RESILIENT ECONOMIC GROWTH THROUGH SECTORAL ADAPTATION ACTIONS IN GEORGIA

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Georgia, 2024

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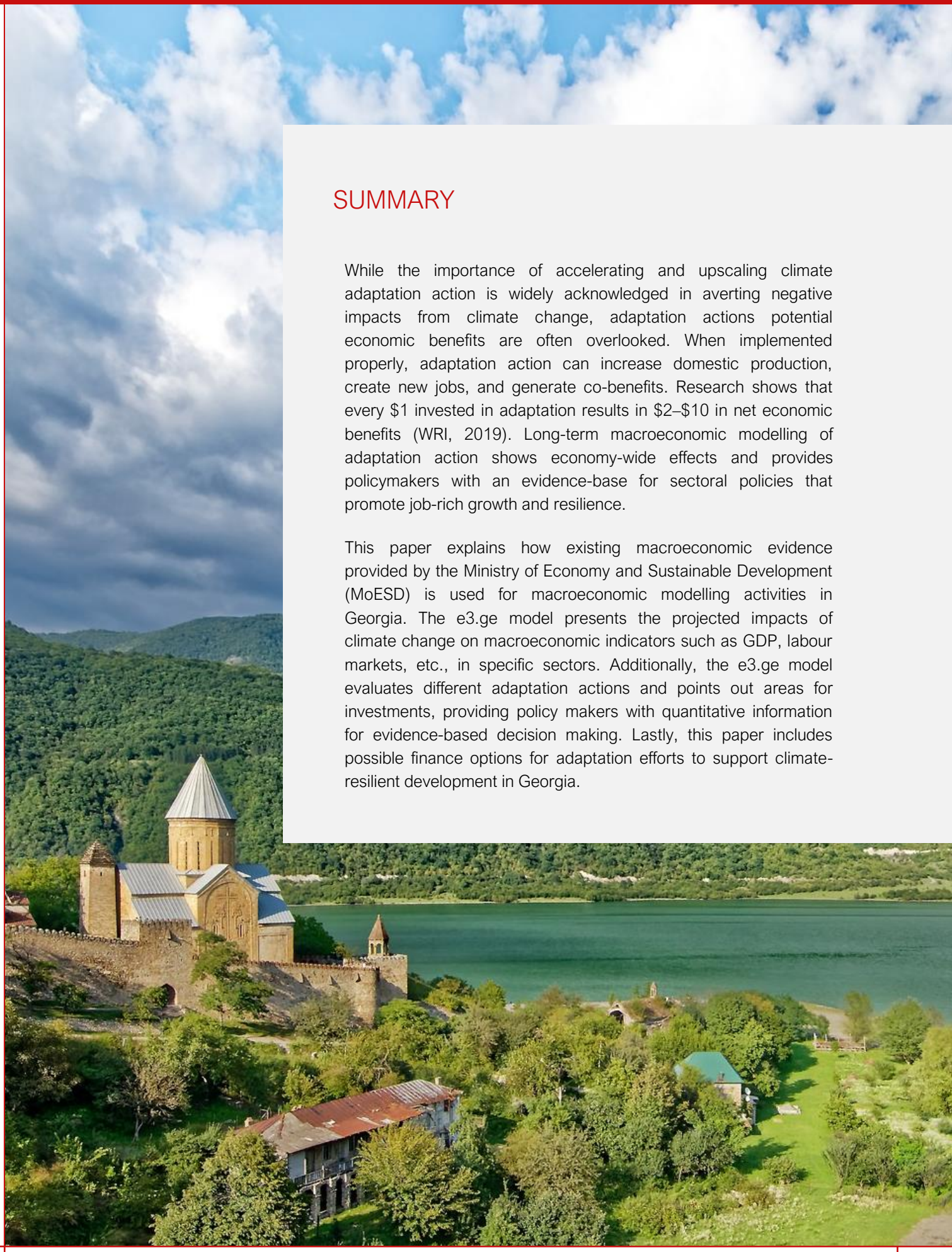


SUMMARY

While the importance of accelerating and upscaling climate adaptation action is widely acknowledged in averting negative impacts from climate change, adaptation actions potential economic benefits are often overlooked. When implemented properly, adaptation action can increase domestic production, create new jobs, and generate co-benefits. Research shows that every $1 invested in adaptation results in $2–$10 in net economic benefits (WRI, 2019). Long-term macroeconomic modelling of adaptation action shows economy-wide effects and provides policymakers with an evidence-base for sectoral policies that promote job-rich growth and resilience.

This paper explains how existing macroeconomic evidence provided by the Ministry of Economy and Sustainable Development (MoESD) is used for macroeconomic modelling activities in Georgia. The e3.ge model presents the projected impacts of climate change on macroeconomic indicators such as GDP, labour markets, etc., in specific sectors. Additionally, the e3.ge model evaluates different adaptation actions and points out areas for investments, providing policy makers with quantitative information for evidence-based decision making. Lastly, this paper includes possible finance options for adaptation efforts to support climate-resilient development in Georgia.

1. CLIMATE CHANGE AND ITS IMPACT IN GEORGIA

1.1 Country Climate Information

Climate change and its associated adverse effects pose a great threat to humankind. The impacts are far-reaching and affect people, the environment, and the economy. Developing countries like Georgia are more vulnerable to climate change than developed countries. Furthermore, the situation is expected to be aggravated due to environmental, social, and economic constraints on the country. Climate change is a long-term change in the average weather patterns. These changes have a broad range of observed effects in Georgia.

Climate projections in Georgia expect increasing average annual temperatures in the range of 1.6 to 3°C in 2041 to 2070 and a further increase in the period from 2071 to 2100 (compared to the baseline period 1971–2000). The lowest increase in temperatures is expected in the Black Sea coastal area. Furthermore, an increase in the number of hot days (maximum temperature over 25°C) and more frequent heat waves during summer are expected. The number of frost days is decreasing, especially in the mountain regions where a decrease of up to 71 days (period 2071-2100) is expected. Glacier melt proceeds, and a complete loss of the glacier mass is in projected by 2160. Changes in precipitation differ: While precipitation will decrease in eastern Georgia, it will remain almost unchanged along the coastal zone. In addition, an increase in extreme weather events leading to an increased risk of flash floods, mudflows, landslides, and droughts is expected (GWS, 2022).

The "Report on the climate hazards analysis for Georgia" by Navarro and Sanchez (2021) provides and analyses modelling scenarios for significant areas, cities, or physical infrastructures in Georgia, illustrating the evolution of climate hazard indicators in Georgia for the RCP8.5 scenario and the RCP2.6 scenario. The report covers the following events:

- Droughts
- Extreme temperature
- Heatwaves
- Extreme precipitation
- Extreme wind.

