy that the state engages in climate change adaptation efforts through a variety of governmental projects, both directly and indirectly. The World Bank reports that 80% of the programs executed by the Ministry of Environmental Protection and Agriculture of Georgia pertain to climate change adaptation, representing an expenditure of approximately 94 million GEL, which constitutes 12% of the Ministry's total program budget. In contrast, only three programs from the Ministry of Economy and Sustainable Development address climate change adaptation, with a combined cost of 1.14 million GEL. Meanwhile, the Ministry of Regional Development and Infrastructure allocates around 868 million GEL to climate adaptation-related initiatives, accounting for 25% of the total budget for the ministry's programs.

To address the adverse effects of global warming and the heightened risks it presents to the tourism industry, it is essential to incorporate climate change considerations more comprehensively into tourism development strategies. Additionally, promoting research that explores the relationship between climate change and the tourism sector is of utmost importance. It is advisable to devise adaptation measures in tourism regions based on empirical evidence and research to prevent the misallocation of financial resources. Furthermore, enhancing public awareness regarding global warming, particularly in relation to adaptation and mitigation strategies, is crucial. The alignment of climate mitigation efforts with adaptation initiatives remains a pertinent topic, given the tourism sector's capacity to contribute to greenhouse gas reduction.

Overall, there are six fundamental pillars of climate adaptation in the tourism sector: business adaptation, consumer adaptation, place adaptation, policy adaptation, framework adaptation, and sustainable adaptation. Business adaptation emphasizes the behavior of the private sector, the implementation of climate-smart business practices, and the integration of environmental technologies. Consumer adaptation pertains to the behaviors and travel choices of tourists. Place adaptation involves the perceptions of local economic stakeholders—such as businesses, local governments, communities, and residents—regarding climate-related risks and challenges. Adaptation policy addresses the tourism sector's strategies in response to climate change. The adaptation framework evaluates the various adaptation options available to managers and policymakers. Lastly, sustainable adaptation focuses on fostering the tourism sector's development in an environmentally sustainable manner.

Winter tourism is notably susceptible to the impacts of climate change, making adaptation policies particularly significant in this context. While it is evident that global warming may not lead to catastrophic outcomes for mountain and ski tourism, there is an expectation of declining recreational conditions over time, such as reduced snowfall. This decline could adversely affect tourist numbers and the associated revenue. Therefore, when planning and executing the development of winter tourism, it is essential to incorporate climate change considerations as a key factor, alongside other influences such as international competition, to facilitate necessary structural changes within the sector.There are generally four strategies for addressing winter tourism: I. Preservation of ski tourism (enhancing artificial snow infrastructure, relocating resorts to higher elevations, modifying ski run slopes, fostering collaboration); II. Financial support (annual or one-time subsidies); III. Development of alternatives to traditional mountain and ski tourism (engaging in winter activities that do not require snow, promoting off-season tourism); IV. Fatalism (ceasing mountain and ski tourism in favor of other economic pursuits, adopting a strategy of inaction or "business as usual") (Elsasser, Burki, 2002).

Considering its unique resources—financial, human, and natural—Georgia should adopt a tailored combination of these strategies based on the specific characteristics of its mountain and ski tourism regions, such as Samtskhe-Javakheti, Mtskheta-Mtianeti, Svaneti, and Adjara.

Maritime tourism is marked by distinct characteristics and challenges. In this context, three primary avenues for adaptation can be identified: informational, institutional, and financial-investment.

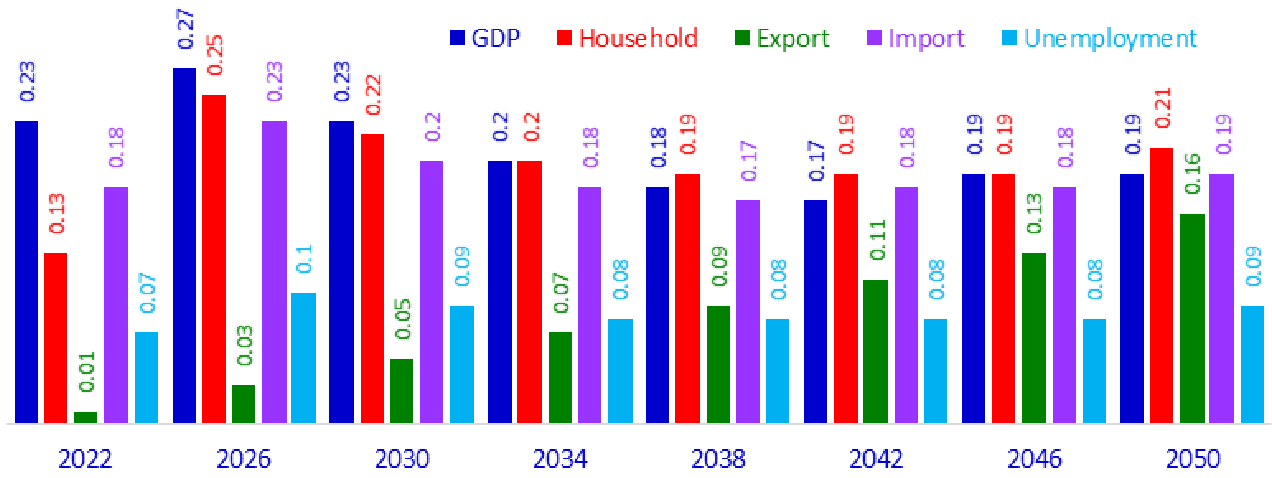
The informational avenue focuses on incorporating climate change considerations into coastal planning. This includes evaluating climate-related risks, gathering pertinent data, disseminating information, and enhancing understanding of the advantages associated with adaptation strategies.

The institutional avenue involves the formulation of a comprehensive development framework and policies for coastal regions. It encompasses the creation of integrated plans aimed at bolstering climate resilience and facilitating adaptation to climate change, as well as the advancement of green infrastructure and the appropriate allocation of responsibilities.

The financial and investment avenue within the climate adaptation strategy for maritime tourism entails identifying necessary funding requirements, securing financial resources, fostering partnerships between the private and public sectors, and prioritizing adaptation initiatives (Climate Change Impacts on Georgia's Coastal Zone - Vulnerability Assessment, World Bank, 2020).

The E3.ge model, created by the Ministry of Economy and Sustainable Development with assistance from GIZ, was employed to evaluate the long-term economic consequences of climate change in Georgia. This model generates scenarios and examines the macroeconomic impacts of climate change-related phenomena, including coastal erosion, rising sea levels, alterations in sediment composition, floods, landslides, and mudslides. Additionally, the analysis encompassed the potential economic implications of climate change adaptation strategies.

FIGURE 4.9.9: IMPACT OF BLACK SEA COASTAL PROTECTION MEASURES ON GEORGIA'S GROSS DOMESTIC PRODUCT AND ITS COMPONENTS IN PERCENTAGE TERMS OVER THE PERIOD 2022-2050



The primary assumptions of the aforementioned macroeconomic model, E3.ge, include: annual investments for coastal protection are projected to be 100 million GEL; the implementation of coastal protection measures is expected to alleviate the adverse effects of global warming, thereby enhancing maritime tourism and consumption; the anticipated growth in tourism is likely to positively influence the country's service exports, estimated at an annual increase of 0.25%. The findings are expressed in percentages, reflecting the variance between the climate change scenario (baseline scenario) and the scenario incorporating adaptation measures.

According to the macroeconomic implications derived from the E3.ge model regarding Black Sea coastal protection adaptation initiatives, the following outcomes are observed: from 2022 to 2050, the effects of coastal protection efforts on macroeconomic indicators such as gross domestic product (GDP), household consumption, imports, exports, and employment are expected to be beneficial, albeit not uniformly distributed; during this timeframe, the short-term impact of these adaptation measures on the country's GDP is projected to reach 0.28%, with a gradual decline in the long term, stabilizing around 0.2%; the influence of coastal protection initiatives on exports is anticipated to show a consistent increase, reaching 0.15% by 2050; conversely, the repercussions of these actions on employment are expected to be minimal, with an estimated impact of approximately 0.07% by 2050 (refer to Figure 5.9.8).

In Georgia, the principal challenges persist, including inadequate acknowledgment of climate change issues, a deficiency in research, limited integration of climate change considerations in strategic tourism development documents, low public awareness, financial limitations, and a lack of long-term vision within society, particularly among decision-makers in the tourism sector, such as hotel managers.

To effectively incorporate climate change considerations and adaptation strategies into the development of the tourism sector, it is essential to undertake specific measures related to coordination and the sharing of pertinent information. Additionally, the collection of relevant data and the promotion of climate-focused research are vital, as they will facilitate the implementation of evidence-based policies.Furthermore, it is imperative to establish an action plan aimed at securing climate finance and technology for the tourism sector. This plan should identify potential funding sources and donor organizations, such as the Green Climate Fund and the Adaptation Fund, that are willing to support initiatives for climate change adaptation and mitigation within the tourism industry.

In light of the aforementioned context in Georgia, the state recommends several actions: enhancing the integration of climate considerations into strategic regional and national planning, conducting vulnerability assessments of tourist areas with research support to develop their climate adaptation plans, evaluating risks associated with global warming and incorporating these findings into tourism development policy documents, fostering collaboration with related sectors such as transportation, insurance, and finance, aligning mitigation efforts with adaptation strategies, embedding climate adaptation topics into educational and advisory programs, launching awareness-raising campaigns, promoting and diversifying tourism services, advocating for the adoption of climate-smart technologies, and advancing eco-tourism and agro-tourism initiatives..

4.10 CLIMATE CHANGE IMPACT ON THE ECONOMY

4.10.1. ECONOMIC ASPECTS OF THE IMPACT OF CLIMATE CHANGE ON THE AGRICULTURAL SECTOR

Agriculture has consistently been a prominent economic sector in Georgia. Traditionally, the nation has been agrarian, with a significant portion of its population relying on agricultural activities. As of 2022, the rural demographic was approximately 1.5 million, representing 40% of the total population (refer to Table 4.30.). Therefore, it is essential to examine the agricultural sector within the framework of climate change to accurately assess the long-term vulnerabilities the country may face if the implications of global warming are not properly evaluated and the associated risks are overlooked.

The agricultural sector in Georgia is comprised of three major sub-sectors: crop production, which constitutes about 47% of the sector; livestock production, also around 47%; and agricultural services, accounting for approximately 6%. In 2022, the total value of agricultural output reached 7.4 billion GEL at current prices. The combined contributions of agriculture, forestry, and fisheries represent roughly 7% of the country's gross domestic product (GDP) (see Table 5.10.1 below). Additionally, around 229 thousand individuals were employed in the agricultural sector in 2022, making up 18% of the overall workforce.

It is important to highlight that the agricultural sector has experienced steady growth over the past decade. The average increase in total output for this sector from 2010 to 2022 was 8.4%. Notably, the agricultural services sub-sector exhibited the highest average growth rate at 15.7%, encompassing logistics, marketing, credit, consulting, and various service types. Furthermore, the agricultural sector has managed to navigate the challenges posed by the Covid-19 pandemic with relative resilience, maintaining a positive growth trajectory (see Table 4.30.).

Georgia is primarily known for its cultivation of grapes, various nuts including walnuts, hazelnuts, almonds, peanuts, and chestnuts, as well as a range of fruits such as apples, peaches, plums, apricots, and citrus fruits like tangerines, kiwis, and oranges. The country also produces berries, vegetables, wheat, and corn. According to the Food and Agriculture Organization (FAO), the agricultural sector accounted for approximately 9.2% of Georgia's total exports between 2018 and 2020. The National Statistics Service of Georgia reported that in 2022, food products valued at 419.5 million USD were exported, representing 7.5% of the country's overall exports. The primary agricultural export items include fruits, non-alcoholic beverages, mineral waters, wine, and spirits.

TABLE 4.30. GENERAL DESCRIPTIVE STATISTICS OF THE AGRICULTURAL SECTOR OF GEORGIA.

Variable/year	2010	2015	2020	2021	2022
Agricultural output, million GEL	2,777	4,160	6,044	6,381	6,985
Crop farming, %	40	46	51	49	47
Livestock farming, %	56	48	43	45	47
Agricultural services, %	3	6	6	6	6
Share of agriculture, forestry and fisheries in GDP, %	9.6	8.8	8.3	7.4	7
Rural population (thousand people)	1,655	1,586	1,522	1,513	1,487
Share of rural population in total population, %	44	43	41	41	40

Source: National Statistical Service of Georgia. https://www.geostat.ge/ka/modules/categories/196/soflis-meurneoba

The primary agricultural imports into Georgia include wheat, sugar, milk powder, poultry, and vegetables. According to estimates from the Food and Agriculture Organization (FAO), approximately 12% of Georgia's total imports during the period from 2018 to 2020 were associated with the agricultural sector. The National Statistics Service of Georgia reported that in 2022, food imports reached a value of 1.85 billion USD, constituting 13.7% of the country's total imports for that year.

Climate plays a crucial role in agricultural practices, alongside land availability. Consequently, climate change poses both positive and negative implications for the agricultural sector, which may influence its long-term development. For instance, one of the consequences of global warming is the increased frequency and duration of droughts, adversely affecting crop yields.

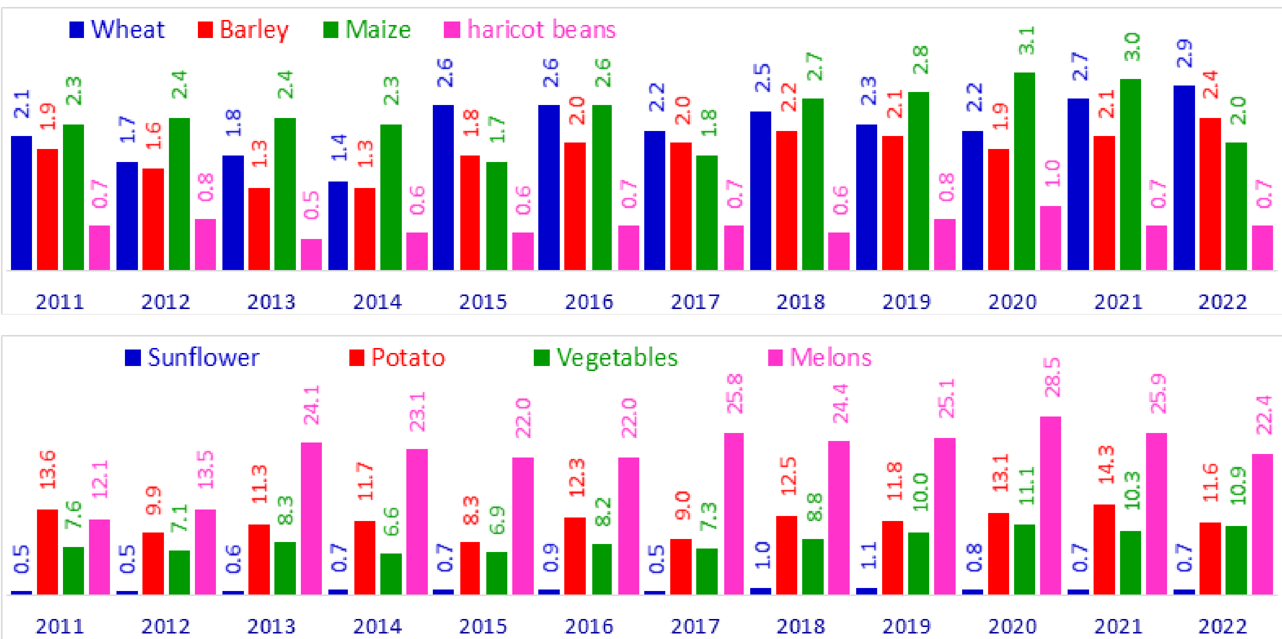
On the other hand, global warming may also yield beneficial effects for agriculture. In the long run, climate change could open up new areas for agricultural development in certain regions, driven by improved climatic conditions such as elevated temperatures and increased carbon dioxide levels. This could enhance the agricultural production capacity of the economy. Nevertheless, it is essential to recognize that other supportive conditions, including water availability, soil moisture, and the structure and composition of the soil, are necessary to fully harness these potential benefits.

Climate change is anticipated to lead to various phenomena, including alterations in precipitation patterns, soil degradation, an increase in drought occurrences, heightened severity of natural disasters such as floods and hail, a greater likelihood of disease outbreaks, shifts in seasonal cycles, and diminished water availability. These developments adversely impact agriculture by directly influencing crop yields and overall productivity.

The agricultural sector's productivity in Georgia is particularly vulnerable to the aforementioned climate-related events. Overall, the country does not exhibit remarkable productivity levels, with both annual crops (such as wheat, corn, and sunflower) and perennial crops (including apple, peach, and pear) yielding relatively low outputs. For instance, the average wheat yield in Georgia for the year 2022 was recorded at 2.9 tons per hectare, in stark contrast to the European Union's average of 5.76 t/ha and the United Kingdom's 7.8 t/ha. Furthermore, the yield growth for most agricultural crops in Georgia has been minimal. Between 2006 and 2022, the increases in corn and sunflower yields per hectare were negligible. Similarly, productivity improvements in the cultivation of beans, potatoes, and various vegetables (such as compost, herbs, cucumbers, and tomatoes) have also been limited. In contrast, the yield of certain horticultural crops, including watermelon, melon, and pumpkin, has nearly doubled during the same period.

It is important to highlight that, over the long term, phenomena associated with global warming—such as an increase in the frequency and duration of droughts, a rise in natural disasters, a reduction in both surface and groundwater resources, an uneven distribution of precipitation, and an accelerated rate of river erosion—can impede the growth of crop yields or diminish agricultural productivity. This decline, in turn, may adversely affect the sector's competitiveness and the income levels of farmers and households. If decision-makers, including farmers, government entities, and households, fail to adopt appropriate climate adaptation strategies, these consequences could lead to significant social and economic repercussions for the population.

FIGURE 4.10.1: YIELD OF ANNUAL CROPS IN GEORGIA, TONS/HECTARE

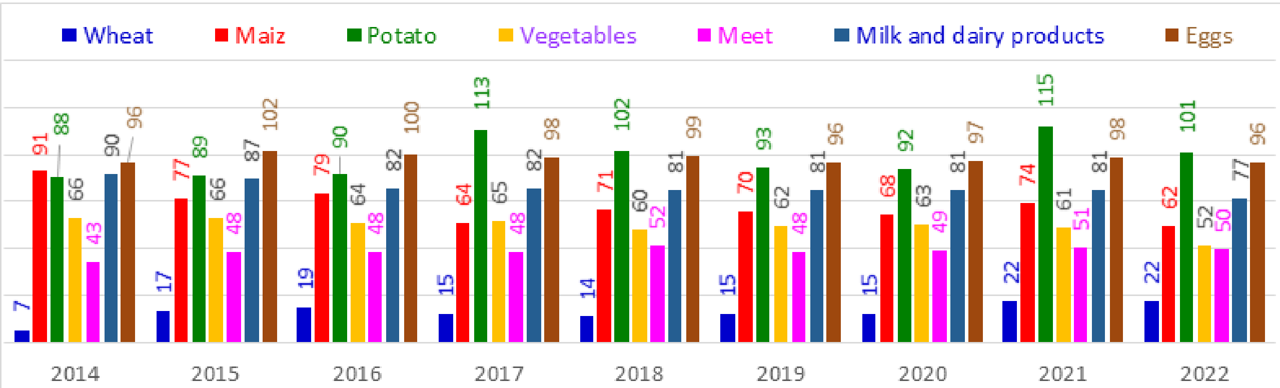


https://www.geostat.ge/ka/modules/categories/196/soflis-meurneoba

Georgia's agricultural land area covers 2.3 million hectares. There are 16 different types of soil in the country, which create favorable conditions for the development of agriculture (both crop and livestock).

Climate change may have a certain negative impact on soil fertility in the long term, as global warming promotes wind and water erosion processes, which are mainly associated with the increase in the frequency of natural disasters, excessive precipitation, and changes in wind speed. These events have the potential to negatively affect the productivity of agricultural activities in the future, as soil is one of the main factors. Thus, the decline in rice productivity, in turn, may reduce yields, which will negatively affect the competitiveness of the sector, farmers' incomes and living standards, investments in the sector and the well-being of the population. Climate change, due to the events and processes described above, may also affect the country's food security. Georgia, in terms of food security, does not have a favorable situation, since it imports a large amount of food products due to low levels of self-sufficiency..

FIGURE 4.10.2: SELF-SUFFICIENCY RATES OF AGRICULTURAL PRODUCTS, %



https://www.geostat.ge/ka/modules/categories/297/sasursato-usafrtkhoeba

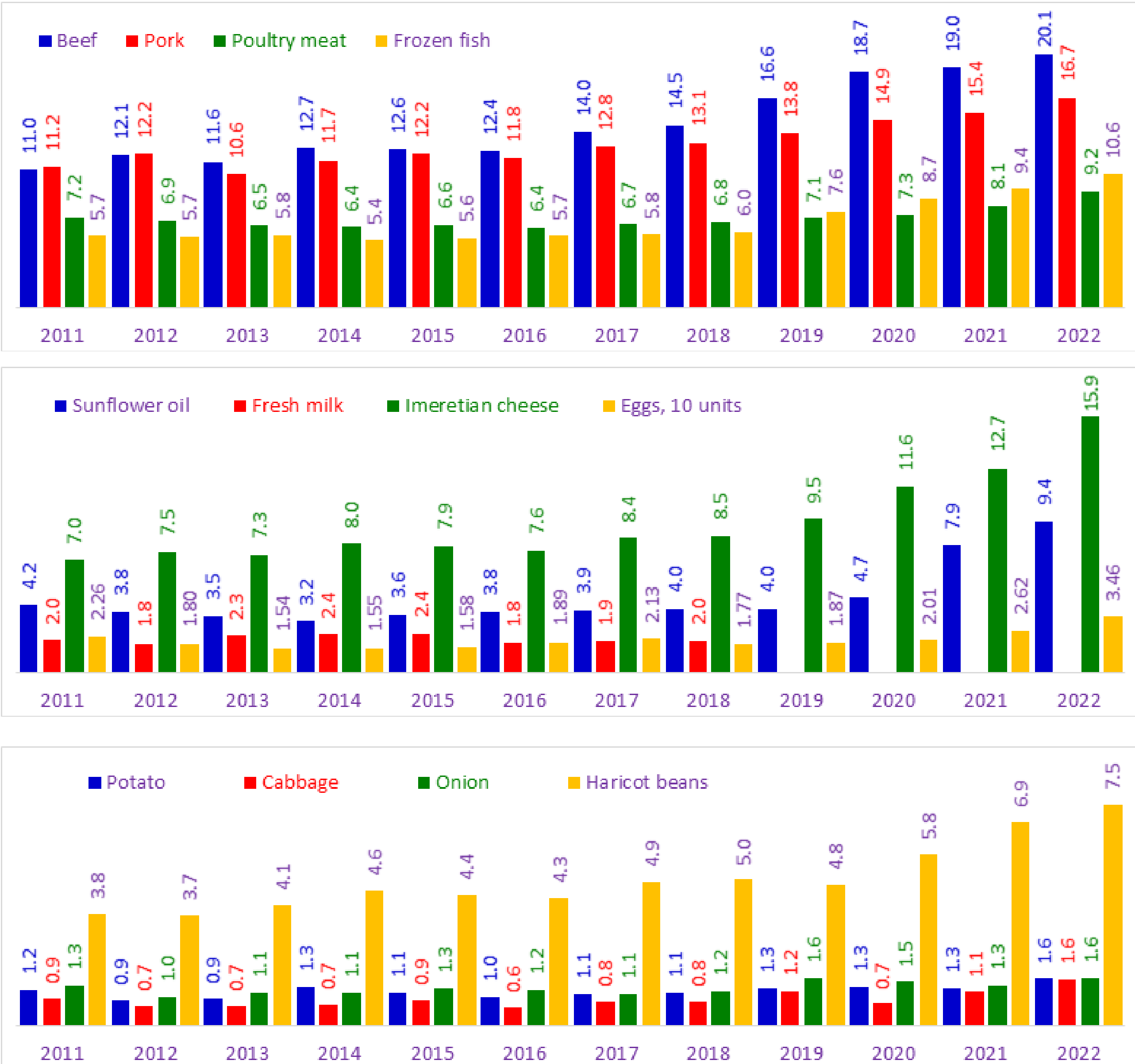
Georgia exhibits low self-sufficiency ratios for essential agricultural products. Specifically, the self-sufficiency rate for wheat is notably low at 22%. In comparison, the rates for meat, vegetables, corn, and dairy products stand at 50%, 52%, 62%, and 77%, respectively. The country demonstrates relatively higher self-sufficiency in the production of potatoes, eggs, and grapes.

It is important to recognize that events and processes associated with climate change could adversely affect the long-term competitiveness of the agricultural sector. This decline may exacerbate self-sufficiency ratios, leading to an increased reliance on foreign economies and heightening vulnerability to external influences, thereby compromising the country's food security.

Global warming is recognized as a contributing factor to fluctuations in food prices and inflation. Between 2006 and 2022, there was a notable increase in the prices of key agricultural products in Georgia. Specifically, sunflower oil, cheese, pasta, wheat flour, cabbage, and apples saw significant price hikes during this timeframe. In contrast, the prices of chicken meat exhibited the least variation, with an average annual increase of

2.3%. The prices of agricultural products during the period from 2006 to 2022 were marked by considerable volatility, particularly for cabbage, sunflower oil, and onions.

