ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT STRATEGIES (EC-LEDS) CLEAN ENERGY PROGRAM

GEORGIA'S LOW EMISSION DEVELOPMENT STRATEGY (LEDS)

DRAFT

COOPERATIVE AGREEMENT NO. 114-A-13-00008

September 2017

This publication was produced for review by the United States Agency for International Development. It was prepared by Winrock International.

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ACKNOWLEDGEMENTS

Winrock International and Sustainable Development Center, Remissia prepared this document under the USAID-funded EC-LEDS Clean Energy Program. The following technical experts developed and significantly contributed to the development of this document:

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- Marina Shvangiradze, Sustainable Development Centre Remissia
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- Benjamin Mueller, University of Illinois at Urbana-Champaign
- Dimitris Tsotsos, Winrock International
- Arthur Neher, Winrock International
- Yoav Brand, Winrock International
- Pat DeLaquil, Decision Ware Group (DWG)
- Gary Goldstein, Decision Ware Group (DWG)
- Giorgi Giorgobiani, Winrock International
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- Natela Dvalishvili, Sustainable Development Centre Remissia
- Tite Aroshidze, Sustainable Development Centre Remissia
- Zaal Kheladze, Sustainable Development Centre Remissia. New Technology Centre
- Archil Papava, , Sustainable Development Centre Remissia. New Technology Centre
- Ani Kobalia, Winrock International, Georgian Co-Investment Fund
- Nodar Kevkhishvili, Winrock International, Professor of Heat-power and Hydro-power Engineering, Department of Energy and Telecommunications, Georgian Technical University

The authors acknowledge the significant contribution of:

- Marika Gvianidze, Batumis Tskali Ltd
- Natia Iordanishvili, National Forest Agency

- Khatuna Chikviladze, Solid Waste Management Company
- Medea Inashvili, independent expert
- Kote Kobakhidze, Ltd. “Mzis Sakhli”, Director
- Giorgi Melikidze, Geothermal Association, President
- Archil Zedgenidze, Energy Research Centre “Qarenergo”, Director
- Temur Chkheidze, Sustainable Development Centre Remissia

In the process of elaboration and improvement of the document the significant recommendations and suggestions were provided by various sectoral ministries and sectoral sub working group members. Namely:

- Ministry of Environment and Natural Resources protection
- Ministry of Energy
- Ministry of Agriculture
- Ministry of Sustainable Development and Economy
- Ministry of Finance
- Ministry of Internal Affairs
- Georgian Railway
- Georgian Water and Power Ltd.
- LEDS Energy Working Group
- LEDS Transport Working Group
- LEDS Buildings Working Group
- LEDS Industry Working Group
- LEDS Land Use, Change in Land Use and Forestry (LULUCF) Working Group
- LEDS Agriculture Working Group
- LEDS Waste Working Group

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ACRONYMS

Acronym	Full name
AA	Associate Agreement
AR	Autonomous Republic
BAT	Best Available Technique
BAU	Business As Usual
BREFs	BAT Reference Documents
BUR	Biennial Update Report
$CaCO_3$	Calcium Carbonate
CCU	Climate Change Unit
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon dioxide
CO_2 eq	Carbon Dioxide equivalent (in terms of global warming potential)
CoM	Covenant of Mayors
EBRD	European Bank for Reconstruction and Development
EC-LEDS	Enhancing Capacity for Low Emission Development Strategies / Clean Energy Program
EE	Energy efficient
EIEC	Environmental Information and Education Centre
EU	European Union
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FDI	Foreign Direct Investment
GCS	Geothermal Circulation Systems
GDP	Gross Domestic Product
GeoStat	National Statistics Office of Georgia
Gg	Gigagram (10^9G=10^3T)
GHG	Greenhouse Gas
GJ	Gigajoule (10^9 Joule)
GoG	Government of Georgia
GWh	Gigawatt hour (109 Wt h)
GWP	Global Warming Potential
IED	Industrial Emissions Directive
INRMW	Integrated Natural Resources Management in Watersheds
IPCC	Intergovernmental Panel on Climate Change
KV	Kilovolt (103 volt)
KWh	Kilowatt-hour (10^3 W.h)
LEDS	Low Emissions Development Strategy
MENRP	Ministry of Environment and Natural Resource Protection
MOA	Ministry of Agriculture of Georgia
MoE	Ministry of Energy

Acronym	Full name
MoENRP	Ministry of Environment and Natural Resources Protection
MoESD	Ministry of Economy and Sustainable Development
MRV	Measuring, Monitoring and Verification
MVA	megavolt-ampere
MW	Megawatt (10^6 W)
MW	Megawatt (106 Wt h)
N_2	Molecular nitrogen
N_2O	Nitrous oxide
NAMA	Nationally Appropriate Mitigation Actions
NC	National Communication to UNFCCC
NCC	National Contributions Committee
NDC	Nationally Determined Contributions
NFA	National Forestry Agency
NGO	Non-Government Organization
NH_3	Ammonia
NO	Nitrogen monoxide
NO_x	Nitrogen oxides
PJ	Petajoule (1015 Joule)
PJ	Petajoule (10^{15} Joule)
RES	Renewable Energy Source
SEAP	Sustainable Energy Action Plan
TJ	Terajoule (10^{12} Joule)
TJ	Terajoule (1012 Joule)
TPS	Thermal Power Station
TSU	Technical Support Unit
UNFCCC	United Nations Framework Convention on Climate Change
USAID	US Agency for International Development
WWF	World Wildlife Fund

PREAMBLE

The purpose of this strategy is to ensure a low emissions transition and sustainable path for Georgia's economic and social development, through: the identification of main sources/sectors of emissions and their trends in development process, assessing and removing barriers to low emission development, defining goals/policies/measures within each sector in the context of sustainable development of the country, establishment of relevant legislation system, infrastructure and coordination process for implementation, and monitoring of results and mobilizing the national and international financial sources for implementation of LEDS.

FOREWORD

The concept of Low Carbon Development has its roots in the United Nations Framework Convention on Climate Change (UNFCCC) adopted in Rio in 1992. In the context of this convention, Low Carbon Development is now generally expressed using the term Low Emission Development Strategies (LEDS), also known as Low Carbon Development Strategies, or low carbon growth plans. Since the Convention was established, the enhanced understanding of the urgency to address climate change and the experiences from the Kyoto Protocol have led to negotiations focusing increasingly on engaging all countries in the global mitigation effort while reflecting the Convention principle of a common but differentiated approach to meet the overall emissions reduction objectives:

> *"All countries shall prepare Low Emission Development Strategies… nationally-driven and representing the aims and objectives of individual Parties in accordance with national circumstances and capacities"* (Cancun Agreement).

Though no formally agreed definition exists, LEDS are generally used to describe forward-looking national economic development plans or strategies that encompass low-emission and/or climate-resilient economic growth[1]. LEDS have been specifically mentioned in the Copenhagen Accord, which recognized that a LEDS is indispensable to Sustainable Development (SD).

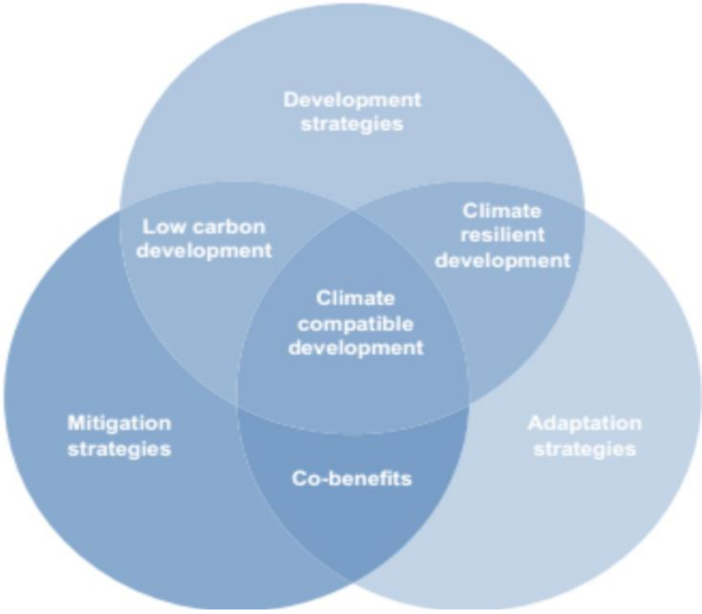


Figure 1. Relationship between Development Strategies and Climate Change Thematic Areas[2]

Possessing the attribute "low emission," the concept of LEDS is predominantly related to the climate change mitigation thematic area, essentially emissions reduction. Therefore, as presented in Figure.1 the low carbon development coincides with the intersection between development strategies and mitigation strategies. In the most vulnerable countries, the adaptation to climate change could also be an issue, which united with development strategies will produce climate resilient development. Finally, when mitigation and adaptation are integrated in the development strategies, one could talk about climate compatible development (low carbon + climate resilient development).

[1] Clapp C., Briner G., Karousakis K., Low-emission Development Strategies (LEDS): Technical, Institutional and Policy Lessons, OECD, IEA, 2010.

[2] Source: Climate & Development Knowledge Network (CDKN), http://cdkn.org/?loclang=en_gb

In short, the LEDS can be understood as a strategy for developing societies while at the same time reducing the greenhouse gas (GHG) emissions (mitigating climate change). Therefore, the concept of "*mitigation potential*" has been developed to assess the scale of GHG emission reductions that could be made, relative to emission baselines, for a given level of carbon price (expressed in cost per unit of carbon dioxide equivalent emissions avoided or reduced). The GHG emission reduction is realized with the implementation of specific measures and/or practices which are called *mitigation measures and practices*.

Basically, the mitigation potential of a given measure/practice accounts for the following two parameters:

- ***Environmental effectiveness*** – volume of GHG reduction achieved annually with implementation of the given measure/practice, expressed in tons CO_2-eq (How much can be reduced?).
- ***Economic effectiveness*** (also called specific cost) – the annualized finances needed to reduce 1 ton CO_2–eq. with the given measure/practice, expressed in US$/ton CO_2-eq (How much does the reduction of 1 ton CO_2–eq. cost?).

Incorporated in the national developmental pathways, appropriately selected LEDS options could help in harnessing the immense potential for reduction of GHG emissions over the sectors, delivering at the same time benefits for some or all dimensions of sustainable development.

The global mitigation potential is associated with a number of sectors – energy supply, transport, buildings, industry, agriculture, forestry and waste, while it can be realized worldwide – in OECD countries, non-OECD countries, as well as in the countries with economies in transition (Figure 2)

The biggest mitigation potential lies in the sector of buildings, both in terms of achievable reduction as well as in terms of mitigation costs. The buildings mitigation potential is almost equally distributed in OECD and non-OECD countries. In all other sectors, the non-OECD region has higher mitigation potential than the one of OECD region.

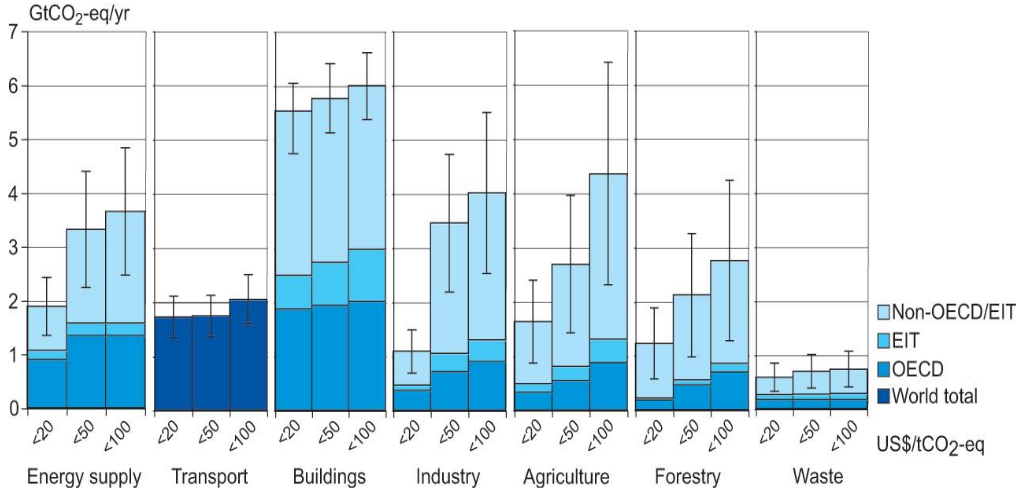


Figure 2. Estimated Sectoral Potential for Global Mitigation for Different Regions as a Function of Carbon Price in 2030 from Bottom-up Studies, compared to the Respective Baselines Assumed in the Sector Assessments[3].

[3] Source: Intergovernmental Panel on Climate Change (IPCC). IPCC Fourth Assessment Report: Climate Change 2007, Working Group III: Mitigation of Climate Change

The LEDS may serve a range of domestic purposes for government, the private sector, the general public and other institutions and stakeholders, as well as the international community. The process of establishing a LEDS can enhance coordination across different ministries and communication with other stakeholder groups such as businesses and civil society, and increase public awareness of climate change science and policy. The LEDS can help guide diversification of an economy. Clarification on economic development and climate change priorities can in turn help providing early signals to investors in the private sector, as well as for new possible directions for research and development. The LEDS can identify priorities for climate actions and identify needs for funding and support.

Beyond the domestic functions that are served by the LEDS, this strategy can also enlighten the international community in a variety of ways. Most importantly, the LEDS could highlight gaps and identify priority actions for funding to the international community. Furthermore, the LEDS can provide information to better assess global climate change impacts and actions and how mitigation actions are expected to impact emission trajectories. Consequently, the LEDS should be utilized as a basis for implementation of the nationally determined contribution (NDC) under the Paris Agreement and for developing a renewed NDC.

In Georgia, the LEDS process was initiated in 2012. On December 17, 2012, USAID and the Ministry of Environment Protection of Georgia signed a memorandum of understanding that supports LEDS and provides the framework for bilateral cooperation in Georgia. Areas for cooperation included activities that increase and encourage the use of clean and energy efficient resources; support the development of a national GHG inventory system; improve the policy environment in low emission economic growth; expand economy-wide and technical modeling efforts; and improve governance of Georgia's natural resources.

The purpose of the Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) Clean Energy Program, funded by USAID/Caucasus, was to support Georgia's efforts to increase climate change mitigation through energy efficiency and clean energy. The broader goal was to enable more responsible management and development of Georgia's natural endowments.

The bilateral EC-LEDS initiative provided a strategic framework for the Government of Georgia (GOG) to articulate concrete actions, policies, and programs that slow the growth of emissions, while advancing economic growth and meeting Georgia's development objectives. This framework provided a foundation for achieving long-term, measurable GHG emission reductions, as compared to a business-as-usual development pathway, and improving environmental management in Georgia. Representatives of the U.S. Government, including USAID, and representatives of the GOG (from various ministries) formed working groups to achieve the goals and actions agreed upon by both countries in the Memorandum of Understanding.

On July 23, 2013, the government of Georgia issued a Resolution (No 184) on Creation of Steering Committee (SC) for Development of Georgia's Low Emission Development Strategies. The SC of the Georgia's Low Emission Development Strategies was formed with the Committee members: Minister of Environment and Natural Resources Protection of Georgia; Deputy Minister of Environment and Natural Resources Protection of Georgia; Deputy Minister of Energy; Deputy Minister of Education and Science of Georgia; Deputy Minister of Agriculture; Deputy Minister of Regional Development and Infrastructure; Deputy Minister of Labor, Health and Social Protection of Georgia; Deputy Minister of Economy and Sustainable Development; Deputy Executive Director of the National Statistics Office of Georgia; USAID Caucasus Mission Director; Head of Energy and Environment Office of USAID Caucasus Mission in Georgia.

The main function of the SC was to develop and execute LEDS supported by Exert Working Group (WG) and sectorial sub-working groups (sub-WG) (Figure 3):

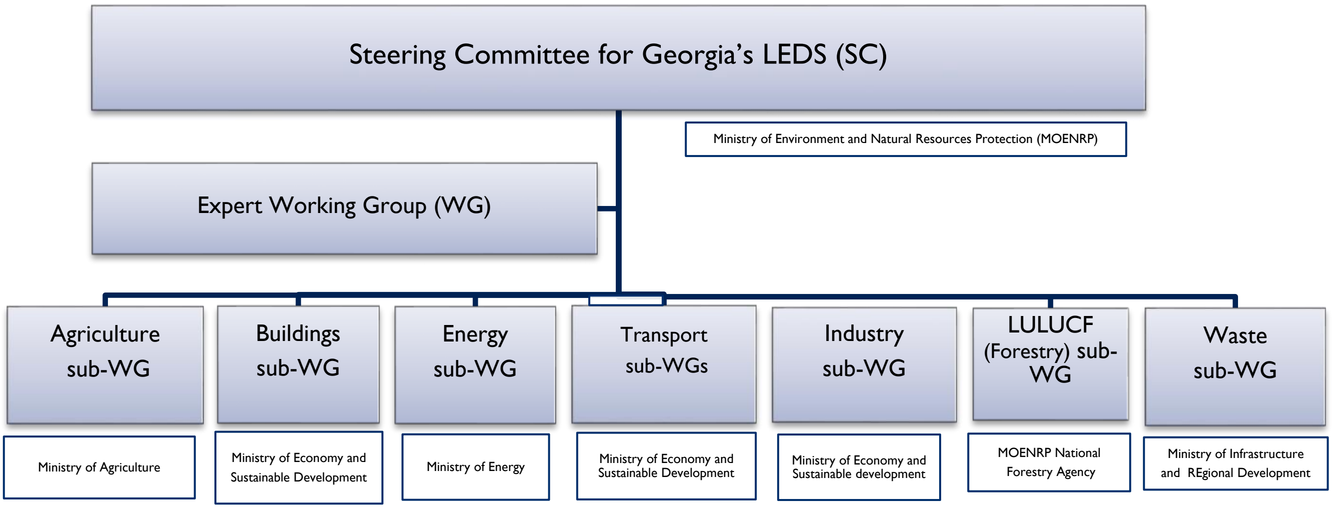


Figure 3. LEDS Steering and Working Bodies

The SC was mandated to:

- Direct the process for developing and executing the LEDS
- Approve the detailed work plans for each of the issues, activities, and elements identified in the Memorandum of Understanding (MOU),
- Delegate tasks and responsibilities relating to the work and activities of the MOU to members of the Committee,
- Approve the working schedule of the WG,
- Review and approve the WG deliverables and present them to the Government of Georgia for consideration,
- Create sectorial working groups under the WG for elaboration of LEDS in respective sectors.

The WG functions included (but were not limited to):

- Defining the WG's priorities
- Developing detailed work plans for each of the issues, activities, and elements identified in the LEDS MOU with the USG
- Identify priority sectors and elaborate LEDS for these sectors
- Invite experts in specific areas for solving particular issues
- Report on the progress of the WG's activities to the SC

The sub-WGs were established for the following sectors: Agriculture, Buildings, Energy, Transport, Industry, LULUCF (Forestry) and Waste. The sectoral sub-WGs developed the LEDS components for the respective sector by producing data, analyses and documents that include:

- Data and key sectorial assumptions for the Business-as-usual emissions projections and alternative scenarios to be considered
- Draft sectorial mitigation actions and a list of key indicators to be used to evaluate them
- Economic and other analyses of various policy and sectorial programs and approaches relevant for LEDS
- Integration of the LEDS analyses and planning into economic development planning processes in the relevant sector(s)
- Draft and final versions of the sectorial LEDS components

Furthermore, each of the LEDS components was developed through a transparent and participatory process. Each sub-WG included relevant key stakeholders and institutions with access to data and analysis. The sub-WG Chair was responsible for identifying candidate sub-WG members and submitting them to the Secretariat, for review and approval.

EXECUTIVE SUMMARY

The Georgia's Low Emissions Development Strategy (LEDS) was prepared under the US Agency for International Development (USAID) Enhancing Capacity for Low Emissions Development Strategy (EC-LEDS) Clean Energy Program for Georgia, which supports increased climate change mitigation by building capacity to stimulate private sector investment in energy efficiency and green buildings, raising public awareness, and strengthening Government of Georgia (GOG) capacity to develop and implement a national LEDS.

On December 17, 2012, USAID and the Ministry of Environment Protection of Georgia signed a memorandum of understanding that supports LEDS and provides the framework for bilateral cooperation in Georgia. Marking the start-up of the LEDS processes, the GOG issued a Resolution on Creation of Steering Committee (SC) with a mandate to develop and execute LEDS. The SC was composed of

- Minister of Environment and Natural Resources Protection of Georgia,
- Deputy Minister of Environment and Natural Resources Protection of Georgia,
- Deputy Minister of Energy of Georgia,
- Deputy Minister of Education and Science of Georgia,
- Deputy Minister of Agriculture of Georgia,,
- Deputy Minister of Regional Development and Infrastructure of Georgia,
- Deputy Minister of Labor, Health and Social Protection of Georgia,
- Deputy Minister of Economy and Sustainable Development of Georgia,
- Deputy Executive Director of the National Statistics Office of Georgia,
- USAID Caucasus Mission Director, and
- Head of Energy and Environment Office of USAID Caucasus Mission in Georgia,

and supported by Exert Working Group (WG) and sectorial sub-working groups (sub-WG) established for the following sectors: Agriculture, Buildings, Energy, Transport, Industry, LULUCF (Forestry) and Waste. Winrock International was a leader of the EC-LEDS Clean Energy Program, while the analytical work was performed by DecisionWare Group (DWG) and Sustainable Development Center Remissia in cooperation with Winrock International and the Ministry of Energy Analytical Department (MoE-AD).

The LEDS is meant to serve a range of domestic purposes and enlighten the international community in a variety of ways. Domestic purposes include enhancing coordination across different ministries and communication with other stakeholder groups such as businesses and civil society, increasing public awareness of climate change science and policy and helping and guiding diversification of the economy. Also, identifying priorities for climate actions and needs for funding and support, the LEDS helps providing early signals to investors in the private sector, as well as new possible directions for research and development. Accordingly, the LEDS should be utilized as a basis for implementation of the Intended Nationally Determined Contribution (INDC) under Paris Agreement and for developing a renewed INDC.

The LEDS is composed of three main parts. Part I provides the international context and elaborates the achievements needed for realization of the "Georgia 2030 - LEDS Vision".

Two major international processes – the new international climate agreement under the United Nation Framework Convention on Climate Change (Paris Agreement), and adoption of Sustainable Development Goals (SDGs) by the United Nations General Assembly as part of the 2030 Agenda for Sustainable Development, represented the main international context of the Georgia's LEDS process. Georgia needs to make strong and determined steps towards shifting the economy to a low emission development pathway in order to fulfil its INDC commitment by 2030. Furthermore, at

European level, the LEDS process could contribute toward fulfilling certain part of the commitments undertaken under the Association Agreement, and specifically for the area of energy, under the Energy Community.

Against this backdrop, through a transparent and participatory process including relevant key stakeholders and institutions with access to data and analysis, the LEDS guides and combines the development of eight LEDS sectors into one coherent, thought-through low emission high economic growth roadmap towards 2030:

	• A maximum of 2% losses from the gas distribution system • Hydropower generating 85% of electricity • 150 MW of wind power plants in place • Modern, efficient combined cycle power plants replacing the two existing inefficient gas-fired power plants
	• 50% of new purchases of electric appliances are based on advanced technologies • 50% of the existing public buildings completely are renovated • 50% of private commercial buildings are retrofitted • At least 20% higher energy efficiency of all newly constructed residential and commercial buildings • 40% of the existing residential buildings are completely renovated • 80% of new biomass heating stoves in rural households are efficient biomass stoves • 30% of all new water heaters in households are solar water heaters • 50% of all commercial water heaters are solar water heaters • 90% of all public lighting fixtures are replaced with LED bulbs

Transport

- 15% improvement of average vehicle efficiency
- 5% market share for hybrids and 1% market share for electric vehicles
- A shift of 3.8% of total passenger transport demand to bus and away from LDV and minibus
- 60% of total bus fleet used for passenger transportation run on clean energy
- 3% decrease in LDV transport demand
- At least 9% railway's share in total passenger transport
- At least 50% railway's share in total freight transport

Industry

- Several energy efficiency measures implemented in Rustavi Azoti plant (savings of up to 434TJ of natural gas and 612TJ of electricity)
- 30% utilization of advanced process heat technologies in food industry
- Coke intensity improved by 20% and electricity intensity by 5% in ferroalloy production
- 15% reduction in gas consumption in iron and steel industry (Rustavi Steel)
- Natural gas savings of 5.1 TJ annually at Heidelberg Cement Georgia
- Dry processing introduced in the cement industry (two plants of Heidelberg Cement Georgia)
- 50% utilization of advanced and variable speed motors in all industrial plants
- 5% increase of limestone share in clinker in all cement plants
- Replacement of 50% of clicker by fly ash in all cement plants
- CO_2 solvent scrubbing introduced in ammonia production (Rustavi Azoti)
- Oxidation step optimized in nitric acid production (Rustavi Azoti)

Agriculture

- Up to 80% of dairy cattle and 12% of medium and small sized cattle kept in smaller farms subjected to forage quality optimization and feed improvement
- Covered lagoon type of animal waste management system used in 90% of commercial dairy farms

Waste

- Complete reprocessing of solid waste generated throughout Tbilisi
- 80% of methane emissions from Tbilisi and Rustavi landfills, new Adjara and other new regional landfills throughout Georgia, captured and flared
- Kutaisi, Telavi and Borjomi landfills closed (80% of their methane emissions captured and flared)
- Extraction of organic fraction for further composting in 20% of the new regional landfills
- 80% of methane generated at Adlia wastewater treatment plant captured and flared
- Legal base for incineration and co-incineration practices established

LULUCF

- An area of 36,500 ha of forest rich in biodiversity and typical of local habitats on the degraded areas
- 51 ha cultivated forest plantation on free areas of the forest fund lands
- Natural forest renovation supported on the area of 361ha
- Approximately 20% of the territory of Georgia are protected areas
- Introduction of sustainable forest management for 295,000 ha
- Illegal felling reduced by at least 50%

Figure 4 depicts the relation between starting (2014) and ending (2030) points, as well as deviation in the ending points of the two GHG emission trajectories - first, when the Georgia 2030 – LEDS vision is achieved (LEDS scenario) and second, which assumes continuation of the current policies and practices (Business As Usual – BAU scenario). The full mitigation potential of the LEDS scenario will slow overall emission growth from 127% above 2014 levels to just 33%, reducing GHG emissions in 2030 by some 42% compared with the BAU.

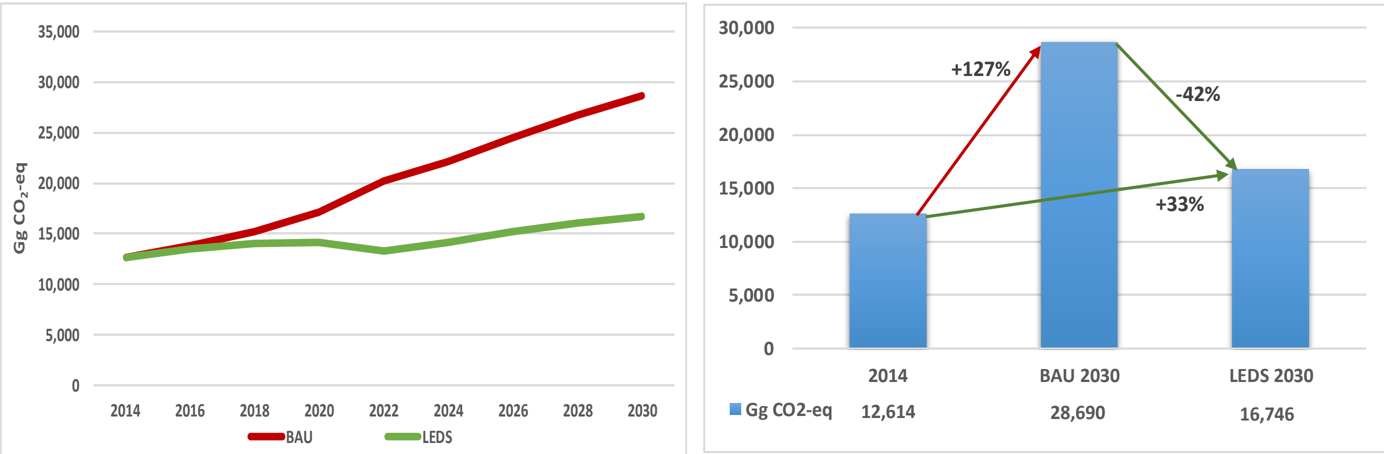


Figure 4. BAU and LEDS Emissions

Part II of the LEDS delves into the details of Georgia's LEDS sectors by defining sectoral strategies and goals within the context of Georgia's national strategy. The analyses of the energy LEDS sectors (energy supply, buildings, transport and industry) were performed using the MARKAL-Georgia model and the best available local data, augmented by international data for future technology characterizations. The sector-specific LEDS measures were identified by sector-based working groups as the most feasible and implementable options for Georgia, and the model calculated the quantitative metrics of the impacts of each option, as well as the aggregated impact when several potentially overlapping measures are combined.

Likewise, a number of sectoral experts were engaged to identify most practical and implementable options to reduce GHG emissions in the non-energy sectors (industrial processes, agriculture, waste and Land Use, Land Use Change and Forestry (LULUCF)). These measures have been incorporated into the MARKAL-Georgia model. It should be noted that developing cost estimates for many of the measures is challenging and for some measures no cost estimates were able to be provided. As a result, the examined LEDS scenario is prescriptive in nature - that is each measure identified by the experts is assumed to occur at a particular (or ongoing) point in time and achieve the (maximum) level of reduction that has been determined as feasible and policy-wise acceptable.

The eight chapters of Part II (sectoral chapters) provide background information of the respective LEDS sector (facts and figures, subsectors, institutional and legislative framework), address the sectoral strategic aspects (strategic goals, challenges and barriers and requirements associated with EU accession) and report the sectoral GHG emissions (by gases and by subsectors, specific emissions and historical trends). Furthermore, the sectoral chapters elaborate the sectoral BAU and LEDS scenarios – the drivers and assumptions and GHG emission trajectories.

A template-table is used to detail all sectoral LEDS measures which are aggregated in Annex I: Low Emission Development Pathway.

Finally, Part III deals with implementation aspects of the LEDS, starting from the required institutional and legal framework and technological base, through the financing options and framework to measure, report and verify the implementation, to the variety of capacity building needs and strategy to communicate and raise awareness about LEDS.

The key institutional challenge is to build leadership, trust, and mutual accountability in advancing the LEDS. Political commitment at the highest level, GOG (Cabinet of Ministers), facilitates the necessary institutional arrangements and coordination across ministries and can increase engagement and awareness both domestically and internationally.

Along this line is also the function of the National Contributions Board, which was created on initiative of the Ministry of Environment and Natural Resources Protection and consists of high officials (at least deputy ministers) from all ministries within the government that are relevant to climate change and economic development. In order to set up an effective mode for working across relevant ministries and other institutions, the following cross-ministerial committees shall be established: Legal Committee, Financial Committee, Innovations and Technologies Committee, Committee for Involvement of Self-governing Units, Committee for Involvement of Private sector and Monitoring Committee. The monitoring shall be guided by Information Monitoring and Knowledge Management System, while the role of Secretariat can be granted to the Climate Office of the Ministry of Environment and Natural Resources Protection.

As to the legal framework, a gap analyses was conducted of the current legislative acts, by-laws and other normative acts, as well as policy documents, strategies and programs. A range of recommendations were developed, enforcement of which will support implementation of the LEDS measures.

Due attention has also been devoted to LEDS technologies. The country specific technology needs were assessed and a number of recommendations derived to facilitate technology transfer and development: Modernization of educational system of the country (particularly technical educational and academic institutions), establishment of joint technological institutes and joint enterprises in the priority areas, nomination of Georgia's representative in the Climate Technology Center established under the UNFCCC and adoption and enforcement of appropriate legislative base including tax and other financial regulations.

The chapter on attracting finances proposes a Climate Finance Strategic Roadmap, which, while not a complete National Climate Finance Strategy, aims to provide the strategic directions and describe some of the critical success factors required for attracting public and private sector financing for full scale implementation of the LEDS measures. The main recommendations can be summarized as follows: Establishment of a national level financial institution – Georgian Green Investment Bank, set up a Climate Intelligence Taskforce, and creation of additional sources of financing and integration of these into Blended Finance transactions.

The progress towards goals should be continuously tracked through an appropriate measuring, reporting and verification (MRV) framework. Developing an adequate country-specific MRV framework is also among the LEDS components. The ssuggested MRV framework is based on already existing MRV elements in programmes/projects in the country that are relevant to LEDS. It identifies all institutions to be involved in the system, describes their respective functions and provides a clear mechanism for an effective data/information flow among those institutions, as well as options for data/information archiving and analysis. The responsible body for monitoring is the Ministry of Environment and Natural Resources Protection (Climate Change Office), together with Ministry of Energy and Ministry of Economy and Sustainable Development, which are responsible for monitoring the energy efficiency national action plan and renewable energy action plan.

Capacity building represents another implementation aspect and is dully addressed in the Georgia's LEDS. A Capacity Building Gap Analysis Survey was conducted with respondents selected from six ministries, in order to identify and analyze the capacity barriers and gaps of the GOG and to develop pertinent recommendations for their alleviation.

Finally, to engage effectively with the stakeholders, a LEDS communication strategy was designed, which defines the most appropriate messages and channels of communication with various stakeholder groups and contributes towards a wide understanding what LEDS is about, as well as towards changes in behavior and perceptions where necessary.

PART 1: NATIONAL APPROACH TO SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

1.A. INTRODUCTION: INTERNATIONAL CONTEXT

The year 2015 was a significant turning point for both the climate and sustainable development agendas. Two major international processes were concluded: the adoption of a new international climate agreement, the Paris Agreement, under the UNFCCC, and the adoption of the Sustainable Development Goals (SDGs) by the United Nations General Assembly (UNGA) as part of the 2030 Agenda for Sustainable Development.

The Association Agreement (AA) between the European Union (EU) and Georgia, which aims to deepen political and economic ties became a reality in July 2016. The AA will enhance cooperation between the EU and Georgia in many areas including, for example, environmental protection, social development and protection, transport, consumer protection, education, youth and culture, industry, and energy.

Specifically, for the area of energy, in October 2016, the 14th Energy Community Ministerial Council approved the accession of the Republic of Georgia to the Energy Community Treaty. The Parliament of Georgia ratified it on April 21 with all 89 members of the Parliament present voting unanimously in favor of endorsing the agreement on joining the Energy Community, an organization uniting the European Union member states and its neighbors with the aim to create an integrated European energy market.

SECTION ONE: PARIS AGREEMENT

The Paris Agreement is underpinned by 162 proposed nationally determined contributions (INDCs) that reflect the national climate policies and actions of 189 countries. Once countries formally join the Paris Agreement, their "INDCs" will be considered "NDCs" for the purpose of the Paris Agreement. The Agreement provides a broad foundation for meaningful progress on climate change, and represents a dramatic departure from the Kyoto Protocol and the past 20 years of climate negotiations. Indeed, covering close to 100% of global emissions is in significant contrast to the Kyoto Protocol, which now covers countries (Europe and New Zealand) accounting for no more than 14% of global emissions (and 0% of global emissions growth).

The main highlights are the following:

- Article 2 of the Agreement reaffirms the goal of limiting the global average temperature increase above the pre-industrial level to 2 degrees C, and adds 1.5 degrees C as something even more aspirational.
- Article 3 makes it clear that the INDC structure is central and universal for all parties, although Article 4 introduces references to the circumstances of developing country Parties.
- Article 4 describes transparency requirements (domestic monitoring, reporting, and verification). This is crucial, and represents a striking compromise between the United States and Europe on one hand, and China and India on the other hand. All countries must eventually face the same monitoring and reporting requirements, regardless of their status as developed or developing.
- Article 6 provides for international policy linkages, not only international carbon markets, but international linkage of other national policy instruments.
- Article 9 discusses "finance," but the numbers do not appear in the Agreement, only in the accompanying Decision, where item 54 states that by 2025, the Parties will revisit the total quantity of funding, using the current $100 billion target as a "floor."

- Article 8 on Loss and Damage was necessary from the point of view of the most vulnerable countries, but the most contentious issue is settled in Decision 52, where the Parties agree that this "does not involve or provide a basis for any liability of compensation."
- Article 14 includes five-year periods for the submission of revised INDCs (and global stocktaking of the impact of the Paris Agreement), that are included in the first stocktaking review in 2018, with the start date for new INDCs set for 2020.

On 5 October 2016, the threshold for implementation of the Paris Agreement was achieved - at least 55 Parties to the Convention accounting for at least 55 percent of the total global greenhouse gas emissions submitted their documents for ratification, acceptance, approval, or accession. The Paris Agreement entered into force on 4 November 2016. The first session of the Conference of the Parties to the Paris Agreement (CMA1) took place in Marrakech, Morocco in conjunction with the Conference of Parties 22 (COP 22) and the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP 12). Meanwhile, a decision has been made by the US to withdraw from the Paris Agreement.

At the 2017 G20 summit in Hamburg, 19 members of the Group of 20 stated that the Paris Agreement is irreversible and reiterated the importance of fulfilling the UNFCCC commitment by developed countries in providing means of implementation including financial resources to assist developing countries with respect to both mitigation and adaptation actions in line with Paris outcomes. They reaffirmed their strong commitment to the Paris Agreement, moving swiftly towards its full implementation in accordance with the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances and, to this end, agreed to the G20 Hamburg Climate and Energy Action Plan.

It is clear that the problem has not been solved, and it will not be for years to come, but the new approach presented by the Paris Agreement can be a key step toward reducing the threat of global climate change.

As the Climate Action Tracker has noted (Figure 5), the national mitigation contributions associated with the Paris Agreement, even counting the US, would lead to a median warming of around 2.7°C by 2100 (a full range of 2.2-3.4°), which means there is a likely chance of holding warming below 3°C, but not below 2°C

The emissions gap in 2030 between governments' INDCs and a 2°C consistent pathway, currently around 17 $GtCO_2eq$, can be reduced by 25-45%, without imposing additional economic burdens over the next 15 years on the governments undertaking the additional effort.

A positive element in the Paris Agreement is that countries are asked to 'formulate and communicate long-term low greenhouse gas emission development strategies.' Developed countries that already have 2050 targets can review their plans in the context of the agreed goals, as most of these plans must be strengthened, and developing countries can build on the experience of the INDC process to work from existing plans and develop longer-term visions.

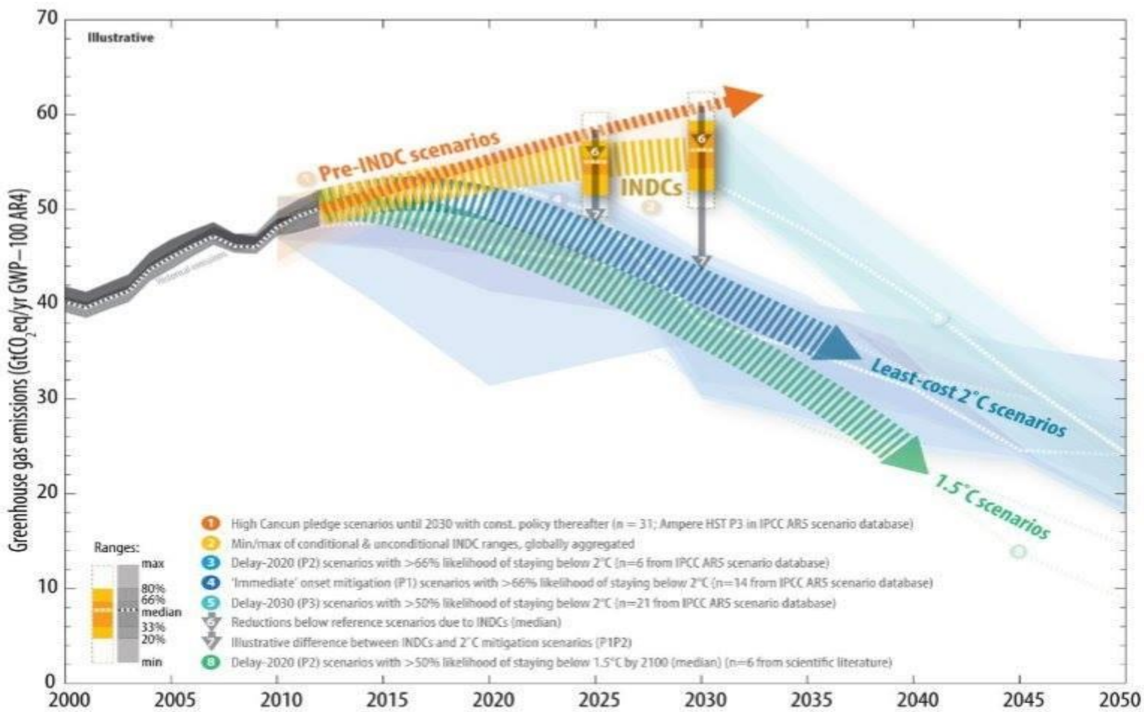


Figure 5. Emissions pathways under current policy and pledge scenarios[4]

Elements crucial to reaching the ambitions of the Paris Agreement are:

- Provisions to update the actions of countries every five years, while each successive step must be equally as strong as the current one. This starts with a government submitting an updated climate pledge when it ratifies the agreement. Then new or renewed contributions for 2030 must be submitted 9-12 months in advance of the Conference of the Parties in 2020.
- A government can adjust its contribution to enhance its climate action pledge at any time.
- Individual review of the actions will include suggestions for improvement for each country.
- A global stock-take will regularly measure progress, starting in 2018.
- A facilitative implementation committee will assist governments in implementing their pledged actions.
- Countries will continue to work together to increase ambitions before 2020.

The initiated LEDS process in the country and the Strategy itself should be utilized as a basis for NDC implementation and for developing a renewed NDC.

[4] Source: Climate Action Tracker, http://climateactiontracker.org/

SECTION TWO: SUSTAINABLE DEVELOPMENT GOALS

In September 2015, the countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda: Transforming our world: the 2030 Agenda for Sustainable Development (

Figure 6):

Figure 6. The 17 Sustainable Development Goals[5]

Each goal has specific targets to be achieved over the next 15 years. All the vested actors need to do their part: governments, the private sector, academics, civil society, and individuals if the goals are to be reached.

LEDS is directly related to SDG 13 which calls for an urgent action to combat climate change and its impacts along three lines:

- Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Target 13.2: Integrate climate change measures into national policies, strategies and planning.
- Target 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

The most important cross-sectoral linkages of SDG 13 include the following sectors:

- Climate Change Adaptation and Resilience: Agriculture and food security, forestry, health, water resources, biodiversity, spatial planning, land management, urban planning, rural development, tourism, and disaster risk reduction.

[5] Source: http://www.un.org/sustainabledevelopment/sustainable-development-goals/

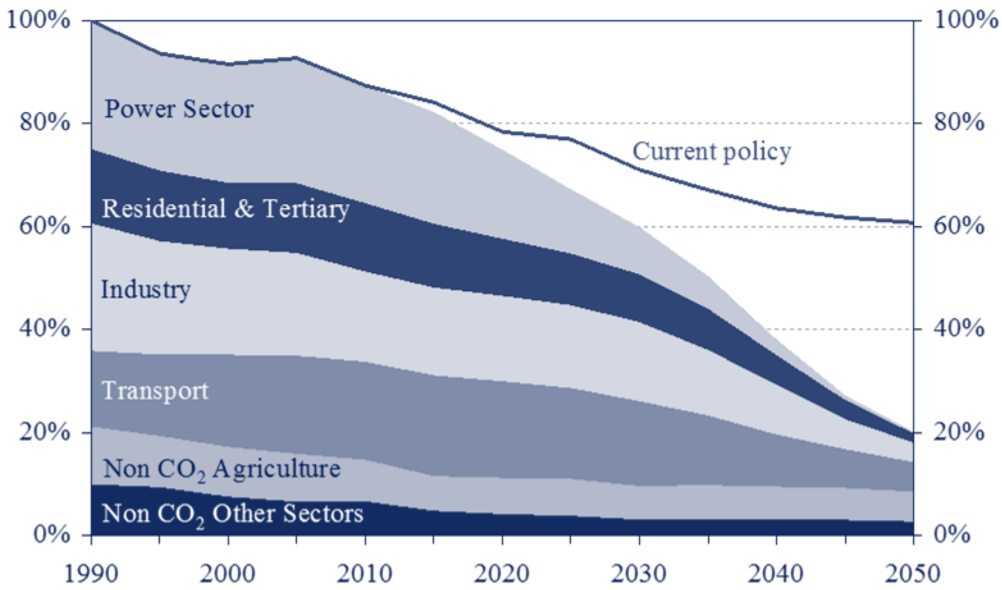
- Climate Change Mitigation: energy, transport, buildings, industry, waste, water, agriculture, and forestry.
- Climate Change horizontal issues: education, R&D and innovation, communication strategies of relevant sectors, reforms of administration, and gender.

Linkage with other SDGs: SDG 13 is interconnected with almost all, but the most pronounced connection is demonstrated with SDG 7: Affordable and clean energy, SDG 11: Sustainable cities and communities, SDG 3: Good health and well-being, SDG 12: Sustainable Consumption and Production and SDG 15: Life on Land.

Mostly, the SDG 13 indicators are global, measuring the number of countries that adopted/implemented/integrated something. Therefore, at the country level, those indicators will be a YES/NO type. The master indicator for SDG 13 will be the national greenhouse gases emissions. Other national indicators could include, but are not limited to: investments in mitigation, investments in adaptation, carbon intensity (emissions per GDP, or per capita) and others.

SECTION THREE: EUROPEAN UNION LOW CARBON VISION

Particularly relevant for LEDS is the flagship initiative for resource efficient Europe[6], which, besides a White Paper on Transport and the Energy Efficiency Plan, delivered a Roadmap for moving to a competitive low carbon economy in 2050[7]. To keep climate change below 2°C, the European Council reconfirmed the EU objective of reducing greenhouse gas emissions by 80-95% by 2050 compared to 1990 (Figure 7) in the context of necessary reductions according to the Intergovernmental Panel on Climate Change by developed countries as a group. This is in line with the position endorsed by world leaders in the Copenhagen and the Cancun Agreements. These agreements include the commitment to deliver long-term low carbon development strategies. Some Member States have already made steps in this direction, or are in the process of doing so, including setting emission reduction objectives for 2050.



6 European Commission. A resource-efficient Europe – Flagship initiative under the Europe 2020 Strategy. COM(2011) 21, 26.1.2011. http://ec.europa.eu/resource-efficient-europe/

7 European Commission. Roadmap for moving to a competitive low carbon economy in 2050. COM(2011) 112 final, 8.3.2011.

Figure 7. EU GHG Emissions towards an 80% Domestic Reduction (100% - 1990)[8]

The Roadmap identifies possible action up to 2050 which could enable the EU to deliver greenhouse gas reductions in line with the agreed 80-95% target. It outlines milestones which would show if the EU is on course for reaching its target, policy challenges, investment needs and opportunities in different sectors, bearing in mind that the 80 to 95% reduction objective in the EU will largely need to be met internally. It also shows the path for the main sectors responsible for Europe's emissions; power generation, industry, transport, buildings and construction and agriculture. All of these sectors can make the transition to a low-carbon economy most cost-effectively.

[8] Source: European Commission. Roadmap for moving to a competitive low carbon economy in 2050. COM (2011) 112 final, 8.3.2011.

1.B. GEORGIA NOW

FOREWORD

Georgia is situated at the crossroads of Europe and Asia, specifically, in the Caucasus. It is bounded to the west by the Black Sea, to the north – the Russian Federation, to the south-east –Azerbaijan, to the south – Armenia and Turkey.

Almost all types of the subtropical climate are present in Georgia – humid subtropical, moderately humid, moderately dry and dry-continental. This is due to its position at the boundary of the subtropical and moderate climatic zones, as well as the presence of natural barriers – the Caucasus mountain range and southern highland region and the impact of the Black Sea.

The area of Georgia is 69,700 sq.km, and the population as of 2014[9] was 3,718,200. Tbilisi, a city in East Georgia is the capital of the country. As of 2014, the population of Tbilisi is 1,114,600. 57.2 percent of the population of the country live in urban areas, and 42.8 percent in rural settlements[10].

Following the breakup of the Soviet Union and the restoration of independence by Georgia, the economy of the country effectively collapsed entirely. The shift to decentralized management, for which the country appeared not to be ready, along with the stoppage of the supply of energy resources has had especially large negative effect on the economy of the country. As a result, industry was halted, natural gas supply to inhabitants was ceased and electricity was supplied based on a schedule. Naturally, in these conditions, greenhouse gas emission in Georgia plunged sharply (it was the lowest in 1995) and this was attended by the reduction of forest fund – the source of capturing CO2, since firewood became main source of heat during 1995-1997. During that period, the consumption of firewood by the country reached about 4 million m^3 and this process is still underway. In 2014, the amount of firewood derived and consumed through illicit cutting, according to official statistics, was 2.5 m^3. The trend of change of total emissions in Georgia in 1990-2014 is presented in Figure 8.

9 As in the Low Emission Development Strategy

10 http://www.geostat.ge/cms/site_images/_files/georgian/population/Population%20press_28%2004_2017%20geo.pdf

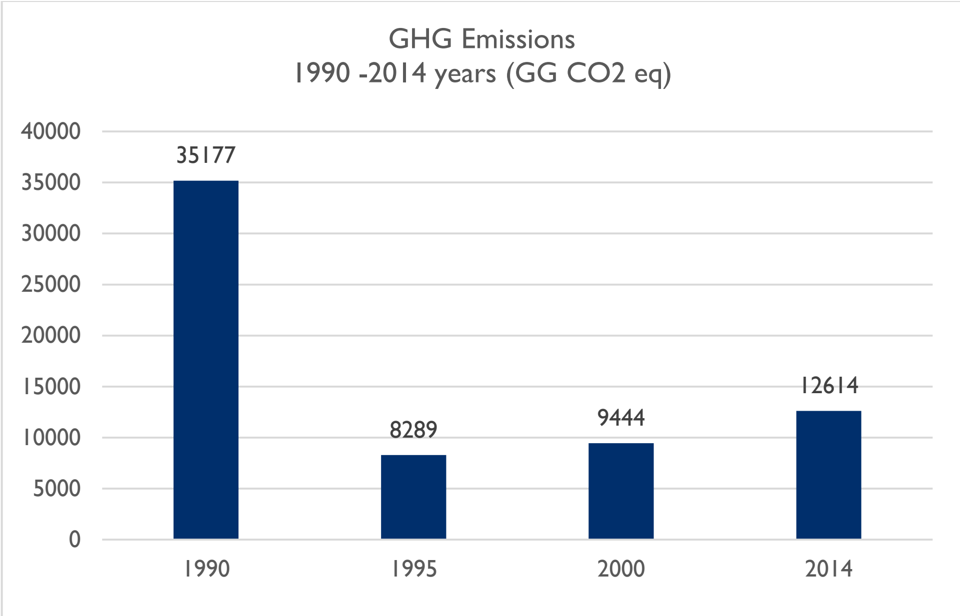


Figure 8. Net greenhouse gases emission in 1990-2014

The relationship between the economy and greenhouse gas emissions is evident from Figure 1, although main goal of the Low Emission Development Strategy (LEDS) is to ensure fast and effective increase of economic parameters so that greenhouse gases are not increased but are decreased. For this version of the Strategy, 2014 has been taken as a baseline year and respectively economic, or other parameters are mainly assessed relative to 2014 indicators. greenhouse gas emissions in CO2 equivalent (CO2 eq.) as of 2014, for the sectors covered in the document are provided in Figure 9.

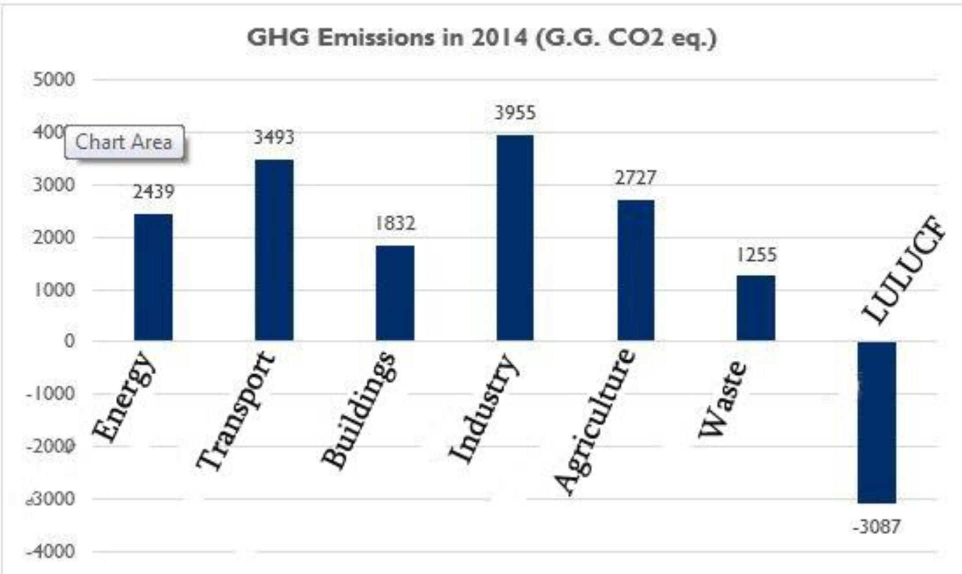


Figure 9. Greenhouse gas emissions in 2014 from various sectors of economy of Georgia

Later, this collapse was followed by two waves of economic reforms. Reforms that formed the institutional basis for a new economic system, were implemented following the crisis in early 1990's.

At the first stage of the reforms, this policy has resulted in stimulating economic growth, which was delayed by late 90's. The second wave of reforms launched in 2004, were directed at market liberalization, demonstrated by the reduction of the number of taxes, permits, licenses, among other issues. During earlier years, state investments served as one of the key factors for economic growth, majority of these investments were directed at infrastructure projects. Furthermore, the share of workforce in the economic development was negative and was on average characterized by 1.6% falling trend[11]. During these years, there was the expectation that FDIs would contribute to obtaining new knowledge and the introduction of technologies, which is a precondition for export growth and diversification and the creation of new jobs. Although, the scale of these processes was not sufficient for facilitating long-term economic growth. Specifically, majority of investments were directed at capital intensive fields, where the scale of employment is low. One of the key directions of this strategy, without which it cannot be implemented, is the very supporting of the introduction of modern technologies and their dissemination locally.

According to 2014 data, GDP per capita in Georgia was GEL 6,491.6 ($3,676.2); in 2015, this indicator was GEL 13,988 (USD 8,550.9). And according to 2016 preliminary data, GDP per capita is GEL 9,117.7 (USD 3,852.5)[12].

At present, the growth of the volume of import is a serious macroeconomic risk for the county; it has significantly outpaced the rate of export volume growth, resulting in increasing the negative foreign trade balance. Effectively, the waves of reforms and the economic policy implemented to date has not derived desirable result in respect of raising export competitiveness, and the results of this strategy have to make significant contribution in this. Effectively, it is impossible to ensure competitiveness at international and even domestic market without adopting modern technologies.

To resolve existing problems and accelerate economic development, Georgia 2020, Social Economic Development Strategy of Georgia, was approved under the June 17, 2014 Government of Georgia Decree N 400. The activities stipulated in the Strategy are aimed at forming the basis for long-term inclusive economic growth and enhancing the welfare of population.

Moreover, to establish favorable environment for doing business and FDIs, Georgia 2016-2020 Small and Medium Enterprises Development Strategy has been designed. State Program Produce in Georgia, aimed at supporting the private sector, should be noted. The Program envisages supporting enterprises engaged in industrial production and agriculture, supporting forming new enterprises / expanding/revamping existing enterprises and increasing the competitiveness of private sector and export potential growth through access to finances, immovable property and technical assistance. The following bodies are implementing Program: the Ministry of Economy and Sustainable Development of Georgia LEPLs – Produce in Georgia; Georgia Innovation and Technology Agency, National Agency of State Property, and the Ministry of Agriculture of Georgia LEPL – Agricultural Projects Management Agency. LEDS has to become one of the auxiliary sources of funding for successful implementation of this Program. Since 2015, Produce in Georgia micro and small enterprises support direction has also been launched, main goal of which is to promote increasing economic activity in the regions of Georgia. Micro and small enterprises support direction envisages two components: financial and technical assistance. As part of TA, beneficiaries will receive business and individual consulting services and will undergo trainings. Program evaluation and monitoring[13] is envisaged for increasing program effectiveness, as well as for identifying possible gaps. The Strategy monitoring system can successfully be used for this purpose.

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[11] http://www.economy.ge/uploads/ecopolitic/2020/saqartvelo_2020.pdf

[12] http://www.geostat.ge/cms/site_images/_files/georgian/nad/pres-relizi_2016_GEO.pdf

[13] http://www.economy.ge/uploads/ecopolitic/%E1%83%9B%E1%83%AA%E1%83%98%E1%83%A0%E1%83%94_%E1%83%93%E1%83%90_%E1%83%A1%E1%83%90%E1%83%A8%E1%83%A3%E1%83%90%E1%83%9A%E1%83%9D_%E1%83%91%E1%83%98%E1%83%96%E1%83%9C%E1%83%94%E1%83%A1%E1%83%98%E1%83%A1_%E1%83%92%E1%83%90%E1%83%9C%E1%83%95%E1%83%98%E1%83%97%E1%83%90%E1%83%A0%E1%83%94%E1%83%91%E1%83%98%E1%83%A1_%E1%83%A1%E1%83%A2%E1%83%A0%E1%83%90%E1%83%A2%E1%83%94%E1%83%92%E1%83%98%E1%83%90.pdf

In addition to national processes, international processes should also be noted; they will contribute to the implementation of LEDS and vice versa, the Strategy will make significant contribution to fulfilling international commitments.

One of the most important international documents signed by the GoG over the past years is the Association Agreement (AA). By signing the document, Georgia made a significant step forward on the road to EU membership. The Document – the Association Agreement between the European Union and the European Atomic Energy Community and their Member States, of the one part, and Georgia, of the other part, was signed on June 27, 2014 and it entered into effect provisionally from September 1, 2014. While, from July 1, 2016, the Agreement entered into force. The AA can provisionally be divided into three parts: political cooperation; sector based cooperation and deep and comprehensive free trade area (DCFTA)[14]. DCFTA is a crucial part of the Association Agreement. It opens the door to the EU internal market for Georgia, enabling the country to enjoy three freedoms out of four freedoms specific to the EU internal market: free movement of goods, services and capital. The fourth freedom – free movement of people – has been facilitated by the visa liberalization. furthermore, notably, sector based cooperation regulated under the Association Agreement regulates cooperation between Georgia and the EU in a number of fields, including: energy; environment; industry; transport; Georgia is required to harmonize national legislation with the EU legislation. One of the objectives in a climate change direction is the development low emission strategy. Thereby, the AA is very important in the context of the strategy as well. Specifically, activities envisaged in the Strategy and those stipulated under the AA are matching. Hence, through implementing commitments under the AA, Georgia will fulfil activities stipulated in the Strategy, and vice versa.

Georgia is actively involved in international processes related to the environment and climate change. The country has ratified UN Framework Convention on Climate Change in 1994. Next, on December 11, 1997, Kyoto Protocol was adopted and it entered into force on February 16, 2005. The Protocol set mandatory goals for the reduction of greenhouse gases for industrialized countries. Georgia acceded to the Kyoto Protocol on June 16, 1996.

On Debember 12, 2015, under the UN Climate Change Framework Convention, Paris Agreement was adopted. The Agreement mandates the parties to present activities/plans to be implemented in this direction as "nationally determined contribution". Georgia signed the Paris Agreement on April 22, 2016[15]. While, in 2015, Ministry of Environbment and Natural Resources of Georgia, in cooperation with other key ministries, prepared Georgia's Nationally Determined Contribution for presenting to the UN Climate Change Convention [16]. The part of the document relating to the reduction of greenhouse gases, is primarily based on the results from the strategy. According to the National Contribution Document, for achieving the greenhouse gases reduction goals, Georgia will be guided by the activities stipulated in the Strategy.

On April 21, 2017, the Parliament of Georgia passed a decree on Joining the Protocol about Georgia acceding with the Energy Union Founding Agreement. As a result, Georgia became a member of the Energy Union and became liable for meeting the demands of the community, which, first and foremost, envisages producing the Energy Efficiency National Action Plan and producing Georgia's First Renewable Resources Action Plan.

Moreover, in the country, by the Ministries, in relation to the matters within their scope, strategies are designed that more or less envisage issues related to the climate change. In relation to this, notably, is the Georgia Agriculture Development 2015-2020 Strategy. It should be underscored that

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14 http://www.parliament.ge/uploads/other/22/22585.pdf

15 By the Ministry of Environment and Natural Resources Protection.

16 http://moe.gov.ge/res/images/file-manager/strategiuli-dokumentebi/strategiebi-gegmebi/erovnul-doneze-gansazRvruli-wvlili.pdf

at this stage, the above-mentioned document is the only strategy that has recognized the importance of climate change. Namely, the document underscores negative impact of climate change on agricultural production and is aimed at supporting climate-smart agriculture. The latter comprises: food security ensuring through increasing production and revenues, adaptation to climate change and supporting climate change mitigation[17].

Despite the fact that certain activities are implemented at the national level, the municipal level development is ahead compared to the national level. Covenant of Mayors is a vivid example of this. In 2008, following passing the EU Energy and Climate Package, Under the European Commission city mayors initiative Covenant of Mayors was formed to promote and support local authorities in implementing energy sustainable policy. Covenant of Mayors Agreement unites local and regional authorities who voluntarily undertake the commitment to increase energy efficiency and use renewable energy sources on their territories. Covenant signatories set a goal to reduce CO2 emissions by 2020 by at least 20% versus business as usual and thereby make their contribution in the development of green environment oriented economic development and the improvement of living conditions.

From Georgia, sixteen municipalities are signatories of the Covenant of Mayors. Out of these sixteen, ten municipalities have submitted Sustainable Energy and Climate Development Action Plan that comprises activities to reduce greenhouse gases emissions until 2020 in transport, buildings, street lighting, waste and greening and their effect assessment through monitoring plans. Municipalities have already commenced acting towards implementing measures stipulated in the Action Plan. Measures envisaged by municipalities action plans and LEDSs measures are in full compliance. Therefore, through implementing LEDS activities, the country will contribute to implementing commitments taken under the Covenant of Mayors more effectively, and vice versa.

Tourism is one of the fastest growing sectors of Georgia's economy. In 2016, tourism was an important factor of economic growth. In 2016, revenues from international tourism increased by 11.9% (by $230 million) and its share in services export amounted to 65%[18]. In general, the share of tourism in GDP in Q1, 2017 was 6.8%. It should also be mentioned that although tourism is not a sector reviewed independently in the Strategy, tourism development is significantly related to the increase of energy consumption. Increased number of tourists is directly related to increasing the amount of waste; increased use of public transport and increased energy consumption by buildings (hotels, hostels). This underscores once again the importance that the country implement duly activities envisaged under the Strategy document for sustainable economic development of the country. Organized public transport and taxi sector; buildings where energy efficiency activities are implemented; organized waste management system, along with other infrastructure activities, will play crucial role in attracting tourists into the country.

This is evidenced by Georgia Tourism Strategy 2025[19] envisaging the improvement of domestic transport network, improvement of the infrastructure of the country among the means for attracting tourists to Georgia.

In the next chapter we will analyze the stage of development of the sectors stipulated in the Strategy.

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17 file:///C:/Users/zinaida/Downloads/STRATEGIA_-geo_print%20(1).pdf

18 http://www.economy.ge/uploads/publications/economy_8484723758fdf66e4c9332.50742461.pdf

19 http://www.economy.ge/uploads/ecopolitic/turizmi-/sakartvelos%20turizmis%20strategia%202025.pdf

I.C. 2030 VISION

Georgia needs to make strong and determined steps towards shifting the economy to a low emission development pathway in order to fulfil its Intended Nationally Determined Contributions (INDC) commitment by 2030. Demonstration of strong political will from the government is crucial to ensure the necessary transformational change underlying this strategy, which guides and combines the development of various Low Emissions Development Strategy (LEDS) sectors into one coherent, thought-through low carbon high economic growth roadmap. LEDS sectors are the ones that contribute to national Greenhouse Gas (GHG) emissions, offering thus opportunities for mitigation action (Figure 10).

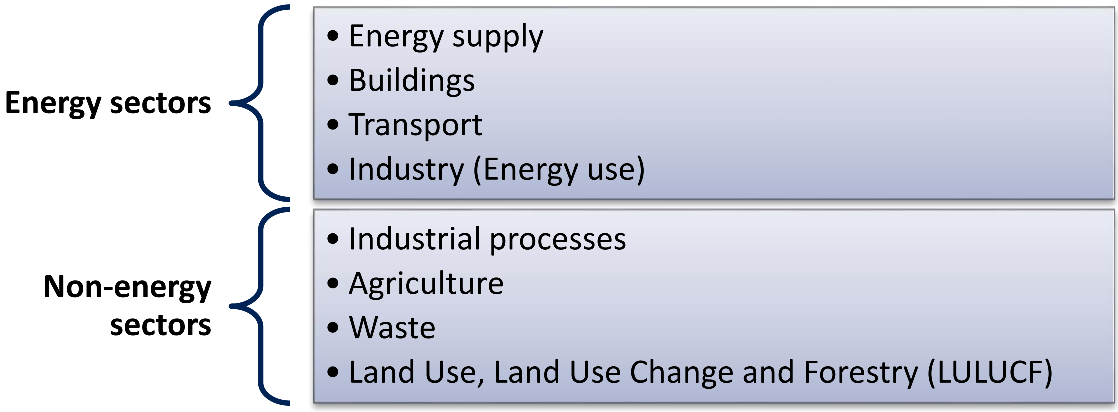
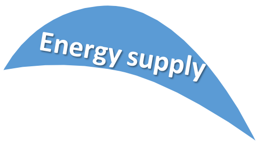


Figure 10. Georgia LEDS Sectors

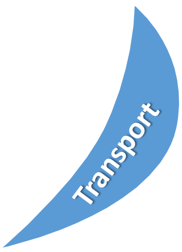
Each of the above sectors are well analysed and thoroughly examined, while their interaction and mutual impacts are fully considered with a methodology that identifies pathways to minimize costs and maximize benefits to the country's economy. The responsibility of carrying out LEDS activities for each sector are allocated to corresponding different government bodies, which implement, coordinate and monitor the activities for that sector and coordinate with bodies responsible for other sectors. Strong coordination between the implementing ministries and other government and non-government stakeholders and clear allocation of the sector related responsibilities should ensure the parallel implementation of a majority of the planned measures with prioritization of activities within the sectors as discussed in the eight sectoral chapters.

Based on the analytical work and in close cooperation with the National LEDS Steering Committee (SC) and associated technical Working Groups (WGs) the following LEDS vision for 2030 can be articulated (Figure 11).



- A maximum of 2% losses from the gas distribution system
- Hydropower generating 85% of electricity
- 150 MW of wind power plants in place
- Modern, efficient combined cycle power plants replacing the two existing inefficient gas-fired power plants

- 50% of new purchases of electric appliances are based on advanced technologies
- 50% of the existing public buildings completely are renovated
- 50% of private commercial buildings are retrofitted
- At least 20% higher energy efficiency of all newly constructed residential and commercial buildings
- 40% of the existing residential buildings are completely renovated
- 80% of new biomass heating stoves in rural households are efficient biomass stoves
- 30% of all new water heaters in households are solar water heaters
- 50% of all commercial water heaters are solar water heaters
- 90% of all public lighting fixtures are replaced with LED bulbs



- 15% improvement of average vehicle efficiency
- 5% market share for hybrids and 1% market share for electric vehicles
- A shift of 3.8% of total passenger transport demand to bus and away from LDV and minibus
- 60% of total bus fleet used for passenger transportation run on clean energy
- 3% decrease in LDV transport demand
- At least 9% railway's share in total passenger transport
- At least 50% railway's share in total freight transport

- Several energy efficiency measures implemented in Rustavi Azoti plant (savings of up to 434TJ of natural gas and 612TJ of electricity)
- 30% utilization of advanced process heat technologies in food industry

- Coke intensity improved by 20% and electricity intensity by 5% in ferroalloy production
- 15% reduction in gas consumption in iron and steel industry (Rustavi Steel)
- Natural gas savings of 5.1 TJ annually at Heidelberg Cement Georgia
- Dry processing introduced in the cement industry (two plants of Heidelberg Cement Georgia)
- 50% utilization of advanced and variable speed motors in all industrial plants
- 5% increase of limestone share in clinker in all cement plants
- Replacement of 50% of clicker by fly ash in all cement plants
- CO_2 solvent scrubbing introduced in ammonia production (Rustavi Azoti)
- Oxidation step optimized in nitric acid production (Rustavi Azoti)

Agriculture

- Up to 80% of dairy cattle and 12% of medium and small sized cattle kept in smaller farms subjected to forage quality optimization and feed improvement
- Covered lagoon type of animal waste management system used in 90% of commercial dairy farms

Waste

- Complete reprocessing of solid waste generated throughout Tbilisi
- 80% of methane emissions from Tbilisi and Rustavi landfills, new Adjara and other new regional landfills throughout Georgia, captured and flared
- Kutaisi, Telavi and Borjomi landfills closed (80% of their methane emissions captured and flared)
- Extraction of organic fraction for further composting in 20% of the new regional landfills
- 80% of methane generated at Adlia wastewater treatment plant captured and flared
- Legal base for incineration and co-incineration practices established

LULUCF

- An area of 36,500 ha of forest rich in biodiversity and typical of local habitats on the degraded areas
- 51 ha cultivated forest plantation on free areas of the forest fund lands
- Natural forest renovation supported on the area of 361ha
- Approximately 20% of the territory of Georgia are protected areas
- Introduction of sustainable forest management for 295,000 ha
- Illegal felling reduced by at least 50%

Figure 11. Achievements Necessary to Realize Georgia 2030 - LEDS Vision

Figure 12 presents the GHG emission trajectory over the period 2014-2030 for two cases - first case, when the Georgia 2030 – LEDS vision is achieved (LEDS scenario) and second case which assumes continuation of the current policies and practices (Business As Usual – BAU scenario). Figure 13 depicts the relation between starting and ending points (2014 and 2030 emissions, respectively) for each of the trajectories, as well as deviation in their ending points. The full mitigation potential of the LEDS scenario will slow overall emission growth from 127% above 2014 levels to just 33%, reducing GHG emissions in 2030 by some 42% compared with the BAU.