The report mentioned above gives a detailed description of the definition and estimation of climate hazard indicators.

1.2 Climate Change Threats

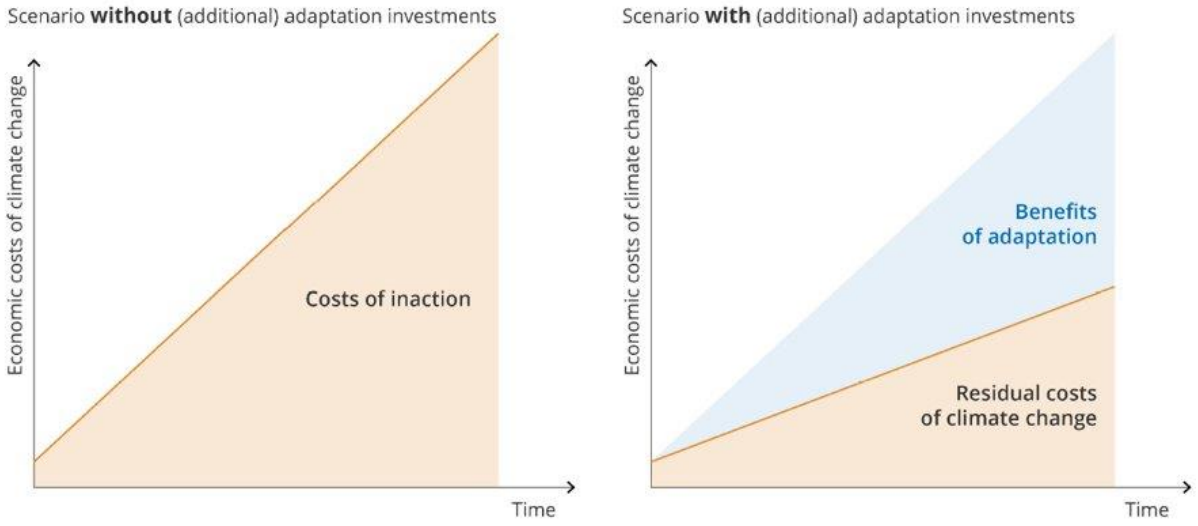
Climate change not only causes direct damage to infrastructures but also leads to indirect economic losses, such as road damage, energy supply cuts or transport connection interruptions (OECD, 2018). The indirect losses often even exceed the direct damage over the time horizon. Additionally, climate change affects human health through different impact pathways. While there are direct and indirect health impacts, such as accidents and deaths or changes in certain disease risks, indirect social and economic risks arise, such as loss of jobs and livelihoods, for example, through reduced food yields, property loss, or infrastructure damage (GWS, 2022). For instance, heat stress resulting from a 1.5°C global warming scenario will lead to a decrease of 0.09% of the Georgian GDP in 2030 and a total loss of 1.700 full-time jobs (ILO, 2019). Thus, climate change negatively impacts economic and social welfare and increases both sector and economy development risks.

The economic activities in Georgia are affected by different climate threats. Specifically, the agricultural sector greatly depends on climate conditions. While on the one hand, climate change can have some advantages for agriculture (such as an extended vegetation period, which enables harvesting several times a year and makes agriculture possible in regions not previously considered), on the other hand, the frequency and intensity of extreme weather patterns, such as hail, drought, and heavy rains increases. Resulting from that, the effects of the climate changes on the agriculture sector in Georgia range from the displacement of agriclimatic zones, the reduction of crop productivity due to extreme weather events, the reduction of the agricultural lands' fertility, the reduction of irrigated land areas to a higher demand for irrigation water (MEPA, 2017). Further, increased eutrophication due to high evaporation, better wintering of diseases, and increased wind erosion can also be related to climate change. Also, earlier flowering makes fruit trees more susceptible to late frosts, and the risk of spreading plant-damaging diseases increases. Hot temperatures also mean more stress for crops. In the long term, climate change could reduce yields because the crops are no longer well-adapted to their previous location (MEPA, 2017).

Within the tourism sector, its climate is one of Georgia's main competitive advantages, including different natural climatic zones, temperature ranges, natural settings, recreational properties, and diverse landscapes, enabling a set of tourism activities (USAID, 2016). Tourism is strongly affected by climate change in Georgia, since adjusted to natural systems tourism infrastructure and activities greatly depend on weather conditions, e.g., temperatures, precipitation, sea turbulence, and the number and seasonal distribution of sunny days. Thus, some threats from climate change, such as heavy rain, flooding, cut power lines, etc., may have severe implications for the economic activities within the sector.

Given the expected occurrence of extreme weather events and climate hazards, it is essential to invest in climate adaptation measures and reduce the overall expected economic losses through evidence-based adaptation actions that increase resilience, consider the macroeconomic impact, and minimize overall economic losses (see Figure 1).

Figure 1. Schematic Overview of the Costs of Inaction and Benefits of Adaptation to Climate Change



Source: (EEA, 2022).

2. CLIMATE ADAPTATION MODELLING

2.1 e3.ge Model and Modelling Process

The Climate Resilient Economic Development (CRED) programme activities in Georgia are conducted by GIZ in coordination with its partner institution, the Ministry of Economy and Sustainable Development of Georgia (MoESD). They are directed towards the following application areas focusing on climate adaptation:

- Developing methods and tools for modelling the economic impacts of climate change;
- Supporting the lead executing agencies and implementing partners to become independent users of macroeconomic models (capacity building through training and coaching);
- Supporting the lead executing agencies and relevant stakeholders in integrating the results in policy-making processes and adaptation planning.