FIGURE 4.10.3: PRICE DYNAMICS OF MAJOR AGRICULTURAL PRODUCTS (GEL/KG)



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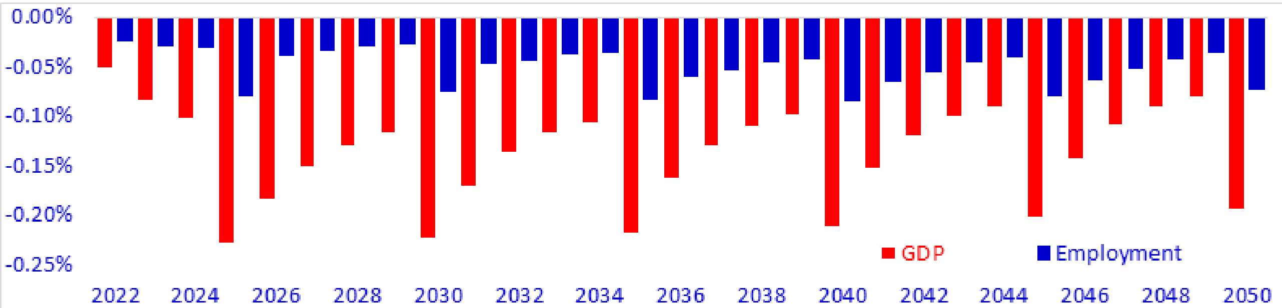
Agricultural price volatility is likely to be intensified by climate change over the long term, as it adversely affects productivity and yield. This decline in productivity can diminish the sector's competitiveness and its capacity to produce and supply agricultural goods in the marketplace. Consequently, climate change may lead to increased market price volatility by limiting the sector's ability to meet market demands. This situation, combined with factors such as seasonality, fluctuations in energy prices, and the costs of agricultural inputs (including land, fertilizers, and pesticides), could emerge as significant contributors to the volatility of agricultural product prices. The heightened volatility in these prices introduces additional inflationary pressures on the Georgian economy, given that agricultural products are essential for the production processes in light industries, such as the food sector. Such price fluctuations may adversely affect related industries by increasing business risks. Furthermore, as a developing and less industrialized nation, Georgia remains heavily reliant on its agricultural sector, with a significant portion of its population depending on domestically produced food. It is important to recognize that increased volatility in agricultural product prices may hinder farmers' decision-making regarding reinvestment of income and expansion of production, as greater price instability correlates with heightened business risks.

The E3.ge model, created by the Ministry of Economy and Sustainable Development with assistance from GIZ, was employed to evaluate the long-term economic repercussions of climate change in Georgia. This model generates scenarios and examines the macroeconomic impacts of climate change-related phenomena, including soil wind erosion, coastal erosion, rising sea levels, increased frequency of droughts, alterations in precipitation patterns, floods, landslides, and mudslides. Additionally, it assessed the potential economic implications of climate change adaptation strategies.

This macroeconomic model was specifically utilized to analyze the effects of climate change on soil, a critical factor in agricultural production. Key assumptions of the E3.ge model include: the contribution of grain to the overall wealth generated by the agricultural sector is 44% in monetary terms; the annual losses due to direct erosion amount to 1.5% of the crop yield; starting in 2025, severe winds are expected to occur once every five years, resulting in damage equivalent to 5% of the annual crop yield. The findings are expressed as percentage losses, indicated with a negative sign.

Figure 4.10.4 presents the impact of wind erosion and strong winds on the country's GDP and employment. In the long term, the impact on GDP will be in the range of 0.05-0.2%, and the impact on employment will be in the range of 0.02-0.09%.

FIGURE 4.10.4: IMPACT OF WIND EROSION AND STRONG WINDS ON GEORGIA'S GROSS DOMESTIC PRODUCT AND EMPLOYMENT OVER THE PERIOD 2022-2050



It is important to highlight that the macroeconomic implications of windbreaks as a strategy for mitigating soil erosion caused by wind were evaluated using the E3.ge model. The findings indicate that, overall, the implementation of windbreaks is projected to enhance crop yields by 16% from 2022 to 2050, provided that strong winds are not prevalent. Additionally, the influence of windbreaks on the country's GDP is expected to be beneficial, with fluctuations estimated between 0.2% and 1.2% of GDP.

The E3.ge model was also employed to analyze the potential repercussions of droughts on the Georgian economy. The primary outcomes are as follows: during periods of drought, there will be an increase in imports to address the product shortages in the market; the effect of droughts on GDP is anticipated to be consistently negative, and in the absence of adaptation measures—such as enhancements to irrigation systems—the adverse impacts are likely to escalate over time; the agricultural sector's productive capacity will diminish due to drought conditions without the implementation of adaptation strategies; and employment within the agricultural sector is expected to decline.

Consequently, climate change poses a significant risk to both the population and the economy of the country in the long term, particularly under certain conditions such as the lack of adaptation policies and heightened vulnerability. The aforementioned phenomena associated with global warming adversely affect productivity, price stability, food security, and the decision-making processes of farmers. Ultimately, these effects deteriorate the agricultural business environment, rendering it less appealing for investment, which in turn hampers the country's economic progress and the improvement of real incomes and overall well-being of its citizens. To alleviate the detrimental impacts of global warming, it is crucial to prioritize the adoption of climate-smart environmental technologies and the mobilization of climate finance..

4.10.2. ECONOMIC ASPECTS OF THE IMPACT OF CLIMATE CHANGE ON THE TOURISM SECTOR

The tourism industry in Georgia is regarded as one of the most rapidly expanding sectors of the economy, attributed to the country's abundant natural resources, such as the Black Sea coastline, ski resorts, high-altitude regions, protected areas, and mineral water spas. Additionally, the country boasts significant anthropogenic tourism assets, including cultural landmarks like churches and monasteries, fortifications, Georgian culinary traditions, and traditional music and dance. These diverse resources provide a solid foundation for the growth and advancement of the tourism sector, leading to expectations of continued expansion in the future.

The tourism industry is recognized as a key component of Georgia's economic landscape. According to the National Statistics Service of Georgia, the total added value of this sector reached approximately 4.4 billion GEL in 2022, representing 7% of the country's gross domestic product for that year. In comparison, this figure was 8.4% in 2019. It is important to highlight that from 2010 to 2022, the added value generated by the tourism sector experienced an average annual growth rate of 11.6%, indicating robust growth. The impact of the COVID-19 pandemic must also be considered, as evidenced by a 30% decline in this indicator in 2020, which significantly impeded the sector's growth (refer to Table 4.31.).

TABLE 4.31. GENERAL DESCRIPTIVE STATISTICS OF THE TOURISM SECTOR OF GEORGIA.

	2010	2015	2019	2020	2021	2022
Added value created by the tourism sector, billion GEL	1.37	1.96	3.63	2.56	3.5	4.38
Share of tourism in GDP, %	7.1%	6.5%	8.4%	5.9%	6.7%	7.0%
Number of domestic visitors, million people		10	11.9	10.9	14.9	14.5
Number of international visitors, million people		4.0	6.1	1.1	1.4	– 3.9
Transactions carried out with foreign cards, million GEL	376.9	1,459.1	2,689.1	1,104.5	2,261.2	3,623.7

https://www.geostat.ge/ka/modules/categories/100/turizmis-statistika

It is important to highlight that the tourism sector in Georgia is experiencing positive growth, as evidenced by the increasing indicators of both domestic and international visitors, as well as transactions conducted with foreign cards. In 2022, the total number of domestic visitors reached 14.5 million, while international visitors numbered 4.7 million. From 2015 to 2022, the average annual growth rate for domestic visitors was approximately 6%. Furthermore, transactions made with foreign cards totaled 3.6 billion GEL in 2022, with an impressive average annual growth rate of 24% from 2007 to 2023 (refer to Table 4.27.).

The marine and mountain-skiing sectors are pivotal to Georgia's tourism landscape. These types of tourism are predominantly found in regions such as Adjara, Guria, Samegrelo-Zemo-Svaneti, Samtskhe-Javakheti, and Mtskheta-Mtianeti. In 2022, these regions collectively received 8.9 million visits, accounting for approximately 38% of all visits. Notably, international visitors spent an average of 2,283 GEL, while domestic visitors spent an average of 182 GEL, according to the Geostat survey conducted in 2022.

Tourism activities are closely linked to climatic and weather conditions. Consequently, global warming poses a risk of altering the appeal of tourist destinations, with potential effects including rising temperatures, shifts in precipitation patterns, variations in sunny days, reduced snow cover, and changes in the duration of tourist seasons, particularly affecting winter resorts. Additionally, climate change may have long-term repercussions on tourism resources and infrastructure, biodiversity, transportation systems, and coastal tourist areas.

Climate change represents a critical long-term factor influencing the development of the tourism sector in Georgia. The effects of global warming, including rising temperatures, diminishing snow cover, an increase in natural disasters, rising sea levels, alterations in biodiversity, and changes in water quality, yield both adverse and beneficial consequences.

For the Georgian tourism industry, climate change is a particularly pertinent concern, as the sector heavily relies on natural attractions, or nature-based tourism. Consequently, the long-term climate risks are considerably heightened in this context. Furthermore, winter and coastal tourism, which are significant components of the industry, are classified as high-vulnerability sub-sectors.

Given the aforementioned characteristics, processes, and interconnections within the country, it is anticipated that climate change will introduce additional risks to the tourism sector, necessitating increased awareness and adaptation measures. These adaptations will incur costs. The situation is further complicated by a lack of research and data, leading to insufficient information and a relatively low level of awareness among stakeholders.

Tourism in Georgia is fundamentally linked to economic revenue. As per data from 2023, the nation garnered approximately 4.125 billion USD from international travel, a figure that mirrors that of 2019. It is important to highlight that from 2005 to 2023, revenues from international tourism experienced significant growth, with an average annual increase of 30.3%. Given that Georgia's tourism is predominantly nature-oriented, the adverse effects of climate change on tourism resources, such as biodiversity, could substantially influence tourists' choices due to altered conditions, leading to considerable long-term financial losses.

Additionally, substantial investments are being directed towards Georgia's tourism sector, recognizing the country's untapped potential. However, the precise evaluation of these investments remains challenging due to incomplete data. The National Statistics Service reported that in 2022, foreign direct investment in the tourism and restaurant sector amounted to 64 million USD, compared to 134 million USD in 2019. It is also crucial to note that investments in Georgia exhibit high volatility and are particularly responsive to situational changes.

Furthermore, if Georgia fails to effectively adapt to climate change and related events, the repercussions of global warming may adversely affect investment decisions. This could manifest in reduced profitability for winter resorts due to shorter seasons, thereby increasing volatility and obstructing the sector's growth.

Climate change represents a significant global challenge that impacts numerous sectors, with tourism identified as one of the most susceptible, particularly in its winter and coastal segments. The phenomenon of global warming introduces increased uncertainty and risks within this sector, adversely affecting tourism resources. This, in turn, influences tourists' choices regarding destinations, expenditure levels, and investment initiatives, ultimately impacting national revenue streams. To mitigate potential losses and damages associated with climate change risks, it is essential to implement sustainable practices within the tourism industry. Such measures will facilitate the attraction of climate finance, the transfer of climate-smart technologies from developed nations, the advancement of renewable energy sources, the reduction of greenhouse gas emissions, and the adaptation of the tourism sector to the realities of climate change and its ongoing development.

4.10.3 ECONOMIC ASPECTS OF THE IMPACT OF CLIMATE CHANGE ON HEALTH CARE

The healthcare sector in Georgia is significantly susceptible to the impacts of climate change. This vulnerability arises primarily from phenomena associated with global warming, including heat waves, rising temperatures, fluctuations in humidity, and an increased occurrence of natural disasters, all of which adversely affect public health. While it is acknowledged that climate change may yield some positive outcomes in the future, its overall effect on Georgia's healthcare sector is deemed detrimental.

Investigating the relationship between human health and climate change is particularly pertinent in Georgia. The government is committed to enhancing the healthcare sector and plans to allocate substantial financial resources for its advancement. It is important to note that global warming will directly influence labor productivity, particularly in industries such as agriculture, construction, and logging, where outdoor work is prevalent. Given that agriculture remains a vital component of the Georgian economy, largely due to its low level of industrialization, the transmission of climate change effects through the healthcare system to the broader economy is a critical concern.

The Ministry of Labor, Health and Social Protection of Georgia serves as the principal governmental authority responsible for policy implementation, with a key focus on developing, executing, and coordinating public health policies. This encompasses areas such as ensuring the quality of medical services, formulating state healthcare programs, and establishing regulations for medical services.

The primary strategic framework guiding healthcare initiatives is the National Health Care Strategy of Georgia for 2022-2030, which aims to mitigate morbidity, disability, and mortality linked to climate change..

The sector continues to face significant challenges due to the substantial proportion of out-of-pocket expenses for pharmaceuticals, the considerable burden of morbidity, and the elevated mortality rates associated with non-communicable diseases.

In 2022, healthcare and social services accounted for 3.4% of the country's total GDP, reflecting a consistent upward trend from 2010 to 2021. Additionally, the frequency of patient visits to clinics has also risen, thereby intensifying the demands placed on the healthcare system. Regarding diseases closely linked to climate change, such as infectious, respiratory, and circulatory conditions, their prevalence exhibits considerable variability. Notably, respiratory diseases have shown a marked upward trend, increasing by an average of 6% annually from 2002 to 2022.

TABLE 4.32. GENERAL STATISTICS OF THE HEALTHCARE SECTOR

Period	2005	2010	2015	2020	2021	2022
Share of healthcare and social services in GDP, %		2.6	3.7	3.6	4.3	3.4
Number of visits to doctors in outpatient and polyclinic institutions, million	7.7	7.6	13.2	13.7	15.0	15.2
Infectious disease incidence of the population, thousand	14.7	24.1	32.9	10.8	8.8	13.0
Diseases of the respiratory system, thousand	249.1	439.3	703.7	334.5	308.4	419.5
Diseases of the circulatory system, thousand	82.5	98.2	174.7	97.5	103.3	104.1

One significant metric in the healthcare sector is the proportion of out-of-pocket payments (OPP) relative to the total healthcare expenditure of the population. This metric was approximately 73% in 2012, reduced to 55% in 2017, and is projected to be around 40% in 2023. Consequently, this variable exhibits a pronounced downward trend, which is a favorable development, as it indicates a reduction in the financial burden of healthcare costs.

Climate change can exert a range of direct and indirect effects on human health. Events associated with global warming, such as elevated temperatures, increased frequency and severity of heat waves, fluctuations in humidity, and natural disasters, heighten specific health risks and threats. Among natural disasters, flash floods, floods, and wildfires are particularly hazardous. Flooding can not only inflict physical harm on individuals but also damage water supply systems and infrastructure, disrupt sanitation services, and consequently elevate the risks of water contamination and shortages, potentially degrading water quality. In the case of wildfires, the combustion process releases significant quantities of pollutants into the atmosphere, further exacerbating health risks. The groups most vulnerable to the health impacts of climate change include the elderly, children, individuals with obesity, and those suffering from chronic illnesses.

It is also worth noting that climate change can affect air quality, which in turn leads to an increase in the frequency of diseases, which in turn negatively affects people's working capacity. Global warming also has the potential to change the infectious background in the environment, which increases the risk of infectious outbreaks. The final effect of climate change in this regard will be the deterioration of human health, which leads to a decrease in labor productivity and labor productivity, which in turn negatively affects economic growth and activities.

The impacts of heat waves have been studied to some extent in Georgia. There has been a sharp increase in both the number of heat waves and their duration. There is a relatively high increase in heat waves in the cities of Tbilisi, Telavi, Poti, Zugdidi and Batumi. These cities are characterized by high vulnerability to climate change in the territory of Georgia. Heat waves are currently considered an acute urban problem.

Heat waves resulting from global warming are projected to have enduring impacts on the Georgian economy. The E3.ge model, developed by the Ministry of Economy and Sustainable Development (MoESD) in collaboration with GIZ, indicates that these heat waves will produce both adverse and beneficial economic effects over the long term, extending to 2045. Among the most significant negative consequences are: (i) a decline in exports, primarily due to diminished productivity and competitiveness within the agricultural sector, leading to an anticipated rise in agricultural imports; (ii) a reduction in labor productivity, particularly in industries where employees are required to work outdoors or remain in open environments for extended periods; (iii) an escalation in prices, largely driven by heightened demand for energy (for cooling), drinking water, soft drinks, and medical services as a result of the heat waves; and (iv) a decrease in hydropower generation. On the positive side, it is important to highlight the potential for increased market demand—for instance, for soft drinks, water, medical services, or pharmaceuticals—which may stimulate production and investment in specific economic sub-sectors.

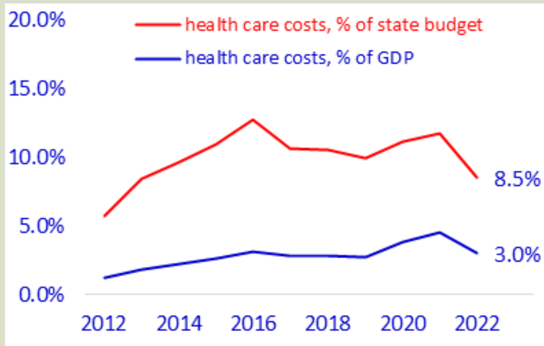
Climate change is anticipated to diminish the workforce's capacity over the long term due to its adverse effects on human health, which will, in turn, impact productivity and labor efficiency negatively. Between 2011 and 2022, labor productivity in Georgia exhibited growth, with an average annual increase of 4.4%, a rate that is not considered particularly robust. In 2022, the labor productivity in the nation surpassed 21 GEL per person-hour, representing approximately 1.7 times the figure recorded in 2010. It is also crucial to highlight that Georgia's productivity levels are significantly lower than those in both developed and developing European countries, in some instances being three times less. Furthermore, it is important to stress that climate change, given the aforementioned effects, is projected to adversely influence the long-term development of labor productivity and impede its growth to some extent, contingent upon the climate scenario that unfolds. This, in turn, will negatively affect the country's economic growth and the overall well-being of its population.

The government places significant emphasis on the healthcare sector, as evidenced by its budget allocations. Between 2012 and 2022, expenditures in healthcare exhibited a predominantly upward trajectory, peaking during the pandemic when public healthcare spending reached 4.5% of real GDP in 2021. However, in 2022, due to budgetary reductions and a rise in economic activity, this figure declined to 3.0%. Regarding the proportion of healthcare expenditures within the overall state budget, a similar growth trend was observed, although it fell to 8.5% in 2022, a notable decrease from 11.7% in 2021. Additionally, it is important to highlight the significant increase in healthcare spending from 2012 to 2016, during which the budgetary share for healthcare doubled (refer to Figure

4.10.5). Furthermore, it is crucial to recognize that climate change is expected to adversely affect the health of the population in the long term, leading to heightened demand for medical services and pharmaceuticals. This scenario may further strain the budget and the healthcare system. Consequently, it is essential to devise and implement adaptation strategies to mitigate or avert these risks in the future..

FIGURE 4.10.5: EXPENDITURES ON HEALTH CARE OF THE POPULATION, %

Consequently, climate change represents a significant risk to the healthcare system, necessitating a strategic response from both governmental bodies and society to prevent or lessen economic losses and harm. To achieve this, it is essential to formulate and execute adaptation strategies grounded in research, with the primary objective of enhancing the healthcare system's preparedness for global warming and improving the adaptive skills and capacities of the community.



4.11 GENDER ISSUES IN CLIMATE CHANGE ADAPTATION

4.11.1. OVERVIEW OF GENDER-RELATED CLIMATE DECISIONS ADOPTED BY THE FRAMEWORK CONVENTION ON CLIMATE CHANGE

Climate change impacts women and men in distinct ways, particularly regarding their vulnerability, the advantages they derive from climate change initiatives, and their involvement in decision-making processes related to the climate crisis. A report published in 2019 by the Secretariat of the United Nations Framework Convention on Climate Change emphasized that these disparities stem from pre-existing gender inequalities and imbalances in power, as well as unequal access to and control over resources, alongside discriminatory laws and cultural practices, rather than any intrinsic traits of women or men.

Since 2012, the gender dimensions of climate change have been recognized as a persistent issue within the UNFCCC framework. In 2014, the Conference of the Parties initiated the first Lima Work Programme on Gender (LWPG) (Decision 18/CP.20) aimed at fostering gender equality and incorporating gender considerations into the efforts of Parties and the Secretariat in executing the Convention and the Paris Agreement, with the objective of developing climate policies and actions that are responsive to gender needs.

At the 21st Conference of the Parties (COP21), the Parties affirmed gender equality and the empowerment of women as fundamental principles within the preamble of the Paris Agreement. The Agreement further requires initiatives aimed at promoting gender-responsive adaptation and capacity-building. In 2017, during COP22 held in Marrakesh, decision 21/CP.22 was adopted, which extended the Lima Work Programme for an additional three years, concluding in 2019. This decision obligated all bodies under the UNFCCC to report regularly on their progress in incorporating a gender perspective into their operations. At COP23 in Bonn, decision 3/CP.23 led to the adoption of a multi-year Gender Action Plan

(GAP), emphasizing the importance of gender-disaggregated monitoring and reporting of climate change impacts for COP24 (UNFCCC, 2018). Furthermore, COP25 acknowledged the ongoing necessity to integrate gender considerations across all relevant target groups and objectives within the Convention's activities, recognizing this as a vital factor in enhancing effectiveness, equity, and sustainability. By decision 3/CP.25, a five-year enhanced Lima work programme on gender and its accompanying gender action plan was also adopted.

4.11.2. GENDER IN GEORGIA'S CLIMATE POLICY, STRATEGIES AND ACTIONS

4.11.2.1 Why Gender in Adaptation?

Studies have shown that climate-related disasters have impacted populations in many areas, including agricultural production, food security, water management, and public health. The study also provided more evidence that the results are not gender-neutral, as women and children are among the highest-risk groups. Key factors that contribute to differences in vulnerability between women and men to climate change risks include: gender-based differences in time use; access to assets and credit; attitudes towards formal institutions that may constrain women's opportunities; limited access to political discussions and decision-making; and a lack of sex-disaggregated data for policy change.

The Westminster Foundation for Democracy, in its latest report "The Impact of Climate Change on Women's Vulnerability in Georgia," describes how climate change is exacerbating existing inequalities and disproportionately affecting women, vulnerable groups, and minorities. "Climate justice involves recognizing, addressing, and seeking to redress these unequal impacts in a fair and equitable manner. In the Georgian context, recognizing the social and gender impacts of climate change is essential but has not yet been explored. Women in Georgia are experiencing the effects of increased drought, strong winds, hail, heat, and flooding, which are seriously affecting their livelihoods, security, health, and mental well-being.

The effects of climate change and the strategies available for coping with it are influenced by a variety of factors, such as socio-economic status, type of housing (whether rural or urban), levels of poverty, gender, and education. An **intersectional approach** underscores that the consequences of climate change are not uniformly experienced. Vulnerable populations are disproportionately impacted, and the effects can be exacerbated when various forms of discrimination intersect.

Women frequently play a crucial role in making decisions related to adaptation. Despite their current underrepresentation in leadership roles, adopting an inclusive and intersectional framework for climate justice is likely to produce the most effective outcomes. Leveraging women's traditional knowledge and enhancing their capacity can significantly contribute to adaptation initiatives, promoting equitable participation and access to resources.

4.11.2.2 Gender in Georgia's adaptation policy

The revised Nationally Determined Contribution (NDC) of Georgia features a distinct section dedicated to the intersection of gender and climate change. This section seeks to integrate gender considerations, promote equal participation, empower women, enhance capacity building, and formulate climate policies that are sensitive to gender issues. Furthermore, the updated document references Sustainable Development Goal 5, which aims to eradicate gender inequality and discrimination against women and girls by fostering their economic, political, and social empowerment. However, it omits Target 5c of Goal 5, which underscores the necessity of legislative measures to achieve gender equality. Additionally, the document highlights the significant roles women play as educators, decision-makers, and catalysts for change, noting their active participation in the education sector and their unique influence within households to improve energy efficiency. It also acknowledges women as a vulnerable demographic in the context of climate change. Nevertheless, the document falls short of addressing how women's empowerment can be achieved through their involvement in decision-making processes or the execution of other gender-sensitive objectives, nor does it establish measurable targets.

The Climate Change Strategy and its Action Plan are expected to operationalize the NDC; however, gender representation remains limited within the action plan.

The Long-Term Concept of Low-Emission Development for Georgia stresses the importance of incorporating gender considerations in the formulation of climate change policy documents, particularly regarding adaptation strategies, as women are especially susceptible to the impacts of climate change.

The report titled "Climate Change Impacts on Georgia's Coastal Zone – Vulnerability Assessment and Adaptation Measures" (World Bank, 2020) highlights women as a particularly vulnerable demographic and emphasizes the necessity of empowering them as catalysts for change regarding the Nationally Determined Contributions (NDC). However, this perspective is not reflected in the analysis presented.

The National Climate Change Adaptation Plan for Georgia's agricultural sector offers a comprehensive technical evaluation but fails to address social or gender-related aspects.

The Disaster Risk Reduction Strategy of Georgia for the years 2017-2020 acknowledges women and individuals with disabilities as vulnerable populations, stressing the importance of addressing their specific needs and ensuring their participation in the formulation of disaster risk reduction strategies.

The Country Climate Risk Profile (World Bank, 2021) touches upon gender issues in a broad manner within a single subsection, outlining the varying vulnerabilities and climate-related impacts experienced by women and men. Nonetheless, this information, along with other gender and social considerations, is not woven into the overall narrative of the document.

The significance of incorporating gender perspectives into climate policies, strategies, and actions cannot be overstated. However, the **annual budgets** reviewed for the Ministries of Environmental Protection and Agriculture, Regional Development and Infrastructure, and Economy and Sustainable Development lack specific provisions or items that address the gender dimensions of climate initiatives in a comprehensive manner. This omission raises concerns regarding the inclusivity and effectiveness of the existing budgetary frameworks in addressing the gender implications of climate change in Georgia.

The Sustainable Energy Action Plan (SEAP) highlights that a crucial component of awareness-raising campaigns involves the collection and analysis of gender-disaggregated data. This data is essential for understanding the differing needs, resource utilization, and distribution of roles and responsibilities between women and men, thereby facilitating the planning of relevant activities.

The "Interim Action Plan (2023-2026) - Development and Management of Regional and Infrastructure Development Policies" adopts a holistic approach to regional development, infrastructure, and tourism, placing a particular focus on the integration of gender considerations across various programs and sub-programs. Under the priority "Development and Management of Regional and Infrastructure Development Policies (Program Code - 25 01)", the plan underscores the promotion of "gender equality" as a core principle within the decentralization strategy. The program is designed to ensure the active involvement of both women and men in decentralization and self-governance processes, with anticipated outcomes that include the formulation of regional development policies that explicitly incorporate gender considerations.