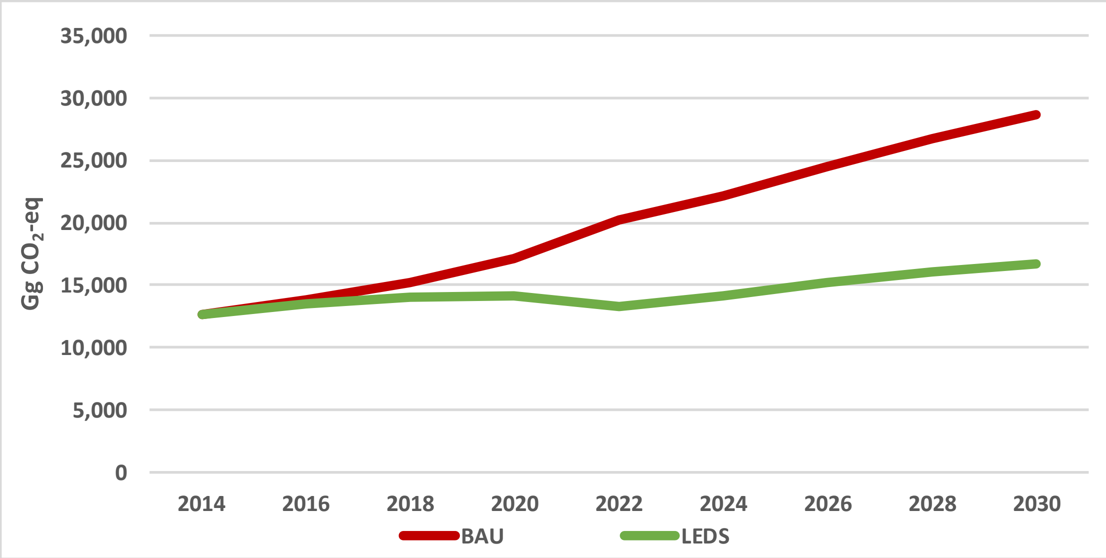


Figure 12. BAU and LEDS Emission Trajectories

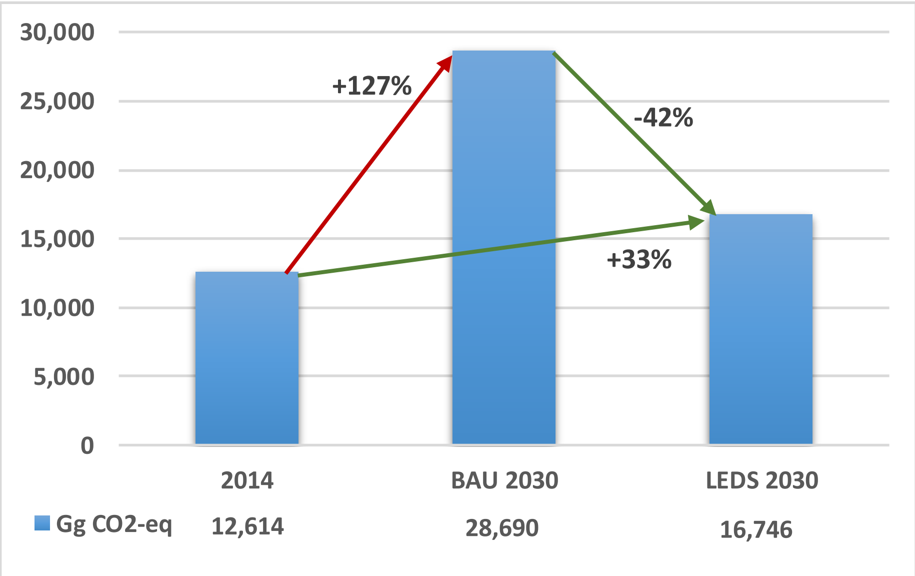


Figure 13. Comparison of BAU and LEDS Emissions

I.D. SCENARIO FOR REACHING 2030 VISION

This chapter focuses on two of the many possible now till 2030 pathways the country could take. The first one is Business As Usual (BAU) pathway corresponding to the BAU scenario, which represent the expected evolution of the Georgia energy and non-energy sectors under current policies and practices. The BAU scenario does not represent a forecast of evolution of the system; rather it serves as the comparison scenario for quantifying the emissions, costs, benefits, technology changes, fuel switching and other impacts of potential measures that collectively will shape the LEDS for Georgia. The other represents the LEDS pathway, underpinning the LEDS scenario, which ensures realization of Georgia 2030 – LEDS vision while supporting robust economic growth.

The principal demand drivers for the scenarios for all sectors except LULUCF are the Gross Domestic Product (GDP) and population growth assumptions. The GDP growth rates were allocated equally to all demand sectors. All other parameters (GDP (2014 M Euro), Population, GDP/capita) are derived from these growth rates and the 2014 historical values. (Figure 14). In LULUCF sector, the country has managed to maintain the same level of illegal felling over the last years, while the increasing energy demand has been covered by gas. Unsustainable forest management practices have resulted in further degradation of forests, decreasing thus the carbon stock and CO_2 absorption level.

Figure 14. Now - 2030 Pathways

Figure 15 depicts the BAU emissions and removals. GHG emissions from the energy sectors are calculated endogenously in the MARKAL-Georgia model, while the non-energy sector BAU emissions are an exogenously prepared projection by sector experts based on the anticipated growth of GHG emissions from the four non-energy sectors. Without intervention to mitigate emissions overall emissions can be expected to grow 127% by 2030. Note that the -54% change for LULUCF is arising because the level of removals occurring from the sector is decreasing. Looking at the BAU without the LULUCF the increase over the planning horizon is 92%.

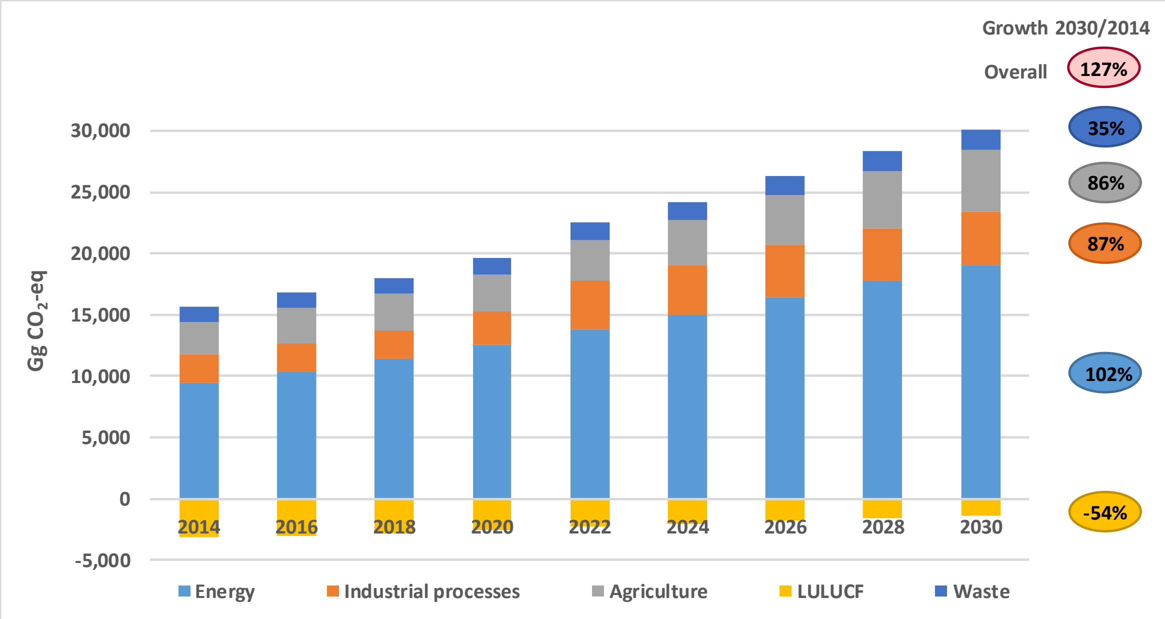


Figure 15. BAU Aggregate GHG Emissions and Removals for All Sectors

The challenge for Georgia as it looks to plan its LEDS pathway is to find the right balance of most effective measures to curb GHG emissions while supporting robust economic growth. Figure 16 presents measures for each sector, selected through a broad stakeholder consultation covering the comprehensive GHG landscape in the country, which will help Georgia to achieve its LEDS goals.

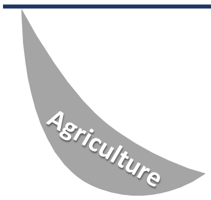
From the information provided by the energy sector LEDS WGs and the non-energy sector experts a comprehensive LEDS scenario was established as a combination of energy and non-energy measures, where the maximum level of mitigation that can be achieved by each measure is determined outside the model. Thus, the comprehensive framework (MARKAL-Georgia) provides more of a simulation than an optimization (with partial optimization among some of the energy sector measures and full consideration given to the interdependencies of specific energy sector measures). The integration of the energy and non-energy sector measures showed very little overlap, except for the crosscutting nature of biomass (firewood) supply and forest conservation measures. As a result, the integrated energy system and non-energy sector emissions profile is largely the combination of the results from each sector.

In what follows, the emission profile (Figure 17) and level of avoided GHG emissions (Figure 18) are presented for the four main scenarios:

- BAU with full GHG accounting;
- All energy sector mitigation measures;
- All non-energy sector mitigation measures, and
- LEDS scenario - combined energy and non-energy mitigation measures (prescriptive).

These figures clearly show the importance of looking at the entire emission profile and mitigation options to get a complete picture for LEDS since nearly equal levels of mitigation will come from the energy and non-energy sectors by 2030. Also, the difference in cumulative emission levels and reductions from all measures is clearly seen, pointing out that approximately 25% of emissions arise from the non-energy sector (40% excluding LULUCF sequestration).

Energy supply	• Improve gas and electricity networks • More renewable electricity, in particular hydro • More solar and geothermal heating • More efficient thermal generation
Buildings	• Efficient lighting (phase out Incandescent bulbs) • Labeling of appliances • Public and commercial buildings retrofits • New building codes • Residential buildings retrofits • NAMA for biomass heating stoves • NAMA for solar water heating • Commercial solar water heating • LED lamps for public lighting
Transport	• Promote biofuels • Improve road transport efficiency • Promote hybrid and electric vehicles • Promote urban transport • Promote clean buses • Improve taxi regulations • Promote public parking systems • Promote cycling and walking • Promote two wheelers • Improve intercity passenger rail • Improve intercity bus transport • Promote freight transport shift from heavy truck to rail
Industry	• Efficiency measures in chemicals • Process heat improvement in food industry • Intensity improvements in iron & steel ferroalloy • Automated controls in iron & steel industry • Utilization of waste heat for clinker drying in cement industry • Conversion from wet process to dry process in cement industry • Increase the limestone share in clinker in cement industry • Replace part of clicker by fly ash in cement industry • Move to solvent scrubbing in ammonia production • Optimize oxidation step in nitric acid production



- Forage quality optimization and feed improvement
- Improving efficiency of animal waste management systems
- Setting stage for widespread adoption of biogas systems

- Setting up a paper, plastic, glass and metal separation system in municipalities
- Construction of solid municipal waste processing plant in Tbilisi
- Setting up biogas flaring/utilization systems in landfills
- Biodegradable waste composting
- Methane collection and application in Adlia water treatment plant

- Afforestation/restoration of forest lands
- Cultivation of planted forests
- Supporting natural renovation of forest
- Increasing the areas of protected areas
- Introduction of internationally accepted sustainable forest management
- Strengthening and enforcement of the legislation related to illegal felling
- Increasing of areas of perennial plantations
- Grasslands rehabilitation

Figure 16. Key Measures towards Georgia 2030 - LEDS Vision

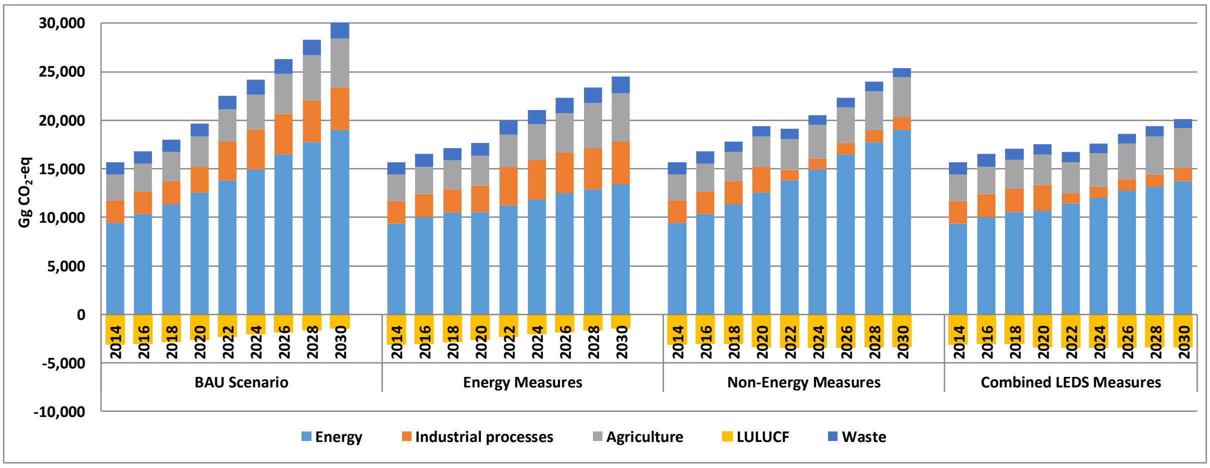


Figure 17. GHG Emission Profile of Various Scenarios

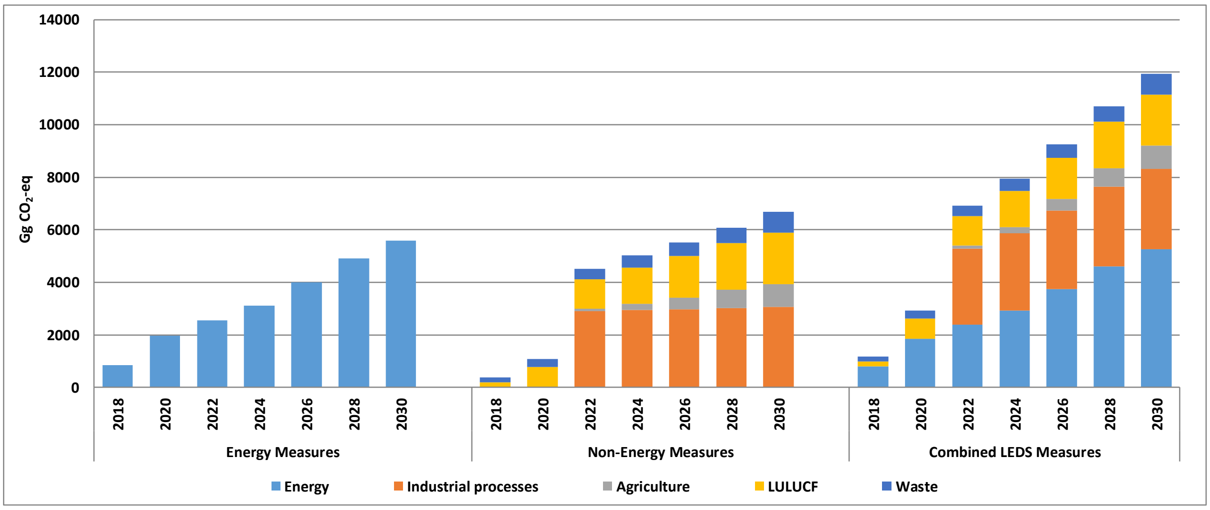


Figure 18. GHG Emission Reductions from BAU

LEDS aggregate GHG emissions and removals for all sectors are displayed in Figure 19, indicating almost four times lower 2030/2014 growth compared to BAU (33% versus 127%). The impact of all measures acting in concert to reduce the BAU emission trajectory is shown in Figure 20 indicating that overall BAU emissions are cut 42% by 2030.

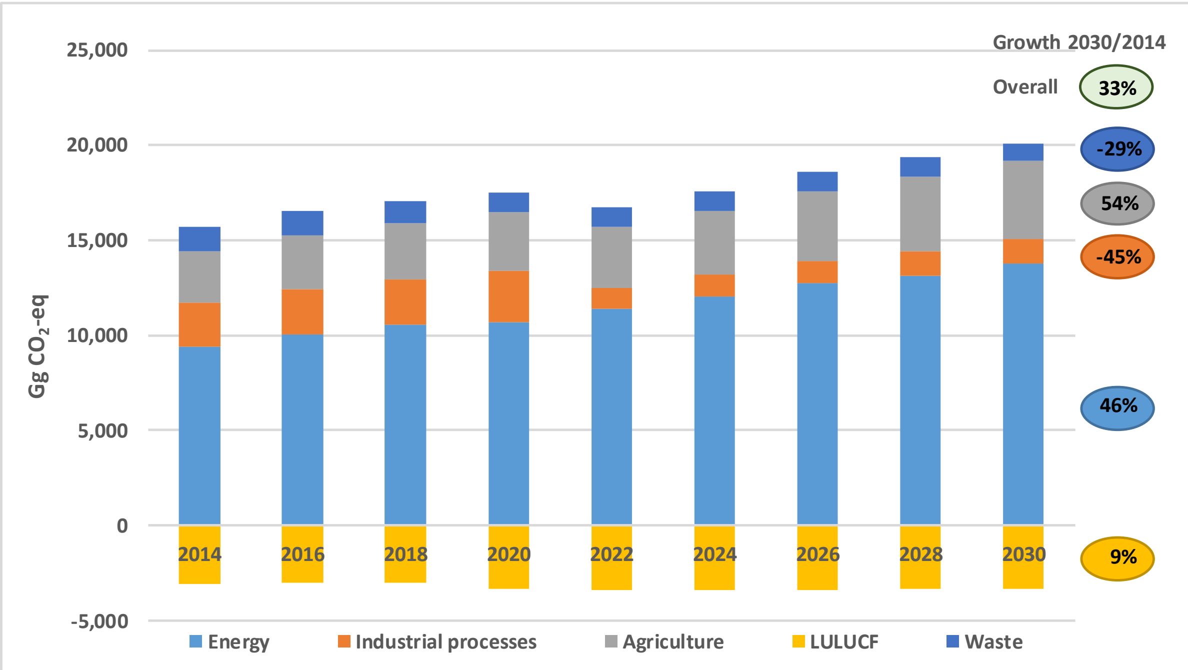


Figure 19. LEDS Aggregate GHG Emissions and Removals for All Sectors

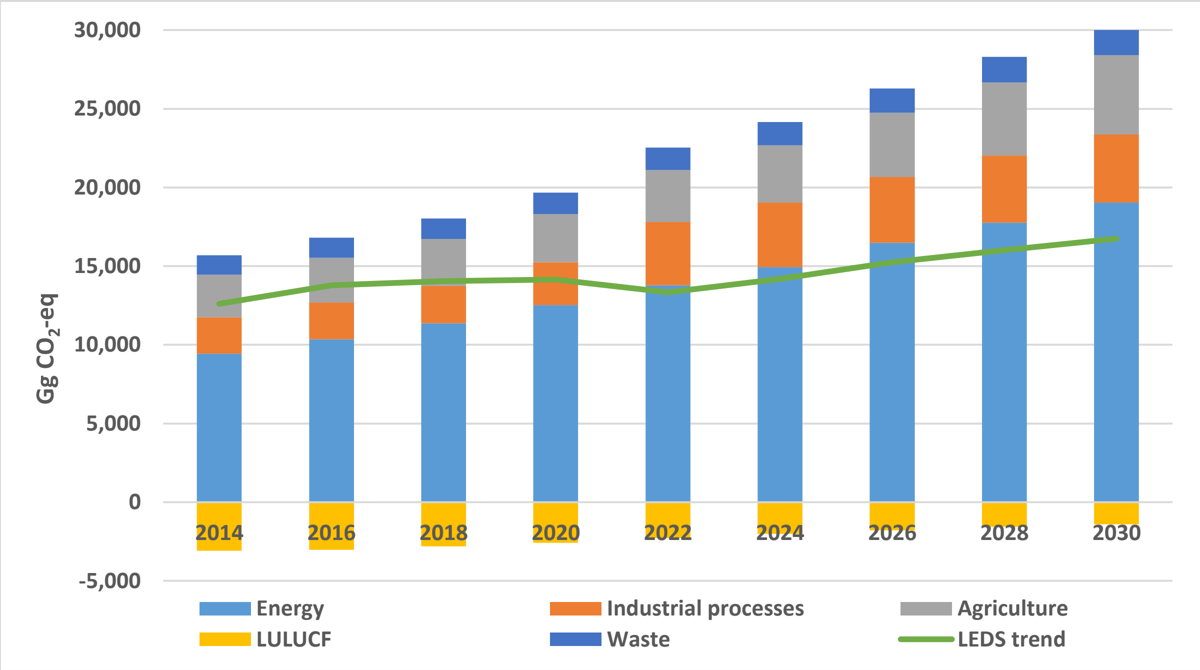


Figure 20. BAU GHG Emission Profile and LEDS Emission Trajectory

PART 2: GEORGIA'S LOW EMISSION DEVELOPMENT STRATEGY

2.A. ENERGY SUPPLY

SECTION ONE: OVERVIEW

The Energy Sector in Georgia is represented by almost all branches of the electricity and fuel industry, including thermal and hydro generation facilities, electric networks, natural gas transmission and distribution systems, transit oil pipelines, oil and gas mining enterprises and coal mines. Georgia is currently actively working to exploit and fully utilize the available potential of renewable energy resources that include wind, solar and biofuel.

In 2014, approximately 187,397 TJ of primary energy resources have been produced in Georgia. If the electricity supplied to occupied Abkhazeti is subtracted, the total is equal to 181,958 TJ of primary energy resources and on a per capita basis 0.05 TJ (1.17 TO eq.) in the territory controlled by the central government[20]. This is significantly lower than the global per capita value of 0.08 TJ (1.6 TO eq.). The Georgian per capita usage is more in line with the regional values and countries with similar climate conditions such as Azerbaijan, Turkey, Romania, Bulgaria, and Greece.

Figure 21. Total Primary Energy Supply, 2014

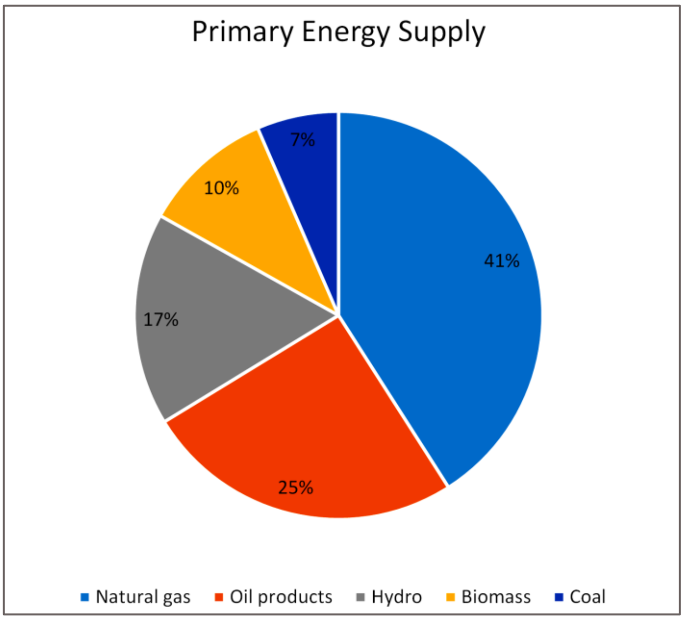


Figure 21 shows the Georgian primary energy mix, which is dominated by fossil fuel (natural gas and oil products), comprising approximately 70% of total primary energy. This is lower than the global average of 81%. Georgia has substantial hydro resources which currently makes up approximately 17% of the primary energy consumption.

[20]According to the census conducted in 2014, the number of Georgia's population was 3,713,804, excluding the residents living in the occupied territories.

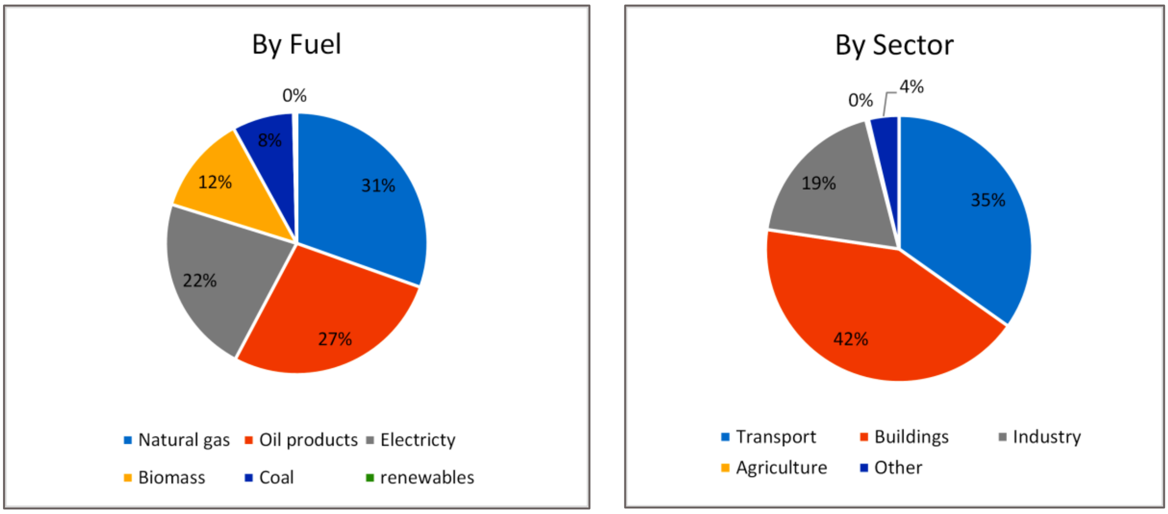
Bio resources like firewood are important resources for Georgia and are 10% of the primary fuel resource. Georgian coal also plays a role in the primary fuel mix, but coal is only 7% of Georgia's primary fuel compared to a global average of 29%. Solar and geothermal make up less than 1% of Georgia's primary fuel mix and are not currently a significant factor.

The power generation of Georgia is represented by four gas fired thermal power stations and fifty hydro power plants. One of the thermal power stations (TPS) has recently been modernized and has an installed capacity of 230 MW. The total installed generating capacity is approximately 3,750 MW. In 2014, the power plants of Georgia generated 10,371.2 GWh of electricity, 19.6% was produced by thermal power stations, and the remaining by hydro power plants. The country's power supply grid operates with 500, 330, 220, 110 and 35 kV voltages. The total length of the electrical transmission lines is 3,350km and total installed capacity of 92 sub-stations is 10,212.6 MVA.

The technical potential of hydro power is estimated at 50 billion KWh per year, yet only 16.5% is utilized. Wind power potential is estimated at 4 billion KWh/yr, and recently small Gori 20MW wind plant has been put in operations which marks the starting point in utilizing this tremendous resource. Georgia has exploitable levels of other renewable resources as well, such as solar, geothermal and biomass (including residues) but the potential of these resources still needs to be researched and Georgia yet lacks the infrastructure and legal framework to exploit these resources.

Georgia's energy consumption for 2014 was estimated at 159,767 TJ, with the largest share in natural gas 31%, oil products 27%, and electricity 22%. The highest energy expenditure occurs in buildings and transport: 42% and 35% of total national energy consumption. Figure 22 shows final energy consumption in Georgia in 2014 according to national Energy Balance [1].

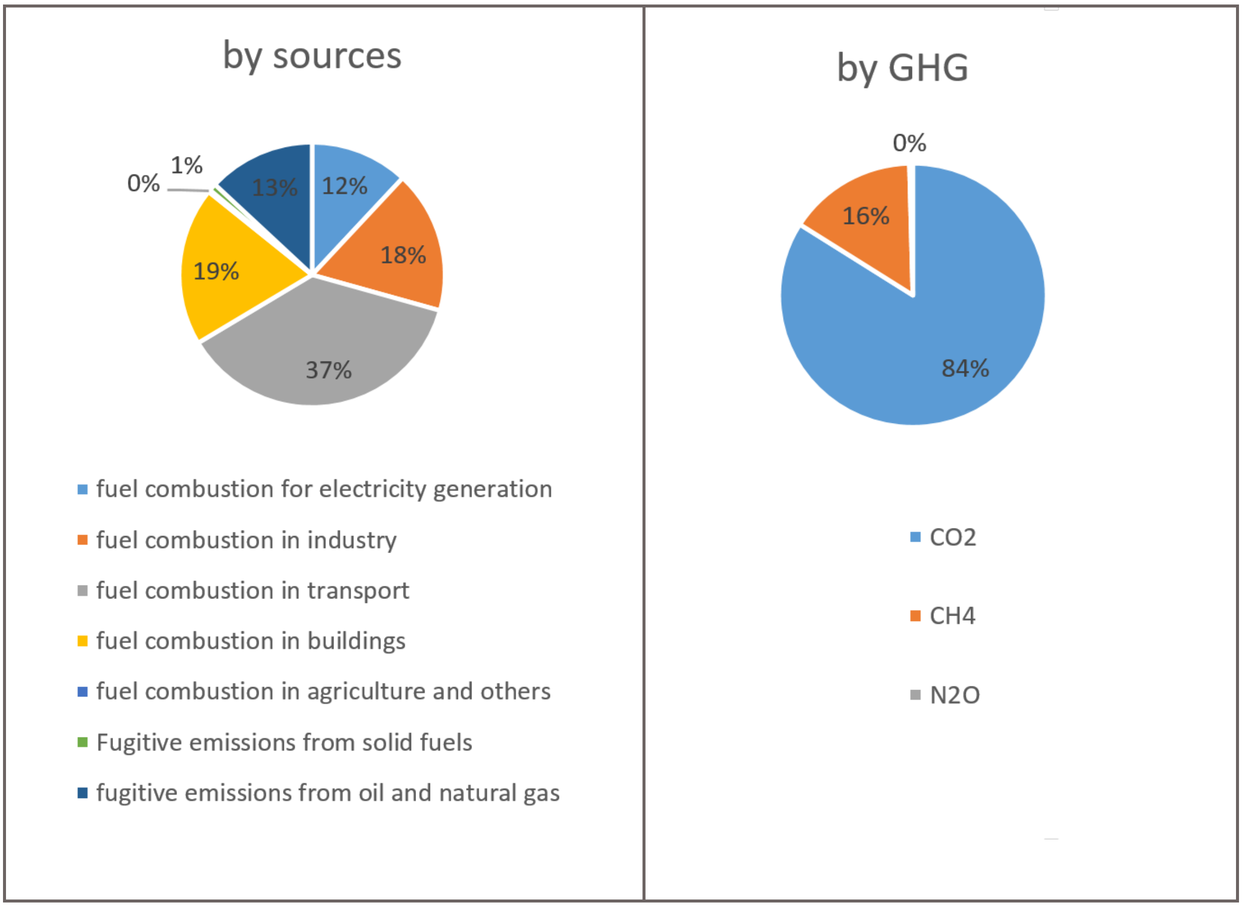
Figure 22. Final Energy Consumption by Energy carrier and sector, 2014



According to the 2014 data, distribution losses were 3,169TJ (103.8 million m3), equaling 6.5% of total final gas consumption and electricity grid losses were 2,160 TJ, equaling 6.1% of the final electricity consumption.

Figure 23 shows the GHG emissions by source and by gas in Georgia in 2014. In total, the GHG emissions from the energy sector was 9,410 Gg CO_2e in 2014, of which 8,098 Gg CO_2 eq., or 86.1%, was emitted through the process of burning fuel and the rest were fugitive emissions. The highest emissions, 43%, occurred in the transport sector from fuel combustion, which primarily utilizes oil and gas products. Industry is one of the largest consumers of energy and contributes 20% of total emissions primarily through the combustion of coal and coke in their industrial processes. The residential sector contributes mainly through the utilization of firewood and gas, which accounts for 17% of emissions. The main GHG emitted (84%) is CO_2, followed by methane, main source of which are fugitive emissions.

Figure 23. GHG Emissions by sources and GHGs, 2014



This chapter considers emissions from energy supply which include emissions from electricity generation and fugitive emissions. GHG emissions from the electricity generation sector leveled at 1,123.6 Gg CO_2 equivalent in 2014. The emissions from electricity generation sector fluctuate over time and mainly depend on the availability of hydro resources in particular year.

The fugitive emissions, 14% of the total emissions, are predominantly (93%) related to the transmission and distribution of oil and gas. In recent years fugitive emissions have a decreasing trend which is related to the improvement of transmission and distribution infrastructure and consequent decrease of losses. More details on the trends of emissions can be found in [2].

The Ministry of Energy elaborates and implements the energy policy, defines the rules for business relations and collaboration between different parties. The Georgian National Energy and Water Supply Regulatory Commission (GNEWRC) independently regulates the relations between consumers and energy companies mainly based on the Georgian Law on "Electricity and Natural Gas" and the legal acts of the Commission itself. On the wholesale market of electricity generation the following actors are presented and functioning: generators, importers, and exporters of electricity, licensees of distribution (on supply side), direct customers, also service providers – transmission system operator, market operator, licensee of network transmissions services. The main actors of the retail market are: distribution licensees (on network services and supply side), small capacity power electricity plants, end-user consumers (among them so called, "qualified consumers" who have the right to select wholesale suppliers based on competitive prices). The market operator trades balancing electricity and guaranteed capacity based on tariffs defined by the

GNEWRC. The operator is responsible to ensure the stability of the network and to balance the market.

The energy supply sector of Georgia, and the energy security of the country in general, face serious challenges which are closely related to low emission development as well. These barriers are listed in Box 1.

Box 1. Barriers to the Low Emission Development of Energy Supply Sector in Georgia

- Dominant role of imported energy resources in country's energy balance, and insufficient use of national energy sources (including renewable);
- Lack of modern, resource-saving technologies, and unjustifiably low level of energy efficiency potential adoption;
- Relatively low-efficient basic heat generating means emit unjustifiably high level of GHG, and country's energy sector is oriented to utilize hydro energy resources that critically depend on climate conditions;
- Vulnerability of existing energy infrastructure to natural disasters caused either by climate and geographic characteristics, or by insufficient technological reliability of amortized systems;
- Inability to store heating resources of strategic importance;
- Increasing threat of terrorism especially on strategic objects located inside country's occupied territories;
- Insufficient number of skilled personnel to implement modern, energy efficient technologies;
- Low operational and quality standards in energy industry, and limited excess of socially vulnerable people and local industries to vital energy resources;
- Possible politicization of tariff regulations might lead to financial deficit;
- Disharmony of international and national regulations and standards in operations' technical regulations and energy infrastructure construction works.

SECTION TWO: LOW EMISSION DEVELOPMENT VISION FOR 2030

The Business As Usual (BAU) scenario presents the projected GHG emissions of Georgia if no mitigation measures and actions are implemented. The BAU scenario for the energy supply sector is calculated using the MARKAL-Georgia model. The demand on electricity and natural gas in different sectors are projected within the sectors based on economic and demographic drivers, and consider price evolutions for future. For the electricity generation sector, the main assumption is that the share of thermal plants in the total final electricity consumption in the country will remain as it was in 2014, i.e. 20%, with new coal power plant also being available and running when the price of generating electricity there becomes competitive with natural gas thermal plants, i.e. after 2026. The main assumption for fugitive emissions is that the percentage of losses remains the same as in 2014. Model set-up as well as all other relevant assumptions for the development of the BAU scenarios are described in detail in [3]. According to BAU scenario by 2030 emissions from electricity generation will increase by 88% and fugitive emissions by 110%. Other results of BAU scenario are described in [4].

The economic growth and sustainable development of the country is largely based on improving the efficiency of energy consumption, representing one of the most effective means of reducing production expenditures, increasing the products' competitiveness, ensuring energy security, and environmental protection.

Besides reducing specific energy consumption, it is also very important to increase the renewable energy share in total primary energy consumption. Renewable Energy Sources (RES) can reduce dependence on imported fuel, improve energy security, help meet the global goals of environment protection, and ensure significant reduction of GHG emissions, as well as promote employment and the creation of additional jobs.

Renewable sources in Georgia (geothermal, solar and wind energies) have significant technical and economic potential and the low level of their utilization today is unjustified. This potential cannot be realized without targeted and coordinated planning for the utilization of the country's renewable energy resources, thus missing the opportunity to get a positive effect from sector development and GHG emissions reduction. In 2016 the government of Georgia adopted new legislation permitting a power exchange from renewable energy sources with a capacity not exceeding 100kW with a grid using net metering. Such legislation is expected to have significant positive impact on the deployment of rooftop solar PV systems in Georgia.

Therefore, the low emission development strategy of the country together with emissions reduction is aiming to reduce final energy consumption and increase renewable energy share in primary and final energy consumption.

In the energy sector, the increase of energy efficiency and consequently, emissions reduction strategy considers the following directions:

- Increasing the efficiency of thermal power plants and using these stations as reserve to the climate-dependent hydro plants, limiting their operation only for own consumption and in the case of urgency;
- Permanent monitoring of realization of legal norms limiting gas transmission and distribution losses, and methane emitted at coal mines by corresponding authorities and encouragement of gradual synchronization of the process to internationally accepted practice;
- Increasing energy efficiency in energy consuming sectors (the respective strategy and measures are discussed in the appropriate sectoral chapters).

In the energy sector of Georgia, the increase of renewable energy share and consequently, the emissions reduction strategy considers the following directions:

- Timely launching of the new hydro generation facilities and development of a transmission grid, as well as efficient integration of an energy supply system in regional systems both at infrastructural and legal levels, balancing export-import of electricity using locally produced cheap hydro power for domestic consumption and in the long run (2026-2030) prioritizing the use of this energy in country via legal regulations; etc.;
- Utmost exploitation of local renewable resources, among them wind, solar, bio and geothermal resources in different energy sectors (in the demand sectors the programs promoting renewable energy utilization are discussed in the respective sectorial chapters).

The main goals for energy sector development should be the development of laws and regulations, and working out financial mechanisms, action plans and its monitoring system. In 2016 Georgia joined the European Energy Community and took responsibilities which will ensure the adoption of market mechanisms in the country's energy sector, creating transparent, non-discriminatory and environmentally friendly legislation which is synchronized with the EU legal framework and attracting investments in order to support modern resource-saving technologies, products and launching new renewable energy facilities. In compliance with the Association Agreement concluded between the European Union and Georgia, Georgia has undertaken an obligation to implement the directives related to energy efficiency and renewable energies. The National Energy Efficiency Action Plan (NEEAP) has been developed, but needs to be adopted. Development of Renewable Energy Action Plan (REAP) has been started.

Box 2 presents energy sector overarching low emission development strategy.

Box 2. Energy Sector Overarching Low Emission Development Strategy

Short-run (2017-2020):

- Developing the action plan for fulfillment of obligations to the Energy Community.
- Implementation of a new open model for the energy market
- Adoption and Execution of a Law on Energy Efficiency.
- Adoption and implementation of a national energy efficiency action plan
- Development of a national renewable energy action plan
- Utilization of energy statistics, including monitoring of energy efficiency indicators to guide policy makers.
- Gradual switch to the procurement of energy efficient technologies, products and transportation by introducing mandatory requirements and special tax incentives for energy efficient equipment in procurement law.

Long-run (2020-2030):

- Adoption and refinement of the legislation to encourage renewable energies.
- Implementation of Energy Efficiency and Renewable Energy Utilization Action Plan.
- Adoption and refinement of a more rational tariff system to encourage the utilization of efficient technologies and renewable energy sources.
- Implementation of electricity and gas transmission network development plans.

The Annex describes the mitigation measures for energy supply sector. The main goals are to increase the share of power generated from renewable sources, improving efficiency of thermal power stations and reducing grid losses. In Box 3 the main strategic objectives for energy supply sector are presented:

Box 3. Strategic Goals for Energy Supply Sector

- Share of power generation from hydro resources in domestic electricity consumption[21] – at least 85%.
- Share of power generation from other renewables (wind, solar) in domestic electricity consumption[2] – at least 2%.
- Natural gas distribution losses – maximum 2%.

The list of all mitigation measures considered for the energy supply sector is given in Table 1. The highest emission reduction can be achieved by reducing natural gas losses in distribution systems. In this regard, it should be mentioned that there are already two Clean Development Mechanism (CDM) projects underway for reduction of these losses in networks owned by KazTransGaz-Tbilisi[22] and Socar Georgia Gas[23]. It should be understood though, that since these are CDM

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[21] Without considering electricity export/import.

[22] Leak Reduction in Above Ground Gas Distribution Equipment in the KazTransgaz-Tbilisi Gas Distribution System- Tbilisi, Georgia, https://cdm.unfccc.int/Projects/DB/SGS-UKL1234786138.56/view

projects the emission reduction credits are sold to other countries, the United Kingdom in the case of KazTransgaz-Tbilisi project and Switzerland in the case of Socar Georgia Gas project and couldn't be accounted by the country as national mitigation measures. However, reducing fugitive gas leaks will result in the decrease of natural gas imports projected in Business-as-Usual case by 2030 and will improve country's energy security. The GHG that is reduced by this measure is methane with 21 times higher GW (global warming) potential than carbon dioxide.

Table 1. Mitigation Measure Descriptions & 2030 Impacts – Energy Supply Sector

Mitigation Measure	Description	Impact by 2030
EPOL1: Membership of the Energy Community (EC) and meeting its requirements.	Developing energy efficiency and renewable energy action plans, liberalization of energy markets and developing the necessary supporting strategies	Policy measure, impacts included in other measures
EPOL2: Refinement of tariff policy	Refinement of the current tariff system in such way that tariffs support implementing energy efficiency measures instead of hindering them (especially for natural gas) and helps the optimal distribution of load curve (for electricity).	Policy measure, impacts included in other measures
EMEA1: Increasing the share of hydroelectricity in domestic electricity consumption through the improvement of the existing transmission grid and optimization of dispatching.	Increasing the share of hydro power in domestic electricity consumption through improvement of west-east transmission capacity and dispatching.	389 Gg
EMEA2: Replacement of the outdated thermal power plants with maneuverable and efficient combined (steam-gas turbine) thermal power plants.	Construction of two 250 MW modern and efficient natural gas power plants, which will be commissioned in 2020 and 2026 and will replace Mtkvari and Tbilsreri thermal power plants.	364 Gg
EMEA3: Commissioning new renewable energy power plants.	Construction of a 150 MW wind powered station in eastern Georgia by 2026.	144 Gg
EMEA4: Reduction of natural gas losses in distribution networks.	Reducing the losses from distribution pipelines to 2% by the rehabilitation and development of networks and equipping them with modern regulating, control and metering technologies.	1,614 Gg
EPOL1: Ensuring and promoting the use of geothermal resources	Development of long-term policy to ensure geothermal resource exploitation.	Policy measure, impacts not estimated

Implemented together, the aforementioned measures will allow for the reduction of emissions in the electricity generation sector by 841 Gg CO_2 e annually, which make 39.1% of total projected emissions of this sector for 2030. Fugitive emissions will decrease by 1,700 Gg which makes 61.8% compared to BAU in 2030. The measures that are implemented in other sectors (buildings, transport, industry, LULUCF) also affect emissions from energy supply sector causing farther reduction both in electricity generation sector, as well as in fugitive emissions. Overall, considering all measures in LEDS strategy, emissions in electricity generation are reduced by 982 Gg CO_2e

[23] Leak Reduction in Above Ground Gas Distribution Equipment in 'Socar Georgia Gas' gas distribution system, Georgia, https://cdm.unfccc.int/Projects/DB/RWTUV1336989522.71/view

(46.3%) and fugitives by 1,848 Gg CO_2e (67.1%) compared to BAU. Figure 23 and Figure 24 demonstrate projections of GHG emissions in electricity generation and fugitive emissions, correspondingly. The blue line is emission projections according to BAU scenario, the red one shows projections if only the energy supply sector measures are carried out, while the yellow line shows projections if all LEDS sector measures are implemented.

Figure 24. BAU and Mitigation Trajectory (CO2eq) – Energy Supply (Electricity Generation)

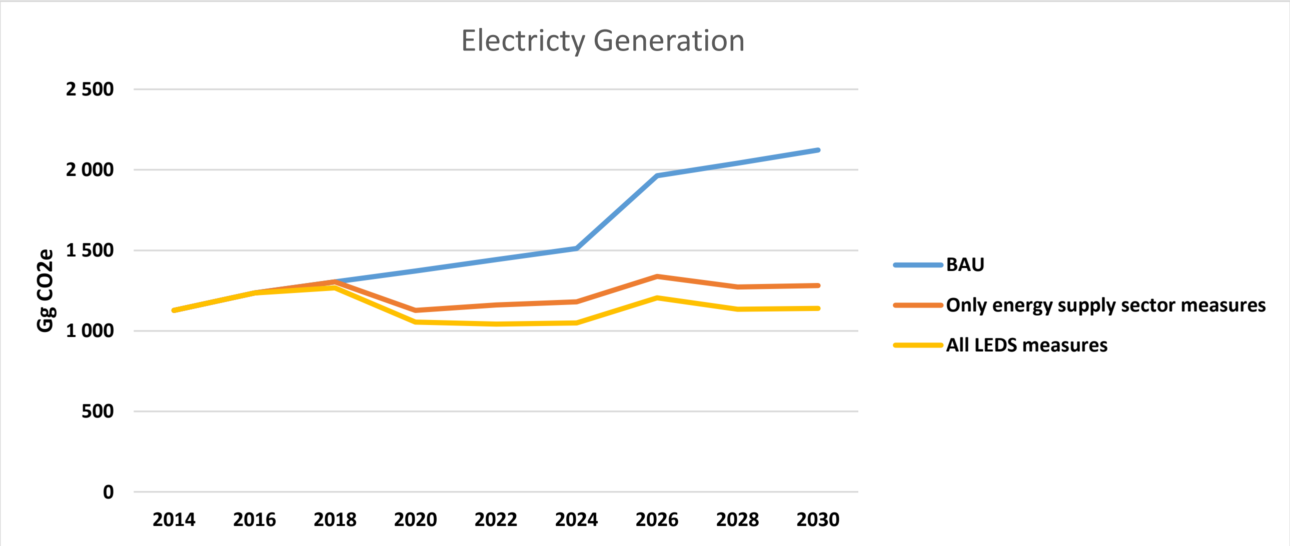
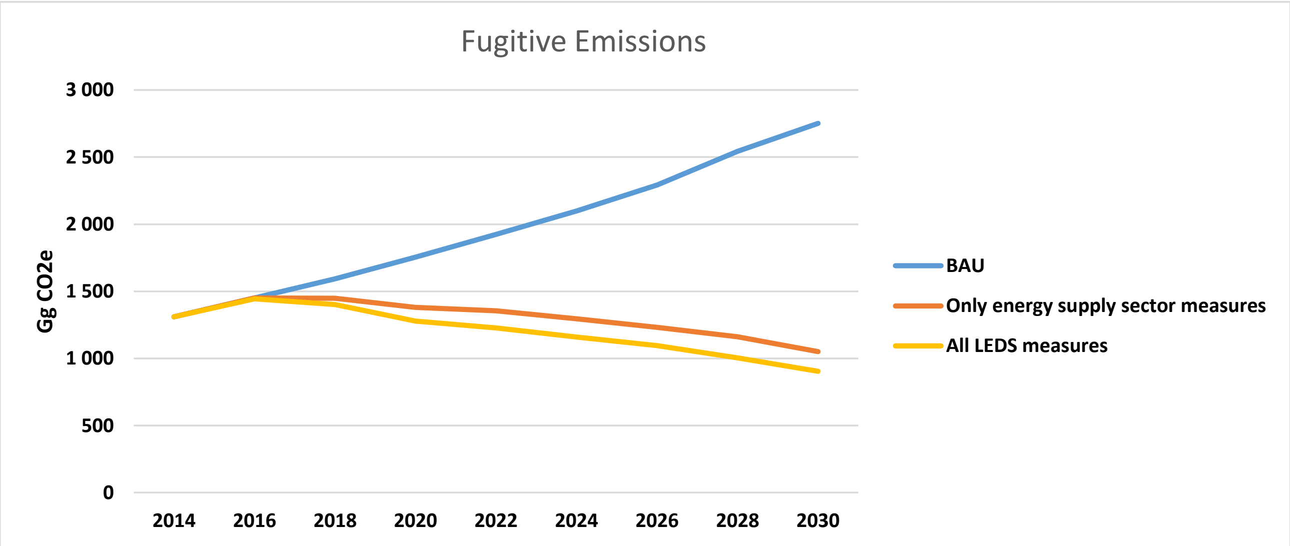


Figure 25. BAU and Mitigation Trajectory (CO2eq) – Energy Supply (Fugitive Emissions)



The numerical values of emissions in BAU and LEDS mitigation scenario for energy supply sector are given in Table 2.

Table 2. BAU and Mitigation Scenario Emission Levels – Energy Supply

		GHG emissions and Removals (Gg CO2e)								
Greenhouse gas source and sink categories		2014	2016	2018	2020	2022	2024	2026	2028	2030
BAU Scenario										
Energy Supply										
Electricity Generation		1,128	1,235	1,305	1,372	1,442	1,511	1,963	2,041	2,122
Fugitive Emissions		1,311	1,452	1 593	1,754	1,925	2,099	2,292	2,544	2,751
Mitigation Scenario										
Energy Supply										
Electricity Generation		1,128	1,236	1,268	1,055	1,043	1,049	1,205	1,135	1,140
Fugitive Emissions		1,311	1,444	1,401	1,279	1,228	1,160	1,096	1,004	905
Electricity Generation	Reduction			37	316	399	462	758	907	982
	% Reduction			2.8%	23.1%	27.7%	30.6%	38.6%	44.4%	46.3%
Fugitive Emissions	Reduction			192	476	697	939	1,195	1,540	1,846
	% Reduction			12.1%	27.1%	36.2%	44.7%	52.2%	60.5%	67.1%

2.B. BUILDINGS SECTOR

SECTION ONE: OVERVIEW

The buildings sector in Georgia is diverse in construction type and function. The sector includes buildings constructed in the 20th century Soviet era ranging to current day. Fifty-three percent of the country's population lives in urban regions and 47% in rural areas, and this is reflected in the diversity of residential houses. In Georgia, there is no complete register of the country's buildings stock. However, definite information and data for cities has been obtained in the process of developing Sustainable Energy Action Plans (SEAP) and Low Emission Development Strategies (LEDS) [2]. Based on this information and other available sources, the number of buildings and their total area have been assessed in the territory of Georgia.

Intensive construction of multi-apartment buildings, so called "Khrushchevka" began in Georgia in the1960s. Initially, five story buildings were introduced in which the engineering and construction criteria followed the government policy of that time, aimed at satisfying the minimum requirement of the population's living conditions. Khrushchyovka standard types are classified into "disposable," with a planned 25-year life and "permanent."[24] The majority of disposable "Khrushchevka" buildings were built 50 years ago[25]. Each of these building types were designed using different construction materials with a focus on seismic resilience to earthquakes. Initially these houses were built of bricks, subsequently substituted with big concrete construction blocks and panels. Later, using the same design, construction of eight story buildings began. The thermal resistance of buildings built in this period was low, as the comfort and hygienic criteria were minimal. The thermal resistance index of such buildings satisfied the obligatory standard, not exceeding the value of R=0.575 $m^2\ {}^0C/W$[26] according to the Technical Regulations of Soviet time [СНИР]. It should be noted that eventually this code was revised (in 2003), but the above-mentioned obligatory criterion was the highest in Soviet engineering.

Sixty-five percent of buildings in Georgia are predominantly multi-story buildings constructed in the period of 1950-2000 (Figure 26):

Figure 26. Distribution of Area for Multistory Buildings and Dethatched Houses in Large and Small Cities

The majority of detached residential houses of one or two families were constructed in the Soviet period as well and mostly satisfy the requirements of that time. Most of them are constructed with bricks or cement blocks, the thermal resistance index mainly being in the frames of obligatory value

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24 Khrushchyovka. https://en.wikipedia.org/wiki/Khrushchyovka

25 The most wide-spread design standards in this period were: N1-319C, N1-450C, N1-464AC.

26 m2 0C/W is the thermal resistance unit, being dependent on climate zone.

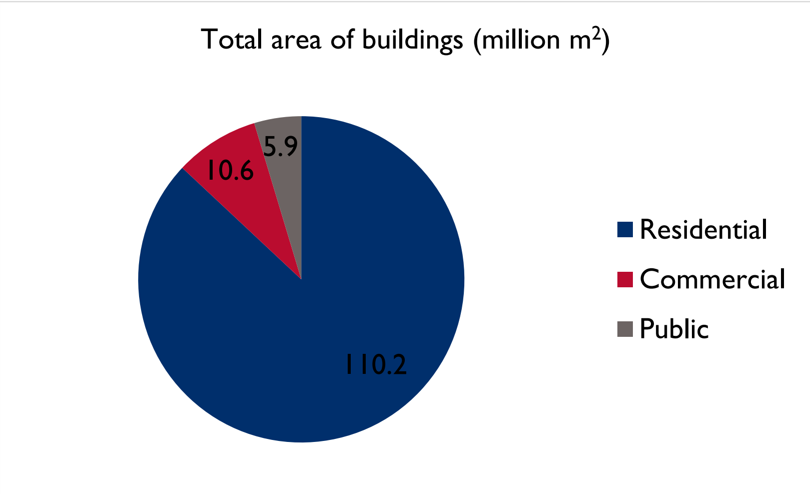
(R= 0.575 m² ⁰C/W), indicating the need for excess supply of heat to warm the building[27]. For the time being, these norms are still in force in Georgia.

In the buildings sector of Georgia, the total buildings stock is grouped and assessed by different criteria, aimed at introducing energy efficiency measures and increased use of renewable energy applications (or provision of low emission buildings sector). These are:

- Ownership form (seven types);
- Location by climate zone (three zones);
- Location per technological zone (five zones);
- Functionality of buildings;
- Types of buildings by construction design;
- Specific and overall energy consumption by building.

Per an analysis of different estimations, the total area of buildings existing in Georgia makes up 129.2 million m², from which about 86 million m² (67%) are heating areas. As there is no precise data on the country's dwelling stock, the assessment of this value was made using various sources (survey conducted under LEDS project [2], the SEAP data of the cities[28]) and different methods of estimation (methods of estimation of different characteristics of building stock and its energy consumption provided in Annex I to the EC-LEDS Technical Paper [///]). The overall residential area in Georgia equals approximately 110.2 million m² (Annex I to the EC-LEDS Technical Paper [///]). The analysis estimates also revealed that commercial and state-owned areas make 10.6 million m² and 8.4 million m² (Figure 27), respectively.

Figure 27. Distribution of areas by the form of ownership



30 percent of buildings' total heating area and 38% of residential area is concentrated in large cities and 48% of overall total area is in Tbilisi.

Four main types of buildings exist in the residential sector. Although similar in some way, the differences between them should be accounted for the introduction of large-scale energy efficiency programs and implementation of complete renovation of buildings.

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[27] In Europe, the minimal obligatory index is different according to climate conditions. E.g. the minimum requested value in the city of Split (Croatia) makes 0.83 m2 0C/W for wall and 1.33 m2 0C/W for roof (www.eurima.org/uvalues-in-europe). At this link minimal requirements by U index (R = 1/U) are given. The given indexes are different for various colors of rooftop as well.

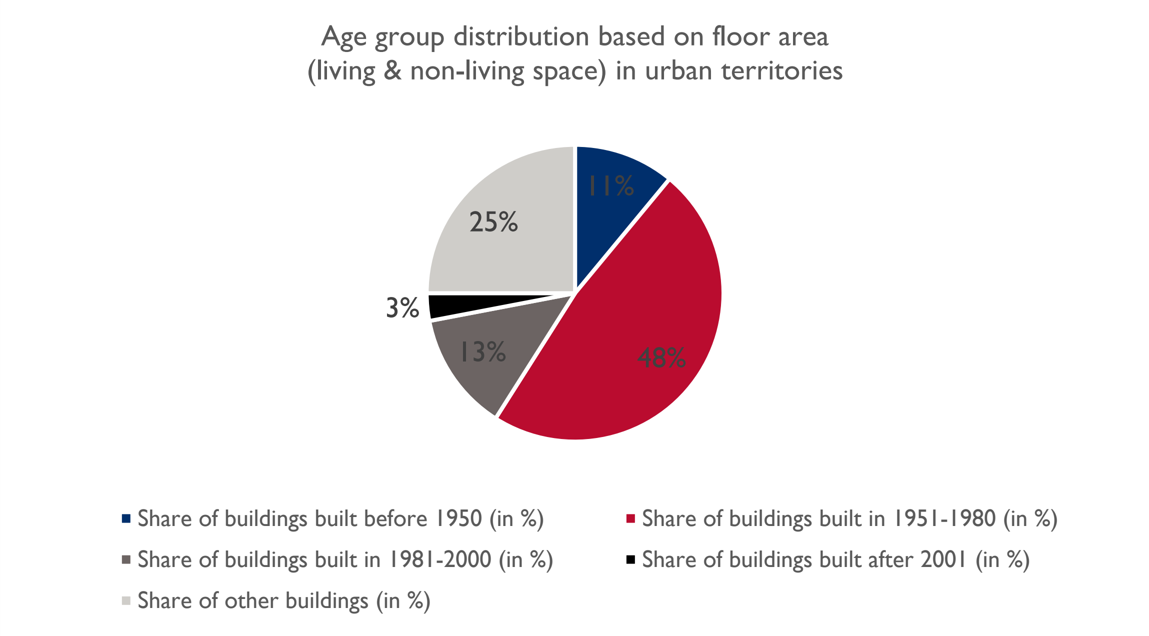
[28] http://remissia.ge/index .php/ka/2014-12-09-16-12-09/seaps

Box 1. Residential buildings

- Buildings with common areas are block buildings. According to Georgia's Legislation, the buildings are managed by home owners' associations[29].
- Multi-apartment buildings also include "Social-houses," mainly constructed by local authorities for critically low-income families, eco-migrants, and internally displaced persons (IDPs).
- Residential houses with cultural heritage status are mainly located within large cities. These one to three story buildings are in private ownership, though their owners are restricted from making significant changes during the renovation, especially concerning the reconstruction of the façade.
- Energy audits undertaken during the development of SEAPs have revealed that the one to two story private houses possess the highest potential of energy saving in case of their complete heating.

Share of residential buildings by construction years per the EC- LEDS project survey are presented in the Figure 28.

Figure 28. Share of residential buildings by construction years



Non-residential/commercial buildings are under state or commercial construction and ownership. State structures, on the other hand, are under municipal ownership or central or Autonomous Republic's possession, including public buildings.

29 This Low regulates homeowner associations common property management process, determines forms of home owners' association and forms of homeowners' property, as well as main juridical conditions for the creation, formation, activity and liquidation of such associations. The Low (Article 7, Paragraph 3) obliges flat owner to maintain common property and make financial contribution to the buildings exploitation, determining in some aspects the execution mechanism, consisting of debt of flat owner to association in case of rejecting to make contribution, which may be recorded in the Public Register (if the sum exceeds 500 GEL) on behalf of that flat. In case of selling the flat new owner will be responsible for the debt, though this approach is not usually in use. In the process of maintaining the buildings important barrier is the fact that association is not a legal entity that weakens its responsibility and makes it unable to get a credit, the more as, according to the same Low, the association is not responsible for the individual debt of flat owner.

Public buildings[30] occupy an important portion of state belongings and account for about 40% of total property [4]. According to present policy of the government, it attempts to ensure maximum privatization of state property, prioritizing public buildings, and to minimize the number of premises necessary for state administrative functions. **Commercial buildings** include those in private services (private schools, kindergartens, universities, private utilities of medical service and all other commercial edifices in the frames of private sector).

In total building stock, the share of administrative buildings accounts for 1% area. Three main categories of administrative constructions can be identified: (1) historical buildings under the possession of municipalities or the state, but still requiring special permit for rehabilitation works, (2) Soviet era buildings, and (3) modern constructions, trimmed predominantly with glass, which were constructed in **2005-2012 and are in small number.**

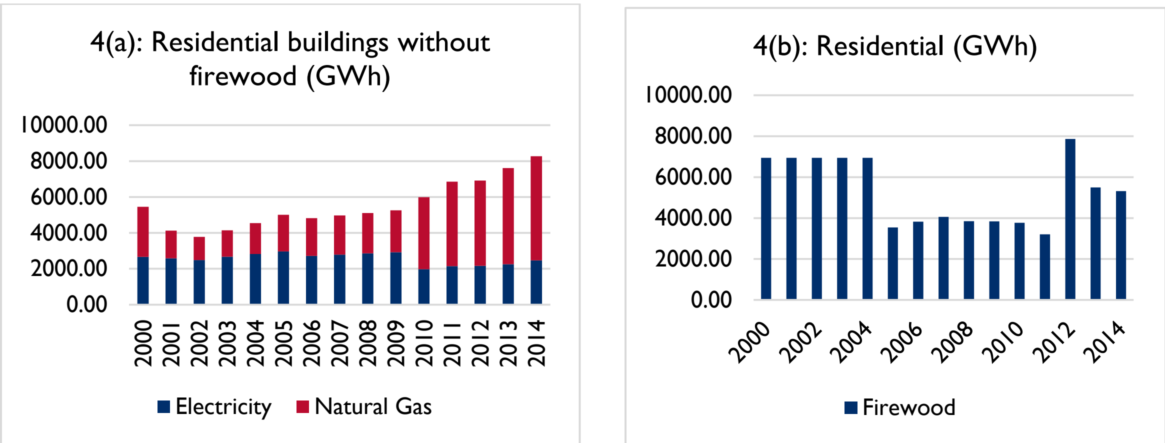
Baseline (2014) Energy Consumption by Buildings Sector

The energy consumption trends in Georgia's buildings sector are not statistically reassuring. However, 2012 stands out as a notable year, when energy consumption was significantly high. Since the 1990s the official energy balance in Georgia was prepared in a fragmented manner, and after the 2000 energy balance, the first official energy balance was developed for 2013. Now, Georgia has the 2013 - 2015 official energy balances prepared by National Statistics Office of Georgia.

In line with the methodology of statistical energy balance development and preparation of the GHG inventory, the total stock of existing buildings is divided into two major categories: Residential and Non-residential (Commercial) buildings. According to this classification, state and municipal buildings fall under the commercial buildings category. However, for the purpose, of proper planning for energy efficiency measures, this report divides commercial buildings into two separate categories: commercial and public buildings covering state and municipal buildings.

Figures (Figure 29 and Figure 30) demonstrate fuel consumption trends in residential and non-residential (commercial) sectors in 2000-2014.

Figure 29. Fuel consumption trends in residential buildings (GWh)



Wood fuel consumption in Georgia (Figure 29 (b)) does not follow the same increasing energy consumption trend as demonstrated by Figure 29 (a). Information on fuel wood consumption gathered during the SEAPs[31] preparation shows that despite decreasing trends of wood consumption

[30] Schools, kindergartens, sporting and music schools, clinics and hospitals.

[31] SEAP-Sustainable Energy Action Plan, document developed by the Covenant of mayors (CoM) signatory cities and municipalities.

in big cities, the same trend is not observed in small cities and rural areas, even more some increases have occurred in certain years. As it was explained by the local authorities the consumption decreases in 2005 - 2011 was the result of unreliable statistics which was later improved.

Figure 30. Fuel consumption trends in non-residential (commercial) buildings (GWh)

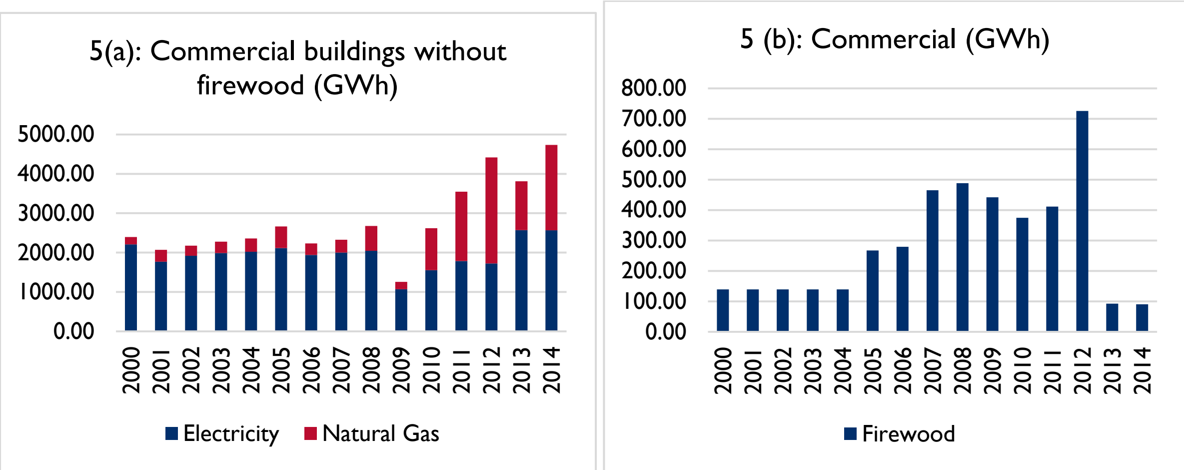


Figure 30 shows fuel consumption of non-residential (commercial) buildings (comprised of state and municipal buildings). The 2009 decrease in energy consumption could be explained by decreased economic activities in the post 2008 August war period.

Compared to previous years, Georgia experienced high fuel wood consumption in 2012 in both the residential and non-residential sectors. The National Environmental Agency (NEA) checked and confirmed that high consumption of wood in 2012 was correlated with the falling temperature by 3^0C comparing the long-term average for heating season. Details of study are available in EC-LEDS Technical Paper [??]. Particularly high was wood consumption in small cities and rural areas using mainly wood fuel for heating and having a more severe climate.

Per several sources[32], firewood consumption in 2012 reached almost 4 million m^3. This was1.5 million m^3 more than the annual wood consumption (2.5 million m^3) officially confirmed by the National Energy Balance produced by the National Statistics Office of Georgia [3}.

Figure 31 illustrates changes in total energy consumption shares (in %) of residential and non-residential sectors in 2013 and 2014.