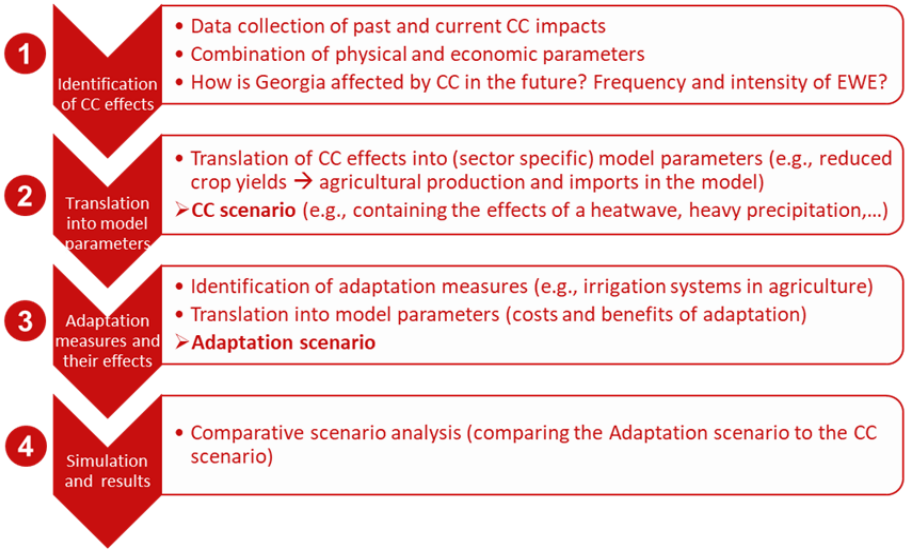
Generally, three basic types of macroeconomic models can be distinguished according to the system dynamics of interaction within the economy: Computable General Equilibrium models (CGE), static Input-Output models (IO), and (macro)econometric Input-Output models (IOE – Econometric Input-Output models (GWS, 2022). For Georgia, the macro-econometric (dynamic) IO modelling approach is a suitable solution as international experiences as well as other climate change adaptation projects show that this approach fulfils the requirements and can be successfully implemented (GWS, 2022). Combined with a scenario analysis technique, the modelling approach is suitable for studying both the wider economic impacts (e.g., changes in economic indicators such as GDP and employment) of climate change effects and climate change adaptation (GWS, 2022).

Under the current CRED activities in Georgia, GIZ, together with its technical implementing partner GWS (Gesellschaft für Wirtschaftliche Strukturforschung GmbH), has developed a macroeconomic dynamic Input-Output model named e3.ge (e3.ge stands for Economy, Environment, and Energy - Georgia). The e3.ge model estimates economic values of the impacts of climate change and climate change adaptation measures at different macroeconomic sectoral levels in Georgia. The Georgian national accounts form the basis of the e3.ge macroeconomic model, correspondingly, the interdependences between different economic sectors in Georgia are described in input-output tables. Using national accounts and input-output data, the sectoral impacts, and second-round effects of climate change as well as adaptation measures and instruments can be recorded and projected.

The core economic data for the e3.ge model was obtained through literature and data research and complemented during the meetings and training sessions. Data collection for climate change costs and damages has been facilitated by the partner institution, MoESD, supported by local subcontractor organizations and consultants. Climate forecasts were projected by an external consultant from UIB (Universitat de les Illes Baleares).

The e3.ge model assesses adaptation measures from a macroeconomic perspective (see Figure 2). The central role of the e3.ge model application is the macroeconomic and sectoral analysis of climate change and adaptation options. The model is run for different adaptation scenarios and measures identified for a specific sector, and the results can be used to compare each adaptation measure in terms of their macroeconomic impacts. Results from the scenario analysis can help determine which measures are likely to have a positive or negative macroeconomic impact in the long term and the least or the highest macroeconomic impacts (in terms of GDP, employment, and economy-wide effects) (GWS, 2022).

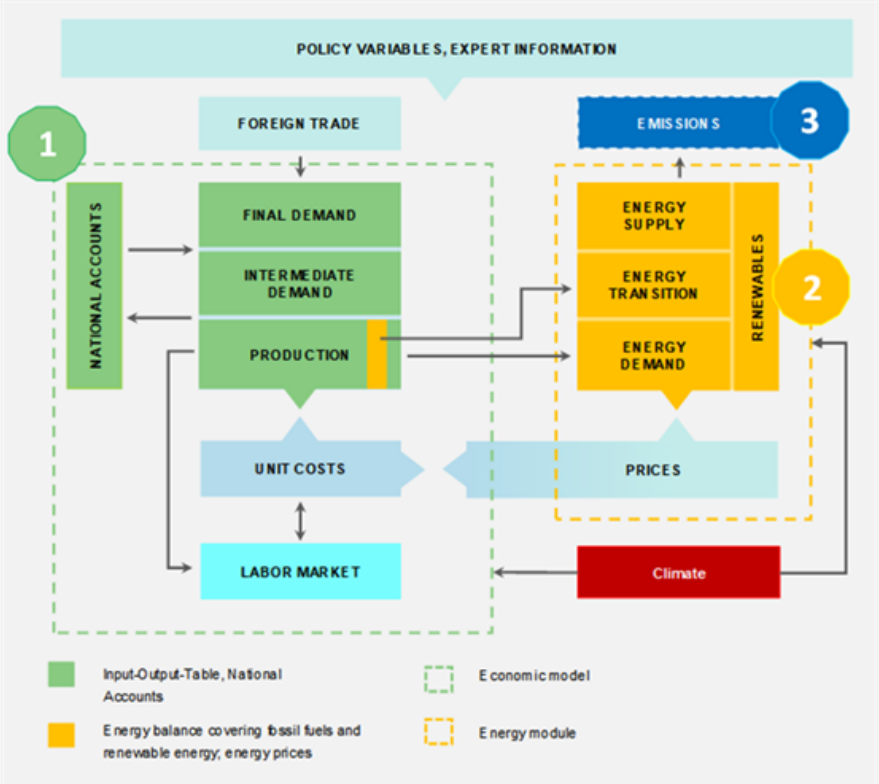
Figure 2. The e3.ge Approach of Integrating Climate Change and Adaptation in an Economic Model



Source: (GWS, 2022)

The unique capacity of e3.ge is to integrate the economic impacts of climate change and already identified adaptation options in a comprehensible economic framework and consequently analyse the economy-wide impacts of climate change and adaptation options (see Figure 3). The model provides additional capacities by quantifying not only the direct impacts but also the indirect, induced, and total socio-economic impacts of both climate hazards and adaptation (GWS, 2022).