The White Paper on the Climate Change Law of Georgia embodies a comprehensive approach to gender considerations. It explicitly addresses gender justice while effectively incorporating gender perspectives into climate objectives, governance, adaptation strategies, equitable transitions, and public engagement. This integration acknowledges the varied effects of climate change on different genders, highlighting the necessity of gender-responsive strategies in all facets of climate action. In particular, the adaptation chapter underscores the importance of developing inclusive and gender-sensitive national adaptation plans. The document advocates for prioritizing the unique needs, challenges, and priorities of vulnerable populations, including women, adolescents, internally displaced individuals, and ethnic minorities. By fostering inclusive participation from a range of stakeholders, including marginalized communities and civil society organizations, the White Paper seeks to empower these groups and enhance their resilience. This strategy aligns with international agreements such as the Paris Agreement and demonstrates Georgia's dedication to promoting social justice and gender equality within its adaptation initiatives.

4.11.2.3 Gender Issues in the Ongoing Project "Expanding the Multi-Hazard Early Warning System and Utilization of Climate Information in Georgia"

The project titled "Expanding the Multi-Hazard Early Warning System and Utilization of Climate Information in Georgia," funded by the Green Climate Fund, addresses gender considerations and has undertaken a gender assessment, resulting in the formulation of a gender action plan (mandatory requirement from the donor organization). The following is a compilation of activities and measures incorporated within this project that are pertinent to other adaptation initiatives as well.

1. Conduct a **gender-sensitive vulnerability assessment**

- This document pertains to a supplementary analysis of the 2014 census data, which offers insights into social vulnerability across various regions, categorized by gender and age. It includes evaluations of employment, education, health issues affecting functional adequacy, limitations in abilities, and physical capabilities such as swimming, climbing, and running. Additionally, it addresses aspects related to property ownership, household and productive assets, agricultural potential, the ratio of dependents within households, household composition—including single male and female households and those led by women—sources of livelihood, and responsibilities associated with paid care and domestic work.

- The process involves the identification of households benefiting from state subsistence allowances through an analysis of the social assistance database across various regions.
- Furthermore, it entails organizing focus group discussions and conducting in-depth interviews with key stakeholders. This approach guarantees equitable representation of women, individuals aged over 65, persons with disabilities or their family members, community leaders, and government officials in the hazard and risk mapping process. It also includes the collection of existing community coping strategies, the identification of local businesses and institutions that can support disaster risk management (DRM) activities, and the determination of priority needs, responses, and segregation mechanisms tailored for women, the elderly, individuals with disabilities, and economically disadvantaged groups.

2. Ensure the collection of **sex- and age-disaggregated data** for project indicators

- Gender-disaggregated reporting will be expanded beyond the scope of the project at the national level, utilizing the multi-stakeholder disaster risk information and knowledge system established by the project.

3. Strengthen gender aspects in **disaster preparedness** activities:

- Disaster preparedness and response strategies must be informed by gender analysis and incorporate gender considerations.
- It is essential to engage men and women from various age groups, along with representatives from vulnerable communities, in both the planning and execution phases. Community advisory groups should be formed, ensuring that women comprise at least 30 percent of the membership.
- It is crucial to disseminate information regarding hazards, including their nature, probability of occurrence, potential threats to life, and impacts on livelihoods, housing, agriculture, livestock, and protective measures, to both women and men through suitably tailored communication channels.
- Enhancing the readiness of educational institutions is vital. Information should be provided to teachers, students, and academic staff regarding various disaster types and effective response strategies. Emergency plans must be developed for kindergartens, schools, vocational training centers, and universities, with regular training sessions conducted. Additionally, first aid training should be offered to staff members.

4. Guaranteed **universal access to disaster warnings**

- Gender-sensitive alerts designed to address the specific needs and capabilities of various demographic groups, including children, the elderly, individuals with health issues, and those with disabilities;

- Developing community-oriented early warning systems that effectively cater to the needs of both women and men;
- Employing diverse communication methods to reach a broad audience, such as television, radio, the Internet, sirens, flashing lights, and registration-based warning systems that deliver messages to mobile devices, accompanied by clear verbal and visual information;
- Engaging pregnant women, the elderly, and individuals with disabilities in the emergency planning process. Promoting gender mainstreaming and the active participation of women in resilience-building initiatives, gender analysis, and action planning;
- Ensuring that women constitute 30 percent of participants in capacity-building and training programs supported by the project;
- Guaranteeing equal access for women to livelihood opportunities facilitated by the project;
- Promoting the dissemination of information and encouraging the inclusion of populations in risk-prone areas in insurance schemes, including crop insurance.
- Distributing information regarding high-risk areas along with guidelines for housing development, agricultural practices, and livestock management;
- Encouraging job opportunities for women and economically disadvantaged individuals; ensuring the inclusion of women in employment guarantee programs designed within community-based disaster risk management initiatives; offering social care services to alleviate the burden of unpaid caregiving responsibilities predominantly shouldered by women. Establishing social care infrastructure can also generate employment for both women and men as part of disaster recovery efforts;
- Enhancing social capital by forming community groups aimed at planning, safeguarding against, and alleviating the adverse impacts of natural disasters, with a minimum of 30 percent female participation;
- Guaranteeing that all members of ethnic minority groups have equitable access to the benefits of the project.

5. Facilitate training sessions focused on gender mainstreaming and the **enhancement of capacities for national stakeholders involved in the project**, who hold responsibilities for diverse functions related to disaster risk reduction.

- In 2016, the UNDP Istanbul Regional Centre (IRH) created and tested a three-module training manual focused on integrating gender considerations into disaster preparedness and response. This resource is designed for UNDP personnel and government officials engaged in disaster management within the Europe and CIS region. In 2017, the manual was piloted in the Western Balkans in collaboration with practitioners from the Disaster Risk Reduction (DRR) project. A series of training sessions and capacity-building workshops on gender integration will be organized under the GCF project, utilizing the UNDP training manual and aimed at a diverse array of stakeholders, including government entities, NGOs, community leaders, youth organizations, women's groups, and farmers' associations, at both national and local levels.

- The initiative specifically focuses on compact settlements of ethnic minorities in certain areas of Georgia, such as the Armenian and Azerbaijani communities in Kvemo Kartli and Samtskhe-Javakheti, who are not proficient in the Georgian language. Consequently, the project will facilitate the equal involvement of these groups in training and capacity-building efforts. Furthermore, it will develop educational and informational materials in the languages of the predominant ethnic groups and distribute them to the intended beneficiaries. The project will also offer simultaneous translation during training sessions in English, Russian, and Georgian, ensuring the participation of representatives from ethnic minority communities.

6. **Involving women in decision-making processes**

- Guarantee that women comprise a minimum of 30 percent of participants and are actively involved in consultations with project stakeholders, as well as in decision-making bodies at both local and national levels, including in technical assistance working groups that are established and/or supported by the project.
- Facilitate the inclusion of a gender advisor in all technical assistance working groups associated with the project.

7. Requirements for **project personnel**

- A gender-responsive approach to social vulnerability can only be effectively executed by project personnel who are attuned to both gender and vulnerability issues. Consequently, it is essential that the project team includes a minimum of 30 percent women, ensuring equal representation across all levels of decision-making. Additionally, staff members must possess documentation verifying their involvement in training programs focused on gender mainstreaming and social vulnerability strategies.

4.11.3.4. The Lima Work Plan on Gender and its Gender Action Plan Implementation in Georgia

Priority Area A. Capacity Development, Knowledge Management, and Communication

A1. *Enhancing capacity development for the integration of gender considerations.*

While the **Nationally Determined Contributions (NDC)** reference capacity development broadly, they do not specifically address adaptation efforts. Nevertheless, the initiative titled "Expanding Multi-Hazard Early Warning System and Utilization of Climate Information in Georgia" focuses on capacity development related to disaster risk reduction, which is anticipated to be incorporated into the National Adaptation Plan.

A4. Advancing evidence and research regarding differential impacts and the roles of women

The Westminster Foundation for Democracy (WFD) has undertaken a study examining the effects of climate change on women in Georgia..

A5. Promoting communication regarding the Lima Gender Work Programme (LWPG) and the Gender Action Plan (GAP)

There has been a lack of organized efforts to disseminate information about the LWPG and GAP, aside from the initiatives undertaken by smaller non-governmental organizations.

Priority Area B. Gender Balance , Participation And Women's Leadership

B1. Promoting and forming women's leadership opportunities in negotiations

The Georgian Government delegation demonstrated reasonable gender balance (from 33% to 67% in 2017-2023) at UNFCCC COPs or intersessional meetings and in 6 out of 10 meetings, a woman was a head of the delegation.

B2. Provide travel expenses for female delegates and participants in negotiations.

The Georgian government relies on international and non-governmental organizations to promote the participation of women and local communities in the negotiations.

B3. Collaboration with the local communities and indigenous peoples platform facilitation working group

Does not match

Priority Area D. Gender-sensitive implementation and tools of implementation

D1. Capacity building support on gender budgeting

The initiative has not yet been implemented.

D2. Raise awareness about available financial and technical support to promote the strengthening of gender mainstreaming in climate

It is very limited.

D3. Promoting gender-sensitive technology

The Green Climate Fund's preparedness proposal to update the technology needs assessment takes gender into account and promotes gender-responsive technology.

D4. Gathering information on gender and climate change expertise.

Unknown

D5. Engaging women's groups in climate policy and action

Planned for 2024

D6. Exchange of information on gender and climate by the Parties.

Unknown

D7. Availability of sex-disaggregated data.

The NDC undertakes a commitment to collect sex-disaggregated data. Individual projects also collect sex-disaggregated data, as does Geostat to some extent . However, consensus exists that there is not enough data to develop coherent climate policies.

CHAPTER 5.
CONSTRAINTS AND GAPS AND RELEVANT FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER, AND CAPACITY BUILDING NEEDS AND SUPPORT RECEIVED

5.1. CLIMATE CHANGE FINANCING

5.1.1. FINANCIAL ASSISTANCE REQUIRED TO ACHIEVE CLIMATE CHANGE PRIORITIES AND NATIONALLY DETERMINED CONTRIBUTIONS

To guarantee the fulfillment of Georgia's obligations regarding the climate change agenda, it is crucial to mobilize and efficiently manage sufficient financing while engaging all relevant stakeholders. Utilizing both domestic and international resources is vital, with the involvement of representatives from both the public and private sectors. This strategy reflects Georgia's commitment to mobilizing climate finance. Beyond the primary objective, the mobilization of climate-related funding also encompasses secondary goals, such as enhancing business opportunities, advancing technologies, and generating employment. These initiatives must align with the country's inclusive green economic growth agenda and its established priorities.

Expert evaluations outlined in the document titled "NDC Financing Strategy and Investment Plan," which was developed in 2022 under the EU4Climate initiative funded by the European Union[307] and executed by the United Nations Development Programme (UNDP), indicate that approximately 13 billion GEL (around 5 billion USD, based on an exchange rate of 1 USD = 2.62 GEL) is necessary to implement the mitigation strategies specified in the Nationally

307 https://www.undp.org/sites/g/files/zskgke326/files/2022-12/undp-georgia-eu4climate-ndc-financing%20strategy%202022-geo.pdf

Determined Contribution (NDC) document. This total includes 8 billion GEL (approximately 3 billion USD) allocated for unconditional commitment measures and 5 billion GEL (2 billion USD) for conditional commitment measures. Regarding adaptation, the Intended Nationally Determined Contribution (INDC)[308] document submitted to the Convention Secretariat in 2017 suggests that economic losses due to climate change from 2021 to 2030 are estimated to be between 10 and 12 billion USD, while the costs associated with adaptation measures are projected to be between 1.5 and 2 billion USD (3.9 to 5.2 billion GEL). Considering the more ambitious targets established in the revised NDC document, the required financing for both mitigation and adaptation efforts is expected to rise.

Formulating a financial strategy for the execution of the NDC measures is crucial, as it will enable the identification and mobilization of the requisite financing from both domestic and international, public and private sources to meet the national objectives established for 2030. Although the country lacks a distinct climate-related financing strategy, financing considerations are addressed in various documents, primarily focusing on mitigation efforts, including:

- In 2021, the "Georgia 2030 Climate Change Strategy and Action Plan 2021-2023" was established, primarily outlining a short-term budget for executing climate change mitigation initiatives. This document specifies the entities accountable for these measures, the timelines for implementation, the projected budget, and the sources of funding.
- In 2024, the "Georgia 2030 Climate Change Strategy Action Plan 2024-2025" received approval. The total budget allocated for this Action Plan[309] is approximately 3.694 billion GEL, with state funding contributing 83.6 million GEL (2.3%). The majority of the budget, amounting to 3.603 billion GEL (97.5%), is sourced from various other funding avenues, including donor contributions and private sector investments, leaving a deficit of only 7.2 million GEL (refer to Table 5.1). However, this modest deficit does not imply that all climate change requirements are adequately addressed. The "Georgian Climate Change Strategy 2030"[310] document states that "Interventions that have the potential to reduce emissions but have a high financial deficit/need cannot be included in the Climate Action Plan."

The plan excluded projects for which the required financial resources had not been identified.

TABLE 5.1: FINANCING OF THE 2024-2025 CLIMATE CHANGE ACTION PLAN (IN MILLION GEL) AND SOURCES OF FINANCING BY SECTOR.

	Full budget	Among them:		Deficit
		Other	State	
Goal 1. Energy Sector	2,934.6	2,934.5		
Goal 2. Transport Sector	375.7	373.4		2.3

308 https://policy.asiapacificenergy.org/sites/default/files/INDC_of_Georgia_0.pdf
309 https://www.matsne.gov.ge/ka/document/view/6145369?publication=0
310 https://mepa.gov.ge/Ge/PublicInformation/32027

	Full budget	Among them:		Deficit
		Other	State	
Goal 3. Buildings Sector	35.7	33.7		2.0
Goal 4. Industry Sector	17.8	17.8		
Goal 5. Agriculture Sector	5.7	4.4	0.9	
Goal 6. Waste Sector	319.7	237.2	79.5	3.0
Goal 7. Increasing the carbon sequestration capacity of the forestry sector	5.1	1.9	3.2	
Total	**3,694.3**	**3,602.9**	**83.6**	**7.2**

In 2023, Georgia adopted its Long-Term Low Emission Development Strategy (LT-LEDS)[311], which encompasses aspects of climate finance. This strategy evaluates various scenarios for reducing greenhouse gas emissions by the year 2050 and identifies essential factors necessary for the successful implementation of long-term climate change mitigation initiatives aimed at securing funding from both public and private sectors. The field experts estimate that the total investment needed amounts to USD 50.5 billion under the With Existing Measures Scenario (WeMs) and approximately USD 78 billion under the With Additional Measures Scenario (WaMs). The investment requirements by sector leading up to 2050 are detailed in Table 5.2.

TABLE 5.2: AMOUNT OF INVESTMENT REQUIRED BY SECTORS IN 2020-2050

Sector	Amount of investment required, million USD	
	Current Events WeM Scenario	Additional events WaM scenario
Energy	5,980	7,310
Transport	44,000	70,100
Industry	160	200
Agriculture	33	65
Land use, land use change and forestry	307	414
Waste	20	20
Total	**50,500**	**78,109**

5.1.2. CHALLENGES IN ATTRACTING FINANCIAL RESOURCES

Georgia has acquired a degree of experience in mobilizing climate finance; however, practical observations indicate that several challenges must be addressed to secure sufficient funding for climate initiatives within the country. The LT-LEDS outlines the primary obstacles to accessing and mobilizing climate finance in Georgia.

- Insufficient resources to supply the required level of risk capital;
- Exaggerated views on climate risks and heightened “cost” associated with available capital;

311 https://www.undp.org/sites/g/files/zskgke326/files/2023-07/leds_geo_web1.pdf

- The absence of transparent, dependable, and accessible data that accurately reflects the technical performance, energy output, and environmental effects of climate-related initiatives hinders potential investors from evaluating the success of current projects, thereby amplifying risks;
- Investors' inclination towards short-term investment opportunities;
- A tendency to favor relatively large-scale transactions;
- Limited comprehension of the short-term or long-term implications of climate change risk;
- A deficiency in practical guidance on climate-smart investments, often referred to as "guidelines," which would aid in making informed investment choices.

Barriers of this nature establish a detrimental atmosphere for the accessibility, mobilization, and expansion of financial capital. They also obstruct the execution of necessary initiatives aimed at climate change mitigation, adaptation, and green investment opportunities. The impact of these barriers is shaped by the country's developmental status, international evaluations, economic conditions, the maturity of capital markets, and various other specific national factors.

The document titled "NDC Financing Strategy and Investment Plan" examines several issues, particularly focusing on the elements that impede the financing of climate change-related initiatives in Georgia. Specifically, the following challenges have been identified:

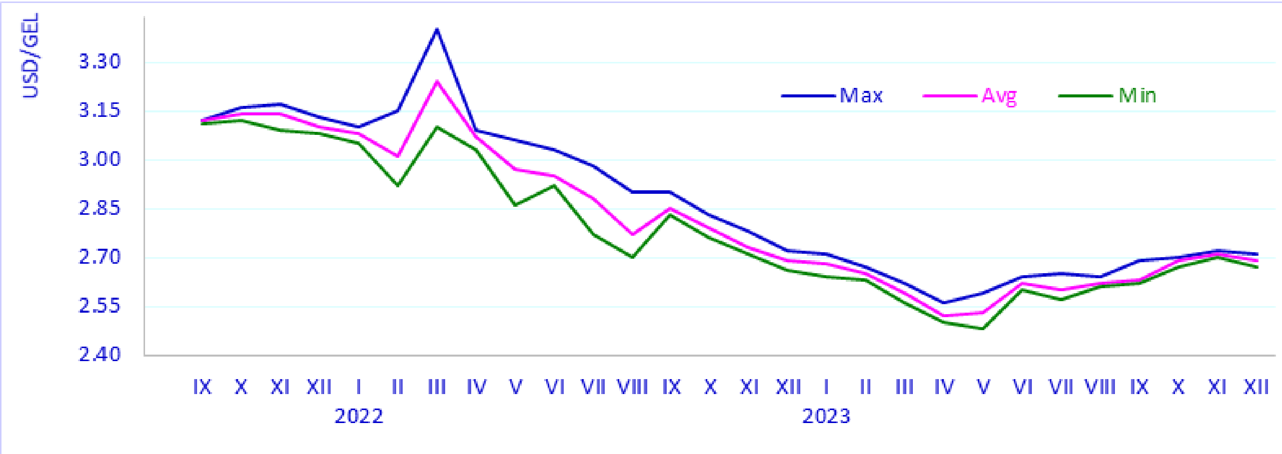
- **The absence of a cohesive national climate change strategy to mobilize climate finance is evident** - Despite considerable governmental initiatives aligned with international climate commitments and national objectives, climate change remains insufficiently incorporated into national, sectoral, and regional policy frameworks.
- **Insufficient private sector investment** poses a challenge to attracting funding for climate-related initiatives. The limited access to affordable, long-term capital within the private sector is a significant barrier. Furthermore, many innovative financial incentives and funding mechanisms available to the private sector in Georgia remain underutilized.
- The economic impact of climate change has resulted in ***decreased revenues,*** increased expenditures, and heightened public debt. The Covid-19 pandemic significantly affected revenue streams and led to a rise in expenditures, consequently increasing public debt. However, the economy rebounded relatively swiftly in the post-pandemic phase, with the ratio of government debt to gross domestic product falling within the 60% threshold[312] established by the Law on Economic Freedom. By the end of 2023, the total government debt, including obligations from public-private partnerships, was recorded at 39.3% of Gross Domestic Product (GDP)[313]. The anticipated fiscal risks associated with climate change could adversely affect the country's economic indicators, potentially resulting in an escalation of government debt.

312 https://matsne.gov.ge/ka/document/view/1405264?publication=3

313 https://www.mof.ge/images/File/sagvalebi/2023/27-12-2023/პრეზენტაცია-%20მთავრობის%20ვალის%20მართვის%20სტრატეგიის%20პროექტი%202024-2027%20წლებისთვის.pdf

- **The significant reliance on external financing** - Georgia's reliance on foreign funding reached its highest point in 1991 following the August 2008 conflict, and it has not seen a substantial reduction since that time. The levels of annual official development assistance (ODA) remain elevated, accounting for 2.89% of gross national income in 2019. This situation poses a risk of erratic aid and an excessive dependence on programs funded by donors.
- **Depreciation of the national currency** - The decline in currency value is primarily influenced by the worsening balance of payments, the depreciation of currencies of trading partners, negative public sentiment, and diminished foreign financing. In 2010, the official exchange rate of the lari against the US dollar was 1.78; by 2021, it peaked at 3.4, subsequently falling to 2.5, with an average rate of 2.69 recorded in December 2023 (Figure 5.1).

FIGURE 5.1. EXCHANGE RATE OF THE GEL AGAINST THE USD (USD/GEL)[314]



- The high rate of dollarization in the country is noteworthy. As of December 2023, 49.27% of deposits and 55.3% of loans were in the national currency. In contrast, 78.78% of foreign currency deposits were held in US dollars, while 19.36% were in euros.[315] This situation inherently places the nation at a disadvantage regarding external shocks, and the various risks associated with high dollarization present specific obstacles to securing financing.
- The integration of programs and sub-programs related to climate change issues within the state budget commenced in 2022. To enhance the connection between strategic and policy documents and the budget, the "Policy Classifier" was incorporated into the electronic budget management system in alignment with the Public Finance Management Reform Strategy and Action Plan for 2023-2026. This development enables Georgian ministries and other expenditure entities, including municipalities, to associate the programs and sub-programs outlined in the budget with the relevant "Policy Classifier" in the electronic budget management system (ebudget.ge). The associations between programs and the policy classifier are documented in the program budget annex. Currently, the electronic budget

314 National Bank of Georgia.https://nbg.gov.ge/monetary-policy/currency
315 https://nbg.gov.ge/en/page/deposits

management system (ebudget.ge) includes the following policy classifiers: UN Sustainable Development Goals (SDG), Human Capital Goals, Gender Equality, Climate Change - Mitigation, Climate Change - Adaptation, Climate Change - Mitigation and Adaptation, Energy Efficiency, Human Rights, Green Budget, Rural Development, and Sectoral Strategies. The Government of Georgia's Resolution "On Measures to be Implemented for the Development of the Country's Basic Data and Directions Document for 2024–2027" No. 90, dated February 28, 2023, mandated that during the formulation of medium-term action plans, the ministries of Georgia must identify the connections between their respective programs and subprograms and climate change. These connections are to be incorporated into budget applications via the "Policy Classifier," in collaboration with the Ministry of Environmental Protection and Agriculture of Georgia. To facilitate the identification of these connections and assess their fiscal implications on climate change, training sessions were organized for finance department representatives from four ministries, supported by the World Bank and involving the Ministry of Environmental Protection and Agriculture of Georgia. The training focused on mechanisms for recognizing linkages and fiscal impacts, including the utilization of the policy classifier features within the electronic budget management system.

To ascertain the existing financial requirements within the climate sector, an analysis was conducted on the "Climate Change Strategy and Action Plan of Georgia 2030 for 2024-2025" (CSAP) and the "Fourth National Environmental Action Programme of Georgia for 2022-2026" (NEAP). This analysis included a review of their respective budget components. The focus was placed on the activities outlined in these action plans, leading to the identification of measures that exhibit a funding shortfall. For NEAP 4, a qualitative assessment of climate-related activities was performed by experts, which involved categorizing actions pertaining to climate change in terms of mitigation or adaptation. However, this assessment did not provide a separate monetary allocation for the climate components of these actions. The identified financing gap for climate-related initiatives for the years 2024-2026, as derived from these two documents, totals 56,507,535 GEL (equivalent to 20,907,057 USD). The distribution of this financing gap across various sectors reveals that the forestry sector experiences the most significant shortfall, representing 63% of the total gap, followed by agriculture (land resources) at 14%, water resources at 7%, the waste sector at 5%, and both air protection and buildings sectors at 4% each. Other sectors account for 1% or less of the financing gap (refer to Table 5.3).

TABLE 5.3. DISTRIBUTION OF FINANCING GAP FOR CLIMATE-RELATED ACTIVITIES BY SECTOR (2024-2026) (%).

Sector	Required funding (deficit)	
	USD	Share, %
Forest management	13,217,004	63.2
Land resource protection	2,937,320	14.0
Water resources and the Black Sea protection	1,513,429	7.2
Waste management	1,100,512	5.3
Transport	840,375	4.0
Buildings	735,662	3.5
Air quality protection	286,890	1.4
Environmental governance	127,858	0.6
Natural hazards and risk management	120,255	0.6
Industry	27,751	0.1
Total	**20,907,056**	**100**

It is important to highlight that the funding requested pertains solely to the years 2024-2026; however, the financial requirements will significantly increase when taking into account Georgia's climate change policy objectives for 2030 and 2050.

Table 5.4 presents comprehensive details regarding the financial requirements associated with climate change, which are intended to be addressed through non-budgetary, supplementary resources (such as grants, loans, etc.).