32 IEA. http://www.iea.org; CENN, http://forestry.cenn.org/index.php/news/gigla-agulashvili-sheshis-mothkhovna-mitsodebis-shesadzleblobaze-gatsilebith-maghalia.html

Figure 31. Shares in energy consumption of residential and non-residential sectors in 2013-2014

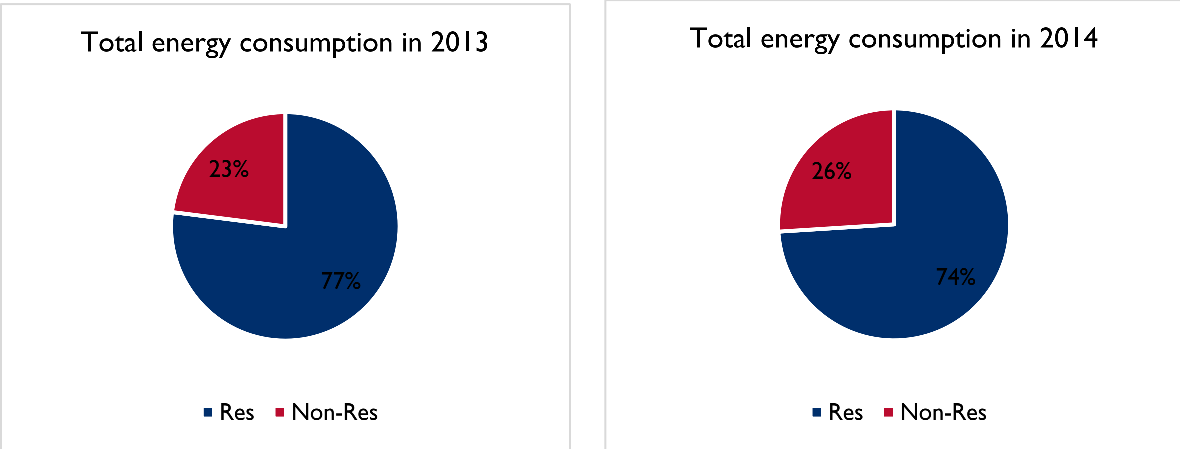
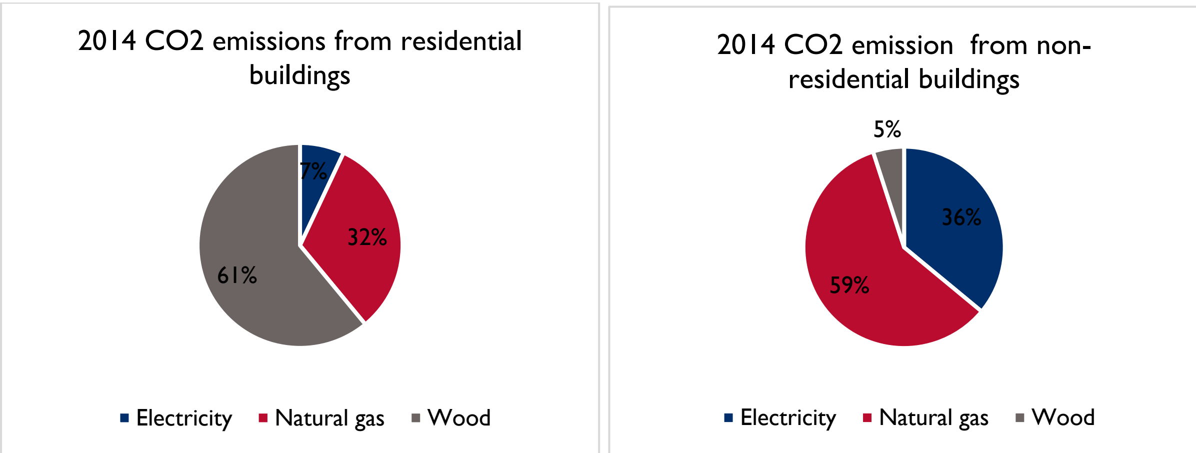


Figure 31 represents CO_2 emissions by fuel types from residential and non-residential buildings in baseline year 2014.

Figure 32 below demonstrates that wood fuel emissions[33] from the residential sector are the largest share of emissions from the residential sector, which was taken into consideration when emission reduction measures for the buildings sector were planned.

Figure 32. Distribution (in %) of CO2 emission by fuel type and buildings ownership



Along with the buildings types considered above, in order to assess the different characteristics of energy efficiency and energy consumption in Georgia's buildings sector, the country was divided into three climate zones [1]. This division is based on heating and cooling parameter (the Heating and Cooling Degree-days[34]).

Based on the population size and types of applied technologies two types of sub-zones were derived in each of the climate zones, the fourth and fifth zones. It should be noted here, that along with the climatic characteristics, the size of population defines the technologies and fuel used in particular zones. Hence, based on technologies and fuel distribution five different zones in total were assessed.

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[33] According to the IPCC Guideline emission from biomass fuel is calculated in GHGs National Inventory but is not summed up with total emission as this emission considered to be 0 because the biomass fuel is neutral (it emits the same amount which was absorbed in its lifetime) under sustainable forest management and it's assumed that in most countries fuel wood is produced in sustainable way. However, under the unsustainable management of forests and production of firewood it is the same type emission source as other fuels and in particular in long-term perspective. In final calculations, energy produced from forest wood considered in buildings sector bur emission is accounted in LULUCF sector in order to avoid double accounting.

[34] Heating degree-day is the amount of heat required during the heating season and it depends on climate zone.

In the fourth zone, the settlements with population more than 2,000 are included, while the fifth zone consists of five large cities (Tbilisi, Batumi, Kutaisi, Rustavi, and Poti) in Georgia. The local climatic conditions (particularly heat degree-days), fuel availability, and heating/cooling technologies are the factors which determine the main energy consumption parameters of buildings: (i) the heating season duration in these zones, (ii) energy efficiency of the buildings, (iii) applied technologies and fuel; and (iv) the efficiency of energy consumption in general.

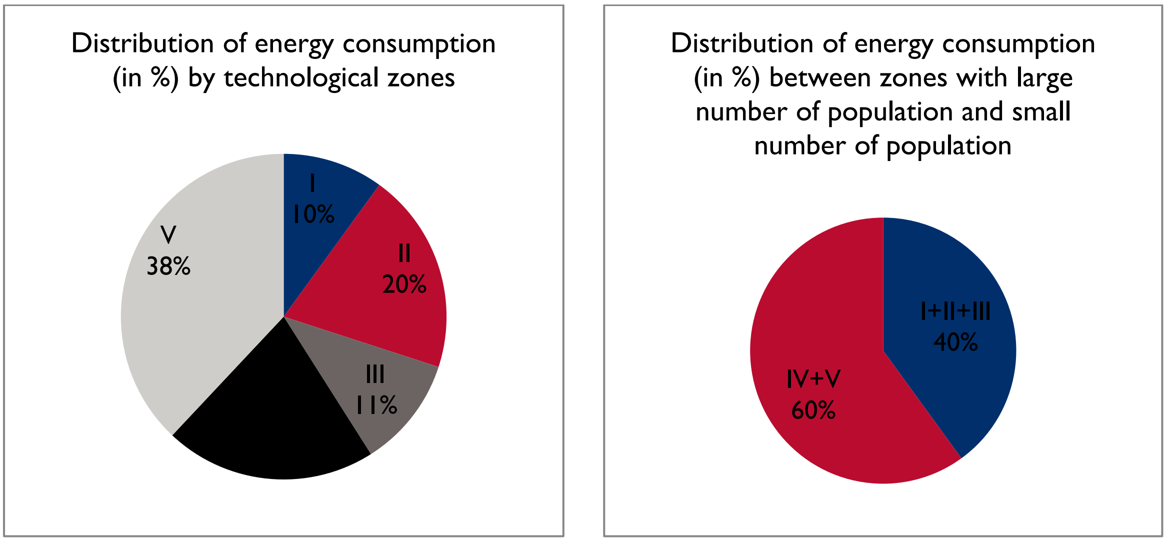
Figure 33. Climatic-Technological zones in Georgia

Brief descriptions of climate-technological zones in relation to the energy consumption of the buildings sector, population size, fuel and technologies used, etc. are provided in EC-LEDS Technical Paper for buildings sector [7].

As explained above, in each of three zones identified by climatic parameters, the sub-zones were singled out, in which energy consumption by buildings is presented with different technologies, unlike those used in the remaining territories. Conditionally, these sub-zones are named as fourth and fifth technological zones which are primarily defined by population and availability of natural gas. The climate indexes of the fourth and fifth technological sub-zones mainly coincide with the climate indicators of zones where they are located. However, in these sub-zones the urban effect is often added and thus the heating/cooling parameters differ from the general features of the zone. As a rule, it's advised that the degree-days for such settlements be calculated separately. This is important to keep in mind for the fourth and fifth technological zones as their energy efficiency and dominant energy resource are different from other zone areas.

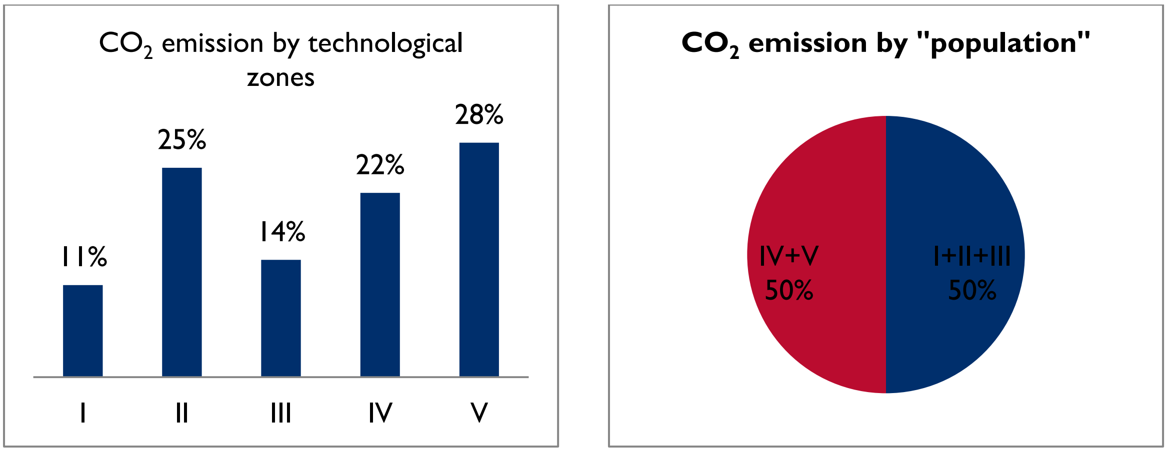
The below figures (Figure 34; Figure 35; Figure 36) present energy consumption and emission features of these zones.

Figure 34. Total consumption of energy (in %) by technological zones



For the efficient planning of emission reduction measures in the buildings sector, energy consumption in the above described climate- technological zones has been assessed. The distribution of energy consumption in the buildings sector in these zones is presented in Figure 34, and the relevant emissions are given in Figure 35.

Figure 35. Distribution of CO_2 emission[35] by technological zones (in %)

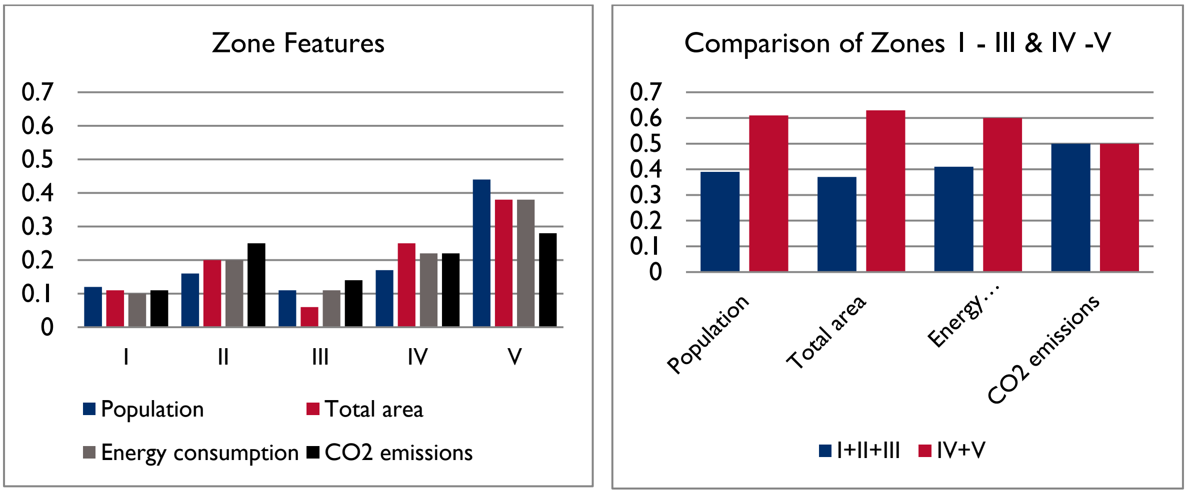


As seen from Figure 34 and Figure 35, the CO_2 emissions from zones I, II and III, featured by a high consumption of firewood, is similar to zones IV and V combined, despite the fact that energy consumption in these two (IV+V) is 20% higher. **Consequently, the highest priority of the emission reductions strategy for the Georgian buildings sector in the first three zones should be the decrease of firewood use.**

Figure 36 shows the summary of characteristic parameters of the zones, from which one sees that in zone II emissions are 3% less than zone V, where the majority of population lives and, correspondingly the consumption of energy is the highest. In this case, the cause is the significant unsustainable use of firewood in zone II and the relatively long and chilly heating period characteristic to this zone.

[35] GHGs emissions from unsustainable fuel wood consumption is also accounted.

Figure 36. Distribution of CO_2 emission and other features by technological zones (in %)



SECTION TWO: LED VISION FOR 2030

The Business As Usual (BAU) scenario presents the projected GHG emissions of Georgia if no mitigation measures and actions are implemented. To evaluate the impact of economic and demographic changes, the BAU scenario for the buildings sector considers the following two main drivers:

- GDP growth, which, consistent with assumptions across all sectors, is projected at 3.5% in 2015-2016 and 5.6% afterwards. GDP growth affects the growth of demand on energy services in commercial sector.
- Population number, which, consistent with assumptions across all sectors, is unchanged until 2030. Population number, together with GDP per capita growth rates affect the growth of demand on energy services in residential buildings.

The BAU scenario for buildings sector is developed using MARKAL-Georgia model. Model set-up as well as all other relevant assumptions for the development of the BAU scenarios are described in detail in [4]. According to BAU scenario by 2030 energy consumption in buildings sector will increase by 73% and GHG emissions by 110% compared to 2014. Other results of BAU scenario are described in [5].

Georgia has not yet created a development strategy for the buildings sector which would be the basis for its low emission pathway. The low emissions pathway mainly considers policy practices in the energy and forestry sectors. According to official statistics [3] in the Georgian residential buildings sector, about 40% of total energy consumption is from firewood. Eventually Georgia's buildings sector low emission development strategy will be in support and full compliance with Georgia's forestry policy, Energy Efficiency National Action Plan, and the EU buildings sector policy, mainly defined by two directives (Directive 2010/31/EU on "Buildings' Energy Consumption" and Directive 2012/27/EU "On the Energy Efficiency"). The EU regulates energy consumption in buildings by means of these two directives. The introduction of these directives' requirements in Georgia is determined by Georgia's Association Agreement with the EU.

The strategy is also grounded on the analysis of barriers emerged while studying the sector and are given in Box 2.

Box 2. Barriers prevailing to the efficiency in the buildings sector

- There is no responsible body in the state, which determines and carries out policy concerning existing buildings (their rehabilitation and conduction of energy efficiency measures, etc.);
- There is no target fund in the state which will facilitate the co-financing of energy efficient measures;
- The country lacks a national accredited entity having direct access to large international funds (GCF, GEF, etc.) which could bring to the country investments on energy efficiency, as well as cheap loans and grants to fill in the Energy Efficiency Fund for the promotion of energy efficiency process;
- The country does not yet have construction standards considering energy efficiency and no monitoring is performed during the process of handing over the buildings. The energy efficiency standards presumably will vary in different climate zones;
- No Green Purchases policy is practiced in the country;
- There is no state policy on maintaining and rehabilitating existing buildings (including multi-story buildings); and the role of the homeowners' association is not clearly defined in this process. The existing legislation on the association is mainly focused on resident's rights and does not clearly define their responsibilities and duties;
- There is complete chaos in the construction market. In the process of rehabilitating existing buildings, relevant quality is not ensured, which is especially important when introducing new technologies, energy efficient construction materials and measures;
- There are no ESCO (Energy Service Company)- type companies (performing complete energy services), which, in the case of energy efficiency, will guarantee actual savings of energy in buildings, where the level of comfort is already provided;
- On the average, 30% of buildings' area (schools, kindergartens, residential houses) is not completely heated in Georgia, making it impossible to save energy as the rise in comfort reduces energy savings potential;
- 48% of existing buildings were constructed in the 1960s through the 1980s and are run-down, the introduction of solely energy efficient measures brings minimum effect and often is unprofitable in such buildings;
- The labeling of electric appliances is not obligatory;
- The request for the buildings' energy consumption certification is not mandatory;
- Local construction materials are not being certified;
- The construction companies are not being certified/licensed.

In order to overcome all these barriers, first the buildings' energy consumption standards must be introduced.

Conducted survey of technology's and the consumers market has revealed that only a small fragment is familiar with energy efficient technologies.

Box 3. Awareness deficiency in energy efficient technologies

- In relation with cooling-ventilation systems, 28 vendors in Georgia have been questioned, the majority of which (64%) operated in the fifth technological zone, and 22% only in Tbilisi. The results of the survey demonstrated that the most widely spread (28%) heating- cooling system in this zone is so called Split system and the second and third positions with equal percentage are divided between Chiller-Fanckoil and channel type conditioning systems. The largest part of respondents (29%) can't indicate which system is the most widely used;

- The questionings have shown that only a quarter (25%) of the population possesses information on energy efficient technologies, from which 27% are limited only to energy efficient lamps;
- A significant portion of both consumers and suppliers of heating-conditioning systems are not informed about the efficiency class of systems and therefore prefer cheap alternatives;
- At the same time, it should be mentioned that only 33% of companies selling energy efficient and renewable technologies believe that these technologies are not in high demand, 25% consider that the potential of these technologies is mainly associated with Georgia's regions (the first to the third technological zones), while 25% find difficulty to respond and 17% believe that there are no geographic differences in the demand.

Boxes 4-7 demonstrate major conceptual visions, creating the basis for the buildings sector low emission strategy.

Box 4. The Forestry Sector

On December 11, 2013, Georgia's Parliament approved a principal document on country's Forestry policy- "Georgia's National Forestry Concept". The document envisions the creation of a Forest Sustainable Management System in Georgia.

According to Section 8.1:

The rural population should be provided with available energy sources and different means of their use, among them:

a) By assessing the potential of energy sources, in accordance with expenses profitability, the introduction of energy efficient wood stoves, thermal insulation of houses, combined generation of heat and energy, extension of natural gas supply network, and by working out Action Plans based upon these assessments;
b) By developing and implementing a program which provides heating firewood among rural populations;
c) By the reasonable consumption of firewood while using more efficient alternatives.

Increasing the responsibility of local rural communities with use of local forest resources, including implementing and piloting of such mechanisms will ensure the involvement of these communities in the management of mentioned resources.

EU buildings sector directives considered in Association Agreement.

Box 5. The directive (2010/31/EU) on "Energy consumption by buildings"

The directive formulates a common framework of methodology for the calculation of energy efficiency of buildings. It establishes the minimum criteria of buildings' energy efficiency, at the same time advancing the need for the energy certification of buildings.

The main requests of the directive are:

- In case of selling or renting the building, the declaration necessarily must be joined with the building's energy consumption certificate;
- EU member countries should provide the **heating and cooling systems' inspection schemes** or introduce such measures, which will ensure the same results;
- EU member countries should establish energy consumption minimum standards for the majority of new buildings and existing buildings, which will be totally modernized or renovated in regard to such elements as heating and cooling systems, roofs, walls, etc.
- EU member countries should develop at the national level, financial measures for increasing the energy efficiency of buildings;
- One of the necessary conditions for the implementation of Directive's is the development of Construction Codes at the national level.

By 31 December 2020, all **new buildings** must become almost zero energy consuming (for the state buildings this date is 31 December 2018).

According to the final agreement with the Ministry of Energy this date for Georgia is June 2024. For state buildings date is June 2022.

The newest directive on energy efficiency is the EU Parliament and Council Directive 2012/27/EU dated 25 October 2012.

Box 6. The "Energy Efficiency" Directive (2010/27/EU). **The Directive explains that:**

- EU member countries must annually renovate at least 3% of buildings owned by the central authority/government and occupied by them; For Georgia and other countries of Energy Community this share is 1%;
- Government of EU member countries must only purchase buildings with very high energy efficiency;
- **EU member countries should finalize the long-range strategy on the renovation of all national buildings, which is part of the "National Energy Action Plan."** The strategy should mainly include: The overview of buildings stock; key political instruments that the country intends to use for the stimulation of renovation process; and the preliminary assessment of energy savings resulting from renovation of buildings.

One more directive which should be taken into account by the buildings strategy is the directive "On the promotion of using energy from renewable sources."

Box 7. The directive "On the promotion of using energy from renewable sources" (2009/28/EC).

Main request of the directive is to increase the use of renewable energies in buildings:

- The establishment of minimum requirements in new and renovated buildings; new state buildings- a model for others.

Based upon the analysis of energy consumption by zones, used technologies and fuel types, barriers to the energy efficiency, EU buildings sector directives, the low emission development vision 2030 Georgia's buildings sector has been formulated and is detailed below:

Develop long-range strategy for the rehabilitation of existing buildings. This program should be developed by 2020 to allow the government the uninterrupted implementation of buildings rehabilitation programs with energy efficient measures (NAMA) from 2020-2030. Firstly, such programs should be developed for the state and municipal buildings and later for multi-story buildings. For commercial buildings and one to two story houses. Regulations and efficient co-financing mechanisms should be developed in parallel. The full energy efficient rehabilitation of buildings results in the largest energy consumption savings (50-60%) in multi-story buildings, especially in dilapidated structures.

Approximate the heat consumption efficiency in buildings per EU standards[36] while constructing new and rehabilitating old buildings. To achieve this goal, it's necessary to adopt the draft Construction Code according to which Technical Regulations[37] of buildings' energy consumption should be approved by the Government Decree by1 July 2019. Technical Regulations should take into consideration the EU Directive 2010/31/EU requirements. Buildings efficiency standards could be established for the entire country as unique, or individually for each climate zones. This is a mandatory condition, without which certifying/licensing of materials and constructions companies, determining the quality of performed measures, and energy efficiency monitoring will be impossible.

Reduce depletion of unsustainable biomass/firewood in climate zones I and II per the measures discussed in the National Concept of Forestry Sector. In particular: extend the natural gas supply network, develop and implement a program in rural population which provisions the use of sustainable and efficient firewood, broadly distribute energy efficient firewood stoves and solar water heaters, implement thermal insulation of houses, combined heat and energy generation systems, make use of dry firewood.

All these activities should be accompanied by increasing local rural communities' responsibility towards local forest resources, including the development and piloting of such mechanisms, which will ensure the involvement of these communities in the management of mentioned resources.

Increase renewable energy (solar and geothermal) in buildings' heat consumption.

By 2030 the share of renewable resources (including firewood) in the buildings sector of climate zones I, II, and III shall not decrease less than 20% at the expense of maximum spread of solar, geothermal energy and heat pumps application.

Increase of biomass use in heat generation for the long-term perspective (after 2050). After the provision of sustainable management of forests, firewood/biomass shall become a local fuel of strategic importance that should be consumed mainly in the heating sector by applying the highest efficiency technologies.

For the implementation of the above-discussed strategy, in addition to programs considered above, the government will enact the following activities, which will essentially transform the management of the buildings sector:

- **The government shall identify the governmental structure which will be responsible for the development of policy** concerning existing buildings and for monitoring of implementation;

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[36] For the EU member countries, presently this value is 50 W/m2. Presumably, at the first stage this number in Georgia will be 80 W/m2, though much more efficient will be the definition of standard values according to climate zones and in this case in the First climate zone the provision of 50 W/m2 is possible as in this zone nowadays, under the inefficiency conditions, the average heat demand already makes 80 W per 1m2.

[37] At the time being the application of several international standards is admissible, the majority of which are not published in Georgian and therefore are hardly to be used by both construction organizations and construction certifiers as well.

- **The legislative basis of flat owners' associations** should be strengthened regarding the widening of associations' rights and obligations, especially concerning the maintenance of buildings owned by them;
- The **construction market should be regulated -** strengthening of quality demand and control. This means both the certification of locally produced materials by energy efficiency and only allowing materials that have passed the energy efficiency certification into the market, as well as licensing construction companies according to international standards.
- Concessional loans and grants should be given to those **developer/construction companies,** which encourage the use of energy efficiency and renewable energies and elaborate a conceptual approach, that implies the designing of the buildings with maximum consideration of the specific conditions;
- The **Energy Efficiency Fund** (including the application of renewables in the buildings) should be set up in the country. The priority of this fund initially should be the state and municipal buildings to facilitate the implementation of EU Directives determined under the Association Agreement;
- The Fund will not be able to perform its valuable and efficient operations until **"energy service" providing companies** for the heat and hot water supply sector are developed in the country. At the initial stage, considering the national circumstances and the condition of buildings stock in Georgia, these complete "energy service" providing companies could be of PPP format[38], or jointly managed with an experienced operator. However, in the long-term, its formation as an independent company is advisable.
- Filling the Energy Efficiency Fund, and in general, to secure the efficient fundraising of international co-financing, it is necessary to facilitate accreditation of national entities and get direct access to the international funds. The primary tasks for the country is to set up a new institution, or strengthen existing relevant national institutions (MDF, banks, etc.) enabling them to receive accreditation for GCF, GEF, etc. In due course, the Energy Efficiency Fund itself may be transformed into such an accredited body, in case of developing appropriate capacities;
- The government should **monitor energy efficiency processes/projects and energy credit programs,** in the country in order to provide complete reporting of energy and GHGs emission savings to the international community.

Mitigation Potential in the Buildings Sector

The mitigation opportunities and main 2030 impacts in the buildings sector are listed in Table 3, and Table 4 provides the emissions levels for BAU and each of the mitigation measures. Overall the GHG emissions are reduced by 7.8% in 2030 compared to BAU scenario and assuming full attainment of the identified mitigation measures in energy and LULUCF sectors.

Table 3. Mitigation Measure Impact by 2030

Mitigation Measure Area	Description	Impact by 2030 (Gg CO2eq.)
Implement and enforce the new Construction Code	This measure implies that the new Construction Code will be put in force in Georgia and by 1 July 2019 Technical Regulations of buildings energy efficiency standards and renewable energy consumption norms will be adopted by the government.	75.0

38 PPP-Public Private Partnership

Renovate state buildings per low emission development strategy (NAMA)	The measure considers that at least 50% of state buildings existing in 2014 will be completely rehabilitated by 2030 with energy efficiency measures	25.0
Renovate commercial buildings per low emission development strategy (NAMA)	The implementation of this measure assumes that 50% of medium restorable commercial buildings, existing in 2014 will be completely rehabilitated by 2030 with energy efficiency measures	83.0
Low emission development of residential buildings (NAMA)	The measure considers EE rehabilitation up to 55% of residential buildings in Georgia (44 million m^2) needed medium rehabilitation, Special programmatic approach should be considered (e.g. NAMA) for rehabilitation of residential buildings stock.	394
State program for the wide-spread utilization of solar water heaters and energy efficient stoves in private houses implemented	This measure implies creation of favorable conditions by the State for the rural population, for the application and dissemination of solar water heaters and energy efficient stoves	62.0
Solar water heaters in commercial and state buildings (NAMA)	This measure implies application of solar heaters in commercial and state buildings	17.0
Mandatory labeling of electric appliances	The measure implies that the EE labeling of electric appliances will become obligatory by 2022 for those electric appliances, which are defined by the Association Agreement	52.0
Replacement of incandescent and halogen bulbs with energy efficient bulbs in residential and commercial buildings	The measure involves the replacement of incandescent and halogen bulbs with energy efficient bulbs in residential and commercial buildings - increasing over time to cover 100% of these buildings by the end of 2022	49.0
Increase energy efficiency in geothermal hot water supply	Maximize utilization of geothermal heat supply potential in Tbilisi both in residential and commercial buildings	6.0
Shift street lighting to LED lanterns	The measure implies the complete shifting of street lighting to LED lamps	7.0
Total		**770**

It should be highlighted here that from 770 Gg total reduction of emissions listed in the Table 3, around 101 Gg are reduced in electricity generation sector due to decrease of electricity consumption in buildings. The combined effect of all measures on direct emissions in the buildings sector itself equal to 630 Gg. In Table 4, trends of emissions in BAU and Mitigation scenarios including the negative impact of LULUCF mitigation measures on buildings sector are provided.

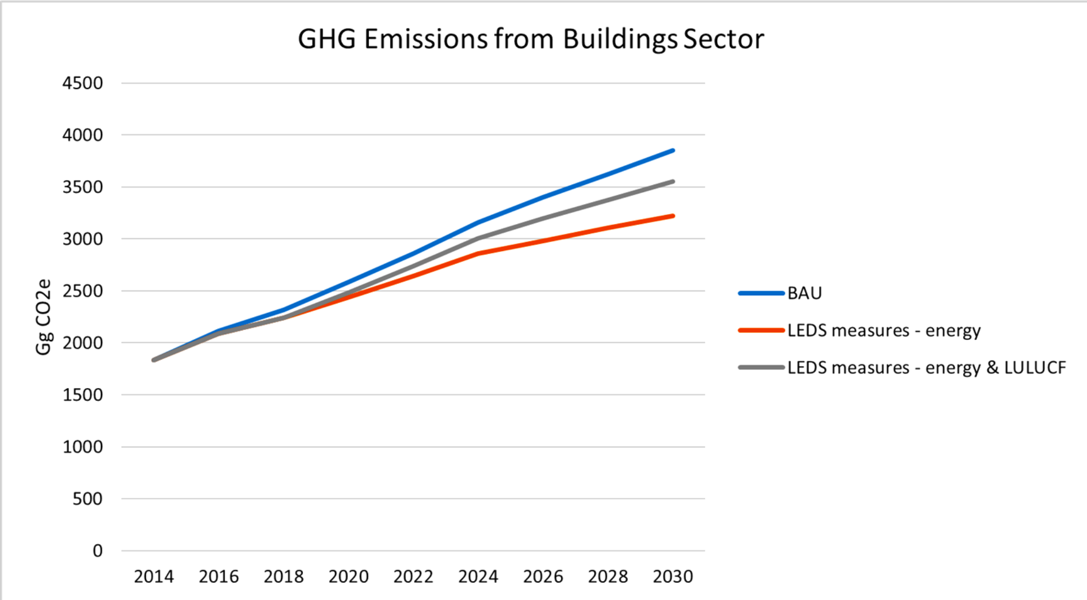
Table 4. BAU and Mitigation Scenario Emission Levels - Buildings

	GHG emissions (Gg CO2eq)									
Greenhouse gas sources	2014	2016	2018	2020	2022	2024	2026	2028	2030	2030 % Reduction
BAU Scenario										
4. Buildings	1,832	2,116	2,316	2,587	2,860	3,157	3,399	3,624	3,853	
4a. Commercial/ Public	465	548	581	631	682	740	774	810	861	
4b. Residential	1,367	1,567	1,735	1,957	2,177	2,417	2,625	2,814	2,991	
Mitigation Scenario										
4. Buildings	1,832	2,078	2,224	2,466	2,723	2,998	3,192	3,371	3,552	7.8
4a. Commercial/ Public	465	540	565	604	640	688	710	732	764	2.5
4b. Residential	1,367	1,538	1,659	1,862	2,083	2,310	2,482	2,640	2,788	5.3
Reduction	-	37	92	121	137	158	207	253	300	
% Reduction	-	1.8	4.0	4.7	4.8	5.0	6.1	7.0	7.8	

Section three of this document, which is Annex I (low emission pathway of buildings sector), provides detailed descriptions of GHG emissions reduction measures in buildings sector, which, according to assessments, could result in the annual saving of 630 GgCO_2eq (16.3% compared to BAU) without taking into consideration the LULUCF measures impact and 300 Gg (7.8% compared to BAU) in case of considering the mentioned impact.

The below Figure 37 demonstrates emissions growth projections in the buildings sectors by 2030 and scenario with measures including the impact of illegal cutting restriction measure in LUUCF sector.

Figure 37. Trends of GHG emissions from the buildings sector under BAU scenario and under the emissions reduction scenario (2014-2030)



If LULUCF measure is not undertaken, buildings sector measures result in a 5.3 % decrease in primary energy[39] compared to the BAU scenario, and a reduction of final energy by 6.4%, while the import of energy is reduced by 5.8% (import of natural gas by 9.4%). Electricity generation decreases by 2,600 GWh (1.4%), leading to a reduction in installed capacity of power plants by 500 MW, in comparison with the baseline (BAU) scenario.

Energy efficiency rehabilitation of residential buildings results in the highest emissions reductions.

Measures planned under the 2020 strategy mainly fall under the "preparatory phase", which includes the following:

- improvement of existing legal environment,
- establishing a clear framework of the responsible structures and their relevant functions,
- developing and implementing/testing programs and pilot projects,
- curtailing all possible barriers to the maximum extent possible,
- Carrying out all provisional activities necessary for executing measures.

Starting from 2020, the following activities will begin: the implementation of specific programs and projects, the actual reduction of GHG emissions, and reduction of energy consumption.

While evaluating the effectiveness of possible measures, activities identified in other energy efficiency strategies and action plans were taken into consideration. However, in this strategy, priority was placed on heating and hot water supply systems, for which 55% of gas and 45% unsustainable firewood was consumed in 2014.

Reducing the consumption of these two energy resources, imported gas and unsustainable firewood, substantially increases the level of power independence as well as the amount of sustainable facilities,

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[39] Primary energy (PE) is an energy form found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels, and other forms of energy received as input to a system. Primary energy can be non-renewable or renewable.

and increases the efficient consumption of local resources, while significantly reducing GHG emissions. Increasing efficiency in electricity consumption is a significant factor in a countries development and energy independence. However, in Georgia's case, improvements in electricity consumption efficiency have less of an impact on GHG reductions due it's relatively clean power grid, in which the share of hydropower (< 82%) is comparably high.

2.C. TRANSPORT SECTOR

SECTION ONE: OVERVIEW

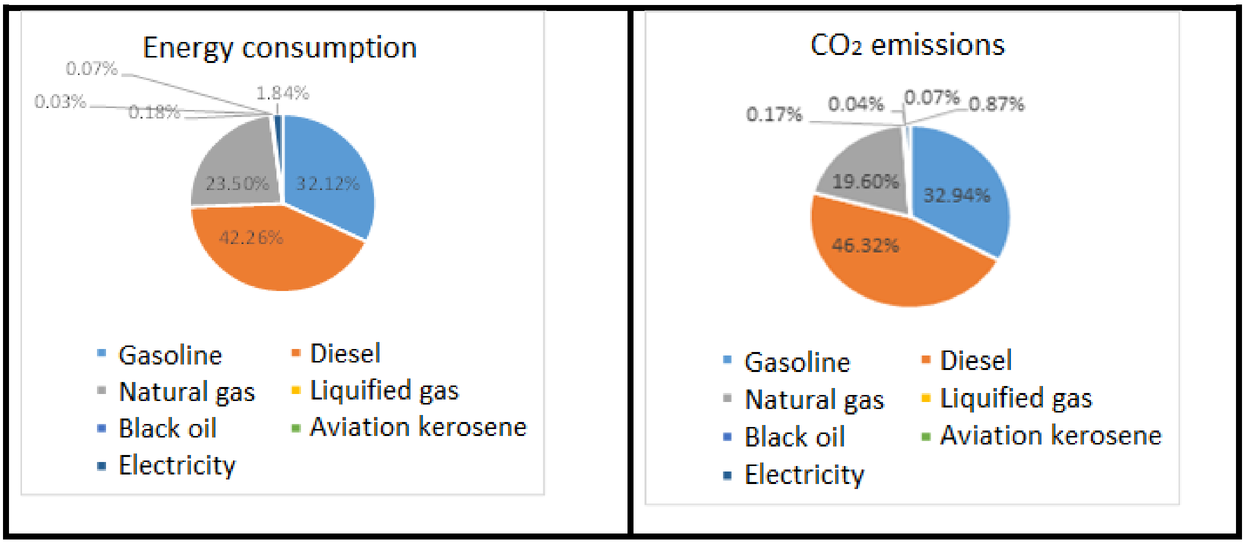
Today Georgia's transport sector consists of four main sub-sectors[40] — (1) road transport, (2) railway, (3) marine transport, and (4) aviation. At least one of these four modes connects Georgian regions, municipalities, cities and villages with each other and with Georgia's neighboring countries. In 2014 the transport sector employed 45,381 people and its turnover reached 3,916.2 million GEL[41]. Compared to 2000, this figure has increased by 746.6%, while the growth in employment reached 7.4%.

According to the National Energy Balance published by National Statistics Office of Georgia (GeoStat) [1], in 2014 the transport sector consumed 55.56 PJ of energy — one third of country's total final energy consumption. 52.14 PJ of energy consumed in transport was used internally in Georgia, while the rest was consumed by international aviation.

In 2014, diesel fuel (42.3%) led Georgia's fuel consumption in the transport sector, followed by petrol (32.1%) and the natural gas (23.5%). In the same year, Georgian Railway and Tbilisi Metro, as well as cable transport with trivial share, consumed 0.96 PJ electricity (1.84%) in the transportation sector.

Due to fossil fuel combustion, the transport sector emitted 3,493 Gg CO_2 equivalent GHG (37.1% of Georgia's total GHG emissions from energy sector) in 2014 and 99.1% of these emissions were emissions of carbon dioxide. Adding the indirect emissions from electricity consumption (with average grid emission factor of 0.115 tons of CO_2 per MWh), sector's GHG emissions was totaled 3,524 Gg and, again, combustion of diesel and petrol fuels was main source of emissions. Figure 38 shows the distribution of energy consumption and emissions by energy carriers in 2014.

Figure 38. Energy consumption and CO_2 emissions in transport sector by energy carriers, 2014



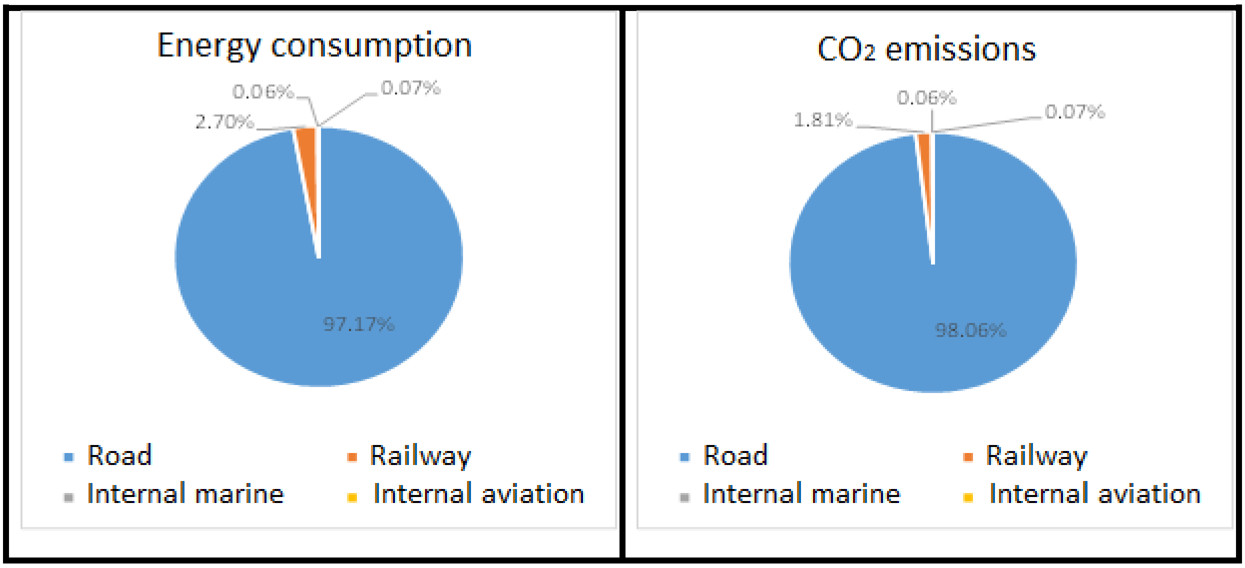
40 Pipelines are also part of the transport sector, but they are not addressed in this chapter as the base for LEDS GHG inventory and mitigation analyses — Energy Balance published by the GeoStat, — does not cover energy consumption of pipelines sub-sector (losses and volatile emissions from pipelines are examined in Energy chapter).

41 Contains employment and turnover figures for category "Complementary transportation, tour-operators activity".

http://geostat.ge/cms/site_images/_files/english/transport/by%20kind%20of%20economic%20activity/number%20of%20persons%20employed.xls

Figure 39 provides the information regarding the shares of different transportation types in sector's total energy consumption and carbon dioxide emissions. Apparently, road transport is the main player in both cases, while the shares of internal aviation and marine transport are negligible. As the cumulative shares of internal aviation and marine transport do not exceed 0.13% neither for energy consumption nor for the CO_2 emission figures, most of the emission reduction measures under the Low Emission Development Strategy are directed to affect road transport and railway.

Figure 39. Energy consumption and CO_2 emissions in transport sector by transportation types, 2014



In recent years, GHG emissions from the transport sector have increased significantly. For instance, CO_2 emissions from fossil fuel consumption are 211.3% higher than the corresponding figure of 2000, 98.2% higher than the value of 2006, and 35.5% higher than the consumption of 2010. Economic development and increased income are the main determinants of increased energy use, car fleet size and GHG emissions. GDP growth is highly correlated (94%) with energy consumption in transport sector, but the correlation with per capita GDP is even higher (97%). Clearly, income and economic activity strongly affect emission growth rates in transport sector.

Despite well-recorded passenger and freight turnover figures for railway, statistical data for road transport is often contradictory or unavailable and thus quality information regarding overall passenger and freight turnover is not accessible for Georgia. Based on obtainable incomplete information (from Geostat, Ministry of Internal Affairs, available residential surveys and other sources), the EC-LEDS project estimated passenger and freight turnover as well as fuel consumption and emission figures for various modes of transport (passenger cars, buses, minibuses, light-duty commercial vehicles, trucks, etc.) in the country. This analysis provided the transport sector's activity and energy intensity insights, and secured some ground for conclusions. The main findings of this analysis are depicted in Box 1. More details can be found in [2]. Nevertheless, to further improve data quality and to reach statistical accuracy, substantial additional work is necessary.

Box 1. Main characteristics of selected transport sub-sectors in Georgia

- Passenger transport constitutes 60.8% of total energy consumption in road transport, 26.5% is consumed by freight transport and the rest by other means of road transportation, like special vehicles (agricultural vehicles, fire trucks, etc.), military transport, etc.;
- Private passenger cars contribute 69% of total passenger turnover (expressed in passenger-kms), while the share of railway transport is just 5%, half of which is due to Tbilisi Metro. As far as the share of passenger cars is 69%, its share in total energy consumption is 89% as it is one of least efficient means of passenger transportation;
- Road transport and railway hold, respectively, 58% and 42% shares of total freight turnover (expressed in tons-km) in Georgia;
- Railway freight turnover declined by 20% compared to 2010, and by 33% compared to 2006. For the same periods, the decline in passenger turnover was 16% and 32% respectively;
- Despite its 42% share in total freight turnover, railway's share in total energy consumption is just 8% and only 5% in total emissions. The reason for this is that railway is the most efficient and least emitting mean of freight transportation, and increasing its share in total freight turnover will further reduce total energy consumption and emissions in transport sector;
- According to GeoStat, in 2014 there were 906.7 thousand road vehicles in Georgia (738.8 thousand of them were passenger cars). In 2014, number of road vehicles was 198% higher than in 2000, 77% higher than in 2007, and 38% higher than in 2010;
- Most registered cars are used vehicles from Europe. Just 1% are less than three years old, while more than 90% were produced 10 years ago;
- At present, biofuel is neither produced nor imported by fuel importers in Georgia. Although Ilia State University carried out a project during 2012-2014 in which they planted (10 hectares in Dedoplistskaro Municipality) and harvested canola plant for the first time in Georgia and produced bio-diesel. According to results, the price of bio-diesel equals 1.50-1.70 GEL per liter, thus it can compete with traditional diesel fuel.

Ministry of Economic and Sustainable Development has jurisdiction over road transport, maritime transport, railways, and aviation infrastructure and services, with its Transport and Logistics Development Policy Department serving as the coordinating body. The Roads Department of the Ministry of Regional Development and Infrastructure builds and operates roads classified as international and secondary. Local authorities are responsible for the other roads in the network, which are classified as local roads. They are also responsible for the organization of public transport routes on their territories, with some of the municipalities (such as Tbilisi) also owning public transport companies. The Land Transport Agency (LTA), Maritime Transport Agency (MTA), and Georgian Civil Aviation Agency are the technical regulators. The Ministry of Internal Affairs of Georgia (MIA) keeps a track of road accidents and issues driving licenses. Georgian Railway is state-owned. Private companies operate all the country's ports and two major airports, while the state-owned United Airports of Georgia operates the newest international airport in Kutaisi, and all regional airports.

Due to the globalization process and the location of Georgia, the country's economic development is directly related to the proper and effective functioning of the transport sectors. Georgia is located at the crossroads of Europe and Asia where the transportation of strategic goods is conducted. Therefore, one of the top priorities of the government of Georgia is coordinated functioning of the transport sectors, modernization/construction of transport infrastructure in accordance with international standards, harmonization of the country's legislation with international law and integration into the Trans-European Transport Network. Considering the above, the government of Georgia undertakes significant infrastructure projects that will facilitate an additional flow of goods towards Georgia and increase the effectiveness of transport systems.

Harmonization of Georgian legislation with European legislation is one of the priorities of Georgian government in line with Georgia-EU Association agreement. Several EU Directives, regulations and/or decisions are to be adopted for transport sector which have a direct effect on GHG emissions (such as Directives 2009/40/EC, 92/6/EEC, 96/53/EC, 2009/33/EC and others). These kinds of directives are adequately addressed and described under the Low Emission Development Strategy (see Annex).

Box 2 lists the main barriers faced by Georgia's transport sector sustainable development and these barriers should be stipulated adequately in the low-emission development action plan.

Box 2. Barriers to implement emission reducing measures in the selected sub-sectors of Georgia's transport sector

- At the present stage the strategic vision and policy of Georgia's transport development, which would treat all transport modes and regions in unified and integrated way is not yet formulated;
- The responsibility for developing a nationwide policy for urban transport (or, in general, priorities for sustainable urban development), and for coordination and support of municipal urban transport policies is not assigned;
- The transport sector's statistical data is not collected regularly, and the monitoring based on this data is not carried out (government only monitors selected economic figures), which hinders the development of efficient policy;
- Regional public road transport and passenger railway do not meet costumers' needs with respect to travel frequency or service quality, and a major share of passengers travel by private cars. In recent years attempts were made to improve public transport service quality, but the standard is still low in various towns or villages. Neither policy to improve services, nor minimum standard requirements exist. Safety and environment protection standards are not monitored and respective penalties are not clearly defined;
- Registering and regulating taxis is currently just an issue under discussion. Consequently, service quality is low and competition rules are not followed between taxis and public transport, as well as between different taxi service providers;
- Roadworthiness tests for private cars is not mandatory, while the fuel quality, which affects GHG emission levels and air quality, is not yet fully adequate to EU standards;
- Heavy-duty trucks damage the road infrastructure approximately by $0.50 per km, e.g., a multi-axle truck that travels 400 km in the country causes $200 damage [3] and this amount is much higher than transit fee fixed at 200 GEL;
- The sharing of freight turnover between road transport and railway is not optimal and the latter can operate with a higher load. The number of passenger carriages is limited and has been declining, and the infrastructure is frequently getting out of order. Railway struggles to compete with road transport as a result of inadequate fiscal policy in road transport;
- The first legal steps to introduce biofuel on the national market have already been taken, and a 20% mix of biodiesel and oil diesel mix has been assigned respective code in Georgian Common Procurement Vocabulary Code. Nevertheless, excise tax of 150 GEL per one ton is applied to production (or import) of both biodiesel as well as oil diesel, and is a significant obstacle for broad introduction of biodiesel to the consumer market.

SECTION TWO: LOW EMISSION DEVELOPMENT VISION FOR 2030

The Business As Usual (BAU) scenario presents the projected GHG emissions of Georgia if no mitigation measures and actions are implemented. To evaluate the impact of economic and demographic changes, the BAU scenario for the transport sector considers the following two main drivers:

- GDP growth, which, consistent with assumptions across all sectors, is projected at 3.5% in 2015-2016 and 5.6% afterwards. GDP growth affects the growth of freight turnover.
- Population number, which, consistent with assumptions across all sectors, is unchanged until 2030. Population number, together with GDP per capita growth rates affect the growth of passenger turnover.

The BAU scenario for transport sector is developed using the MARKAL-Georgia model. Model set-up as well as all other relevant assumptions for the development of the BAU scenarios are described in detail in [4]. According to BAU scenario by 2030 energy consumption in transport sector will increase by 106% and GHG emissions by 94.3% compared to 2014. Other results of BAU scenario are described in [5].

Taking into account the access to clean energy sources for electricity generation in Georgia, long-term emission reduction strategy in the transport sector envisions increased use of electricity. The emphasis will be to utilize electricity-run freight (railway) and public transport means (railway, metro, tram, cable-car, electric bus, etc.). At the same time, fiscal and financial measures will incentivize using electric cars and support a broad introduction of them into private passenger transportation with additional supportive measures once the technology is adequately developed (reaching a significant share of electric cars in vehicle fleet presumably in post-2030 period). Besides the electric car related measures, pre-2030 period strategy also envisions other measures aimed to renew car fleet, to improve fossil fuel quality and others. These strategies are discussed in detail below.

Pre-2030 period transport sector LEDS has three main directions:

- Car fleet and fuel quality;
- Freight transport;
- Passenger transport and urban transportation.

One of the main directions of Georgia's transport sector LEDS is the **improvement of road transport fleet and fuel quality,** which reduces GHG emissions, but also improves air quality as well as public health. At present, outdated cars construct the high share of Georgia's transport fleet, and the demand and supply for old, second-hand and high-emission cars is high. The number of cars is increasing steadily and will continue in the future. This will further deteriorate air quality and public health, will increase the overloading of road traffic and will have adverse effect on the quality of life and public welfare. The average age of Georgia's car fleet is 20 years and most of the cars are technically impaired. Technical standards and a regular roadworthiness tests apply only to selected types of transport.

Renewal/refreshment of car fleet. To improve the quality of the vehicle fleet, the roadworthiness tests will become mandatory for all vehicles by 2017, during which several technical parameters will be checked. In addition, in the short-term, the fiscal stimuli mechanism will be introduced in support of purchasing newer and lower emission cars. This mechanism includes reducing the excise tax for purchasing new and low-emission (hybrid, electric) cars or increasing a similar tax for importing old cars. In the long-term, importing old cars will be completely prohibited. That will be a preliminary step towards preparing and implementing a legal framework for imported/purchased cars' GHG emission standards[42]. These standards might be enforced after 2030.

Improving fuel quality. Fuel quality requirements are lower in Georgia than the EU. But, it is important that the rapid adoption of EU standards will increase fuel prices, thus the Georgian government works hard to synchronize national standards to the EU standards step by step. The government plans that by 2020 Euro-5[43] standard for vehicle fuel will be introduced.

Using biofuel in the transport sector can significantly improve overall fuel quality in Georgia. In addition to reduced CO_2 emissions, biofuel provides advantages like being free of heavy metals and not polluting air with lead, sulphur dioxide, different cancerogenic or other harmful admixtures. Today, biofuel is not commercially available in the country, but surveys showed that there is potential to produce biofuel in Georgia in a commercially profitable way. Consequently, in LEDS the emphasis is on producing biofuel domestically. In this respect, at the first stage (short-term) it will be necessary to carry out a large-scale project, which will examine biodiesel commercialization potential

[42] EU regulations: CO_2 and Cars Regulation (EC) No 443/2009 and CO2 and Vans Regulation (EU) No 510/2011 თანხმად.

[43] EU directive: 2003/17/EC

and precisely calculate emission factors for the whole cycle of biodiesel production. This will be used to verify that biodiesel is sustainable. Also, adoption of biofuel standards and biofuel certification by a designated authority will be important. The barriers (financial, technological, etc.) faced while realizing this project should be used to prepare and implement biofuel production supporting policy, including the fiscal policy like abolition of excise tax on biofuel, etc. Simultaneously, target share of biofuel consumption in road transport should be defined by 2030.[44]

The main strategy of developing the **freight transport sub-sector** in Georgia is promoting railway freight transportation and increasing its compatibility, as it is the least-emitting means of transportation. In this respect, to improve railway traffic capacity, increase the speed and service quality, numerous infrastructural projects are planned. At the same time, railway freight transportation cannot compete with road freight transport that pays less taxes than the value of the damage they impose on infrastructure [3]. There is a plan to modify fiscal policy that will put road and railway transport at the same level, and support competition.

For **passenger transport** the main strategic direction is to work out multi-modal transport system consisting of intercity and urban sustainable public transport. Currently, intercity public transport service quality is low and not regulated. Also, the railway infrastructure goes out of order and declines over time. Because of this, further improvement of road transport (in the short-term) and renewal of railway infrastructure (in the long-term) is planned. Also, as the taxis are neither registered nor regulated, it is necessary to start their regulation and keep their registry.

In the process of low emission transport development emphasis will be made on the **sustainable development of urban transport** and the support of cities that have developed sustainable energy action plans in the framework of the Covenant of Mayors (CoM). Measures in this agreement cover urban public transportation, pedestrian and cycling route development, carrying out parking policy and other identified or planned measures on city level. In the pre-2020 period, in the framework of National LEDS, emphasis will be to support the development of existing plans (which cover period until 2020), while after 2020 municipal-level plans will be prolonged till 2030 and the involvement of more municipalities in the process of CoM and support for planned measures will take place. In this procedure, the realization of population behavior change measures, which aim to reduce people's dependence to private cars and popularizing clean public transport technologies, will be important.

Box 3 lists main directions of Georgia's Transport sector LEDS.

Box 3. Transport sector LEDS

Vehicle fleet and fuel quality

Short-term (2017-2025):

- Introducing obligatory tests for vehicles roadworthiness;
- Carrying out fiscal policy to discourage the import of old cars and encourage the import of low-emission (electric, hybrid) ones;
- Increasing fuel quality standards gradually and introducing government control mechanism;
- Analyzing the potential for biofuel production commercialization.

Long-term (2026-2030):

- Introducing and enforcing Euro-standards to control cars toxic emissions;
- Defining standards and sustainability criteria for biofuel.

Freight transport

[44] According to the requirements of EU Renewable Energy Directive (2009/28/EC).

Short-term (2017-2025):

- Developing railway infrastructure;
- Taxing road freight transport for using certain types or road infrastructure.

Long-term (2026-2030):

- Monitoring the results and revision of approach as necessary.

Passenger transport and sustainable urban development

Short-term (2017-2025):

- Developing intercity public transport;
- Improving taxi registration;
- Carrying out/supporting transport sector measures defined in Georgian municipalities' sustainable energy development plans.

Long-term (2026-2030):

- Rehabilitation/development of passenger railway transport (railway, metro);
- Carrying out/supporting the continuation of energy sector sustainable development plans on Georgian municipalities' level till 2030.

Box 4 lists transport sector LEDS targets defined according to the given strategy:

Box 4. Targets of transport sector LEDS for 2030

Vehicle fleet and fuel quality

- 15% improvement of transport fleet average energy intensity compared to 2014
- Introducing obligatory fuel quality standards according to Euro-5

Freight transport

- Increasing railway's share in total freight turnover – at least up to 50%

Passenger transport and sustainable urban development

- Achieving the share of rail transport in total passenger turnover – at least 9%
- Achieving the share of road public transport in total passenger turnover – at least 20%
- Reducing urban transport sector's GHG emissions (approximately by 20%) on urban territories according to targets defined in SEAPs

The list of all mitigation measures considered in this strategy are listed in Table 5. More detailed descriptions of the measures are given in annex.

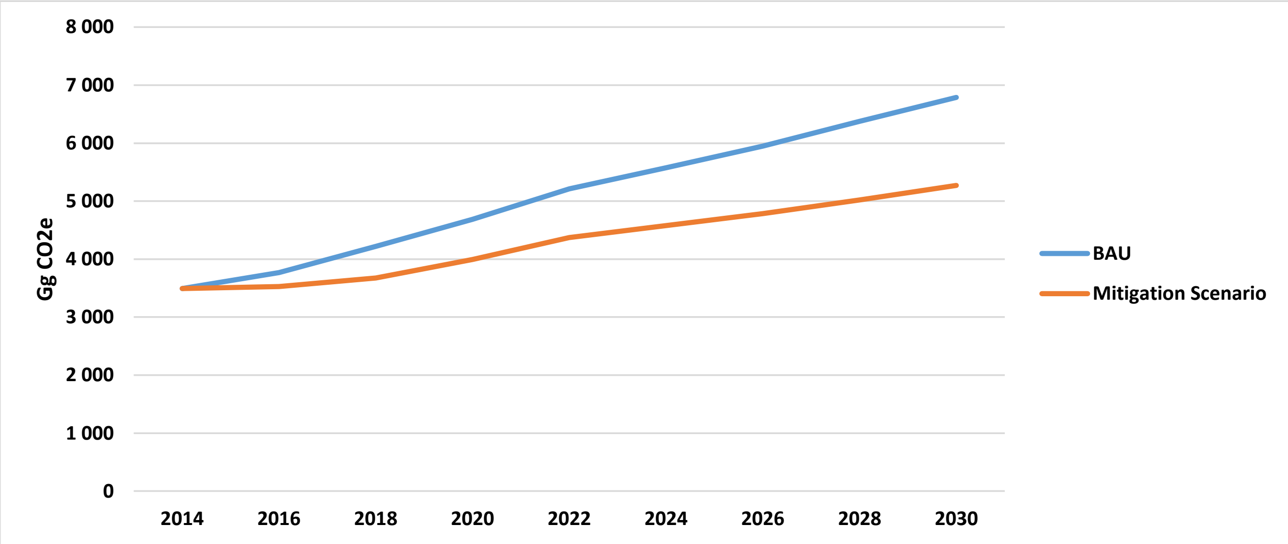
Table 5. Mitigation Measure Descriptions & 2030 Impacts - Transport Sector

Mitigation Measure	Description	Impact by 2030
TPOL1: Road transport technical requirements	Adoption of several EU directives and regulations (including road worthiness tests) which lead to improvement of average fleet efficiency	214 Gg (including the effects of TPOL2-4 measures)
TPOL2: Fiscal policy in relation with old cars	Significant increase in excise tax for more than nine years old cars	included in TPOL1

Mitigation Measure	Description	Impact by 2030
TPOL3: Developing and implementing the legislative base for road transport eco-class awarding and labeling systems	Development of the legislative base for road transport eco-class awarding and labeling system, and calculating import tax with respect to transport eco-class	included in TPOL1
TPOL4: Eco-driving courses for drivers	Introducing the requirements of initial qualification and periodic training for drivers of certain types of transport	included in TPOL1
TPOL5: Encouraging the purchase of electric and hybrid cars	Reduction the excise tax on hybrid and electric cars	Cumulative effect - 69 Gg 83 Gg emissions reduction in transport sector, 14 Gg increase of emissions in electricity generation sector
TPOL6: Improving fuel quality	Adoption of Euro 5 standards for fuels	not estimated
TPOL7: Working out integrated and coordinated tariff policy for freight transport	Increasing the share of railway in freight turnover using relevant tariffs policy	Cumulative effect – 686 Gg 698 Gg CO2 emission reduction in transport sector 12 Gg CO2 emissions increase in electricity generation sector.
TMEA1: Improving railway infrastructure	Several infrastructural projects carried out in Georgia to improve and widen railway infrastructure	included in TPOL7
TPOL8: Improving the quality of intercity passenger transport	Improving the service and quality of intercity public road transport	33 Gg
TPOL9: Taxi registration and regulation	Mandatory registration and licensing for taxis	109 Gg
TMEA2: Development of railway passenger railway transport	Renewal of passenger railway infrastructure and increasing train fleet towards strategic directions	Cumulative effect – 162 Gg 186 Gg CO2 emission reduction in transport sector 24 Gg CO2 emissions increase in electricity generation sector
TPOL10: Working out nationwide sustainable urban transport development policy	Development of national strategy for supporting municipal efforts	not estimated
TMEA3: Improving urban public transport	Incorporates all sustainable public transport development activities discussed in the SEAPs of CoM signatory cities	55 Gg
TMEA4: Clean public transport	Substitute diesel-run buses with either natural gas- or electricity-run buses in the cities	0.6Gg
TMEA5: Supporting walking/cycling/moped traveling	Incorporates walking/cycling/moped travel measures discussed in the SEAPs of CoM signatory cities	157 Gg
TMEA6: Parking policy and other restrictive measures	incorporates parking policy and other restrictive measures discussed in the SEAPs of CoM signatory cities	14 Gg

Implemented together, the aforementioned measures will allow for the reduction of emissions in the transport sector by 1,519 Gg CO_2 e annually, which make 22.4% of total projected emissions of the sector for 2030. Figure 40 demonstrates projected increases of GHG emissions in the transport sector. The blue line is emission increase according to BAU scenario, while the purple one shows increase if only the transport sector measures are carried out.

Figure 40. BAU and Mitigation Trajectory (CO2eq) – Transport Sector



The numerical values of emissions in BAU and mitigation scenario for transport sector are given in Table 6.

But the transport sector measures will also have an effect on emissions from the energy supply sector. Some measures (railway measures, electric car measures, etc.) increase electricity consumption and thus increase emissions for the electricity generation in the energy supply sector. If only the transport sector measures are implemented, the electricity generation emissions will increase by 48 Gg and this equals 2.3% of projected emissions in electricity generation by 2030. Fugitive methane emissions, on the other hand, will decrease by 98Gg CO_2e. Combined effect equals to 1,570 gg CO_2 e annually by 2030.

Due to the transport measures, electricity consumption in the transport sector will increase by 738 GWh and additional 150 installed capacity will be needed by 2030. Although if measures in other sectors (such as buildings and industry) are also implemented, there will be no need for additional capacity, as electricity saved in other sectors will be more than enough to cover transport needs.

The most efficient transport sector measure to reduce GHG emissions are to support and increase railway freight turnover. Overall, the transport sector measures by 2030 reduce projected primary energy consumption according to 2030 BAU scenario by 20.6 PJ (5.0%), final energy consumption by 20.9 PJ (6.9%) and imported fuel consumption by 22.7 PJ (8.5%). Further details on the impacts of measures can be found in [6].

Measures described in Table 6 cover fiscal policy instruments, legal framework modification, institutional and planning measures, as well as specific infrastructural measures. Carrying out administrative and legal measures are significantly cheaper than the transport sector infrastructure development costs and sometimes serve as an income source. All other instruments related to taxation (for example, for taxis or for old cars) could serve the same purpose and they aim to reduce undesirable practices like using inefficient cars. Introducing fuel quality standards, new traffic regulations, prohibiting the import of old cars and like instruments are also cheap solutions as their cost equals the costs of preparing or amending the legislation. Even though roadworthiness tests are also policy measures, they are relatively expensive as they involve the testing of large number of vehicles. On the other hand, special technical organizations carry out these tests and there are ways to recover testing costs. Expenses might be fully covered by car-owners or partly subsidized by the government. The government can support the process, for example, by granting free land use rights for testing service providers. Of course, this puts an additional burden on car owners, but their expenses could be recovered in the future regarding cars' increased energy efficiency and reduced fuel consumption costs.

Though the above-mentioned regulations are sometimes considered unfair as they impose high costs on car-owners, two facts should be highlighted. First of all, these additional costs internalize the social, environment protection, car accident and other external costs borne by the society into car-owners' (externality imposers) private expenditures. Secondly, these regulations encourage drivers to use safer and low-emission modes such as public transport.

Table 6. BAU and Mitigation Scenario Emission Levels – Transport Sector

	GHG emissions (Gg CO2e)								
Greenhouse gas source and sink categories	2014	2016	2018	2020	2022	2024	2026	2028	2030
BAU									
Transport	3,493	3,768	4,221	4,685	5,213	5,576	5,949	6,378	6,789
Mitigation Scenario									
Transport	3,493	3,527	3,674	3,995	4,371	4,579	4,782	5,023	5,270
Reduction		240	548	691	842	997	1,167	1,356	1,519
% Reduction		6.4%	13.0%	14.7%	16.1%	17.9%	19.6%	21.3%	22.4%

2.D. INDUSTRY (ENERGY USE)

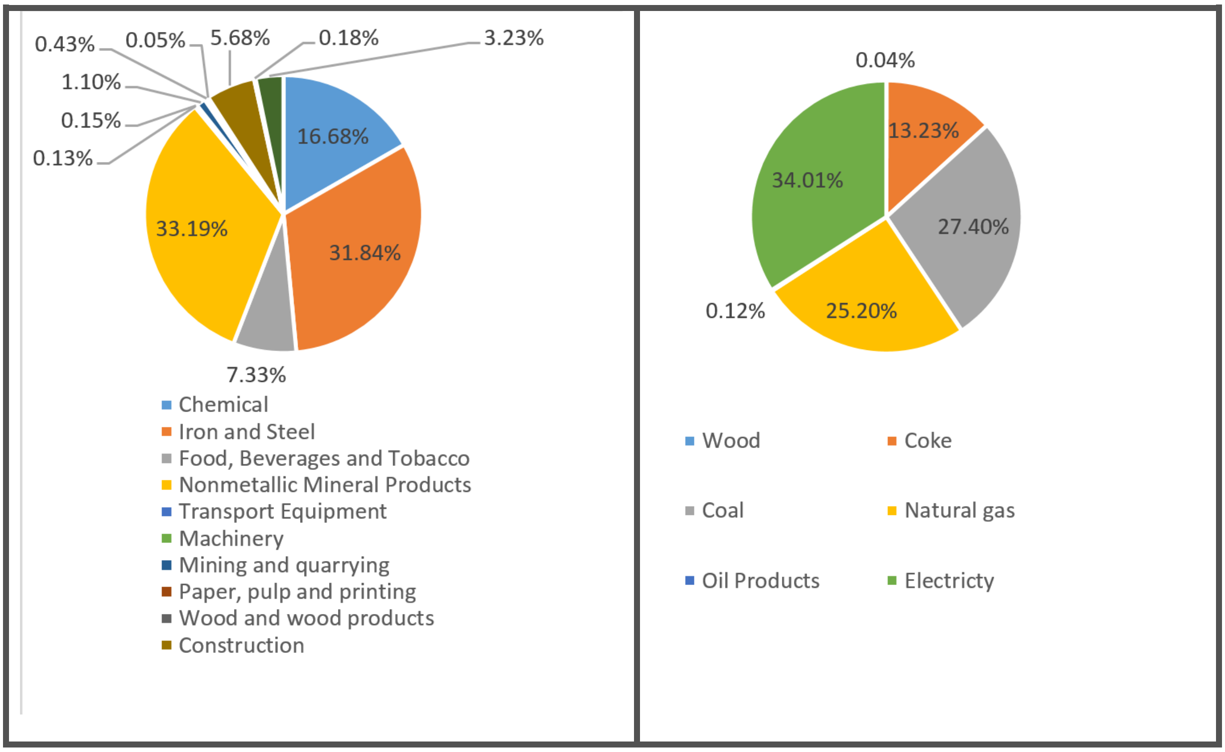
SECTION ONE: OVERVIEW

According to the 2014 data, the industry sector ranks No. 2 with 16.9% in the sectoral structure of the Gross Domestic Product (GDP) of Georgia; the largest share, 17.5%, belongs to the trade sector, and the share of the construction sector is 7.1%. The number of persons employed in the industry sector in 2014 was 166.6 thousand people, production was amounted to 8,201.5 million GEL and fixed assets totaled 6,097.6 million GEL.

According to the data obtained from the National Statistics Office, there were 6,684 industrial enterprises[45] registered in Georgia in 2015; including 536 large, 661 medium, and 5,487 small sized ones[46]. Most are registered in food, beverage, and tobacco sub-sectors.

Industry sector consumed 29.82 PJ[47] of energy in 2014, accounting for 18.7% of the final energy used in Georgia. Breakdown of energy consumption by branches and fuel types is given in Figure 41.

Figure 41. Final energy consumption in the industry sector by industry subsectors and fuel types (2014)



As Figure 41 shows, electricity remains the most common source of energy (34.01%) of the industry sector followed by coal (27.4%) and natural gas (25.2%). Coke consumption is also high (13.23%). Among industry subsectors recorded in the energy balance of Georgia [1], the greatest amount of

45 Except for construction sector.

46 Large enterprises are businesses where annual average number of employees exceed 100 persons, or annual average turnover is above 1.5 million GEL. Small sized enterprises employ no more than 20 people and annual average turnover is not more than 0.5 million GEL. Medium-sized enterprises are the remaining ones.