Figure 3. Structure and Inter-Linkages in the e3.ge Modelling Approach



Source: (GWS, 2022)

3. EVIDENCE-BASED SECTORAL ADAPTATION ACTIONS

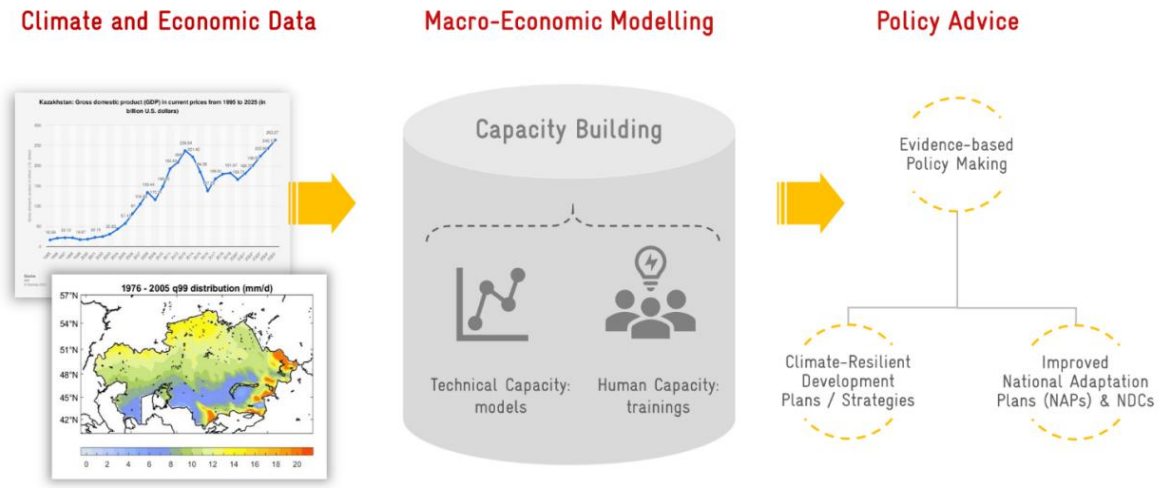
3.1 Translating Climate Economy Modelling into Policy Action

Climate economy modelling can help policymakers in Georgia quantify the future potential impacts of climate change on the economy. Understanding climate effects at the macro-economic level can assist in analysing climate change effects on the demand and supply of goods and services, effects on producers and consumers, and overall effects on the whole economy. Combining climate economy modelling with relevant tools and qualitative analysis can facilitate optimal outcome for the decision-making processes. A mix of quantitative (monetary valuation) and qualitative information is important to obtain a more nuanced picture of climate change impacts (GIZ, 2021).

With that regard, the developed and established e3.ge model can assess potential or planned adaptation measures from a macroeconomic perspective, with a focus on climate change hazards and adaptation measures. Analytical information from e3.ge modelling can address the questions of how an adaptation measure related to one sector could impact other sectors of the economy in terms of gross output, employment, and CO_2 emissions. Results from the model can also help to determine which measures are likely to have a positive or negative macroeconomic impact in the long term. Under certain conditions, this information can help build consensus around complex of adaptation measures across policymakers and actors (GIZ, 2023).

At the present stage, CRED is focusing on developing new and translating already set climate-informed macroeconomic modelling results into relevant development strategies and adaptation policies in Georgia (see Figure 4). In doing so, the country will have the economic decision-making policies, instruments, and processes that will enable it to meet the national adaptation goals articulated in its National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs).

Figure 4. CRED Approach Supports Climate-Resilient Economic Development



Source: (GIZ, 2021)

Currently, Georgia is at the initial stage of formal development of its National Adaptation Plan (NAP) process. It is, however, highly recognized that the impacts of climate change pose severe threats to the country's sustainable development now and in the future. A review of strategic documents indicates that the government's priority has been on addressing the cause of climate change (mitigation). Initiatives on

climate adaptation are fragmented, with no comprehensive climate adaptation policy yet. Two strategic documents released in 2021 provide guidance on national climate adaptation: the updated nationally determined contribution (NDC) identifies eight high-level adaptation priorities, and the Fourth National Communication to the United Nations Framework Convention on Climate Change identifies more detailed adaptation measures across 13 sectors (Government of Georgia (2021a), (2021b)). It is expected that once the Environment and Climate Change Department's Climate Change Division under the Ministry of Environmental Protection and Agriculture (MEPA) secures financing from the Green Climate Fund (GCF) for the development of its NAP process more attention will be given to adaptation. Actions will be taken to integrate adaptation more systematically into development planning and budgeting at national, sectoral, and subnational levels (GIZ, 2023).

Under the project policy advise component, CRED facilitates the creation and holding of dialogue platforms (workshops, dialogue meetings, conferences) among main policymakers in Georgia (MoESD, MEPA, Ministry of Finance, National Bank of Georgia, etc.) to explore ways of supporting the use of the model in national climate adaptation planning.

Six entry points for applying the e3.ge model to inform the national adaptation process were identified based on a review of international studies, key national documents (including the draft proposal to the GCF for the development of the NAP), and exchanges with main stakeholders. These included using the model for:

- The appraisal and prioritization of adaptation measures in key sectors
- The economic appraisals of adaptation options
- Awareness raising on climate adaptation
- Informing climate risk and impact assessments
- Financing climate adaptation
- Research on climate adaptation modelling

The two most promising entry points were further prioritized based on a dialogue between MoESD and MEPA. These include using the model to (1) support the appraisal of adaptation measures and (2) raise awareness of climate change impacts and adaptation measures (GIZ, 2023).

Following the next step of the project policy advice component, further examination of key policy enabling factors is underway to support the effective use and uptake of climate economy modelling results in economic development and adaptation policy planning in Georgia. Together, these key enabling factors can influence the successful application of climate economy modelling results to support the integration of climate adaptation in the development processes. The e3.ge model has identified several sectoral adaptation actions and assessed the investment costs and long-term benefits. The following section presents evidence-based adaptation actions in the agricultural, tourism, and infrastructure sectors. Moreover, it identifies key sectors in Georgia that could benefit from integrating climate risks into macroeconomic analyses.

3.2 Agricultural Sector

Agriculture is one of Georgia's most important economic sectors, employing about 40% of the population but only having a share in GDP of 8.4% in 2020. This share has fallen significantly over the past decades (USAID, 2017). However, the dependence on agriculture is likely to continue into the medium-term future, and the greatest challenges are improving its productivity, increasing farmers' incomes, and reducing rural poverty (MEPA, 2017). Agriculture is one of the most vulnerable sectors to climate change in Georgia.

Thus, climate change increases sector development risks and negatively impacts economic and social welfare (MEPA, 2017). Consequently, the Georgian Agriculture Development Strategy (2015-2020) should focus on three interlinked challenges: ensuring food security through improvement of productivity and incomes, adaptation to climate change, and promotion of climate change mitigation. Regarding that, from a policy perspective, considering the National Adaptation Plan of Georgia's agriculture sector to Climate Change (MEPA, 2017) becomes an integral part of the Agriculture Development Plan (GWS, 2022).