TABLE 5.4. CLIMATE CHANGE FINANCIAL ASSISTANCE NEEDS

1	2	3	4	5		6	7	8	9	10	11	12
Sector	Subsector	Event name	Program/Project Description	Amount of aid (deficit)		Duration	Financial instrument	Area of assistance	Technology development and transfer contribution (Yes 1/No 0)	Contribution to capacity development goals (Yes 1/No 0)	it reflect the national strategy and/or the nationally determined contribution? (Yes 1/ No 0)	Expected Impact, result
				Million GEL	Million US dollars							
Forestry sector	Forest	Ensuring the use of multipurpose forests (fourth phase of environmental protection activities) European Programme / NEAP 4 Task 12.4)	Production of timber resources for sale, taking into account the principles of sustainable management	15.00	5.55	2023-2026	Not specified	Adaptation	0	0	**1**	Maintaining and improving the quantitative and qualitative indicators of forests and increasing the value of forests, taking into account forest ecosystem services
		Forest management and restoration of degraded areas (NEAP 4 objective 12.3)	Establishing a laboratory to effectively carry out forest maintenance and restoration activities . A functional laboratory	3.10	1.15	2023-2026		Penetrating	0	0	1	
		Reduce pressure on forests by promoting the use of alternative sources and energy-efficient technologies (NEAP 4 Target 12.2)	Conducting a situational analysis of the development of energy-efficient infrastructure in public institutions and the replacement of firewood with alternative fuels	0.06	0.02	2023-2026		Penetrating	1	1	1	
			70 business yard layout	11.39	4.22	2023-2026		Penetrating	0	1	1	
		Improve the forest management system by strengthening planning and implementation mechanisms (NEAP 4 Target 12.1)	human resources of forest management bodies with appropriately qualified specialists	5.67	2.10	2023-2026		Penetrating	0	1	1	
	Protected Areas and Biodiversity	Improve management of invasive alien species (NEAP 4 objective 11.5)	Developed legal acts that set out the regulatory norms for invasive species	0.03	0.01	2023-2026		Adaptation	0	1	1	
		Establish an interconnected network of effectively managed protected areas (NEAP 4 Target 11.2)	Research on the impact of tourism on protected areas and preparation of recommendations for sustainable tourism planning	0.16	0.06	2023-2026	Not specified	Penetrating	0	1	1	Protecting biodiversity, maintaining ecosystem services, and ensuring sustainable use of biological resources
			Preparation of a critical spatial analysis of protected areas	0.31	0.11	2023-2026	Not specified	Penetrating	0	1	1	
Agriculture	Land resources	Reduce land degradation/desertification and restore degraded areas (excluding pastures) (NEAP 4 Target 8.1)	Restoration-removal of 400 ha of windbreak	4.00	1.48	2023-2026	Not specified	Adaptation	0	0	1	Protecting biodiversity , maintaining ecosystem services, and ensuring the sustainable use of biological resources

1	2	3	4	5		6	7	8	9	10	11	12
Sector	Subsector	Event name	Program/Project Description	Amount of aid (deficit)		Duration	Financial instrument	Area of assistance	Technology development and transfer contribution (Yes 1/No 0)	Contribution to capacity development goals (Yes 1/No 0)	it reflect the national strategy and/or the nationally determined contribution? (Yes 1/ No 0)	Expected Impact, result
				Million GEL	Million US dollars							
Agriculture	Land resources	Reduce land degradation/desertification and restore degraded areas (excluding pastures) (NEAP 4 Target 8.1)	Complete inventory of windbreaks	3.94	1.46	2023-2026	Not specified	Adaptation	0	0	1	Land resources Promoting sustainable management
Penetrating	Natural hazards	Improve the functioning of the monitoring and early warning system (NEAP 4 Task 14.1)	Preparation/updating of geological hazard zoning maps for the territory of Georgia - Preparation of a GIS database of geological hazards for the 11 main river basins , catalogs and creation of geological hazard zoning maps based on them	0.33	0.12	2023-2026		Adaptation	0	0	1	
Penetrating	Environmental management	Improve public participation mechanisms and increase stakeholder engagement (NEAP 4 Task 1.2)	modules /topics to the Environmental Assessment Portal	0.10	0.04	2023-2026		Penetrating	0	1	1	Improving the natural hazards and risk management system
Penetrating			Conducting 600 public hearings, strengthening the relevant department of the center	0.24	0.09	2023-2026		Penetrating	0	1	0	Improving the efficiency of EIA/SEA procedures
Industry	Atmospheric air	Implementation of an integrated permitting system (NEAP 4 Task 2.1)	Development of subordinate normative acts based on the best available techniques and submission for additional approval	0.08	0.03	2023-2026		Mitigation	0	1	0	Improving the efficiency of EIA/SEA procedures
Water and sanitation	Water resources	To implement an assessment system for the comprehensive assessment of the state of water bodies in line with modern standards, in particular the EU Water Framework Directive (NEAP 4 Task 5.1)	Development and implementation of basin management plans	0.40	0.15	2023-2026	Grant from the European Union	Adaptation	0	1	1	Improving the prevention and control mechanism for emissions from the industrial sector
Water and sanitation	Black Sea biodiversity	Preventing the spread of new alien species from ballast water (NEAP 4 Task 6.1)	Establishment of a ballast water laboratory, where analysis of the number of foreign harmful organisms and pathogens in the water will be carried out for the purpose of ballast water control	0.40	0.15	2023-2026	Not specified	Adaptation	1	1	1	Implementation of an integrated water resources management system
Water and sanitation	Black Sea biodiversity	Promoting the development of marine aquaculture (NEAP 4 objective 6.4)	plan for designated aquaculture zones and implement awareness-raising activities to promote aquaculture tourism .	0.06	0.02	2023-2026	Not specified	Adaptation	0	1	1	Protection of Black Sea species and habitats
Water and sanitation	Black Sea biodiversity	Improve marine litter management (NEAP 4 Target 6.5)	Analysis of the situation regarding marine litter.	0.38	0.14	2023-2026	Not specified	Adaptation	0	0	1	Protection of Black Sea species and habitats
Water and sanitation	Black Sea biodiversity	Implementation of the Black Sea Integrated Monitoring Program (NEAP 4 Task 6.6)	a vessel with appropriate scientific and research equipment (multi-parameter analyzers, sampling equipment, etc.).	1.78	0.66	2023-2026	Grant	Adaptation	1	1	1	Protection of Black Sea species and habitats
Water and sanitation	Black Sea biodiversity	Implementation of the Black Sea Integrated Monitoring Program (NEAP 4 Task 6.6)	Within the framework of the European Union project, it is planned to purchase 4 units of equipment for the Batumi Laboratory.	1.08	0.40	2023-2026	Grant (Eurocav-shire)	Adaptation	1	1	1	Protection of Black Sea species and habitats
Penetrating	Atmospheric air	Reduce emissions of harmful substances from various sources of pollution (NEAP 4 Target 7.1)	Concept for increasing the share of electric vehicles in the fleet.	0.03	0.01	2023-2026	Not specified	Mitigation	0	0	1	Protection of Black Sea species and habitats

1	2	3	4	5		6	7	8	9	10	11	12
Sector	Subsector	Event name	Program/Project Description	Amount of aid (deficit)		Duration	Financial instrument	Area of assistance	Technology development and transfer contribution (Yes 1/No 0)	Contribution to capacity development goals (Yes 1/No 0)	it reflect the national strategy and/or the nationally determined contribution? (Yes 1/ No 0)	Expected Impact, result
				Million GEL	Million US dollars							
Penetrating	Atmospheric air	of an ambient air quality monitoring and assessment system (NEAP 4 Task 7.2.1)	Purchase of automatic monitoring station installation .	4.0	1.5	2023-2026	Grant	Mitigation	1	1	1	Ensuring clean and healthy air throughout Georgia
Penetrating	Atmospheric air	an ambient air quality monitoring and assessment system (NEAP 4 Task 7.2.3)	of the atmospheric air quality portal - air.gov.ge. A corresponding mobile application has been developed.	0.18	0.07	2023-2026	Grant	Mitigation	1	1	1	Ensuring clean and safe air for human health throughout the entire territory of Georgia
Transport	Ogado-Erivi cuisine . Transport	Control of vehicle emissions on roads (CSAP Task 2.1.2)	Equipping the cities of Poti, Zugdidi and Gori with field vehicle emission measurement equipment	0.50	0.19	2024-2026	Not specified	Mitigation	1	1	1	Ensuring clean and safe air for human health throughout the territory of Georgia
Transport	Karzo Transport	of measures envisaged in the Batumi Sustainable Urban Mobility Plan (CSAP objective 2.3.2)	Expansion of the network of zonal-hourly parking lots; 2. Arrangement of a network of bicycle paths	1.17	0.43	2024-2025	Grant	Mitigation	0	0	1	By 2030, a 15% reduction in greenhouse gas emissions in the transport sector compared to baseline projections
Transport	R is a nigga	Prepare a cost-benefit analysis and feasibility study to identify the best options for shifting road freight to rail (CSAP Task 2.4.1)	Preparing a cost-benefit analysis that can help identify the most attractive measures for inclusion in the next version of the Climate Action Plan.	0.30	0.11	2024-2025	Not specified	Mitigation	0	0	1	By 2031, a 15% reduction in greenhouse gas emissions in the transport sector compared to baseline projections
Transport		Development of a spatial development document for the city of Kutaisi (CSAP task 2.4.2)	Development of the so-called 15-minute city concept for the city of Kutaisi	0.30	0.11	2024-2025	Not specified	Mitigation	0	0	1	By 2032, compared to the baseline scenario, greenhouse gas emissions in the transport sector will be reduced by 15%.
Buildings sector	Penetrating	minimum energy performance standards for buildings and certification (CSAP Task 3.1.1)	a program covering the following issues: Training of officials Strengthening the human and infrastructural capacities of state permitting and supervisory bodies	0.04	0.01	2024-2025	Not specified	Mitigation	0	1	1	By 2033, a 15% reduction in greenhouse gas emissions in the transport sector compared to baseline projections
Buildings sector	Public buildings	Preparation of a plan for obtaining an energy performance certificate for public sector buildings (CSAP task 3.3.2)	a plan for obtaining an energy performance certificate , which will include the area (sq m) of modernized public buildings, as well as the percentage of modernized buildings in relation to the total area indicated in the building register.	0.04	0.01	2024-2025	Not specified	Mitigation	0	0	1	Greenhouse gas emissions from the buildings sector
Buildings sector	Commercial buildings	Development of a co-financed modernization plan to achieve minimum energy performance requirements and meet energy certification requirements for buildings in the most energy-intensive commercial sector (CSAP Task 3.3.3)	Identifying buildings with the highest emissions and promoting full or partial modernization	0.40	0.15	2024-2025	Not specified	Mitigation	0	0	1	Greenhouse gas emissions from the buildings sector

1	2	3	4	5		6	7	8	9	10	11	12
Sector	Subsector	Event name	Program/Project Description	Amount of aid (deficit)		Duration	Financial instrument	Area of assistance	Technology development and transfer contribution (Yes 1/No 0)	Contribution to capacity development goals (Yes 1/No 0)	it reflect the national strategy and/or the nationally determined contribution? (Yes 1/ No 0)	Expected Impact, result
				Million GEL	Million US dollars							
Buildings sector	Residential buildings	to modernize and upgrade the stock of buildings for residential communities and vulnerable groups with the highest emissions (CSAP objective 3.3.4)	Create a register of housing associations and buildings of vulnerable groups with the highest emissions. Develop a program for the modernization of these buildings.	0.40	0.15	2024-2025	Not specified	Mitigation	0	0	1	Greenhouse gas emissions from the buildings sector
Buildings sector	Penetrating	Develop a financial incentive mechanism for the installation of solar water heating systems in buildings. (CSAP Task 3.4.1)	Development of a financial incentive mechanism	0.18	0.07	2024-2025	Not specified	Mitigation	0	0	1	Greenhouse gas emissions from the buildings sector
Buildings sector	Penetrating	Develop a program to increase the availability and widespread use of technologies nationwide (CSAP objective 3.4.3)	Conducting feasibility studies on the provision of technologies to improve energy performance in buildings; Developing local manufacturing and installation activities; Strengthening the country's engineering capabilities; Strengthening enforcement capabilities; Market-oriented policies and incentive systems for enterprises, promoting local production; Creating professional associations and supporting existing ones.	0.40	0.15	2024-2025	Not specified	Mitigation	1	1	1	Greenhouse gas emissions from the buildings sector
Buildings sector	Penetrating	Develop a comprehensive feasibility study plan for the building stock (CSAP Task 3.4.4)	Detailed inventory of public facilities and assessment of technical condition; Development of a detailed plan for the modernization of public buildings; Inventory and qualitative research of the commercial building stock; Inventory and qualitative research of the residential stock; Social and environmental research related to the energy characteristics of buildings; Based on the research, determination of the purposefulness, planning, budgeting for the implementation of projects in the public and commercial sectors;	0.13	0.05	2024-2025	Not specified	Mitigation	0	1	1	Greenhouse gas emissions from the buildings sector
Buildings sector	Penetrating	subsidy program for energy-efficient building technologies (both supply and demand side) (CSAP Task 3.4.5)	Program development in the following areas: (a) local production, engineering and installation; (b) improvement of existing financing mechanisms, financing or co-financing of programs; (c) establishment of financing programs, national financing by donors and the state , financing of interest on loans	0.40	0.15	2024-2025	Not specified	Mitigation	1	1	1	Greenhouse gas emissions from the buildings sector
Waste		of needs for the conversion of biodegradable waste into energy (CSAP Task 6.2.3)	Development of a needs assessment document for the conversion of biodegradable waste into energy	0.57	0.21	2024-2025	Not specified	Mitigation	0	0	1	Number of emissions reduced as a result of waste recycling
Waste		Assessment of plastic waste streams (CSAP Task 6.2.4)		0.42	0.16	2024-2025	Not specified	Mitigation	0	0	1	
Waste		Collection and treatment of greenhouse gases at the Kobuleti wastewater treatment plant . (CSAP objective 6.3.4)	Installation of gas collection and processing systems at the Kobuleti wastewater treatment plant.	1.99	0.73	2024-2025	Not specified	Mitigation	0	0	1	
Total				**56.51**	**20.91**							

5.1.3. FINANCES ALLOCATED TO ACHIEVE EXISTING PRIORITIES AND NATIONALLY DETERMINED CONTRIBUTIONS IN TERMS OF COMBATING CLIMATE CHANGE

Climate-related initiatives in Georgia are supported by a range of funding sources, with the primary sources being:

i. International financial institutions, partner states, and their respective international development agencies

ii. The budgets of both the central and local governments of the country

iii. The private sector

5.1.3.1. International funding

International support plays a crucial role in advancing a country's climate change agenda, particularly in the execution of mitigation and adaptation strategies. In Georgia, the provision of financial aid, technology transfer, and capacity building is vital for the effective implementation of climate-related initiatives. Funding for these initiatives primarily comes from Official Development Assistance (ODA)[316], which is facilitated through various multilateral climate funds, bilateral co-financing arrangements, and multilateral development banks.

To enhance the transparency, accountability, and efficiency of foreign aid directed towards Georgia, the Government of Georgia has established the e-Aid Information Management System (eAIMS)[317], This tool, overseen by the Administration of the Government of Georgia, serves as an online database that catalogs projects financed by international development partners. The information organized within eAIMS adheres to the sector classifications set forth by the Organisation for Economic Co-operation and Development (OECD). Although there is no distinct filter for climate change projects within the system, it is possible to identify such initiatives under the OECD thematic category of "Sustainable Use of Natural Resources" and through the existing filter for sustainable development goals.

The entry of project information into the eAIMS by donors is conducted on a voluntary basis. Consequently, both the presence of information within the system and the thoroughness of the data provided are contingent upon the donors' willingness to contribute. Evidence suggests that a considerable number of projects are documented in the system; however, a portion remains unrecorded. Thus, the comprehensive input of all project information into this database continues to pose a challenge. Furthermore, the system does not facilitate the classification of projects based on their adaptation or mitigation efforts. Additionally, it remains unclear what proportion of the project budget is allocated to initiatives addressing climate change.

According to eAIMS data, as of 2023, there are 78 projects that are somewhat related to climate change, with the earliest project commencing in 2013 and concluding in 2039. The total financing for these projects amounts to approximately USD 676.7 million, of which 53

316 *The OECD Development Assistance Committee defines "Official Development Assistance (ODA)" as official assistance to achieve economic development and prosperity in developing countries.*

317 eAIMS (e-Aid Information Management System) is a tool for collecting, analyzing and reporting information on foreign aid, which aims to improve the transparency, accountability and effectiveness of foreign aid flows to Georgia.https://eaims.ge/AboutUs/

projects (68%) totaling USD 211.5 million have been completed. The majority of the funding is concentrated among the largest financial institutions, with 43% allocated to the European Bank for Reconstruction and Development (EBRD), 23.4% to the Asian Development Bank (ADB), and 7% to the World Bank (WB). Additionally, the European Union (EU) contributes 11%, while Germany provides 6%, and both the Green Climate Fund (GCF) and Sweden, along with Switzerland, contribute 4%. Other funding sources account for less than 1% (refer to Table 5.5).

TABLE 5.5. CLIMATE CHANGE-RELATED PROJECT FUNDING BY SOURCE BASED ON EAIMS DATA IN 2023.

Source of funding	Million US dollars	Share, %
European Bank for Reconstruction and Development	290.9	43.0
Asian Development Bank	158.7	23.4
European Union	74.4	11.0
World Bank	50.0	7.4
Germany	39.9	5.9
Green Climate Fund	27.1	4.0
Sweden	19.5	2.9
Switzerland	7.3	1.1
Austria	3.8	0.6
World Health Organization	2.7	0.4
United Kingdom	1.2	0.2
Slovakia	0.8	0.1
Millennium Development Goals	0.1	0.02
Czech Republic	0.1	0.01
Estonia	0.1	0.01
Japan	0.08	0.01
Netherlands	0.04	0.01
Norway	0.02	0.00
Lithuania	0.02	0.00
Total	**676.7**	**100.0**

A distinct perspective on climate-related initiatives emerges from the data obtained from state agencies, local governments, non-governmental organizations, and international institutions. This data is more extensive than that found in the eAIMS databases and encompasses certain non-official development assistance (ODA) projects. However, it remains incomplete, as not all recipients have provided their information. Based on the received data, and after minimizing duplications, a total of 101 projects have been identified, with an estimated total value of around 1 billion USD.[318] A total of 39 projects have been finalized, while 62 are currently in progress. In terms of sectoral distribution, the majority of projects are allocated to transport, accounting for 40.5%. Other sectors include emergency management at 10.4%, agriculture at 9.7%, forestry at 8.4%, energy at 7.9%, construction at 7.0%, and multisector projects at 7.2%. The remaining sectors collectively represent a smaller portion, totaling 8.76% (refer to Table 5.6).

TABLE 5.6. SECTORAL DISTRIBUTION OF CLIMATE-RELATED PROJECT FINANCING FOR 2018-2028.

Sector and Subsector	Financing	
	Million US dollars	Share
Transport	407.0	40.54%
Emergency Management	104.7	10.43%
Agriculture	97.6	9.72%
Forestry	84.7	8.44%
Energy, Energy Efficiency, Renewable Energies	79.7	7.94%
Multi-Sector	72.4	7.21%
Construction, Energy Efficiency	70.0	6.97%
Waste Management	19.0	1.89%
Social Development	15.0	1.49%
Urban Development	13.0	1.29%
Protected Areas, Biodiversity	12.2	1.21%
Environmental Education	6.0	0.60%
Land Degradation	5.2	0.52%
Industry	5.0	0.50%
Digital Technologies	5.0	0.50%
Water Resources and Water Supply	4.0	0.40%
Non-agricultural entrepreneurial activities	2.1	0.21%
Economy	1.6	0.15%
Total	**1,004.2**	**100%**

5.1.3.2 Budget financing

Substantial resources are allocated from the state budget for the execution of climate-related initiatives, particularly in the area of adaptation, which includes activities such as the restoration of gasification systems, the expansion of the hydrometeorological observation network, and shoreline reinforcement projects. However, until recently, these expenditures were not categorized as budgetary allocations pertaining to climate change. Consequently, during the reporting period from 2018 to 2022, it is not feasible to ascertain the climate-related financial allocations from the budget. In 2022, the integration of the

318 Project budgets were presented in different currencies (mostly USD, EUR and GEL and a small part in Norwegian krone), but were then converted to USD at the exchange rate prevailing for the analysis period.

"Policy Classifier" into the electronic budget management system was accomplished, enabling Georgian ministries and other spending entities to associate budgeted programs and sub-programs within the electronic budget management system (ebudget.ge) with the relevant "Policy Classifier." The connections between programs and the policy classifier are documented in the program budget annex. This process includes the identification of relationships between climate-related initiatives and the programs outlined in the state budget. Furthermore, the fiscal risk analysis document, which is prepared alongside the draft state budget, encompasses information regarding the implications of climate change-related consequences and associated fiscal risks. These reforms are being executed in alignment with the Public Finance Management Reform Strategies for the periods of 2018-2022[319] and 2023-2026[320].

To identify expenditures related to climate change, a guidance document has been developed. This document enables ministries, particularly the Ministry of Environmental Protection and Agriculture of Georgia, in collaboration with the Ministry of Finance of Georgia, to associate the programs and sub-programs they execute with the Climate Change Policy Classifier. Consequently, they will identify pertinent expenditures, which will be progressively documented in the budget in alignment with the actions outlined in the Public Finance Management Reform Strategy.

5.1.3.3. Linking budgeted programs to climate change

By Resolution No. 88, issued by the Government of Georgia on February 25, 2022[321], the Ministry of Finance of Georgia has taken steps to enhance the connection between strategic and policy documents and the national budget. This was achieved by incorporating the "Policy Classifier" into the electronic budget planning system. This integration enables Georgian ministries and other spending entities, including municipalities, to associate the programs and sub-programs outlined in the budget within the electronic budget management system (ebudget.ge) with the relevant "Policy Classifier." The associations between programs and the policy classifier are documented in the program budget annex. During the years 2022-2023, measures related to climate change and their associated expenditures were identified within the programs and sub-programs outlined in the budgets of four ministries. There are plans to enhance the electronic budget management system to specify particular expenditures, thereby capturing the fiscal implications of climate change within the context of budgeted programs, utilizing the policy classifier functionality in the electronic budget management system.

In the period of 2022-2023, measures and expenditures associated with climate change were recognized within the programs and sub-programs outlined in the budgets of four ministries. There are plans to enhance the electronic budget management system by incorporating the capability to specify particular expenditures, thereby enabling the assessment of the fiscal implications of climate change within the budgetary framework through the policy classifier functionality.

Identifying programs related to climate change in the budget presents a challenge for

319 https://www.mof.ge/5189
320 https://www.mof.ge/5613
321 https://matsne.gov.ge/ka/document/view/5393449?publication=0,

public sector financial institutions, as it necessitates specialized knowledge from those tasked with planning the relevant sectoral policies and programs involved in the budgeting process. Therefore, it is crucial to establish a methodology for recognizing climate change connections during budget planning. This will ensure the effective execution of the aforementioned initiatives. To this end, guidance documents, including the "Methodology for Classification of Climate-Related Budget Expenditures" and a Technical Report, were developed in 2022 under the EU4Climate program by Gauss International Consulting S.L. and Georgia's Environmental Outlook/GEO. Consultative meetings with relevant stakeholders were conducted to analyze programs and budget expenditures linked to climate change. Additionally, seminars and workshops were organized to present the methodology for identifying these linkages. Furthermore, during 2022/2023, the World Bank provided financing to enhance the capacity of several ministries and local governments in identifying, strategically planning, and budgeting for climate-related expenditures, thereby fostering practical knowledge. As part of this initiative, a relevant methodological manual and practical guide titled "Linking the Budget to Climate Change in Georgia" were produced.

The draft version and brochure were developed in 2023 with the assistance of the World Bank, as part of the "Enhancing Government Capacity to Lead Green Transformation" and "South Caucasus Climate and Environment" regional initiatives. Although significant progress has been made in this area, further efforts are required to implement suitable methodologies and establish an effective regulatory framework. This includes the creation of guides, instructions, or practical manuals, as well as capacity-building initiatives through training programs.

At the behest of the Ministry of Finance of Georgia, the program budget annex for 2023 incorporated the connections between the spending institutions' programs and sub-programs to the "Policy Classifier" concerning climate change. Specifically, 13 programs and 10 sub-programs were associated with the climate change classifier, while 3 programs were linked to the "Sustainable Development Goal 13 / SDG 13 - Achieving Climate Resilience" classifier.

The assessment of the fiscal implications of climate change was initially conducted as part of the EU4Climate initiative during the 2021-2022 period, focusing on the budgets from 2018 to 2020. This process involved key representatives from major state agencies responsible for significant financing and climate policy, although only six ministries were included in the expenditure analysis. These agencies were asked to provide budgetary data for the years 2018 to 2020, and the labeling was executed in collaboration with representatives from the same agencies, following the established methodology. Throughout the labeling period, the total budget financing for these agencies showed an annual increase, reaching 594.9 million GEL in 2020. In terms of their share of the overall actual budget expenditures, the percentages for 2018, 2019, and 2020 were recorded at 6.45%, 6.94%, and 5.68%, respectively (refer to Table 5.7).

TABLE 5.7. STATE BUDGET EXPENDITURES AND CLIMATE-RELATED SHARE BY 2018-2020.[322]

Year	Budgetary expenditure (thousand GEL)	Costs associated with climate change	
		Volume, thousand GEL	Share in the total budget, %
2018	7,125,460	459,851	6.45
2019	8,229,412	571,477	6.94
2020	10,469,152	594,920	5.68

The Ministry of Regional Development and Infrastructure of Georgia has been recognized as holding the predominant share of funding for extensive infrastructure projects associated with climate change, with an allocation of approximately 950 million GEL over a three-year period. In contrast, the Ministry of Environmental Protection and Agriculture has been noted for having the largest proportion of the total budget allocated to climate change initiatives within its agency (refer to Table 5.8).

TABLE 5.8. VOLUME AND SHARE OF CLIMATE-RELATED STATE EXPENDUTURES BY STATE AGENCIES IN 2018-2020

Years	Actual expenditure of the agency, thousand GEL	Costs associated with climate change	
		Volume, thousand GEL	Share in the agency's budget, %
Ministry of Environmental Protection and Agriculture			
2018	263,009	78 , 97 9	30. 03
2019	358 , 04 5	104 , 239	29. 11
2020	496 , 804	115 , 117	23. 17
Ministry of Regional Development and Infrastructure			
2018	1,668,777	250 , 896	15. 03
2019	2 , 121 , 193	345 , 385	16. 28
2020	2 , 202 , 373	353 , 92 5	16. 07
Ministry of Economy and Sustainable Development			
2018	227 , 528	21 , 38 6	9. 40
2019	260 , 409	22 , 588	8. 67
2020	759 , 36 4	39 , 26 7	5. 17
Ministry of Finance			
2018	76 , 216	781	1. 02
2019	85 , 567	92 9	1. 09
2020	76 , 91 2	843	1. 10
Ministry of Internally Displaced Persons from the Occupied Territories, Labor, Health and Social Protection			

322 Climate Labeling of Public Finances and Institutional Review. May 2022, Georgia, Technical Report, prepared under the EU/UNDP Action: EU4Climate, CRIS, Gauss International Consulting S.L. and Georgia's Environmental Outlook (GEO).