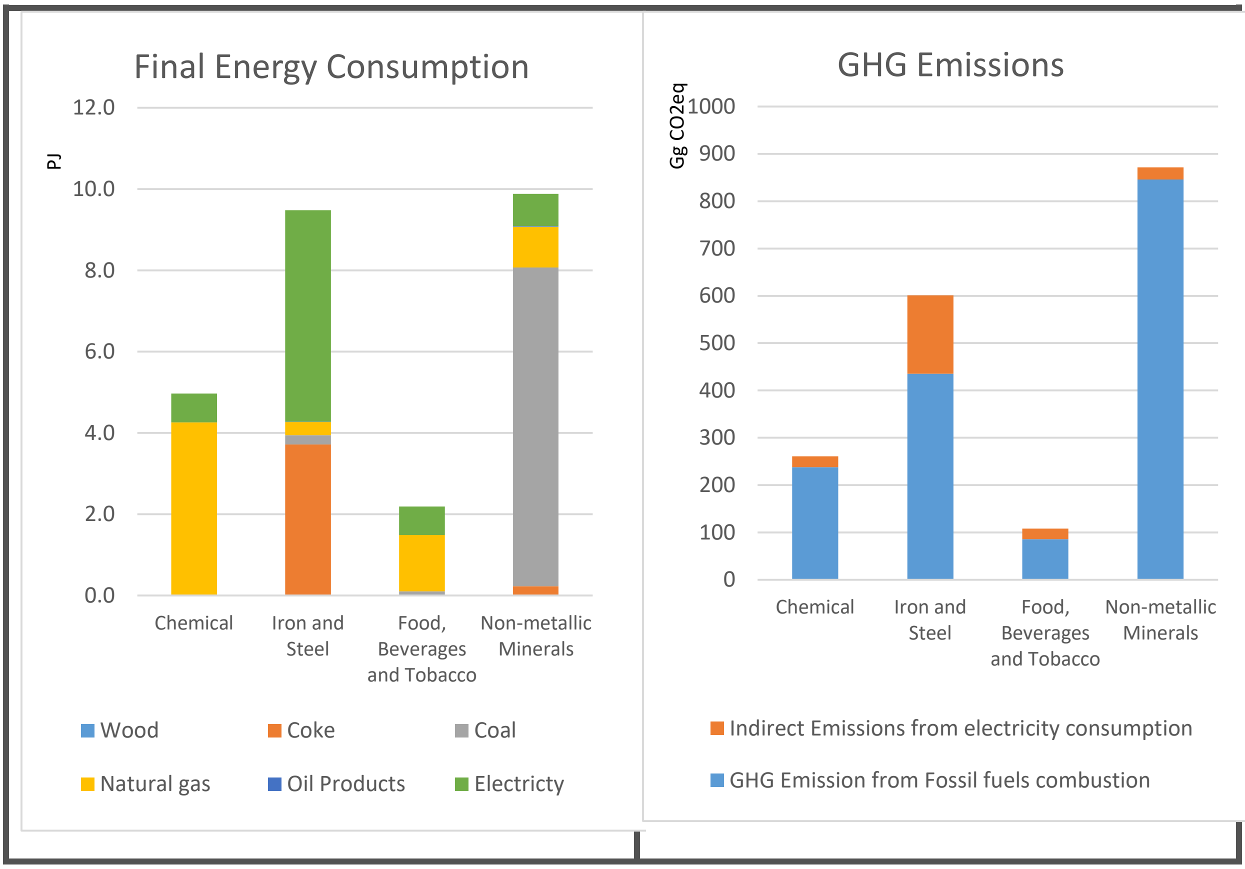
47 The amount of energy used for energy purposes as reported in national energy balance[1] is adjusted by adding the amount of natural gas used for energy purposes in chemical production, which in energy balance is completely reported under non-energy consumption.

energy is consumed by: non-metallic mineral products (33.19%); chemical and petrochemical products (16.68%); iron and steel 31.84%; food products, beverages and tobacco (7.33%).

Combustion of fossil fuels accounted for 1,638 Gg CO_2 eq. greenhouse gas emissions in the industry sector in 2014 which is 17.4% of total emissions from the energy sector that year. Industry sector emissions in 2014 decreased by 6.42 compared with 1990 due to the collapse of the Soviet Union and the accompanying shut down of many enterprises; in 1990, greenhouse gas emissions from the industry sector were about 10,530 Gg CO_2 eq. The main driver of fuel consumption and emissions in industry sector is national GDP [2].

As in case of energy consumption, the same four subsectors are responsible for the largest shares of GHG emissions[48], including non-metallic mineral products (51.67%); cast iron and steel (26.58%); chemical and petrochemical products (14.55%); food products, beverages and tobacco (5.22%). These subsectors in total cover 89% of energy consumption and 98% of emissions from fossil fuel combustion in the industry sector (94% if indirect emissions from electricity consumption are included). The main source of emissions in non-metallic mineral products subsector is consumption of coal for clinker production. In the iron and steel subsector it is coke consumption for ferroalloys production, and in the chemical industry-natural subsector it is gas consumption for ammonia and nitric acid producion. The main source of emissions in food, beverage and tobacco industry is consumption of gas in various industrial processes. Figure 42 shows final energy consumption and GHG emissions in most energy intensive subsectors

Figure 42. Final energy consumption and the GHG emissions in energy intensive industry subsectors (2014)



48 Without taking into account indirect emissions of electricity

Policies for economic growth (including the industry sector), identification of important directions for economic development and working out proper action plans and programs are the prerogative of the Ministry of Economics and Sustainable Development of Georgia, while the Ministry of Environment and Natural Resources Protection is responsible for state accounting of released pollutants. Development and implementation of the energy efficiency and renewable energy utilization in all sectors (including the industry) is the responsibility of the Ministry of Energy. Under the EU-Georgia Association agreement Georgia will have to implement various EU directives that will impact emissions from the industry sector, including the Industrial Emissions Directive and Energy Efficiency directive, which are both addressed in the Low Emission Development Strategy in the next section and annex.

During the strategy preparation, a survey of large industrial facilities and a comparison of emissions intensity was carried out by the EC-LEDS, which revealed significant differences in energy consumption and emissions intensity in various industrial facilities [1]. It was also revealed that there are three enterprises in Georgia responsible for 71.8% of the GHG emissions from fuel combustion in the industry sector. The share of these enterprises in total energy consumption in the industry sector is 58.8%. These enterprises are "Heidelberg Cement," "Georgian Manganese," and "Rustavi Azoti."

The survey also revealed significant barriers, the consideration and elimination of which will be necessary to implement emission reduction measures in the industry sector. In order to remove barriers, clear energy efficiency policy should be introduced in the country, which might be enforced through various political and financial instruments. It is also important that the companies monitor and report achieved progress in energy efficiency as well as encourage research and development activities in energy efficient technologies. Also, the government should disseminate information about energy efficiency in industrial facilities as far as possible.

Barriers to emissions reduction measures in the industry sector

- *Lack of disposable capital for such measures, payback periods of which are relatively small;*
- *Cutting the energy price rather than reduction of energy consumption is considered as a net cost reduction method by the majority of industry managements;*
- *Lack of information and knowledge on energy and emissions reduction opportunities and lack of qualified workforce as in enterprises so throughout all the country;*
- *Absence of clear and effective energy efficiency and emissions reduction policy in the country.*

SECTION TWO: LOW EMISSION DEVELOPMENT VISION FOR 2030

The industry sector consists of a wide range of industries, technologies and processes, so it would be strategically unjustified to focus only on a limited amount of emission reduction measures. In general, three types of technical measures are considered in the industrial sector:

- To increase energy efficiency in the industrial sector that includes maximum growth of energy efficiency of production via substitution of old technologies and processes by new and efficient ones;
- Fuel substitution; replacing currently used high-carbon-containing energy sources with cleaner low-carbon-containing substitutes;
- Application of carbon capture and storage technologies.

The last two directions are usually more expensive than the first option, thus the first option should be promoted first. This option, i.e. energy efficient measures, is usually profitable for enterprises, having a relatively short payback period of investment. There are less profitable energy efficiency measures as well, with a longer payback period. Energy efficient measures are divided into two types based on possibilities of identification and dissemination:

1. Measures which are characteristic only for specific industrial processes. Identification and evaluation of economic benefits of such measures require detailed energy audit;
2. Relatively general measures that could be beneficial for wide range of enterprises, e.g. introduction of energy efficient motors (el. motors with frequency regulators), efficient cooling system etc. These can be deployed without prior energy audit.

Both types of measures should be encouraged in Georgia. In the first case, the main emphasis should be placed on large, energy-intensive enterprises. It is also important to support medium and small enterprises in conducting energy audits in order to determine specific measures for the enterprise. This can be done by availability of qualified personnel and the possibility of using financial instruments. As for the second listed measures, they may be enforced through introducing standards or special programs, and can achieve significant savings in various different types of enterprises (both in large organizations and SME's).

The above-mentioned measures are technological, the identification and implementation of which additionally requires corresponding policy instruments and other supporting measures in order to achieve reduction on relatively large-scale. These mechanisms determine state policy on emissions reductions in this sector.

The following types of policy tools and supporting measures are approved worldwide for reduction of emissions in the industry sector:

- Mandatory measures, such as establishment of a cap on energy consumption and/or emissions or requirement for mandatory energy audits, etc.;
- As already mentioned, even economically beneficial measures cannot be implemented due to various barriers (see Box 1). Therefore, it is important to remove these investment, knowledge, and technology related barriers.
- Measures that are more expensive can be enforced through imposing taxes for emissions or energy consumption, encouraged by subsidies or other economic or fiscal policies.
- Supporting of energy efficient/low-carbon technology research, development and demonstration to create new, climate change mitigation technologies or support technology transfer.

Under LEDS, over a period of the next eight years, emphasis should be laid only upon cost-effective measures that have a potential of economic savings for the industry sector. Therefore, there is a concentration on such supporting activities, which are directed to remove or relieve barriers and include the following measures:

- To conduct energy audits aimed at determining energy consumption and emissions reduction measures in industrial facilities and assess their economic efficiency;
- Training and awareness raising activities for representatives of industrial facilities to demonstrate how energy efficiency measures can reduce production expenses and cost;
- Development of such financial mechanisms that will make primary investment capital available for industrial facilities. This might be cheap loans of targeted energy efficiency, energy efficiency fund or other;
- Wide promotion of energy efficient technologies (e.g. engines, cooling systems, boilers etc.) through development of special programs and introducing legislative requirements.

At the same time, it will be important to monitor measures and emissions in the industry and use obtained results to determine auditing priorities and make farther policy decisions.

In addition to these measures, it will be necessary to enforce mandatory mechanisms for regulating emissions in large enterprises (e.g. to conduct mandatory energy audits, or set emission cap) or to sign a voluntary agreement aiming to encourage facilities to implement energy efficient measures (where encouragement can be performed through corresponding fiscal policy). Such measures need large-scale consultations with the industry sector however, which should be carried out before preparing a corresponding legislative portfolio by 2025.

The low emission development strategy of the industry sector considers the period until 2025 as a preparatory period for industrial facilities to commence binding mechanisms of the industry sector from 2025, requiring energy and emissions reduction measures on a legislative level. Box 2 shows the main directions of the low emission development strategy for the energy sector

Box. 2. Low Emission Development Strategy of the Industry Sector

Short-term (2017-2025):

- To determine the shape of the legislative regulation of GHG emissions (or energy consumption) and prepare a relevant legislative portfolio based on a dialogue with the industry sector representatives;
- To develop financial mechanisms to promote emissions reduction measures in the industry sector (including audits, etc.) and organize state monitoring on financial aids;
- To implement a flexible monitoring system on energy consumption and the GHG emissions;
- To deploy permit systems for industrial emissions;
- To study the possibility of introducing the best international practices in the industry sector

Long-term (2026-2030):

- To enforce legislative regulations of the GHG emissions in the industry sector
- To prepare short-term state program/plans to reduce the annual amount of emissions from existing facilities (includes both the GHG emissions and other industrial gases)

The Table 7 lists mitigation measures in the industry sector. Farther descriptions of the measures are given in the annex. The measures include policy instruments planned in the industry sector, as well as individual technical measures resulting from the mentioned policy instruments and causing a real reduction of energy consumption and emissions.

Table 7. Mitigation Measure Descriptions & 2030 Impacts – Industry (Energy use)

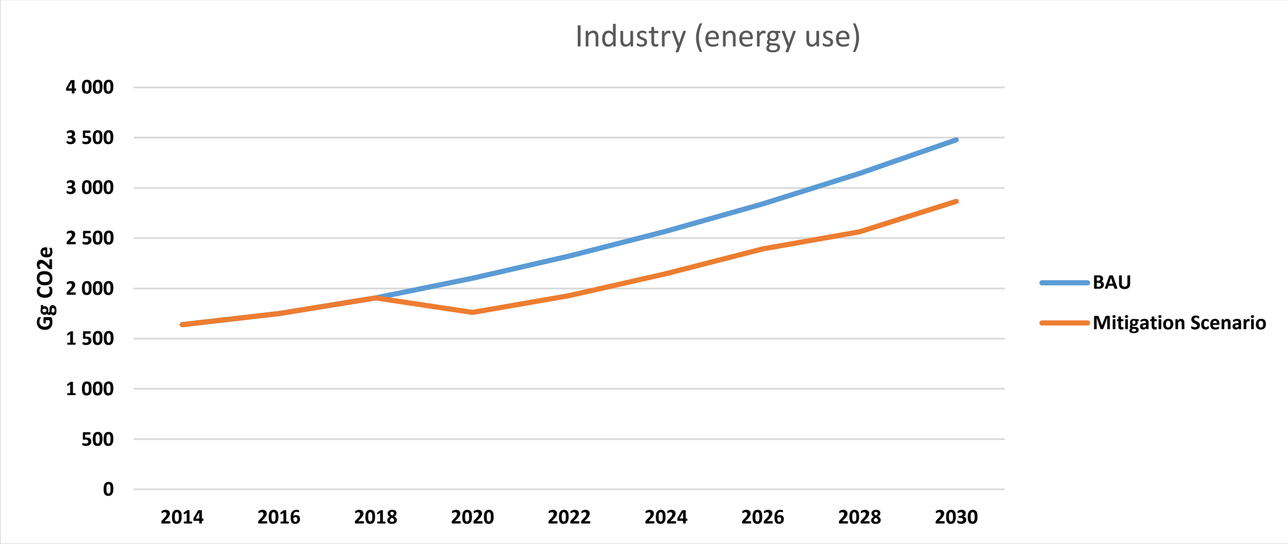
Mitigation Measure	Description	Impact by 2030
IPOL1: Determination of legal mechanisms to regulate emissions from large, energy intensive industries of Georgia	Development of legal mechanisms for regulating emissions from large industries by appropriate dialogue and research	not estimated
IPOL2: Financial instruments to support carrying out emissions reduction activities in the industry sector and monitoring on these instruments	Elimination of the initial investment capital scarcity/insufficiency barrier and includes the programs providing financial and technical support for industrial facilities to carry out emissions reduction measures	not estimated
IPOL3: Inventory of energy consumption and the GHG emissions at the enterprise level and identifying corresponding benchmarks	Collecting of information from the industrial facilities about their energy consumption and emissions and using this information for calculation intensities and setting up benchmarks	not estimated
IPOL4: Carrying out energy audits and research on applicability of	Preparing and training experts in the industrial sector to conduct an	not estimated

Mitigation Measure	Description	Impact by 2030
Best Available Techniques (BAT)	energy audit and introduce the Best Available Technique (BAT) in the industrial facilities	
IMEA1: The transfer of clinker production from wet method to dry method in the Kaspi and Rustavi Heidelberg Cement Plants	Assuming that the Kaspi plant will be transferred to dry method by 2018 and second Rustavi plant in 2028	413 Gg
IMEA2: Other energy efficiency measures in producing non-metallic mineral products	Implementing other energy efficiency measures in non-metallic minerals products subsector	285 tons (only additional measure of Heidelberg Cement)
IMEA3: Energy efficiency measures in chemical industry	Implementation of different types of measures at "Rustavi Azot" Plant	Cumulative effect - 37.5 Gg 24.2 Gg emissions reduction in industry sector 13.3 Gg emissions reduction in electricity generation sector
IMEA5: Energy efficiency measures in ferroalloys production	Improving energy intensity in ferroalloys production	Cumulative effect - 146 Gg 137 Gg emissions reduction in industry, 9 Gg emissions reduction in electricity generation sector
IMEA6: Energy efficiency measures in iron and steel industry	Implementation of different types of measures in the iron and steel industry (except production of ferroalloys)	10 Gg
IMEA7: Energy efficiency measures in food products, beverages and tobacco industry	Implementation of different types of activities in food products, beverages and tobacco industry	23 Gg
IMEA8: Efficient motors	Implementation of eco-design requirements for electric motors (Regulation (EC) No 640/2009)	11 Gg

The most significant reduction of emissions in emissions reduction scenario in 2020 is caused by changing the method of clinker production from wet to dry (see measure IMEA1) in Heidelberg Cement plants.

If implemented together these measures will reduce 710 Gg CO_2eq GHG emissions from fuel consumption per year by 2030. 612 Gg is saved in the industry sector, representing 17.6% of expected emissions by 2030. An additional 33 Gg emissions are saved in electricity generation under the energy supply sector by reduction of energy consumption in the industry sector and representing 1.6% of expected emissions in the energy generation sector by 2030. Also 66 Gg CO_2eq methane fugitive emissions in the energy supply sector are saved due to reduction of gas consumption in the industry. Figure 43 shows expected growth of energy related emissions in the industry sector. The blue line represents baseline growth in case of the BAU scenario, and the red line- the case of implementation of measures planned for the industry sector.

Figure 43. BAU and Mitigation Trajectory (CO2eq) – Industry (energy use)



The numerical values of emissions in BAU and mitigation scenario for the transport sector are given in Table 8.

Table 8. BAU and Mitigation Scenario Emission Levels – Industry (energy use)

	GHG emissions (Gg CO2e)								
Greenhouse gas source and sink categories	**2014**	**2016**	**2018**	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**
BAU									
Industry (energy use)	1,638	1,749	1,906	2,100	2,321	2,568	2,841	3,144	3,478
Mitigation Scenario									
Industry (energy use)	1,638	1,749	1,905	1,760	1,928	2,147	2,393	2,561	2,866
Reduction		0	2	340	393	421	449	582	612
% Reduction		0.0%	0.1%	16.2%	16.9%	16.4%	15.8%	18.5%	17.6%

Following the implemented measures from the industry sector, primary energy compared to the BAU in 2030 is decreasing by 2.1%, final energy by 2.7%, and import of energy carriers by 1.7%. Energy generation is decreasing by 454GW (1.4%), which is why a 90 MW less power plant installed capacity will be required compared to the BAU.

2.E. INDUSTRIAL PROCESSES

SECTION ONE: OVERVIEW

1.1 BRIEF DESCRIPTION (THE SECTOR TODAY)

The industry sector (approx. 500 large and 6,000 medium/small enterprises) plays an important role in the country's economic development. Of all the structural sectors accounting for Georgia's total Gross Domestic Product, industry is in the second place, comprising 16.9% (the first place is held by the trade sector, 17.5%).

Industry is a significant greenhouse gas emissions (GHG) contributor which are generated from the use of fuels for energy production in the facilities as well as from various production processes. According to the first biannual update report industry contributes up to 20% of the overall GHG emissions in Georgia for the year 2013 (energy use + production processes).

In Figure 44 the trends of GHG emissions generated in industry by energy use and industrial processes for the period 2014 – 2030 are presented. Concerning emissions from industrial processes, the main subsectors (contributors) are considered (cement, ammonia/nitric acid, iron/steel, ferroalloys): It is expected that a significant increase from the year 2020 onwards will occur based on forecasted increase in the production capacity for these subsectors.

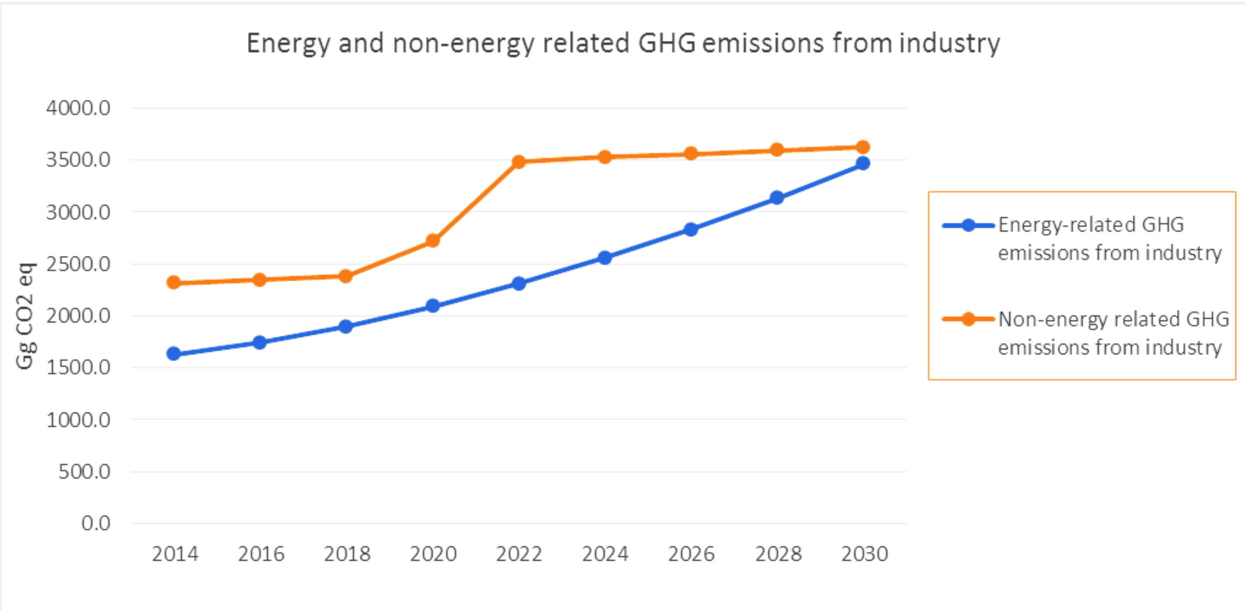


Figure 44. Trends of energy/non-energy related emissions for the industrial sector (main contributors)

A brief overview of the existing situation in the most important industrial subsectors is presented below. Information about future capacities is provided in all cases by the plants' owners and it seems that, in some cases, there are concrete development plans to double the production until the year 2030.

Detailed production data of the major industrial sectors can be found in [7]. In [8] historical data about the production capacities and the relevant GHG emissions are presented.

The major industrial sectors which considerably contribute to Georgia's economy but also to the emissions of GHG are the following:

1.1.1 Non-metallic mineral products

This category includes four subsectors that are most energy intensive:

- Cement
- Glass containers
- Bricks and building blocks of baked clay
- Lime

1.1.2 Cement production

Three major cement manufacturing factories have been operating in Georgia, all three belonging to Heidelberg Cement. In 2014 Heidelberg Cement Georgia produced 100% of clinker and 74.4% of cement in Georgia.

Production of clinker is the main driving force for the generation of process emissions: CO_2 is generated from the cement kiln during the calcination of $CaCO_3$ which is the main CO_2 generating process.

It is expected that the clinker production will considerably increase in the forthcoming years (Figure 45). This increase is caused by the expected production increase in the forthcoming years (up to 2030) of the existing plants and the commencing of operation of a new plant (Senaki) from 2020 onwards.

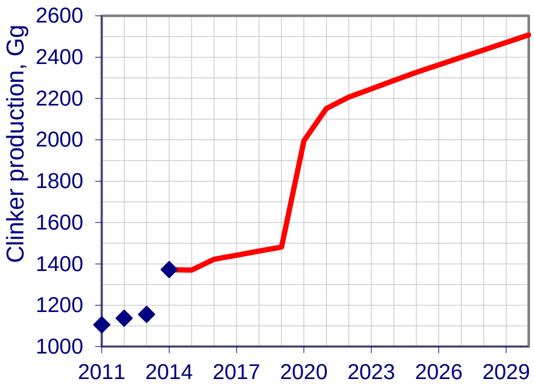


Figure 45. Clinker production (trend)

1.1.3 Lime Production

In 2014 Industria Kiri produced approx. 53% of the lime produced in Georgia. CO_2 is generated during the decomposition of $CaCO_3$ to lime (0.78 – 0.91 tons/ton of lime).

1.1.4 Glass Production

In 2014 Mina produced 65,674 tons of glass.

The glass melting and refining process generates both energy emissions and non-energy process CO_2 emissions from the heating of carbonates (soda ash and limestone).

1.1.5 Brick Production

In 2014 Metekhis Keramika produced approximately 10 million bricks. Natural gas and electricity are used during the production process.

1.1.6 Iron and steel production

Three enterprises produce steel/iron. In these plants, the steel is produced by means of melting scrap and metal slag in an electric arc furnace. The biggest portion (80%-85%) of the material is produced from scrap (secondary steel production).

A considerable production increase is forecasted for the next decade (Figure 46).

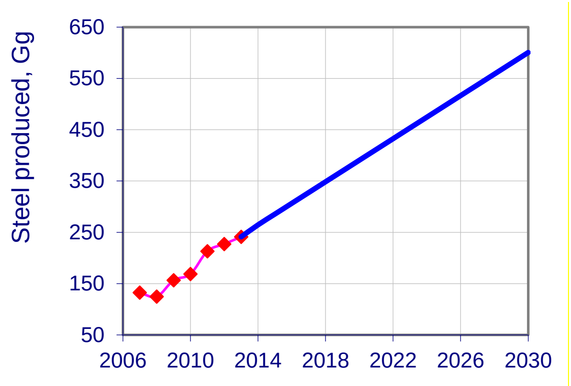


Figure 46. Iron/steel production (trend)

1.1.7 Ferroalloys production

The ferroalloys production is one of the largest production lines in Georgia. Four industrial enterprises are active in ferroalloys production. Production of ferroalloys includes metal reduction process which results in significant emissions of carbon dioxide due to coke use as raw material.

Due to capacity increase of siliconmanganese and the commencing of ferromanganese production the trend shows an approximate 50% increase up to the year 2030 (Figure 47).

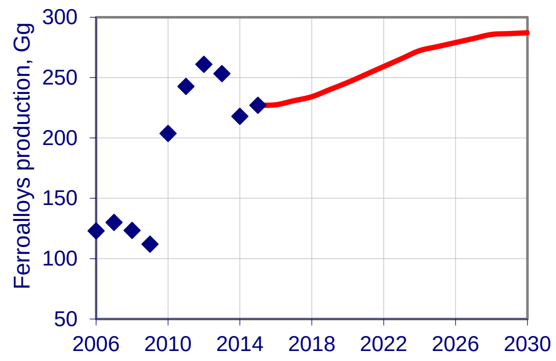


Figure 47. Ferroalloys production (trend)

1.1.8 Ammonia production

The Rustavi Azot chemical production integrated plant is the center of chemical production in Georgia. Two main types of products are manufactured in the factory: ammonia and nitric acid used in the production of nitric fertilizers.

Part of the natural gas used in ammonia production to generate hydrogen needed for the production process is approximately 55% of the total consumed gas. This share of natural gas is the amount spent for non-energy purposes.

Ammonia production for 2030 is projected based on the plant owner's decision to double production of ammonium nitrate by 2021.

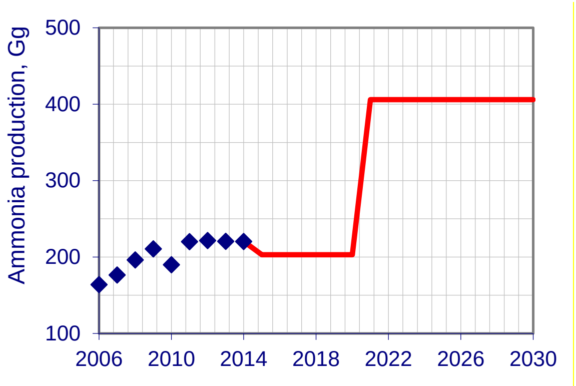


Figure 48. Ammonia production (trend)

1.1.9 Nitric acid production

Nitric acid is produced by Azot at the same facility where the ammonia production takes place. As for ammonia production, a refurbishment is planned which will approximately double production from 2021 onwards.

Nitric acid is produced as a result of catalyzed oxidation of NH_3 where nitrous oxide (N_2O) is generated as an accompanying product.

Future plans of the factory include the production of carbamide (urea) by 2020.

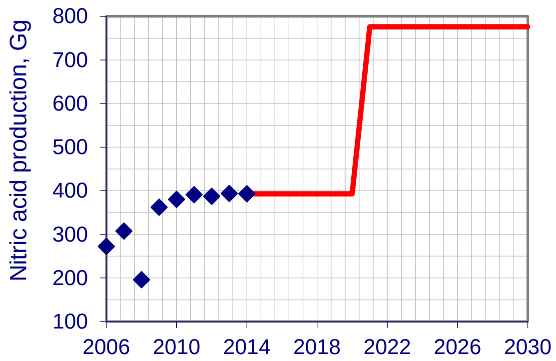


Figure 49. Nitric acid production (trend)

1.1.10 Food, Beverages and Tobacco

Five large enterprises have been examined in this subsector: bread production, juice production from fruits and vegetables, dairy products, sugar production, tobacco products.

The **institutional and legislative framework** concerning the operation of industrial activities is reflected in the Georgian "Law on Entrepreneurs": this law regulates industrial entrepreneurship (administrative and legal issues). Additionally, the Georgian "Law on Control of Entrepreneurship" defines the procedures/standards to be applied by the state and self-governing units while controlling entrepreneurial activities.

Coordination of the policy for economic growth of Georgia (including the industry sector), identification of the main directions of economic development and elaboration of corresponding programs are the tasks of the Department of Economic Growth and Planning at the Ministry of Economy and Sustainable Development. The Unit of Sustainable Development of the same Ministry is responsible for elaboration of the strategy for sustainable development and for supporting state programs as well as for the coordination of the review and analysis of innovation projects.

The Ministry of Environment and Natural Resources Protection issues the environmental impact permit for industrial activities according to the The Law of Georgia on Environmental Impact Permit.

According to the Georgian "Law on Ambient Air Protection" and "Technical Regulations for Self-monitoring and Reporting of Emissions of Harmful Substances from Stationary Sources of Pollution" the Ministry of Environment and Natural Resources Protection conducts the registry of emissions of harmful substances from stationary sources of pollution and consequently also from the industrial processes.

In case of Adjara, the enterprises submit the abovementioned state registry forms to the Department of Environment Protection and Natural Resources in order to report on the stationary sources of harmful substances polluting the air.

From 2017 onwards, in order to simplify the reporting process by enterprises to the Ministry, an electronic system of reporting will be introduced. Accordingly, in 2017 an electronic registry form should be filled in online before February 15 on the following web site: www.emoe.gov.ge (the amendment on electronic reporting will be reflected in a corresponding law).

1.2 CURRENT STRATEGIC ASPECTS

1.2.1 Strategic goals

In recent years, the Georgian economy has been increasing by 5.6% annually (average). This increase is due to reforms undertaken for the liberalization of the economy. However, these reforms turned out to be insufficient for supporting the increase of production, competitiveness and long-term economic growth especially for the industry: The industry sector has the smallest increase in production, while other sectors of the economy have been furthermore developed.

One of the important strategic directions of "Georgia 2020", the government's economic development strategy, is the increase of competitiveness of the private sector. The following actions are defined to support the strategy:

- Improvement of investment and business environment
- Innovation and technologies
- Supporting the increase in export

Improvement of availability of finances is also prioritized in "Georgia 2020." Nowadays there are two main obstacles in this regard: a) the country's economy cannot produce enough internal resources for investments and b) inadequately developed financial institutions cannot provide effective financial intermediation.

To overcome this barrier, the following directions are considered in "Georgia 2020":

- Mobilization of investment resources
- Supporting the development of financial intermediation

1.2.2 Challenges and barriers

The main task of "Georgia 2020" is to overcome the barriers that hinder the sustainable increase of productivity and competitiveness of private sector (including industry).

In order to implement **low-emission measures** in the industry sector of Georgia, the following important barriers and challenges should be taken into consideration:

- Lack of consideration of low-emission development in strategic planning of economic development
- Lack of free financial capital
- Lack of energy efficient and other technologies and qualified professionals

- Low level of general awareness

As a matter of fact, the main principle of the economic development strategy of the country is to ensure a free environment for business development and create a less bureaucratic burden that in many cases imply environmental regulations as well. In addition to that, the governing bodies of the country often consider low-emission development as a hindering factor of economic development and such thinking negatively affects the strategic decision-making process which has to combine the increase and modernization of the industrial processes with adequate environmental performance.

This major barrier is often combined with the lack of available financial resources and of appropriate knowledge of on-going technical developments in the environmental sector worldwide where any modernization efforts in the industrial processes to meet relevant environmental requirements are considered as **resource conservation** (raw materials, energy, water) and lead to cost reductions.

Within Georgia's Association Agreement with the European Union there are concrete obligations to be followed for the smooth approximation of the industries' environmental performance with the requirements set in the Industrial Emissions Directive (IED) where the principle of Best Available Techniques (BAT) introduction and production process optimization is the major driving force for meeting environmental requirements.

It is expected that when/if this approximation will occur the industry will adapt itself to a new modernization process leading, among other benefits, to the reduction of GHG emissions.

1.3 GHG INVENTORY

Some historical data about GHG emissions from industrial processes exist [8]. The trends for the relevant sub-sectors show a considerable increase up to the year 2014 which can be explained by the revival of the industrial production after the collapse in the 1990s. The processes which mainly cause GHG emissions (driving forces) and the recorded GHG quantities are summarized in Table 9.

Table 9. Historical trends of GHG emissions from 5 industrial sectors up to 2014

Sector	Driving force for GHG emissions (industrial process)	GHG	Year of earliest data availability	GHG emissions in 2014 (Gg)	Increase (%)
Cement	Cement kiln during the calcination of lime ($CaCO_3$)	CO_2	2011	832	26
Ammonia	Steam/air reforming process of natural gas	CO_2	2003	331	77
Nitric acid	Oxidation of ammonia (NH_3) with air (catalytic reaction)	N_2O	2003	2.65 823 (CO_2 eq.)*	90
Iron/steel	Electric arc furnaces (EAF) processing scrap materials	CO_2	2007	21	91
Ferroalloys	Metal reduction process (coke as raw material)	CO_2	2006	305	77

* Calculated according to Global Warming Potential (GWP) = 310

SECTION TWO: LOW EMISSIONS DEVELOPMENT VISION BY 2030

2.1 BUSINESS AS USUAL (BAU) SCENARIO

In Table 10 the Emission Factors according to IPCC Guidelines 1996 for the relevant industrial sectors are presented.

Table 10. Emission Factors for GHG emissions from five industrial sectors

Sector	Emission Factor	Comments
Cement	• 0.66 CO_2/ton of clinker (wet method) • 0.44 CO_2/ton of clinker (dry method)	
Ammonia	1.5 CO_2/ton of ammonia (HNO_3)	
Nitric acid	6.75 N_2O/ton of ammonia (HNO_3) 310 CO_2/N_2O	 GWP
Iron/steel	0.08 CO_2/ton of steel produced	Graphide electrodes as deoxidant
Ferroalloys	• 1.5 CO_2/ton of ferromanganese • 1.4 CO_2/ton of siliconmanganese	

2.1.1 Aggregated carbon dioxide emissions

In Table 11 and Figure 50 the aggregated CO_2 emissions from the five industrial sectors are presented. A total of approx. 4,300 Gg CO_2 (nitric acid: CO_2 eq.) is expected to be emitted from the major industrial enterprises up to the year 2030 if no mitigation measures will not be implemented. A more detailed breakdown of the expected increase of the emissions per sector is also presented in [9].

The almost doubling of these emissions will occur if the foreseen investment plans by the relevant industries will finally commence.

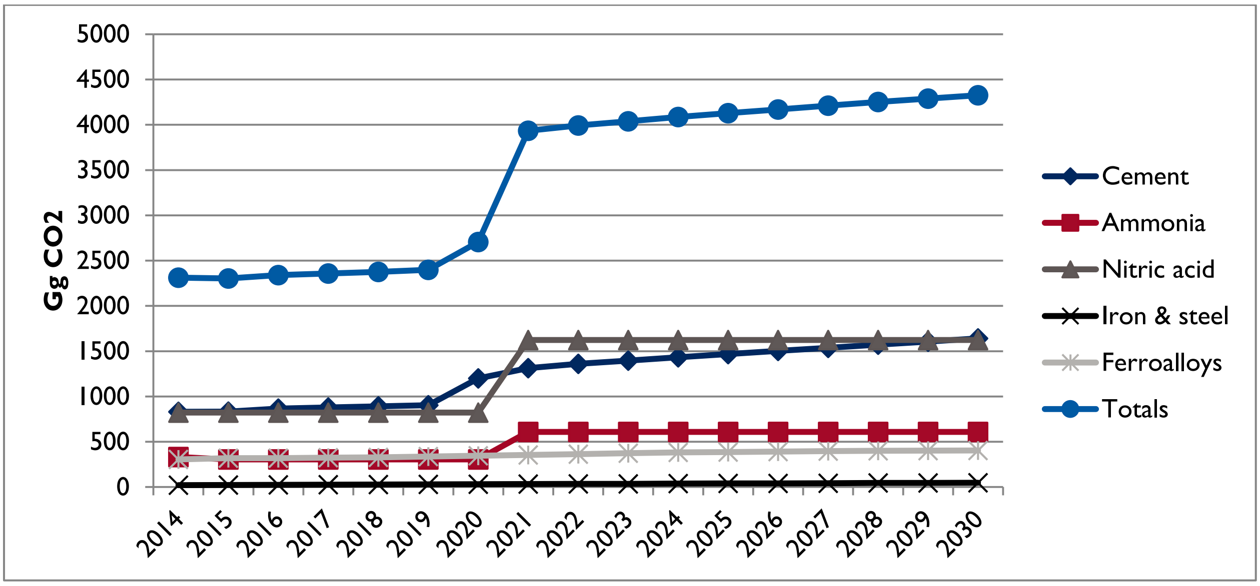
In [8] the assumptions for the BAU development are presented.

Table 11. CO_2 emissions (Gg) from the 5 industrial sectors (2014 – 2030)

Year	Cement	Ammonia	Nitric acid*	Iron & steel	Ferroalloys	Totals
2014	832	331	823	21	305.6	2,312.6
2015	833	305	823	23	319.1	2,303.1
2016	867	305	823	25	319.7	2,339.7
2017	879	305	823	26	324.4	2,357.4
2018	891	305	823	28	329.1	2,376.1
2019	904	305	823	30	337.3	2,399.3
2020	1201	305	823	31	345.6	2,705.6
2021	1313	609	1624	33	354.8	3,933.8
2022	1360	609	1624	35	364.1	3,992.1
2023	1396	609	1624	36	373.3	4,038.3
2024	1433	609	1624	38	382.6	4,086.6
2025	1469	609	1624	40	387.3	4,129.3

Year	Cement	Ammonia	Nitric acid*	Iron & steel	Ferroalloys	Totals
2026	1503	609	1624	41	391.9	4,168.9
2027	1538	609	1624	43	396.6	4,210.6
2028	1573	609	1624	45	401.3	4,252.3
2029	1607	609	1624	46	402.3	4,288.3
2030	1655	609	1624	48	403.3	4,338.0

*CO_2 eq.



*nitric acid: CO_2 eq.

Figure 50. Aggregated CO_2 emissions (2014 - 2030)

A summary of the expected BAU emissions is presented in Table 12. It shows that for the main GHG contributors (cement, nitric acid, ammonia) an almost doubling of the emissions will occur if no corrective actions are taken.

Table 12. Increase of CO_2 emissions (2014 - 2030)

Industrial processes	2014	2030	Growth
Total	**2,317 Gg**	**4,338 Gg**	**87%**
Mineral products (Cement)	838 Gg	1,655 Gg	97%
Chemical industry (Ammonia + Nitric acid)	1,153 Gg	2,233 Gg	94%
Metal production (Iron/steel + Ferroalloys)	326 Gg	451 Gg	38%

2.2 MITIGATION SCENARIO

For each sector, a "basic" mitigation option has been taken for the scenario elaboration which allows a substantial reduction of the GHG emissions.

2.2.1 Qualitative description of the mitigation measures

The technical measures presented in annex (Low Emission Development Pathway) provide a set of technical alternative options for the industrial operators to decide which of these measures fit better to their specific needs since they contain technical data i.e. the conditions under which the measures are applicable and the expected emissions reductions; on the other hand the indications about the investment costs for similar installations worldwide give them a "rule of thumb" to calculate the investments needed.

The **implementation** of the mitigation measures depends on three major aspects:

1. The adaptation of the permitting procedure for industries to the EU requirements. That means that the Ministry of Environment and Natural Resources Protection (MENRP) permitting department has to issue the **integrated permits** according to the requirements of the Industrial Emissions Directive (IED) in which the application of Best Available Techniques (BAT) in production processes is linked with each BAT associated emissions limits. In other words, the emission limit values (ELV) prescribed in the permit cannot be met if the relevant BAT are not applied. As a consequence, those industries, for which the existing permits expire, have to renew their permits according to IED requirements. The main prerequisite for this permit renewal is that MENRP will have approximated its permitting legislation to the IED prescriptions. This will hopefully be accomplished in the next 2 – 3 years. The already approved Twinning project GE 14 ENI EN 02 16 (GE/24), which will be implemented within the next 2 years, aims exactly to this approximation.
2. Industries' commitment. Usually industrial operators are reluctant to modify the relevant production processes fearing that these modifications are associated with extensive costs. They have to understand that the proposed mitigation measures are rather simple and that, if applied, will reduce the consumption of raw materials, energy, water etc. so that, in the longer term, operational costs will be reduced and the overall competitiveness of the industry will be improved.
3. Availability of financial resources. The initial investments for the introduction of the mitigation measures have to be allocated. In doing so, the industrial operators have to apply for "green" loans by the banks or to seek for donors' programs (World Bank, EBRD etc.).

2.2.2 2014 – 2030 emissions projections

From the set of proposed mitigation measures one of them for each industrial sector is selected as basis for the elaboration of the mitigation scenario. Each measure is rather simple and shows a considerable reduction of the relevant emissions. For the cement production, a combination of two mitigation measures has been selected which, all together, achieve an overall efficient emissions reduction.

The mitigation scenario has excluded the iron/steel and the ferroalloys sectors, because there is no information about emissions reduction by any of the proposed mitigation measures. In any case, cement, nitric acid and ammonia production mainly contribute to GHG emissions (BAU scenario) whereas iron/steel and ferroalloys production show much lower emissions (Table 2).

The mitigation measures selected for each sector and the expected impacts in 2030 are presented in Table 13.

Table 13. Mitigation Measure Descriptions & 2030 Impacts – Industrial processes

Mitigation Measure Area	Description	Impact by 2030
Cement production (Mineral Products)	Primarily the shift of Kaspi cement plant from wet to dry process, along with additional process improvements for the other plants (substitution of clinker by lime and/or fly ash/steel slag)	65% reduction of CO_2 emissions
Ammonia production (Chemical)	Primarily the move to solvent scrubbing	85% reduction of CO_2 emissions
Nitric acid production (Chemical)	Primarily optimization of the oxidation step	98% reduction of N_2O emissions
Iron and steel production (Metal Production)	No mitigation options identified	
Ferroalloys production (Metal Production)	No mitigation options identified	

The relevant BAU and mitigation scenario emission levels are presented in Table 14.

Table 14. BAU and Mitigation Scenario Emission Levels – Industrial processes

		GHG emissions and Removals (Gg CO2e)									
Greenhouse gas source and sink categories		2014	2016	2018	2020	2022	2024	2026	2028	2030	2030 % Reduction
					BAU Scenario						
2. Industrial processes		**2,317**	**2,345**	**2,381**	**2,715**	**4,002**	**4,097**	**4,181**	**4,264**	**4,338**	
	A. Mineral products	838	873	898	1,211	1,371	1,444	1,515	1,585	1,655	
	B. Chemical industry	1,153	1,127	1,127	1,127	2,233	2,233	2,233	2,233	2,233	
	C. Metal production	326	345	357	377	398	420	433	446	451	
	D. Other production	0	0	0	0	0	0	0	0	0	
					Mitigation Scenario						
2. Industrial processes		**2,317**	**2,345**	**2,381**	**2,715**	**1,102**	**1,155**	**1,199**	**1,243**	**1,278**	70.5%
	A. Mineral products	838	873	898	1,211	578	610	641	671	701	57.6%
	B. Chemical industry	1,153	1,127	1,127	1,127	125	125	125	125	125	94.4%
	C. Metal production	326	345	357	377	398	420	433	446	451	0.0%
	D. Other production	0	0	0	0	0	0	0	0	0	
	Reduction					2,900	2,941	2,982	3,021	3,061	
	% Reduction					72.5%	71.8%	71.3%	70.9%	70.5%	

The contribution of the mitigation measures from each sector is presented in Figure 51.

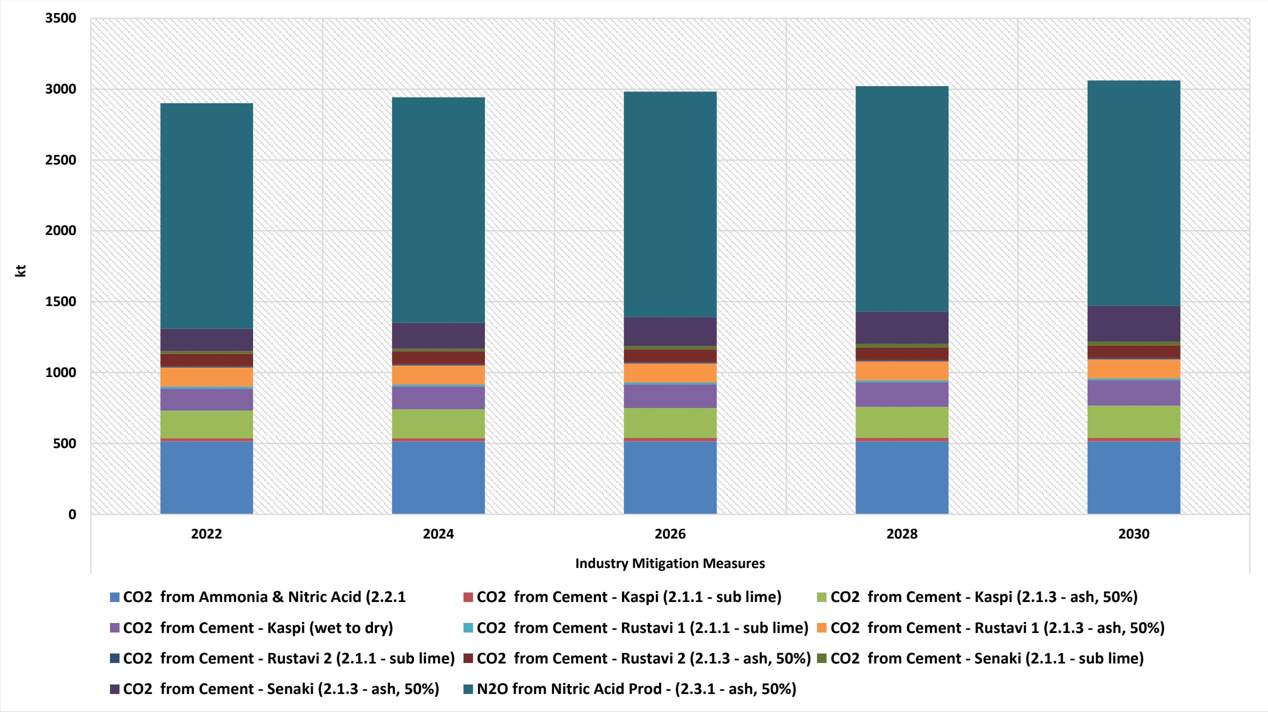


Figure 51. Contribution from Individual Mitigation Measures (CO_2 eq.) – Industrial processes

The year 2020 is taken as the starting point for the elaboration of the mitigation scenario by assuming that by then the mitigation measures can be introduced in the industrial processes (Figure 52): this is the earliest possible year taking into consideration that by then the industrial operators should have obtained the integrated permits which will replace the existing ones and that they will be obliged to introduce BAT in the production processes.

The increase of the emissions from 2022 onwards is caused by the foreseen substantial increase of some of the production capacities.

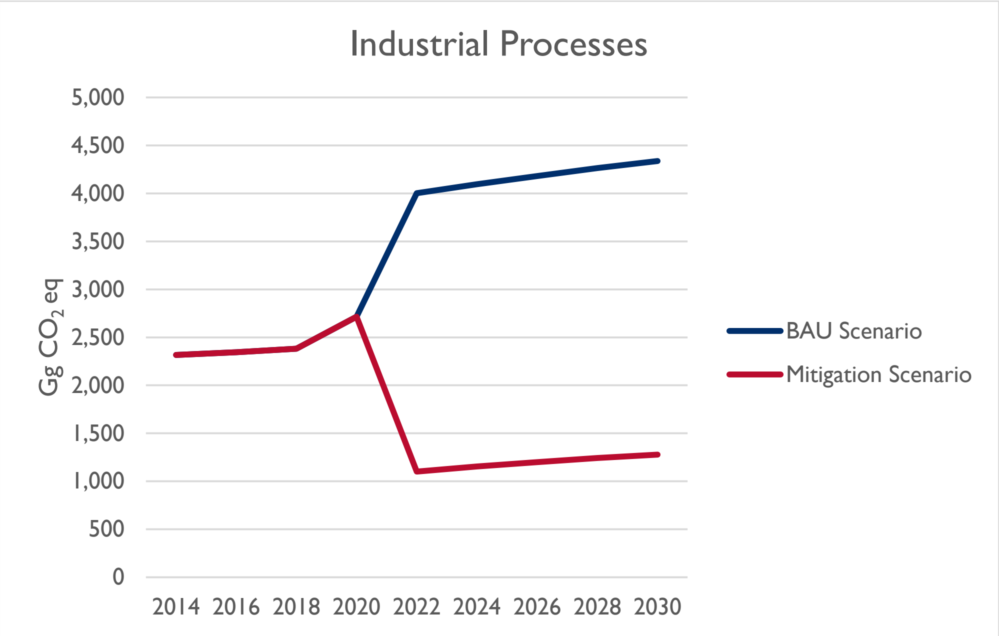


Figure 52. BAU and Mitigation Trajectory (CO_2 eq.) – Industrial processes

2.2.3 Discussion of the mitigation potential

It is clear that even by the forecasted increase in the production capacities the increase of the emitted GHGs is considerably less in comparison to the BAU scenario (> 3 fold). This is understandable because the emissions of one of the main contributors (nitric acid production) are practically eliminated (98%) whereas those ones from the cement industry are reduced by > 50%.

As said above, the proposed options can be applied in the respective industries due to their simplicity: the optimization of the oxidation step in the nitric acid production is practically a good housekeeping process where the improved operational parameters allow a better utilization of the raw materials. Additionally, the substitution of clinker by other materials, as proposed (Annex: Low Emission Development Pathway), is widely used worldwide and is a simple method for the reduction of GHG emissions in the cement sector.

2.F. AGRICULTURE SECTOR

SECTION ONE: OVERVIEW

The agricultural sector is a key component of the Georgian economy, with more than half of the total Georgian workforce employed in agriculture. Despite the employment numbers, the agriculture sector has contributed only 8.8% of Georgia's total gross domestic product (GDP[49]), hinting at the poor economic state of agricultural production. Bringing up the productivity and profitability of the sector should be a cornerstone of the strategy for the economic development of Georgia, as success in this area will have significant overarching economic, social, and food security benefits. Given the expected rise in production levels and the development of large-scale commercial agriculture, it is important to embed environmentally friendly business practices at an early stage, in order to ensure a sustainable development strategy for the sector.

An estimated 42.8% of the Georgian population live in rural areas, most of this population is categorized as "self-employed", usually meaning that they are small-scale subsistence farmers. Georgia's agricultural areas data source is the Land Management State Department. The following are the categories of agricultural areas: arable, perennial plants, natural mowing, and pastures. The average size of farms is approximately 1.2 ha of land and there are approximately four cattle per farm. Forty-three percent of Georgia's total land area is categorized as agricultural, with approximately 800,000 ha of arable land, 270,000 ha of perennial crops and over two million ha of pasture and meadows. Historically, agriculture has been at the center of Georgian economic activity, with diverse climate and nutrient rich soil, Georgia is able to produce a wide array of agricultural products.

During the Soviet era, land and labor consolidation into collectives, a steady supply of materials, and mechanization of agricultural production created conditions for peak productivity and employment in the sector.

The collapse of the Soviet Union and subsequent civil strife that ensued has led to the breakdown of systems supporting agriculture and a rapid decline in the amount of sown areas, productivity and efficiency. In the early 1990s, during the transition to a market-based economy, the government redistributed state-owned land and property to the citizens, leading to the fragmentation of consolidated lands and rise of smallholder agriculture. Family farms sown areas accounted for 96.1% of total sown areas in Georgia, the overwhelming majority of which are on land plots of 0-2 ha in size. Family farms also hold prtivately leased properties. With systemic poverty and lack of information and experience related to agro financing issue prevalent across rural Georgia, access to funding and credit is limited, severely constraining the pace and scale of economic gains for smallholders.

Land title registration also remains a major concern, with a significant part of agricultural land not being accounted for in the public registry. This, along with high fragmentation of ownership for registered land has significantly hindered the development of large-scale commercial farming operations and discouraged investments in the sector. Indeed, the lack of foreign direct investments (FDIs) and consequent diffusion of technology and expertise remains one of the major hindrances to the development of the sector. Recent increases in FDI flows to the sector (Figure 53) show promise in this regard, and foretell a paradigm shift towards the development of technology-intensive commercial agriculture.

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49 Agriculture Census 2014 (http://census.ge/ge/results/census)

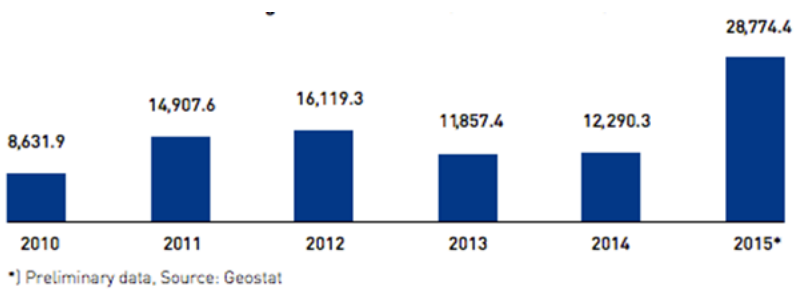

Figure 53. FDI Flows to Georgian Agriculture Sector (Thousand USD), Ministry of Agriculture (MOA) Annual Report

Despite some optimistic developments, outdated technology and ignorance of current farming best practices, along with insufficient capital and lack of economies and markets of scale have made Georgian agriculture inefficient and uncompetitive compared to global standards. As a result, Georgia is a net importer of agricultural products (Figure 54), with more than 70% of its supply of grain, dairy products and meat originating outside the country.

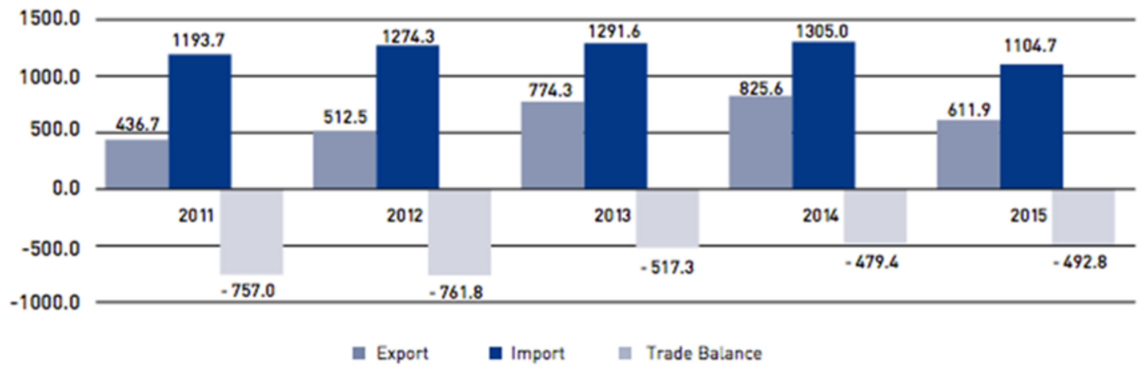

Figure 54. Trade Balance of the Georgian Agriculture Sector (Million USD) MOA Annual Report

The Georgian agriculture sector consists of two sectors: plant growing and animal husbandry (

Figure 55). The production levels of subsectors are close to each other, with animal husbandry having a slight lead. Both subsectors are undergoing a gradual transformation from small-scale subsistence farming to commercial production.

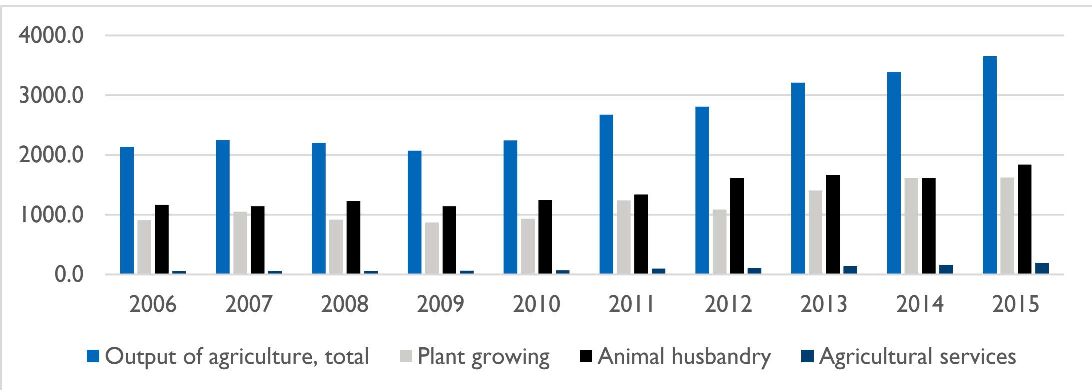

Figure 55. Economic Output of Georgian Agriculture Sector (Million GEL) MOA Annual Report

Production levels have been steadily recovering since the 1990s. According to the trend, agricultural production will surpass pre-independence levels in the short term, and the gains will accelerate with the commercialization of agriculture and sector-wide improvements in efficiency in medium to long term. Government budget assigned to agriculture has increased by 170% from 2008 to 2015, with programs supporting mechanized tillage and fertilization. Because of increased government support, the sown area of annual crops increased by 19% from 2012 to 2015. However, Geostat reports that compared to 2013 the consumption of Nitrogenous fertilizers in 2015 decreased by 12%.

The government's business-friendly agenda, along with the signing of Deep and Comprehensive Free Trade Agreement with the EU, and increased foreign direct investment will aid the economic recovery process considerably.

The Georgian government has declared the development of the agriculture sector to be one of its core strategic priorities, with a multitude of programs supporting smallholders (fertilization, land tillage) and large-scale investors alike (Produce in Georgia program, land grants, and anchor investment vehicles). The MoA is committed to raising the competitiveness of farmers by providing them with necessary skills and the means of production. Integration, development, and refinement of agricultural value chains is at the top of the strategic agenda, with programs supporting improvements in infrastructure, post-harvest storage, and value-adding processing of agricultural products. The Ministry of Environment and Natural Resources Protection (MENRP) of Georgia and the Ministry of Energy of Georgia are working on ways to make clean, renewable energy accessible to remote regions of Georgia, along with projects supporting sustainability across all sectors of the economy. All government stakeholders are heavily committed to fulfilment of all obligations undertaken as part of the EU Association Agreement process.

The constraints imposed by lack of capital, land fragmentation, and rural poverty make Georgian agricultural production inefficient at a fundamental level, contributing to high greenhouse gas (GHG) emissions per unit of end product.

The main strategic goal of LEDS in the agricultural sector should be to facilitate increases in productivity and efficiency while mitigating an accompanying rise in GHG emissions. Mitigation of agricultural emissions is generally achieved through the reduction of GHGs emitted per unit of end product. However, given the developing state of the Georgian economy, it is possible to implement measures which abate emissions in absolute terms. With increasing GDP growth and industrialization of the Georgian agriculture sector, it is crucial to make use of new technologies and embed international best practices at early stages in order to ensure a smooth development of sustainable agricultural practices.

Excess emissions from the agriculture sector are usually a result of inefficiencies in the absorption of primary materials. In case of CH_4 emissions, methane production by microbial fermentation results in net energy loss between 2% and 12% for the ruminant animal[3]. For N_2O, the main contributing factor towards excess emissions is inadequate absorption of synthetic nitrogen fertilizers by the plants, caused by excessive or inefficient application. As such, mitigation strategies that increase the efficiency of agricultural systems generally result in lower emissions per unit of product through reduction in wasteful byproducts and economies of scale.

Certain mitigation measures, such as implementation of manure management practices that turn methane to an energy source, as well as improvement of animal feeding practices to increase productivity and suppress enteric fermentation/rumination, could lead to significant abatement of emissions in absolute terms.

Raising consumer awareness on the issue of climate change and assisting producers in embedding environmentally friendly practices within their production would also reap significant rewards over the long term.

The focal point for LEDS in the agriculture sector needs to be mitigation activities, which are feasible in the Georgian context, as well as effective, and actionable on the part of stakeholders involved.

Therefore, measures need to be prioritized according to cost-effectiveness, mitigation impact and feasibility.

Primary challenges and barriers for the effective execution of a LED strategy in the sector are economic. While considerable progress has been made in devising GHG mitigation strategies in the agriculture sector globally, few of these measures would be feasible in Georgia. Any mitigation measure that increases the costs to the producer or price to the consumer is unlikely to be effective in Georgia, as the sector is extremely price sensitive and consumer awareness of climate change is low. Land fragmentation, lack of finance, and prevalence of smallholder agriculture across the country may present an additional barrier, as dissemination of technology, best practices, and materials is bound to be challenging and costly. Additionally, owing to a developing economy and poverty of the agricultural producers, the costs for implementation of a LEDS will probably need to be assumed by the government and/or donor organizations.

An additional challenge is the recruitment and involvement of international research experts to design and partner with Georgian scientists to study the effectiveness of mitigation measures and monitor progress to reduce emissions. There are complicating issues in the reduction of GHGs with cattle in both manure management and feeding practices. International expertise is critical in monitoring and evaluating the proposed mitigation measures and abatement recommendations for GHGs. GHG emission reduction strategies pursued in the Georgian agriculture sector as related to dairy/cattle can be of great interest and worthy of developing international research partnerships to study and monitor mitigation measures and abatement strategies. This is particularly the case as related to research with dairy/beef cattle.

High levels of coordination and cooperation will be required between government entities, donor organizations, international researchers, smallholders, and industrial producers. Aligning the interests of all stakeholders and ensuring cohesion will be key towards achieving effective implementation of a LEDS.

As per the Association Agreement (AA) between the EU and Georgia, the parties have agreed to cooperate on issues regarding agriculture and climate change. Georgia has taken responsibility to harmonize and approximate its legislation regarding agriculture, rural development, and climate action with that of the EU. As part of the AA, the EU has agreed to support Georgia in promoting modernization and sustainability of its agricultural production, improving the competitiveness and efficiency of the agricultural sector and harmonization of issues dealt within the framework of international organizations. The EU will support Georgia in the development and implementation of a National Environment Action Plan, National Adaptation Plan of Action, and Low Emissions Development Strategy (LEDS).

Additionally, with Georgia's 2010 accession to the Copenhagen Accord, Georgia has undertaken the responsibility to "take steps to achieve a measurable, reportable and verifiable deviation from the baseline scenario (below "business as usual" levels) supported and enabled by finance, technology and capacity building."

Two main GHGs that are produced by the agricultural sector of Georgia are methane (CH_4) and nitrous oxide (N_2O). According to the emission classification standards set out by the Intergovernmental Panel on Climate Change (IPCC), there are seven emission categories that are material and applicable to the Georgian agriculture sector. According to the GHG categories, these are:

Methane:

- Enteric fermentation
- Manure management
- Field burning of agricultural residues

Nitrous Oxide:

- Direct emissions from agricultural soil
- Indirect emissions from agricultural soil
- Manure management
- Field burning of agricultural residues

Other IPCC categories of rice cultivation, prescribed burning of savannas and "other" are not considered, as their contribution to GHGs in Georgia is negligible. Manure management includes all emissions produced as a result of animal waste management systems, such as: anaerobic lagoons, liquid systems, solid storage & drylot, "used for fuel" and "other systems." Animal waste emissions produced by excrement left on soil during grazing on grasslands ("pasture range and paddock") are included under categories of direct and indirect emissions from agricultural soil[50].

Data for GHG emissions in the agriculture sector have been estimated in the framework of the National Greenhouse Gas Inventory Report[51] and First Biennial Update Report[52] for the United Nations Framework Convention on Climate Change (UNFCC). The National GHG inventory for Georgia has been prepared by the MENRP, based on data from the MoA. The data has been prepared in accordance with respective IPCC methodologies for each GHG source and modified according to expert judgment where necessary. Details of methodologies are available in Annex 1.

The main source of CH_4 emissions is enteric fermentation, or CH4 produced by the microorganisms in the rumen of grazing animals. Enteric fermentation accounts for 49% of all GHG emissions in the Georgian agriculture sector and 8.1% in total national GHG emissions. The main contributing subcategories of nitrous oxide emissions are direct and indirect emissions from agricultural soil, collectively accounting for 40% of all agriculture sector GHG fluxes and 6.6% of national fluxes. According to data from the MENRP of Georgia, in the period from 2006-2013 GHG emissions of CH_4 and N_2O from the agriculture sector remained constant or, in some cases, slightly decreased. As of 2013, the agriculture sector's emissions were estimated to be approximately 6% of the national GHG emissions.

SECTION TWO: LOW EMISSION DEVELOPMENT VISION BY 2030

The emission projections of the agriculture sector are based on several key drivers. First, and perhaps the most important driver for expected GHG emission growth, is the large-scale introduction of industrial beef/dairy cattle production. For the purposes of the BAU scenario, it is assumed that large-scale commercial farms start operating in 2021, although major projects are already well underway. The main driver of growth will be the introduction of specialized dairy cattle. A second important driver is the CH_4 production from Animal Waste Management Systems

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50 In general, N2O emissions from the agricultural lands are produced form direct and indirect sources. Direct source meaning-emissions are produced directly from the soil. These emissions are caused by: injaction of nitrogen containing fertilzers and manure into soil, nitrogen biological fixsing, crops residues mineralization causing nitrogen production and processing organic(peaty) soils, causing existing nitrogen mineralization. Emissions from the indirect sources are produced in sintetic fertilazers and manure as a result of nitrogen evaporation and leaching. Ministy of Environment and Natural Resources Protection of Georgia, GHG National Inventory Report to UNFCCC.

51 Ministry of Environment and Natural Resources Protection of Georgia, National Greenhouse Gas Inventory Report to UNFCCC.

https://unfccc.int/files/national_reports/non-annex_i_natcom/application/pdf/ghg_national_inventory_report___georgia.pdf

52 Ministry of Environment and Natural Resources Protection of Georgia, First Biennial Update Report to UFCCC

https://unfccc.int/files/national_reports/non-annex_i_parties/ica/application/pdf/first_bur_-_georgia.pdf

(AWMS). GHG emissions from AWMS are also expected to grow exponentially, as increasingly more livestock will be placed in controlled environments.

While the GHG emissions from swine production and other ruminants such as buffalo, sheep, and goats are represented as part of the BAU projections their level of emissions is significantly less than the projections from cattle/dairy. Similarly, economic growth and the growing demand for domestic production will lead to an increased amount of sown areas of crops. However, the demand for commercially produced nitrogen fertilizers will be tempered by the offsetting costs and lack of affordability for the vast majority of smallholder agricultural producers and the advent of modern agricultural practices that are less reliant on commercial fertilizers.

The mitigation opportunities and main 2030 impacts in the agriculture sector are listed in Table 15, and Table 16 provides the emissions levels for BAU and each of the mitigation measures. Overall the GHG emissions growth is slowed from 86% in the BAU scenario to 54% assuming full attainment of the identified mitigation measures.

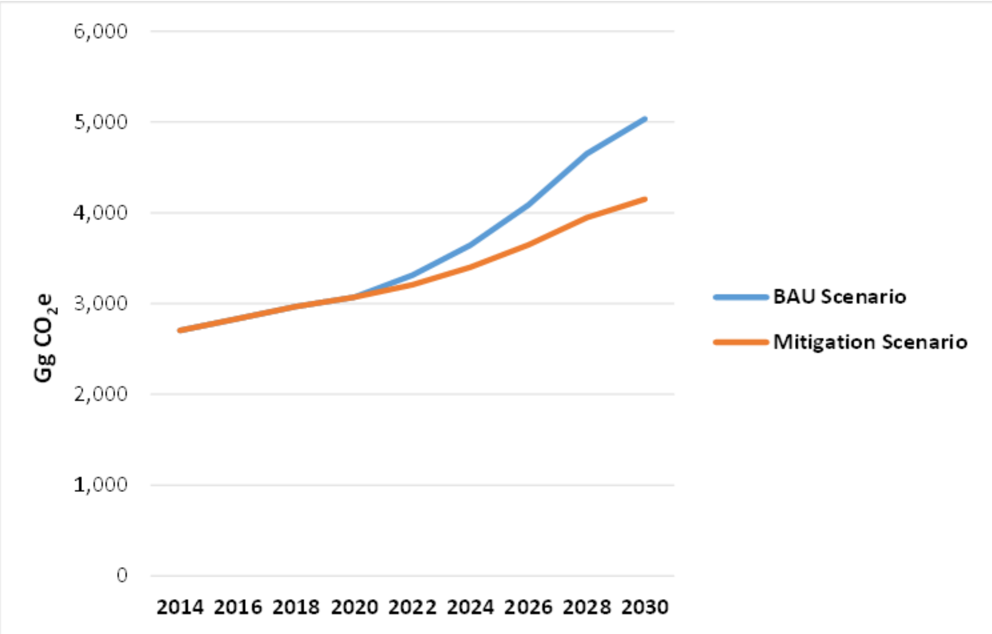


Figure 56 shows the BAU and mitigation scenarios emission profiles, and

Figure 57 the reduction contribution from each agriculture measure.