Options for Adaptation in Agriculture

There are several ways for farmers to adapt to the expected changes due to climate change. The cultivation of adapted varieties and new crop types in connection with adapted cultivation methods can contribute to soil conservation and water saving, reducing the possible effects of climate change. Other options for adaptation include efficient irrigation systems (e.g., drip irrigation), fertilization to realize higher yields, and improved crop protection to limit pests and diseases. Improved weather forecasting and early warning systems for extreme weather events can also help to limit the damages caused by climate change. Frost protection measures (e.g., frost protection irrigation), hail protection nets, hail guns, and windbreaks are further structural adaptation measures. Insurance against crop failures compensates farmers, but the foregone harvest needs to be compensated in other ways (e.g., by increasing imports) (GWS, 2022). The e3.ge model analysed various adaptation measures in the agricultural sector and identified two adaptation actions (1) irrigation systems and (2) windbreaks that increase climate resilience, yield positive economic effects (GDP growth, productivity, employment), and lasting co-benefits.

Adaptation Options with Regard to Irrigation Systems

The rehabilitation and modernization of irrigation systems are key to supporting a greatly expanded horticultural crop production (MEPA, 2017). Since the temperatures in Georgia will continue to rise and the estimated precipitation varies greatly, irrigation systems can sustain high yields in the future. The irrigation strategy in Georgia "encompasses the rehabilitation of decayed irrigation infrastructure and the development of a modern data-based professional and participatory irrigation management capacity". The irrigation strategy contains a broad range of information on cost and benefits (GWS, 2022).

In the climate change scenario, severe droughts are assumed to occur every five years, starting in 2025. The effects on agriculture are increasing over time due to the intensifying climate change. The rehabilitation of existing gravity irrigation schemes is done by construction works (e.g., canals, drainage, reservoirs), and water-saving technologies (e.g., drip irrigation systems) will be imported from abroad (China or of higher quality from Turkey and Israel) (MoA, 2017). The local construction industry is needed to rehabilitate and install the irrigation systems. The benefits of irrigation systems include increased agricultural productivity and, thus, increased crop yields in years without severe heat and drought and reduced damages in years with extreme temperatures (see Table 1). Water availability does not seem to be constraining (MoA, 2017).

Table 1. Cost-Benefit-Analysis of irrigation systems; Input for the e3.ge model – Scenario Output

	INVESTMENTS OR BENEFITS
Rehabilitation investment in irrigation systems	• 2021 to 2025: in total 700 million GEL • 2026 to 2050: 50 million GEL p.a.
Allocation of investment	• 2021 to 2025: 85% irrigation channels, • 15% drip irrigation systems • 2026 to 2050: 25% irrigation channels, 75% drip irrigation systems
Increased crop yields from irrigation	• 2021 to 2025: steady growth up to 15% p.a. • 2025 to 2050: 15% p.a.

Source: (GWS, 2022)

The macroeconomic assessment from the e3.ge model shows that investments in irrigation systems can lead to annual GDP increases of up to 1% and up to 0.6% higher employment per year corresponding to more than 10,000 additional jobs until 2050 compared to the scenario without adaptation.

Adaptation Options with Regards to Windbreaks

Land erosion caused by high winds is a problem, especially in dry land areas in Georgia. The high wind removes and transports soil material and causes land degradation. As a result, the crop yields are reduced. Planting windbreaks can reduce wind speeds over fields, which protects the soil and thus provides additional protection for the plants in the fields. Therefore, when designed for wind reduction purposes, windbreaks can enhance crop production, improve crop quality, reduce fruit rubbing, decrease fruit drop, increase water-use efficiency, and offer control of blowing snow and dust, to mention some of the positive effects (GWS, 2022). The windbreaks usually consist of trees and bushes that are placed at the edge of the fields or between the fields (GWS, 2022).

Planting/replanting windbreaks is one key element to adapting to climate change's effects. This restoration could be done in a way that the new trees and bushes are climate-resilient and even multifunctional, providing protection from the wind and additional food security through introducing fruit species. This combination of protection and production can be a significant incentive to reactivate the windbreaks (GWS, 2022).

Based on research and modelling results, beginning in 2025, heavy wind is assumed to occur every five years, which will destroy 5% of the annual crop yield (GWS, 2022). In addition, an annual loss in crop yields of 1.5% due to wind erosion is being assumed. The benefits of windbreaks include increased agricultural productivity (see Table 2) and, thus, increased crop yields in years without heavy wind and reduced damages in years with heavy wind.

Table 2. Cost-Benefit-Analysis of windbreaks; Input for the e3.ge model – Output Scenario

WINDBREAKS	INVESTMENTS OR BENEFITS	
Investment (p.a.)	• Plants: 6 million GEL • Plastics: 4 million GEL	• Agricultural services: 5.2 million GEL • Machinery: 2 million GEL
Increased crop yields (p.a.)	• Maize: 18% • Wheat: 15% • Barley: 25% • Potato: 15%	• Fodder crop: 20% • Vegetables: 15% • Others: 15% • Total (weighted by share in agriculture): 17,8%

Source: (GWS, 2022)

The macroeconomic assessment from the e3.ge model shows that investments in the restoration of windbreaks can result in up to 1.4% higher GDP (resp. GEL 747 million) and up to 0.7% higher employment corresponding to more than 12,000 additional jobs per year. Additionally, investments have positive sectoral linkages leading to increased wage levels and higher consumption expenditure of up to 1.1% per year compared to the scenario without adaptation.

3.3 Tourism and Infrastructure

Tourism is one of the priority sectors of the national economy and (at least before the pandemic) one of the fastest-growing industries in Georgia (USAID, 2016). During the past decade, Georgia's tourism growth has increased on average by more than 12.8% per year. Between 2009 and 2016, the growth of tourism was one of the fastest globally. In 2018, the tourism revenues comprised 36% of Georgia's total exports. Moreover, international visitors contributed to the consumption in several economic sectors, namely accommodation (84% contribution in spending), food and beverages (20%), culture and entertainment (51%), and transportation (16%). On the other hand, revenues from domestic tourism only accounted for 4.2% of Georgia's GDP. Shopping contributed the largest share of revenues (33.5%), followed by served food and drinks (23.0%) and domestic ground transportation services (17.6%). However, Georgia's tourism still relies mainly on tourists from neighbouring regions and countries. The number of international visits peaks in summer. Visitors to the coastal region of Georgia are attracted by seaside resorts, local cuisine, historic monuments, cultural diversity, and national parks (GWS, 2022). Cultural heritage is one of the main resources for tourism and tourism revenues (USAID, 2016). Since Georgia is located in different climate zones, there is also the possibility for winter tourism, which is still developing but already providing a comparative balance between summer and winter tourism (GWS, 2022). Georgia is ambitious to become a four-season tourist destination by offering the appropriate activities (e.g., hiking, climbing, cycling, wine tasting, skiing, etc.) (World Bank, 2020).