Years	Actual expenditure of the agency, thousand GEL	Costs associated with climate change	
		Volume, thousand GEL	Share in the agency's budget, %
2018	3,688,462	46 , 49 4	1. 26
2019	4,055,432	46 , 498	1. 15
2020	5,631,137	56 , 44 3	1.00
Ministry of Education, Science and Youth of Georgia			
2018	1 , 201 , 467	61 , 316	5. 10
2019	1,348,76 5	51,837	3. 84
2020	1 , 302 , 561	29 , 32 8	2. 25

In 2023, the World Bank undertook a climate-sensitive assessment of the budget allocations proposed for 2024. This assessment[323] focused on the draft budgets of four ministries, which collectively represent 67% of the total budget for these ministries, amounting to approximately 12.92 billion GEL. The evaluation identified programs and sub-programs linked to climate change, along with their respective budgetary allocations in GEL. It was found that 29 out of 39 programs were associated with climate change concerns, with 22 addressing mitigation efforts, 27 focusing on adaptation, and 20 incorporating both adaptation and mitigation strategies. Overall, 13.48% of the budgets from the four assessed agencies were classified as climate-related financing, totaling around 1.74 billion GEL (refer to Table 5.9).

TABLE 5.9. CLIMATE-RELATED BUDGETS OF MINISTRIES IN 2024.[324]

Activity	Number of programs	Share of activities, %	Climate-related budget, thousand GEL	Climate share in the agency's budget, %
Climate Mitigation	22	56%	601,780	4.66%
Climate Adaptation	27	69%	1,139,692	8.82%
Climate Mitigation and Adaptation Together	20	51%	1,541,732	11.93%
Climate Related	29	74%	1,741,473	13.48%

The Ministry of Regional Development and Infrastructure accounted for the largest portion of budget programs and funding associated with climate change, representing 37.7% of the total. Conversely, the Ministry of Internally Displaced Persons from the Occupied Territories of Georgia and the Ministry of Labor, Health and Social Protection had the lowest share of climate-related budget allocations, at just 3.6% (refer to Table 5.10).

323 Climate Marking of the Budget in Georgia. 2023, World Bank, Draft Report.
324 Climate Marking of the Budget in Georgia. 2023, World Bank, Draft Report.

TABLE 5.10. CLIMATE-RELATED BUDGETS BY MINISTRIES IN 2024.

Name	Number of programs	Total budget of programs, thousand GEL	Climate-related programs	Share in programs	Climate-related budget, thousand GEL	Climate share in the agency's budget
4 ministries	39	12,920,834	29	74%	1,741,473	13. 48 %
Ministry of Regional Development and Infrastructure	8	3 , 400 , 700	8	100%	1 , 283 , 380	37.7 %
From the occupied territories of Georgia Ministry of Internally Displaced Persons, Labor, Health and Social Welfare	6	6,051,920	6	100%	197 , 224	3. 26 %
Ministry of Education, Science and Youth of Georgia	10	2,780,214	3	30%	142 , 148	5. 11 %
Ministry of Environmental Protection and Agriculture	15	688,000	12	80%	118 , 72 1	17. 26 %

The initial steps in the climate marking of the budget are of significant importance. The subsequent phase will involve the harmonization and implementation of the established methodologies for climate marking, representing a crucial advancement in the evaluation of budget expenditures concerning climate considerations and facilitating informed decision-making.

5.1.3.4. Fiscal Risk Analysis

The "Fiscal Risk Analysis Document" published by the Ministry of Finance in 2022[325] addresses the implications of climate change. This document evaluates the fiscal risks associated with various climate change scenarios[326]. It presents four scenarios developed using a methodology supported by the International Monetary Fund. The first scenario, termed the "Paris Agreement Scenario,"[327] – is deemed the most optimistic. The subsequent scenarios are characterized by increasingly adverse conditions: the second is the "Unmitigated and Deteriorated Climate Change Scenario,"[328] the third is the "Unsustainable, Variable Scenario,[329]" and the fourth is the "Extreme Scenario."[330] and the fourth is the "Extreme Scenario."[331]. The analysis indicates that climate change is expected to have a detrimental effect on labor productivity. Specifically, the deteriorated scenario is projected to reduce GDP by 0.2% by 2026 due to anticipated declines in revenue. Even if spending remains

325 https://info.parliament.ge/file/1/BillReviewContent/314006
326 Harris J et al (2022), Updating the Balance Sheet and Quantifying Fiscal Risks from Climate Change in Georgia: https://www.imf.org/-/media/Files/Publications/CR/2022/English/1GEOEA2022001.ashx
327 A maximum increase in global temperatures of 20C above pre-industrial levels
328 Global temperature increase of about 40C compared to pre-industrial levels
329 In addition to temperature increases, these include high weather variability (eg, unseasonal snowfall) and extreme meteorological events (hotter summers and colder winters).
330 In addition to temperature increases, it includes increased weather variability (e.g., unseasonal snowfall) and extreme meteorological events (hotter summers and colder winters)
331 Macroeconomic effects of more frequent, severe, and large-scale floods and droughts

constant, this will significantly impact the primary deficit ratio.[332] Furthermore, the analysis underscores that the adverse effects of climate change on the economy will manifest as a combination of sluggish economic growth and an elevated primary deficit ratio, leading to an increase in the debt-to-GDP ratio. By 2050, under the most severe scenario, this ratio could surpass the 60% threshold established by fiscal regulations.

5.1.3.5. Private sector financing

The reforms enacted in Georgia have markedly enhanced the tax framework, streamlined services for business initiation and operation, and improved various other conditions, thereby augmenting the country's appeal for investment. Data from the International Monetary Fund indicates that private investment in Georgia surged 3.5 times between 2010 and 2019, reaching over 8.28 billion GEL by 2019, which was 2.3 times greater than public investment in that same year. Additionally, in 2019, Georgia's total capital was reported at 121.98 billion GEL, with 61% allocated to the private sector (74.88 billion GEL), 37% to state capital (45.44 billion GEL), and 2% to public-private partnerships (exceeding 1.66 billion GEL).[333]

The identification of the proportion of private investment in climate change initiatives poses a significant challenge, primarily due to the absence of a centralized system for tracking and documenting both ODA and non-ODA projects in Georgia. Currently, data is gathered through expert insights, which raises concerns regarding the completeness of this information.

Regarding private sector financing, it is important to highlight specific initiatives undertaken by commercial banks that facilitate the mobilization of private funds from the Global Climate Partnership Fund (GCPF) in Georgia. The GCPF operates as a public-private partnership, leveraging public funds to draw in private capital for investments in collaboration with local financial institutions. This fund is dedicated to financing climate change mitigation projects in developing nations, promoting sustainable growth and energy efficiency among small and medium-sized enterprises and households, while also encouraging the adoption of renewable energy sources. Additionally, the fund enhances weather monitoring, information sharing, research initiatives, and the development of early warning systems and greenhouse gas monitoring capabilities. With the backing of the GCPF, Basisbank has intensified its efforts in green lending and the evaluation of green projects, while TBC Bank has expanded its capacity to finance climate-related private initiatives. Notably, in 2021, TBC Bank became the first commercial bank in the Caucasus region to gain accreditation from the Green Climate Fund, enabling it to secure funding for various climate change adaptation and mitigation projects. Furthermore, TBC Bank, in partnership with the EBRD, has successfully raised funds for the Green Economy Financing Facility (GEFF) and the Green for Growth Fund Green Facility (GGFGF), aimed at financing projects that enhance energy efficiency, resource efficiency, and renewable energy, thereby

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332 Empirical estimates from Kahn et al. (2021) for Paris, unmitigated, and baseline scenarios are used. Kahn, M., Mohaddes, K., Ng, R., Pesaran, M., Raissi, M., & Yang, J. (2021). Long-term macroeconomic effects of climate change: A cross-country analysis. *Energy Economics, 104* (105624), 105624-105624. https://doi.org/10.1016/j.eneco.2021.105624

333 „The NDC Financing Strategy and Investment Framework, 2022, was prepared under the EU/UNDP EU4Climate programme by Gauss International Consulting S.L. and Georgia's Environmental Outlook (GEO).

contributing to energy savings and reductions in carbon dioxide emissions.[334]

The Bank of Georgia stands out as a prominent private institution facilitating the provision of green loans within the Georgian market. It has secured various forms of financing from multiple financial entities to support the issuance of loans across different credit lines aimed at enhancing energy efficiency and promoting renewable energy sources. Notable partners in this endeavor include the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), Kreditanstalt für Wiederaufbau (KfW), and the Green for Growth Fund (GGF).[335].

Additionally, ProCredit Bank has made significant strides in advancing the climate agenda, particularly through its eco-loans designed for investments in energy-efficient materials and equipment. These initiatives aim to bolster the productivity and efficiency of small and medium-sized enterprises, as well as households. Furthermore, their retail loan program, which supports home improvements and the acquisition of electric vehicles, deserves recognition.

A segment of Georgian businesses views climate change-related financing as a potential avenue for growth and is actively seeking to attract such funds. However, there remains a challenge in fully capitalizing on the opportunities available to Georgia through international collaboration.

It is important to highlight that a range of internationally recognized financial incentives and innovative financing mechanisms exists for the Georgian private sector. Nevertheless, a significant portion of these mechanisms remains underutilized. The findings from the 2018 OECD survey regarding the application of these mechanisms in Georgia are presented in Table 5.11.

TABLE 5.11: AVAILABLE PRIVATE FINANCING MECHANISMS IN GEORGIA[336]

Mechanism	Internal sources				International sources	
	Commercial banks	Microfinance institutions	Institutional investors	Non-financial corporations	Financial institutions	Non-financial corporations
Corporate bonds	Available but not yet used	Available but not yet used	Available but not yet used	Available but not yet used	Available but not yet used	Available but not yet used
Project bonds	Available but not yet used	-	Available but not yet used	Available but not yet used	Available but not yet used	Available but not yet used
Direct lending	Operating mechanism	Available but not yet used	Available but not yet used	-	Operating mechanism	-
Mezzanine financing	Operating mechanism	-	Operating mechanism	-	Available but not yet used	-
Direct investment	-	Available but not yet used	Operating mechanism	Operating mechanism	Operating mechanism	Operating mechanism
Capital investment	-	-	-	-	Operating mechanism	-

334 Green Financing, TBC Bank

335 https://www.oecd-ilibrary.org/sites/bce6b2de-ka/index.html?itemId=/content/component/bce6b2de-ka

336 OECD (2018), Mobilizing Climate Finance in Georgia, Green Finance and Investment, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264289727-en

Mechanism	Internal sources				International sources	
	Commercial banks	Microfinance institutions	Institutional investors	Non-financial corporations	Financial institutions	Non-financial corporations
Guarantees/ Insurance	-	-	-	-	Available but not yet used	-
Initial investment	Available but not yet used	Available but not yet used	-	-	Available but not yet used	-
Currency swaps	-	-	-	-	Existing channel	-
Securitization	-	-	Available but not yet used	-	Available but not yet used	Available but not yet used
Union/ Difficulty	-	-	Available but not yet used	-	Available but not yet used	Available but not yet used

„-" 1. Not applicable for completion.

5.1.3.6. Financial instruments used to obtain assistance and priority areas of funding

According to information from the Foreign Assistance Information Management System, which is current as of 2023, 93% of international climate-related resources were directed towards financial assistance, while 7% was allocated for technical and expert support, and less than 1% was invested in technologies (refer to Table 5.12). Notably, nearly half of the financial assistance, around 50%, is designated for investment projects, with 30% allocated for budget support, and 21% provided as grants.

TABLE 5.12: FOREIGN ASSISTANCE RELATED TO CLIMATE CHANGE FROM 2013 TO 2039, CATEGORIZED BY FINANCING TYPE.

Type of foreign aid	Amount of assistance Thousand US dollars	Share, %	
		In help	In financial aid
Financial assistance	629,565	93.04	100
Grant / Budgetary Assistance	*689*	*0.10*	*0.11*
Grant	*131,129*	*19.38*	*20.83*
Loan / Budgetary assistance	*185,927*	*27.48*	*29.53*
Loan / Investment Project	*311,820*	*46.08*	*49.53*
Technical / Expert Assistance	46,939	6.94	7.46
Technologies	156	0.02	0.02
Total foreign aid	**676,660**		

The volume of foreign aid provided by the OECD in relation to climate change, along with its distribution across primary sectors, is detailed in Table 5.13, based on data from the Foreign Assistance Information Management System (eAIMS.GE).

TABLE 5.13. ALLOCATION OF FOREIGN AID IN THE CONTEXT OF CLIMATE CHANGE (CATEGORIZED BY THE KEY SECTORS OF OECD).

OECD **Sectors (main)**	**Million US dollars**	**%**
Energy conservation and savings on the demand side	261.7	38.7%
Water Supply Sector Policy and Administrative Management	157.1	23.2%
Multisectoral assistance	50.0	7.4%
Energy Policy and Administrative Management	41.5	6.1%
Financial intermediaries in the formal sector	35.0	5.2%
Disaster risk reduction	27.1	4.0%
Waste management/disposal	20.1	3.0%
General environmental protection	18.0	2.7%
Disaster prevention and preparedness	11.2	1.7%
Biosphere protection	7.5	1.1%
Transport Policy and Administrative Management	6.2	0.9%
Biological diversity	6.1	0.9%
Environmental Policy and Administrative Management	6.1	0.9%
Environmental education/training	4.5	0.7%
Decentralization and support for local governance	4.2	0.6%
Food safety and quality	3.2	0.5%
Democratic engagement and civil society	2.7	0.4%
Agricultural development	2.1	0.3%
Health care, general	1.9	0.3%
Forestry sector development	1.6	0.2%
Public Sector Policy and Administrative Management	1.5	0.2%
Agricultural Policy and Administrative Management	1.4	0.2%
Rural development	1.1	0.2%
Government and civil society, general	1.0	0.2%
Other	3.7	0.5%
Total	**676.7**	**100%**

During the same timeframe, the allocation of foreign aid by thematic group concerning climate change reveals that the predominant portion, constituting 45.7%, is directed towards the sustainable utilization of natural resources. This is succeeded by economic development, which receives 6.8%, while social welfare and democratic governance each account for roughly 1%. The remaining categories primarily encompass financing from the EBRD and World Bank associated with the energy sector (refer to Table 5.14).

TABLE 5.14. DISTRIBUTION OF FOREIGN AID IN THE CONTEXT OF CLIMATE CHANGE BY THEMATIC GROUPS IN 2013-2039[337]

No.	Thematic group	Help	
		US Dollar	%
1	Social welfare	4,609,922	0.7
2	Economic development	45,927,473	6.8
3	Democratic governance	9,418,791	1.4
4	Sustainable use of natural resources	307,459,570	45.4
5	Other	309,244,576	45.7
Total		676,660,332	100.0

A major challenge lies in the creation of a comprehensive database encompassing climate change-related projects funded in Georgia. The eAIMS database contains a substantial number of foreign aid projects; however, it is limited to Official Development Assistance (ODA) funding and remains incomplete, as the submission of this data by donors is voluntary. Additionally, the database maintained by the Ministry of Environmental Protection and Agriculture may not fully account for projects financed independently by various organizations. Nevertheless, it is likely that such information is captured in the eAIMS by the donors. In these instances, it is crucial to prevent any instances of double counting. Furthermore, the data provided by the Ministry of Finance regarding foreign aid allocated for state projects across various sectors is also incomplete. To achieve a thorough collection of data, it is essential for relevant institutions to enhance their efforts in regularly engaging with representatives from the public sector (including ministries, local governments, and other public entities), donors, and the non-governmental sector, which necessitates additional resources and a suitable mandate.

5.2. SUPPORT NEEDED AND RECEIVED FOR TECHNOLOGY DEVELOPMENT AND TRANSFER

The implementation and integration of cutting-edge climate technologies represent a crucial element of climate change policy. Without these advancements, it is unfeasible to meet the country's obligations under the Paris Agreement (Nationally Determined Contribution) and to realize the objective of achieving climate neutrality by 2050, as outlined in the long-term low-emission development strategy. Both the 2030 Climate Change Strategy and Action Plan, as well as the LT-LEDS, emphasize the significance of innovative technologies. However, the country currently lacks adequate financial resources for their introduction and deployment. Consequently, Georgia will significantly depend on the technology transfer mechanisms established by the UN Framework Convention on Climate Change and will utilize biennial transparency reports to indicate the technologies that are required and have been implemented.

337 Databases of the Foreign Aid Information Management System.https://eaims.ge/InfoGraphics/

5.2.1. NEEDS AND PRIORITIES RELATED TO TECHNOLOGY DEVELOPMENT AND TRANSFER

Technologies are essential in the implementation of measures related to climate change, significantly influencing their effectiveness and, ultimately, the success in achieving established objectives. The advancement of technology is heavily reliant on the transfer of innovations from developed nations, as outlined in the Climate Change Convention and the Paris Agreement.

The modernization of existing technologies and the introduction of new innovations are vital for enhancing efforts against climate change and fulfilling the objectives of the Paris Agreement. Currently, Georgia's status regarding climate technologies does not align with the targets set forth in the country's nationally determined contributions, nor with the long-term aim of achieving climate neutrality by 2050.

Georgia's technological requirements are articulated in various climate policy documents, long-term strategic visions, and technology needs assessments, which are developed based on the country's commitments, research conducted through projects, and expert evaluations. The Nationally Determined Contribution of Georgia is notably ambitious, with target indicators expected to rise with each revision. As the impacts of global climate change become more pronounced, the demand for adaptation measures also escalates. Consequently, technological advancement represents a crucial opportunity to meet the increasing demands for both climate change adaptation and mitigation.

Georgia's Nationally Determined Contribution outlines an unconditional commitment to reduce greenhouse gas emissions by 35% by the year 2030, relative to 1990 levels. This target will be revised in the forthcoming updated Nationally Determined Contribution document, which will adhere to the principle of ambition, necessitating substantial technological advancements within the country. Given Georgia's unique developmental context, considerable progress in technology is essential across various sectors, including energy generation and transmission, agriculture, industry, transport, and construction. Furthermore, the agricultural sector's vulnerability to climate change and the heightened risk of natural disasters underscore the need for technologies that facilitate swift and effective adaptation to anticipated climate shifts.

The "Climate Change Strategy 2030 and the Action Plan 2024-2025" play a crucial role in identifying the requisite technologies, as they establish targets for greenhouse gas emission reductions. The mitigation strategies outlined for each sector within this document also emphasize the integration of suitable technologies. Due to its geographical and climatic characteristics, Georgia is particularly susceptible to the adverse effects of climate change. As such, adaptation is recognized as a national priority, a commitment reflected in the Nationally Determined Contribution and other strategic frameworks. However, the country has yet to formulate a comprehensive national adaptation plan for climate change.

A significant political document that outlines technological needs is the LT-LEDS, which delineates the development scenarios for the country and aims for climate neutrality by 2050. This concept provides a framework for strategies addressing climate change over the coming decades and identifies the period from 2030 to 2040 as critical for technological advancement, based on the current technological landscape. It specifies greenhouse gas reduction strategies for each sector, emphasizing the necessity of innovative technologies.

The evaluations presented in the document indicate that Georgia will be unable to meet its objectives without substantial transformations, which must occur within a constrained timeline. It is important to highlight that the adoption of technologies for both the pessimistic and optimistic scenarios outlined in the concept is essential for achieving climate neutrality across all sectors. Timely and effective technological upgrades are deemed vital for realizing the vision set forth in the "Long-term Low-Emission Development Concept."

- An essential document that comprehensively outlines the requirements for climate technologies—encompassing both mitigation and adaptation—over a designated timeframe, while considering the priorities established in existing climate action plans, is the "Climate Technology Needs Assessment" document. In 2023, the third iteration of the Climate Technology Needs Assessment and Action Plan[338] was developed, reflecting the initiatives undertaken since the release of the previous second document. This latest assessment addresses technological advancements and identifies new technological requirements for both mitigation and adaptation across various sectors. The document evaluates the country's climate change policies, objectives, and the current technological landscape, including both implemented and unimplemented measures during the reporting period. Based on the country's developmental objectives and the significance of various sectors in relation to climate change, energy (generation and transmission), buildings, transport, and agriculture were designated as priority sectors, with three key technologies identified for each. The criteria for prioritizing these technologies included their efficiency, economic viability for private sector engagement, potential for widespread adoption, alignment with national development priorities, and their capacity to reduce greenhouse gas emissions and enhance climate change adaptation.

5.2.1.1. Current status of strengthening local capabilities and technologies

The examination of technological advancements and regional competencies reveals that the prevalence of outdated technologies, coupled with insufficient local capabilities to adopt new technologies, poses significant challenges across all sectors. This technological lag results in diminished efficiency, reduced cost-effectiveness, and lower productivity levels. The successful integration of new technologies necessitates the involvement of stakeholders, including businesses, as well as a supportive regulatory framework that facilitates rather than obstructs the adoption and utilization of these innovations. Additionally, adequate technical support, encompassing services, spare parts availability, and skilled technical personnel, is essential. The absence of local capabilities represents a substantial obstacle to the adoption and execution of new technologies, which can be attributed to several factors.

- The legal regulatory framework, encompassing laws and regulations, is gradually being aligned with European standards;
- There exists a significant deficiency of suitably qualified technical staff, skilled

338 Georgia's Climate Technology Needs Assessment and Action Plan, 2023, 'Remission Center for Sustainable Development'

tradespeople, technical materials, and services;

- The training and certification system for technical personnel is not operating effectively;
- Several normative acts and standards require development.

A notable challenge is the disinterest of businesses in adopting and implementing new technologies. This reluctance can be attributed not only to the inadequacies of existing regulations but also to a lack of preliminary research and knowledge, which fosters a tendency to avoid the risks associated with innovation. Furthermore, financial constraints pose an additional obstacle for small and medium-sized enterprises.

Facilitating the adoption of technologies that lower entry barriers involves several key factors: the presence of political will to enact policies that support technological integration, the enhancement of regulations to streamline this process, the elimination of legislative obstacles, and the encouragement of businesses. Additionally, there is a need for increased research efforts, the expansion of knowledge and expertise, training and retraining of technical staff, and the establishment of certification programs. The creation of consulting centers and services, along with the provision of flexible financing options tailored to specific technologies by financial institutions, is also essential. Recent developments during the current reporting period indicate some progress in these areas:

Improving the legislative framework and developing policies

- Georgia is actively pursuing the commitments established under the Association Agreement with the European Union, which aims to align its regulations with EU standards. This alignment enhances the overall legislative and regulatory framework, particularly in relation to the facilitation of technology imports.
- To fulfill its obligations under the Paris Agreement, Georgia has adopted a long-term vision aimed at achieving climate neutrality by 2050, a goal that necessitates significant technological advancements.
- The execution of the 2030 Climate Change Strategy, along with its associated Action Plans for the periods 2021-2023 and 2024-2025, also includes measures for technological advancement.
- As outlined in the preliminary version of the National Integrated Energy and Climate Plan for Georgia (2021-2030), the country, as a member of the European Energy Community, commits to reducing greenhouse gas emissions and restructuring its energy sector, which entails technological upgrades.
- The Paris Agreement reiterates the responsibility of developed nations to transfer technology to developing countries, thereby supporting the achievement of the Convention's ultimate objectives. It also mandates that all countries consistently report on the technologies they have transferred, received, and require, as part of their biennial transparency reports.
- The recognition of climate change and the various climate technologies, along with their associated advantages, is on the rise, thereby enhancing the impetus for the adoption and application of these technologies.

- Climate considerations are increasingly being incorporated into development strategies across various sectors, including agriculture, energy, transportation, healthcare, waste management, and tourism.
- There is a growing volume of research, improved access to information, and strengthened connections between researchers and manufacturers.
- Financial institutions are enhancing their offerings, with banks launching eco-friendly products and loan options.

5.2.1.2. Needs for strengthening local capacities and technologies

Certain sectors, alongside the general categories, possess distinct technological requirements and face unique challenges. These requirements were analyzed and documented in the Climate Technology Needs Assessment Report published in 2023, which highlighted four priority sectors.

- Electricity generation and supply;
- Buildings;
- Transport;
- Agriculture.

These sectors have the potential to play a crucial role in mitigating greenhouse gas emissions within Georgia and in enhancing the resilience of those sectors that are particularly susceptible to the impacts of climate change. A multi-criteria analysis was employed to rank the sectors, which involved identifying essential criteria and assigning weights as determined by experts. Subsequently, four priority sectors were identified based on these established criteria. Within these selected sectors, twelve priority technologies—three for each sector—were also identified through the multi-criteria analysis. Project proposals for the most significant of these technologies have been developed for submission to the Green Climate Fund.

One of the key criteria for selecting priority technologies was the presence of both mitigation and adaptation capabilities. Among the technologies related to adaptation—whether specifically targeted or combined—climate-smart agricultural practices stand out, particularly conservation tillage techniques and the utilization of agricultural waste as fertilizer. In the building sector, technologies such as thermal insulation for building envelopes and highly efficient heating and cooling systems, including water and electric heat pumps, demonstrate significant potential for both mitigation and adaptation. Additionally, the multi-sector adaptation technology known as soil nailing for landslide protection (dalursmva) is noteworthy, as it aims to safeguard areas vulnerable to hazardous geological events, including landslides and mudslides.

The support required for the development and transfer of these technologies is summarized in Table 5.15. The information contained in the table is derived from the findings of the Technology Needs Assessment Report, as well as data collected from various national sources and interviews regarding technology requirements across different sectors. Technologies identified as priorities and those requiring local capacity building are indicated with (*).