Table 15. Mitigation Measure Descriptions & 2030 Impacts - Agriculture

Mitigation Measure Area	Description	Impact by 2030
Manure Management	Use of lagoon to handle cattle and swine manure	By 2030 a 54% reduction in CH_4 emissions can be achieved
Enteric Fermentation	Maximize superior feed quality, leading to lower emissions from enteric fermentation in absolute terms.	By 2030 a 4% reduction in CH_4 emissions can be achieved
Direct Emissions from the soil	No mitigation options identified	Emissions remain as in BAU
Indirect emissions from the soil	No mitigation options identified	Emissions remain as in BAU

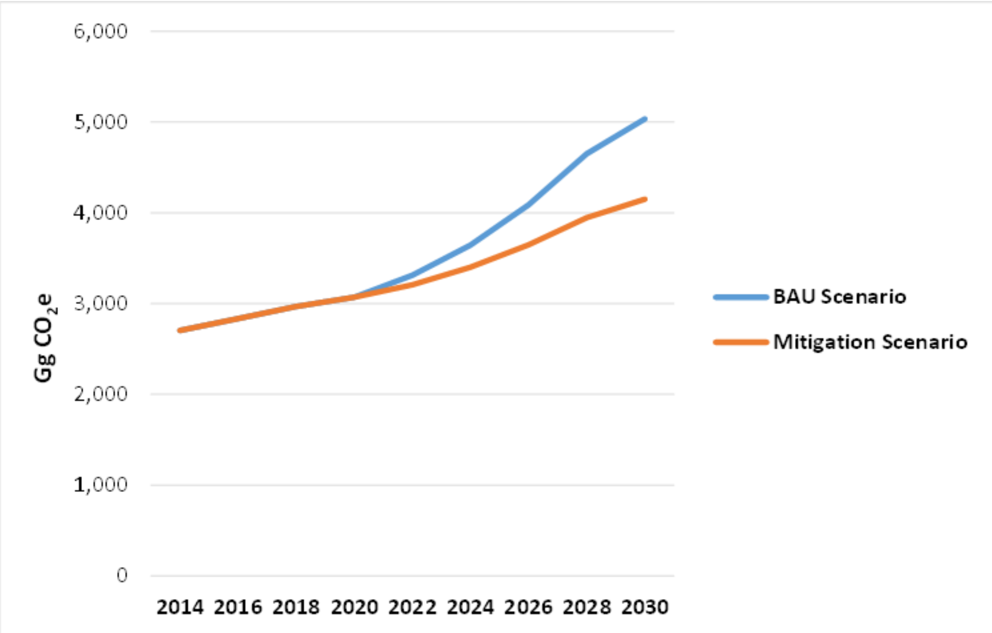


Figure 56. BAU and Mitigation Trajectory (CO2eq) – Agriculture

Table 16. BAU and Mitigation Scenario Emission Levels - Agriculture

Greenhouse gas source and sink categories	GHG emissions and Removals (Gg CO_2e) 2014	2016	2018	2020	2022	2024	2026	2028	2030	2030 % Reduction
BAU Scenario										
4. Agriculture	**2,702**	**2,833**	**2,967**	**3,071**	**3,314**	**3,643**	**4,089**	**4,651**	**5,034**	
A. Enteric fermentation	1,345	1,371	1,398	1,398	1,405	1,444	1,526	1,642	1,694	
B. Manure management	293	300	309	316	454	646	913	1,261	1,489	

Direct Emissions from the soil	638	700	762	824	886	948	1,010	1,072	1,139	
Indirect emissions from the soil	426	462	498	533	569	605	640	676	712	

Mitigation Scenario

4. Agriculture	**2,702**	**2,833**	**2,967**	**3,071**	**3,207**	**3,399**	**3,647**	**3,946**	**4,153**	17.5%
A. Enteric fermentation	1,345	1,371	1,398	1,398	1,396	1,428	1,499	1,595	1,626	4.0%
B. Manure management	293	300	309	316	356	418	498	604	675	54.6%
Direct Emissions from the soil	638	700	762	824	886	948	1,010	1,072	1,139	0.0%
Indirect emissions from the soil	426	462	498	533	569	605	640	676	712	0.0%
Reduction					107	244	442	705	881	
% Reduction					3.2%	6.7%	10.8%	15.1%	17.5%	

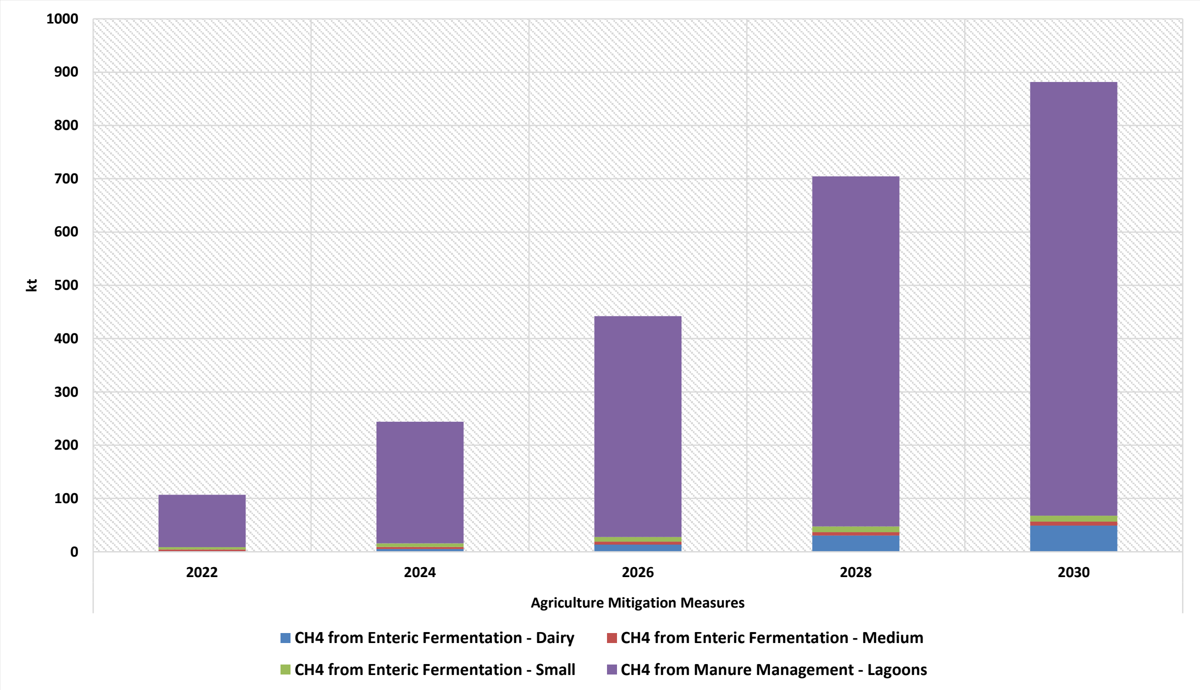


Figure 57. Contribution from Individual Mitigation Measures (CO2eq) – Agriculture

The mitigation measures fall into two categories: measures quantified as part of the mitigation scenario and those recommendations requiring additional research and data before they can be implemented. Nearly all of methane (CH_4) emissions and approximately half of the nitrous oxide (N_2O) emissions can be attributed to emission sources related to livestock.

Therefore, the focus of an effective mitigation strategy should be actionable measures which would increase the efficiency of livestock systems while reducing the amount of GHGs produced. UN Food and Agriculture Organization's (FAO) technical guidance on mitigation of GHG Emissions in Livestock Production has been used to formulate a mitigation pathway. The general consensus on reduction of agricultural emissions in the developed world is that the most effective mitigating measures reduce emissions per unit of the agricultural product.

The quantitative mitigation measures focus on improving feeding and manure management practices in industrial livestock farms, which are assumed to start operating in 2021 and steadily grow their production up to 2030. The measures are both actionable and economically beneficial to the businesses. It is imperative that sufficient government support and international expertise are provided to industrial farm operators to ensure a sustainable agricultural development trajectory for Georgia.

Enteric fermentation accounts for nearly half of GHG emissions in Georgia. For the purposes of the mitigation scenario, potential mitigating effects of improving feeding practices in large industrial dairy farms are projected under the "dairy cattle" category, smaller farms are accounted for in "small" and "medium" sized cattle categories. The FAO report[53] has identified 14 categories of measures to tackle methane production in the rumen, out of which two were determined to be feasible and applicable to Georgia – improvement of forage quality and improvement of livestock feed by including dietary lipids and condensed tannins. According to the report, optimizing forage quality with various plants (e.g. lucerne and alfalfa) can lead to significant reductions in methane production (10%-20%), while the use of feed containing dietary lipids could reduce the emissions by 5%-20%. The mitigating effects of condensed tannins are also wide ranging according to the plant, and are

53 http://www.fao.org/docrep/018/i3288e/i3288e.pdf

particularly applicable to the Georgian context, as grape marc – primary waste byproduct of the wine industry, is incidentally rich in tannins.   Research[54] [55] has shown that the use of grape marc in various forms (distilled, pelleted, dried, ensiled) leads to significant CH_4 emission decreases of up to 20% when mixed with other feed in proportions ranging from 5%-15%. The mitigating effect will vary according to the tannin composition of the cultivar and the state of the additive. The effect on milk production also varies from a slight decrease[4] to a slight increase[56].

It is important to note that the Georgian government subsidizes the winemaking industry through paying a significant fraction of the cost of cultivating grapes. This presents a unique opportunity for setting up a supply chain whereby cattle farmers could procure grape marc additive from wine producers at a reduced cost.

Research, coordination, and possible investment in logistical infrastructure is needed to adequately execute this strategy.

Manure management in industrial dairy and swine farms is a major contributor of GHG emissions. Manure treated in AWMS emits a significant amount of CH_4 and small amounts of N_2O. It is assumed in Business As Usual (BAU) scenario that 90% of dairy cattle and swine manure will be treated in lagoons.

With adequate covers for lagoons, it is theoretically possible to mitigate all methane emissions from anaerobic lagoons. However, in practice, there are still leakages accounting for up to 10% of emissions and the digesters may remain inactive for approximately 10% of the year, therefore, a conservative emission reduction factor of 80% has been used to project emissions. It was decided to keep the adoption factor level at 90%, since all commercial farms would benefit from lower leakage and should be willing to upgrade their systems if the price constraints were alleviated. Stakeholders represented in the LEDS Agriculture Sector Work Group and other private and public stakeholders (Caucasus Genetics and Ministry of Energy) have endorsed the mitigation measures we have recommended.

54 Australian Wine Research Institute, Using Grape Marc as a Feed Additive in Commercial Settings
https://www.awri.com.au/wp-content/uploads/2016/11/Using-Grape-Marc-as-a-feed-additive-Final-Report.pdf

55 Moate et. al. (2014), Grape Marc Reduces Methane Emissions When Fed to Dairy Cows
https://www.ncbi.nlm.nih.gov/pubmed/24952778

56 Nistor et. al. (2014) Grape Pomace in Sheep and Dairy Cows Feeding
http://journal-hfb.usab-tm.ro/2014/Lista%20lucrari%20PDF/Vol%2018(2)%20PDF/26Nistor%20Eleonora.pdf

2.G. WASTE SECTOR

SECTION ONE: OVERVIEW

Waste management, in compliance with international standards, has been playing an increasingly important role for Georgia after the country signed the Association Agreement with the European Union (EU) [1]. Currently solid waste disposal at the landfill is the only form of solid waste management in Georgia. Inert waste, including construction waste, is partially disposed at non-hazardous waste landfills and is used for filling/leveling activities. There is not a hazardous waste landfill in the country and the annual amount of generated hazardous waste is unknown. Also, there are no management systems for specific waste, including separated collection systems. However, recycling of specific waste, such as tires, batteries, packaging waste, etc., or disposal (such as asbestos waste) does occur in a fragmented and uncoordinated way.

Presently, 56 landfills are recorded in Georgia. Only four of them, one private and three state-owned landfills, comply with international standards and have an Environmental Impact Assessment permit. These are: Tbilisi Norio landfill, Rustavi landfill, Borjomi landfill and the privately owned BP landfill.

According to the active legislation (Waste Management Code), construction and management of non-hazardous (municipal) landfills (excluding Tbilisi and Adjara Autonomous Republic [AR] landfills) is the responsibility of the Waste Management Company of Georgia owned by the Ministry of Regional Development and Infrastructure. The company conducts active measures to improve the conditions of the old/current landfills and construct new regional landfills. As of 2016, the Solid Waste Management Company manages 53 of the existing landfills. Twenty of them were closed and others were improved in recent years. The company continues working on construction of new regional non-hazardous waste landfills.

Tbilservice Group (municipal company established in 2007) manages Tbilisi's landfills. Two entities, Kobeuleti Dasuptaveba, a non-commercial legal entity, and Mr. Potelidze, an individual entrepreneur, manage two municipal waste landfills in Adjara AR with temporary formal agreements for a one-year term.

Currently, the operation of active municipal landfills in Georgia has significantly improved: all solid waste landfills are enclosed by a fence to prevent access to humans and domestic animals, checkpoints are arranged, weighbridges are installed on most landfills, and landfill operators record waste. Waste collection has improved in the cities throughout the country, and the first steps were taken in 2014-2015 in several private or governmental agencies towards sorting some of the waste fractions (paper, plastic, metal, and glass). Despite this, waste is still not collected in some rural areas. Around 18% of waste generated in the country is dumped into ravines, river banks and other illegal, spontaneously formed dumpsites near residential areas. To a certain extent, the problem is that no systematic identification of the morphological composition of the incoming waste takes place at official landfills. For the moment, none of the landfills collect methane and flare or utilize for energy.

Presently, harmonization of the waste management process implemented by the government of Georgia with the European waste policy is one of the priority issues that should be aimed at waste reduction and reuse. A law of Georgia, Waste Management Code [3] developed in view of commitments undertaken within the Georgia-EU Association Agreement and in compliance with the European guidelines, came into effect in order to address waste management issues in Georgia. The Code is aimed at the creation of legal bases in the waste management area to conduct activities preventing waste generation, increase the reuse of waste and environmentally-safe waste disposal. In order to assess the current waste management situation, identify challenges, and develop ways to solve problems, the National Waste Management Strategy for 2016-2030 and National Action Plan for 2016-2020 [2] was adopted by Resolution No. 160 of the Government of Georgia on April 1, 2016, which are inseparable parts of the waste management policy of Georgia.

The National Strategy includes a 15-year period that can be periodically renewed; the Action Plan is developed once every five years. The main objectives of these two documents are to develop, implement and enforce waste management legislation in compliance with EU requirements and international conventions to ensure safety of human health and environment.

The key principle of the national waste strategy is waste reduction and recycling. Appropriate objectives, targets and actions were developed based on this principle. The objectives of national waste strategy are listed in Box 1:

Box1. Objectives of National Waste Strategy

Objective 1. Waste management legislation in harmony with EU requirements and International Conventions transposed, implemented, and enforced

Objective 2. Waste management planning system established and implemented nationally and locally

Objective 3. An effective waste collection and transportation system developed and implemented

Objective 5. Waste prevented, reused, recycled, and/or recovered to the extent possible

Objective 6. Waste management costs fully covered in accordance with the Polluter Pays Principle

Objective 7. Extended producer's responsibility (EPR) promoted and implemented to the extent possible

Objective 8. Waste data and information management system developed and implemented

Objective 9. Capacities strengthened for the national and local public sector, private companies' capacity development supported and public awareness raised.

Each objective has its own set of targets. It's important to note that an increase in greenhouse gas (GHG) emissions is anticipated as a result of implementing some of the targets described in the Strategy. Increase of GHG emissions will result from activities such as improvement of waste collection, as an example.

It is also worth mentioning that a whole range of activities provided by the Strategy are emission-reducing activities, and thus are considered within the Low Emission Development Strategy.

The situation in regard to domestic and industrial wastewater management is complicated, as in most cases industrial and non-industrial wastewaters are discharged into surface waters without prior treatment. Discharging untreated wastewaters of industrial and non-industrial entities into surface waters is a significant environmental problem. In order to solve this problem in the sector and develop an efficient and active water resource management system, the United Water Supply Company of Georgia Ltd. was established under the management of the Ministry of Regional Development and Infrastructure of Georgia with 100% share state ownership (2010).

Currently, United Water Supply Company of Georgia Ltd. provides a supply of drinking water and a drainage water system in self-government cities and administrative centers of municipalities excluding Adjara AR, Tbilisi, Rustavi, and Mtskheta. Service in the above-mentioned cities is provided by a private company, Georgian Water and Power Ltd., and in Adjara AR – by Batumi Water (Batumis Tskhali) Company and local self-government. Concerning the water supply of the settlements beyond administration centers, their service is provided by local municipal entities.

Three wastewater treatment facilities operate in Georgia today: Gardabani (serving Tbilisi and Rustavi), Adlia (serving Adjara AR) and Sachkhere (privately owned) treatment facilities. The rest of the cities and villages completely lack or have a partially constructed sewerage system, while the wastewater treatment systems have been out of order since the 1990s, so wastewater flows into surface water bodies without any treatment.

Discharge of industrial and domestic wastewaters is regulated by the Law of Georgia on Water [4]. According to the law, wastewater to be discharged into a water body shall be treated to an established norm. Different bylaws, quality norms, discharge limits, and water usage quotes are adopted based on the requirements of the Law. Unfortunately, there is no national strategic vision on wastewater treatment yet. The United Water Supply Company of Georgia has plans to design and construct sewerage treatment facilities in Kutaisi, Tskaltubo, Telavi, Ureki, Poti, Zugdidi, Anaklia, Mestia, and Marneuli before 2018 with the financial support of the Asian Development Bank (ADB) and the Swedish International Development Agency (SIDA). The United Water Supply Company of Georgia was tasked to conduct research aimed at studying drinkable water resources and the country's potential in this regard. An interagency working group will develop a long-term strategy for sustainable extraction and use of water resources, as well as review the rule of disposal and licensing of resources. [5].

Despite above-mentioned reforms and improvements in both in the solid waste and waste water sectors, there are still many challenges that these sectors face in Georgia. The sanitary and environmental situation in the waste management sector negatively impacts both the natural and climatic conditions of Georgia (ecosystems and climate change) and socio-economic development (living standards, tourism, agriculture, etc.). Presently, implementation of emissions reduction in the waste sector faces the following key obstacles:

- Limited financial resources allocated for waste management;
- Lack of a united waste management system;
- The problem of construction, medical, hazardous, and other waste management;
- Disposal of various mixed (household, construction and other) waste into municipal waste landfills;
- No reliable data on the amount of waste disposed at the landfills;
- Limited capacities/practice for waste recycling and inaccessibility of information;
- Lack of waste separation;
- Lack of availability of updated information on dumpsites;
- Lack of utilization landfill gas utilization practice at the landfills;
- Improper functioning of wastewater diversion systems;
- Inadequate number of wastewater treatment facilities;
- Problems related to sludge generated in the active wastewater treatment facilities - lack of stabilization practice;
- Lack of wastewater treatment facilities at industrial entities – for instance, treatment of wastewaters generated at metal manufacturing plants and resulting from mining activities is not mandatory;
- State Procurement system makes it extremely difficult to acquire the specific repair parts of existing wastewater treatment systems quickly.

It is noteworthy that wastewaters of many manufacturing plants such as food, chemical, and textile industry plants flow into municipal sewerage network and therefore depend on the effectiveness of the provided municipal services.

All the above are important problems for both waste recycling as well as utilization of biogas generated as a result of their decomposition.

Generally, greenhouse gas (GHG) inventories for the waste sector include greenhouse gas emissions from the following categories:

- Solid waste disposal;

- Biological treatment of solid waste;
- Incineration and open burning of waste;
- Wastewater treatment and discharge.

An emission assessment for the waste sector in Georgia was conducted for two categories: solid waste disposal and wastewater treatment and discharge. The latter is divided into two sub-sectors. These are: domestic wastewater treatment and discharge, and industrial wastewater treatment and discharge. There is no biological treatment of solid waste in Georgia, thus this sub-sector has not been considered. There is a small portion of hazardous (medical) waste that is incinerated (1,876 tons) [6], and the rural population in some places has a habit of burning waste, but information about the amount of burned waste is unknown. The category of incineration and open burning of waste has not been accounted for in LEDS for two reasons[57]. First, as already stated, the amount of incinerated waste is very small, and second, to be consistent with the latest submissions of the national inventory to UNFCCC, where this category was not considered. In future submissions, however, it could be recommended to include emissions from this category.

The greenhouse gas emission inventory for the 2014 base year for solid waste disposal sites was evaluated using the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines for National Greenhouse Gas Inventories [7] (hereafter referred to as IPCC 2006). For Wastewater, IPCC 1996 Revised Guidelines for National Greenhouse Gas Inventories [8] was mainly applied. IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories [9] is also used for default values of some parameters.

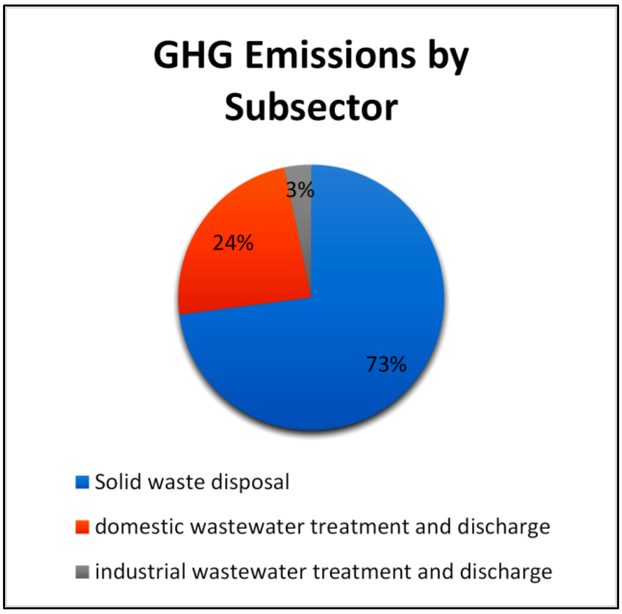
In 2014, total GHG emissions from the waste sector amounted to 1,273 Gg of CO_2e. This inventory covers only the territories controlled by the Government of Georgia. For uncontrolled territories (Abkhazia and South Ossetia), there is a lack of data on population and other parameters, so the GHG emissions from waste sector were just roughly estimated at 67Gg CO_2e[58].

The waste sector has the lowest share in Georgia's GHG emissions compared to other sectors (7-8% in recent years [10]). The methodology used for the development of the emission inventory as well as activity data and emission factors are described in detail in [11].

Figure 58 shows waste sector GHG emissions by subsector and by gas. The largest share of emissions is contributed by solid waste subsector (73%), followed by domestic wastewater treatment and discharge (24%). The major anthropogenic GHG emitted in this sector is methane, which is responsible for 93% of emissions, followed by nitrous oxide, emitted in the domestic wastewater category.

[57] Nevertheless, the CO2 emissions from combustion of medical waste was estimated using IPCC 2006 and equals to 1.24Gg.

[58] Calculated using population numbers found in internet and other parameters similar to rural population in Georgia.



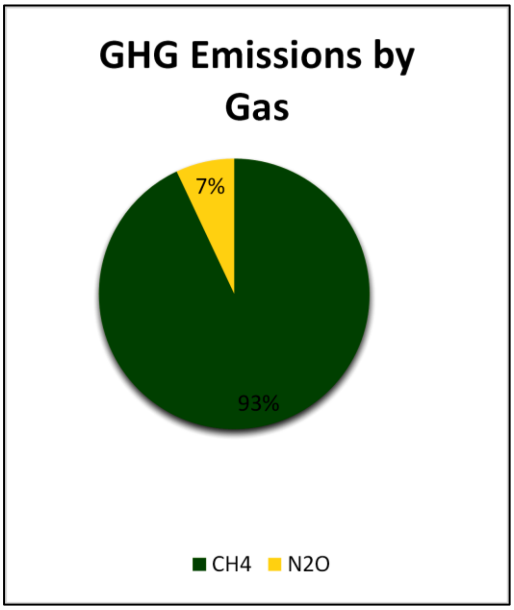


Figure 58. Waste sector GHG emissions by subsector and gas in 2014

Compared to 2000, waste sector emissions have increased by 22% in 2014, caused by the increase of waste generation per capita, as well as improvement of waste collection and landfill management. The interconnectedness between solid waste disposal, domestic wastewater sub-sectors, and population is evident (correlation > 0.9). Also, close dependence is apparent between Gross Domestic Product (GDP) of Georgia and emissions in solid waste disposal category (correlation >0.9), as well as with industrial wastewater category (correlation=0.736). This indicates the following, (1) both population and GDP are drivers for emissions in the solid waste disposal category, and (2) population is a prime driver for the domestic wastewater category and GDP for industrial wastewater.

This being said, the increase of GHG emissions per capita as compared to 2000 is more drastic, around 45%, caused by the improvement of living standards as well as by industrial development. The per capita amount of methane released from the solid waste disposal category in Georgia in 2014 made 12 kg/person/year, which is quite a low rate compared to other countries. This situation could be explained by a smaller amount of waste generated per capita in Georgia in comparison with other, developed countries, which will inevitably increase as economic situation in country improves.

SECTION TWO: LOW EMISSION DEVELOPMENT VISION BY 2030

The Business As Usual (BAU) scenario presents the projected GHG emissions of Georgia if no mitigation measures and actions are implemented. To evaluate the impact of economic and demographic changes, the BAU scenario for the waste sector considers the following two main drivers:

1. GDP growth, which, consistent with the energy sector assumptions, is projected at 3.5% in 2015-2016 and 5.6% afterwards. GDP growth affects the growth of solid waste generation per capita and industrial wastewater generation.
2. Population number, which, consistent with the energy sector assumptions, is unchanged until 2030. Furthermore, the migration from rural areas to urban areas (including the ones connected to sewage systems) is 0.5% annually, which affects domestic wastewater emissions.

Other parameters, such as waste composition, wastewater generation per capita, and others remain unchanged until 2030. To account for the uncertainty related to the solid waste collection rates, as well as to the establishment of wastewater collection and treatment systems in urban areas, two BAU scenarios are being considered:

1. BAU1: conventional BAU – assuming that solid waste collection rates remain the same as in 2014 and only three existing wastewater treatment plants remain operational until 2030.
2. BAU2: BAU with waste sector development – assuming that: 1) 90% of solid waste is collected and brought to managed landfills in 2020 and 100% in 2025; and 2) Up to 60% of the remaining urban population (excluding those that are connected to Adlia, Gardabani and Sachkhere systems) is connected to new sewage systems and wastewater treatment plants by 2030.

All assumptions for the development of the BAU scenarios are described in detail in [11].

According to a conventional BAU scenario, the GHG emissions from the waste sector will reach 1,545 Gg CO_2e by 2030, which is a 23% increase over 2014 values. The largest increase happens in the Industrial wastewater category (125%), driven by an increase of industrial production. According to the BAU scenario with waste sector development, the GHG emissions will reach 1,690 Gg CO_2e by 2030, which is a 35% increase over 2014 values. Methane emissions from solid waste increase by 28% (21% in Conventional BAU), due to improvement of waste collection rates. Methane emissions from domestic wastewater increase by 51% (15% in Conventional BAU), due to a higher number of the population connected to sewage systems and wastewater treatment plants.

The strategy to mitigate greenhouse gas emissions in waste sector is largely based on the 2016-2030 National Waste Management Strategy and the 2016-2020 National Action Plan [2] as well as plans of specific organizations involved in management of waste water and solid waste (such as the Solid Waste Management Company, Tbilservice Group, Georgian Water and Power, Batumis Tskali).

The low emission development strategy for waste sector includes measures to be taken at national level, as well as at landfill level or by wastewater treatment plants. Box 2 shows the overview of low emission development strategy for waste sector:

Box 2. Low Emission Development Strategy for waste sector

Solid Waste Disposal:

- At national level:
    - Enforcing the separation of waste (paper, plastic, glass, metal) at the source, gradually increasing the amounts of collected/recycled waste (**Measure W1**)
    - Development of legislative basis for Incineration/co-incineration (**Measure W9**)
- By landfills:
    - Tbilisi landfill:
        - Deployment of solid waste treatment plant by 2019 (**Measure W2)**.
        - Collection and flaring of methane at landfill (**Measure W3**) from 2018**.**
    - Adjara Landfills (owned by municipalities in Adjara Autonomous Republic)
        - Old landfills closed by 2019 (no effect on overall emissions)
        - New landfill opened with methane collection and flaring/utilization system **(Measure W4)**
    - All other landfills (which are operated by Solid Waste Management Company)
        - Rustavil Landfill – Installation of collection and flaring/utilization of methane from 2019 **(Measure W5)**
        - Other existing landfills (Borjomi, Kutaisi, Telavi), Installation of collection and flaring/utilization of methane from 2019, closure of landfills by 2025 **(Measure W6)**
        - Opening of new regional landfills by 2025, where
            - At 80% of new regional landfills - Installation of collection and flaring/utilization of methane **(Measure W7)**

- At 20% of new regional landfills – separation of biodegradable waste and composting **(Measure W8)**

Waste Water Treatment:

- Adlia Wastewater Treatment Plant
  - Methane collection and use for electricity generation **(Measure W10)**
- Gardabani Wastewater Treatment Plant
  - Methane collection and utilization – presumably after 2030.

It should be noted that in addition to the measures described in this document, the National Waste Management Strategy [2] contains other actions designed for waste management improvement as well, but due to the absence of their impact on GHG they are not considered. One of the important measures considered in the Solid Waste Management Strategy is the prescribing of the separated collection of specific waste streams (portable batteries, accumulators, tires, and others) using the Extended Producer Responsibility principle. This measure does not have a direct effect on the reduction of GHG emissions, since considered waste doesn't cause methane emissions at landfills. Despite this, the measures have an indirect effect, because recycling of these streams will reduce energy and associated emissions from production and mining of materials for these products. Although the vast majority of waste covered under this plan is not produced in Georgia and is imported, these reductions will happen outside of Georgia. These activities will still have effect on global emissions. In addition, these measures have a significant effect on the reduction of other local pollutants in Georgia and help to reduce the waste disposed to landfills, thus extending their lifetime and improving management. A more detailed description of these measures and their associated affects can be found in Annex of [12].

As for the Gardabani Waste water treatment plant, the facility requires substantial reconstruction and improvements (improvement of mechanical purification processes, chemical treatment and addition of biological treatment) which are more urgent than methane collection. These measures are already planned and the process has been started by first stage of procurement process for upgrading the plant. But specific details of the planned upgrade are not known yet, and considering the amount of work needed at the plant, biogas capture and utilization should be considered distant prospects - presumably they will take place later than 2030.

The list of all mitigation measures considered in this strategy are listed in Table 17. More detailed descriptions of the measures are given in annex.

Table 17. Mitigation Measure Descriptions & 2030 Impacts -- Waste Sector

Mitigation Measure	Description	Impact by 2030
Measure W1. Setup of paper, plastic, glass and metal separation system in municipalities	A gradual introduction and proper functioning of municipal waste separate collection system, which implies a reduction of waste at landfills, as well as facilitation of their reuse and recovery, including recycling.	Methane reduction in Solid waste disposal category of 5.10 Gg CH_4 (107.19 Gg CO_2 eq) by 2030
Measure W2. Construction of solid municipal waste processing plant in Tbilisi	Complete reprocessing of solid waste generated throughout Tbilisi from 2018 onward.	Methane reduction in Solid waste disposal category of 14.57 Gg CH_4 (306.03 Gg CO_2 eq)
Measure W3. Setup of biogas flaring/utilization system on Tbilisi (Norio) landfill	It is assumed that starting from 2018 80% of methane emissions from Tbilisi landfill will be captured and flared.	Methane reduction in Solid waste disposal category of – 3.00 Gg CH_4 (63.09Gg CO_2 eq) (together with measure W2)

Mitigation Measure	Description	Impact by 2030
Measure W4. Biogas collection and flaring/utilization system setup in new Adjara landfills	It is assumed that 80% of methane emissions from new Adjara landfills will be captured and flared.	Methane reduction in Solid waste disposal category of 3.38 Gg CH_4 (71.09 Gg CO_2 eq)
Measure W5. Biogas flaring/utilization system setup in Rustavi landfill	It is assumed that starting from 2019, 80% of methane emissions from Rustavi landfill will be captured and flared.	Methane reduction in Solid waste disposal category of 1.11 Gg CH_4 (23.35 Gg CO_2 eq)
Measure W6. Biogas collection and flaring/utilization system setup in Kutaisi, Telavi and Borjomi landfills	It is assumed that starting from 2019 80% of methane emissions from Kutaisi, Telavi and Borjomi landfill will be captured and flared. The landfills will be closed in 2025.	Methane reduction in Solid waste disposal category of 1.65 Gg CH_4 (34.63 Gg CO_2 eq)
Measure W7. Biogas flaring/utilization system setup in new regional landfills of Georgia	It is assumed that 80% of methane emissions from new regional landfills throughout Georgia, which will be commissioned in 2025, will be captured and flared.	Methane reduction in Solid waste disposal category of 7.01 Gg CH_4 (147.13Gg CO_2 eq)
Measure W8. Reduction of biodegradable waste allocation - biodegradable waste composting	The measure assumes that the extraction (separation) of organic fraction (food and garden bulk) for the purpose of further composting will be performed in 20% of new regional landfills reaching up to 80% of organic waste allocated there.	Methane reduction in Solid waste disposal category of 0.85 Gg CH_4, (17.86 Gg CO_2 eq) by 2030 N_2O Increment in the category of biological treatment of solid waste by 0.013 Gg N_2O (4.04 Gg CO_2 eq)
Measure W9. Incineration and co-incineration	Measure includes creation of legal base for incineration and co-incineration practices in Georgia.	Emission reductions not assessed and thus not considered in mitigation scenario results.
Measure W10. Methane collection and application in Adlia water treatment plant	To assess the effect of the measure it was assumed that 80% of methane generated at Adlia wastewater treatment plant will be captured and flared.	Methane reduction at domestic wastewater treatment and disposal category of 1.12 Gg CH_4 (23.4 Gg CO_2 eq). In case part of methane is used for electricity generation, additional 0.176 Gg CO_2 will be reduced from energy sector, but this is not considered in mitigation scenario.

Summing up, the aforementioned measures will allow for the reduction of emissions by 790 Gg CO_2eq by 2030 in the waste sector. Another 0.176Gg CO_2eq will be reduced in the energy sector as a result of using methane collected at the Adlia wastewater treatment plant for energy purposes (Measure W10). As indicated in Figure 59, the mitigation measures, as described above will result in the decrease of waste sector emissions in 2030 by 58.3% from BAU1 scenario and by 53.3% from BAU2 scenario, which shows a relatively high mitigation potential in this sector.

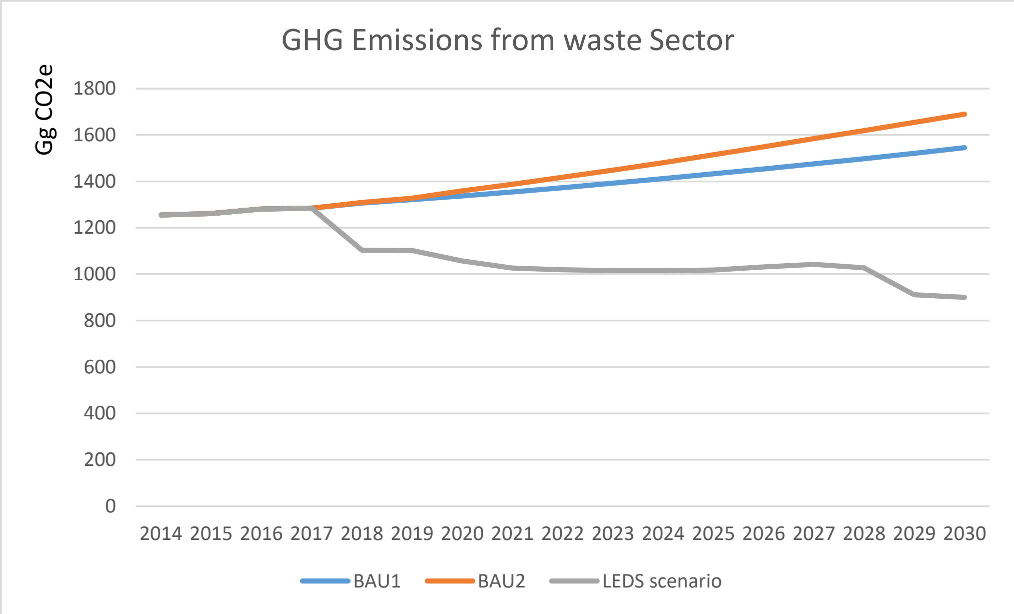


Figure 59. BAU and Mitigation Trajectory (CO_2eq) – Waste Sector

The numerical values of emissions in BAU and mitigation scenarios for individual waste sub-categories are given in Table 18.

Table 18. BAU and Mitigation Scenario Emission Levels – Waste Sector

Greenhouse gas source and sink categories	GHG emissions and Removals (Gg CO_2e)									
	2014	2016	2018	2020	2022	2024	2026	2028	2030	2030 % Reduction
BAU Scenario										
6. Waste	**1,255**	**1,281**	**1,310**	**1,360**	**1,417**	**1,481**	**1,549**	**1,619**	**1,690**	
A. Solid waste disposal on land	905	915	934	962	995	1,034	1,076	1,120	1,163	
B. Biological treatment of solid waste	0	0	0	0	0	0	0	0	0	
C1. Domestic wastewater treatment and discharge	308	321	327	344	362	380	398	416	434	
C2. Industrial wastewater treatment and discharge	41	44	49	54	60	67	75	83	93	
Mitigation Scenario										
6. Waste	**1,255**	**1,281**	**1,119**	**1,057**	**1,019**	**1,015**	**1,031**	**1,025**	**896**	47.0%
A. Solid waste disposal on land	905	915	743	659	597	568	558	546	389	66.6%
B. Biological treatment of solid waste	0	0	0	0	0	0	0	3	4	n/a
C1. Domestic wastewater treatment and discharge	308	321	327	344	362	380	398	392	411	5.4%
C2. Industrial wastewater treatment and discharge	41	44	49	54	60	67	75	83	93	0.0%
Reduction					398	466	518	594	794	
% Reduction					28.1%	31.5%	33.5%	36.7%	47.0%	

The share of impacts of each measure on reductions from BAU emissions are shown in Figure 60. It should be noted that impacts of measures W2-W7 are considered in combination of W1, which is the national level measure.

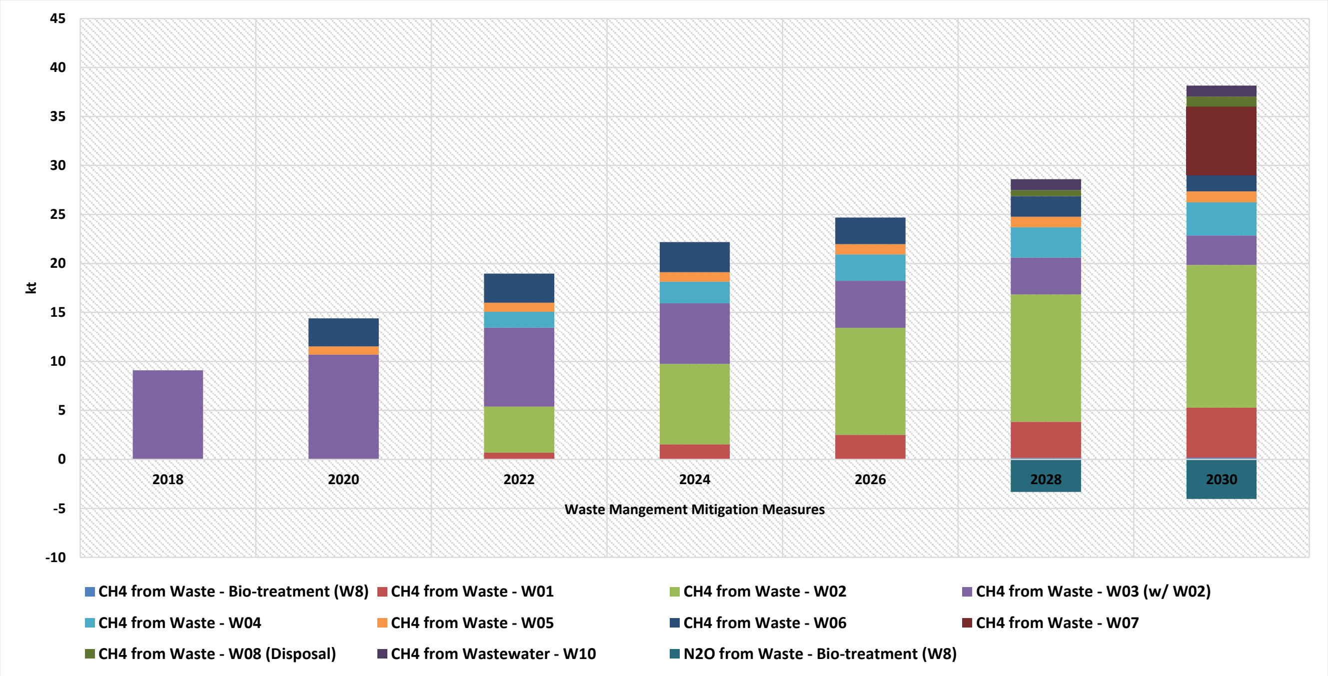


Figure 60. Contribution to Reductions from Individual Mitigation Measures (CO2eq) – waste Sector

From all the measures considered in the strategy, the highest impact (around 47% of impact of all measures by 2030) is related to the measures at Tbilisi landfill (W2 and W3), which is caused by the fact that Tbilisi landfill is the largest landfill in Georgia, serving about 25% of total Georgian population. It should be also noted that effects of W2 and W3 are not comparable, because the effects of W3 are evaluated with taking into consideration that W2 is implemented, and would be higher if it is not. This is why these two measures should be actually considered together when discussing the impacts.

2.H. LAND USE, LAND USE CHANGE AND FORESTRY

SECTION ONE: OVERVIEW

The Intergovernmental Panel on Climate Change (IPCC) introduced the LULUCF (Land Use, Land Use Change, and Forestry) sector as a means to assess greenhouse gas (GHG) emissions from activities (e.g.: forestry, agriculture, hydropower generation, peat extraction, urbanization, etc.) carried out in various land types and forests. Economic sectors covered by LULUCF are mainly forestry, agriculture, energy, and development of urban areas. According to the methodological guidance adopted by the IPCC (IPCC, 2003) [4], greenhouse gas inventories in the LULUCF sector shall be carried out in compliance with the land categories provided in Table 19. According to the IPCC, GHG inventories of these land use categories require the development of an annual land- use matrix and a matrix of annual changes in the land use categories [4]. Table 19, land-use in Georgia in 2014-2015 (2014 is the base year for Georgia's LEDS), was constructed based on the data available from the National Statistics Office [26] and the Ministry of Environment and Natural Resources Protection (MENRP) of Georgia [27], and from Food and Agriculture Organization Corporate Statistical Database(FAOSTAT) where national data was not available [1]. There is a significant change in the total cropland area from 2013 to 2014; 576 thousand ha to 911.4 thousand ha, respectively. This change came from the latest census of agricultural lands carried out in 2014 [26]. In addition, sown and fallow lands were differentiated in 2014 (under the annual croplands sub-category), which had an impact on the CO_2 emissions from this land category as well. Other changes in the land-use matrix starting from 1990 are discussed in the respective sections of this chapter and are available in the EC-LEDS Technical Paper for the LULUCF sector [34]. Nevertheless, significant changes are the result of the agricultural lands census (2014) [26] and fragmented forest inventories conducted in certain regions of Georgia[59].

Table 19. Land use matrix of Georgia from 2013-2015 (including Abkhazia and South Ossetia), thousand hectare.

Land use categories	Land use sub-categories	Year		
		2013	2014	2015
1. (5A) Forest lands (Covered with forest)[1]	Managed forest	2,521.8	2,424.3	2,423.7
	Forest area in the protected territories	300.6	326.5	326.5
	Total	2,822.4	2,750.8	2,750.2
2. (5B) Croplands [1, 26]	Perennial plantations	125.0	109.6	109.6
	Croplands (including sown)	451.0	801.8 (316.6)	801.8 (308.4)
	Total	576.0	911.4	911.4
3. (5C) Grasslands [1, 26]	Pastures	1,804.2	1,796.0	1,796.0
	Hayland	135.8	144.0	144.0
	Total	1,940.0	1,940.0	1,940.0
4. (5D) Wetlands (water fund, bogs)[1]	Territorial water (Black Sea) area	679.0	679.0	679.0
	Internal waters	215.1	215.1	215.1
	Total	894.1	894.1	894.1
5. (5E) Settlements[1]		88.4	88.4	88.4

59 Updated data of forest areas for the LEDS purposes is provided by the NFA through official letter.

6. (5F) Other lands (including areas in the forest fund)	1,307.5	1,043.7	1,044.3
Total territory of Georgia	7,628.4	7,628.4	7,628.4
Including land area	**6,949.4**	**6,949.4**	**6,949.4**

IPCC guidance suggests that source categories in which carbon stock changes are more significant, and therefore represent key source-categories,[60] be emphasized and higher tiers be used as appropriate. The results of the latest key source-category assessment conducted within the First Biennial Update Report (BUR) of Georgia determined the most important sub-sectors of the LULUCF sector to be assessed for LEDS measures [3]. The BUR was prepared in 2013 and for the LULUCF sector, inter alia, it identified the forest land (5A) and grasslands (5C, including pastures) as first and second place in key categories, respectively. Key source-categories also include croplands (5B) and perennial crops. Therefore, three (5A, 5B, and 5C) land use categories are considered in the LEDS LULUCF sector.

Forest lands (5A)

Forests cover approximately 40% of Georgia's total territory. Ninety-five to ninety-eight percent of Georgia's forest are of natural origin. As such, Georgia ranks, among other countries, rich in forest. Composition, structure, development and other indicators of Georgia's forest provide conditions for high biodiversity – about 400 species of trees and bushes are present in Georgia. An abundance of endemic tree plants, 61 species out of which are endemic to Georgia and 43 to the Caucasus region, is an indicator of high dendroflora diversity.

Forests, over two-thirds of which are located on medium and high slopes, mostly carry out soil-protecting, water-preserving, water-regulating, sanitary, and other protective functions. Furthermore, the forest areas still preserved in the Great and the Lesser Caucasus are of global environmental importance as they constitute the last virgin forests remaining in the temperate climatic zone. In addition to the above ecological functions that are of national importance, the forest resources of Georgia are used to meet various needs of the national economy and population. Forests provide timber and firewood necessary for everyday life, as well as non-timber products including medicinal plants.

According to the "Forest Fund Single Inventory Data Indicators[61]," in 2003 the Georgian state forest stock covered 3,005,300 ha, with 2,772,400 ha of forested area.[62] Out of the total forested area, about 0.5 million ha constituted intact forests, 2.2 million ha comprised modified natural, and 0.06 million ha represented artificially cultivated forest. It should be noted that due to the absence of inventories over several decades, there is no actual accurate data on forest fund areas (including forested areas). The total reserve of forest (wood) in 1990 was 400 million m^3 and the average annual increment of wood resources was 4.0 million m^3. It is worth mentioning that forests are unevenly distributed throughout the country – along with regions rich in forest, there are also numerous regions that are poor in forest resources (where forest share in total area does not exceed 10 percent).

The forests of Georgia mostly consist of the following species of woody plants: leafy species- beech (42% of forested area), hornbeam (11.2 % of forested area), oak (11.2 % of forested area), alder-tree

[60] IPCC method for identification of most important source categories/sinks.

[61] The document contains indicators obtained through forest inventory. Approved in 2003 by State Department of Forestry, it is used as a basic guideline document – until country-scale renewal of relevant indicators is performed.

[62] Including Autonomous Republics of Adjara and Abkhazia

(7.2% of forested area) and chestnut (3.8 % of forested area); and coniferous species- fir-tree, spruce and pine (17.4 % of forested area).

Presently, Georgian forest areas are totally state-owned. The Forest Code of Georgia(1999) stipulates the current institutional setup of forestry sector administration and management. The MENRP of Georgia is the highest national authority with executive power, responsible for national forest policy development as well as its implementation and enforcement through subordinated structural units. In particular, development of a national-level forest policy is the responsibility of the Forest Policy Division of the Ministry's **Department of Biodiversity and Forest Policy**. Operational and management functions within the ministry (including regional level) are performed by the following bodies:

- LEPL **National Forestry Agency** and its Territorial Units (nine Forestry Units in total).
- LEPL **Agency of Protected Areas** and its Territorial Administrations (20 Administrations).

Management control is the function of the **Department of Environmental Supervision** which is a state institution within the jurisdiction of the Ministry. The Department of Environmental Supervision provides oversight via territorial bodies throughout Georgia, including the Autonomous Republic of Adjara (eight territorial bodies, including the Black Sea Convention Division). Management of forests located in the territory of the Autonomous Republic of Adjara (except for protected areas) is performed by the Legal Entity of Public Law under the Division of Environment and Natural Resources Protection of Adjara (LEPL **Forestry Agency of Adjara)**. Other than these structures, the **Akhmeta Municipality Board** is involved in forest management through it's control of Tusheti Protected Lands. Currently, the forests of the Autonomous Republics of Abkhazia and South Ossetia are beyond control of the government of Georgia. Long-term logging license holders and the Patriarchate of Georgia are considered the subjects involved in forest sector management. As of 1 January 2017, 38 licenses for 154,445 ha are still valid (validity term of last license expires in 2029). It should be noted that according to the amendments made to "Rule for Forest Use" approved by the Resolution of the Government of Georgia N242 of 20 August 2010, it is prohibited to issue logging licenses until the forests national inventory is carried out. Likewise, the National Forest Concept and Georgian Forest Management Policy adopted by the government of Georgia do not assume any licenses.

Over the years, the processes occurring in the forestry sector were characterized by frequent institutional and legislative changes caused by instability of political and strategic priorities. Absence of a clearly defined strategy and action plan prevented consistent development of processes. The reform planned for the sector since 2014 implies a change from the current forest management approach, in particular towards the country-scale formation of forest husbandries, and introduction of a sustainable forest management model based on long-term economic benefit.

Over the last 30 years, forest exploitation in Georgia has been limited exclusively to timber production, and this trend continues. The largest share of the timber industry is occupied by so-called "social cutting", aimed to satisfy the consumers' demand for materials (first class wood) and firewood (second class wood). Mainly long-term license holders conduct commercial timber harvesting.

Research conducted in 2013-2015, as well as inventories of forests in certain regions, show that local citizens and the public sector are highly dependent on forest resources, especially in rural areas. Firewood continues to remain the cheapest and/or only source of energy for domestic heating and food preparation. In order to counter the rising energy deficit, the amount of harvested timber exceeds the allowed limit (0.5 to 0.7 million cubic meters every year, usually via illegal woodcutting), which in turn leads to irreversible degradation of the ecosystem, setting the country on a path to an ecological disaster. Forest stocktaking conducted over recent years in the regional forests revealed that overconsumption of resources has resulted in the reduction of forest density to a critical point (in the range of 0.41-0.49)[63]. Inefficient consumption of firewood is also noteworthy; 90% of timber is burned while still damp, thereby increasing carbon dioxide emission. In addition, firewood is burned in obsolete, inefficient ovens, which results in both loss of energy and an increase in atmospheric pollution. "Illegal cutting" officially stated by the National Forestry Agency (NFA) amounts only to the number of illegal acts officially recorded by the agency, and according to the national energy balance, the real number significantly differs from this official figure.

The draft document, 2017-2020 Forest Sector Reform[64] Action 6, states the following: **"Interdepartmental cooperation is necessary to establish an energy balance and develop a state program for providing the population with a resource for heating; within this program's framework, an evaluation of the feasibility of using alternative energy sources for overcoming the energy deficit will be conducted and appropriate action will be taken depending on its results[65]."**

The new management model (based on, among others, the new Forest Code) envisions a gradual transformation of the National Forest Agency into a multipurpose forest management enterprise, authorized to manage the forest (including the development of infrastructure, management of hunting industries, control of recreational forests, selling forest resources, introduction/selling of tourist, and other kinds of services) and capable of reinvesting those revenues into forest restoration, fire prevention, infrastructural, and other forestry activities.

Currently, the major regulatory document for the sector is the Forest Code of Georgia adopted by the Georgian Parliament in 1999. According to the National Forest Concept of Georgia, adopted by the Georgian Parliament at the end of 2013, inadequate legislative framework is one of the most significant barriers related to forest management, monitoring of licenses, and implementation of the social cutting process.

In 2016, with the support of the World Bank, the new Forest Code was developed as agreed within the EU Association Agreement and reflected in the action plan (2015). **The purpose of the Code is to create a legal basis for the sustainable management of forests, which should ensure protection of the biological diversity of Georgian forests as well as maintain and improve the quantitative and qualitative characteristics of forest properties and resources for implementing its ecological, social, and economic functions. Without approval and enforcement of the new Forest Code, implementation of LEDS as well as the LULUCF component of Georgia's Intended Nationally Determined Contributions (INDC), submitted within the context of Paris Agreement, is not realistic.** In addition, the new forest code introduces a definition of "forest" which is consistent with the United Nations Food and Agriculture Organization (FAO) requirements, as well as requirements established by the United Nations Framework Convention on Climate Change (UNFCCC) process for Clean Development Mechanism (CDM) and Reducing Emissions from Deforestation and Forest Degradation (REDD) Plus implementation and monitoring. According to the draft law, **forest is a land plot with a minimum width of ten meters and at least 0.5 hectares of land area covered by one or more timber species, where tree[66] crown density accounts for at least 20% of the land area.**

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63 Average density of normal forest should be 0.7 and more.

64 It is planned to present the final document to the Government for approval in 2017

65 The initiative to elaborated the State Program for Providing the Population with Firewood is being implemented by the Caucasus Environmental NGO Network as well as the European Neighborhood and Partnership Instrument. Draft paper is submitted to the MENRP for stakeholder consultations.

66 Article 2 of the draft new Forest code defines "Tree – a perennial timber plant which develops a main stem or, in case of side shoots, forms a brachiferous crown, and reaches a minimum of 3 meters height in maturity";

Another key issue introduced by the Forest Code is determining the borders of municipal forests. The municipal forest status is assigned to a certain part of the state forest by decision of the Government of Georgia. A motion of the municipalities' representative body provides the basis for this decision. Transferring forests to municipalities, with proper management, for up to a ten-year period is designed to introduce sustainable forest management principles. This is a very important step for the fulfillment of the municipalities' commitment taken under the Covenant of Mayors (CoM) initiative, as well as contributing to the national process of NDC implementation.

The goal of the draft Forest Code of Georgia is to introduce sustainable forest management tools in Georgian reality. This is achievable through active public participation in the process. To ensure public involvement, all interested parties are free to take part in the decision-making process on forest management.

The forest national inventory is the basis for implementing sustainable forest management recommended by the New Code. There are still some key barriers to the inventory: local financial resources, shortage of people/private companies to carry out works, and the absence of a simple data collection on the status qua - due to the absence of baseline data, which would be used to assess changes over time.

Agricultural Lands: Croplands (5B) and Grasslands (5C)

As of 2015, Georgia's agricultural land area was 2.8 million ha, equaling about 41% of the country's total territory. A major part of agricultural land is grasslands (5C) consisting of pastures and hayfields, while the second position belongs to croplands (5C), consisting of annual croplands, fallow lands, and perennial croplands [26].

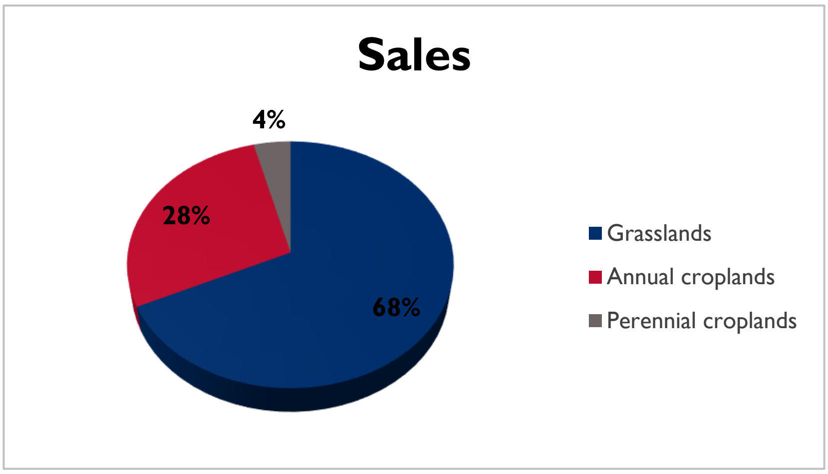

Figure 61. Distribution of Georgia's agricultural land by land categories

The reorganization of Georgia's agricultural land started in 1992, when state-owned agricultural land was distributed among private holders. As a result of this process, 0.75 million ha was unconditionally transferred to individual possessors, mainly to rural households. Of these lands, a major part consisted of annual and perennial (orchards) croplands, while 1.75 million ha of grasslands remained owned by local administrations and the Ministry of Economy and Sustainable Development (which are presently used by local communities or are for sale by the Ministry). Currently 45% of agricultural lands are privately owned and 55% are state owned. At least 70% of croplands (arable lands and perennials) are under private ownership, while the majority of grasslands are owned by the state [28].

Agricultural production is primarily made up of small farmers. 86.5% of agricultural lands are cultivated by 571,900 households, the majority of which possess small plots. At most, 77% of households own land, and the average lot area is 1.2 ha.

Perennials (5B, perennial croplands)

Perennial crops in agricultural lands imply fruit orchards, vineyards, and other plantations. According to the census of agricultural lands conducted every ten years by the National Statistics Office of Georgia [26], perennials land area in Georgia has declined sharply. Particularly, in 1990 perennial crops occupied a total area of 334.2 thousand ha, while in 2015 this number decreased to 109.6 thousand ha, a total decrease of 224.6 thousand ha. Perennial crop area decline consequently led to a reduction of annual CO_2 gain and carbon reservoirs in this land category. Unfortunately, the present statistics do not show which land-use category has changed, e.g. to which category has transformed the area covered, in past, by perennial plants- to cultivated arable, grassland or any other kind of category.

This decline could be related to the substitution in many areas of annual crops with perennials in the 1990s. In West Georgia, tea was replaced by corn, while in some parts of East Georgia, vines were replaced with sunflower and watermelon. In the Kartli Region, fruit orchards were replaced with wheat. During the Soviet era, grain crops in Georgia were succeeded by perennial crops: vines in the eastern part and tea in the western part of the country. However, after restoring independence, the shortage of wheat and grain became obvious, leading to a bread deficit. Therefore, to provide the population with food products, the production of grain began on a wider scale. At the same time, one of the causes of perennial area decline was the lack of plant maintenance, leading to land degradation and shifting to other land-use categories, e.g. grasslands.

Currently, to encourage the development of orchards and other perennials in the Agriculture Sector, an important project has begun in Georgia. Namely, under the 12 February 2015 Decree of the Government of Georgia, the State Program "Adopt the Future" began. This program was initiated by the Ministry of Agriculture of Georgia and implemented by Agricultural Projects Management Agency in the framework of "Joint Agroproject," supported with state budget. The increasing trend of perennial cropland areas will contribute to the increase of carbon sinks in agricultural lands. This process is accompanied by an increase in the area of fallow lands, which is also a sink, but will be temporary.

Grasslands (5C)

Georgia's natural grasslands occupy 28% of the total territory of the country (1,940.0 thousand ha). A major part of this land is owned by the state and is being leased. According to the June 2010 Decree, "On the State Property," the pastures are not subject to privatization. The taxation of grasslands is differentiated by the quality and location of the land and varies in the range of 2-8 lari/ha per annum.

Georgia's grasslands are one of the most important and indivisible components of biodiversity. Their rational utilization is significant for rural development. In the 1990s, the use of grasslands was unsystematic and chaotic, intensifying the degradation process, which is especially noticeable in the Dedoplistskaro Region. To date, the state of grasslands in many regions is nearing the critical margin and prompt measures must be taken to avoid irreversible damages.

Georgia's semi-arid ecosystems, the majority of which are used as winter pastures (the Taribana Valley and neighboring territories), are threatened by overgrazing and unsystematic feeding of livestock. The situation is the same at the alpine pastures of the Greater Caucasus. The alpine and semi-arid grasslands are highly sensitive to climate change. The legislation and state programs do not define institutional frameworks for the sustainable use of common pastures. The utilization of grasslands under the community ownership of villages is not controlled and the principles of sustainable management of grasslands are not observed. Under the Georgia law, "On the Protection of Soil," the grazing norms are determined only for high-mountain pastures. The law does not regulate grazing items for winter pastures. The exception is traditional usage zones of protected territories. According to the law, the National Park's traditional usage zone is for conducting commercial activity related to the protection of the environment and traditional utilization of natural resources. In this zone haymaking and grazing, limited by the requirements of the local population and natural productivity, is allowed, but cultivation of land and placing of non-traditional agricultural buildings is prohibited. Oversight of these territories is performed through the management plans, in which the elements of grassland management are formulated - including the development of methodology to reveal eroded plots, initiation of measures to improve their state and sustainable use, monitoring, etc. These management plans could be used as models for a pilot program to facilitate and introduce sustainable grasslands management elements throughout the entire country. The BAU scenario shows that because of the severe degradation of pastures and forests, the LULUCF sink will be moving to a zero sink.

Baseline Inventory (2014) of LULUCF

For 2014, understood to be the base year for LEDS, the forest sector inventory was carried out based on two approaches: one approach uses the same methodology and assumptions that were used in the 1990 – 2013 GHGs National Inventory which was submitted to the UNFCCC; the other approach uses the same methodology but different assumptions specifically developed for the LEDS and based on recent studies and the energy balance of Georgia.

Calculations carried out in both approaches apply default values of emission factors (Tier I approach) and match with climate conditions in Georgia. According to the latest data provided by the NFA, the forested area in 2014 reduced by 2.5% compared to 2013 (see Table 19). Table 20 shows total net carbon dioxide emissions for the LULUCF sector in 2013-2014 calculated with the same approach as in national inventory (BUR) [3] and with the approach agreed for the LEDS process. Details on calculation methodology, activity data, and emission factors are available in EC-LEDS Technical Paper [34].

Table 20[67]. Results of GHGs inventory of 2013-2014 in the LULUCF sector

Year	Forest lands		Agricultural lands				Grasslands		Net emission/absorption	
			Croplands		Perennial plantations					
	Thousand Ton C	Gg CO_2	Thousand Ton C	Gg CO_2	Thousand Ton C	Gg CO_2	Thousand Ton C	Gg CO_2	Thousand Ton C	Gg CO_2
National inventory approach for both years										
2013	-1,301.0	-4,770.0	-225.0	-825.0	-253.0	-927.0	+654.0	+2,398.0	-1,125.0	-4,124.0
2014	-1,232.5	-4,518.5	-499.2	-1,830.6	-230.2	-844.0	+636.4	+2,333.5	-1,325.5	-4,859.6
LEDS inventory approach only for 2014										
2013	-1,301.0	-4,770.0	-225.0	-825.0	-253.0	-927.0	+654.0	+2,398.0	-1,125.0	-4,124.0
2014	746.5-	-2,740.0	-501.8	-1,840.0	-242.7	-890.0	+635.5	+2,330.0	-855.6	-3,137.3

67 In Table 2 (+) indicates CO_2 emission into atmosphere and (-) indicates CO_2 absorption from atmosphere.

In accordance with the First Biannual Updated Report of Georgia [3] total annual emissions in 2013 was 16,679.0 Gg CO_2eq. without the LULUCF sector, and 12,555.0 Gg CO_2eq. with the LULUCF sector sequestering 4,124.0 Gg in CO_2eq. According to the national inventory, 25% of total emissions is reduced through sinks in 2013. Recalculation of forest lands (5A) emissions with new assumptions and improvements in methodology shows that the absorption potential of Georgia's LULUCF sector decreased by 24% in 2014. In the LEDS 2014 inventory, the absorption potential of LULUCF in the total inventory is 20%, instead of 25% from the previous approach.

LULUCF Sector Inventory 1990-2014

Source Category Forest Lands (5A)

2014 and 2015 inventories for the LULUCF sector were carried out as a basis for preparing the BAU scenario for the LEDS. Carbon dioxide (CO_2) absorptions from and emissions into the atmosphere is a cyclical process in forest stands, caused by natural processes and human influence on the forest ecosystem. Carbon (C) which is a part of absorbed CO_2, accumulates in the forest biomass, whereas the emitted oxygen (O_2) returns to atmosphere. These processes vary in forests of different type and age; thus it is preferable and recommended by the IPCC to assess them separately according to forest type (foliage and coniferous), age, climatic zone, etc. [4]

As mentioned above, the LEDS preparation process took a different approach from that used in the GHG national inventory of the Georgian forest sub-sector in 1990-2013 in order to assess the basic inventory and possible future trends. Specifically, data on fuel wood actually consumed by the population was verified not only by the evaluations of various projects, but also by the 2013-2015 energy balance issued by the National Statistics Office of Georgia. In other words, the energy balance data was used instead of official data on felling. Both the annual absorption/emission of carbon and trends of carbon changes in stocks were recalculated for the forested areas of Georgia in 1990-2015.

In accordance with the IPCC guideline, the GHG inventory of Georgia's forests was carried out on an entire area of managed forest (1,863.2 ha) and forest areas (326.5) of Protected Areas (PA) (except for Abkhazia and South Ossetia). Additionally, the national inventory of 1990-2013 and BUR only assessed managed forests for GHG emissions and protected areas were not considered in the category called "forests converted to another category," although the only category in which managed forests are converted is Protected Areas. Therefore, it is important to separately assess both managed forests and forests in protected areas and calculate the total absorption. This prevents distortion of the real picture, particularly because an increase of the overall area of protected areas is one of the most significant activities for increases of emission absorption from the forest land (5A) sector.

Methodology

1.1 INVENTORY METHOD

In accordance with IPCC guidelines, selecting the appropriate Tier[68] approach depends on the availability of national data. In addition, while selecting the Tier level to improve inventory results, the focus shall be on the importance of the emission source category (land use category). According to IPCC methodology, accumulation of carbon in the forest sector takes place in several "reservoirs": 1) biomass (above-ground and below-ground); 2) dead organic matter; and 3) soils (mineral and organic). Definitions of these reservoirs are given in the IPCCC methodology [7].

[68] Different level of methodologies which could be applied depending from the significance of source-category and availability of national data and capacity.

Along with the carbon gain, the emissions of CO_2, methane (CH_4), nitrous oxide (N_2O), CO, and NO_X gases caused by forest fires are considered in net emissions.

1.2 ACTIVITY DATA

Another difference in the baseline inventory process, while preparing the low emission strategy, is the division of the Georgian forest territories into seven categories instead of two (East and West Georgia forests). These categories, defined by ownership and climatic zones are: West Georgian humid, West Georgian dry (Zemo Svaneti), East Georgia humid (Borjomi - Bakuriani), East Georgia dry, Ajara, Abkhazia and South Ossetia forests, and protected areas. Emission factors relevant to the considered zones and tree species were selected: coniferous and deciduous.

Areas covered by managed forests in 2014-2015, located in various climate zones, are discussed in the EC-LEDS Technical Paper [34]. Forests as well as climatic parameters in these seven regions significantly differ from each other. Along with a decrease of precipitation from the Black Sea coast eastwards and the increase of continental climate, a general trend of change in forests and vegetation cover is evident. The activity data of those climatically different forest districts differ by forest cover, dominant species, growth rate, etc. Therefore, separate calculations were carried out for the Zemo Svaneti (Mestia) and Borjomi-Bakuriani forests.

A summary of changes in forest areas by ownership is provided in Table 21.

Table 21. Georgian forest areas by ownership in 1990 and 2014, (thousand ha)

Year	Managed forest area (LEPL National Forestry Agency)	Ajara forest area (LEPL Ajara Forestry Agency)	Managed forest areas of Georgia total	Forested areas under Protected Area category	Total (4+5)	Abkhazia and South Ossetia[27]	Total (6+7)
1	2	3	4	5	6	7	8
1990	1,911.9	159.8	2,071.7	147.8[69]	2,219.5	561.1	2,780.6
2014	1,723.6	139.6	1,863.2	326.5[70]	2,189.7	561.1	2,750.8
2015	1,723.5	139.1	1,862.6	326.5	2,189.1	561.1	2,750.2

As shown in Table 21, during the period of 1990-2015, the forested areas owned by the NFA of the MENRP of Georgia decreased from 1,911.9 thousand ha to 1,723.5 thousand ha, mainly due to increasing forested territories in protected areas. Data sources of areas and other details on changes provided in Table 3 are available in the EC-LEDS Technical Paper [34].