Options for Adaptation in Tourism and Infrastructure

The aim of adaptation to climate change in tourism is to maintain the tourist attractiveness of a destination even under future climate risks and conditions. Climate-resilient infrastructure is crucial to that. Several options exist to adapt tourism and infrastructure to climate change. While on the one hand, the improvement and building of climate-resilient infrastructure account for structural building activities, softer measures such as information campaigns and warning systems can also serve to adapt to the climate impacts in the tourism sector. Thus, adaptation measures can be grouped into two categories: 1) structural adaptation measures (e.g., changing the composition of road surfaces so that they are resilient to high temperatures, building seawalls etc.) and 2) management adaptation measures (e.g., early warning systems, insurances, monitoring of existing assets, changing maintenance patterns) (GWS, 2022).

Infrastructure relevant for tourism purposes needs to be adapted to climate change. Existing infrastructural facilities like accommodation, utilities, roads, beaches, etc., should be maintained and retrofitted by adaptation activities to make them climate resilient. New infrastructure assets should be planned, designed, built, and operated to account for the climate changes that may occur over their lifetimes (GWS, 2022). To do so, buildings and infrastructure need to be less exposed to natural hazards and risks, e.g., by establishing new building standards, a beach and dune nourishment, and setbacks in the coastal development. The structural stabilization of the shoreline is one major adaptation measure to adapt to the coastline erosion (World Bank, 2020). This infrastructure for stabilization could, on the one hand, include traditional infrastructure, such as hard defences, and on the other hand, also natural infrastructure, such as wetlands and other nature-based solutions (World Bank, 2020). The construction

and development of new infrastructural facilities should be located at places recommended by the coastal protection service. This could be supported by a destination development plan. New tourist areas should be based on sustainable development principles. Further adaptation measures increase human safety, healthy ecosystems, diversified livelihoods, and planning (World Bank, 2020).

Adaptation could also lead to co-benefits regarding social and environmental aspects, e.g., by using green infrastructure. Ecosystem-based approaches (or "green") can provide an effective complement or substitute for traditionally built (or "grey") infrastructure, providing on-the-ground climate adaptation as well as environmental benefits (World Bank, 2020).

(Re-)Construction of Coastline Protection

Climate change will impact tourism flows and activities and needs to be considered when creating adaptation strategies and national action plans related to the tourism industry (World Bank, 2020). The erosion of the seacoast and rising sea levels are the most manifested impacts of climate change. Adaptation to these impacts is one of the most resource-intensive interventions. To retain the commercially important beaches and to protect the infrastructure located on the coastline, it needs to be stabilized (World Bank, 2020), e.g., by (re)-construction measures. However, sea-level rise also has an impact on assets and infrastructure, which can only be evaluated if the hazards are analysed spatially and temporally in detail.

3.4 Energy Sector

The energy sector is one of the most important sectors in Georgia, with a rising demand for energy within the last decade (Pignatti, 2023). In 2021, the country's share of renewable sources of electricity peaked at 81,1% in summer, relying almost exclusively on hydropower (IEA, 2023). Yet, due to seasonal changes in water availability, the energy production capacity from hydropower is limited in winter, making Georgia dependent on imports from Russia and Azerbaijan (IEA, 2023). Further, the increasing likelihood of extreme weather events resulting from climate change, such as droughts and floods, results in insecurity and even the risk of damage to the energy infrastructure.

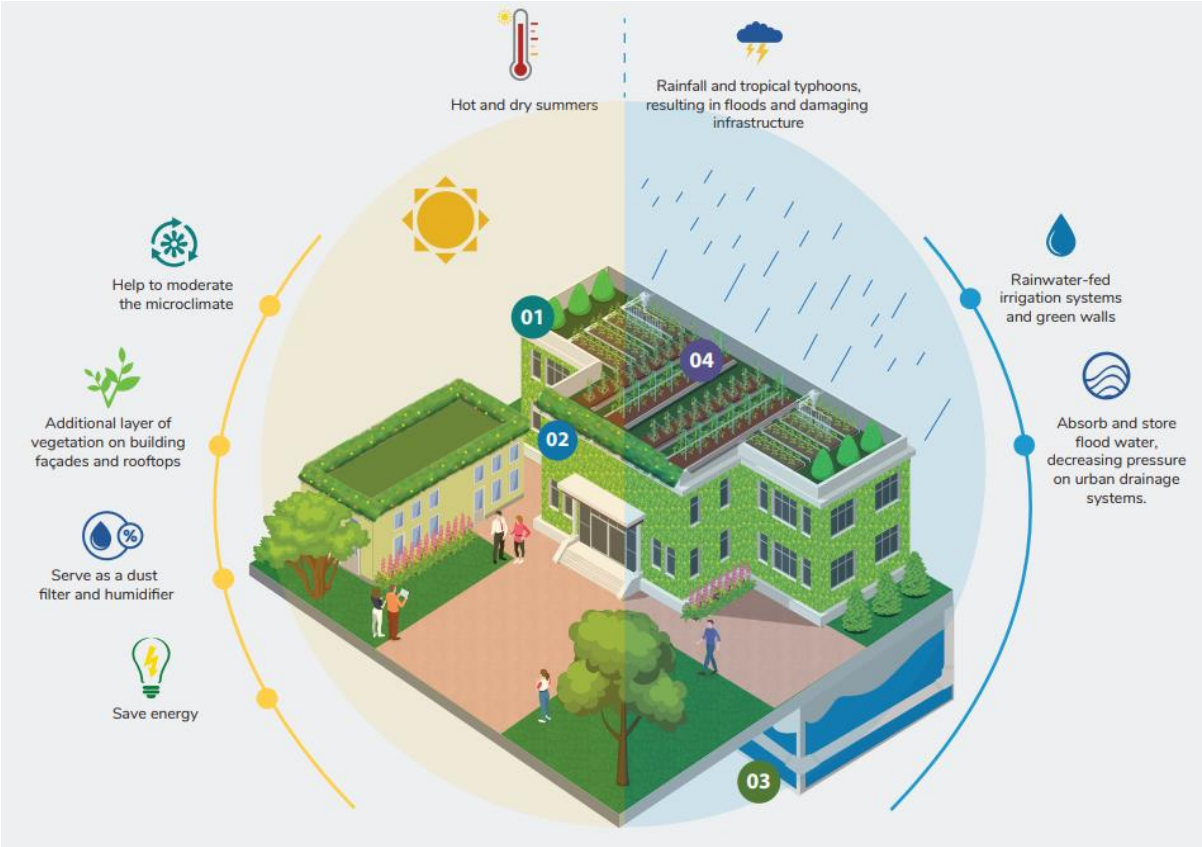
As the energy industry is highly interconnected with other sectors, disruptions, and outages in the industry likely result in (economic) losses in dependent industries. To circumvent this, Georgia's energy infrastructure must adapt to the impacts of climate change (OECD, 2018). An increased resilience and energy security would consider the susceptibility of energy infrastructure like pipelines, power lines, transformer stations, etc., to climate threats (UNECE, 2019). Resulting from that, structural adaptation measures such as investments in protective infrastructure (like dams), climate-proofed designs (improved power plants or underground power lines), and refurbishment to increase its robustness are necessary (OECD (2018), (2021)).