Sector	Subsector	Name of activity, program, project	Program/Project Description	Type of assistance	Estimated use, impact and outcome assessment	Additional information
Energy	Generation	Combination of wind power plants and hydroelectric power plants (WIND+PHS) *	Combining wind and pumped storage power plants, ensuring equal energy generation throughout the day and night and throughout the year	Mitigation	Reducing GHG emissions; Equal generation of electricity; Increasing system sustainability; Promoting the development of gas-fired power plants; Reducing imports; Promoting the reduction of the share of thermal generation.	Project stages and barriers have been studied; actors and stakeholders have been identified
Energy	Generation	Combining solar photovoltaic power plants (PV) with energy storage batteries (ESB)*	Combining FES with EDB for balanced/flexible generation of electricity	Mitigation	Reducing GHG emissions; Equal generation of electricity; Increasing system resilience; Promoting the development of FES; Reducing imports; Promoting the reduction of the share of thermal generation.	Project stages and barriers have been studied; actors and stakeholders have been identified
Energy	Generation	Run-of-river hydroelectric power plants and green hydrogen *	The technology is a combination of tidal power plants and green hydrogen.	Mitigation	1. Decrease in greenhouse gas emissions; Generation of renewable energy by leveraging seasonal fluctuations; Encouragement of sustainable energy production; Minimization of imports; Advocacy for a decrease in the proportion of thermal energy generation.	Project stages and barriers have been studied; actors and stakeholders have been identified
Energy	Buildings	Thermal insulation of the building envelope *	The thermal insulation of the building envelope, which includes walls, roofs, doors, windows, and foundations, is essential. **Component 1** focuses on enhancing local capabilities to fully and effectively implement energy efficiency standards for buildings. **Component 2** aims to develop local resources to facilitate the successful functioning of Energy Service Companies (ESCOs) while reinforcing existing frameworks to guarantee their sustainable and long-term operation. **Component 3** involves the energy-efficient renovation of public buildings financed through a low-cost sovereign loan provided by the government.	Mitigation	GHG emission reduction from the subsector	
Transport, Energy	Road transport	Electric vehicles Implementation Expansion And Intensification *	Electric vehicles Implementation Expansion And Intensification This Disturbing Barriers I'm going to break it.	Mitigation	SG Emission Reduction From the sector	Project stages and barriers have been studied; actors and stakeholders have been identified
Transport, Energy	Road transport; fuel Burning	Biodiesel Production Increase *	Barriers Disruption Biodiesel Local-brief Production Growth Delay To eliminate	Mitigation	SG Emission Reduction From the sector	Project stages and barriers have been studied; actors and stakeholders have been identified

Sector	Subsector	Name of activity, program, project	Program/Project Description	Type of assistance	Estimated use, impact and outcome assessment	Additional information
Transport	Road transport	Georgia By Government Resolution No. 353 of July 4 , 2022 Hurt me - Bull Georgia 2022 – 2025 Road Safe - safe National Strategy And His 2022-2023 Action Plan Within	Inspection	Mitigation		
Energy	Generation	Hydropower plants , dams , solar power Photovoltaics	Build	Mitigation		Defined by sector development plans
Industry		N2O reduction And Monitoring Technology	N_2O reduction and monitoring technologies at the nitric acid production plant (Rustavi Azoti enterprise)	Mitigation		
Agriculture	Manure management	Manure management	Evaluation of manure management options and pilot measures by farm type	Mitigation		
Agriculture	JSC Soils	In Georgia Conservative By methods Soil Processing . Considers Several Pilot Meur - Neobi to create , as well as Color - for mayors Modern Approaches About Information Campaign And Daint - heretic Parties Opportunities Strengthening *	Soil Quality Improvement In the soil Water By maintaining And Organic Activity For growing grain (wheat , barley , corn) Soil Conservative By methods Processing By the way	adaptation Mitigation	Will decrease On the ground Negative Impact , slowing down And Eliminated Soil Erosive Processes will be reduced Agricultural Seats Processing Process Accompaniment Emissions And Air Pollution	
Agriculture Agriculture	Livestock - Oba	Highly productive Livestock Breeding Strengthening	Small number , but Highly productive With goods Staffed Pilot Farms , straight With food And By driving .	Mitigation		
Agriculture Agriculture	Agricultural Waste , manure Management	Agricultural Waste As fertilizer Use Technology .	JSC Waste And Manure Use Soil As fertilizer And For fuel Use	Mitigation adaptation		
Forestry Farming	Forest Management	Forest Maintenance and restoration Ghoni - the searchers Modeling Software Carefree Climate Change Influence Mitigation For the purpose *	Climate Scenarios Considering Forest Recovery Events Perfectly Planning	Mitigation		National Forestry Agency Development Strategy and Action Plan 2021-2026
Forestry Farming	Forest Management , biomass Use , update , etc. Energies	Biomass Effective Use - allow And Energy efficient Heating-cooling Systems	In the forest Pressure Reduction Alternative Sources And Energy efficient Technology Use With encouragement	Mixed		4th National Environmental Action Program
Aerological Observation Station Setup	Monitoring / Forecasting			adaptation		*KMF-funded GGP project "Expanding the Multilateral Hazard Early Warning System and Utilization of Climate-Related Information in Georgia"*
Plural Dangers Modeling And Maps Methodology	Monitoring / Forecasting			adaptation		

5.2.2. SUPPORT RECEIVED IN THE FIELD OF CLIMATE TECHNOLOGY

Numerous initiatives in Georgia facilitate the transfer and implementation of technologies within the country. These initiatives are carried out by local government entities or various organizations, often supported by international or bilateral financial and technical assistance. Such support is primarily aligned with national and sectoral policies and development programs, aimed at advancing Georgia's international obligations regarding climate change. This includes commitments under the United Nations Framework Convention on Climate Change, the Paris Agreement, the EU-Georgia Association Agreement, the European Energy Community, and other pertinent conventions and agreements. The financial aspect of this assistance is sourced from the Financial Mechanism of the Climate Convention, the European Union, and development agencies from allied nations.

5.2.2.1. Examples of successful and unsuccessful practices

Numerous technologies have been adopted in Georgia, demonstrating their effectiveness across different sectors. Details regarding these technologies, as supplied by the implementing organizations, are outlined in Table 5.16 below. The assessment of the technologies' success was conducted by the same organizations.

TABLE 5.16: EXAMPLES OF SUCCESSFUL PRACTICES - TECHNOLOGIES

##	Type of technology	Sector(s)	At what stage did the assistance occur (was it provided)?	From whom (country, donor)
1	Greenhouse farming	Agriculture	Demonstration, installation-placement	HEKS/EPER Switzerland
2	Preparation of river basin resilience zoning and hotspot maps across Georgia based on modeling of natural processes	Climate change, forest resources	Completed	Austrian Development Cooperation (ADC)
3	Solar-powered charging device	Climate change, renewable energies		EU
4	Battery chargers for hydro and meteorological stations	Climate change, water resources		EU
5	Linking the budget to climate change (budget tagging)	Climate change	Development and demonstration completed; rollout underway	Climate change
6	The establishment of policy dialogue platforms that facilitate collaboration among the public, private, civil, and scientific sectors to promote legislative and institutional reforms in the management of sustainable natural resources.	Forestry, Rural Development, Tourism, Energy, Disaster Management (DRM)	Completed	Austria
7	Creation of databases, information systems and technological mechanisms	River basin management, DRM, forestry		Austria
8	Development and implementation of non-formal education programs/systems	Environmental education, rural development		Austria

##	Type of technology	Sector(s)	At what stage did the assistance occur (was it provided)?	From whom (country, donor)
9	1. Various renewable (RE) and energy-efficient (EE) measures were implemented in 2 kindergartens of Telavi Municipality (Telavi #1 & Ikalto), where the following RE and EE technologies were introduced: 2. Complete rehabilitation and insulation of the building's roofs with 20 cm. of glass wool; thermal insulation of the external walls and foundation with 10 cm. of rock wool and 8 cm. of XPS. 3. Low-emissivity double-glazed metal-plastic doors and windows. 4. Individual/decentralized (airflow-ventilation wall recuperators) in Ikalto Kindergarten, and central ventilation systems in Telavi Kindergarten #1 5. Autonomous heating system powered by solid fuel (vine grate): • Technical storage for the boiler (boiler house); • Biomass boiler (116&174 kW), including control system; • Biomass (vine tops) bunker; • Fuel supply system (screw); • Chimney; • Two-circuit heating system, radiators, including heat meter. 6. Solar water heating systems connected to an autonomous heating system; 7. Grid-connected solar photovoltaic systems with a total installed capacity of 5.45 kW (Ikalto) and 6.875 kW (Telavi#1). 8. Biomass (Tsalami) Supply Chain Scheme • Biomass (stubble) storage facility; • 2 tractors with trailers, • Biomass (stubble) round baler and shredder equipment	Energy efficiency, renewable energies Energy efficiency, renewable energies	from start to end from start to end	EU EU
10	A modern autonomous central heating system powered by local agricultural waste (nut shells); Solar water heating system (230 liters) for hot water; Grid-connected (1300W) photovoltaic system (PV) for electricity generation; Thermal insulation of the building's attic (full thermal insulation: 10 cm glass wool) and external wall (partial: 5 cm EXP);	Energy efficiency, renewable energies	from start to end	BP EXPLORATION (Caspian Sea) Ltd. Georgia
11	Grid-connected (5.52 kW) photovoltaic system (PV) for electricity generation and a screen for continuous monitoring of solar modules; Two units of solar water heaters (150 lt) and (800 lt)			Swedish International Development Cooperation Agency (Sida)

The data presented in the table indicates that a significant proportion of successful technologies is attributed to renewable energy technologies, along with efforts in awareness-raising and information management. Additionally, there is a clear prevalence of small-scale technologies, with the European Union and Austria being the leading contributors among donors. It is important to note that the implementing organizations did not provide information regarding unsuccessful technologies.

Nevertheless, instances of failure in certain implemented technologies have been observed, often resulting from:

- insufficient preliminary research and planning,
- Inadequate technical expertise and support,
- Deficiencies in the monitoring system, and
- a lack of accountability for acceptance and maintenance.

5.2.2.2. The importance of assistance for technology development and transfer, local capabilities and know-how

Technology transfer in Georgia, along with the establishment of local capacities and the integration of know-how, faces significant challenges at this stage without external support. Typically, such support encompasses both financial and technical elements. An examination of the assistance provided indicates that these components may only be partially involved (through co-financing or limited technical support). In many instances, financial aid is essential, while technical assistance may be absent altogether. This situation primarily pertains to smaller technologies that do not qualify as innovations. Conversely, entirely new and large-scale technologies invariably necessitate both technical and financial support.

The development of local capacities and the acquisition of know-how are often critical for technology transfer, particularly when dealing with new technologies that are unfamiliar within the country. However, even in cases where the technology is not innovative but rather an enhancement of an existing one, support for capacity development remains vital. Georgia faces a significant shortfall in training, knowledge, qualifications, and the number of technical personnel required for the implementation of new technologies. The findings from the 3rd Technology Needs Assessment Report of Georgia reveal that there are notable gaps in capacity for all essential technologies that must be addressed. The Georgia Technology Needs Assessment Project offers comprehensive tables outlining the barriers associated with each technology evaluated.

It is crucial for both technology transfer and the development of associated capacities to be systematic and ongoing to ensure the successful completion of the process and its long-term sustainability. In this context, monitoring the process and maintaining a continuous exchange of information are of paramount importance.

5.2.2.3. Stages of the technology cycle at which assistance was provided, including research and development, demonstration, deployment, dissemination and transfer

The examination of the gathered information indicates that the predominant portion of the technology transfer process is concentrated in the research and development phase, during which the viability of proceeding with the process is evaluated. The subsequent phases are represented to a significantly lesser extent in this assistance. In terms of duration, the research and development stage is the most time-consuming. The advancement of technologies, particularly their dissemination, appears to be the most challenging aspect. This scenario clearly illustrates the existing capacity deficiencies within the country and underscores the necessity of incorporating a capacity-building element into the transfer and implementation of each technology. This finding aligns completely with the insights provided in the Climate Technology Needs Assessment Report, which highlights that all the new technologies examined suffer from a lack of technical expertise and qualified personnel.

5.3 STRENGTHENING THE COUNTRY'S CAPACITY TO COMBAT CLIMATE CHANGE

5.3.1. EXISTING NEEDS AND PRIORITIES FOR CAPACITY BUILDING

The nation is actively engaged in enhancing its capabilities and understanding regarding climate change; however, significant gaps remain in terms of needs and opportunities that require both external support and domestic initiatives.

The priorities for capacity building and the associated needs are shaped by the country's climate change policy framework, which encompasses its international obligations and national climate change strategies, as well as the requirements identified through various projects.

The Nationally Determined Contribution document highlights the limited capacity for adaptation as a primary challenge confronting the nation. In response, the document outlines specific adaptation objectives that are focused entirely on bolstering this capacity.

These objectives include:

1. Enhance national capabilities for formulating adaptation strategies;
2. Bolster the ability of policymakers to devise plans for adaptation;
3. Improve the capacity of communities to mitigate their susceptibility to the negative effects of impending climate-related hazards;
4. Augment the capacity of national health systems to address long-term health risks associated with climate change.

The forthcoming climate change legislation will also focus on capacity building, mandating the Government of Georgia to: (a) enhance the adaptive capacity and resilience of the nation and its systems, and (b) mitigate vulnerability to climate-related hazards, in alignment with the Paris Agreement.[339]

339 Georgia's Climate Change Law. White Paper for Public Consultationshttps://web-api.parliament.ge/storage/files/shares/Komitetebi/garemo/White-Paper-WDF-geo.pdf?fbclid=IwAR0MHGbWgUasQmIoxllesGiaSODUPAuQ6r-qnTN_kPLjBzaNZ93vt6Qwof8

In the realm of capacity development, it is essential to enhance institutional capabilities that support data analysis and consultation processes addressing the effects of climate change, including both acute and gradual events. This enhancement aims to mitigate or eradicate the damages inflicted by climate change. Generally, the presence of weak institutions, particularly at the local and municipal levels, represents a significant obstacle to building climate change capacity. Addressing climate change necessitates sustained and ongoing efforts. Consequently, it is vital to bolster capacities and competencies at both national and local/municipal levels to enable more ambitious climate initiatives.

The Climate Change Law outlines the government's intention to create a Just Transition Fund, primarily aimed at supporting local communities, individuals, municipalities, and business sectors in their shift towards a zero-carbon economy. This support will focus on capacity building, which includes training, education, and retraining opportunities.

In the realm of climate change, enhancing technical skills and institutional capacity in transitioning economies is essential for effectively addressing the causes and impacts of climate change, as well as for facilitating a broader green transformation. Skills deficiencies represent a significant barrier to the advancement of various sectors, such as agriculture, renewable energy, energy and resource efficiency, construction, environmental services, and manufacturing. The urgency for green transformation and the development of green skills is explicitly emphasized in the "Vocational Education Strategy 2021-2025." Additionally, the necessity for a green growth strategy is underscored in the "Action Plan of the Georgian Small and Medium Business Development Strategy 2021-2025." Various other strategies, conceptual documents, and legislative frameworks also focus on skills development pertinent to the green agenda. A notable trend is emerging in the increasing demand for both new and existing professions that require green skills. The legislative and political framework established in the country over the last decade has fostered a need for new "green" professions, such as environmental managers and energy auditors.

The key sectors that require capacity enhancement include:

5.3.1.1 Agriculture

The decrease of greenhouse gas emissions within the agricultural sector is significantly associated with the enhancement of current capabilities in this field. In this context, it is important to highlight the creation of a methodology for designing feed rations and implementing a recommendation initiative aimed at mitigating emissions from enteric fermentation in cattle. The objective is to examine the effects of various animal feeding rations in Georgia on enteric fermentation and to establish an optimal methodology for ration formulation that will minimize greenhouse gas emissions resulting from this process.

To promote awareness and bolster capacities, it is essential to set up demonstration plots in various regions. These plots will serve to introduce practices that optimize manure utilization, decrease N2O emissions, and integrate cover crops and green manures into crop rotation systems.

To promote the adoption of climate-smart agricultural practices, it is essential to provide farmers with climate services through extension[340] programs and awareness initiatives, supplemented by targeted information dissemination across various platforms. This initiative is envisioned as a climate-oriented service delivery system that will equip farmers with vital information regarding natural hazards, disease outbreaks, and irrigation management via a specialized mobile application developed by the Rural Development Agency. Furthermore, the application should feature automatically updated bulletins on a weekly, monthly, and seasonal basis, along with both short-term and long-term weather forecasts.

Georgia intends to evaluate and enhance adaptation strategies for the cultivation of agricultural crops that significantly contribute to the GDP, such as grapes, nuts, and tangerines, as well as for the production of the country's unique products, including Georgian honey and non-timber forest products. This evaluation will involve analyzing potential changes in climate parameters and the spread of diseases to ensure the conservation of species and the security of food supplies.

In the agricultural sector, the "Agriculture and Rural Development Strategy 2021–2027" is particularly significant, highlighting the necessity of enhancing the qualifications of agricultural professionals and educating farmers and rural entrepreneurs. The strategy identifies a shortage of agricultural specialists and qualified experts, underscoring the critical role of higher education, vocational training, and non-formal education in building capacity.

5.3.1.2 Forest Management Sector

A critical requirement within the forest management sector pertains to the adoption and implementation of software designed for modeling forest maintenance and restoration efforts aimed at alleviating the effects of climate change. Enhancing the sector's capacity to effectively plan forest restoration initiatives, while considering various climate scenarios, is essential.

Additionally, there is a pressing need to develop and incorporate the primary modules of the monitoring and information system to enhance the oversight of forest activities, including utilization, maintenance, and restoration, as outlined in the forest management plans. This integration will contribute to more effective forest management planning.

To bolster the planning of fire prevention strategies, the nation intends to carry out fire risk assessments in forested regions and formulate forest fire management plans at the district level. Initiatives are also in progress to establish a comprehensive forest fire management and early warning system.

In light of these considerations, it is vital to gather and enhance relevant technologies while promoting local knowledge transfer.

5.3.1.3 Industry sector

In the industrial sector, there are significant areas where the country requires support

340 Agricultural extension represents a non-formal educational approach aimed at equipping farmers with pertinent guidance and information. This initiative seeks to enhance their production levels, increase output, improve competitiveness, and elevate their overall quality of life.

for capacity building. Notably, the advancement of nitric acid production with reduced greenhouse gas emissions is of particular importance. Since 2020, Georgia has partnered with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of Germany to participate in an initiative focused on providing nitric acid manufacturing companies within the member states with technology designed to mitigate nitrogen oxide emissions that contribute to climate change. It is anticipated that Rustavi Azoti LLC, a producer of nitric acid, will receive state-of-the-art technology aimed at decreasing N_2O emissions during their production processes. Additionally, a project is currently in progress to enhance the measurement of greenhouse gases within the electricity transmission and distribution sector. This year, a refined methodology for estimating greenhouse gas emissions resulting from the use of SF_6 as an insulating gas in electrical applications is being developed.

Furthermore, it is crucial for the country to cultivate expertise in biomass and biogas technologies, as well as in green hydrogen and storage solutions for system and market analysis. This includes the need for specialists in green hydrogen modeling who are proficient in DIGSILENT and PLEXOS software, as well as experts experienced in the planning, construction, and equipping of green hydrogen production facilities.

5.3.1.4 Renewable energies and energy efficiency

To enhance energy efficiency, it is crucial to establish a program aimed at bolstering the enforcement of minimum energy performance standards and the certification of buildings. This involves augmenting both the human resources and the physical infrastructure of state permitting and supervisory authorities.

A notable challenge lies in providing consumers with more comprehensive information when they purchase household appliances, thereby increasing their awareness and promoting a higher market share of energy-efficient products. This initiative entails a systematic and substantial expansion of the range of appliances, equipment, products, and devices that require labeling. To facilitate this, it is essential to translate and adopt pertinent European and international standards for assessing the energy efficiency of selected household appliances. The implementation of a comprehensive set of energy labeling regulations should be complemented by an informative campaign regarding energy labeling.

In terms of capacity building within the sector, it is vital to create programs aimed at enhancing the skills and competencies of energy audit engineers. This will ensure that relevant professionals receive the necessary retraining and certification to effectively contribute to the energy sector.

It remains pertinent to implement initiatives aimed at enhancing public awareness regarding energy efficiency across the nation. This includes information campaigns focused on the Incandescent light bulbs, which aim to achieve a 100% adoption rate of energy-efficient lighting in new residential and commercial buildings by 2026. Additionally, it is crucial to promote consumer awareness of solar water heating systems nationwide.

There is a need to bolster the capacity for the effective utilization of biomass and the adoption of energy-efficient heating systems by promoting alternative energy sources and technologies. This approach will significantly alleviate the pressure on forest resources.

In this context, the country requires experts in solid fuel and biomass heating systems, with an emphasis on enhancing engineering expertise in this technology. It is essential to establish a supportive policy and legislative framework that facilitates the use of agricultural waste as an energy resource and the implementation of associated technologies. Furthermore, there is a demand for builders skilled in the installation of thermal insulation materials, energy-efficient doors and windows, and solar photovoltaic water heating systems.

From an energy standpoint, it is crucial to implement battery energy storage systems (BESS) and to enhance expertise in this domain within the country. In this context, it is vital to develop specialists in BESS modeling, particularly those proficient in DIGSILENT and PLEXOS software, for comprehensive system and market analysis.

Energy, being a high-tech sector of strategic significance, necessitates a robust framework of research, analytical capabilities, and information support, along with appropriately qualified personnel. To facilitate informed strategic decisions, it is essential to monitor, consider, and integrate global and regional energy trends, political-economic factors, and technological advancements. Consequently, the energy sector should be prioritized within the realms of science and education. Innovative approaches and mechanisms must be established to engage research and educational institutions in addressing energy challenges. Furthermore, a legislative and institutional framework that fosters innovation and scientific inquiry should be created. The development of export capabilities and professional expertise within the energy sector is imperative, alongside enhancing collaboration between research institutions, educational entities, and energy sector organizations.

The requisite competencies in the energy sector encompass the ability to analyze renewable and fossil energy resources and their potential, devise optimal utilization strategies, and improve climate and meteorological forecasting, as well as hydrological regime predictions. Additionally, there is a need for research and implementation of new clean and alternative technologies, including hydrogen energy.

5.3.1.5 Waste management

Enhancing waste management capabilities is an essential prerequisite for nearly all programs and initiatives that are either in the planning stages or currently in progress. In this context, projects concerning municipal waste landfills nationwide are particularly significant, as they encompass various measures, including the advancement of landfill leachate treatment systems and the establishment of materials recovery facilities, along with the implementation of gas collection and recycling systems.

At the community level, it is essential to implement effective awareness-raising initiatives to encourage municipalities to commence waste separation at the source and attain higher recycling rates.

A significant opportunity for enhancing capabilities within the sector arises from empowering both the community and public institutions engaged in waste management, as well as increasing awareness among various stakeholders, including kindergartens, schools, and universities.

Furthermore, capacity building is linked to the establishment of a cohesive process for the collection and regular updating of data pertaining to the waste sector. This encompasses the development of a comprehensive electronic database for waste management and the formulation of reporting guidelines.

5.3.2 SUPPORT RECEIVED AND COUNTRY'S EFFORTS TO STRENGTHEN CAPABILITIES

Georgia has made notable advancements in its ability to fulfill its obligations under both international and national climate change policy frameworks when compared to the previous reporting period. This progress is evidenced by a substantial rise in the number of measures aimed at climate change mitigation and adaptation. The enhancement of capacity has been achieved through a combination of domestic resources and technical assistance projects facilitated by international cooperation.

Nearly all technology transfer initiatives or specific projects executed within the country incorporate capacity building as an essential element. This approach enables the nation to gain the requisite experience and skills necessary for the effective utilization of the technologies received. The process encompasses raising awareness, implementing targeted educational and training programs, disseminating information on best practices, and providing training on the opportunities and mechanisms for technology transfer or the establishment of best practices.

It is important to highlight that the enhancement of local potential, along with knowledge and awareness regarding climate change, is a fundamental aspect incorporated into nearly all ongoing projects or programs in the country related to climate change, irrespective of the specific sector in which a program is executed.

Regarding capacity building, the initiatives undertaken by the LEPL Environmental Information and Education Information Centre of the Ministry of Environmental Protection and Agriculture are particularly significant. This institution serves as a key public entity in the realm of environmental education and capacity development. The Center engages with a diverse array of target groups, including institutional units within ministries, as well as representatives from the private sector and local municipalities, to promote environmental education and capacity building.

During the reporting period, numerous medium and large-scale projects were executed in the country with the assistance of foreign grants. The primary donor organizations include the Green Climate Fund (GCF), the European Union (EU), the United States Agency for International Development (USAID), the German Corporation for International Cooperation (GIZ), along with the governments of Austria, Germany, the Netherlands, Norway, Sweden, Switzerland, and the Czech Republic. The principal organizations responsible for implementing these projects are the United Nations Development Programme (UNDP), the Ministry of Environmental Protection and Agriculture, the Regional Environmental Center for the Caucasus, the Energy Efficiency Center, Georgia's Environmental Outlook (GEO), and the company "Geonakhazi," among others. These initiatives also afford Georgia the opportunity to engage in knowledge and experience sharing with other countries, which is crucial for the adoption of specific technologies and the enhancement of related capabilities. Such projects encompass activities focused on the exchange of information and experiences, enabling Georgian experts to participate in regional or global capacity-building workshops and to acquire insights into new mitigation and adaptation technologies. These endeavors are vital for fostering expertise within the country.

Regarding capacity development, it is essential to highlight the following key areas:

5.3.2.1 Disaster Risk Management

Disaster risk management, particularly in relation to climate change, has emerged as a key area of advancement in capacity development within the country. A notable initiative in this context is the project titled “Expanding the Early Warning System for Multilateral Hazards and Utilization of Climate-Related Information in Georgia,” which is spearheaded by the UNDP in collaboration with the Environmental Information and Education Centre and the Emergency Management Service. The primary objective of this project is to mitigate the effects of climate-induced natural hazards on the population, livelihoods, and infrastructure of Georgia by establishing a nationally operational, multilateral early warning system and promoting risk-informed actions at the local level. A critical aspect of the project involves capacity building and education, which includes the introduction of modern methodologies for hazard assessment, the development of emergency management plans in selected municipalities, and the implementation of community risk management plans and early warning systems. Additionally, the project encompasses the creation of manuals and educational resources on various hazards tailored for teachers, municipal authorities, media representatives, and groups such as women and youth. Enhancing the capacity and awareness of municipal authorities, local NGOs, community organizations, and residents in community-based disaster risk management and adaptation constitutes a significant focus of the initiative.