The average annual timber increase data for forest types in various climatic zones was taken from various respective taxation or statistical data sources (Table 22).

[69] National Statistics Office of Georgia, Natural Resources of Georgia and Environmental Protection, Statistical Publications 2004, Page 41, http://geostat.ge/cms/site_images/_files/georgian/agriculture/garemo/Kr.Garemos%20dacva_2004.pdf;

[70] Data were provided by the Agency of Protected Areas (APA) through official letter.

Table 22. Average annual increase of timber in forests in different climatic zones, m^3/ha

Species	West Georgia		East Georgia		Ajara
	Dry, continental climate	Humid climate	Dry, continental climate	Humid climate	
Coniferous	2.1	2.7	2.0	2.6	3.4
Deciduous	1.7	2.1	1.5	1.9	2.8

Average annual growth values (m^3/ha) and trends in biomass of managed forests and protected areas from 1990-1995, with supporting data sources, are provided in the EC-LEDS Technical Paper [34]. As mentioned previously, the official statistical data on felling differs from the actual scale of firewood consumption. Two components are assessed in forest inventories: annual net carbon gain and carbon trends in reservoirs. In order to assess the carbon reservoir in forests and annual carbon gain/loss in 2014, starting from 1990 the whole trend was recalculated based on assumptions that took real historical circumstances into consideration. In particular, it was assumed that in 1995-97, when the gas supply from Russia to Georgia was discontinued, fellings increased drastically, reaching an annual amount of four million m^3 just for energy consumption**.** The feasibility and the conservative nature of this assumption is confirmed by the inventory results of 45,000 ha of forest conducted in Borjomi -Bakuriani forests in 2014. According to this assessment, the biomass resources in this forest decreased from 10.9 million m^3 in 1998 to 8.9 million m^3 in 2014, which corresponds to approximately two million m^3 during the considered period. The result of the inventory implies that over these 16 years an annual reduction of biomass equaled 2.2 m^3/ha per year, which means that under the conditions of an average annual natural increment of 2.1 m^3/ha per year, a total annual decrease/felling was 4.3 m^3/ha annually. The assumed four million m^3 annual fellings in 1995-96 equals 2.2 m^3/ha/year. Keeping in mind that an average two m^3/ha/year is a natural increment; actual losses of stock were 0.2 m^3/ha/year, which is very low and more conservative than the that demonstrated by the Borjomi-Bakuriani inventory.

The gas supply started to resume gradually in 1997, resulting in the stabilization and reduction of felling. According to Georgian energy balances, over the last years (2013-2015), 2.5 million m^3 of fuel wood was consumed/cut in Georgia for energy purposes only. As to industrial felling, officially 100,000 m^3 of timber is prepared annually on average (including that prepared by permit-holders).

Carbon sequestration from the atmosphere or emissions to the atmosphere mainly depend on the net annual increment of biomass/timber or decrease in timber stock. Timber also has an economic and energy value for Georgia and therefore changes in timber trends are provided in this section along with carbon emissions. Figure 62 demonstrates that in 1995-1996 biomass amounts drastically decreased from 3.78 million m^3 to -0.05 m^3, due to the discontinuation of gas supply to the population in 1995 and the reduction of forested areas to the advantage of protected ones. Since 1997, the gas supply to the population gradually resumed, resulting in the reduction of fuel wood consumption, especially in big cities. In 2014-2015 the increment reached the figure of 1.57 million m^3 per year, although it is still far from the situation in 1990.

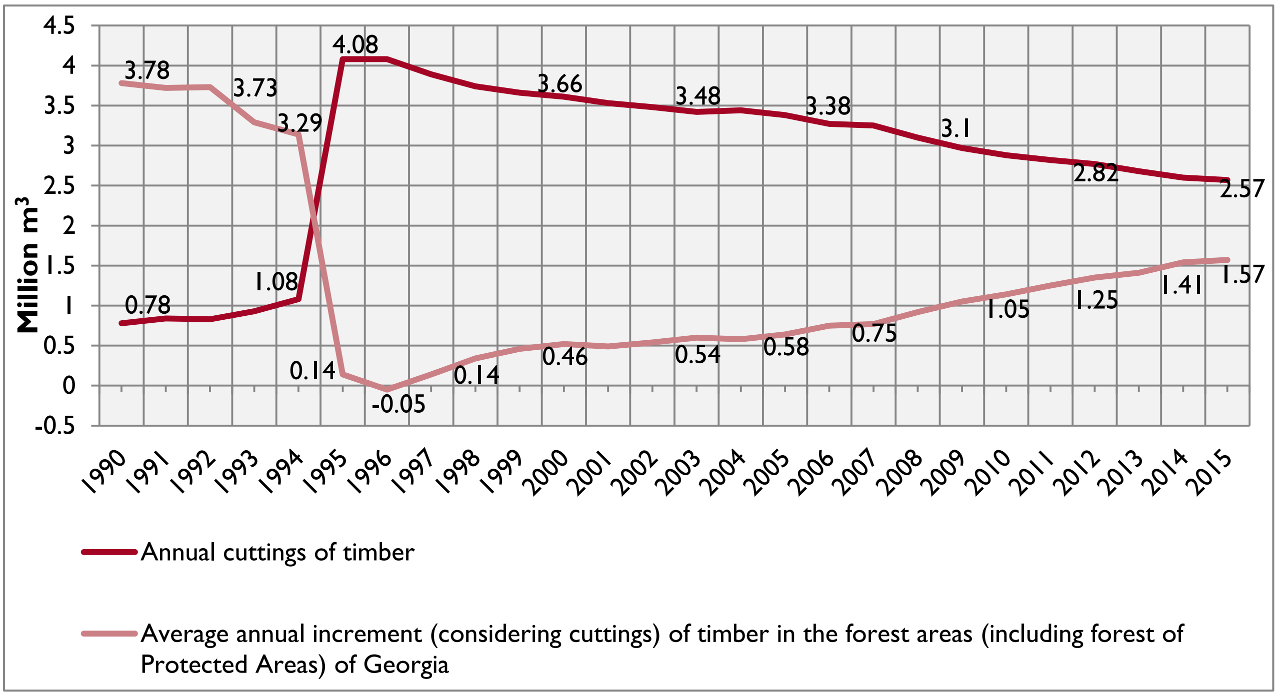

Figure 62. 1990 – 2015 Trend (in million m³) of annual increment (including losses) of timber in forested areas of Georgia

Figure 63 demonstrates that the assessment results of timber stock in Georgian forests performed through different sources and based on the annual net increment from Figure 62 are quite similar. These findings enhance the reliability of the assessment approach applied and assumptions made.

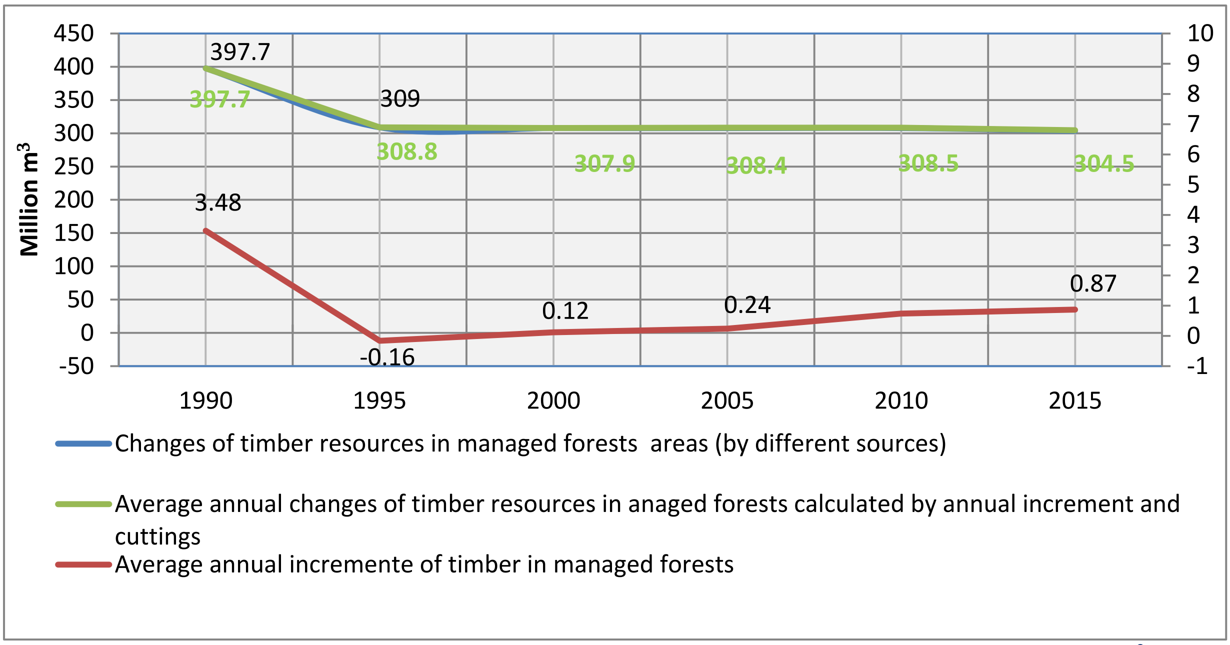

Figure 63. Trends of accumulated timber resources and annual increment in Georgia's forested areas (million m³)

There are no deforested territories in Georgia. The relative stability of the forest-covered area is due to the absence of clear-cutting in the country. The main problem of Georgia's forests is degradation. Official statistics on consumption of industrial timber and fire wood in 2014-2015, as well as forest fires, are available in the EC-LEDS Technical Paper [34]. A calculation of greenhouse gases emitted as a result of fires was conducted using the equation given in IPCC 3.2.20 [10].

1.3 EMISSION FACTORS

The carbon emission factor for forest biomass is calculated from the basic wood density (D, tons dry matter in volume, t d.m.m^3) of trees multiplied by the relevant coefficient depended from tree species (delicious, conifer). Basic wood density was calculated for five climatically different regions of Georgia: west Georgia, east Georgia, Adjara, Zemo Svaneti, and Borjomi-Bakuriani. This parameter depends on forest stands, age class, and climatic zone.

In the calculations of average basic wood density, percentage distribution of the dominant species type was taken into consideration. It should be noted that the default values of basic wood density for dominant species in countries of moderate climate given in the IPCC best practice methodology table coincide with the values calculated in the EC-LEDS process for Georgia. Calculated data are available in the EC-LEDS Technical Paper [34].

1.4 EMISSIONS CALCULATED IN FORESTRY SECTOR

Annual absorption of GHGs in the forest sector for 2014 is provided in Table 23.

Table 23. Baseline carbon sequestration by managed forests in Georgia

Year	Areas covered by forest, ha	Carbon absorption, thousand t. C	Carbon losses, thousand t. C	Net carbon absorption (considering losses), thousand t. C	Absorption of carbon dioxide, 44/12 $GgCO_2$
2014	**2 ,189, 700.0**	**-2, 095.5**	**1, 348.2**	**747.3**	**-2, 740.0**

Table 23, shown below in section two of this document, presents annual net gain trends of CO_2 in managed forests and protected areas of Georgia, as well as summarized results. Compared to 1990, the annual net CO_2 absorption in managed forests of Georgia decreased by three times in 2014-2015. Additionally, CO_2 growth in protected areas increased by 1.2 times.

Figure 65 also in section two, shows changes in the amount of carbon stock deposited in Georgian forests since 1990. By 2015, the total resources of biomass diminished by 94 million m^3 (24%) and the amount of deposited CO_2 diminished by 61 million tons (11%) in the territory of Georgia (managed forests and protected areas).

1.5 SOURCE CATEGORY CROPLANDS (5B)

Perennial plantations and lands used for cultivation of annual crops both fall into the category of croplands. The amount of carbon accumulated in croplands depends on the cultivated species, management practices, and climatic conditions. A GHG inventory of agricultural land for 2014-2015 was performed using the same methodology and assumptions as the 1990-2013 national inventory. However, due to lack of statistical data, in the 1990-2013 inventory, assessing the fallow lands as a sub-category of annual croplands was not done separately as is required by IPCC methodology [13], but was assessed in the sub-category of sown lands, while different emission factors should be applied to cultivated and fallow lands due to different land management modes. Methodology, activity data, emission factors, and other details are available in the EC-LEDS Technical Paper [34].

Figure 64 shows the dynamics of carbon accumulation in croplands by 2015.

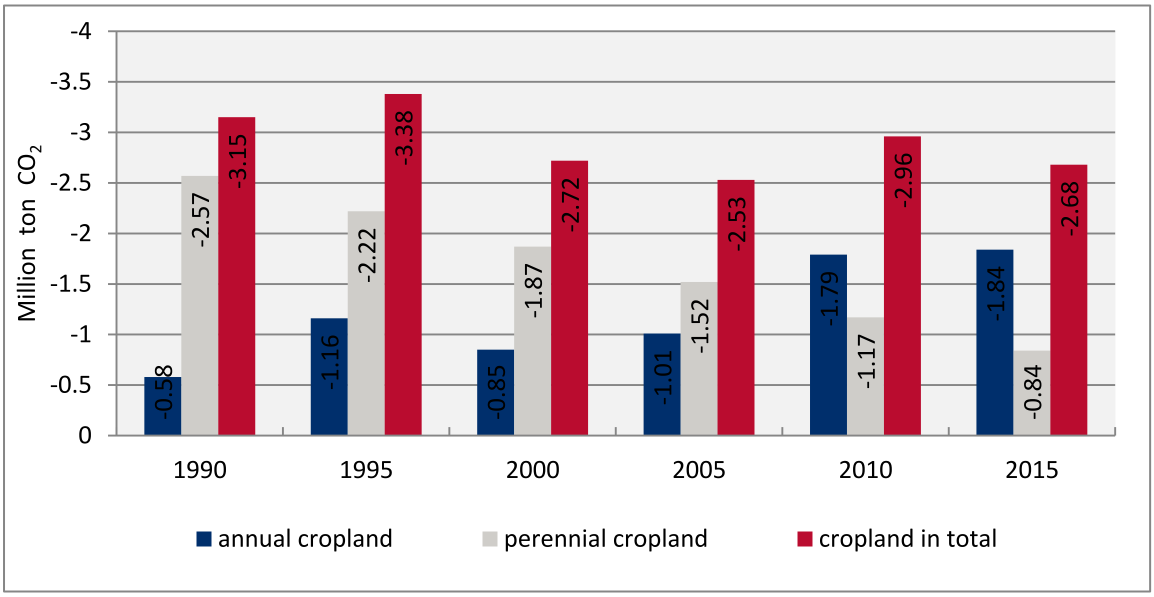

Figure 64. Trends of carbon dioxide emissions in croplands

For the purpose of calculating the change in carbon resources in perennial plantations (orchards), IPCC Table 3.3.2. [14] was used, according to which moderate climatic zone default data was applied to Georgia. In particular, carbon accumulation volume in the above-ground biomass of plantations is 2.1 tons C/ha per year and 63 tons of carbon are accumulated in 1ha of perennial plantations (by methodology, this figure is acceptable for both moderate warm humid and moderate warm dry climates). Losses are annually calculated according to data resulting from reduced planted areas (clear-cut). In this case, an assumption is made that the total accumulated emissions of carbon were released into the atmosphere instantaneously.

The default emission factor used for inventories in croplands, particularly in mineral soils, were taken from relevant tables of IPCC methodology, taking into account the location (climatic parameters) and different land management modes (for instance, rested and cultivated land). Further details of calculations are available in the EC-LEDS Technical Paper [34].

1.6 SOURCE CATEGORY GRASSLANDS (5C)

Even though pastures and hay-lands are both considered to be in the category of grasslands, their management modes are radically different. For this reason, emission calculations for pastures and hay-lands soils were performed separately. Only soil carbon emission/absorption is assessed in this land category. Annual emissions of CO_2 from grasslands in 1990 -2030 is shown in Figure 67.

As demonstrated in Figure 67 grasslands fall under the "emission source" category. Since 1990, emissions from this category have increased due to severe degradation of pastures. In 2015 emissions from this category reached 2.33 million tons CO_2, which is 2.7 times higher compared to 1990.

Overall, as seen in Figure 67, although the grassland sector is an emitter in Georgia in 2014, in total agricultural lands still absorbed CO_2.

1.7 SUMMARY

In Figure 68, shown in section two, emission trends from the total LULUCF sector are presented for the years 1990-2030. By 2015 the LULUCF sector is still a net carbon-sink, however its potential as a sink is reduced by 2.7 times comparing it with 1990 - from -8.31 million tCO_2 to - 3.13 million tCO_2.

SECTION TWO: LED VISION FOR 2030

2.1 SOURCE CATEGORY FOREST LANDS (5A)

While building the Business as Usual (BAU) scenario for the forest sector, several assumptions were made, detailed below:

- The managed forests' areas do not change and remain the same as recorded in 2014.
- Forest degradation is in progress; the indicator of average annual increment per hectare decreased from 2 m^3 (in 1990) to 1.8 m^3 (in 2014) and in case of inactivity will shrink to 1.6 m^3/ha by 2030.
- Use of timber as firewood by residents remains the same as is shown by the energy balance in 2014-2015 and is 2.5 million m^3 per year;
- Increased demand for energy resources (heating– hot water supply), resulting from growth of the GDP and population, is met through energy efficiency measures, natural gas supply, energy efficient biomass fuel, and solar energy.
- In the BAU scenario, grassland degradation continues to increase.

In order to assess the projected CO_2 annual gain in 2030, biomass gain and losses in managed forests and forests of protected areas should be analyzed for 2016-2030. The changes in biomass gain/losses in 1990-2015 have already been analyzed during the calculation of the LULUCF GHGs inventory for 1990-2015 and results for 1990-2030 are presented below. Further details are available in the EC-LEDS Technical Paper [34].

As noted above, an assumption was made that firewood consumption in Georgia will stay the same by 2030 as it was in the 2014 baseline year, but degradation will increase, resulting in a decline of average annual net timber increment from 3.48 million m^3 in 1990 to 0.52 million m^3 by 2030. The forest degradation indicator in this case is annual timber increment per ha of managed forest areas, which will steadily decline from 1.8 m^3/ha in 2014 to 1.6 m^3/ha by 2030.

Based on the woody biomass increment trend, projected annual absorption of CO_2 by the managed forests of Georgia will decrease by five times between the years 1990 and 2030; and by 1.5 times between the years 2015 and 2030, as shown in Figure 65.

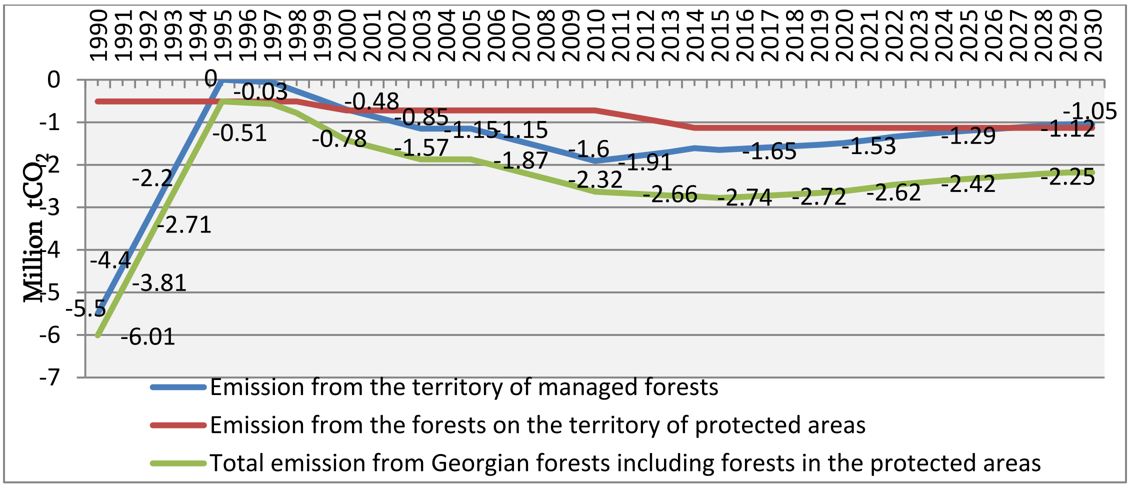

Figure 65. Trend of carbon dioxide absorption by Georgian forests in 1990-2030 (BAU)

The projected decrease in average annual forest gains (mainly due to forest degradation) will result in existing timber resource reduction. Timber resources on forested areas continues to decrease after 2015 and will be reduced by 30% (equaling 279.9 million m^3) by 2030 as compared to 1990.

Carbon stock trends in 1990-2030 were assessed. The results presented in Figure 66 demonstrate that the amount of carbon stock in managed forest areas will decrease by 26.1 million tons (7%), dropping to 355.6 million tons CO_2 by 2030. Unlike managed forest lands, indicators of carbon deposited in the forests of protected areas will keep steady at the level of 102.3 million tons CO_2.

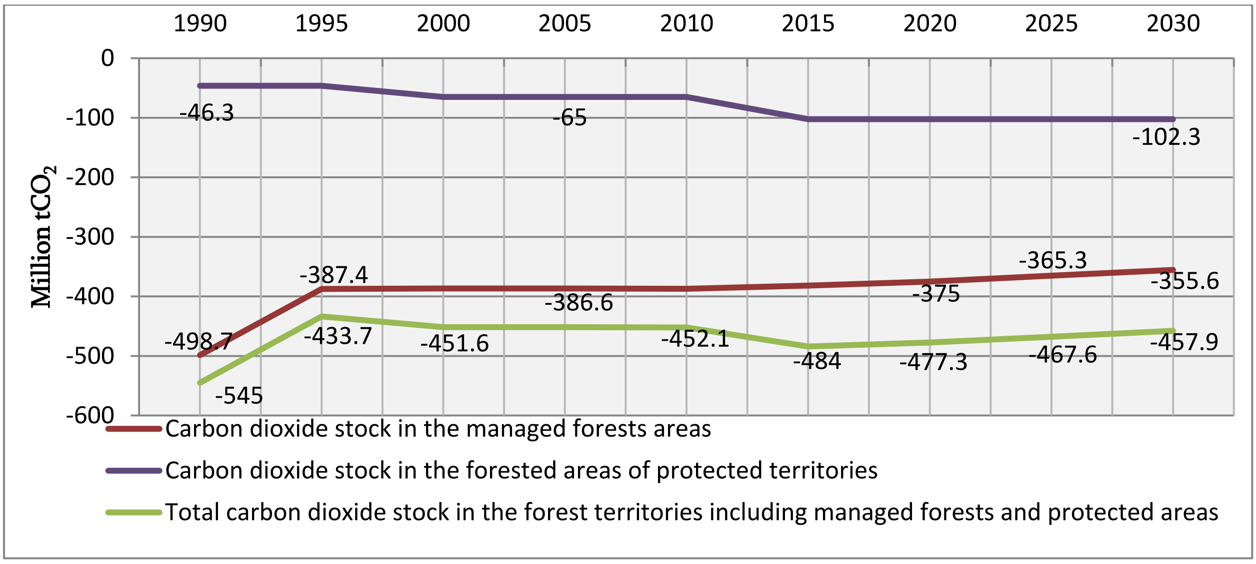

Figure 66. Trend of carbon stock in managed forest areas (in CO_2 eq.)

In comparison with 1990, the amount of carbon deposited in forested areas (managed and protected) is projected to decrease by 16%; solely in managed forests by 29%.

2.2 CROPLANDS (5B) AND GRASSLANDS (5C)

It was assumed that agricultural land areas will not change until 2030; they remain the same as in 2014. Extreme scarcity of current data on the degradation status of agricultural lands in Georgia hinders reliable forecasting of changes in agricultural land through 2030. Therefore, the assumption was made that the degree of degradation of agricultural lands (except pastures) will remain the same until 2030. Emission BAU scenario was calculated on the basis of the above-mentioned assumptions.

Regarding the pastures in the BAU scenario, degradation will continue and CO_2 emissions from pastures will increase, demonstrated in Figure 67.

Although the pastures sub-category of grasslands (5C) is an emitter, and annual absorption in perennial plantations has decreased, overall agricultural land is still considered a reservoir of CO_2. Nevertheless, as demonstrated in Figure 67, grassland emissions intensify from 2015 and will transform agricultural land into an emitter, and emissions from the sub-sector will reach 0.77 million CO_2 by 2030 in the BAU scenario.

Figure 67 depicts total emissions in 2030 from agricultural lands.

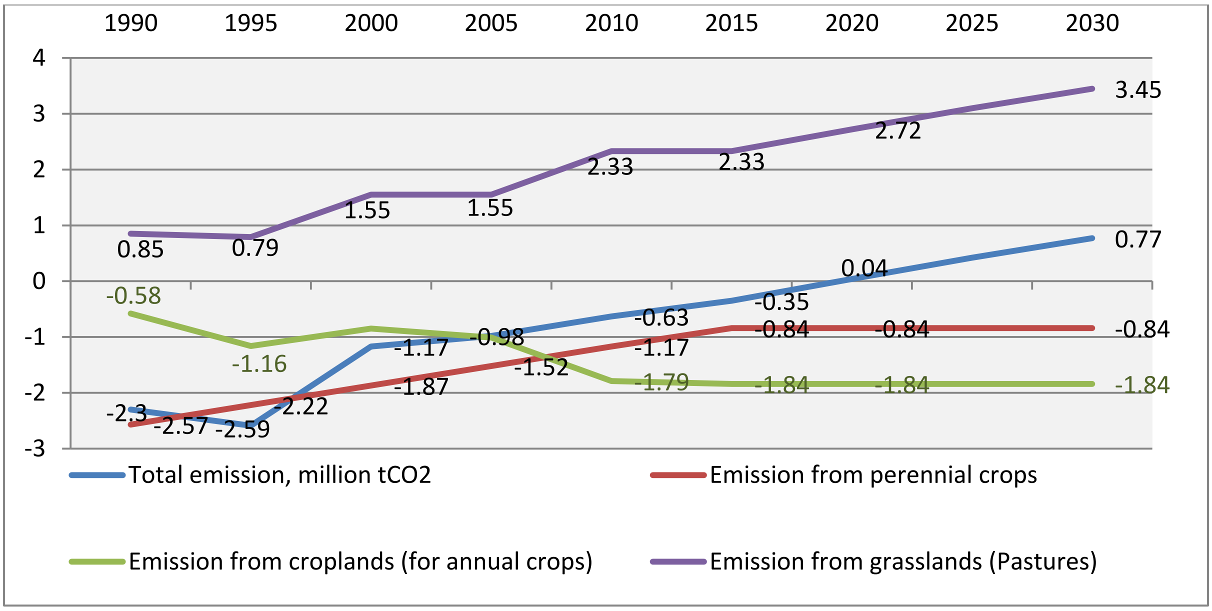

Figure 67. Trends of carbon dioxide emissions in agricultural lands

Figure 68 represents trends of LULUCF source-categories by 2030.

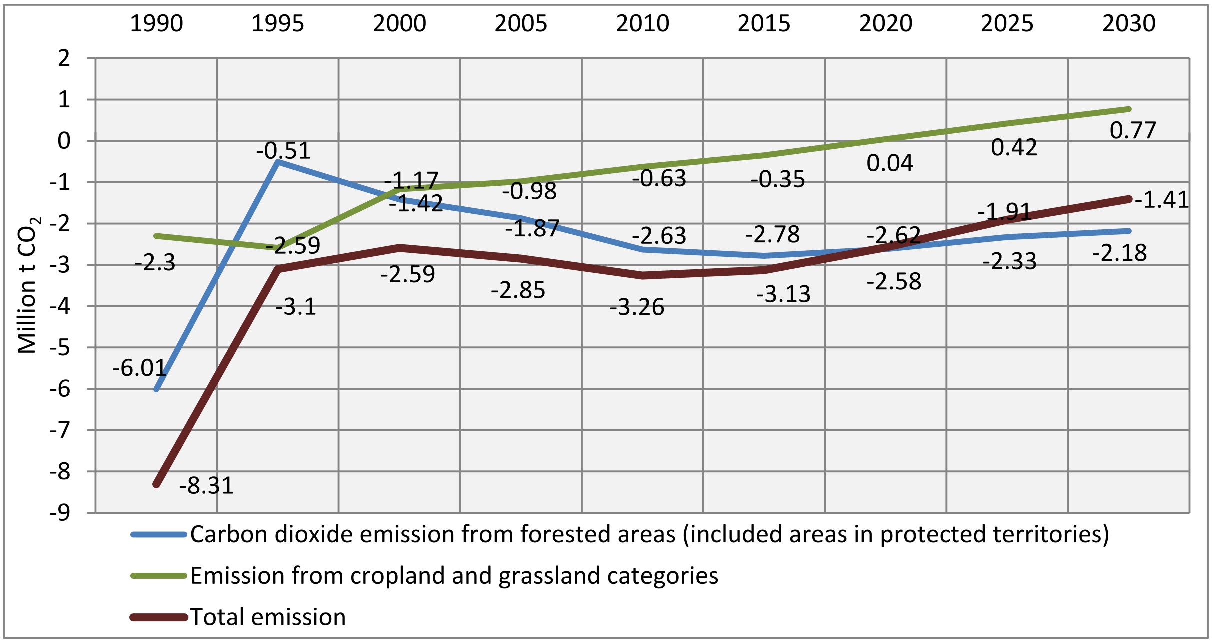

Figure 68. Trend of carbon dioxide emissions in LULUCF sector (1990-2030)

Figure 68 demonstrates that by 2030, the LULUCF sector will remain a sink, but its annual absorption potential will decrease by 6.5 times, thus resembling an emitter category.

2.3 MITIGATION POTENTIAL IN THE LULUCF SECTOR

The mitigation opportunities and corresponding impacts for the LULUCF sector in 2030 are listed in

Table 24.

Table 24. Mitigation Measure Impact by 2030

Mitigation Measure Area	Description	Impact by 2030 (Gg CO2eq.)
Afforestation/restoration of forest lands	Goal is a forest rich in biodiversity and typical of local habitats in the degraded areas. Total identified area is 36,500 ha.	-135.9
Cultivation of planted forests	Cultivation of a forest plantation on free areas of the forest fund lands comprising 51.0 ha.	-0.2
Supporting natural renovation of forest	Supporting natural forest regeneration in the area of 361.0 ha.	-83.2
Increasing the areas of protected areas	Increase protected areas from 0.52 million ha (including the 0.33 million ha covered with forest) to 1.3 million ha (approximately 20% of the territory of Georgia). The increased area includes at least one million ha (including approximately 0.63 million ha covered with forest) of forested area.	-390.0
Introduction of internationally accepted sustainable forest management	Supporting sustainable forest management in the forest fund areas, including introduction of sustainable forest management for 295,000 ha by 2030 (claimed by the country in INDC).	-430.7
Strengthening the legislative base and ensuring its enforcement to prevent illegal felling of trees in national forests	Strengthening the legislative base related to illegal felling with penalty provisions which will reduce the felling by at least 50%. The measure will be conducted in areas not included in the other measures: increasing the protected areas and introducing internationally accepted sustainable forest management practices. As far as this measure has impact on increase of emission in energy sector, the net contribution or combined effect will be (-506) $GgCO_{2eq}$.	-848.9
Increasing of areas of perennial plantations	Increasing areas of perennial crops.	-26.9
Grasslands Rehabilitation	Grassland improvement measures are planned with respect to surface and fundamental practices.	-34.2

Error! Not a valid bookmark self-reference. provides the emissions levels for BAU and each of the mitigation measures. Overall, GHG emissions growth is slowed from an increase of 119% in the BAU scenario (due to less sequestration) to an 8% reduction in 2030, assuming full attainment of the identified mitigation measures.

Table 25. BAU and Mitigation Scenario Emission Levels - LULUCF

	GHG emissions and Removals (Gg CO2eq)									
Greenhouse gas source and sink categories	**2014**	**2016**	**2018**	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**	**2030 % Reduction**
BAU Scenario										

5. LULUCF	**-3,087**	**-3,023**	**-2,804**	**-2,578**	**-2,276**	**-2,024**	**-1,798**	**-1,578**	**-1,408**
A. Forest Lands	-2,737	-2,748	-2,688	-2,618	-2,468	-2,368	-2,288	-2,208	-2,178
B. Croplands	-2,680	-2,680	-2,680	-2,680	-2,680	-2,680	-2,680	-2,680	-2,680
C. Grasslands	2,330	2,405	2,564	2,720	2,872	3,024	3,170	3,310	3,450

Mitigation Scenario

5. LULUCF	**-3,087**	**-3,024**	**-3,001**	**-3,355**	**-3,397**	**-3,403**	**-3,372**	**-3,343**	**-3,359**	-138.5
A. Forest Lands	-2,737	-2,749	-2,885	-3,391	-3,579	-3,727	-3,829	-3,924	-4,068	-86.7
B. Croplands	-2,680	-2,680	-2,680	-2,682	-2,685	-2,689	-2,694	-2,701	-2,707	-1
C. Grasslands	2,330	2,405	2,564	2,718	2,867	3,014	3,151	3,283	3,416	1

Reduction			196	777	1,120	1,378	1,573	1,764	1,950
% Reduction			-7.0	-30.1	-49.2	-68.1	-87.5	-111.8	-138.5

Contribution of each mitigation measures planned shown in

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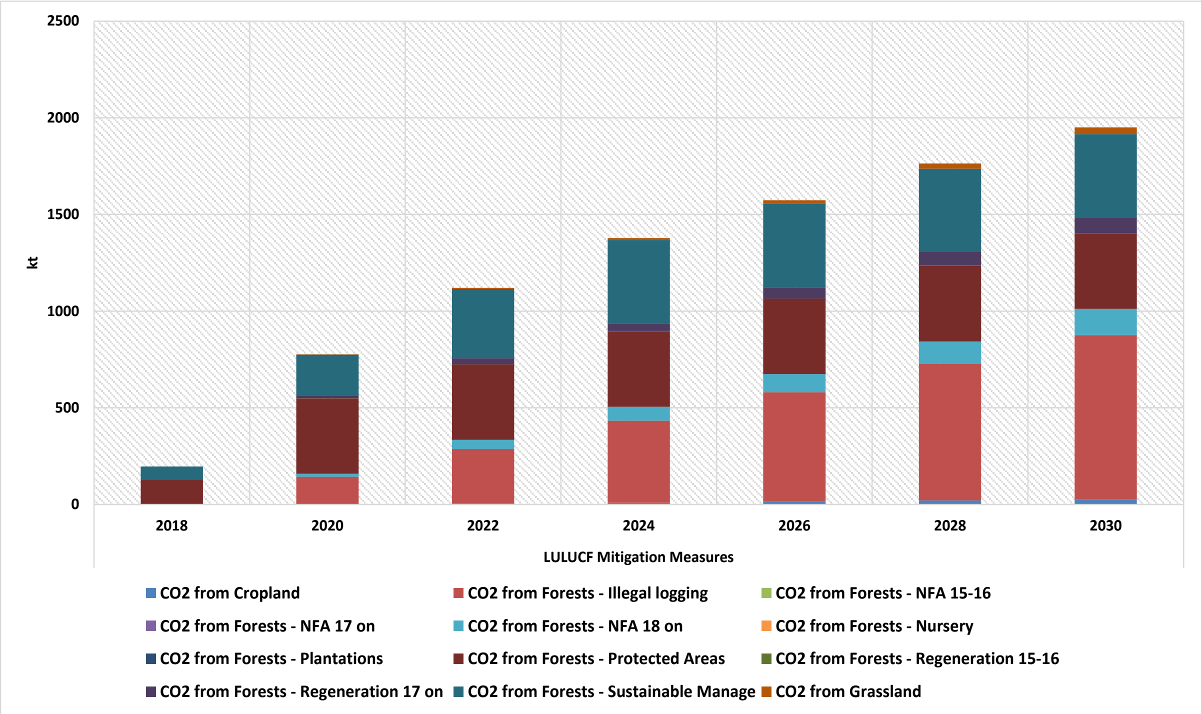

Figure 69. Contribution to Reductions from Individual Mitigation Measures (CO_2eq) – LULUCF

Figure 70 shows the emission profiles of the BAU and mitigation scenarios.

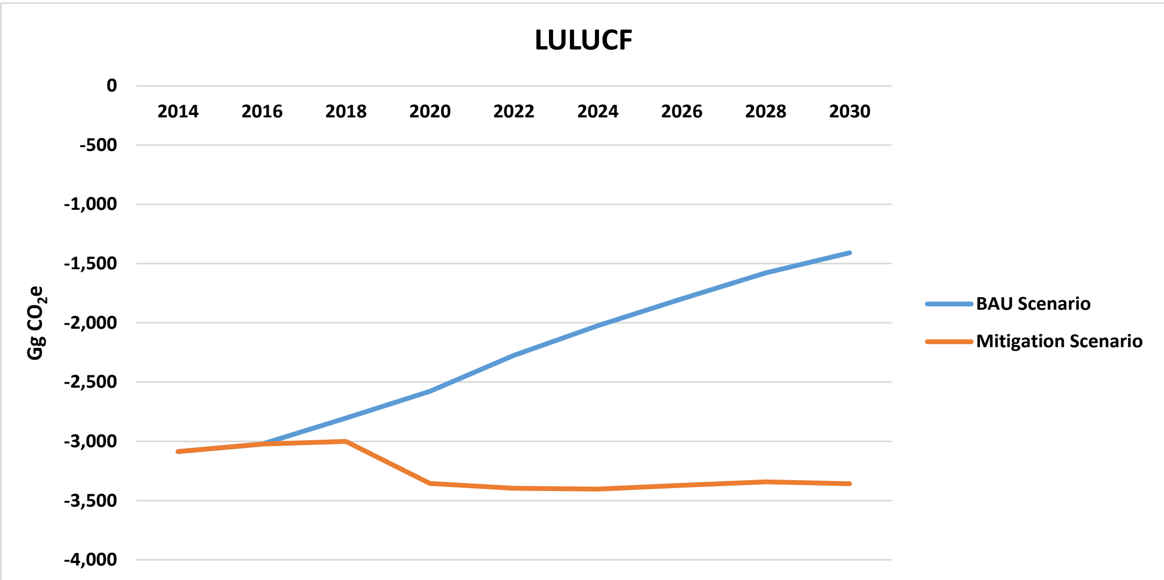

Figure 70. BAU and Mitigation Trajectory (CO_2eq) – LULUCF

In accordance with the low emission development vision, the emission reduction capacity of Georgia's managed forests in 2030 will be sustained at the 2014 baseline level through implementing the measures listed in Table 6. The increased demand for energy from the buildings sector in the 2030 BAU scenario will be fully satisfied by gas (natural or liquid). The key measures for maintaining the 2014 baseline situation center around the National Forest Agency's policy and programs planned to preserve and improve the quality of the country's forests through implementing a new forest code, sustainable management practices, and reducing illegal cuttings. The planned measure to combat illegal felling could be implemented only in coordination with the Ministry of Energy, and local municipalities simultaneously implementing the state program on energy supply to the population[71]. Along with the LULUCF sector, this measure effects energy sector emissions as well, because when the amount of recently (in 2014) available fuel wood reduces, the population will need to use some other fuel for heating, hot water, and cooking. The Table 26 shows the net effect of the measure to reduce illegal forest loggings.

Table 26. Effect of illegal logging reducing measure on energy sector emission (Gg CO_2eq)

Years	2020	2022	2024	2026	2028	2030
Increase of removals in LULUCF sector	-141	-283	-424	-566	-707	-849
Increase of emissions in energy sector	43	102	152	225	280	343
Overall net removals from the measure	-98	-181	-272	-341	-427	-506

According to the MARKAL results, the most affected sector is residential, where fuel switches to natural gas (gas consumption is increased by 1.7PJ in 2030) and to liquefied petroleum gas (increase of 5PJ in 2030). This switch causes an increase in CO_2 emissions, and a decrease in CH_4 and N_2O emissions due to incomplete combustion of wood, (because fuel wood has quite high emission factors from methane and N_2O from incomplete combustion). Overall, GHG emissions in the buildings sector increase by 330 Gg CO_2eq. in 2030. Figure 71 shows: the GHG emissions from the buildings sector in the BAU scenario (blue); if only building sector measures are implemented (red); and if the LULUCF measure (on illegal logging) is also implemented (gray). It shows that LEDS energy measures reduce emissions in the buildings sector by 630Gg by 2030, but the LULUCF measure on illegal cuttings causes an increase of these emissions by 330Gg, so overall emissions in the buildings sector are reduced by 300Gg only when combining them with the energy and LULUCF measures.

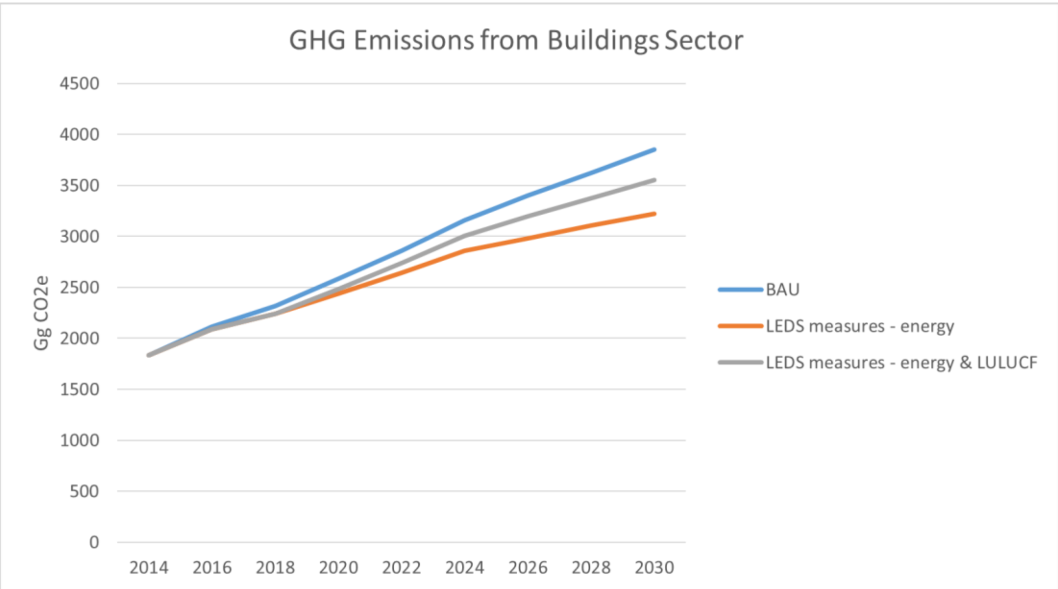

Figure 71. Impact of illegal logging LULUCF measure on energy sector emissions

[71] Draft of this program is already prepared.

In total, all of the planned LULUCF measures will absorb 1,950 $GgCO_2eq$ more emissions compared with the BAU scenario.

PART 3: IMPLEMENTING LOW EMISSION DEVELOPMENT STRATEGY

3.A. INSTITUTIONAL AND LEGAL FRAMEWORK

SECTION ONE: BACKGROUND INFORMATION

Actions to be implemented within Georgia's Low Emission Development Strategy (LEDS) are planned to be implemented in seven key sectors of Georgia's economy: Energy (generation, supply, distribution); out of energy-consuming sectors: transport, buildings, industry, agriculture; industry and agriculture are also reviewed from non-energy emission viewpoint; waste and waste water management; land use and forestry sector. Both, legislative and regulatory as well as infrastructure/technological measures are planned to be carried out.

It is noteworthy that large part of the measures planned within LEDS and the actions to be implemented by Georgia in order to fulfill the commitments undertaken within EU-Georgia Association Agreement are in complete harmony with each other. Thus, through implementing the measures stipulated by LEDS the country will fulfill certain part of the commitments taken within the Association Agreement and vice versa.

Speaking about a series of measures, there is a legal basis in place for their implementation; however, national legislation is in certain cases faulty or certain issues are not regulated at all; in such case due implementation of meaures is jeopardized.

While preparing this document, we analyzed the country's active legislative acts, by-laws and other normative acts as well as policy documents, strategies and programs. On the basis of this analyses, a range of recommendations were developed, enforcement of which will support implementation of the measures. At the same time, the analyses revealed the degree of necessity of involvement of Ministries and other agencies (private sector, municipalities, etc.) in the process, and on this basis institutional arrangement necessary for LEDS development process was identified.

SECTION TWO: LEGAL FRAMEWORK FOR IMPLEMENTATION OF LEDS

Ministry of Economy and Sustainable Development of Georgia

Ministry of Economy and Sustainable Development of Georgia (along with LEPL – Land Transport Agency and LEPL – National Agency of State Property) is one of the bodies responsible for implementation of 19 measures planned within the LEDS. Measures are divided per sectors as follows: Transport sector – nine measures; buildings sector – seven measures; industry – one measure; energy sector – one measure; waste sector – one measure. In addition, the Ministry is not responsible for either of the measures in land use, forestry and agriculture.

It should be also noted here, that the Ministry of Economy and Sustainable Development is the leading ministry in transport and buildings sector.

Transport sector. As per the Law of Georgia on "Land Transport", Ministry of Economy and Sustainable Development shall develop and implement a unified policy in the land transport area. In transport sector the Ministry is responsible for (along with the Land Transport Agency) implementation of nine measures: *technical requirements related to land transport; promotion of electric and hybrid cars; teaching eco-driving to drivers; development of integrated and coordinated tariff policy for cargo transport; improvement of the quality of inter-city passenger transportation service; registration of taxis and regulation of their work; elaboration of national plan for sustainable urban transport development; development and introduction of legislative base on ecology classes and labeling system.*

In this sector, the following picture has outlined in regard with implementation of measures set forth by LEDS:

In regard with introducing technical requirements related to land transport: All legal actions related to full implementation of testing of land transport suitability for roads have been carried out and testing system shall enter into effect from 2018. In addition, LEPL – Land Transport Agency developed draft Decree of the Government of Georgia "On Approval of Determining maximum dimensions and maximum weight of certain categories of vehicles allowed on roads"72. The draft Decree has not yet been approved by the Government.

As *for promotion of electric and hybrid cars,* it should be noted that amendments to the Tax Code of Georgia resulted in 60% decrease of excise tax on the import of 0 – 6 hybrid car; vehicles having electric engine[73] are exempt of import and excise taxes. These amendments are important favourable factor for implementation of LEDS measures; however, there is still a need for implementation of additional legislative amendments which will ensure complete exemption of hybrid cars from import and excise taxes. It is desirable that the Government of Georgia initiate another stage of amendments to the Tax Code, as it had done on the first stage. In this process the leading role is assigned to the Ministry of Economy and Sustainable Development.

Furthermore, legislative amendments related to import of electric cars will not have promotional effect unless there is infrastructure and services necessary for proper utilization of these cars. It shall be noted that two charging stations for electric cars have been opened in Tbilisi; however, this is not enough for the whole country[74]. LEDS stipulates elaboration and implementation of infrastructure development strategy for electric cars. Deriving from the functions granted by the law, the above-mentioned strategy and action plan shall be developed by the Ministry of Economy and Sustainable Development.

Currently the *private taxi sector* is not regulated in Georgia, it is chaotic and out of control. Thus, regulation of this field is a complex measure, which will bring amendments to many legislative acts or by-laws, as well as introduction of new regulations to the agenda. A law, stipulating procedures of licensing of taxis, safety standards for taxi drivers and passengers, requirements that various transportation means (taxi) shall meet and the issues related to registration and taxes, shall be adopted; the law shall also stipulate the bodies responsible for implementation of respective actions as well as the bodies responsible for supervision over observation of the requirements of law. The draft law may be initiated either by the Ministry of Economy and Sustainable Development or municipalities.

In regard with teaching eco-driving to drivers the Ministry of Economy and Sustainable Development (LEPL – Land Transport Agency) of Georgia started implementation of certain actions in 2016. In particular, land plot has been allocated for construction of a training center and preparatory works to start the project has commenced. Achieving LEDS objectives, requires more specific action plan, which shall be approved by the Minister of Economy and Sustainable Development (construction of a training center, development of a respective program, teaching eco-driving to drivers, certification and initiation of respective legislative amendments).

Development and introduction of legislative base for ecology classes and labeling system for vehicles; development of integrated and coordinated tariff policy for cargo vehicles; improvement of integrated inter-city passenger transport quality; elaboration of national policy on development of sustainable urban transport; improvement of urban public transport – these are the measures that are not currently included in any of the

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72 Report on the implementation of Association Agreement and 2016 National Action Plan for EU-Georgia Association Agenda; 134.5; page 260

73 Law of Georgia "Tax Code of Georgia", sub-paragraph "k", paragraph 5, Article 194; paragraph "p", Article 199.

74 http://www.tabula.ge/ge/story/114235-tbilisshi-eleqtromobilebis-dasamuxti-ori-ufaso-sadguri-gaixsna

legislative bases, policy document or strategy. Thus, implementation of these measures requires making complex legislative or other types of actions.

Elaboration of development of legislative base for ecology classes and labeling system for vehicles is initiated by the Ministry of Environment and Natural Resources Protection of Georgia which shall be a leading organization in this measure; however, deriving from the functions granted to the Ministry of Economy and Sustainable Development and based on its regulation, its full involvement in the process is necessary. Recommendations related to the measure are proposed in the part of the Ministry of Environment and Natural Resources Protection of Georgia.

In regard with development of integrated and coordinated tariff policy related to the cargo transport, it is important to clarify whether the Ministry of Economy and Sustainable Development is authorized to carry out this action. In compliance with the sub-paragraph "y" of paragraph 2 of Article 2 of the Regulation of the Ministry of Economy and Sustainable Development of Georgia approved by Decree N70 of 11February, 2016 and Article 4 of the Law of Georgia on Motor Vehicles, Ministry of Economy and Sustainable Development of Georgia shall be responsible for development of unified policy in motor vehicle sector. If we consider a tariff policy as a part of state policy, then the Ministry of Economy and Sustainable Development is authorized to develop tariff policy. If a unified state policy in the motor vehicle field does not include tariff policy, then the Regulation of the Ministry shall not be amended or the tariff policy shall be approved by a Governmental legislative act.

First thing to do for *improving integrated inter-city passenger transport service quality*, is to improve registration of transportation means for massive transportation of passengers, number and income of passengers and keeping respective statistics. Functions and authorities for keeping transport statistics and analyses fall within the scope of the Department for Transport and Logistics Policy Development under the Ministry of Economy and Sustainable Development of Georgia[75]. Consequently, based on the instructions given by the Minister, the Department may carry out actions for keeping statistics and analyses, or, on the basis of the decision of the Minister and taking into account the experience and resources of LEPL National Statistics Office of Georgia may keep the above-mentioned statistics.

In addition to keeping statistics, following measures shall be carried out for to improve integrated inter-city passenger transport service quality:

- Establishing service quality standards and monitoring over observing these standards. Approval of regulations, that will make for the operators, moving on international routes, mandatory to renew and upgrade their bus fleet and ensure control. It is recommended if the above-mentioned norms and regulations be developed by the Ministry of Economy and Sustainable Development of Georgia along with the Assemblies of municipalities.
- Development of informational systems: development of a unified base on transportation service , web-pages, etc. – it is recommended that the Ministry of Economy and Sustainable Development develops a state strategy on these issues; municipalities, taking into consideration the local priorities, will use this strategy. In addition, development of a unified state strategy by the Ministry of Economy and Sustainable Development on the development of information systems in transport field.
- Development of inter-city motor transport infrastructure (improving amenities of inter-city stations, selecting parking lots along with municipalities and improvement of their amenities) – it is recommended that the Ministry of Economy and Sustainable Development of Georgia developes a strategy on development of inter-city motor vehicle infrastructure.

[75] Decree N 70 of 11 February, 2016 of the Government of Georgia on "Approval of the Regulation of the Ministry of Economy and Sustainable Development of Georgia", paragraph "o" of Article 7.

It is necessary to reflect country's urban transport development policy in the state policy document. Thus, it is recommended that the Ministry of Economy and Sustainable Development creates National policy document on development of sustainable urban transport. The document shall fully consider the issues to be regulated under the EU initiative – Covenant of Mayors. It is also recommended that, under the above-mentioned document, municipalities be committed with making amendments to local legislative acts and harmonize these amendments with the national policy document (especially Regulations of Municipality Boards and Municipalities' functions and authorities). As for the "Sustainable Actions Plans on Energy" prepared by municipalities within the frames of the Covenants of Mayors, the documents shall be approved by the Municipal Assembly before its submission to the EU. This will create a normative base for development of low emission public transport.

Buildings' sector. Ministry of Economy and Sustainable Development of Georgia is one of the leading public agencies in the buildings' sector. Its one of the main scopes is spatial planning, construction regulation and organization and coordination of construction-design standards and procedures. As per the Regulation of the Ministry, it shall develop, implement, coordinate, manage and monitor the policy of spatial planning and construction through the Department of Spatial Planning and Construction Policy under it. It should be highlighted that analyses of the functions of the above-mentioned Department shows that the Ministry is responsible for determining, management and monitoring of the policy of only new constructions and determining of policy/energy efficiency policy of existing buildings remains beyond the competence of the Ministry.

One of the key functions of the Ministry of Economy and Sustainable Development is supporting sustainable development of the country. In this regard, Ministry's main objectives are: development, implementation and coordination of measures necessary for sustainable development of the country; promotion and coordination of energy efficient measures in production, construction, transportation and service fields; taking measures necessary for promotion of green economy. The Ministry shall fulfill its functions of sustainable development through the Sustainable Development Division one of the main functions of which is preparation of sustainable development strategy and development of a state program for its promotion. Description of the functions of the Division does not say anything on implementation-coordination of this state program. However, no such strategy exists right now and consequently, it should be said that sustainable development functions of the ministry is faulty and needs improvement. The same can be said on promotion of energy efficient functions. Article 2 of the Regulation stipulates one of the tasks of the Ministry promotion and coordination of energy efficient measures in production, construction, transport and service fields. However, the following Articles of the Regulation stipulates none of the divisions taking any measures in this respect, which makes this function as a "dead" function. It is a gap and it shall be corrected in order to make practical implementation of generally energy efficient and, in this particular case, building related energy efficient possible.

In buildings sector the Ministry has a leading function in implementing following seven measures: *Putting a new Construction Code into effect; low emission development of public buildings; promotion of spread of solar water heaters in public and commercial buildings; promotion of low emission development of commercial buildings through various promotional measures; low emission development of residential buildings; state program for spread of solar water heaters and energy efficient ovens; increasing energy efficiency of geothermal hot water supply systems in residential buildings and private sectors (jointly with the Ministry of Energy).*

Currnetly the Ministry of Economy and Sustainable Development elaborated draft Code of Spatial Planning and Construction of Georgia. In regard with the energy efficiency the document stipulates two issues: maximum level of ensuring energy efficiency at buildings and utilization of renewable energy in designing and construction of buildings. The document sets forth that based on the respective decree (Decree on the "Energy efficiency of buildings") the Government shall adopt technical regulation on the issues of utilization of energy by buildings after the Code enters into force. Paragraph 6 of article 142 of the Draft Code makes taking into consideration the requirements set forth in Directive 2010/31/EU of the EU obligatory while developing the above-said regulation.

As for other measures in buildings sector, their implementation requires preparing of the programs, raising co-funding from the climate-change related funds (for example, "Green Climate Fund"), for which, in the first place it is necessary to stipulate public agency responsible for implementation of the energy efficiency measures related to buildings set forth by the LEDS. Considering the fact that the Ministry of Economy and Sustainable Development is the leading Ministry in buildings sector, it is possible that the Ministry be imposed the above-mentioned functions. In this case, it would be necessary to make respective changes to the Ministry's Regulation. In addition, the Ministry of Economy and Sustainable Development, along with the Ministry of Energy shall be committed with the function of developing respective legislative proposals on energy efficient measures, within the frames of the sectors under its competence. There are lots of broke down buildings in the country, which first need rehabilitation and later, carrying out energy efficiency measures. In this regard, it is recommended that the Ministry of Economy and Sustainable Development prepares the program of rehabilitation of the buildings.

Industry sector. Despite the fact that the Ministry of Environment and Natural Resources Protection of Georgia is one of the leading agencies in the industry sector, in terms of legislative measures, deriving from the functions of the Ministry of Economy and Sustainable Development and the authorities granted by the legislation, the latter shall participate in the implementation of legislative measures in industry sector. These measures are reviewed in detail in the Ministry of Environment and Natural Resources Protection part.

Energy sector. Participation of the Ministry of Economy and Sustainable Development in energy efficient sector (considering the leading role of the Ministry of Energy) is essential in implementation of one of the measures*: joining energy community and observation of the community's demands.*

On April 21, 2017, the Parliament of Georgia approved a Decree on "Joining Georgia with the European Energy Union Agreement". It should be noted that the Ministry of Economy and Sustainable Development along with the Ministry of Energy, is fulfilling the community's demands and is basically responsible for observation of and monitoring over "National Action Plan for Energy Efficiency", within the frames of the sectors falling within its scope.

Waste Sector. Participation of this Ministry in the waste sector is necessary in the implementation of one measure: *arrangement of paper, plastic, glass and metal separation system in municipalities.*

In terms of establishing legislative-regulatory base in the waste sector leading agency is the Ministry of Environment and Natural Resources Protection of Georgia. Involvement of the Ministry of Economy and Sustainable Development in the process of arrangement of paper, plastic, glass and metal separation system in municipalities along with the Ministry of Environment and Natural Resources Protection of Georgia was stipulated by the "2016 – 2030 National strategy for waste management and 2016 – 2020 National Action Plan" approved by N 160 Decree of the Government of Georgia of April 1, 2016. The Action Plan commits the Ministry of Economy and Sustainable Development of Georgia with boosting the private sector that processes the separated waste. In particular: development of promotional measures for private sector and municipalities, with the purpose of reducing waste, re-utilization, recycling and restoration; development of measures boosting separation at the waste origination source; supporting introduction of the system in which producers of spirits and beverages will return bottles and jars; establishing the system of collecting magazines and papers and boosting capacities of processing facilities.

For effective implementation of the strategy it is necessary that the LEDS committee carries out proper supervision over fulfillment of the actions stipulated by the documents. One of the ways of supervision may be if the Ministry of Economy and Sustainable Development would be committed, under the decision of the LEDS committee approved by the Government, submission of annual report on implementation of the measures set forth for it by 2016 – 2020 national plan of waste management.

Ministry of Environment and Natural Resources Protection of Georgia

The Ministry of Environment and Natural Resources Protection of Georgia is one of ministries (along with LEPL – National Forestry Agency, LEPL – Agency of Protected Areas and state sub-agency – Environment Protection Supervision Department, Atmospheric Air Division) responsible for implementation of 19 measures planned under LEDS. Measures are divided as follows according to sectors: land use and forestry sector – nine measures; waste sector – three measures; transport sector – two measures; energy sector – one measure; industry sector – three measures; agricultural sector - one measure. In the buildings sector, the ministry is responsible for neither of the measures.

It should be also noted here that the ministry is a leading institution in land use and forestry, as well as in waste sector. Consequently, in the above-mentioned sectors it has the obligation of implementation of the most measures.

Land use and forestry sector. In the land use and forestry sectors the ministry is responsible for implementation of the following measures: *introduction of sustainable forest management, approved internationally; making legislative base stricter and ensuring its enforcement for stopping illegal logging; increasing areas of protected territories; rehabilitation/development of forest; supporting natural renovation of forest; cultivation of plantation timber; arrangement of temporary forestry agencies. In terms of reducing emission the most important are the first two measures out of the listed above.*

As the current situation reveals, legislative acts in the forestry sector are faulty and they cannot ensure proper implementation of measures stipulated by LEDS. There is no sustainable forestry management practice in the country, illegal logging cannot be prevented. With the purpose of eradicating legislative gaps Ministry of Environment and Natural Resources Protection of Georgia and LEPL – National Forestry Agency developed a new Draft Forest Code, which is based on sustainable development principles. The new Draft Code will organize the issue of forest protection in a new manner; the document will also stipulate the bodies responsible for supervision. It also regulates forest renovation/cultivation, as well as the issues of natural renovation and cultivation of plantation timber. The new Draft Code sets forth the list of those normative acts, adoption of which is essential for proper enforcement of the Code and achieving the goals set by the document.

EU-Georgia Association Agreement also stipulates the obligation of establishing the principles of sustainable forest management. As per the 2016 National Action plan of implementation of Association Agreement and EU-Georgia Association Agenda, Ministry of Environment and Natural Resources Protection of Georgia shall develop national criteria and indicators for sustainable forest management[76]. It should be noted that the new Forest Code does not stipulate development of this document. The fact that development/approval of national criteria and indicators will significantly improve sustainable forest management implementation shall be highlighted.

There is an expectation that when the new Forest Code enters into effect, it will regulate a number of problematic issues. Although, nobody reckons that the new Code will work in practice without revealing any fault. It's clear that putting the Code norms in practice will show many (practical) gaps, consideration of which was impossible at the time of working on the draft law or, they simply remained beyond regulation. At this stage, it is important that the Parliament of Georgia approves (at its fall session) a new Forest Code at least in the form as it is submitted for review to the

[76] Decree N382 of march 7, 2016 of the Government of Georgia on "Approval of the implementation plan by and between on the one hand EU and European Atomic Energy Community and their member states and on the other EU-Georgia Association Agreement and EU-Georgia Association Agenda implementation"; 115.3; page 134

legislative body. For achieving the goals stipulated by the Code, timely development of by-laws is no less important.

As already mentioned, the existing legislative base of forest sector cannot ensure prevention illegal logging. For eradicating it, the first thing is to regulate the issue in a comprehensive manner on a legislative level. Amendments shall be made to the Administrative Offences Code of Georgia. In particular, the amount of the fine shall increase for the respective offence. However, only increasing the amount of the fine cannot improve the situation if there is no enforcement mechanism in place.

For due enforcement of the law capacities of the LEPL – Forestry Agency and Environmental Supervision Department shall be enhanced. In regard with the latter (capacity enhancement) a project proposal - "Enhancing forestry supervision at the Ministry of Environment and Natural Resources Protection of Georgia, for ensuring sustainable management of Georgia's forests and control illegal measures" – was prepared within the frames of EU project "TWINNING". The project aims at capacity building of a respective service of the Environment Supervision Department under the Ministry of Environment and Natural Resources Protection of Georgia for better control of illegal activities in forestry sector (2016)[77]. In relation with this measure it is recommended that the Ministry of Environment and Natural Resources Protection plans/implements measures for enhancing capacities of the staff of LEPL – Forest Agency and Environmental Protection Supervision Department, whether the above-mentioned project will be funded or not.

Waste Sector- According to the Waste Management Code the Ministry of Environment and Natural Resources Protection of Georgia shall develop and carry out unified waste management policy. Thus, under the line of legislative initiatives in waste management sector, Ministry of Environment and Natural Resources Protection of Georgia is responsible to fulfill following activities:

Establishment of paper, plastic, glass and metal waste separation systems in the municipalities; decrease of biodegradable waste (food waste and garden waste) at landfills – composting of biodegradable waste; incineration and co-incineration; Majority of the above activities have technical character, meaning, that for the purpose of their adoption, it's important to use advance technologies. Fulfillment of these activities shall be difficult without proper legal grounds; hence all the mentioned activities are being discussed in the context of legislative changes.

Waste management sector remains one of the problematic sectors, the elimination of which requires multiple complex activities. Adoption of a new waste management code was considered as one of the decisive activities in this regard and it came into force in 2015. The code resolved some issues and aligned the waste management code with the legislation of European Union. The Code has created legal basis for fulfillment of some activities considered by LEDS: establishment of separation system; incineration and co-incineration; decrease of biodegradable waste (food waste and garden waste) at landfills – composting of biodegradable waste, though the most important activity of LEDS – collection of methane from landfills and its use in power engineering was neglected. Despite the fact that legislation had been improved for some of the activities discussed in LEDS, several issues still remained unsolved in practice. For this purpose, the government has adopted waste management National Strategy 2016-2030 and National action plan 2016-2020; According to the action plan, Ministry of Environment and Natural Resources Protection of Georgia is one of the responsible agencies in fulfillment of activities promoting establishment of separation system (supporting the pilot projects promoting establishment of glass, paper, plastic and "other waste" sources separation systems in Tbilisi and other pre-selected cities; developing measures for promotion of waste separation at its point of generation) together with the Ministry of Economy and Sustainable Development, Ministry of Finance and the municipalities. According to the Low Emission

[77] Decree N382 of march 7, 2016 of the Government of Georgia on "Approval of the implementation plan by and between on the one hand EU and European Atomic Energy Community and their member states and on the other EU-Georgia Association Agreement and EU-Georgia Association Agenda implementation"; 115.3; page 134

Development Strategy, agencies responsible for implementation of separation process are: Ministry of Environment and Natural Resources Protection of Georgia (legislative activities); Ministry of Finance; Ministry of Economy and Sustainable Development (promotion of processing private industry); private sector (increase of processing industry by introduction of advance technologies); municipalities (direct implementation/control of separation);

According to the waste management action plan, the agencies responsible for implementation/promotion of activities connected with decrease of biodegradable waste placement (food waste and garden waste) at landfills – composting of biodegradable waste (biodegradable municipal waste management strategy implementation and etc.), are: Ministry of Environment and Natural Resources Protection of Georgia, except the cases when it concerns agricultural waste.

By LEDS, agencies responsible for execution of above activities are: Ministry of Environment and Natural Resources Protection of Georgia, Ministry of Agriculture, Solid Waste Management Company.

Promotion of activities connected with **incineration and co-incineration** (development/adoption of resolution on terms of waste incineration/co-incineration; conduction of preliminary assessment and promotion of pilot projects for the purpose of energy recovery by the incineration plant), under both documents, have to be fulfilled by the Ministry of Environment and Natural Resources Protection of Georgia.

During the strategy implementation responsibilities and specific tasks envisaged by these two documents must be brought into compliance.

The action plan also discusses set up of biogas collection/processing system at Tbilisi landfills, where Tbilisi City Hall is the responsible agency.

LEDS specifies all activities of biogas collection and incineration for all independent landfills and regional landfills. In these cases, responsible agencies are the municipalities of independent landfills and the Solid Waste Management Company.

Since collection of methane and its incineration on site is not obligatory in Georgia, appropriate advance technologies are being introduced and gain popularity at a very slow pace. For successful implementation of the Strategy waste sector, it's important to regulate methane collection, incineration or use in power engineering from landfills and waste water treatment facilities at the legislative level.

In general wastewater issues are regulated by the law of Georgia on Water, though terms of collection and use of methane directly from the waste water treatment facilities are left beyond this law. Mentioned activities are not described in any other strategy. Nowadays, only Adlia and Gardabani waste water treatment facilities have the potential of methane capture and utilization, but Gardabani facility needs thorough reconstruction first.

Industry Sector- by the EU Association Agreement Georgia undertakes the responsibility to bring environmental legislation in line with the EU legislation, particularly the directive 2010/75/EU on industrial emissions, which requires adoption of appropriate national legislation and determination of competent agency (agencies) for its implementation; definition of industrial installations which need special permissions; implementation of integrated permissions system[78]; introduction of "Best Available Techniques - BAT", considering Best Available Techniques Reference Document (BREF); limitation of emissions of certain pollutants into the air from large industrial plants; development of transitional national plans in order to decrease total annual emissions from existing combustion

[78]Industry Sector (energy emissions) considers activity of emissions regulation form determination for Georgia's large-scale energy-intensive industries.

Activities connected with non-energy emissions envisage adaptation of national environmental legislation with the EU legislation – integrated permissions.

plants (setting the limit of emissions for existing plants is voluntary); The directive discusses no greenhouse gas emissions, as for this issue the European Union has a separate scheme, which covers EU's large industrial units.

Based on all the above, activities to be carried out in industrial sector had been divided in two groups:

- The first one combines emission regulation and technology research activities, such as: definition of emission regulation forms from Georgia's large-scale energy-intensive industries; financial instruments for emission decrease activities in industrial sector and their control; inventory of energy and greenhouse gases at industrial level and identification of energy consumption and greenhouse gas emission limits for each field/sector of the industry; Energy audits and Best Available Techniques (BAT) introduction feasibility study; effective engines; adaptation of National environmental legislation in compliance with EU legislation (based on EU/GE Association Agreement) - integrated permission system.

- The second group combines individual technological activities promoting the use of modern energy-efficient technologies and low carbon industries (for instance: clinker production wet method transfer to a dry method; energy-efficiency activities in chemical industry – particularly in production of ferroalloys, metal and steel, food products, beverages, tobacco and etc.).

Despite the fact that the second group activities have mostly technological character, their implementation in most cases requires some normative grounds.

It should be noted, that participation of the Ministry of Environment and Natural Resources Protection of Georgia in the first group activities is of utmost importance, and furthermore this is the Ministry's direct responsibility, as of the responsible agency for climate change convention in Georgia.

The Ministry of Environment and Natural Resources Protection is also directly responsible to carry out following legislative activities together with the Ministry of Economy and Sustainable Development: adaptation of National environmental legislation in compliance with EU legislation (based on EU/GE Association Agreement) - integrated permission system; definition of emission regulation forms from Georgia's large-scale energy-intensive industries; inventory of energy and greenhouse gases at industrial level and identification of energy consumption and greenhouse gas emission limits for each field/sector of the industry;

In case if The Ministry of Environment and Natural Resources Protection properly conducts alignment of National Legislation with the Directive on industrial emissions, all three activities shall be deemed fulfilled.