3.5 Building Sector

The built environment is a key part of the infrastructure that determines the extent to which climate hazards translate into human well-being and economic impacts. Heat waves are an increasing risk for Georgia. Dark surfaces, residential and industrial sources of heat, absence of vegetation, and air pollution can push temperatures higher than those of the rural surroundings, thus amplifying the heat wave effects in the built environment. Heatwaves, combined with future urban expansion, are likely to damage the productivity of the service sector economy, both through direct impacts on labour productivity, and also through the additional costs of adaptation (ADB, 2021).

Therefore, precautionary consideration of relevant adaptation actions in the building sector is crucial. Using macroeconomic analysis and applicable modelling methods for adaptation actions in the building sector would lead to more effective steps with regard to relevant urban planning, green infrastructure planning, and/or nature-based solutions.

Figure 5. Design and Benefits of Nature-based Adaptation in the Building Sector



Source: (GIZ, 2022)

3.6 Forest Sector

The forest sector is heavily impacted by climate change in many countries. Adaptation measures and synergies between mitigation and adaptation are significant when considering climate change within the forestry sector in Georgia. The forest landscape is a particularly complex phenomenon and produces many ecosystem services, which could be considered a standpoint for development of its adaptive capacities. Adaptive actions are primarily needed to maintain the functioning of forest ecosystems. Also, through ecosystem services, forests reduce vulnerability and, under sustainable management, contribute to society's adaptation to climate change (Khardziani, 2023). Based on Georgia's Nationally Determined Contributions (Government of Georgia, 2021a), from a conceptual point of view, the forests in Georgia contain a carbon sink function in terms of mitigation to climate change. Actions taken in the forestry sector with that regard primarily serve to increase the carbon capture capacity by expanding the network of protected areas, restoring burned forests, and promoting natural forest regeneration. There is a general understanding that it is necessary to increase the number of adaptive measures in the forestry sector, where the importance of other services of forest ecosystems in the adaptation of the local community to climate change will be considered. A wide range of ecosystem services, including water protection, soil protection, and climate regulation, could be considered the implementation of respective adaptive

measures. Macroeconomic consideration of adaptation measures with that regards could bring a more holistic consideration of effective actions that bring immediate economic effects at the local level and contribute to sustainable development of the country (Khardziani, 2023).

ECO.Georgia is a Green Climate Fund (GCF) funded project (commissioned by BMZ) to enable the implementation of a forest sector reform implemented by GIZ and the Government of Georgia. The project aims to mitigate greenhouse gases through improved, nature-based management of the country's forests and improved energy efficiency to reduce the demand for fuelwood. Potential synergies with CRED would imply developing and updating a climate hazard database, macroeconomic analysis of adaptation measures in the forest (partially land use) sector, energy efficiency components of adaptation measures, and relevant adaptation policy development.

4. ADAPTATION FINANCE OPTIONS

Adaptation action is underfinanced globally. The most recent Adaptation Gap report by UNEP clearly shows how adaptation costs for developing countries are higher than previously estimated while public multilateral and bilateral adaptation finance flows are insufficient. The adaptation costs are US$215 billion to US$387 billion per year in this decade and requires ambitious action now to reduce future climate-related costs, losses, and damages (United Nations Environment Programme, 2023).

The brief structural description presented in this chapter aims to provide an overview of which international and domestic development finance systems could support Georgia. Also included are references to potential financial sources that might be additionally needed for the sustainability of the CRED approach in ensuring that all the systems and capacities (model ownership and development, scenario analysis, policy mainstreaming/implementation, etc.) are in place to support the development and use of climate economy modelling. Additionally, this chapter aims to present financing sources for the adaptation actions in the various sectors identified through the modelling activities.

Climate financing in Georgia is provided through private funding channels, domestic budgets, domestic funds, incentive mechanisms, and international bilateral and multilateral cooperation and investments dedicated to climate change efforts (UNDP Georgia, 2022). National and regional governments, state-owned enterprises, and international development financial institutions are currently Georgia’s major financial source providers for climate action. Generally, climate financing is conveyed through development initiatives and programmes, targeting different sectors and directions, but it is unlikely sufficient to achieve the country’s overall climate goals. Further investment is already planned under the state’s budget, private investment mechanisms, and international funding frameworks (UNDP Georgia, 2022). However, climate action financing often focuses on mitigation rather than adaptation.

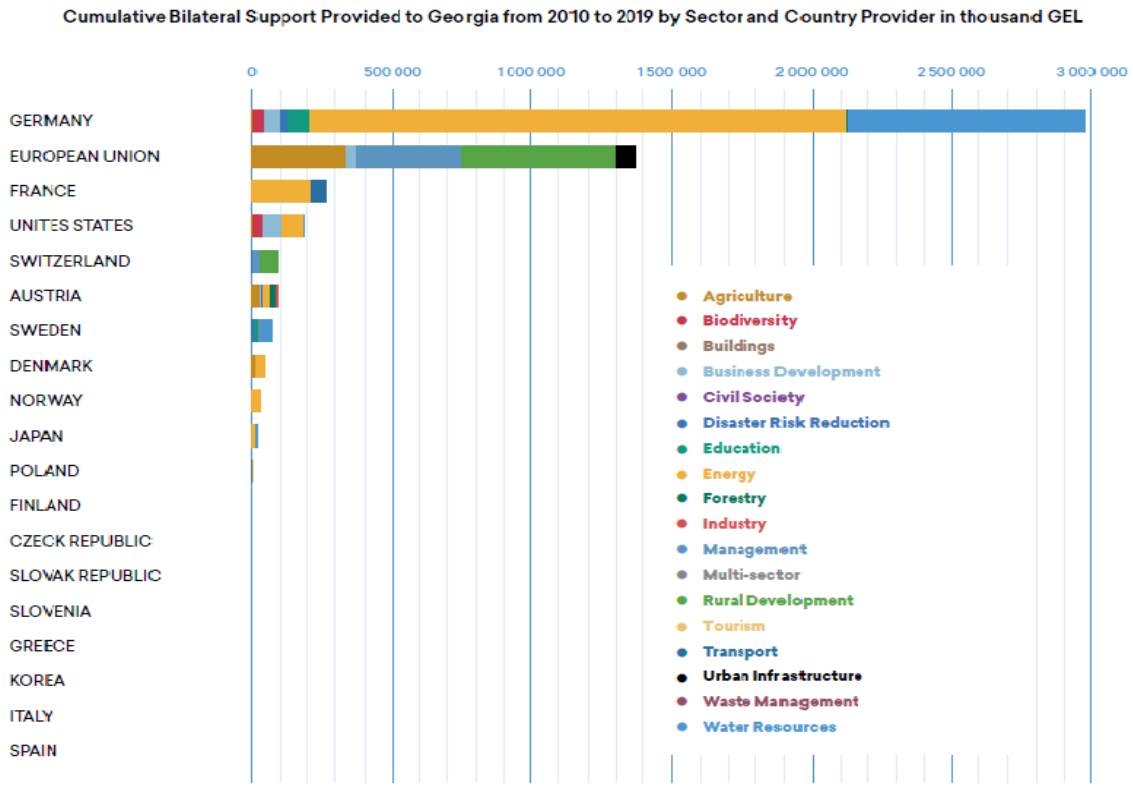
Georgia first submitted its NDC for the period 2021 to 2030 to the UNFCCC in 2017 and updated its NDC in 2021, which shows a strong commitment to climate action and the need for additional climate finance. The NAP is currently being developed with the support of the GCF Readiness Programme (UNDP Georgia, 2022).