The Emergency Management Service has experienced a substantial enhancement in its capabilities, largely due to the retraining of its personnel. This has notably fortified the agency’s proficiency in managing the risks associated with forest fires. The National Environmental Agency consistently conducts research to analyze the outcomes and predict the progression of natural geological processes. This research serves as the foundation for developing pertinent recommendations and strategies aimed at significantly mitigating the adverse effects resulting from geological activities.

The standardization and harmonization of the national multi-dimensional hazard mapping and risk assessment methodology are crucial for enhancing risk management capabilities. This initiative aims to develop a cohesive risk information system with a well-defined structure at the national level, facilitated by the establishment of an institutional and legislative framework. Furthermore, it has enabled the execution of on-site assessments regarding risks and economic losses associated with natural hazards.

5.3.2.2 Forestry sector

The initiatives and programs executed within the forestry sector have facilitated the enhancement of both technical and human resources in the country, particularly regarding forest inventory and statistical inventory methodologies. Additionally, there has been a notable improvement in the capabilities related to the utilization of modern tools and equipment necessary for inventory processes. A forest monitoring and information system has been established and put into operation, which is expected to significantly enhance the incorporation of climate change adaptation strategies into the planning and management frameworks of the forestry sector.

Furthermore, capacity-building initiatives can be viewed as efforts to bolster the resilience of local communities involved in forest management and to foster the development of skills for utilizing renewable energy sources within the sector.

5.3.2.3. Use of alternative energies and energy efficiency

The nation has undertaken considerable initiatives to promote alternative energy sources and enhance energy efficiency, utilizing both international aid and domestic resources. These efforts have been closely linked to capacity building. A notable emphasis has been placed on increasing awareness, particularly regarding the “Covenant of Mayors” policy and sustainable energy investment initiatives, which aim to facilitate the replication of such projects in other municipalities across Georgia, especially among the signatories of the “Covenant of Mayors.” The activities have focused on fostering the development of green economy opportunities at the local level, which are associated with improved income and employment prospects, thereby contributing to enhanced energy security in the regions and the decarbonization of local economies. Additionally, it is important to highlight the strengthening of municipal capacities to execute sustainable energy investment projects, as well as the support provided to local governments in enhancing energy security, decreasing reliance on imported fossil fuels, and lowering greenhouse gas emissions.

At the local level, there was a vigorous promotion of the production and utilization of renewable energy, leveraging locally sourced biomass and cutting-edge technologies. In this regard, the initiative titled “Biomass Energy and Energy Efficiency Technologies as Sustainable Energy Solutions for Cities Signatory to the Covenant of Mayors” stands out, as it aimed to enhance local capabilities in this field.

The evaluation of the potential for establishing a renewable energy supply chain and its implementation in selected municipalities of Georgia contributed to the enhancement of renewable energy utilization capacities.

In recent times, initiatives and projects focused on alternative energy sources and energy efficiency have significantly bolstered both capacity and awareness. For instance, the promotion of energy efficiency measures and the adoption of renewable energy sources were facilitated through the execution of comprehensive pilot investment projects in municipal buildings across Georgia.

In rural areas, there was substantial support for households to improve their access to solar photovoltaic technologies, which inherently involved strengthening the capabilities of the beneficiary households.

5.3.3. RECORDING CAPACITY NEEDS IN A TABULAR FORMAT

Capacity building and development serve as a fundamental theme and are recognized as essential elements in all projects addressing the financial assistance requirements associated with climate change. As indicated in column 10 of Table 5.4, there is a marked emphasis on “Contribution to capacity building objectives,” denoted by a “1.” It is virtually unfeasible to disentangle the assistance provided from the perspective of capacity building. Furthermore, it is exceedingly challenging to pinpoint the financial aspects specifically linked to capacity.

5.3.3.1. Improved Transparency Framework - Support Received and Needed

In line with the Paris Agreement, the country made efforts and achieved progress during the reporting period in terms of establishing transparency, which was reflected in the following key results:

- The nation has notably enhanced the vertical alignment between the planned and executed local climate change initiatives and national objectives. Consequently, the synergies between national and local climate policy measures have been improved. A Municipal Development Coordination Platform (MDCP) has been established as a component of the Enhanced Transparency Framework (ETF). Relevant technical assistance, capacity-building efforts, and awareness-raising initiatives have been implemented, which include the creation of software tools for municipalities that are signatories to the Global Covenant of Mayors for Climate & Energy[341] Sustainable Energy and Climate Action Plans (SECAP), as well as Measurement, Reporting, and Verification (MRV) reports. Both line ministries and municipalities are actively utilizing the online climate change data management system.
- The national greenhouse gas inventory system has undergone substantial enhancements, notably through the creation of country-specific emission factors for major sources. Additionally, the tools and capabilities for the collection of greenhouse gas inventory data, as well as for quality assurance and quality control (QA/QC) management, have been refined across various sectors, including energy, agriculture, industry, and waste.
- Furthermore, a national tracking system has been established to monitor the execution of nationally determined contributions. This system has particularly empowered key stakeholders within the country to effectively track and evaluate their progress towards achieving nationally determined contribution targets, as well as to accurately and transparently report on the implementation of mitigation strategies, facilitated by a data management system for transferred technologies.

341 https://www.globalcovenantofmayors.org/gcom-charter-v2/

5.4 GENDER MAINSTREAMING IN CLIMATE CHANGE ISSUES, SUPPORT RECEIVED AND NEEDS

5.4.1 GENDER MAINSTREAMING AND SUPPORT RECEIVED IN THIS REGARD

1. Integrating gender considerations into climate policy and practice presents significant challenges, with the lack of a centralized agency or data system for accessing cohesive and comprehensive information on gender mainstreaming in climate-related initiatives being a particularly pressing issue. Although an individual has been informally designated as responsible for gender matters within the Ministry, this arrangement is inadequate, as the position lacks official recognition, defined responsibilities, and remains intertwined with other primary functions.

This chapter endeavors to analyze, to the extent feasible, the integration of gender considerations in activities supported by assistance in the realm of climate policy. The existing body of research is limited, reflecting the aforementioned challenges, and relies on data gathered from a variety of local and international organizations.

The chapter aligns with the key elements of the Lima Gender Action Plan established in 2014 and encompasses the following sections: capacity development, knowledge management and communication; participation and women's leadership; coherence; gender-sensitive implementation processes and means of implementation; as well as monitoring and reporting. It outlines the principal activities undertaken during the reporting period across each of these areas.

5.4.1.1 Capacity building, knowledge management and communication

A public opinion survey conducted in 2023,[342] indicates that the majority of respondents (28%) believe that enhancing public awareness is the most effective strategy for mitigating the adverse effects of climate change. Nevertheless, the same survey reveals that the general population's understanding of climate and environmentally friendly initiatives, programs, projects, and policies in Georgia remains significantly low. In terms of knowledge improvement, some advancements have been noted in specific areas compared to the previous survey round. Notably, awareness of the National Notification Scheme on Climate Change has risen (2023: urban - 16%; rural - 13%; 2022: urban - 6%; rural - 6%). Additionally, there has been a relative increase in the proportion of individuals familiar with the early warning system (2023: urban - 15%; rural - 17%; 2022: urban - 4%; rural - 5%).

The ongoing initiative titled "Expanding the Multi-Hazard Early Warning System and the Use of Climate Information in Georgia" aims to enhance knowledge and awareness regarding climate issues. This project is financially supported by the Green Climate Fund (GCF) and is co-financed by the Georgian government. It seeks to establish an early warning system for various hazards and to integrate climate information into planning and decision-making across all sectors, thereby fostering risk reduction, prevention, and preparedness. A key aspect of this initiative is to elevate public understanding of environmental and climate-related matters. This aspect actively promotes gender mainstreaming and is guided by a

342 Georgia-wide public opinion survey on knowledge, perceptions, attitudes, behavior and preferred policies on environmental and climate issues, 2023. WFD, ISSA, UKaid.

gender action plan. The monitoring report associated with this plan indicates that gender considerations were integrated into the project's awareness-raising efforts. Specifically, training modules addressing gender and vulnerable populations in the context of natural disasters were developed and incorporated into various training sessions and seminars for diverse stakeholders, including local media, green camps, discussions, teacher training, and community forums. According to program data, women constituted 68% of the participants in these awareness-raising activities.

The same study indicates that a significant portion of respondents hold largely accurate views and understandings regarding the factors that contribute to and impede climate change. Notably, only 13% of the population perceives climate change as an unrealistic phenomenon or myth. However, the study fails to explore the relationship between climate change and gender equality, making it challenging to assess the level of knowledge and awareness among the population concerning this connection. Nevertheless, the responses to the statement, "Women are more vulnerable to the risks caused by climate change than men," offer an indirect insight into societal perceptions. Specifically, 27% of respondents concurred with this assertion, while 39% expressed disagreement.

CENN is engaged in various initiatives aimed at enhancing women's capacities regarding climate-related matters. These initiatives are part of the Georgia Climate Action Project (GEO CAP)[343], which receives funding from the European Union. Programs across multiple regions of Georgia facilitate the incorporation of women's concerns into both mitigation and adaptation strategies, collaborating with women and youth groups to empower them through the development of knowledge and skills. Furthermore, CENN is executing the "Climate Resilient Agriculture" program in Marneuli Municipality, specifically targeting women and youth.

Additionally, with financial backing from the UK Government, the Westminster Foundation for Democracy (WFD) has undertaken a study titled "Assessing the Impact of Climate Change on Women in Georgia" as part of the ongoing program "Promoting Environmental Protection, Climate Change Resilience and Democratic Sustainability in Georgia." This study serves as a vital resource for knowledge management and policy formulation concerning these issues.

To summarize, in terms of capacity development, knowledge management, and communication on gender and climate issues:

- Information retrieval, processing, and analysis present significant challenges due to the fragmented and unstructured nature of information at the project and activity levels across various organizations;
- The majority of the activities conducted are on a small scale and fail to reach a substantial portion of the population;
- Furthermore, the knowledge management process lacks organization, as there are no established framework documents within the Ministry of Environmental Protection and Agriculture, nor is there a designated individual with the requisite expertise and defined responsibilities to oversee knowledge management related to these matters within the Ministry and other relevant agencies.

343 https://www.cenn.org/georgia-climate-action-project-geo-cap-promoting-civil-society-engagement-in-climate-change-policy-design-and-implementation/

5.4.1.2 Participation and women's leadership

The extent of women's involvement in decision-making processes and their leadership skills serves as an indicator of their vulnerability within society. This involvement is also linked to the overall resilience of women in managing various crises, including those associated with climate-related disasters.

As of September 2023, the Parliament of Georgia comprises 27 women, representing 19.3% of its members. In the local government elections of 2021, women accounted for 31.4% (441) of those elected through the proportional list and 7.6% (50) under the majoritarian system. Consequently, women's representation in municipal councils has risen to 24%. However, political parties often lack well-defined and effectively implemented gender policies, which impedes the recruitment, engagement, and advancement of female candidates. Female politicians frequently encounter challenges in gaining visibility, facing various forms of criticism related to their age, appearance, and personal lives. To significantly enhance women's political participation, it is essential to reform democratic processes within political parties.

The 2022 Parliamentary Report from the Public Defender (Ombudsman) of Georgia indicates that the number of female professional civil servants at the executive level is relatively high, although this varies across different agencies. For instance, 42% of female professional civil servants hold decision-making roles within the Civil Office of the Ministry of Defense of Georgia. Conversely, as of December 2022, only 7% of managerial positions in the Ministry of Internal Affairs are occupied by women, with men making up the remaining 93%. In the Ministry of Environmental Protection and Agriculture, one of the two deputy ministers is a woman, and four out of thirteen departments are led by women.[344]

A study carried out by the Public Defender's (Ombudsman) Office in 2022 revealed that women's participation in municipal meetings and decision-making processes, such as budget development, is markedly insufficient. This low level of involvement can be attributed to various factors, including a lack of awareness, distrust in the process, domestic responsibilities, limited access to transportation, and prevailing stereotypes. Furthermore, individuals from vulnerable groups encounter even more significant obstacles, particularly women with disabilities, members of ethnic and religious minorities, the elderly, displaced women, and others.[345]

5.4.1.3. Consistency

The Lima Action Plan outlines a strategic approach that necessitates the establishment and execution of mechanisms aimed at systematizing gender mainstreaming within climate policy planning and execution. This approach is intended to ensure that there are cohesive strategies for integrating gender considerations into climate policy at the national level. It is crucial to note, however, that this aspect currently poses the greatest challenge to the effective integration of gender in climate policy. This challenge arises from two primary factors: firstly, the existing changes and initiatives aimed at promoting gender mainstreaming in climate policy are considerably constrained; and secondly, the initiatives and changes that have been implemented during the reporting period are

344 Source: Official website of the Ministry of Environmental Protection and Agriculture of Georgia.

345 Assessment of Gender Equality Policies of Municipalities, Public Defender of Georgia, 2022

isolated efforts that do not embody a comprehensive strategy.

A significant advancement in this area is the establishment of commitments regarding gender and climate change within the revised Nationally Determined Contribution document. This marks a foundational step towards the systematic integration of gender considerations in the climate sector. The document underscores the importance of women's participation in decision-making processes and addresses health issues stemming from climate change and associated activities and programs. Additionally, it highlights the necessity for gender mainstreaming in energy and water efficiency initiatives. Furthermore, the document stresses the importance of gathering sex-disaggregated data and incorporating it into national accounts related to climate change.

Another key document is the National Low-Emission Development Strategy of Georgia 2050 (LT-LEDS), which was adopted in 2023. This strategy also incorporates a gender mainstreaming component and seeks to integrate gender considerations throughout its implementation process in various ways.

- Ensuring that women have equal access to economic opportunities and societal participation within the framework of low-emission development is essential;
- It is important to include women in the planning, monitoring, and revision processes related to low-emission development initiatives;
- Women should be actively engaged in evaluating technological requirements and the implementation of related processes, particularly through the establishment of a supportive environment and the enhancement of their capacities;
- The expertise and skills of women must be effectively utilized across all economic, environmental, and climate change sectors, as well as in mitigation strategies. Furthermore, women should be equally represented in all sectors, reflecting their experiences and preferences.

An additional significant document introduced during the reporting period, which is expected to play a crucial role in the organization of climate policy, particularly in relation to gender mainstreaming, is the "White Paper"[346] developed for the formulation of the Climate Change Law. This document was created in 2023 with the assistance of the Environment and Natural Resources Committee, the Westminster Foundation for Democracy, and the United Kingdom. The "White Paper" outlines the fundamental principles that should be incorporated into the Georgian Climate Change Law. It is essential to highlight that the proposed legislation will undergo a regulatory impact assessment, along with a gender and socio-economic evaluation. Among various topics, the "White Paper" addresses gender justice and incorporates its principles. The document acknowledges that gender disparities can exacerbate the impacts of climate change, affecting different genders in distinct manners. Therefore, achieving gender justice within climate change legislation necessitates the integration of principles and practices that tackle gender inequalities and promote substantial progress toward gender equality in climate policy and legislation through capacity building, gender mainstreaming, and adherence to international commitments. More specifically, the White Paper advocates for the following measures to ensure gender justice.

346 https://eiec.gov.ge/Ge/News/Details/5170

- The government is tasked with establishing a practice of gender analysis that includes the collection, analysis, and reporting of gender-disaggregated data every five years;
- A gender perspective must be integrated into climate change policies, specifically focusing on the needs, priorities, and challenges faced by women, girls, men, boys, and their respective groups in relation to climate change;
- It is essential to ensure the meaningful involvement of both genders in climate change policies, which entails considering diverse viewpoints, empowering marginalized communities, and creating avenues for women to engage and take leadership roles in climate-related initiatives. The Climate Change Law mandates the appointment of at least one gender expert to the Independent Expert Advisory Body.

In conclusion, the majority of the modifications to climate legislation and policy during the reporting period are recent, making it challenging to evaluate their effectiveness at this time. However, it is anticipated that these changes will yield positive results in the future, provided they are implemented successfully.

5.4.1.4 Gender-sensitive implementation process and means of implementation

This section focuses on the strategies and mechanisms that facilitate the planning and execution of gender-sensitive climate policies within the country. During the reporting period, two significant modifications were introduced, aimed at enhancing the process of gender mainstreaming in climate policy.

Beginning in 2023, an amendment was made to the electronic budget management system, mandating that agencies identify policies and programs through markers (classifiers) that encompass both gender and climate elements. As this change is relatively recent, it is challenging to evaluate the effectiveness of this mechanism at this time; however, the decision itself represents a considerable advancement. This system will also aid in recognizing gender and climate initiatives being implemented across the country, thereby streamlining the information collection process for future reports.

The second notable advancement in this area is the UNDP program titled "Expanding the Multi-Hazard Early Warning System and Utilization of Climate Information in Georgia." Within this framework, a gender-sensitive socio-economic vulnerability assessment methodology has been developed and is currently being applied to identify 100 vulnerable villages. This methodology incorporates indicators that are crucial for integrating gender considerations into the vulnerability assessment process.

5.4.1.5. Monitoring and reporting

Gender mainstreaming within the climate policy is a relatively recent endeavor, and currently, there are only a limited number of strategic documents that incorporate this approach. However, initiatives aimed at actual implementation remain scarce.

The chapters of this report mark a pioneering effort to document gender mainstreaming in climate policy, representing progress in this area. Furthermore, the modifications made to the electronic budget management system in 2023 are expected to enhance the monitoring of gender and climate aspects within state programs. Nevertheless, it is important to emphasize that this change will not suffice unless relevant indicators are integrated into the programs, which is not occurring at this time. An analysis of the document titled "Information on Expected Results and Indicators of Programs Defined by the 2023 State Budget of Georgia"[347] revealed that even in programs where gender mainstreaming is identified as a priority, appropriate indicators for subsequent monitoring and evaluation are lacking.

347 Appendix to the 2023 Program Budget

ANNEXES

ANNEX 1: *SELECTED CLIMATE INDICES*

#	Symbol	Index description	Unit
1	**TMm**	Average T M. The average of the average daily temperatures over a month or year.	0 C
2	**TXm**	Medium TX . The average of the maximum daily temperatures over a month or year	0 C
3	**TNN**	Minimum T N. The lowest of the daily minimum temperatures during a month or year (absolute minimum temperature)	0 C
4	**TXx**	Maximum TX. The greatest of the maximum daily temperatures during a month or year (absolute maximum temperature)	0 C
5	**TXn**	Minimum TX. The lowest of the maximum daily temperatures during a month or year	0 C
6	**TNN**	Minimum T N. The lowest of the daily minimum temperatures during a month or year (absolute minimum temperature)	0 C
7	**TNx**	Maximum T N. The greatest of the daily minimum temperatures during a month or year	0 C
8	**TX90p**	Hot days. Percentage of days with TX > 90th percentile	%
9	**TN90p**	Warm nights. Percentage of days when T N > 90th percentile	%
10	**TX10p**	Cold days. Percentage of days with TX < 10th percentile	%
11	**TN10p**	Cold nights. Percentage of days when T N < 10th percentile	%
12	**TMge10**	TM is greater than or equal to 10 0 C. Over the course of a month or year Number of days with average temperature ≥10°C.	Days
13	**TMlt10**	TM less than 10 0 C. The number of days during a month or year when the average temperature is <10 0 C.	Days
14	**FD**	Frosty nights. Number of days during a month or year when TN < 0 0 C. Days when minimum temperature <0 0 C	Days
15	**ID**	Frost days. Number of days during a month or year when TX <0 0 C. Days when maximum temperature <0 0 C	Days

#	Symbol	Index description	Unit
16	**TR**	Tropical nights. Number of days during a month or year when TN >20 0 C. Days when minimum temperature >20 0 C	Days
17	**SU**	Summer days. Number of days during a month or year when TX >25 (30) 0 C. Days when maximum temperature >25 (30) 0 C	Days
18	**GSL**	Number of days between the first occurrence of TM > 5 0 C for 6 consecutive days and the first occurrence of TM < 5 0 C for 6 consecutive days	Days
19	**WSDI**	Indicator of the duration of the warm period. The number of days per year when TX >90th percentile for at least 6 consecutive days	Days
20	**CSDI**	Cold period duration indicator. Number of days per year when T N <1 0th percentile for at least 6 consecutive days	Days
21	**GDDgrown**	Active Temperature Sum. The annual sum of the positive values (TM > n) of the daily (TM - n) difference, where n is the base temperature characteristic of the user-defined location. n = 10 0 C.	Degree-day
22	**HDDheatn**	Heating degree days. The annual sum of the positive values (n > TM) of the daily (n - TM) difference, where n is the base temperature characteristic of the user-defined location. n = 18 0 C	Degree-day
23	**CDDcoldn**	Cooling degree days. The annual sum of the positive values (TM > n) of the daily (TM - n) difference, where n is the base temperature for the user-defined location. n = 18 0 C	Degree-day
24	**HWN (EHF)**	Number of heat waves. The number of individual heat waves in the summer (May-September) as determined by the Excess Heat Factor (EHF). A heat wave is defined as 3 or more days with a positive EHF.	Events
25	**HWD (EHF)**	Heat wave duration. The duration of the longest heat wave, as determined by the excess heat factor (EHF), in days.	Days
26	**CWN (ECF)**	Number of cold waves. Number of individual cold waves determined by the Excess Cold Factor (ECF)	Events
27	**CWD (ECF)**	Duration of a cold wave. The duration of the longest cold wave in days, as determined by the excess cold factor (**ECF).**	Days
28	**nTXx**	Maximum daily maximum temperature (with 5, 2, 1% security) TX year, possible once in n (20-, 50-, 100) years	0 C
29	**nTNn**	Maximum value of daily minimum temperature (with 5, 2, 1% security) TN per year, possible n (20-, 50-, 100) times a year	0 C
30	**PRCP(TOT)**	Total precipitation from rainy days. The sum of daily precipitations during a month or year when the daily precipitation PR ≥ 0.1 mm.	mm
31	**R95p**	Annual total precipitation from heavy precipitation days. Annual total precipitation when daily precipitation >95th percentile. Precipitation amount from days with heavy precipitation.	mm
32	**R99p**	Annual total precipitation from extremely heavy precipitation days. Annual total precipitation when daily precipitation >99th percentile	mm
33	**R95pTOT**	Contribution of heavy precipitation days. Share (in percent) of precipitation from heavy precipitation days (R95p) in total annual precipitation	%
34	**R99pTOT**	Contribution of extremely heavy precipitation days. The share (in percent) of precipitation from extremely heavy precipitation days (R99p) in the annual total precipitation.	%
35	**Rx1day**	1-day maximum precipitation. The maximum amount of precipitation that has fallen in a single day during a month or year.	mm

#	Symbol	Index description	Unit
36	**Rx5day**	5-day precipitation maximum. The maximum amount of precipitation that falls on 5 consecutive days during a month or year.	mm
37	**R10mm**	Number of days with heavy precipitation. Number of days during a month or year when PR ≥10 mm.	Days
38	**R30mm**	Number of days with heavy precipitation. Number of days during a month or year when PR ≥30 mm.	Days
39	**R50mm**	Number of days with heavy precipitation. Number of days during a month or year when PR ≥50 mm	Days
40	**nRx1day**	1-day maximum of precipitation (5, 2, 1% certainty), possible once in n (20-, 50-, 100) years	mm
41	**nRx5day**	5-day maximum precipitation (5, 2, 1% certainty), possible n (20-, 50-, 100) times a year	mm
42	**CWD**	Consecutively rainy days. Maximum duration of the wet season. Maximum number of consecutive days during the year when the daily precipitation amount PR ≥1 mm.	Days
43	**CDD**	Consecutively dry days. The maximum number of consecutive days during a month or year when the daily precipitation PR <1 mm.	Days
44	**RH**	Average RH. The average relative humidity of the air over a month or year.	%
45	**RH80**	Humid days. The number of days during a month or year when the afternoon relative humidity is ≥80%.	Days
46	**RH30**	Dry days. The number of days during a month or year when the minimum daily relative humidity is ≤30%.	Days
47	**WS**	Average WS. Average wind speed over a month or year	m/s
48	**Wg**	Maximum Wg. The maximum wind speed during a month or year.	m/s
49	**Wg15**	Number of days with strong winds. Number of days during a month or year when the maximum wind speed is ≥15 m/s	Days

ANNEX 2. *ABOUT EMISSION SCENARIOS*

Following the completion of Georgia's Fourth National Communication, the Intergovernmental Panel on Climate Change (IPCC)[348] released its Sixth Assessment Report (AR6)[349] which presents new insights into the ongoing and potential alterations within the climate system, supported by over 14,000 scientific studies.

This report encapsulates the latest developments in climate science, drawing from various fields and their integrated applications, including in situ and remote sensing observations, paleoclimate data, enhanced comprehension of the factors driving changes in the climate system, as well as the physical, chemical, and biological processes involved and their interactions.

It also incorporates global and regional climate modeling, advancements in analytical techniques, and the expanding domain of climate services.

The AR6 report builds upon the conclusions of the IPCC's Fifth Assessment Report (AR5)[350]

348 https://www.ipcc.ch/
349 https://www.ipcc.ch/report/ar6/wg1/
350 https://www.ipcc.ch/report/ar5/wg1/

2013, published in 2013, along with the Special Reports released in 2018 and 2019.

The report assesses the present climate situation within a long-term framework, taking into account human impacts, potential future climate scenarios, evaluation of climate-related risks, and pertinent information for regional adaptation strategies aimed at mitigating human-induced climate change.

Coupled Model Intercomparison Project (CMIP6)[351]

The outcomes of the integrated global models involved in the CMIP6 initiative were examined. The CMIP project is overseen by the World Climate Research Programme)[352] and coordinated by the IPCC Working Group 1 (WG1), which is tasked with providing the scientific foundation for the assessment reports. The findings from the Phase 6 models of this initiative were incorporated into AR6, similar to how the CMIP5 models were included in AR5. A primary focus of the enhancements made to the models participating in CMIP6 is to more accurately represent climatic, biological, and chemical processes at higher resolutions, along with large-scale indicators of climate change.

Discrepancies persist between recent simulations and observational data, particularly regarding regional precipitation patterns. In historical simulations, the ensemble mean surface temperature derived from CMIP6 models is recorded as 0.2°C higher than the observed figures. While there is a high level of confidence in the ensemble results, it is noteworthy that certain member models exhibit significant deviations from the mean.