It's notable that The Ministry of Environment and Natural Resources Protection has already developed a project application - Twinning Fische – on industrial pollution and industrial threats, which had been discussed and approved by the EU.

Transport Sector. In transport sector the Ministry of Environment and Natural Resources Protection takes the initiative to develop legislative basis and implement motor vehicles ecology classification and labeling system; and to improve the quality of fuel.

Nowadays there is no motor vehicles ecology classification and labeling system in place in Georgia. Though, air protection service of the Ministry of Environment and Natural Resources Protection of Georgia has already developed draft technical regulations on motor vehicle ecology classification. In the future it's planned to ban import of motor vehicles according to their ecology classes. Mentioned draft technical regulations shall be approved by the end of the year. As for the labeling system introduction, for its proper implementation, there is the need of technical specifications regulating issues connected with motor vehicles ecological labeling.

For the purpose of harmonization of diesel and petrol fuel qualitative and ecological characteristics with the norms established in EU, Georgian Government made amendments in #238 decree of December 28, 2005 of Georgian Government on "diesel composition norms, analysis methods and activities for their implementation" and #124 decree of December 31, 2004 on "motor vehicle petrol qualitative norms". As a result, petrol qualitative standards shall be brought in line with the norms established by EU, but diesel qualitative norms (sulfur content) still need stricter regulations for full compliance with EU norms. In this regard Air Protection Service of The Ministry of Environment and Natural Resources Protection of Georgia plans to make amendments in the decree of Georgian Government on "diesel composition norms, analysis methods and activities for their implementation".

Compliance of diesel and petrol with the established norms is being monitored by sub-agency of the Ministry of Environment and Natural Resources Protection of Georgia – Department of Environmental Supervision. Though, inspections have no systematic character for is high costs of such inspection.

Agricultural Sector. In the Strategy framework, The Ministry of Environment and Natural Resources Protection of Georgia takes part in following activities concerning agricultural sector: support to animal waste management systems efficiency; preparation of grounds for biogas systems introduction;

In general, animal waste issues are regulated by Animal Waste Management Code of Georgia. Waste management National Strategy 2016-2030 and National action plan 2016-2020 consider obligation to adopt animal waste management subordinate normative act and develop animal waste management action plan. According to the action plan one of the responsible agencies for the above activities is The Ministry of Environment and Natural Resources Protection (adoption of animal waste management subordinate normative act and development of animal waste management action plan); It should be mentioned that The Ministry of Environment and Natural Resources Protection carries out these activities with the Ministry of Agriculture, which represents a leading agency in this case.

Energy sector. In the energy sector, The Ministry of Environment and Natural Resources Protection participates in activities for provision/promotion of energy-efficient use of geothermal resources.

Neither Georgian legislation nor strategy/policy documents regulate promotion of geothermal resources in the Country. As the Ministry of Energy is responsible public body for execution of activities in energy sector, appropriate recommendations concerning the activities are represented in section of the Ministry of Energy. It is notable that the Ministry of Environmental Protection issues the permission for the use of natural resources, including geothermal waters, thus its role in activities' implementation is still important. Besides this, one of the priorities of Climate Change Convention is maximum and effective use of renewable energy resources.

Ministry of Energy of Georgia

The Ministry of Georgia is one of the responsible parties in fulfillment of 18 activities planned within LEDS. Sector-wise the activities are distributed as follows: energy sector – seven activities; building sector – eight activities; industrial sector – two activities; agricultural sector – one activity. Participation of the Ministry of Energy in activities concerning forest use and especially decrease of illegal felling is also very important. The ministry is not responsible to carry out any activities in waste and transportation sectors.

Energy Sector. The Ministry of Energy is responsible to implement seven activities in the energy sector: join the energy community and fulfillment of its requirements; tariff policy improvement; increase of hydropower share in power consumption by development of transmission grid and improvement of dispatching in Georgia; substitution of outdated thermal power plants by economically combined (steam-air turbine) thermal power plants; activation of new renewable energy power plants; decrease of gas loss in distribution networks; support/promotion of the use of geothermal resources;

Activities promoting the use of geothermal resources are neither regulated by the legislation, nor considered by any policy document or strategy. Thus, the Ministry of Energy is recommended to develop ways to promote energy-efficient use of geothermal resources, National Policy and action plan with the Ministry of Environment and Natural Resources Protection. Following issues have to be considered in the document: assessment of current condition of geothermal resources; mine rational exploitation; State-supervision control of mine exploitation; long-term preferential credits and promotion of entrepreneurs wishing to introduce new technologies or drill new bore wells.

It's important that the document defined all agencies responsible on supervision of the above activities and certainly this policy and the plan must be reflected in Georgia's first National action plan on Renewable Energy.

Tariff policy improvement activity: according to the law of Georgia on Electricity and Natural Gas and the provisions of Georgian National Energy and Water Supply Regulatory Commission (GNERC), GNERC sets the tariffs under main directions of state policy in Georgian energy sector and the above state policy is developed by the Ministry of Energy of Georgia. It is notable that the policy provisions state no obligation that the ministry shall develop tariff policy in the energy sector at all. If we consider tariff policy as a part of State Policy in Energy Sector, then there is no basis for carrying out all the above activities. In order to avoid ambiguity, it's recommended to amend the provision so that it stated specifically the obligation on tariff policy development. After this the Ministry of Energy of Georgia shall develop and approve new tariff policy, on the basis of which GNERC shall determine the tariffs.

Increase of hydropower share in power consumption by transmission grid development and improvement of dispatching in Georgia; substitution of outdated thermal power plants by economically combined (steam-air turbine) thermal power plants; activation of new renewable energy power plants – all these activities attribute to activities having technological character and their implementation requires the use of new/advance technologies. This process shall also be complicated without proper legislative grounds and such ground may be deemed transmission grid ten-year development plans produced by JSC Georgian State Electrosystem and approved by order of the Ministry of Energy.

The action plan regarding renewable energy resources has more descriptive character, without specific action plan/obligations. It should be noted that the licensees, determined by the ten-year plan bear responsibility of action plan fulfillment. In this case the Ministry of Energy needs to supervise their proper execution.

As for the activities concerning gas loss in gas distribution network, 2017-2026 Energy Development draft strategy (gas sector) [79] includes small-scale rehabilitation works. The strategy briefly mentions about the need of rehabilitation-reconstruction works, which are also important for gas distribution network outdated infrastructure[80], but the detailed description of this problem is limited in the document. It's recommended to develop an action plan, providing proper implementation of goals set forth in the strategy.

Building sector. Support of the Ministry of Energy of Georgia in the building sector is needed for carrying out eight different activities: low emission development of State buildings; low emission development of commercial buildings; low emission development of residential buildings; state

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[79] draft version of the strategy is available at:

http://www.energy.gov.ge/projects/pdf/pages/Sakartvelos%20Energetikis%20Ganvitarebis%20Strategia%2020172026%20Bunebrivi%20Gazis%20Natsili%201637%20geo.pdf

[80] same

program in distribution of solar water heaters and energy efficient stoves in private houses; solar water heaters in commercial and state buildings; increase of geothermal water supply and energy efficiency; mandatory labeling of electric appliances; replacement of incandescent lamps by energy efficient ones in commercial and residential buildings;

Since the leading public institution in building sector is the Ministry of Economy and sustainable Development recommendations connected with the above activities are presented in activities to be carried out under the responsibility of this Ministry.

For the activity – "replacement of incandescent lamps by energy efficient ones in commercial and residential buildings" approval of incandescent lamps replacement strategy and action plan by the Ministry of Energy of Georgia is recommended.

Labeling of electric appliances is not regulated at national level, but except LEDS, this activity is considered by the Association Agreement, according to which Georgia undertakes obligation to bring Georgian legislation in line with the requirements of directive of May 19, 2010 of the European Parliament and EC directive 2010/30/EU "on the indication by labeling and standard product information of the consumption of energy and other resources by energy-related products".

Labeling of household appliances can be made mandatory by making amendments in the "product safety and free movement Code of Georgia. On the basis of mentioned amendments, Georgian Government shall approve a resolution on technical regulation of household appliances mandatory labeling.

Land use and forestry sector. In the sector of land use and forestry, only one activity needs involvement of the Ministry of Energy: tightening the legislation and ensuring its enforcement. First it should be mentioned that the main implementing body of these activities is the Ministry of Environment and Natural Resources Protection, but other than control of illegal felling the population has to be provided with alternative fuel, or the activity won't have successful results. Provision of population with alternative fuel is the very point where involvement of Ministry of Energy is needed.

Industry Sector. In industry sector participation of the Ministry of Energy is necessary for implementation of two activities: financial instruments for implementation of emission reduction activities in industry sector (from the ministry perspective these are energy efficiency activities in industry sector) and their supervision; energy efficient engines;

It's recommended to adopt a "law on energy efficiency," which shall regulate the above issues and support implementation of energy efficiency national plan.

Agricultural Sector. The Ministry of Energy takes part in only one activity in agricultural sector: "preparation of grounds for introduction of biogas systems."

Since the lead organization in mentioned activity is the Ministry of Agriculture of Georgia, appropriate recommendations are introduced in the part of the Ministry of Agriculture.

Ministry of Regional Development and Infrastructure of Georgia

Ministry of regional development and infrastructure of Georgia has a special role in implementation of activities planned in transport and waste management sectors. This Ministry together with its LEPLs and LTDs is involved in six main activities:

It's notable that this Ministry shall take part in legislative, strategic and action document development processes connected with infrastructural arrangements needed for activities' implementation or issues concerning its competence.

This Ministry shall be the most active in implementation of technological activities, as fulfillment of regional and municipal level projects is under its direct responsibility and it has a sound financial mechanism – “municipal development fund”; The Ministry also has Ltd “Solid Waste Management Company of Georgia” and Ltd “United Water Supply Company of Georgia”, Ltd “State Construction Company”, “Roads Department of Georgia” and department for regional projects. At the moment, the role of this ministry in low emission development strategy is not properly presented, but later on, with the strategy implementation process it shall become more obvious. The Ministry of Regional Development and Infrastructure of Georgia coordinates direct implementers of the development strategy, such as local self-governing bodies, which outpace even national level in undertaking emission reduction obligations and their fulfillment.

Transport sector. Participation of the Ministry of Regional Development and Infrastructure in transport sector is defined by two activities:

Promotion of electric and hybrid motor vehicles - the role of the Ministry is considered in development of policy for arrangement of relevant infrastructure for vehicles having electric engines.

Long-distance passenger transport service improvement, which needs elaboration of the strategy on long-distance motor vehicle transport infrastructure development by active participation of the Ministry of Regional Development and Infrastructure.

Waste management sector. In this field, the Ministry shall be involved (by means of Ltd. “Solid Waste Management Company”) in implementation of three activities: arrangement of biogas utilization/incineration system at Rustavi landfill; arrangement of biogas collection and utilization/incineration system at new regional landfill of Georgia; decrease of biodegradable waste (food waste and garden waste) at landfills – composting of biodegradable waste;

Majority of the above activities have technological character, meaning that for the purpose of their implementation, it’s important to use new technologies. Besides, their fulfillment requires existence of relevant legislative grounds.

Waste management 2016-2030 Strategy and action plan consider implementation of only one activity concerning biogas: arrangement of biogas collection/processing system and temporary storage of biochemical and other hazardous waste. Tbilisi City Hall is responsible entity for this activity implementation. At the same time, 2014-2014 strategy[81] of Ltd “Solid Waste Management Company” considers implementation of activities concerning landfill gas, particularly: introduction of biogas and leachate management systems at landfills of Georgia; gas collection feasibility study at existing landfills;

Besides all the above, according to the strategy, 2014-2017 waste management integrated system introduction supporting activities and capacity building project is in progress. Together with specific practice and methodology adaptation activities the project envisages feasibility study of gas collection potential. Furthermore, within the EU technical cooperation program, the project INOGATE is being implemented at active landfills for the purposes of gas potential determination methodology implementation.

In this case we face competence confusion, which may hinder implementation of activities concerning biogas. For elimination of this issue, waste management action plan needs to be amended. Specifically, it must consider more activities of arrangement of biogas incineration and utilization systems and determine the Ministry of regional development and infrastructure as one of the

[81] http://waste.gov.ge/ka/wp-content/uploads/2016/09/%E1%83%99%E1%83%9D%E1%83%9B%E1%83%9E%E1%83%90%E1%83%9C%E1%83%98%E1%83%98%E1%83%A1-2014-2024-%E1%83%AC%E1%83%9A%E1%83%94%E1%83%91%E1%83%98%E1%83%A1-%E1%83%A1%E1%83%A2%E1%83%A0%E1%83%90%E1%83%A2%E1%83%94%E1%83%92%E1%83%98%E1%83%90.pdf

responsible and leading agencies in this regard together with Ltd "Solid Waste Management Company of Georgia". In addition, elaboration of action plan is necessary for proper implementation of Solid Waste Management Company strategy.

Ministry of Agriculture of Georgia

The Ministry of Agriculture of Georgia has comparably moderate role in implementation of this strategy, as currently agricultural sector in Georgian economy is rather deemed as the most vulnerable sector towards climate change than a large-scale and fast-growing emitter of greenhouse gases. Despite this, the strategy still discusses all the activities already having an impact on the trend of greenhouse gases emission in Georgia. Hence, this Ministry is one of the responsible Ministries in implementation of 5 (five) activities. Sector-wise the activities are distributed as follows: agricultural sector – 2 activities, waste management sector – one activity, land use and forestry sector – two activities.

Agricultural Sector. The Ministry of Agriculture of Georgia is responsible to carry out only one activity in agricultural sector: support to animal waste management system efficiency, preparation basis for biogas systems introduction. As for support to animal waste management system efficiency, Waste management National Strategy 2016-2030 and National action plan 2016-2020 consider obligation of the Ministry of Agriculture to adopt animal waste management subordinate normative act. Moreover, the Ministry of Agriculture undertakes responsibility to elaborate action plan on animal waste management. It should be noted, that the waste management action plan determines no obligations of the Ministry of Agriculture concerning biogas systems introduction. Thus, for activity implementation it's important to make amendments in waste management action plan and make the Ministry of Agriculture responsible for preparation of grounds for biogas system introduction.

Waste sector. Participation of the Ministry of Agriculture is needed only in one activity for waste sector: decrease of biodegradable waste (food waste and garden waste) at landfills – composting of biodegradable waste;

National Strategy 2016-2030 and National action plan 2016-2020 consider obligation of the Ministry of Agriculture to carry out pilot project of biodegradable waste for wine makers and a pilot project of biodegradable agricultural waste composting.

Land use and forestry sector. Ministry of Agriculture needs to participate in fulfillment of two activities in to land use and forestry sector: increase of the area of perennial plants; pasture rehabilitation;

Nowadays, pasture management issues are not regulated by law. At the strategy level, the issue is considered by 2017-2020 strategy of agricultural development[82]. According to the strategy, sustainable use of natural resources has to be provided for improvement of pastures. For this purpose, Lagodekhi and Tusheti protected area pastures have to be assessed in 2017 within the action plan; sustainable management (pilot) plans for Vashlovani, Lagodekhi and Tusheti protected area pastures have to be elaborated and implemented. Despite the fact that introduction of pasture sustainable management system in one of the most important issues for implementation of LEDS activities, pasture quality optimization and food quality improvement tasks have to be regulated by more efficient/specific activities.

In regard to increase of perennial plant (fruit trees) area, by the initiative of the Ministry of Agriculture, the Agricultural Project Management Agency started the project "Plant the Future" since 2015, aiming at supporting agricultural land use at a maximum extent in all municipalities of Georgia

82 http://www.moa.gov.ge/m/Public/Strategy/9

(except Tbilisi, Rustavi, Batumi, Kutaisi and Poti), cultivation of perennial fruit orchards and arrangement of nurseries.

Ministry of Finance of Georgia

Despite considering this ministry in the last place among other ministries, in fact it is the most important one in entire process of the strategy fulfillment, together with the private sector and municipalities. Special attention should be paid to the ministry's role in provision of strategy implementation by its strict fiscal policy towards high carbon processes and promotion of preferential taxation systems by different financial schemes and mechanisms. Almost all sectors (energy, transport, building, industrial and waste management) include activities proper implementation of which require relevant financial activities/strategies' planning and fulfillment. The ministry's initiatives in promotion of activities having encouraged preferential character are of utmost importance and this analysis highlights mentioned direction of the ministry's work. During strategy implementation process LEPL Revenue Service has a special role among all other subordinate organizations of the ministry.

Energy Sector. In energy Sector participation of the Ministry of Finance is necessary for development of renewable energy field by carrying out preferential tax policy in the process of advance technologies import and in supporting setting up energy resources (geothermal, wind, solar, biomass) enabling environment in the Country in general (for instance: renewable energy funds and etc.);

Transport Sector. The Ministry of Finance takes part in development of instruments/activities needed for three activities in transport sector: electric and hybrid motor vehicle promotion; integrated and coordinated tariff policy elaboration for cargo transportation; taxes registration and regulation.

Building Sector. Involvement of the Ministry is important in support of those state programs, which concern energy efficient rehabilitation of buildings and maximum use of renewable energy by these buildings. Implementation of mentioned activities is necessary for fulfillment of Paris Agreement, as well as for low emission strategy and for meeting the obligations undertaken by Association Agreement in the field of energy efficiency. In this case review of procurement law and adoption of green procurement legislation is very important, especially where the issue concerns procurement for State buildings (schools, kindergartens, military and penitential, administrative buildings).

As already mentioned above, special programs, financial instruments and co-financing sources from climate change funds (for instance: "Climate Green Fund") are needed for implementation of such activities.

Industry Sector. The role of the Ministry is considered in determination of available preferences (at least in the beginning) which might be given to private sector for promotion of energy efficiency in their industries and replacement of outdated technologies by new, energy-efficient ones. Bank sector certainly plays an important role in this process together with the Ministry of Finance.

Waste Management sector. Here the Ministry of Finance supports only one activity: Establishment of paper, plastic, glass and metal waste separation systems in the municipalities; Decree #160 of April 1, 2016 of the Government of Georgia on "Waste management 2016-2030 National strategy and 2016-2020 national action plan" considers implementation of promotion measures for separation of waste at their point of generation; promotion of bottle and can recycling system establishment by alcoholic and non-alcoholic beverage manufacturers; creation of magazine and newspaper collection system and capacity building for their recycling units; The Ministry of Finance is determined as one of the responsible agencies for supporting all the above activities.

Municipalities and self-governing bodies

In the process of strategy implementation, two main participants, which are prerequisites of success in long-term are private sector and local governments. They are already involved in low emission development processes. Private sector has joined clean development mechanism determined by "Kyoto Protocol" since 2005 and the municipalities are involved in the process initiated by EU cities and municipalities - "Covenant of Mayors" since 2010.

Nowadays the process is followed by sixteen municipalities of Georgia, ten municipalities and self-governing cities of them have energy sustainable development plan and two of them have "sustainable energy and climate action plan". One municipality (Tbilisi) has already carried out monitoring and submitted the monitoring report to the EU.

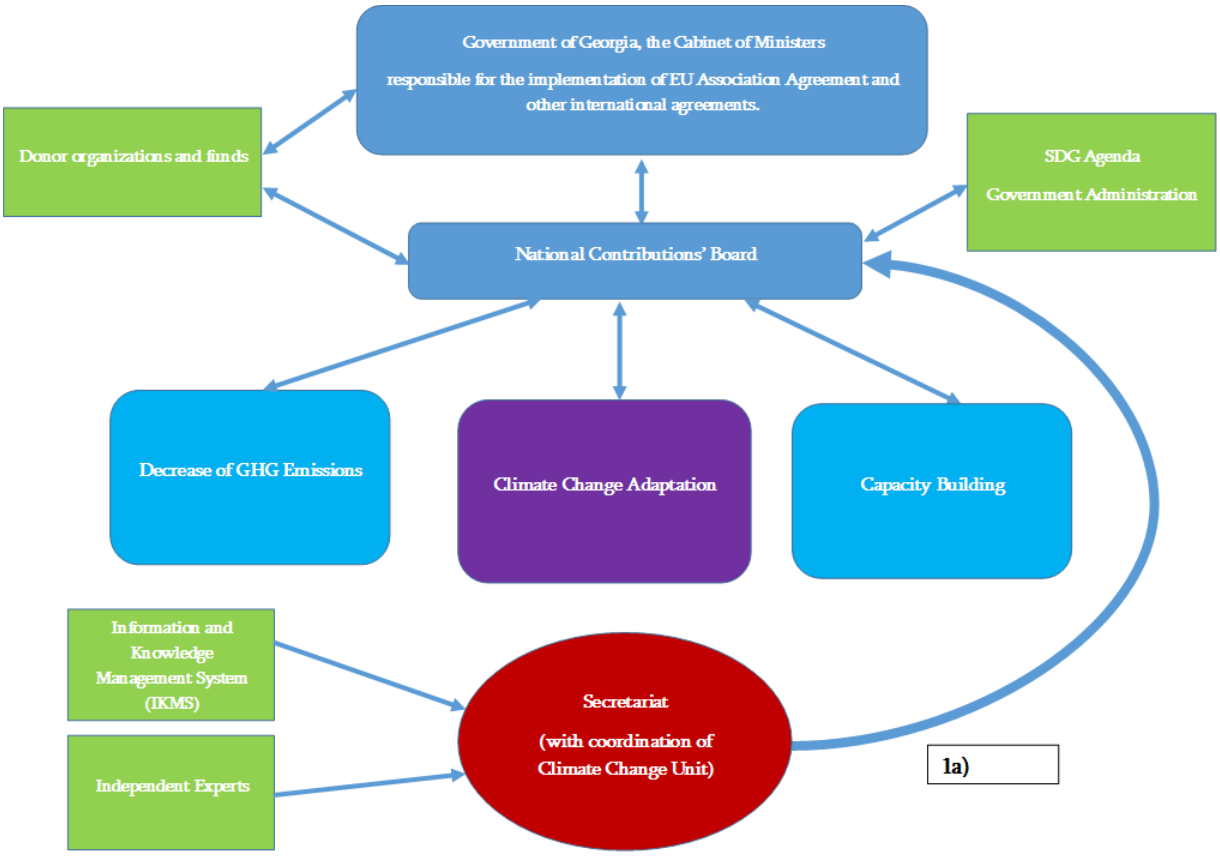
A clean development mechanism is not very active in the country. Ministry of Environment and Natural Resources Protection is the responsible for supporting and coordination of these processes. As for the "Covenant of Mayors", it has two coordinating Ministries at the national level: Ministry of Environment and Natural Resources Protection and Ministry of Energy. As already stated above, policy of the Ministry of regional development and infrastructure has an important role in municipalities' success; Ministry of Finance also actively supports municipalities in all the above activities.

In conclusion, each of the governmental bodies can make significant contribution to successful strategy implementation by legislative basis, financial mechanisms and provision of access to technologies for these two important participants.

SECTION THREE: INSTITUTIONAL FRAMEWORK FOR LEDS IMPLEMENTATION

Effective implementation of low emission strategy of Georgia substantially depends on accurate distribution of functions among different participants. The Strategy discusses three main directions, where significant obstacles had been revealed and without their elimination strategy implementation shall be at risk. These directions are: legal framework, financial mechanisms and potential of advanced technologies absorption (introduction-distribution). Herewith, all implementers of programs and projects offered within the strategy must be clearly defined.

Figure 72 shows a) climate change process in Georgia and b) institutional framework for LEDS implementation (mitigation)



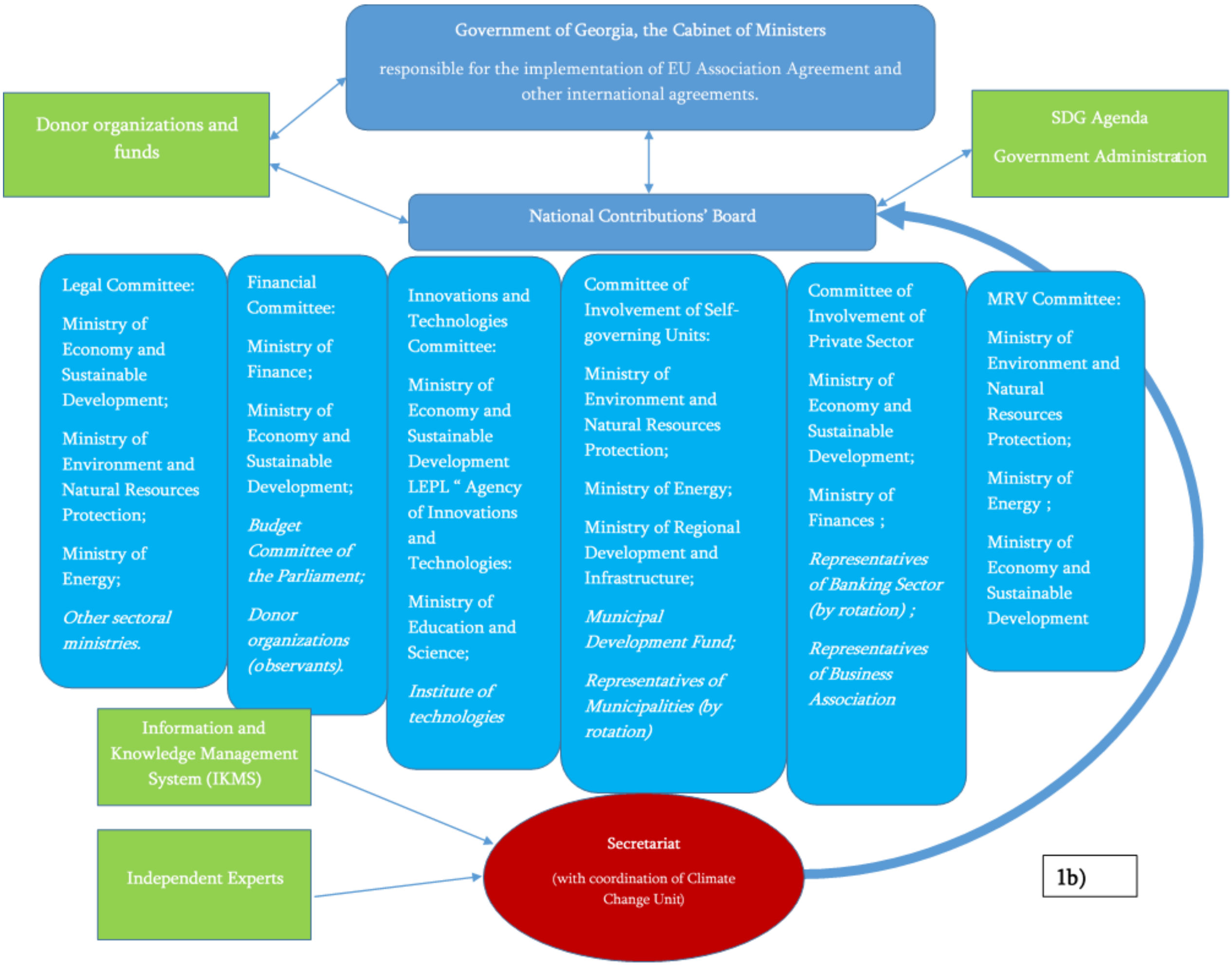


Figure 72. a) climate change process in Georgia and b) institutional framework for LEDS implementation (mitigation)

As the analysis in this section has shown, leading ministries responsible for creation of **legislative framework** supporting the Strategy implementation, are: Ministry of Economy and Sustainable Development, Ministry of Environment and Natural Resources Protection and the Ministry of Energy. Certainly, involvement of other Ministries is also important, especially when it concerns the sector being under direct responsibility of such Ministry.

Ministry of Finance together with the Government must take lead in creation of **Financial Mechanisms (green funds)** and offer different encouraging tax benefit programs and projects. Active participation of the Ministry of Economy and Sustainable Development and donor organizations engagement in the process is also very important.

Leading agency for the increase of technological progress potential in the Country, should be the LEPL "Innovation and Technologies Agency of Georgia" under the Ministry of Economy and Sustainable Development. The agency has to join climate technologies network (established by the Convention), as a contact/coordinating agency in Georgia.

Ministry of Education and Science of Georgia should also have an important role, as it is responsible for reforms in educational system to the direction of technological process promotion. For the purpose of local technologies development, creation of united technological institute is recommended, which also shall enable introduction/distribution of imported technologies. Technologies needed for strategy implementation and existing barriers are discussed in technologies section of the document. Together with all the above, implementers also play the significant role in these processes: municipalities, State Limited Liability Companies, private sector (including banks), non-governmental sector, media and population. Implementers' Capacity building should be goal-oriented by means of different educational programs and active participation of media for the population and non-governmental sector; as for the private sector, more results would bring different qualification courses for employees in the countries producing advance technologies and for the bank sector - introduction of new schemes of financing;

For the municipalities, the most important would be their support in energy and climate action plan preparation and fulfillment, which would also significantly increase their potential at local level.

Within the EU initiative "Covenant of Mayors" preparation and implementation of energy and climate action plans by the municipalities is coordinated by two leading ministries: Ministry of Environment and Natural Resources Protection and the Ministry of Energy. Their role is decisive in productivity of this process. At the moment, only 16 municipalities have voluntarily joined the "Covenant of Mayors", 10 of which have their action plan. The strategy implementation would be more facilitated if this process becomes mandatory at the national level for all municipalities.

Low emission development strategy represents a constantly changing process that has to be implemented in parallel with ongoing processes in the country and on the basis of implementation monitoring results.

Monitoring process is introduced in the relevant section of the strategy. The responsible agency for monitoring is the Ministry of Environment and Natural Resources Protection (Climate change office), together with Ministry of Energy and Ministry of Economy and Sustainable Development, which on their behalf are responsible for monitoring of energy efficiency national action plan and renewable energy action plan. Mentioned two plans are fully presented in low emission development strategy.

Consequently, low emission development strategy of Georgia must be implemented as follows:

- Georgian Government (the Cabinet of Ministers) are fully responsible towards international institutions on strategy implementation and achievement of goals. Government administration has the obligation of bringing sustainable development plans in line with the national agenda. Particularly, sustainable development goals (SDG) must be harmonized with current priorities and strategies of Georgia - the Document "Georgia 2020", EU Association Agreement, Human Rights national strategy and action plan and many other documents, including low emission strategy, serving for implementation of SDG 13. Government and the "National Contributions Board" equally share responsibilities on active work with the donors on attraction of cheap money and grants for low emission strategy implementation. At the same time, the Ministry of Environment and Natural Resources Protection, as contact and responsible agency within the Climate Change Framework Convention, shall provide mentioned agencies with relevant reports and monitoring results.

- By the initiative of the Ministry of Environment and Natural Resources Protection, within the Paris Agreement Georgian Government creates a responsible body for achievement of contributions defined at national level (hereinafter referred to as the "National Contributions Board") which consists of high officials (at least deputy ministers) from all governmental agencies, whose activities are connected with climate change. The Government approves common number of board members, number of voting members (decision makers) and their statute;

- "National Contributions Board" has to be a decision maker, important decisions of which (the statute shall define particularly which decisions shall be subject of approval) shall be agreed/approved by the Government and shall have binding force for relevant the governmental bodies.

- "National Contributions Board" together with the Government of Georgia is responsible not only for implementation and monitoring of LEDS, but also for adaptaion strategy development and implementation, strengthening of local capacity that is neccesry to support the implementation of the national strategies.

- "National Contributions Board" together with the Government is responsible for close cooperation with the donors for creation of proper financial mechanisms providing smooth and successful implementation of the strategy.

- According to the statute, "National Contributions Board" has to establish at least following committees: **Legal Committee**, consisting of the Ministries having tasks of legislative gap elimination, such as: Ministry of Economy and Sustainable Development, Ministry of Environment and Natural Resources Protection, Ministry of Energy; **Financial Committee**: led by the Ministry of Finance together with Ministry of Economy and Sustainable Development, Budget and Finance Committee of the Parliament and main donor organization representative may be invited as observers; Innovations and Technology Committee: led by LEPL "Innovation and Technologies Agency of Georgia" of Ministry of Economy and Sustainable Development, Ministry of Education and Science and Technological Institute (in case of its establishment); **Self-Governing Bodies Contributions Committee**: consisting of ministries coordinating "Covenant of Mayors"(Ministry of Environment and Natural Resources Protection, Ministry of Energy), Ministry of Regional Development and Infrastructure and its Municipal Development Fund, municipality representatives by rotation (first of all those signing the "Covenant of Mayors", number and rotation principles have to be determined). **Private Sector Contributions Committee**: led by Ministry of Economy and Sustainable Development and Ministry of Finance, bank sector representatives by rotation and representatives of Georgian Business Association. **Monitoring Committee**: guided by Ministry of Environment and Natural Resources Protection and its LEPL "Environmental Information and Educational Centre", engagement of the Ministry of Energy and Ministry of Economy and Sustainable Development in these processes is also very important in order to establish joint monitoring on strategy implementation, as well as energy efficiency national action plan and renewable energy national action plan implementation.

- Monitoring shall be guided by Information Monitoring and Knowledge Management System, created on the basis of LEPL "Environmental Information and Education Centre".

- The responsible agency approves all provision of this Committee, as well as defines the secretariat functions and its statute. Guidance of the secretariat may be granted to the climate office of the Ministry of Environment and Natural Resources Protection.

- One of the functions of the secretariat must be invitation of sectoral experts selected on the basis of tender announcement and creating their unified list; in case of necessity these experts shall be invited to participate in working groups for technical tasks and assessments.

- Structure of the secretariat and its financing issues must be decided by the responsible committee at its first meeting. The first meeting must be organized by the Ministry of Environment and Natural Resources Protection.

3.B. TECHNOLOGY TRANSFER AND DEVELOPMENT

SECTION ONE: BACKGROUND INFORMATION

Introduction of modern, environmentally-friendly technologies covers producers, market, services and other supporting conditions in place for the technologies or ensuring these conditions in parallel with the introduction process. Successful functioning of the technology requires survey of the market in advance in which the technology will be functioning (operating). In other words, it is necessary to research and prepare every stage of the whole process, otherwise called "market mapping", of introducing a specific technology, to ensure every pre-condition necessary for successful functioning of a specific technology. Figure 73 below depicts diagram of market mapping for imported technologies.

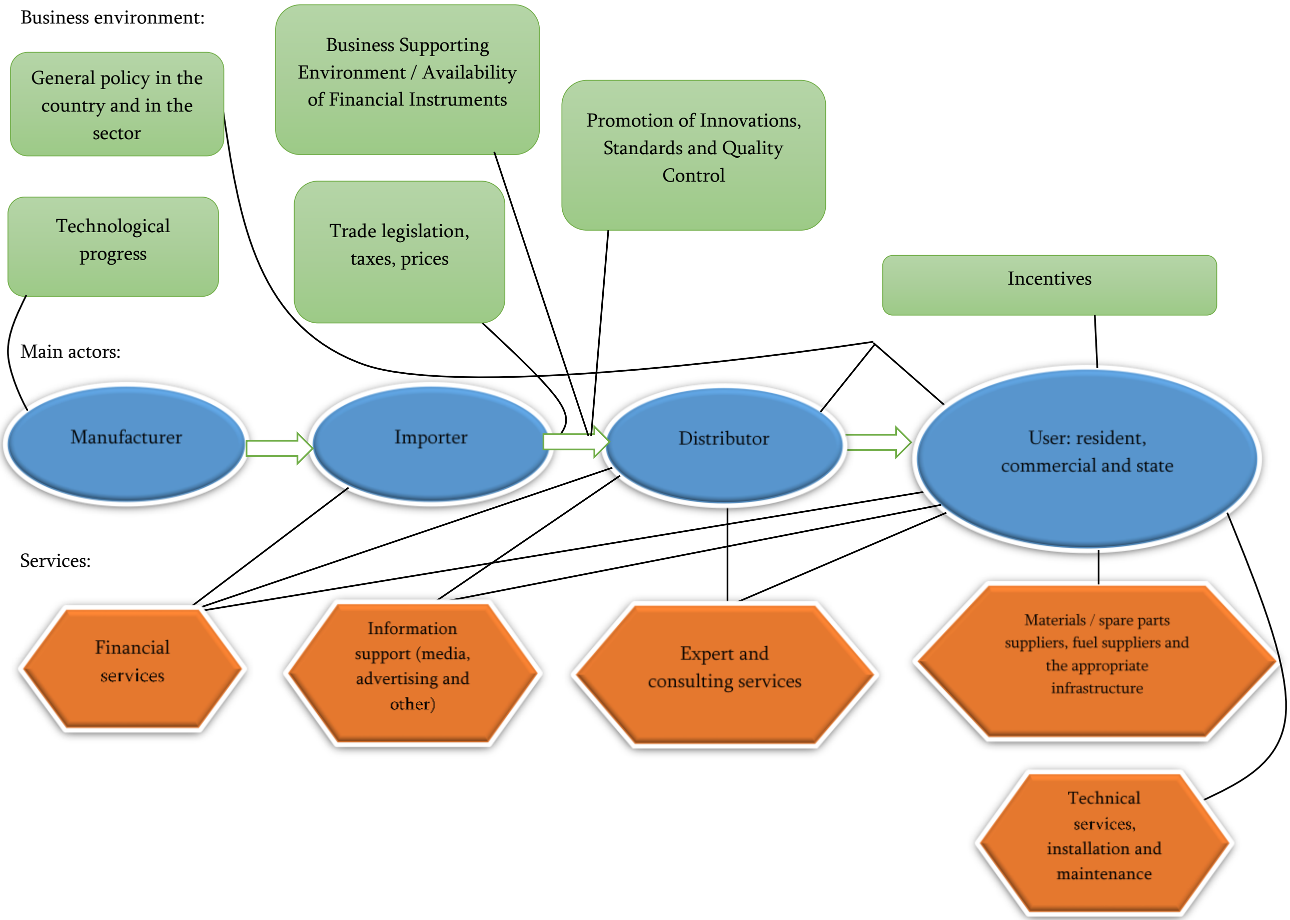


Figure 73. Diagram of market mapping for imported technologies

The figure reveals that during the introduction of the technologies three basic tiers shall be reviewed and studied: legislative, regulatory and tax setting (given in green); main actors of the complete chain of production-introduction-realization-consumption (given in blue) and necessary services (given in brown).

Challenges existing in the marketing chain, given on Figure 70 can be grouped in two for each of the technologies:

- Generally existing barriers on national level in introduction and mastering (using) general Technologies. The barriers are common for every sector and their identification and eradication on national level shall be carried out in coordination with every line ministry and with active involvement of private and non-governmental sectors; and
- Barriers related to features of a specific sector and specific technologies, which can be often solved through the support from a line ministry, though active involvement of private and non-governmental sectors are still necessary.

Significance of the state policy in the process of introduction of modern, advanced technologies shall be also underlined. It is evident that when the private sector introduces technologies attractive from marketing viewpoint, it often ensures the services necessary for successful functioning of these Technologies and other conditions (to attract the dumping price market); however, the process goes on in very slow pace and in chaotic manner. These technologies also include energy efficient and environmentally friendly technologies too, though the private sector is focused on its private interests and does not take into consideration state priorities and international commitments which often poses an additional obligation to it. Thus, state's involvement, carrying out relevant policy for promoting introduction of the technologies to which the state shows special interest and which are necessary for fulfillment of national priorities as well as for observing international commitments, is essential. Consequently, if the state applies uniform policy, it will result in quicker speed and effect of spreading environmentally friendly technologies across the market. Rapid increase of the number of imported hybrid cars can serve as one of the examples of the results yielded through the above-described promotion. As of 2016, 18% of imported cars have diesel engine, 0.8% worked on liquefied natural gas whereas number of imported hybrid cars increased 4 times and made 5.7% out of the whole number of imported cars. As a result of the government's excise policy and according to 2017 statistical data, 581 hybrid cars were imported in January, while the number in February was 777, making total of 1, 358 hybrid imported cars, which is a significant increase taking into account the fact that in 2016 total number of hybrid cars for which duty was paid, was 4, 701. Pace of import of electric vehicles is still low so far and important factor in this case is the pace of development of the infrastructure necessary for using electric cars (road quality, electric vehicle charging stations). As the grid power in Georgia has low emission and it is a local resource, shifting transport sector (civil: tram and underground; passenger and cargo transfers via rail road; private transport: hybrid cars and electric mobile cars) to electric power as much as it is possible is one of the main directions of low emission development strategy in parallel with boosting energy efficiency of buildings and growing forests as the source of absorption. Please see details in transport sector section.

Out of the barriers on national level emphasis shall be made on challenges such as acute deficit of technical/engineering know-how and lack of qualified specialists in this direction and establishing environment promoting innovative technologies. Both challenges are closely connected with the educational system, especially with the higher and vocational educational system, which has not yet managed to reshape in compliance with modern standards. In this regard, the state already implements important programs, such as delivering vocational education and training of specialists through active cooperation with the private sector, which is unquestionably a step forward; however, training of specialists shall acquire massive scales in terms of technical/engineering education. Interest of the state towards these scales shall be the same as towards informational technologies, where there is still deficit of specialists, though significant progress can be observed as a result of political will and prioritization of the field shown from the government. The state shall make more investments in training of technical specialists of targeted fields in foreign countries which, at first sight, seems to be entrusted only to private sector. Donors' role is also important in this process, though the Donors already have their priorities and priority programs developed. The state shall prescribe priority engineering/technological programs and raise/allocate funding for it.

Market chain is composed of three basic parts: actors covering the bodies acting throughout the whole way of technology movement, starting from producer to end user; second part implies favorable environment which is in place in the form of legislation, policy and regulations of respective field – tax, financial, business and political; third part covers various services that the technology to be introduced requires for successful functioning.

The market chain scheme analysis is essential for every relatively serious technology before deciding upon its introduction to the country. The second part of this document covers analyses of such market chains within the frames of Georgia's low emission development strategy for introducing technologies picked and recommended for lowering GHG emission in various sectors.

As the sector's' analyses identified, the main sectors within Georgia's low emission development strategy implementation process are buildings, transport and forests (renewable bio-fuel). Accordingly, the primary focus was on assessment of the technologies necessary for low emission development in these sectors, although other important sectors were also reviewed. Monitoring process over implementation of the strategy also takes into account monitoring over introduction of new, modern climate change technologies, which shall provide more information to the government on where the barriers are and where more efforts shall be made and finances invested.

SECTION TWO: OVERVIEW OF LEDS TECHNOLOGIES BY SECTORS

2.1 ENERGY SUPPLY

Renewable energy technologies

Hydro resources, biomass and geothermic water represent renewable energy sources relevant to Georgia. Hydro resources, biomass and geothermic water are historic characteristics for Georgia; however their development and energy efficient usage, except for hydro resources, have not been in practice. The rest of the sources of renewable energy (sun, wind and energy efficient solid biomass fuel) is not characteristic to and developed in Georgia. Low emission development strategy takes into account maximum support to utilization of these rich resources. Georgia also undertook commitment of supporting renewable energy development under Energy Cooperation which shall be reflected in the national plan for using renewable energies which is currently being developed.

When talking about technologies related with renewable energy two types of technologies shall be considered: one that can be common with population (solar energy in water supply and energy production, energy efficient solid biomass) and the other, which shall be managed by private sector and large companies (hydroenergy, wind farms and solar farms, geothermal water).

Technologies that are basically used for production of large amounts of electric power and heat (wind turbines, solar power stations and biomass thermal power stations, geothermal water), except for hydro power stations, face the same problems as the technologies which are not produced in the country and have no wide scope of spread (for ex.: waste management technologies), while the technologies that can become widespread within the population (solar water heaters and photovoltaic panels, solid biomass) face the similar problems as the energy efficient technologies recommended in building sector for heating and hot water supply as well as energy efficient electric devices).

From renewable technologies Georgia is familiar only with hydroenergy and it has favorable conditions in the country, including technological know-how. Nevertheless, deriving from recent climate changes it is important to move on to automatic system of hydropower management, which ensures management of the risks expected due to climate change. Financial institutions (EBRD, EIB, KfW) are the one who spread these technologies and are planning to introduce modern management technologies into Georgia's hydro energy sector.

Production of solid energy efficient bio fuel from biomass

Since ancient times Georgia has been using its forest resource (biomass) for producing heat, though it was the inefficient way of using which has become even hazardous for the country after the dissolution of the Soviet Union, when gas supply to the country was terminated and the country was without it for years. Despite the fact that many settlements enjoy gas supply, still the population does not use gas in producing heat. One of the reasons for it is the difference in prices between these two energy carriers with preference to fuel wood; yet another reason is that the government cannot control illegal logging. In addition, country has quite a significant potential of solid waste biomass – minimum 500, 000 t annually- except the reserve (around the same amount) that is currently in the forests and which can be used for producing modern, highly efficient, solid bio fuel (pellet, briquette, chips) and replace the wood used illegally/unsustainably for heating-water-heating and cooking mainly in the regions of the country. This biomass mainly includes the waste obtained as a result of corkwood processing and agricultural waste. Including these waste in energy and economic circulation requires taking complex measures on state level which, on its part, requires development of strategy and action plan on the spread of production and utilization of technologies of modern, effective bio fuel. The action plan shall be a part of the national plan for renewable energy management which is currently being developed. These measures shall be carried out jointly by the Ministry of Environment and Natural Resources Protection of Georgia and the Ministry of Energy. "State program on providing population and buildings of public agencies with heating resources" was prepared by CENN[83] and was submitted to the Ministry of Environment and Natural Resources Protection for further revision and approval.

If the favorable conditions are in place, using the waste biomass and forwarding it to fuel production has a significant potential of financial profit as, on the one hand, it will result in reduction of the waste left in forests which interrupts new shoots and, on the other, find beneficial use for it (waste biomass) and bring social and financial benefit to the country and the population.

For production of energy efficient solid biomass (brequettes and pellets) are used special devices that can press biomass. Biomass can be also fragmented (wood chips) with special equipment and used in energy efficient furnaces or in central heating boilers (in a small and tight settlements). Another important condition for increasing biomass efficiency is its dryness, which is necessary for its direct use as well as for producing pellets, brequettes and chips of it.

Despite the fact that production and usage of solid energy efficient fuel has already started in Georgia in the form of couple of pilot projects, there is still lot more to do for introduction and development of relevant production and market capacities and connections. It implies regulation of all the components of introduction and spread market of modern technologies in this sector with respective legislative, financial, technical awareness raising. Despite the fact that this business is mainly intended for private companies, support from the government is still necessary, chiefly in legislative field.

Favourable environment

Favorable environment for production and spread of solid biomass are commitments undertaken by the government within the frames of international agreements in the field of renewable energies, such as: Framework Convention on Climate Change and its Paris Agreement, EU Association Agreement Energy Community, EU Initiative Covenant of Mayors, Forest Sustainable Development Program intending to reduce forest degradation, National Plan for Development of Renewable Energies which is currently being developed, etc. Development of bio fuel production strategy and,

[83] National Firewood Programme is developed by CENN in the framework of ENPI East FLEG II project supported by International Union for Conservation of Nature (IUCN) and funded by Austrian Development Cooperation (ADC)

on its basis – development of action plan, is advisable in this process; it will stipulate legislation necessary for this field establishing business supporting environment. Legal relations between business companies and the government shall be regulated by legal acts. Development strategy of this field shall also support formation and functioning of other links such as services (financial support/credits, technical service, consultation, transfers, informational service). All the above-mentioned will support formation of effective business in the field of sustainable usage of biomass and production of bio fuel. Strategy offered through the Project of GEF/UNDP/Government of Georgia "Supporting production and utilization of biomass in Georgia" reflects existing needs and in case of taking the basic recommendations of the Project into consideration, pre-conditions necessary for development of this field will be established.

Hindering factors

- Main raw material for solid biomass is forest waste which remains after logging. The raw material is not always obtained legally, therefore, sustainability of the process becomes questionable. Consequently, if the EU directives 2009/29/EC for sustainability are not applicable in the country, it becomes dangerous that instead of being energy efficient this business becomes harmful for forests. For excluding the above-said main condition is transfer to sustainable management of forest;
- Biomass composition (forest, agriculture, solid waste) implies coordination between and harmonization of state institutions of various fields and relevant legislation. In case of forests, very close coordination at least between the Ministry of Energy and Ministry of Environment and Natural Resources Protection is essential. Otherwise development of biomass fuel production in the country will face barriers and it may even cause reverse effect;
- Financial support. Financial schemes supporting this business need to be in place. Development of supporting financial schemes between producing and using links is essential. Development of a clear strategy from the government will significantly support development of this business and hinder illegal logging.

Main actors

As it was mentioned above, currently the main actor in this field is private sector, which finds it quite difficult both: to meet the demands of the market independently as well as to boost its potential. With the purpose of effective implementation of governmental programs in the field of renewable energy and for ensuring coordination of the process among various structures, it is advisable to establish Agency of Sustainable Energy Development. The Agency would ensure coordination of the renewable energy development process and implementation of state programs. One of the hindering factors in this production is availability of waste biomass for the private sector. Legislation does not regulate this issue; that's why private sector representatives currently use material of other representatives, who have the right to obtain and process corkwood. Often, they use these themselves. For development of this direction, waste shall be legally available and the market will regulate the price itself.

Services

Technologies for producing effective fuel from solid biomass are mainly imported from other producing countries (China, Turkey, Belarus, Russia, etc.), though still there are some efforts of creating these technologies (drying, pressing equipment, etc.) locally. The largest plant currently working in Georgia, which is planning widening, is the sawdust processing plant "Kera" LTD, in

Samtredia. The plant is currently working only on sawdust. Capacity of the plant is 360kg/hr, and, in case of maximum load (working days – 240 days annually and hours – 8 hours per day), it can process 691.2 t. sawdust. The plant belongs to the small (788 t/y) enterprise category. “Kera” LTD has planned opening of couple of other plants in various regions of Georgia, which altogether requires investment of 3.5-4 million dollars. Equipment of 500kg/hr capacity has already been ordered for Kakheti region. The company is also planning to introduce mobile line (equipment attached to semi-trailer) for processing corkwood waste which will have the capacity of processing maximum 20-25 cm diameter wood branch or other type of corkwood waste. Consequently, it will be possible to process waste immediately in the middle or in the vicinity of a forest. Looking at this example we can say that the private sector cannot yet risk buying this type of equipment assembled locally and they are ordering it in neighbor countries. Establishing a joint enterprise for development of energy efficient fuel out of solid biomass will be important.

Technologies for using solar and wind energy

Technologies for using solar and wind energy are one of the most expensive in the field of renewable energy, especially when it comes to hydro-power stations. However, lots of countries are successful in introducing these technologies and this way they are supporting reduction of GHG emission as well as reduction of energy costs in the long-run. What is most important for Georgia, renewable energy in its primal form is a local resource. It should be also noted that these technologies are being refined and improved on a day-to-day basis, their efficiency is increasing and their price on international market is decreasing (they become cheaper).

Solar energy can be used in two ways: heating (solar water heaters) and electric (photovoltaics). Both of these directions are developed to a certain extent in Georgia:

- First solar water heaters in Georgia were installed in the 50s of the previous century. Since then this field has been developing and improving: several important projects have been implemented through the aid of foreign donors, private companies that are working on designing, installation and service of this system have been established; according to the available information, total capacity of solar heating systems in Georgia amounts to more than 100 ton – equivalent to 3,600 kwt/hr thermal energy per day;
- Using photovoltaics in Georgia started in the 80s of the previous century. Despite some success, utilization-development of solar energy in Georgia went on at quite a low pace; however, since the Government of Georgia adopted a law on buying solar electric power installed capacity up to 100 kw produced by the grid, population has become quite interested in this technology. Total electric power produced by solar photoelectric systems in Georgia amounts to around 450 kwt/hr per day. On July 30, 2016 two, comparatively strong on grid solar power stations has been commissioned. These stations produce around 1, 000 kwt/hr electric power per day.
- Wind electric station in Georgia was first initiated in October 2016, near Gori City. Its capacity is 20.7 mgwt and its efficiency so far is 54%, which is the best indicator even on international scale. It’s obvious that the pilot project, which was funded by EBRD under concessionary loan, could not be feasible without the support and involvement of the state. If the project successfully operates afterwards, this direction shows a good prospective for development and will probably kindle interest in the private sector; however, it is necessary to study the technical protentional of electric grid to find out how much unstable electric power the Georgian electric network can currently receive and what kind of technical re-tooling the network requires to achieve maximum capacity/generate electricity. Therefore, it is necessary to elaborate legislative base regulating connection of private sector working on this type of power to the grid and setting tariffs for generated power.

Development of this sector requires the removal of two main barriers: first is adoption of all necessary regulations and technical standards and provision of services. For achieving the above-said delivery of intensive on the job training courses for local specialists will be necessary. In the countries where these directions are developed with advanced technologies and initially, before staffing of local specialists, joint enterprises shall provide service. Theoretical researches on wind and solar energy at vocational schools shall be replaced with targeted practical studies. Private sector providing services shall be exempt of taxes for some time. Along with development of technological market wind energy subsidized by the state shall shift on to commercial principles if theoretically calculated potential is close to the real.

As for solar energy technologies (water heaters and photovoltaics), processes have kicked off in this direction and it is planned that these directions shall develop through the support of state programs. However, service necessary for these programs has not been developed yet and it should be prepared through the involvement of state programs.

Geothermal energy technology

Geothermal potential in Georgia can be used mainly in heating. It has been developing in the country for quite a while, though at a very low pace, inefficiently and without introducing modern achievements (geothermal circulation system).

Current situation in this field, deposits and activity of enterprises that have respective license makes inefficiency of this production obvious, highlights that use of resources is uneconomic, and, in the end, unproductivity and low efficiency. These factors are mainly caused due to gaps in resource management: tax, legislative field (of respective sector), incorrect licensing and low level of awareness of the license holders on the technologies and energy efficiency existing in the field.

Judging from this, development of the field is impossible without eradicating the above-listed gaps.

Main actors in this field are state agencies (licenses, regulations) and private business companies who use thermal energy in green houses, bathes and only in Tbilisi (Saburtalo district) population can enjoy geothermal gravity heat water. Functions of the "Geothermal Association - Georgia" – an organization operating in Georgia – in the field of managing these resources are not clear-cut.

Scarcity of the resource and not so high parameters of water imposes lots of technical barriers because of which the resource is not attractive either for the government or for the private sector. In particular, because of high concentration of various chemical elements water is quite aggressive and damages systems in case of direct use, while arranging geothermal circulation system requires incurring additional costs; Water temperature for generating electric power is insufficient; Deposits are located at quite a distance from populated areas (supply is possible only to certain parts of Tbilisi and Zugdidi population) and its usage in thermal supply is inefficient because of big amounts of losses. In spots where water may achieve to population, in winter it is still necessary to further add gas/other heating means. Because of all the above-listed Government's interest in this energy resource is low; however, the government is still searching for the most effective way of its use. In this regard, first step shall be review of the license procedures and development of regulations adjusting relations, including financial and tax allowances, between private business and government. These measures will create favorable environment for development of the field. In parallel, introducing modern technologies (geothermal circulation system, etc.) improving technical expertise and development of technology standards, as well as providing respective services to businesses will be essential. Introduction of geothermal circulation system shall be considered in licensing requirements.

2.2 BUILDINGS

Sector of buildings considers two directions: a) heating-cooling technologies, b) electric devices. They both enjoy common favorable environment and face common barriers; however, there are differences too.

Heating/cooling technologies

Georgia does not produce heating/cooling equipment (central heating boilers working on natural gas, gas wall heaters, electric heaters and air conditioners) except for wood heaters. These technologies are mainly imported from Italy, Turkey, China and Germany.

Price for these technologies varies depending on their size and type. Systems produced in Europe are far more expensive than their Chinese and Turkish counterparts.

As for wood heaters, local market mostly provides traditional tin heaters of local production. Market is replete with ineffective and cheap heaters or heaters with average effectiveness. Market also provides so called "Svanetian" heaters – comparatively expensive wood heater of local production – which are considered among the best heaters on Georgian market. Despite the above-said, effectiveness of the systems is significantly low compared with modern technologies of complex heating working on biomass/wood. These technologies are not popular due to their high price and, consequently, they are practically not present on Georgian market.

Efficiency indicator of a heating/cooling technology is directly connected with the price of the device and cost of energy and, taking into consideration the fact that natural gas and electricity is supplied for a price lower than that of its regional price, there is no economic incentive in gasified and electrified settlements to shift on to energy efficient technology.

Household and commercial electric devices

Household and commercial electric devices include fridges, freezers, washing machines, dishwashers, dryers, electric ovens, lightings, TV sets, receivers, computers, photocopiers, printers, monitors, lap tops, routers and various IT devices.

Neither of the above-listed devices are produced in Georgia. They are imported from various countries across the world. Products are mainly from Turkey, China, Indonesia, Czech Republic and India.

It should be highlighted that modern household and commercial electric devices use far less energy resources than their counterparts used to 15 years ago. For example: modern fridge uses 66% less energy. "A"+ class fridges use around 23% less electric energy than "A" class ones, while "A"++ class use 45% less.

Deriving from the fact that the sector is mainly composed of the products of international brands, which are constantly improving their products, customers automatically buy devices of better effectiveness as a result of wearing out or moral depreciation of products. If the processes continue like this, speed of increase of share of electric devices may rise up to 10% by 2030.

However, product of higher efficiency presented on market is characterized by higher price. Customers generally tend to choose lower price products. Considering all this, it is necessary to promote realization of higher efficiency product through various methods.

Main actors

In the market chain of high efficiency heating/cooling as well as of household and commercial electric devices (see Figure 1.) main actors are product importers (who in some cases also serve as dealers) and dealers (trade centers, brand stores and trade clusters – for ex.: "Eliava bazaar") which work on resident, commercial and state customers both in rural areas as well as urban settlements across Georgia.

In addition, one of the most important participants of the market is the producer of technology. Taking into account the fact that producers are continuously improving, refining, and, consequently, raising efficiency of their technologies, it is natural that market is supplied by new technologies of higher efficiency which has positive effect on reducing the amount of consumed electricity.

Business (favorable) environment

In order to assess the difficulties that hinder wide spread of such technologies, it is necessary to compare current state of market with the desirable one. Future market (desirable) picture may look as follows:

- Intensive import and wide-spread of high-efficient technology may be promoted via stage-by-stage restriction of import of low efficiency technologies or, via ensuring better tax, subsidization or other allowances to high efficiency technologies;
- Making certification of technologies on energy efficiency mandatory. In particular, differentiation of imported devices (marking, showing efficiency class);
- Local production of high efficiency technologies or their parts, which will significantly cheapen technologies on Georgian market;
- Availability of information necessary for selecting and using a specific technology;
- Concessionary loans from banks both for resident and for commercial customers, for buying energy efficient technologies;
- Request of energy efficiency in state procurements;
- Making utilization of highly efficient technologies in buildings, obligatory, which will significantly reduce increase of inefficient technologies and will promote spread of effective technologies.

State's priorities and policy

Sometimes poses various hindrances in widespread of energy efficient heating-hot water supply and electric devices. One of such barriers is inadequate customer's tariffs on energy carriers (gas is cheaper compared with other prices in the region, which is caused by subsidization in energy sector). Such policy stimulates ineffective use of fuel and promotes seldom application of technologies for effective utilization of biomass and energy saving in heating sector.

It should be also noted that fuel wood utilization strategy and vision has not yet been fully developed by the state. Ongoing reform of forest legislation shall ensure adjustment of fuel wood availability and pricing mechanisms on average and long term. Lack of clear cut strategy in this direction interrupts investment in wood and biomass energy efficient utilization technologies by consumers.

Experience of developed countries reveals that spread of energy efficient technologies can be more effective, if subsidies allocated for energy carriers will be re-qualified for energy efficient technologies and be used for subsidization of expenses incurred for buying higher efficiency devices through establishing tax allowance on import.

Financial barriers

In addition to the above discussed, other basic elements of financial barriers are: high price on high efficiency technologies, small and weakly developed supply market of heating/cooling technologies (often products are not warehoused in Georgia and they shall be imported after ordering and paying an advance by costumer) and high risk of sales related to it, low motivation of further development of activity in this field, low availability for public at large.

Informational barriers

At this stage information level of customers on the capacities of high efficiency heating/cooling technologies, profit, price, financial resources, potential implementing bodies of projects and other issues is insufficient. Within the frames of some projects, expected advantages and benefits are promoted and popularized, though in small scales.

Services

For ensuring wide spread of efficient heating/cooling technologies, following services shall be in place in the country:

- Financial/credit institutions for providing financial support;
- High quality technical service, which will ensure smooth operation of systems in compliance with certificate (design organizations of respective heating/cooling systems for ensuring temperature necessary for living or working in a building, installers, energy auditors and persons authorized for maintenance; agencies responsible for installation and maintenance of technologies as well as bodies supervising examination, quality control and standard compliance);
- Fuel suppliers and respective infrastructure (suppliers of solid biomass and wood obtained from sustainable sources and produced in high quality, gasification and respective infrastructure).
- Certified examination and advisory services (such as system designing, properly selected technologies);
- Informational/promotional means (media, advertising agencies, as well as engineers ensuring advertisement of utilization of technologies).

2.3 TRANSPORT

Generally, transport sector is composed of several sub-sectors: air, marine, road and railway. Georgia's Low Emission Development strategy mainly considers railway and road transport interconnectivity. Out of these two, road transport is mainly reviewed on the background of supporting spread of energy efficient vehicles.

There are various methods of increasing energy efficiency in transport sector. For example, in urban areas methods are boosting the role and augmenting the amount of public transport, development of optimal transport schemes, with less stops, "smart" traffic lights system, improving management quality, renewing motor pool, creating "green sections" or smart urban planning.

Other methods include certain restrictions on the amount of emission, good order of motor pool, requirements on age, improvement of infrastructure (roads) quality, optimal planning and distribution of transport network among various means of transports. However, the main target in restriction of transport's energy consumption is its fuel. Utilization of fossil fuel and its replacement with other fuel containing less carbon – this is the most effective direction in terms of improving transport energy efficiency, on which is focused most of the efforts both across the globe and in the strategy.

One of the first solutions in terms of energy efficiency across the world was replacement of petrol with natural gas. This practice has been introduced in many countries, including Georgia. Utilization of natural gas has alleviated, though could not completely eradicate the problem of emission and utilization of fossil.

Currently rapidly increasing technology is using electricity in cars. In particular, production of hybrid cars is increasing and improving; this type of car uses both traditional fuel and electricity; in addition, there are electric cars, which are working only on electricity. So far, these innovations apply only to light vehicles. World statistics show increasing trend of production and sale of these types of cars across the world.

Main focus in transport section of low emission development strategy is made on three directions: promotion of import of electric and hybrid cars; increase of both cargo and passenger transportations in rail road sector at the expense of reducing car transportations and promotion of development of municipal transport in the cities which are signatories of Covenant of Mayors.

Import of energy efficient (hybrid) cars in Georgia was first recorded in 2000. First imported car was Toyota Prius which was working as a taxi. After 2000 other hybrid cars also appeared in Georgia, including Ford Escape, Honda Civic, etc. As for electric cars, they are imported in quite small numbers due to their high price; their battery is expensive.

As it was already mentioned above, import of electric and hybrid cars has risen recently, which is largely connected with the financial allowances policy, carrying out of which the state has started from 2017. Excise tax on hybrid cars was decreased from January 1, 2017. Proposed amendment to Articles 194 and 199 of the Tax Code of Georgia implies exemption of hybrid and electric light vehicles from excise and import taxes. As a result of all the listed steps and influence of international trends, import rate of energy efficient cars in the country is significantly increasing, especially from 2017.

Despite the favorable conditions, there are still barriers to these technologies which impede wide spread of these cars. Similar to other sectors, this sector also requires familiarity with technologies and operation of respective service centers. Hybrid cars imported to Georgia are mostly outdated and they ultimately come out of order. Service centers cannot provide complete service to modern technology cars. Such facts often indicate to high risk and ultimately customers prefer cars working on petrol or diesel.

In addition, infrastructure favorable to **electric cars** is available only on the roads of big cities, (though not in every big city) of Georgia. Electric cars are characterized with low body which makes movement on mountainous or rugged terrain problematic for it. In the process of introducing new technologies it is important the state to establish certain favorable and incentivizing environment for supporting technological process; for ex.: Tbilisi City Hall installed free charging stations in the city for electric cars. In case of absence of respective infrastructure (roads, charging stations, service centers) prospective of wide spread of electric cars is limited. Electric cars are especially important to Georgia as the electricity in the country is clean enough and contains minimum amount of carbon due to high share of hydro energy in the grid. On initial stage, along with other incentivizing measures arranging free stations for electric cars will support increase in the number of electric cars and support them in fulfilment of commitments taken before the EU (Covenant of Mayors).

For incentivizing this trend even further, keeping concessionary tariffs at customs duty for importing energy efficient transport, supporting-incentivizing importer companies, supporting insurance and concessionary loan schemes, public awareness rising on the advantages of using energy efficient vehicle are necessary. Training/re-training of technical specialists for rendering service to new cars and supplying spare parts market is also very important. Indirect way of incentivizing import of electric cars is keeping restrictions on second hand, outdated cars, restoring technical inspection with the practice of obligatory periodic inspection and fines.

One of the hindering factors for **development of railway** in Georgia is absence of international transit trips, which would have been very important financial resource for development of railway. On its part, international transportations are interrupted due to following barriers: defective rail tracks, incompatible with new technologies; defective electric power cables; outdated stations and railway carriages (cargo and tanker-wagons); lack of middle carrier stations; high price for railway service, compared with vehicle transportation. As for passenger carrier, old infrastructure is out of order and new has not been developed yet. Therefore, railway is not competitive either in terms of cargo or passenger carrier, compared with road transport. Implementation of the strategy requires complete re-equipment, making it energy efficient and amending its management policy.

As for transportation among cities, main barrier here is unregulated legislation, which does not allow either development and strengthening of infrastructure or replacement of service field with modern, technically updated energy efficient technologies. In particular: institutional barrier – car stations are not differentiated for cities – identification of car stations according to types; role of municipalities in inter-city passenger transportations is not defined, permit on location of car station cannot be issued, work and technical orders of car stations cannot be inspected; law does not regulate monitoring periodicity and place and whether the standards for passenger and cargo transportation are observed (for ex.: transport-transit vehicles traveling long distances have outlined place and time of rest, inspection, etc.); Infrastructure barrier – there are no properly functioning international passenger carrier stations in either of the municipalities except for minor exceptions, which causes low quality of monitoring; municipalities have no influence on the infrastructure of the stations in private ownership, consequently, motivation on construction-rehabilitation of a comfortable station of modern standards is quite low; private sector does not have the motivation of changing or replacing outdated motor pool, as there is no control and periodic inspection;

Urban transport in Georgia is developed only in a couple of cities, mainly in Batumi and Tbilisi. However, its improvement is still a problematic issue. Development of energy efficient urban transport mostly depends not only on proper functioning of institutional legislative bases but also on technological – technical factors. Basic characteristics are availability of public transport, establishment of comfortable environment, improvement of transport energy efficiency which, on its part, will reduce emissions and fast movement.

In order to observe the above-listed, it is necessary to establish an environment which would change currently existing approach and situation. One of the most important measures for making existing urban transport energy efficient, which is often of outdated technology and works on diesel, is shifting of it to lower emission fuel, such as gas or electricity.

Hindering factors of making municipal transport energy efficient are as follows:

- Existing infrastructure – Properly functioning transport infrastructure is significant for urban transport development. Such infrastructure includes: bus stops, municipal depots, bus lanes;
- Technologies and service – Replacing existing transport with lower emission one is related with modern technologies and familiarity with them. Specialists in these technologies in the municipalities of Georgia are scarce, which will interrupt further utilization of the transport. Most of the specialists have expertise in those vehicles which are not compatible with modern technologies. In addition, one of the difficulties are absence of spare part stores on local or neighboring country markets which ultimately results in wasting time and resources;

Cable way in the cities of Georgia are used in two directions: tourist and recreational (which has been mainly adopted in Georgia) and cable way connected to urban transportation system. Utilization of the first type of cable way is possible in every tourist region of Georgia; however, most important factor, that hinders development of cable way to this direction, is its high price as well as the high price of its service. It is not profitable for private companies; consequently, motivation is low from business. Development of cable ways connected to urban transportation system, which is comparatively new direction, will support thinning of traffic and quick and comfortable movement, though the main barrier here is also high price of its service. In addition, development of cable ways of urban system shall be focused on affordable fairs, which, compared to other types of urban transport, needs more subsidy form municipal budget. Similar to it, in case of waste management and other technologies, design, procurement and service cannot be implemented independently, only through local personnel, hence joint service is carried out (at least for 3 years) along with the representatives of producing company. More attention shall be paid to training of local specialist in this direction.

2.4 WASTE SECTOR

Waste sector covers solid waste and utilized waste water sub-sectors which may or may not have interconnection, considering the fact whether the sludge, coming out of waste water treatment facility, connects to municipal landfill or, whether it is subject to other form of recycling with other solid waste.