4.1 International Climate Financing

Generally, climate finance refers to the financial resources mobilized to fund actions that mitigate and adapt to the impacts of climate change, including public climate finance commitments by developed countries under the UNFCCC. At the global scale, financial resources allocated towards climate change are increasing but remain limited when it comes to the practicalities of acquisition and implementation (GIZ, 2021).

International climate finance mechanisms are an important component for funding climate change mitigation and adaptation actions in Georgia. This is implemented through monetary support, technology transfer, and capacity building programmes. Georgia has been receiving international official development assistance support for climate action projects through a variety of bilateral co-financing country-agency mechanisms, multilateral development banks, and multilateral climate funds. From 2010 to 2019, Georgia received bilateral support from Germany and the European Union to finance climate projects, a large share was channelled to the energy sector and water resource management (see Figure 6) (UNDP Georgia, 2022).

Figure 6. Cumulative Bilateral Support provided to Georgia from 2010 to 2019 by Sector and Country Provider



Source: (UNDP Georgia, 2022)

Globally, different actors provide climate financing. Under the UNFCCC financial mechanisms, the Green Climate Fund (GCF), Adaptation Fund (AF), and Global Environment Facility (GEF) provide dedicated financing to address climate change. Additionally, multilateral development banks, such as the World Bank, the European Bank for Reconstruction and Development (EBRD), and United Nations Agencies, like International Fund for Agricultural Development (IFAD), provide financing through programmes and development initiatives.

4.2 Domestic Financing and Good Governance

The Georgian Ministry of Finance (MoF) coordinates the state's expenditure, including domestic climate financing, through which implementing ministries operate. The national budget for 2022 was allocated to 12 priority areas, where climate impacts are reflected under various priorities, such as agriculture and environment protection as well as management of natural resources. Private investments might play a critical role in climate financing in Georgia. As a recent development trend, private capital stocks are growing exponentially compared to national stocks. However, as there is currently no centralized system in place in Georgia for classifying Development Assistance projects in the country, the share of such private investment into climate change initiatives is not easily quantifiable (UNDP Georgia, 2022).

To ensure that both public and private financing reaches the targeted sectors that aim to reduce GHG emissions and increase resilience, it is vital to establish a coherent national climate change policy framework. So far, Georgia has not adopted a strategic document highlighting climate change and needed climate action as key work areas. Developing an overarching climate change policy framework supports an efficient budget allocation and facilitates long-term planning (UNDP Georgia, 2022).

The enabling environment for effective climate action includes political commitment, well-aligned multilevel governance, institutional frameworks, laws, policies and strategies, and enhanced access to finance and technology (IPCC, 2023). The CRED project works closely with good governance projects in Georgia to support the integration of economically viable climate action, specifically adaptation actions, into national policy frameworks.

Overall, the CRED approach validates sectoral adaptation actions that are scalable and impactful. The macroeconomic evaluation provided through the model provides an added value by analysing the effects on GDP and jobs to support to mid and long-term planning. The next phase of the project focuses on integrating evidence-based adaptation actions into policy recommendations and the National Adaptation Plan, as well as identifying appropriate adaptation financing options.

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6. MORE INFORMATION ON CRED

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Using Climate Economic Modelling for Sustainable Economic Development. A Practitioner's Guide (2021)

Using Macroeconomic Modelling to Inform National Climate Adaptation Planning - Lessons Learned from Georgia, Kazakhstan and Vietnam (2023)

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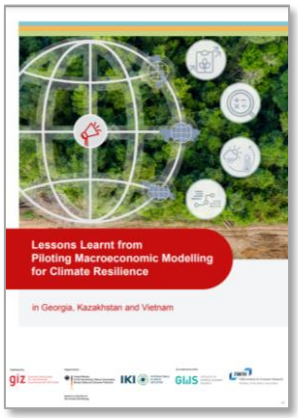
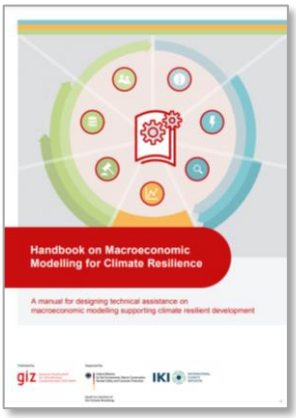
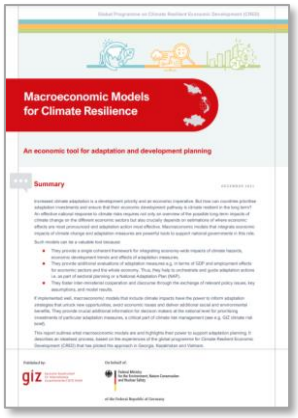


Global Report – Lessons Learnt from Piloting Macroeconomic Modelling for Climate Resilience (2022)



Handbook on Macroeconomic Modelling for Climate Resilience (2023)

Macroeconomic Modelling for Climate Policy Planning (2022)



Macroeconomic Models for Climate Resilience (2021)

Using the e3.ge macroeconomic model to inform adaptation planning in Georgia (2023)