The primary objective of the Coupled Model Intercomparison Project (CMIP) is to enhance the understanding of global climate changes—both past and future—attributable to natural variability and radiative forcing. This endeavor entails evaluating model performance during historical periods and identifying uncertainties that influence future projections, thereby establishing the error range within ensemble forecasts. To facilitate these objectives and to provide a consistent framework for climate projections, a standardized set of experiments known as DECK (Diagnostics, Assessment, and Characterization of Climate) and CMIP historical simulations covering the years 1850 to 2014 have been implemented. These initiatives aim to ensure continuity with earlier CMIP phases while documenting and elucidating the key and evolving characteristics of the models. The World Climate Research Program Infrastructure Panel oversees the development and sets data standards for CMIP. A key aspect of this activity is the dissemination of data through the Earth System Network Federation. [353](Earth System Grid Federation - ESGF; Williams et al., 2016; Petrie et al., 2021).

Reanalysis employing data assimilation techniques merges observational data with models, such as numerical weather prediction models, to yield a continuous and coherent spatial-temporal distribution of various variables. Since the release of the Fifth Assessment Report (AR5), new reanalyses have emerged for both the atmosphere and ocean, featuring diverse combinations of enhanced resolution, extended records, more consistent data assimilation practices, and improved availability of uncertainty estimates. Regional reanalysis utilizes high-resolution, localized models that are informed by regional observations and the boundary conditions derived from global reanalysis. It is highly probable that regional

351 https://www.wcrp-climate.org/wgcm-cmip
352 https://www.wcrp-climate.org/
353 https://esgf.llnl.gov/

reanalysis data will more accurately represent regional precipitation frequency and variability, surface air temperature, and wind patterns.

Certain models from the Coupled Model Intercomparison Project Phase 6 (CMIP6) exhibit advancements in cloud coverage. In contrast, models from CMIP5 typically indicate a negative shortwave radiative forcing of clouds, which was notably weak in the current climate. These inaccuracies have been mitigated, particularly due to a more accurate representation of supercooled liquid droplets over the southern oceans, both in terms of quantity and the corresponding increase in cloud optical depth. In CMIP6 models, the extratropical cloud shortwave feedback is less negative, resulting in improved alignment with observational data (medium confidence). Furthermore, CMIP6 models generally encompass a broader range of processes that influence aerosol-cloud interactions compared to earlier climate model generations, although there remains only medium confidence that this mechanism comprehensively captures the process.

Emissions Scenarios

This report designates five illustrative scenarios as SSPx-y, where 'SSPx' denotes the shared socio-economic scenario, which outlines the socio-economic trends associated with each scenario, and 'y' indicates the projected level of radiative forcing (measured in watts per square meter, or W m–2) anticipated by the year 2100.

In preparation for the IPCC AR6, a new array of emissions scenarios was created, based on varying socio-economic assumptions, known as the 'shared socio-economic scenarios' (SSPs). Several of these SSP scenarios were chosen for inclusion in CMIP6 as projections for future climate conditions. Specifically, a selection of scenarios was made to represent a diverse range of climate change outcomes by the century's end. The IPCC AR5 utilized four representative concentration pathways (RCPs) to investigate different potential future greenhouse gas emissions. These pathways—RCP2.6, RCP4.5, RCP6.0, and RCP8.5—have been updated in CMIP6 to SSP1-2.6, SSP2-4.5, SSP4-6.0, and SSP5-8.5, each corresponding to the same radiative forcing levels by 2100 as their AR5 counterparts.

The average and extent of the multi-model ensemble biases in ocean surface temperature remained consistent between CMIP5 and CMIP6 (with medium confidence). Since the AR5 report, the correlation between observed data and simulations of upper ocean heat content (up to 700 m) has shown improvement.

Models in CMIP6 effectively simulate the sensitivity of Arctic sea ice to human-induced $CO2$ emissions, and the projected trends in Arctic sea ice melt over time align closely with satellite observations (high confidence). The capability to model ice melt processes has significantly advanced since the AR5 report.

One of the key objectives of the CMIP6 scenarios is to enhance the examination of the "no climate policy" condition within potential baseline scenarios. The earlier set of climate models introduced in CMIP5 featured only a single extremely high baseline scenario (RCP8.5) and a limited mitigation scenario that influenced the baseline results (RCP6.0). The RCP8.5 scenario came to be recognized as the sole "no climate policy" baseline scenario, often referred to as "business as usual," despite its projection of the most severe outcomes among the "no climate policy" scenarios.

SSP4-3.4 represents a novel scenario designed to investigate the range of temperature increases between those that typically restrict warming to 2°C (RCP2.6 / SSP1-2.6) and those that approach 3°C (RCP4.5 / SSP2-4.5) by the year 2100. This scenario will enable researchers to more effectively evaluate the consequences of warming in cases where society implements rapid emission reductions but does not sufficiently mitigate to keep warming within the 2°C threshold.

SSP5-3.4OS is classified as an overshoot scenario (OS), wherein emissions adhere to the most severe SSP5-8.5 trajectory until 2040, followed by a dramatic decline that necessitates negative emissions by the century's end.

Lastly, SSP1-1.9 is a scenario focused on restricting warming to 1.5°C above pre-industrial levels by 2100. This scenario was introduced subsequent to the Paris Agreement, during which nations committed to ongoing efforts to cap the temperature rise at 1.5°C. Energy and simple climate models developed to achieve this target were instrumental in the IPCC's Special Report on 1.5°C, published in 2018. The new CMIP6 scenarios will now facilitate comprehensive climate models in analyzing climate change and the effects associated with approximately 1.5°C of warming.

While both the SSP and RCP scenarios indicate similar climate forcing by the century's conclusion, the contributions from CO2 and non-CO2 emissions within these scenarios differ.

These discrepancies arise from several factors. The new SSP scenarios commence in 2014, whereas the previous RCPs begin in 2007. The low-end SSP1-2.6 scenario demonstrates a more gradual decrease in emissions compared to RCP2.6 and starts from a higher baseline, reflecting the elevated emissions observed from 2007 to 2014, which were considerably greater than those projected in the original RCP2.6 scenario. To address the higher starting point and slower reduction, it incorporates significantly more negative emissions in the latter part of the century.

SSP2-4.5 exhibits a higher initial level and a more gradual decrease compared to RCP4.5, influenced in part by the more significant reductions in non-CO2 emissions associated with SSP2-4.5. In contrast, SSP4-6.0 diverges notably from RCP6.0, as CO2 emissions reach their peak and begin to decline post-2050, rather than in 2080. Lastly, SSP5-8.5 demonstrates considerably elevated CO2 emissions relative to RCP8.5, accompanied by a proportionately greater decrease in non-CO2 emissions.

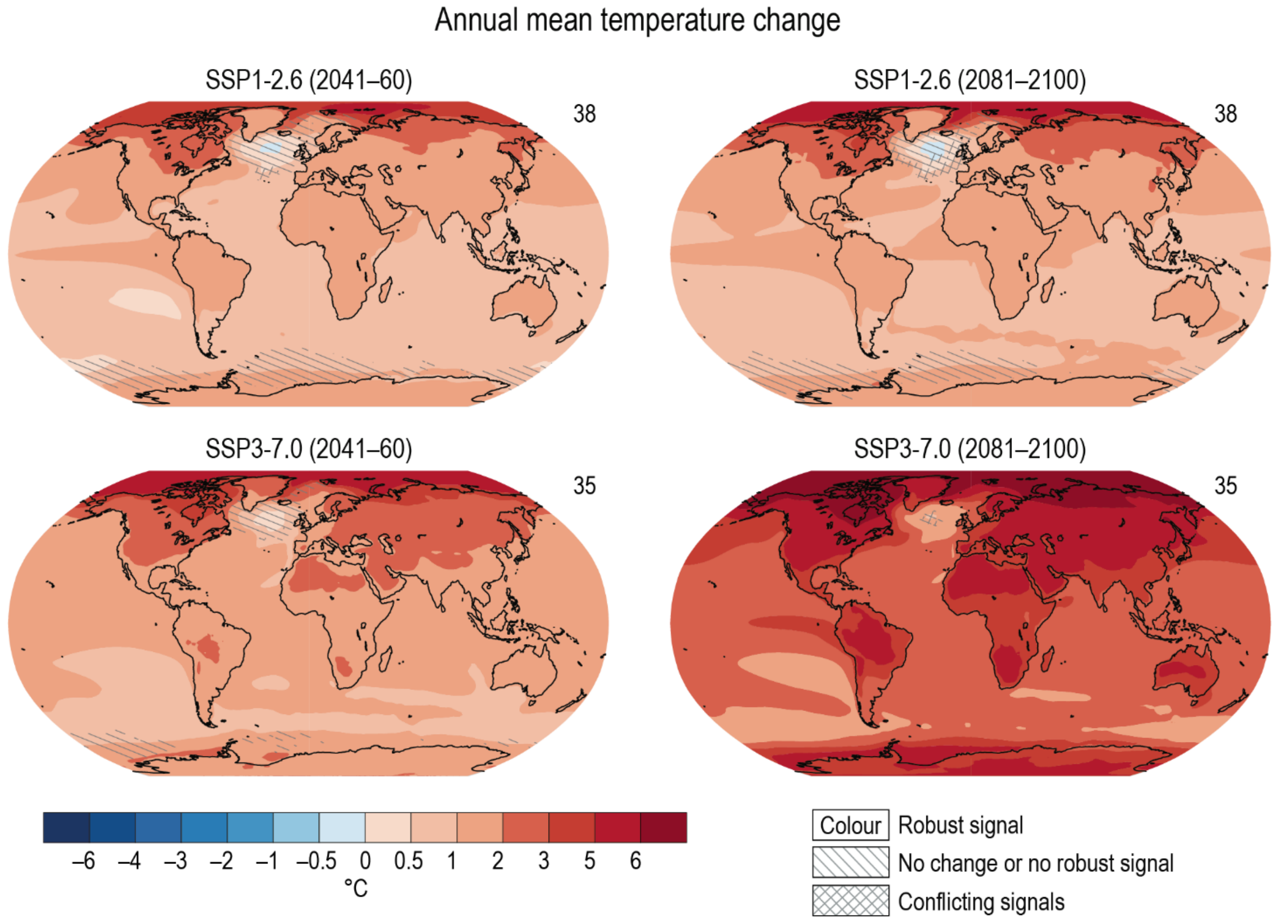
Global Outcomes

The climate projections for the future, as outlined in Angrish, are derived from the results of multi-model ensembles. While individual models are employed to evaluate new theories and conduct experiments, the overall results are achieved by integrating the estimates from these models along with their respective weighting coefficients. The findings from this analysis are detailed below at both global and regional levels.

Surface Air Temperature

The observed trends in surface air temperature indicate a marked increase in warming during the periods of 2041–2060 and 2081–2100 when compared to the baseline period of 1995–2014, across all Shared Socioeconomic Pathways (SSP) scenarios. The extent of the area experiencing warming expands in correlation with the degree of global average temperature rise. As the Global Surface Air Temperature (GSAT) continues to rise, it is highly probable that the majority of land and ocean regions worldwide will experience higher temperatures in the mid- to late 21st century than those recorded during the period of 1995-2014, with a high level of trust.

FIGURE 1. CHANGES IN THE AVERAGE AND LONG-TERM MEAN SURFACE AIR TEMPERATURE (°C) FOR THE PERIODS 2041–2060 AND 2081–2100, RELATIVE TO THE BASELINE PERIOD OF 1995–2014, UNDER THE SSP1-2.6 AND SSP3-7.0 SCENARIOS OF THE MULTI-MODEL ENSEMBLE. THE UPPER RIGHT CORNER OF THE MAPS INDICATES THE NUMBER OF MODELS UTILIZED.

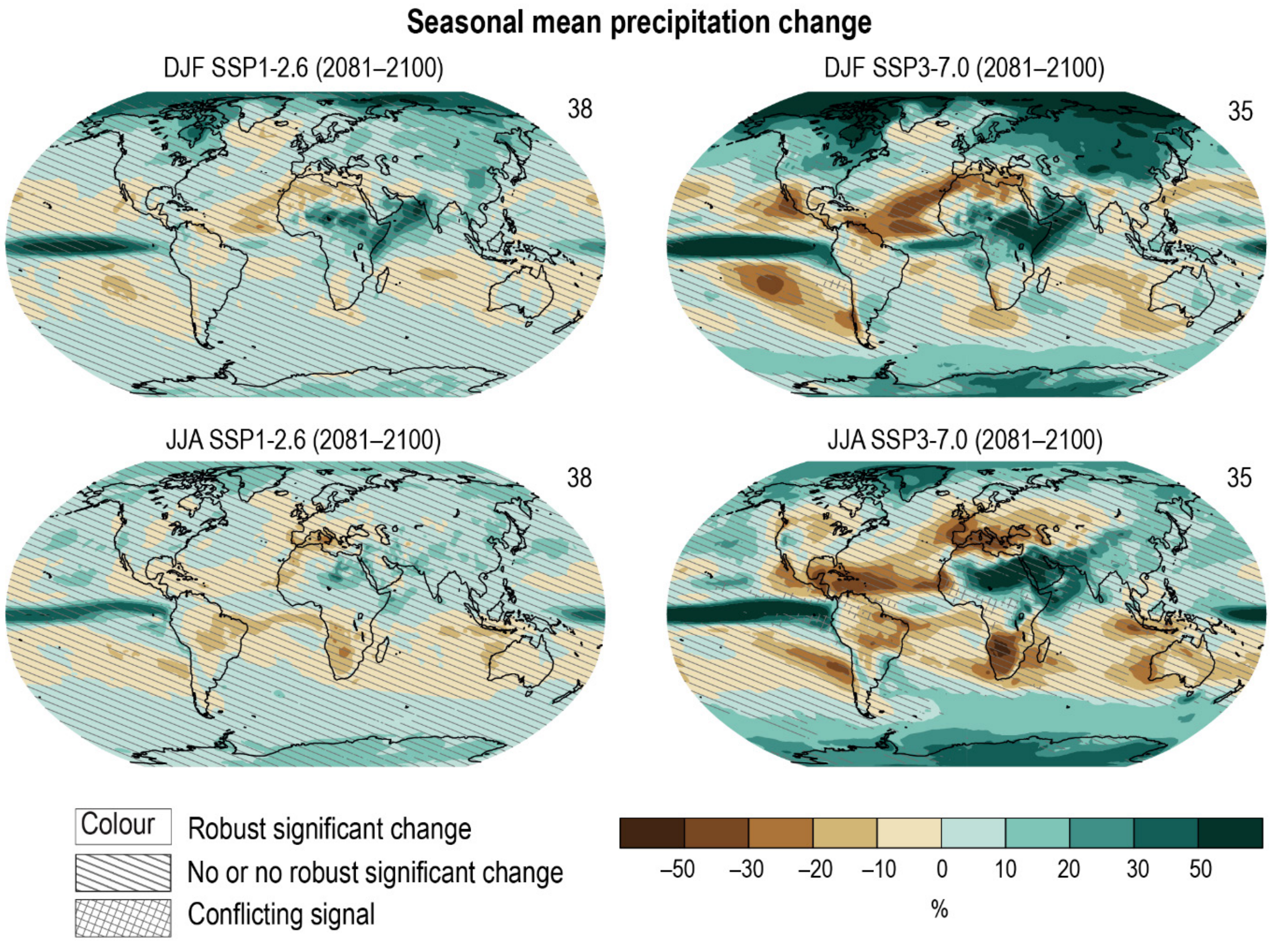


Precipitation

The AR5 report projected that changes in average precipitation resulting from global warming will exhibit considerable spatial variability. Furthermore, the disparity in average precipitation between arid and humid regions, as well as between dry and wet seasons, is anticipated to intensify across much of the globe as temperatures rise. The overarching trend suggests that regions at high latitudes will likely experience increased precipitation due to heightened specific humidity in the warmer troposphere, along with augmented transport of water vapor from tropical areas by the end of this century under the RCP8.5 scenario. Conversely, many arid and semi-arid regions in the mid-latitudes and subtropics are expected to see a reduction in precipitation, while numerous humid mid-latitude areas are projected to receive increased precipitation by the century's end under the same scenario.

Additionally, the report associates the thermodynamic response to global warming with a "wet to wetter" mechanism, where enhanced moisture fluxes lead to drier conditions in subtropical regions and increased humidity in tropical and mid-latitude wet areas. Recent studies indicate that this mechanism may not apply to subtropical land, revealing inconsistencies among models in this context. Moreover, alongside the weakening of circulation patterns in Arctic regions, a shift from wet to dry and from dry to more humid conditions is anticipated.

FIGURE 2. LONG-TERM CHANGE IN AVERAGE SEASONAL PRECIPITATION.



Extreme events

Climate models are capable of accurately reproducing the intensity and frequency of extreme precipitation events on a global scale and in most regions, as demonstrated by the simulations from the Coupled Model Intercomparison Project Phase 6 (CMIP6), which are comparable to those from the CMIP5 models (high confidence). An increase in horizontal model resolution enhances the spatial accuracy of certain extreme events, such as heavy precipitation, especially in areas with diverse topographical features (high confidence). Since the release of the AR5 report, the ability to describe and predict extreme weather and climate phenomena has improved markedly, as our understanding of these events has advanced. Climate models effectively capture trends in extreme temperature changes, although the magnitude of these trends may differ (high confidence). Furthermore, models can adequately represent the large-scale spatial distribution of extreme precipitation over land (high confidence). There is no significant difference between the CMIP5 and CMIP6 models regarding the simulation of extreme precipitation intensity and frequency (high confidence). The intensity and frequency of extreme heat events are projected to rise, alongside an increase in the frequency of extreme cold events, both globally and across continents, affecting all inhabited regions. This trend will persist even if global warming is stabilized at 1.5°C. In comparison to the current conditions, extreme events are expected to double with a 2°C increase and quadruple with a 3°C increase relative to 1.5°C warming. The occurrence of hot days and nights, as well as the duration, frequency, and/or intensity of warm spells or heat waves, will rise across most land areas (virtually certain).

Regional results

Multiple methodologies were employed in the 6th Assessment Report to translate global findings into regional contexts. A significant contribution came from CORDEX data, with some results also featured in the 5th Assessment Report.[354] The CORDEX initiative utilized the complete CMIP5 global and regional climate model framework, which downscaled global models to 14 pre-defined regions, thereby encompassing the entire planet. At the project's request, historical and future periods, scales, variables, and results were established and made accessible through the Earth System Grid Federation (ESGF) and the Copernicus Climate Change Service (C3S)[355] ensuring open access. In the AR6, these regional outcomes were thoroughly compiled and analyzed, acknowledging that enhancements in the global models involved in the project could not be directly mirrored in the regional results, as simulations were conducted solely with CMIP5 models. Furthermore, the available datasets for each region exhibited inconsistencies. Two strategies were implemented to evaluate climate change at the regional level: the grand ensemble and the mosaic ensemble.

In the grand ensemble method, all potential simulations for a specific grid within each region are aggregated. Consequently, the number of ensemble members varies across different spatial points. However, a notable limitation of this approach is that the regional change signal is more influenced by the combination of models included in the ensemble (GCM–RCM pair) rather than by the inherent trends within the region itself.

The "mosaic ensemble" is formed by systematically layering the results derived from various regions based on specific calculation periods, with particular emphasis on regions where these periods intersect. In the AR6 report, the findings from both methodologies are aligned with the observed stable trends within the regions.

Georgia's territory coincides with three calculation periods of CORDEX, which has led to its classification within the West Central Asia region (WCA) in the mosaic ensemble.

According to 30 CMIP6 models, the projected increase in average annual temperature for the region is expected to range from 1.6°C to 5.4°C relative to the average for the period 1981–2010, based on the SSP1-2.6 and SSP5-8.5 scenarios.

The anticipated changes in annual precipitation totals for the period 2070–2099, compared to 1981–2010, are estimated to be between –3% and 29% under the SSP1-2.6 scenario, and between 12% and 107% under the SSP5-8.5 scenario (medium confidence). While a general decline in total precipitation is expected in the region, significant spatial and temporal variations are projected, with an increase in winter precipitation and a decrease in summer precipitation (medium confidence).

354 https://cordex.org/
355 https://climate.copernicus.eu/

Despite the detailed climate projections provided in this report, there are inherent limitations in the information presented, necessitating further refinement and specificity to effectively assess climate pressures and to plan adaptation strategies in Georgia.

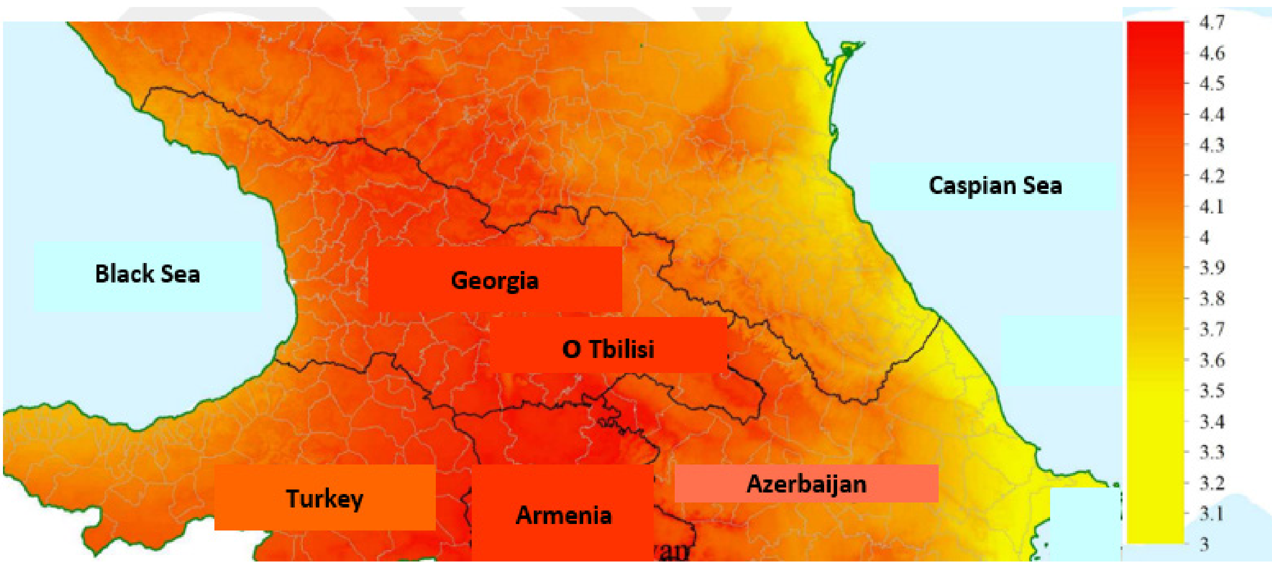
Download and prepare CMIP6 and CORDEX model results to create a high-resolution scenario for Georgia

To enhance the high-resolution climate scenario for Georgia, a comprehensive inventory of the outcomes from the primary models featured in the AR6 report, which serve as updated climate projections, was undertaken. These results were accessible through open databases and encompassed the territory of Georgia.

The findings from the paired global models involved in the CMIP6 project are relatively innovative; however, the resolution of these models remains coarse and fails to account for several characteristics of the regional climate. Currently, the refinement of CMIP6 models through regional models is not available, although statistical regionalization is accessible via the web platform at https://www.worldclim.org/data. This platform contains results for four out of the fourteen CMIP6 models, standardized to the same scale and calibrated against identical historical data from the period of 1970 to 2000.

Due to the substantial volume of data, only one scenario, SSP2-4.5, was selected for download, as it closely aligns with the previously discussed RCP4.5 scenario and encompasses all regional data available within the CORDEX project utilized in this study. The historical data from 1970-2000, along with future projections for the periods 2041-2060 and 2081-2100, were downloaded, focusing on the average monthly values for the sum of average, maximum, and minimum temperatures, as well as precipitation. These periods were predetermined by the data provider and are not subject to modification. The results from all model calculations were averaged to form an ensemble, and monthly increments for all four parameters were derived. The temperature and precipitation increments for the specified future periods were prepared for each selected point on a monthly basis. Figure 3 illustrates the variation in maximum summer temperatures for the period 2041-2060.

FIGURE 3. CHANGE IN MAXIMUM SUMMER TEMPERATURES FOR THE PERIOD 2041-2060.



This approach is limited to estimating monthly trends in temperature and precipitation, and it is unable to assess extreme indices or other specialized parameters that necessitate daily time series data.

Data were obtained from the CORDEX project for this purpose, utilizing the complete range of CMIP5 global and regional climate models. This approach enhanced the dynamic resolution of the global models through downscaling to 14 pre-defined regions, thereby encompassing the entire Earth. In accordance with the project's requirements, previously established historical and future calculation periods, along with the relevant scale, variables, and results, were uploaded and made accessible via the Earth System Grid Federation (ESGF) and the Copernicus Climate Change Service (C3S)[356] for public access. The territory of Georgia is entirely encompassed by two calculation areas within the project: Central Asia (CAS - region 8) and the Middle East North Africa (MENA - region 13).

In this context, an ensemble was created using three simulations derived from two CORDEX calculation regions. The scenario under consideration is rcp4.5, with the global and regional models being CMCC-ESM2, CCSM4, ALARO-0, and RegCMv4. The global model and scenario employed in the formulation of the Fourth National Communication were regarded as the most probable representation for that timeframe. However, recent evaluations suggest that this outcome is associated with a comparatively modest warming trend regarding temperature variations.

Monthly data for the parameters were derived from daily gridded datasets. These data were categorized into three distinct periods: the historical period from 1971 to 2000 was utilized for calibration, while two future scenarios were established by averaging two 30-year periods. To assess growth, the average of the historical period is deducted from the averaged future values.

Changes in average air temperature and total precipitation were analyzed for the two future 30-year periods (2041-2071 and 2071-2100) in relation to the average values from 1971 to 2000.

Climate parameters are accessible at any point during the calculations; however, these gridded datasets have also been converted to point values corresponding to climate stations. This conversion allows for the establishment of a statistical correlation between long-term (50-60 year) observational time series and the outcomes of model calculations.

356 https://climate.copernicus.eu/

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