Solid waste management technologies

Solid waste processing, and generally, management technologies, are being improved on a day-to-day basis and enables countries to minimize the number and space of landfills. In addition, processed waste is used as a resource in various sectors, for substituting traditional resources which is, at the same time, economically profitable and ecologically reasonable. On its part, reduction of the amount of waste is proportional to the reduction of greenhouse gas (methane).

Despite long-term obvious positive economic, environmental and social effect, introduction of waste management technologies is often related with difficulties and requires scrupulous analyses of existing technologies, survey of their cost-effectiveness, advisability of introducing to the country and necessary pre-conditions and defining resources for their preparation. Only on the basis of this type of comparative analysis it is possible to select technologies most optimal for local setting and strategy of their introduction can be developed through taking into consideration of specific places and needs. Following technologies of methane gas reduction will be reviewed on low emission development strategies[84]:

- Landfill management improvement technology (solid waste separation, stabilization and pre-treatment before placing on landfill; providing optimal cover for placing waste and for closing landfill);
- Production of biogas (flaring or utilization);
- Biological treatment of waste (composting);
- Mechanical-biological treatment of waste;
- Thermal treatment (gasification of incineration) with restoration of energy.

[84] Technologies mentioned hereby refer to only municipal solid waste, to which industrial and construction waste may be added.

Landfill management improvement technology

This technology is partly used in Georgia. Improvement of this practice is related to utilization of biocover for landfills. The technology can be introduced during the process of closing old waste disposal sites and arranging new, European standard, regional landfills, which is planned to be completed by 2023. Arranging biocover for new and closed landfills will be partly connected with introduction of composting technology in Georgia.

Making biogas from landfills

Methane recovery from municipal landfill is a common practice in developed countries. Recovered methane is directly used as fuel, or for producing electricity. There is also practice of using compressed landfill gas in transport. Collecting biogas from landfill and its burning in flaring, is one of the simplest and inexpensive ways of methane reduction. Currently, flambeau burning is planned on Rustavi and Tbilisi landfills, as it is impossible to use landfill gas in industry or in population because of its low quality and amount. After the waste management complex system enters into operation, when waste sources separation starts (2019) and landfill gas quality improves, it will be possible to replace this technology with the better one. Despite the fact that both of these cities voluntarily took commitments on reduction of greenhouse gas emission along with other EU cities, installation of technology for burning methane on spot is not possible. Installation of the technology would significantly reduce unpleasant odor in the vicinity of landfills and protest of the nearby population caused by this odor will stop; it would also support these cities in fulfilling their commitments.

Two most important reasons out of various other ones of not introducing this technology shall be highlighted: one is: unavailability of information on technologies and absence of respective local specialists who would be able to implement this type of project and the other: additional costs, which, in this case, are not necessary, as the country does not have respective legislative base, as Georgia undertakes commitment of greenhouse gas emission only after 2020. Modern waste management legislation, which stipulated closure of old landfill and construction of large, well-managed landfill, does not exclude introduction of methane recovery and burning it on spot or using it, in the wake of sorting and recycling; however, this process is not mandatory.

Biological treatment (composting) of waste

Composting is a modern technology, which is becoming increasingly popular in developing countries. It implies making secondary product through biological treatment of wastes.

There are various kinds of composting methods, and composts, which are used for different purposes. For ex.: compost is made through natural aeration out of garden and park wastes. Compost made from solid waste settled as a result of waste water treatment, which is pure of methane, but rich with nitrogen, can be used as an agricultural fertilizer. For making this type of compost it is necessary to demethanize waste ooze or other solid waste in advance.

Thus, selecting composting method depends on and shall be considered in combination with other technologies, in this particular case, with demethanization technology. It is possible and even desirable that separate composting processes be implemented by local businesses, through supporting incentives, if any. Especially, that lots of methods of composting are quite simple and does not require introduction of any special technique or technology. Their introduction in the country may start even before 2019, through the help of technical resources available in the country, after establishing respective agencies and delivering training to specialists.

Mechanical Biological treatment of waste (MBT)

This technology which is oriented to treatment of mixed municipal waste, covers sorting of recyclable wastes and fuel production, mostly in the form of pellets and composts. Recovered product is of low quality and can be used in the form of fuel only in various industrial processes, for example, in cement production.

Introduction of this technology is related to the survey of demand and consumption market and to the fuel standards requested by potential consumer (for ex.: cement producer); after it can be defined type of new technology which is necessary for harmonization existing technologies with the requested standards. Currently, in Georgia it is impossible to carry out this type of feasibility study without assistance of foreign experts, as similar technology has not yet been introduced to the country and there is no respective experience.

Thermal treatment with energy recovery

Thermal treatment implies utilization of heat and maybe even pressure and is transformed into synthetic gas of organic mass of waste, fuel or electric power. Basic types of thermal treatment of wastes are incineration and gasification.

Introduction of **incineration** to Georgia is considered unprofitable and is even related to technical difficulties, though in the distant future, in the wake of further development and improvement of this technology, its introduction is possible.

Gasification is carried out through various methods and is directed to making of gas and oil. There is pyrolitic method, through which various chemical substances (hydrogen, methane, carbon dioxide, carbon monoxide, pure carbon and inert material, acetic acid, acetone, methanoland hydrocarbon mixture), can be made, out of which obtaining high quality fuel depends on further expensive processing. It makes introduction of the technology difficult at current stage.

However, there is first attempt of introducing pyrolitic processing method at Tbilisi landfill: "KDV Georgia" LTD (on the basis of a memorandum concluded between "KDV Georgia" LTD and Tbilisi City Hall on 5.05.2016) is planning construction of solid municipal waste processing plant on Tbilisi landfill, within the frames of private investments.

Treatment of utilized waste water

Waste water can be divided into municipal, commercial and industrial. Often all three of them are discharged into one and the same sewage network. Municipal and commercial waste water mostly contain organic pollution (meaning that big part of commercial enterprises produce food products). Part of industrial enterprises also discharge water, rich in organic mass (for example: leather, paper production), though others discharge water containing chemical substances. It is necessary to remove both organic as well as chemical substances from the water before it is discharged to bigger body of water. Law obliges specific enterprises to take care of their own waste water before it is discharged to sewage network. As for municipal and commercial waters, they are advisable to be treated in special facilities, so called "waste water treatment facilities"; water used by specific city, region or area flows to these facilities and after being treated, it further joins to nearby body of water.

Water treatment technologies in waste water treatment facilities can be divided into aerobic and anaerobic groups. Methane emission reduction is possible both through aerobic, as well as anaerobic ways, though for collecting biogas only anaerobic systems can be used. Water treatment technologies include so-called "natural technologies", such as lagoons, sand filters, bogged areas (constructed marshes, etc.) which do not bear market character and their introduction depends only on local conditions: on deciding the issue of disposal-processing of deposit left from human resource, energy and processing. Other technologies are available on international market and their introduction is possible in case of will and favorable environment. Despite the advantage of "natural" technologies in terms of simplicity and cost effectiveness, open, lagoon system management improvement or installation of additional devices (for ex.: adding biogas collecting devices to open anaerobic reservoirs) may also be considered.

Situation in water, including waste water treatment is not so fair. Currently United Water Supply Company of Georgia carries out management of water treatment systems in the regions of Georgia. At present, there are only three water treatment systems (plant) across the country: in Gardabani, Batumi and Sachkhere. All the rest of the regions, including big cities, currently do not enjoy sewerage system at all.

With the purpose of solving the above-said problem, currently, through funding from various donor organizations (on the basis of loan agreements concluded by the Government), water supply and water treatment facility construction projects for a number of cities has started. As for the already existing three water treatment facilities, treatment quality of two of them (Gardabani, Sachkhere), requires improvement, thus complete re-equipment.

So far Batumi waste water facility is using the most advanced technology and carries out secondary (biological) treatment as well, though methane is not collected and further used.

Gardabani water treatment facility is of the largest capacity in Georgia which requires complete re-equipment in compliance with modern standards. Built in 1985, the facility has 4 methane tanks in which methane has never been collected, despite of the fact that it was planned.

Main actors and barriers in waste sector

Unlike energy efficient technologies reviewed in the sector of buildings and transport, modern technologies in waste management sector (solid waste, utilized waste water) are neither produced in Georgia nor available on Georgian market. They are imported and spread on the basis of feasibility study developed for every specific case, which is related to specific risks, especially in the operational phase of these technologies.

As we can see, despite effective steps being made, technological re-equipment in waste management field that would overcome the challenges facing the country within the frames of commitments undertaken within EU Georgia Association Agreement, still poses as a difficulty. These difficulties are related to legislative, financial and institutional fields.

Providers

In the process of importing waste management technologies, actors of the first phase are **multilateral international financial institutions** and representatives of private sector of those countries in which these technologies are produced. Main actors, outlined during the operational phase of technologies are: **government**, that shall ensure supportive legislative base and **local private sector** or the agency itself, owning the technology, which shall provide necessary services on spot.

Considering the fact that technologies to be introduced within the frames of ongoing and planned projects are selected under recommendations of expert-consultants hired by donor financial institutions, there is maximum compatibility of quality of technologies with EU standards, although import process of technologies is significantly protracted. Unfortunately, besides the fact that the country cannot independently select and buy specific technologies, often maintenance of technologies is also problematic due to lack of service environment in the country, which became obvious in the case of Batumi water treatment facility operation process.

In the process of introduction of modern technologies for collecting and burning methane gas created as a result of solid waste management or utilized waste water, local actors are new LTDs established under the umbrella of Ministries (Ministry of Regional Development and Infrastructure, Ministry of Economy of Adjara) and Municipalities (Tbilisi, Rustavi, Batumi); these actors are not sufficiently qualified to manage modern technologies independently.

As it was already said, importers and introducers of waste management technologies has not yet been clearly identified; however, Solid Waste Management Company is one of the most potential claimants. Currently existing knowledge and experience of modern technologies of the company is insufficient and increase of their capacities or selection of a company through contest, that has a good knowledge of these types of Technologies, is important. Generally, it is better to be a joint company which will ultimately become independent. On Georgian market companies providing such services, whose experience and qualification is not assessed and approved, appear from time to time.

Customers

Direct customers of these technologies in the waste management sector is a service organized by the state/municipality, which at this stage do not represent independent private sector as this direction is not profitable in Georgia so far (exactly because of lack of knowledge in technologies). Private sector may become interested if methane gas collection and realization, or production of secondary material (for ex.: ooze) as a result of waste and polluted water treatment that can be used in agriculture as an organic fertilizer or in production (for ex.: cement production) as an admixture to fuel, takes place. Besides, gas as a product of landfill and water treatment may be used in place as an energy resource. On spot consumption is especially interesting in case of water treatment facility, which uses quite an amount of energy.

Taking into consideration scarce technical knowledge, only methane reduction commitment may speed up the process of utilization of these technologies in Georgia.

Favourable environment

In the process of creating favorable conditions on national level, Ministry of Environment and Natural Resources Protection is a leading actor which is responsible for implementation of the policy in waste management and utilized waste water treatment sector. Law of Georgia on Solid Waste Management entered into force in January 2015. The law does not impose obligation of methane reduction from landfills, which would make introduction of these technologies obligatory and this way, would support development of service potential on spot and would create grounds for comparatively smooth implementation of Paris Agreement from 2020.

As it was already mentioned, in addition to national legislation (Waste Management Code), Ministry of Regional Development and Infrastructure considers enlargement of municipal landfills and arrangement of regional landfills, which would support introduction of new technologies. This is a sector, where, because of small amount of waste, centralized and regional approach to technological development may turn out quite effective.

As for utilized waste water treatment sector, here, in the first place, potable and waste water quality control and monitoring system shall be developed; water resource management, water quality effective management system shall be developed; sewerage management systems, water resources management responsibility is distributed among various agencies, which requires further refinement. Thus, regulation of legislative, including financial, tax field, which implies refinement of existing legislation on internal level and adjustment of it with international regulations as well as distribution of responsibilities among the state and private companies, is a necessary pre-condition for establishing modern water treatment system in the country.

Differences among the state obligations and interests of water treatment facility and landfill managing private companies shall be regulated. Legislative-tax or agreement-financial connection of managing companies with industrial enterprises and their harmonization with state interests is especially important. As the managing companies, on the one hand and private companies on the other, are main actors in the process of introduction of new technologies, in the first place it is necessary to regulate relations between them.

Services: This field needs to be established from scratch. Despite the fact that there are a number of organizations working on waste field issues, it is not enough. On the basis of these organizations it is possible to establish a base providing relevant services. Currently provision of technologies with spare parts does not take place along with introduction of technologies which causes certain hindrances (see water treatment technology).

Provision of services is especially important with regard to utilized waste water treatment. In Georgia, in particular in Batumi there is a water treatment facility of European Standards. One of the main problems for this facility is obtaining spare parts for the system during its operational phase. Spare parts are neither produced in the country nor imported on market. Consequently, they should be bought abroad via bidding process, which is a lengthy process and is quite difficult to ensure full operation of water treatment facility during this period. As currently new water treatment facilities are being constructed in a number of municipalities, it would be necessary to provide them with spare parts and, what is more important, with qualified specialists. If private sector ensures import of spare parts, support from the state in delivering of training to improve qualification of local specialists is also important.

In addition to absence of spare part market another complication is lack of technical expertise and experts, who should have experience in operation of advance technology on spot. It seems, that there is not a single link of technical-financial implementation design, procurement, operation and service provision for this type of Technologies in the country.

2.5 INDUSTRY

Industrial sector in Georgia's low emission development strategy is reviewed in two directions: energy utilization by industrial sector and emissions from industrial processes.

Georgian industry especially heavy one, has become very weak and practically collapsed, as a result of the the developments of the 90s of the previous century. Main reason for this was: energy crisis; change of ownership form; collapse of industrial system (raw material was imported from other countries, but because of cutting connections with them as a result of dissolution of the Soviet Union, import ceased). All the above listed reasons quickly reflected on demolition and weakening of certain sectors, reduction of production amount and lowering of quality.

Enlivening of the industrial sector started after overcoming energy crisis; however, industry development speed is not compatible with the acute requirements of country's development. In the first place, industrial sector shall be re-equipped and replaced with modern, resource saving and energy efficient technologies. It is obvious that private sector cannot manage this and it should be supported via various supportive state programs.

Energy efficiency shall be the main criterium while selecting technologies necessary for small and medium industry and while receiving support from the state

Within the frames of the EU project "Resource efficient and clean production for Georgia's industrial sector" which is implemented by UNIDO, small and medium business were interviewed (total 47 enterprises) on shifting to resource effective production. Survey revealed following topics:

- Generally, environmental protection is important for companies; their decisions, for ex.: on resource efficient production, are influenced by governmental regulations. If environmental regulations will become stricter, requirement of efficient technologies from their side will increase;
- Representatives of companies confirmed that they can use resources more efficiently, though for doing this they need trainings and more information on respective Technologies;
- Quite a number of companies are willing to finance more profitable and resource efficient business; however, they do not want to take risks, as they think that economic setting in the country is not stable and interest rates on loans are high. They need long-term loans at low interest rate, which are also accompanied by grant component.

The biggest barrier that the industrial sector is facing, is lack of engineer specialists.

Thus, for preparing desirable business environment in industrial sector following measures shall be taken:

- Strategy and action plan on development, modernization and technological re-tooling of industry, as a field, shall be developed; time-frames and funding sources shall be determined; priorities shall be set, sequence shall be regulated and coordination among actions shall be ensured;
- Innovations shall be incentivized; capacities of Innovation and Technology Agency shall be enhanced; conditions for entering it into force at full swing shall be ensured;
- Technical expertise, knowledge shall be accumulated; technical specialists shall be provided with trainings for studying, assessment and technical service of advanced technologies; Technological institutes, faculties shall be strengthened and their functioning shall be promoted; youth shall be supported for making internships abroad, at enterprises using advanced technologies, exchange programs shall be promoted, leading experts shall participate in scientific-practical events.
- Possibilities of starting new industries shall be explored looking at the examples of other countries; strategic directions shall be developed;
- While searching for the sources of raw material, prospects of development of other fields and possibilities of utilization of new, unconventional material (for example after introducing solid waste sorting and recycling technologies, utilization of biomass compost cement in production, etc.) shall be taken into consideration.
- For ensuring production and quality, quality management and enterprise certification mechanisms shall be developed.
- Possibilities of mutually beneficial cooperation with other fields shall be explored in the wake of introducing new technologies, for example, along with industrial processes, utilization of products or “waste heat”;
- Priorities and standards shall be set for the industries that shall be re-equipped and regenerated; optimal technologies shall be selected; plans, time-frames, sources of raw material and funding for their introduction shall be developed; implementing agencies shall be identified and intergovernmental regulations shall be developed.

These activities are the incomplete list of those measures, which is common for ensuring technological re-equipment/rehabilitation and fast development of the industry as a field. These actions shall be further added with specific measures for specific productions.

SECTION THREE: CONCLUSIONS AND RECOMMENDATIONS

Review of modern technologies as per sectors necessary for implementation of low emission development strategy showed that there is not enough potential in the country for proper functioning of the most of technologies (legislative and regulative base, services, knowledge, local technical specialists). Currently, priority technologies are introduced to the country and operated for couple of years by international multilateral financial institutions and private sector of the countries producing that specific technology. This is a positive direction and supports development of local services in the country; although, implementation of LEDS will required carrying out more aggressive policy from the state. Modernization of educational system of the country (technical institutions) and mobilization of donor funds, training of specialists abroad, a two to three year program.

Another direction is development of technologies on spot, which requires establishment of joint technological institute and joint enterprises in those technological directions that are priority for the country.

It is necessary to nominate a technical institute (or an institute operating in technological field) or non-governmental sector, responsible for introduction of priority technologies in climate change field, to climate technology center established under within the frames of Convention. It will be a responsible person/organization from Georgia which will have constant connection with the processes going on in this network and will be working with the government and local or international technological centers.

To ensure sustainable process of spread of technologies, it is necessary to eradicate all the above-listed barriers; regulation of gaps in legislation, including tax-financial components, as well as rising informational awareness level and educational system reform. As for services, their introduction and development will be partly caused by proper legislative base and financial support from the state.

3.C. ATTRACTING FINANCING

SECTION ONE: CLIMATE FINANCE STRATEGIC ROADMAP OVERVIEW

1.1 INTRODUCTION

The following section aims to propose to the Government of Georgia a Climate Finance Strategic Roadmap ("Roadmap"). While not a complete National Climate Finance Strategy, it aims to provide the strategic directions and describe some of the critical success factors required for attracting public and private sector financing for full scale implementation of the Low Emissions Development Strategy's mitigation measures. The current section is a summary of a full report produced as part of the EC-LEDS process.

As mentioned above, the current report does not include all the components relevant for a complete National Climate Finance Strategy. Furthermore, the action items and recommendations contained in this report vary in their level of detail depending on their relative importance and the quality of data and information which were available to the writers of the current report. Nonetheless, the report contains – in addition to suggested strategic directions – concrete recommendations and action items.

The Roadmap aims to integrate the various sections of the EC-LEDS document and to include- to the extent possible- all issues, recommendations, and insights identified in the other sections of the document and to refer and relate to their Climate Finance contexts.

The strategic vision which underlined the design of the Climate Finance Strategic Roadmap was that the full implementation of the LEDS recommended mitigation measures will have positive impacts on the Georgian economy including:

1. Increase in foreign direct investment
2. Increase in infrastructure projects implementation
3. Strengthening Georgia's economic competitiveness and increase in its exports through improved resource efficiency
4. Strengthening Georgia's energy independence and reduction of electricity and fossil fuel imports
5. Promotion of pro-poor economic growth in rural areas
6. Support in the implementation of Georgia's commitments under the EU Association Agreement

The aim of the Roadmap is to position Georgia as an attractive investment destination for public and private Climate Finance sources. The public Climate Finance sources referred to in this report [85]include international ones – such as Multilateral Climate Funds (GCF, World Bank Group's CIF, GEF), Multilateral Development Banks, International Financial Institutions and Bilateral Development Banks, Multi-Donor and PPP Funds and International Donors. The Georgian State Budget is also considered a domestic public source of capital. The Private Climate Finance sources referred to in this report include listed and non-listed Private Infrastructure Funds, Private Equity Funds, Private Debt Funds and Impact Investment Funds. Other sources of Private Climate Finance sources can

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[85] Brandt.2017.Review of International Financing Sources for the Implementation of the Georgian Low Emissions Development Strategy (LEDS). Report prepared for Winrock International for EC-LEDS project funded by USAID

include institutional investors such as pension funds and sovereign wealth funds, Philanthropic Foundations and Trusts, and Family Offices.

More specifically, the goals of the Roadmap are to achieve the following:

1. Maximize domestic and international public Climate Finance flows to Georgia for Project and Program Investment, Capacity Building, and Technical Assistance needs.
2. Maximize the catalytic impact of public Climate Finance flows by creating conditions that will attract both domestic and international private sector sources. The sources are expected to be from a wide range of financial market entities not necessarily directly related to Climate Finance.
3. Minimize the associated costs to the Georgian economy and to stakeholders involved in the implementation of the LEDS' mitigation measures (programs/projects), while maximizing the measures' positive economic and developmental impacts

Several Success Factors and principles have been identified during the preparation of the Roadmap and have been integrated in its design. These are critical for achieving the Roadmap goals and will be described in more detail below. They are the following:

1. High country ownership and involvement in all processes related to the procurement and allocation of international public and private Climate Finance
2. Concessional Climate Finance flows must reach the financial flows' end-users and main risk takers in relevant transactions. Other parties sharing the risks associated with the implementation of mitigation measures may also benefit from concessional finance – but at a lower priority.
3. Monitoring the nature and impact of Climate Finance flows is a critical activity. The monitoring is required not only for compliance with the Paris Agreement, but more importantly as a management tool – providing policy makers with the ability to prioritize the implementation of mitigation measures and programs based on accurate estimates of actual GHG emission reduction volumes and economic quantification of the measures' co-benefits and Sustainable Development impacts.
4. A diversified base of private sector finance providers is critical for maximizing the catalytic impact of public Climate Finance. This is mainly due to the difference in characteristics among LEDS mitigation measures' programs/projects and the requirement to match between these characteristics and finance providers' investment strategies, motivations and mandates.

1.2 BLENDED CLIMATE FINANCE

Blended Finance overview

One of the Roadmap's defined goals is to maximize the catalytic impact of public Climate Finance flows by creating the conditions that will attract both domestic and international private sector finance sources. The sources are expected to be from a wide range of financial market entities not necessarily directly related to Climate Finance.

One of the most relevant means to achieve this goal is through the strategic use of Blended Finance – a relatively new approach to financing development projects and programs in countries in transition and developing countries. Given that Blended Finance is a relatively new approach, a clear and acceptable definition for it has yet to be agreed upon on the international level.

The ReDesigning Development Finance Initiative (RDFI)[86] – a joint initiative of the World Economic Forum and the OECD defines Blended Finance as "*the strategic use of development finance and philanthropic funds to mobilize private capital flows to emerging and frontier markets*." The Blended Finance approach deliberately aims to channel private investment to projects, sectors and programs with high-development impact potentials while at the same time delivering risk-adjusted returns to private investors. The sectors Blended Finance targets include healthcare, climate change mitigation and adaptation, infrastructure investment, and any other sector with a high Development Impact. Blended Climate Finance is a sub-set of Blended Finance which focuses on investment in high impact projects and programs related to Climate Change Mitigation, Adaptation and Resilience. A minor difference between the two is that Blended Climate Finance can utilize funds from designated international Climate Funds (GCF, Adaptation Fund, Clean Technology Fund, etc.) in addition to other public Development Finance sources and institutions. In the current report, Blended Finance and Blended Climate Finance will both be used interchangeably depending on the specific context.

According to the RDFI, Blended Finance is commonly confused with two other investment approaches Public Private Partnership (PPP) and Impact Investment. PPPs designate a structure in which some services and infrastructure that are usually the public sector's responsibility are provided by the private sector under an agreed funding model (e.g., water or roads.) These are usually financed by the private sector, and in developing countries and countries in transition can also include public Development Finance (both domestic and international). Impact Investment is defined by the Global Impact Investing Network as "*investments made into companies, organizations, and funds with the intention to generate social and environmental impact alongside a financial return*." Impact investments can be made in both emerging and developed markets, and target a range of returns from below-market to market-rate, depending upon the circumstances. Impact Investments funds usually have elaborate monitoring systems for quantifying the development impacts of their investments.

The Blended Finance approach uses development finance and philanthropic funds in order to catalyze private sector investment in high-development-impact projects, merging these funds with funds raised from a wide range of private sector sources ranging from Impact Investors to other investors who are focused first and foremost on their financial bottom line. These can include Private Equity funds, Infrastructure Funds, AgFunds, pension funds, etc.[87].

[86] ReDesigning Development Finance Initiative.2015.Blended Finance Vol. 1:A Primer for Development Finance and Philanthropic Funders. Report prepared by ReDesigning Development Finance Initiative for World Economic Forum and the OECD

[87] Brandt.2017.Review of International Financing Sources for the Implementation of the Georgian Low Emissions Development Strategy (LEDS). Report prepared for Winrock International for EC-LEDS project funded by USAID

One of the main drivers of Blended Finance is the reduction of investment barriers to private sector investment – both domestic and international. This is achieved via a strategic use of a combination of financial instruments which constitute the building blocks of Blended Finance. Each of the EC-LEDS mitigation measures recommended for implementation has its own risk profile which can be either partially or wholly mitigated by a combination of relevant financial instruments. Financial Instruments which are commonly used in Blended Finance include Grants- which usually fund early-stage costs and activities which lead to investment; Concessional Debt – which provides debt on favorable terms, shifts investments' risk-return profile and provides investors with a risk buffer; Market Rate Debt- which demonstrates investments' viability and provides investor comfort; Junior Equity- which absorbs the highest equity holder risk; Equity (Common Stock) - which demonstrates investments' viability; and Guarantees and Risk mitigation instruments - which protect investors against capital losses and provide credit enhancement.

Blended Finance Characteristics, Drivers, Benefits and Risks

The key characteristics, drivers and potential benefits, and the risks associated with Blended Finance are detailed in the following table. A full description of these is available in the Full Report.

Table 26. Blended Finance Characteristics, Drivers, Benefits and Risks

Characteristics	Drivers and Potential Benefits	Potential Risks
1. Tangible Development Impact: Projects which receive Blended Finance are supposed to drive tangible social, environmental and economic progress	1. Significant financing gap: Available ODA financial flows insufficient to fulfill ambitious development goals.	1. Financial incentives outweighing development principles: It is unclear to what extent the development impact potential of a Blended Finance project was the driver for investment.
2. Market-based returns for private investors: The financial returns for private investors should be in line with market expectations, based on real and perceived risks.	2. Blended Finance's impact potential: Mainstreaming climate related and development impact investments through the strategic use of concessional finance	2. Poor project alignment with developing countries' national development strategies: Blended Financed projects with relatively higher financial returns and relatively lower development impacts could divert ODA/Public finance from high-national-priority project types
3. Leverage: The aim of the funds sourced from development finance institutions, philanthropic funds and national governments is to attract private capital into deals	3. Enhancement of government ownership: Blended Finance's potential in enhancing governments' ownership of development assistance	3. Uncertain Project additionality: Additionality refers to the added value and developmental impact due to the involvement of ODA/concessional finance. If the project **would not** have been implemented without the concessional finance, the project is deemed additional.
4. Investment risk buffer/mitigation structuring: Finance sourced from development finance institutions and other public entities is - in most case- used as a buffer protecting the private sector's investment returns. This is the way in which public finance manages to have a catalytic impact.	4. Increase in ODA effectiveness: Blended Finance's potential in increasing effectiveness of ODA finance through improved coordination among developing countries' governments, development agencies and the private sector.	4. Local financial market distortion: If a project financed by ODA finance is non- additional, it – by definition – distorts the local financial market and crowds out private investment
5. Catalytic impact defines Blended Finance: A transaction which involves only market-priced funding from a development finance institution	5. Reduction of investment barriers to high development impact projects and programs: Blended Finance's potential in	5. Monitoring projects' development impact: Monitoring the development impacts, the financial leverage (catalytic impact) of the ODA/public finance, and quantifying how and whether

Characteristics	Drivers and Potential Benefits	Potential Risks
should not be considered as a Blended Finance transaction as it lacks the catalytic impact and crowds out private finance sources	reducing Investment barriers for international private investment (high transaction costs, lengthy transaction times, local knowledge gaps, challenging domestic regulatory environment, liquidity risks, forex risk and political risk)	the grant element had enhanced the project's positive development impact can be more challenging under a complex Blended Finance structure.
6. Impact Monitoring and Performance Assessment: A Monitoring and Evaluation (M&E) system which provides accurate and quantified estimates of a Blended Finance investment's impact should be an integral part of each investment. Without one, it would be hard to justify the use of public finance in such a transaction. Impact quantification should be performed over the life of the investment and should relate to the actual impact post-implementation rather than to the forecasted impact prior to project implementation.	6. Re-calibrating international and domestic investors' risk perception: This is relevant both for mature technologies which have not yet been implemented in a country, and even more so for less mature technologies. The demonstration effect of projects using such technologies can shift a project category from experimental to mainstream.	1. Reduction of ODA flows' transparency and accountability and Added Related Costs: Blending mechanisms may impact transparency and accountability issues. These can occur in the project selection process, the mechanisms of funding and flows of funds, and most importantly in a lack of a clear identity of the final recipients of concessional finance. In addition, costs related to complex Blended Finance transactions could prove high, and be borne by project developers and implementers. (See Full Report section "Blended climate finance – indications of costs and fee structures")
	7. Building capacity and expertise in domestic private and public sectors: This is especially relevant for domestic financial markets, technological and project management disciplines.	2. Debt burden risks for developing countries from increased lending: Especially if receipt of ODA grant funding is conditional on the country taking market rate debt (typical Blended Finance grant-to-loan ratio is 1:4):
		3. The risk to differentiate in favor of middle-income countries: Most private investment currently flows to middle-income countries .This is a systematic risk for Blended Finance but could prove as an advantage for Georgia.

Conclusions and Implications

The opportunity to use Blended Climate Finance in the implementation Georgia's LEDS/INDC mitigation measures is enormous - both in terms of financial flows' volumes, the large positive potential impact on the Georgian economy, and on Georgia's honoring its European Association and Paris Agreement commitments. A well-structured national level initiative to blend financial flows from designated Climate Funds, MDBs, Development Finance Institutions, international private sector investors (PE Funds, Investment Banks, Infrastructure Funds, Impact Investment Funds, etc.) has the potential to transform the country in many ways.

However, the use of Blended Finance is not risk-free, and therefore requires – quoting the Head of the IFC's Blended Climate Finance Unit when describing the unit' operations – "*Target and Discipline.*" Some of the risks associated with Blended Finance have been described in the table above, and include misuse of development funds to finance non-additional projects with high financial attractiveness but low development impact; poor alignment with developing countries' national development priorities; local capital markets' distortion; unsustainable increase in developing countries' debt burdens; reduction of ODA flows' transparency and accountability through complex transaction structures, etc.

Below is a summary of some of this report's findings related to Blended Finance and its potential implications:

1. <u>Blended Finance- not a long-term subsidy program funded by donor countries:</u> Blended Finance alone will not be sufficient to create attractive and replicable investment conditions for large-scale participation of international and domestic private sector investors. Reform of regulatory and tariff framework- that will most likely result in higher utility tariffs - will be required in order to create such conditions. The government and citizens of Georgia should therefore be considered as equal risk-taking stakeholders in Climate Blended Finance transactions both directly and indirectly.
2. <u>Blended Finance's Catalytic Impact critical importance and variability in performance:</u> Reaching donor countries' and MDBs' catalytic impact objectives[88] is – and will remain in the years to come – an ongoing challenge. On some occasions[89]., the arithmetic value of leverage impact parameters reported by various International Financial Institutions do not necessarily reflect the actual catalytic impact of a Blended Finance transaction. Reaching a high leverage ratio is of critical importance for the successful and full-scale implementation of the LEDS mitigation measures, and should be a high government priority. This will be achieved only through strong and meaningful government involvement –a "*Laissez faire*" approach will not produce the required results.
3. <u>Blended Finance transactions' complexity, transparency and associated costs:</u> Blended Finance transactions are complex – using a variety of financial sources of different natures and a wide range of financial instruments. Blending public and private financial sources can result in low transparency of public finance impact. Costs associated with complex transactions can be consequential and may prevent the full financial concessionality component from reaching the end-user/final recipient of the financing. (Costs for Blended Finance transaction – undisclosed but significant. Costs for Capacity Building and Technical Assistance- 7-10% of budgets. For more information see Full Report in the annex. Sub-section "*Blended Climate Finance – Indications of Costs and Fee Structures*").

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88 According to various source, the Public to Private Leverage ratio of Blended Finance ranges from 1 1 to 1:20. In other words, for every 1$ of public finance an average of 10$ of private sector investment can be leveraged.

89 See Full Report. Sub-section "*Case studies*".

Blended Climate Finance Ready – key skills, capabilities and capacities

Below are some of the key skills, capabilities and capacities that need to be refined, strengthened and developed by the Government of Georgia and other stakeholders in the country – and that reflect the goals and principles of the Roadmap:

1. Creation of a viable Blended Finance pipeline of projects and programs. This includes project and program origination and implementation, the creation of project portfolios and programs (aggregating several or many small-scale projects, when required) and structuring these portfolios and programs in a manner that will allow selling them as investment products to private sector investors. This also includes streamlining of the project and program origination processes through standardized deal terms and standardized use of financial instruments.
2. Facilitation, coordination and relationship/partnership management between the relevant stakeholders and parties in Blended Finance including international sources of capital (public and private), domestic sources of capital, and the domestic private sector (entrepreneurs, asset owners and project developers).
3. Raising finance from public and private sector financing sources in international markets and making optimal matches between finance source and project/program based on their respective risk exposure and risk profiles.
4. Developing the domestic capital market and promoting its integration in Blended Finance transactions.
5. If and when required, have sufficient flexibility to design and implement interventions and support structures as per specific programs' and projects' requirement, and have the capacity to provide the support directly to approved projects. Such design would entail a wide range of financial instruments including concessional loans.
6. Developing an accurate and detailed Monitoring and Evaluation system (MRV[90] system) for all mitigation measures implemented as part of the LEDS. The system would need to comply with Paris Agreement principles and UNFCCC guidelines. It would also need to provide decision makers with an accurate assessment of the impact and performance of all implemented programs and projects in a manner that will allow them to identify and prioritize high performing programs and reallocate resources accordingly. The MRV system should include measurements of GHG Emission Reduction Impacts; Non GHG Co-Benefits and SDG impacts; and Blended Finance Catalytic impact in attracting private domestic and international capital sources. Other relevant financial parameters include- inter-alia - financial instruments' types; level of concessionally in the Blended Finance transaction; and a breakdown of how this concessionally is shared across stakeholders and counterparts in the Blended Finance transaction.

90 MRV- Monitoring Reporting and Verification

SECTION TWO: CLIMATE FINANCE ROADMAP- RECOMMENDATIONS

2.1 INTRODUCTION

The following section includes recommendations for achieving the Roadmap's strategic vision and aim – the full scale implementation of the EC-LEDS mitigation measures and positioning Georgia as an attractive investment destination for public and private Climate Finance sources – both international and domestic.[91] The majority of recommendations are practical and tangible in nature, and have been designed with the aim of providing the government of Georgia with a high degree of flexibility in their implementation. The recommendations are directly linked to the Roadmap's suggested goals and principles which have been defined following extensive analysis of the potential positive impact and risks associated with Blended Climate Finance. For more information relating to the recommendations included here see the full report.

2.2 GEORGIA AS A CLIMATE FINANCE LEADER: TIME TO ACT -NOW

Georgia is a small, middle-income country with a population of 3.7 million people and an area of 69,875 km. The climate of Georgia is extremely diverse, considering the nation's small size – with 12[92] different climatic zones. According to the UN 2013 Human Development Index, Georgia was ranked 40th for the education level of its population (which accounts for historic as well as current trends), while the gross primary enrollment ratio was very high for the period of 2012–2014, the second highest in Europe after Sweden[93]. In 2014[94] Georgia and the EU have signed the European Association Agreement which aims to deepen political and economic relations between the parties to the agreement. The Association Agreement entered into force in July 2016. As part of the agreement, Georgia had made commitments in the areas of democracy and the rule of law, human rights, good governance, market economy and sustainable development.

In terms of previous involvement in Climate Finance, Georgia's track record – and specifically its involvement in the Clean Development Mechanism - had been unimpressive. The lessons from its involvement, and from the involvement of other countries in the Clean Development Mechanism have been incorporated into the design of the Roadmap. It is the opinion of the writers of the current report that positioning Georgia as an attractive investment destination for Climate and Blended Finance is a viable possibility, and that Georgia also has the potential to become a regional Climate Finance hub and a Technology Transfer leader.

Given Georgia's many advantages – a relatively small area with a large number of distinct climatic zones, the European Association agreement under which Georgia has made sustainable development commitments and which opens the door for public and private sector involvement in the fields including Energy and Resource Efficiency, Waste Management, etc., the education level of the population and its status as a middle income country, Georgia has the potential to become a national-size "Climate Finance and Technology Transfer Lab" – where new approaches to Climate Finance; and new, emerging and first-of-their-kind technologies are tested and piloted before being replicated on a larger scale in neighboring countries. The added value to the Georgian economy in addition to the direct impacts from implementing such projects would be to enhance technical, project/program management and other types of expertise which could be transferred and exported at a later stage to other countries in the Caucasus region.

One aspect of Climate and Blended Finance which has not been sufficiently highlighted in the report so far, is that both fields are both in early stages of development and implementation and are

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91 Brandt.2017.Review of International Financing Sources for the Implementation of the Georgian Low Emissions Development Strategy (LEDS). Report prepared for Winrock International for EC-LEDS project funded by USAID.

92 FAO website.2017.Georgia country profile

93 World Bank website.2016.DataBank

94 European Commission website.2016

therefore constantly evolving and dynamic. As a result, common practices are still in the process of development. Under such conditions, there is great value in being active in these fields at their early stages of development. *"Learning by doing"* would not be an exclusive description of Georgia's experience in these fields, it is the shared experience of all stakeholders operating and wishing to operate in them. Under such conditions, a small but motivated developing country that is willing to allocate resources and effort can become a significant and pioneering player in the field, and position itself as a high priority Climate Finance destination.

Given this background, the issue of timing becomes very important. The window of opportunity for Georgia to position itself as a high priority Climate Finance destination is **now**. If the Government of Georgia waits until the field matures, the country's comparative advantages relative to other developing countries will shrink, and the likelihood of Climate Finance flows reaching the country will significantly decrease. As these fields mature Climate Finance and Blended Finance flows are likely to focus on larger and less developed countries. At such a stage, Georgia's population size and middle-income status will likely become impediments for attracting Climate and Blended Finance.

2.3 RECOMMENDATION 1: ESTABLISHMENT OF GEORGIAN GREEN INVESTMENT BANK

It is the conclusion of the writers of the current report, based on the extensive analysis that features in it that the establishment of a national level financial institution – Georgian Green Investment Bank - which will play an active part in Lending and Blending loans to projects and programs related to the implementation of LEDS mitigation measures, should be a cornerstone in the implementation of Georgia's Climate Change related policies.

global Green investment Banks - mandates, goals and functions

According to a recent report by the Natural Resources Defense Council[95] as of 2016, 13 Green Investment banks (GIBs) had been established in local and national jurisdictions around the world. Almost all of these entities were formed by national or local governments with a specialist and a narrow objective of facilitating clean energy, energy efficiency and/or resilient investments. Many reputable organization in addition to the NDRC have published reports[96] which highlight the positive potential of GIBs in developing countries include the UNDP[97] and the OECD[98]. According to the UNDP, GIBs are consistent with several principles of the Paris Declaration on Aid Electiveness and the Accra Agenda for Action, including national ownership and alignment with national priorities; harmonization and coordination; effective and inclusive partnerships; and achieving development results and accounting for them.

Existing GIBs are public or quasi-public entities, capitalized with funds that are derived from legislative action, taxes or other contributions of public money into a special financing vehicle. While many have the moniker, none of these institutions are "banks" in the classic definition, meaning they do not take deposits, manage savings, or provide direct financing to consumers. They are, however, meant to be stand-alone, self-sustaining, specialist finance entities, operating similar to a bank or a national fund that are dedicated to understanding and addressing the specific national and local barriers to increase private investment in low carbon resilient infrastructure.

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[95] NRDC - National Resources Defense Council.2016.Green and Resilience Banks How The Green Investment Bank Model Can Play A Role In Scaling Up Climate Finance In Emerging Markets

[96] These three reports are have been an important source for all content appearing in the current report

[97] "Flynn.2011.Blending Climate Finance through National Climate Funds: A guidebook for the design and establishment of national funds to achieve climate change priorities. Report prepared for UNDP"

[98] OECD.2017.Scaling Up Private Investment In Low-Carbon, Climate-Resilient Infrastructure

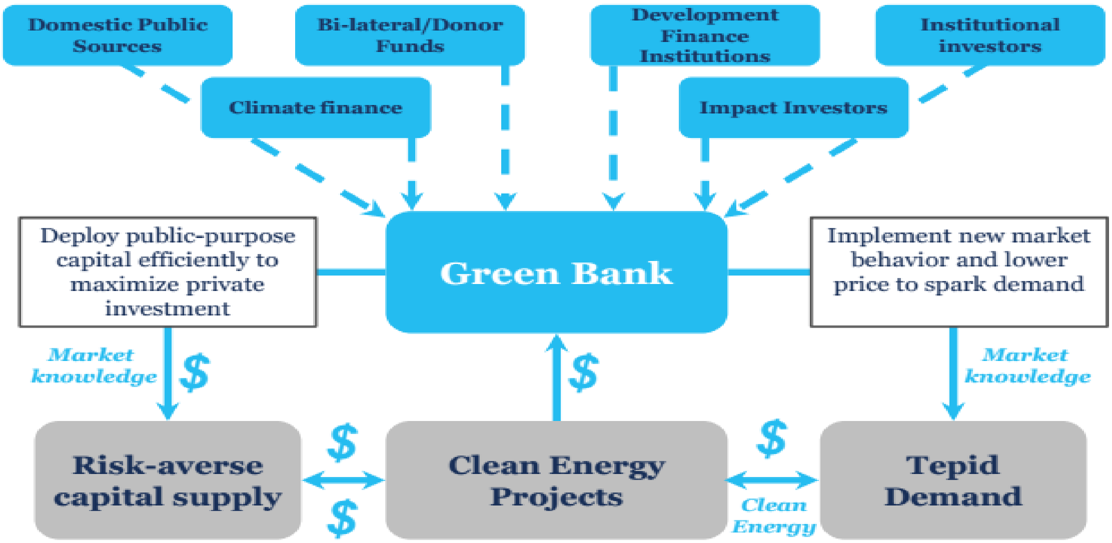
According to the NDRC report, to date most GIBs have been established in OECD countries, but several developing and emerging economies are actively exploring opportunities to establish a GIB or a GIB-like entity as GIBs can have, when carefully designed, well capitalized and dutifully managed, the potential to address many of the barriers inhibiting investments in low carbon and resilient infrastructure. The GIB model can help increase investment in low carbon and resilient infrastructure by performing several functions and goals including:

1. Creating of a viable Blended Climate Finance pipeline of projects and programs.
2. Being a locus of financial innovation to meet local market needs including developing the domestic capital market and promoting its integration in Blended Finance transactions
3. Being a country's main counterparty in Blended Climate Finance involvement and main partner in collaborations with international sources of Climate Finance. This includes facilitation, coordination and relationship/partnership management between the relevant stakeholders and parties in Blended Climate Finance transactions including international sources of capital (public and private), domestic sources of capital, and the domestic private sector (entrepreneurs, asset owners and project developers). Responsibilities under this function can also include raising finance from private and public-sector sources in international and domestic markets and making optimal matches between the finance source and the project/program based on their respective risk exposure and risk profiles.
4. Serving as a depository and local center for expertise related to low carbon and resilience investments. The GIB can become an important central source of knowledge, expertise and practical experience that consolidates and disseminates lessons from the design and implementation of climate related projects and programs.
5. Policy assurance (Social and Environmental safeguards), Financial Controls and Performance Measurements. A GIB can supply national and project-level monitoring systems to ensure that quality standards are met throughout its operations. The implementation and operation of an accurate and detailed Monitoring and Evaluation system (MRV system) should also be integrated as part of a GIB function. It can also assure projects' alignment with national level strategies and priorities.
6. Helping countries achieve climate goals and implement the mitigation means described in their respective Intended National Determined Commitments – submitted to UNFCCC as part of the Paris Agreement.

GIBs mandates and goals differ and have different focuses depending on the specific national context in their market of operation, and on the investment barriers they were designed to alleviate. In addition, when assessing GIBs' mandates and goals from different regions, one finds common goals such as lowering the cost of capital for climate related projects, lowering energy costs, developing green technology markets, supporting local community development, job creation with a focus on high expertise roles, reaching financial sustainability and a profitability level sufficient for the continued operations of the bank with limited injection of additional public financing, and reduction of private investment entities' clean technologies' risk perception.

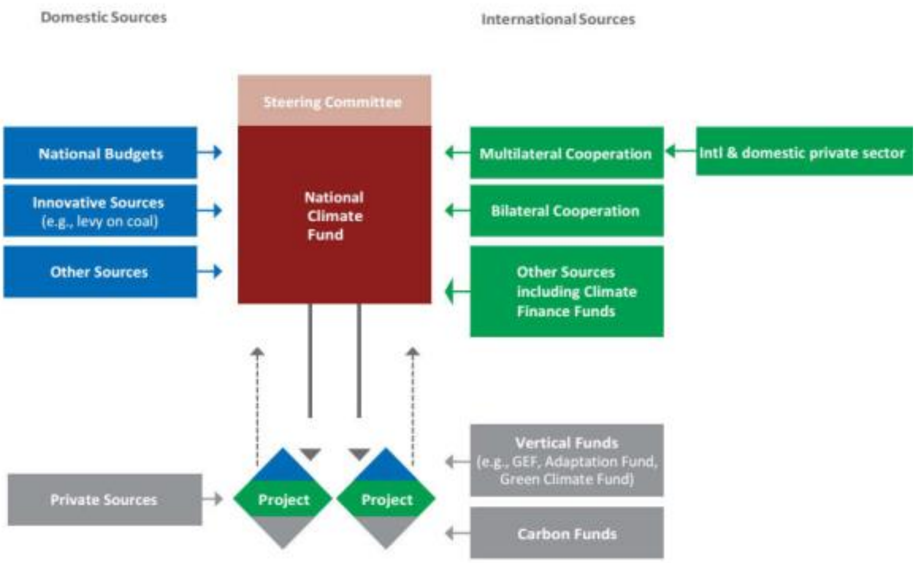
The capitalization of a GIB and its structure are interdependent and while capitalization structures differ across GIBs, there are similarities among them. The vast majority of GIB's have the domestic public sector as the initial source of capitalization – with funding originating from a variety of sources such as state budgets, tax revenues (i.e. excise tax), revenues from utility services and bond issuances. Additional sources of capitalization relevant especially for developing countries include Public Climate Funds, donors, MDBs, DFIs, philanthropic trusts and foundations, Impact Investment Funds, and Institutional Investors such as Pension Funds and Sovereign Wealth Funds.

Below are two examples for capitalization structures appearing in the UNDP and NDRC reports respectively.



Source: NRDC - National Resources Defense Council.2016.Green and Resilience Banks How the Green Investment Bank Model Can Play a Role In Scaling Up Climate Finance In Emerging Markets

Figure 74: Endless Blending possibilities –Conceptual Capitalization Structure of GIB



Source: Updated by writers of report. Based on UNDP.2011.Blending Climate Finance through National Climate Funds: A guidebook for the design and establishment of national funds to achieve

Figure 75 : Endless Blending possibilities -Conceptual Capitalization Structure of GIB

Georgian GIB (GGIB) – Georgia Specific context

A well-designed, well-capitalized and well-managed Georgian GIB, which will function as the national-level entity responsible for implementing the Georgian climate change and development strategies (LEDS mitigation measures/INDC implementation) and as the main stakeholder in Blended Climate Finance transactions, has the potential to address many of the barriers inhibiting investment in low carbon and resilient infrastructure, and to achieve the Roadmap's aim of positioning Georgia as an attractive investment destination of public and private Climate and Blended Finance sources. Below are several important capabilities and functionalities which need to be included in the design of the Georgian Green Investment Bank:

1. **Direct access to GCF and other public finance sources**

   The GGIB should – as early as is practical –become a Green Climate Fund Direct Access Accredited Entity under the Specialized Fiduciary Standards. The accreditation will allow the GGIB to be involved in Lending and Blending, Grant Awarding and Project Management. All of these activities are required for the GIB to fulfill its proposed mandates and goals. Similarly, the GGIB should get relevant accreditation from other sources such as the Adaptation Fund, the Global Environmental Facility etc. Receiving Accreditation from these entities would not only allow the GGIB to originate and provide loans to relevant projects, it will also increase the GGIB's international credibility and will allow it raise finance from to other public sources of Climate and Blended Finance – and specifically Bilateral DFIs and Funds. It is also likely to increase the GGIBs likelihood in partnering with and raising funding from international private sector investors.

2. **Ability to provide Direct Concessional loans- EE example**

   One of the capabilities identified as required in order for the Government of Georgia to be "Blended Climate Finance Ready" was to have the sufficient flexibility and a degree of independence in distributing concessional loans (i.e. loans with below-market rates) directly to selected projects and programs. Given the market disturbance impact of such activities, Central Banks are usually opposed to the implementation of such measures, and it is likely that the National Bank of Georgia will oppose them as well.

   In order to illustrate the risk exposure facing a manager of an SME, public entity (school, kindergarten, etc.) or household who is considering the installation of a generic Energy Efficiency Appliance, a simple Energy Efficiency model was developed. The full assumptions of the model and its results are included in the Full Report. The conclusions and recommendations are the following:

   a. The Equity NPV and IRR are strongly impacted by the interest rate on the loan. When the loan interest rates are relatively high, there is very little room for error in the value of the appliance's technological performance. In other words, for loans with typical Georgian interest rates, a small error in the estimation of an appliance's energy efficiency gains can quickly result in losses to the owner/manager of the SME, household or public entity.

   b. In order to reach widespread adoption of energy efficient technologies, the government needs to offer households and SME's strong risk mitigating incentives. It is the opinion of the writers of the current report that a Georgian Green Investment Bank that will have the mandate to offer below-market interest loans is the optimal entity to provide and manage the required incentive programs.

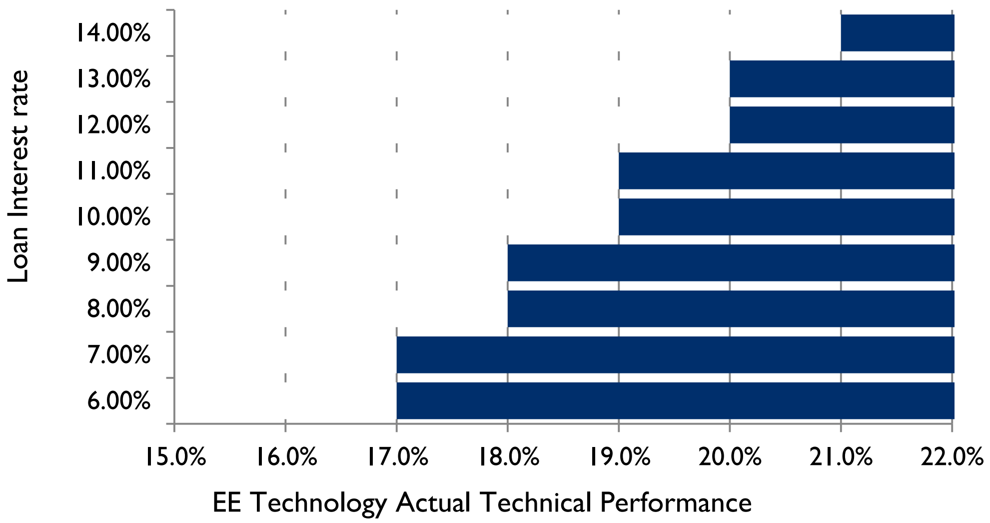


Figure 76. Technical Performance range in which default does not occur as a function of loan interest rate

3. **<u>Exit strategy structuring – from inception</u>**

Crowding out of private sector investment is one of the main arguments presented by opponents to the establishment of a national Green Investment Bank, and it is likely that this argument will also be used against the establishment of the Georgian Green Investment Bank. While the argument can be valid in certain instances, it is the opinion of the writers of the current report that it should be approached as a risk to be mitigated, rather than an argument against the establishment of a Green Investment Bank.

Thus, it is highly recommended that the GGIB approach any investment with an exit strategy in mind – and more specifically – an exit strategy at an optimal stage in the lifecycle of a project or program that would allow the GGIB to reuse the proceedings and potential profits from the exit to finance the next program/project in its pipeline. Furthermore, the exit strategy should first consider domestic Georgian banks as potential buyers of the GGIB investments – and transform the GGIB's exit strategy into a mechanism that crowds in domestic investment in climate related projects.

4. **<u>Georgian GIB Technology Transfer Capabilities</u>**

Georgia has the potential to become a national-size "Climate Finance and Technology Transfer Lab"– where new approaches to Climate Finance and innovative, first of their kind technologies are tested and piloted before being replicated on a larger scale in neighboring countries. In order to achieve this potential, the GGIB would have to develop the technical skills to identify viable innovative technologies, the capacity to integrate these as part of pilot programs in various climatic regions of the country, and the ability to accurately measure and monitor the innovative technologies' impact on a long term and continuous basis. These capacities and skills – though similar to those used with more mature technologies require an extension of the GGIB capabilities and mandates.

It is thus strongly recommended that the GIB have all the necessary tools (i.e. External and internally developed databases), and the market intelligence capacity to continuously identify relevant domestic and international Technology Transfer stakeholders, and to manage the physical implementation of pilot programs.

It is also recommended that such implementation of pilot programs include relevant public Climate and Blended Finance sources (Climate Funds, MDBs, donor, DFIs etc). It is envisioned that such activities would receive Grant and Concessional Loans for the lion's share of their implementation.

5. **Public and Private sector financial sources Identification and Relationship management**

   One of the mandates of a GIB is facilitation, coordination and relationship/partnership management among the relevant stakeholders and parties in Blended Finance including international sources of capital (public and private), domestic sources of capital, and the domestic private sector (entrepreneurs, asset owners and project developers). In order to maximize the catalytic impact of public financial resources and minimize the costs associated with the full-scale implementation of the LEDS mitigation measures, a strong understanding of both the public and private investment sources will need to be developed.

   It is thus strongly recommended that the GIB have all the necessary tools and the market intelligence capacity to continuously map the Blended Climate Finance architecture and identify the most relevant investors for its project and program pipeline. This systematic approach to investor identification is likely to add a dimension to more relationship- and networking- (participation in international conferences, etc.) focused activities. Naturally, given that building relationships with investors is a long process, the GGIB would have to proactively engage and approach public and private sector investors which have been identified as likely to invest in GGIB projects and programs.

6. **Georgian GIB- Climate Resilience and Adaptation Responsibilities**

   Climate related projects and programs have historically focused on climate change mitigation – i.e. reducing the GHG emissions associated with different economic activities by investing and promoting inter-alia renewable energy, energy and resource efficiency and waste management technologies. Certain recommended LEDS mitigation measures, especially in Forestry and Agriculture, have a combined climate related impact of both GHG Emissions mitigation and Climate Change Adaptation.

   According to the UNFCCC, Climate Change Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climate change related effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. It is recommended thus that the GGIB receive a mandate and develop the expertise and capacity necessary for investment in Climate Adaptation projects.

Georgian GIB –Principles of structure selection and capitalization

There are several considerations that need to be taken into account when the Government of Georgia makes a decision relating to how the GGIB should be structured. The entity's structure should allow for the following:

1. Ability to receive Direct Access Accreditation for Lending and Blending activities from the Green Climate Fund and other public Climate Finance entities in as little time as possible.
2. Degree of independence from the Georgian government.
3. High degrees of accountability and transparency.
4. Ability to harness strong government support when required, specifically with respect to reducing administrative barriers related to potential projects and programs
5. Current capacities, skills and expertise include these required from the GGIB as described in the current report. In other words, an entity which already has experience and some of the

technical, financial and other skills in-house would be better positioned to take on the responsibilities of the GGIB.

Even after the application of these principles, there is a high degree of flexibility as to which existing or yet to be established entity could take on the proposed responsibilities of the GGIB. Below are listed a few such alternatives:

1. **Integration of the GGIB as part of the Georgian Partnership Fund:**

   The Georgian Partnership Fund (PF) is a state-owned investment fund, established in 2011.The fund is assigned a Fitch rating of "BB-", which is equal to the sovereign ceiling of Georgia. It was created following the consolidation of Georgia's largest state-owned enterprises operating in the transportation, energy and infrastructure sectors.

   The Fund's main objective is the promotion of investment in Georgia by providing co-financing in projects at their initial stages of development. It aims at attracting and supporting international private investors in Energy, Agriculture, Manufacturing, Real estate and Tourism, and Logistics and Infrastructure.

   Expansion of the roles and responsibilities of the Partnership Fund to encompass the responsibilities of the GGIB is thus a viable alternative. Capacity building will be required in a wide range of disciplines including mitigation measures' program development, MRV system design and implementation, and in sectors in which the Fund is not currently operating in, such as household Agriculture and Forestry.

2. **Integration of GGIB as part of the Georgian Energy Development Fund:**

   The GEDF is a joint-stock company, founded by the Ministry of Economy and Sustainable Development. 100% of the Fund's shares are state owned, and its management rights are with the Georgian Ministry of Energy. It has a historic track record of renewable energy and thermal energy projects' development and investment in Georgia, and in building partnerships with international private sector investors.

   It has strong in-house skills specifically related to renewable energy projects' development and implementation. These include: renewable energy project origination, early stage development, feasibility study management and due diligence; relationship management with international private sector investors; project planning and management; and supervision and oversight of projects during their construction phases.

   Expansion of the roles and responsibilities of the GEDF to encompass the responsibilities of the GGIB is thus a viable alternative. Capacity building will be required in a wide range of disciplines including mitigation measures' program development, and in sectors in which the Fund is not currently operating in, such as Agriculture (commercial and household), Forestry and Industry.

3. **Establishment of a new entity and other potential structure:**

   While the establishment of a new entity would require more time and resources, it is a possible alternative.

The GGIB's initial capitalization will be dependent to a very high degree on the Georgian Government's decision with regards to its structure. One of the recommendations in Georgia's National Energy Efficiency Action Plan[99] includes capitalization mechanisms such as funding from a

[99] Eco Ltd.2017. Georgia: Assistance with the Drafting of the First National Energy Efficiency Action Plan (Phase I).Draft 1. Project prepared by Eco Ltd and partners and financed by the EBRD and SIDA – the Swedish Aid Agency

line item in electricity/natural gas bills; funding from an increased excise tax or other fee on cars which have larger engine sizes/fuel consumption; a levy related to energy usage of industrial companies if they do not meet their commitments for energy efficiency, etc.

Additional capitalization sources - which with time are expected to become substantial-can be the Green Climate Fund, and a variety of public and private sector investors in the Blended Climate Finance space.

Finally, in the long term, it is expected that the GGIB – given its proposed mandate – will reach a financial sustainability and profitability level sufficient for the continued operations of the bank with limited injection of additional public financing. An additional source of long term revenue is expected to be successful exits from investments.

2.4 RECOMMENDATION 2: ESTABLISHMENT OF THE CLIMATE INTELLIGENCE TASKFORCE (CIT):

As mentioned above, the issue of timing is of crucial importance. This is due to the fact that as the Blended Climate Finance field will mature, Georgia's comparative advantages will shrink, and its size and status as a middle-income country may prove to become disadvantages. Furthermore, the current report identified Capacity Gaps that need to be addressed, including legal, regulatory, policy-related, economic and financial analysis, technical, impact monitoring and measurement, etc.

Given the urgency and the need for high prioritization, it is recommended to set up a Climate Intelligence Taskforce which will provide the Georgian Government with the strategic support required for planning, budgeting, policy analysis and design, market intelligence and all other services required for a timely and successful implementation of the Georgian INDC/LEDS through the use of Blended Climate Finance. The taskforce will have to address a wide range of multi-disciplinary challenges, and some of these are likely to become apparent only after the Taskforce commences operations.

There are several structural alternatives for the implementation of the taskforce. The main structural considerations for the successful operations of the taskforce include quick and efficient set-up, ability and expertise to take on the suggested responsibilities listed in this document, continuous operations (Not a matrix structure), proximity to decision makers and ability to coordinate between governmental ministries, donor organizations and other stakeholders.

Given the multi-disciplinary nature of the taskforce, it is likely to include experts from various Ministries including Ministry of Environment, Ministry of Energy, Ministry of Finance, Ministry of Economy, the Prime Minister's Office, etc. In addition, expertise from national agencies such as the Georgian Statistics Agency will also be required – especially relating to the MRV system design and management. While there may be an advantage in terms of proximity to decision makers and a quick and efficient set-up for the taskforce to be part of the Prime Minister's Office, there are also advantages for distributing the responsibilities of the Taskforce between the Ministries with the highest levels of expertise in the relevant fields.

Climate Intelligence Taskforce - Proposed Functions and Priorities

Some high-priority issues that need to be addressed by the taskforce in a timely manner include the following:

1. **<u>The Establishment of the Georgian Green Investment Bank</u>**

   The Georgian Green Investment Bank is expected to be the Government of Georgia implementation arm in the development and full-scale implementation of the LEDS mitigation measures as well as an important stakeholder in Blended Climate Finance transactions. In order to establish the Bank, a variety of executive and administrative decisions need to take place relating to its structure, mandate and goals, initial capitalization sources, legal and regulatory considerations, sectoral focus etc.

   It is thus recommended that all issues pertinent to the establishment of the GGIB receive priority, and be under the responsibility of the proposed taskforce. Beyond the establishment of the GGIB, it is envisioned that the taskforce, or a similar entity, will provide short, mid and long-term policy, strategy, and regulatory support to the Bank; as well as long-term supervision of its activities.

2. Central MRV Design and Implementation Facility[100]

It is recommended that the taskforce be responsible for the initial design, development and implementation of the Georgian Monitoring, Reporting and Verification Framework and system. It is likely that GeoStat and GGIB staff would have to be involved in the design of the system, as it is important that the design of such a system involves all its relevant stakeholders and that the balance required between accuracy and practicality is achieved.

The usual context in which a national MRV system is discussed is related to compliance with the Paris Agreement. The agreement includes universal and harmonized MRV provisions on climate change mitigation activities which will be part of countries' implementation of their Nationally Determined Contributions. The ability to measure the impact of activities, actions and policies implemented by country as part of their NDC is indeed an important one, as is compliance with international agreements. Measurement is needed to identify emissions trends, determine where to focus greenhouse gas (GHG) reduction efforts, track mitigation-related support, assess whether mitigation actions planned under NDCs are proving effective, evaluate the impact of support received, and monitor progress achieved in reducing emissions. In the context of the use of Blended Climate Finance, however, other issues relating to MRV gain in importance. These contexts are the following:

1. MRV as a Georgian Competitive advantage:
    a. The design of a well-functioning MRV system is a technical and conceptual challenge facing many developed and developing countries, and has so far been a time-consuming effort. While challenging, it is the opinion of the writers of the current report that Georgia has the potential to develop a world-class MRV system due to its technical and engineering capacity and its relatively small size. The existence of such a system could serve Georgia in attracting international public institutions (Climate Funds, MDBs, DFIs), as well private sector Impact Investment.
2. MRV as a policy decision-making tool:
    a. The large-scale implementation of the LEDS mitigation measures will surely create both efficient and inefficient project and programs. Given the risks associated with Blended Climate Finance, it becomes imperative for the government of Georgia to control and mitigate these risks. The MRV system should thus be considered a policy decision-making tool allowing decision makers to quickly identify inefficient programs and projects and take mitigating actions ranging from program revision to program termination.

3. Coordination of donor climate related activities

According to various stakeholders consulted during the preparation of this report, the present level of coordination between various climate-related donor-sponsored Capacity Building and Technical Assistance programs in Georgia needs to be improved. Inefficient coordination between such programs can result in reduced efficiency and unnecessary overlap between Capacity Building and Technical Assistance programs. Similarly, it can result in a scenario where the scoping and definition of Capacity Building and Technical Assistance projects and programs are only partially aligned with the Georgian Government's long term strategic goals.

In addition, the current report has identified several capacity gaps that need to be addressed in order to maximize the positive impacts of the full-scale implementation of the

100 For a detailed breakdown of MRV system requirements, see Full Report

LEDS mitigation measures. It is thus likely that new Capacity Building and Technical Assistance projects and programs aiming to address the capacity gaps will be proposed and implemented in Georgia in the years to come. In order to increase the efficiency and positive impact of Capacity Building and Technical Assistance projects, a centrally managed approach to such programs is recommended. Under such an approach, the taskforce, or other entity, would have some of the following responsibilities:

1. Serving as a centralized information and knowledge repository for Climate Finance related Capacity Building and Technical projects and programs.
2. Preparation of a three to five year national-level climate-related Capacity Building and Technical Assistance plan which would prioritize sectoral, thematic and regional scopes of activities based on the capacity gaps identified and the government strategic development goals.
3. Providing the government with advice relating to the optimal use of programs and budgets in order to close capacity gaps identified, and in line with the Capacity Building and Technical Assistance plan (mentioned in item 2 above).
4. Identification of new and relevant Climate Finance-related sources for Capacity Building and Technical Assistance budgets.
5. Participation as a stakeholder in the approval cycle of Climate Finance-related Capacity Building and Technical Assistance programs.
6. Measuring the long-term impact of Capacity Building and Technical Assistance programs and projects – both during program activity and after their completion.
7. Monitoring and measuring the impact of physical implementation components of Capacity Building and Technical Assistance programs and projects (i.e. pilot projects)

4. Strategy support and policy research:

The taskforce would serve as the government's advisor and ad-hoc policy analysis, research and strategy support provider on different topics related to the implementation of the LEDS, the establishment of the Georgian Green Investment Bank, etc. As such, the taskforce personnel will have to have a wide range of expertise including policy and regulatory analysis, an understanding of climate related technologies, finance, economics, etc. The taskforce also needs to have the ability to outsource consultancy projects, if and when required.

A short list of potential strategy related topics that the Taskforce could be in charge of is proposed below:

4.1. National level strategies goal alignment and prioritization:

a. Research and analysis related to the alignment of the Georgian government's Development and Economic Goals, the Low Emissions Development Strategy, the country's Sustainable Development Goals etc; and the development of an economic and financial methodology to evaluate and quantify the development impacts of various policies, activities and measures. The methodology would have to allow decision makers to prioritize among the different measures and policies based on their impact.

4.2. Continuous review of Climate Finance/Blended Finance developments:

a. Climate and Blended Finance are relatively young fields, and as such are dynamic in nature. As a result, continuous follow up on Climate Finance, Blended Finance and the international Climate Change negotiations will be important in order to optimize Georgian involvement in these fields.

4.3. Standardization of deal terms:

a. One of the recommendations relating to the efficient use of Blended Finance is related to the standardization of deal terms and its impact on shortening transaction lead time and simplifying the transaction process. The taskforce could perform an all-encompassing analysis of deal terms concluded in the last five to seven years on PPP and other large infrastructure project. This would first require the government to establish central depository/database of relevant project data, and follow up with financial, legal, technical analyses of the projects' deal terms in order to understand the commonalities and differences between signed deals, what kind of support the government usually agreed to, reasons for unimplemented deals, etc. The lessons from such analyses could provide a framework for the standardized deal terms under which the Georgian Green Investment Bank would operate.

4.4. Analysis of the European Association Agreement:

a. This could include analysis of the impact of the European Association Agreements and its potential to increase Climate and Blended Finance flows to Georgia.

5. **HR, Expertise and Stakeholder Identification and Management:**

The successful full-scale implementation of the LEDS mitigation measures will be a challenging undertaking which will require expertise from a wide range of disciplines. One of the taskforce's responsibilities can be, in the early stages of implementation and development, to map the current niches of expertise (on a corporate but also on an individual expert basis). This in order to maximize the government's understanding of the full range of domestic resources and expertise at its disposal.

Similarly, mapping of relevant domestic stakeholders which will – or could – be involved in the implementation of the LEDS mitigation measures is also recommended.

The output from such work would be a national and regional database of experts and stakeholders. The nature of this activity is expected to be continuous.

2.5 RECOMMENDATION 3: CREATION OF ADDITIONAL SOURCES OF FINANCING AND INTEGRATION IN BLENDED FINANCE

In addition to the establishment of the Georgian Green Investment Bank and the Climate Intelligence Taskforce, there are several recommendations relating to the optimization of domestic and international sources of financing and integration of these into Blended Finance transactions. These include the following:

1. **International Green Bonds Issuance**

One potential financial source is the international Green Bonds market. After the GGIB will have operated for a few years (between 3 and 5), and will have proved its ability to originate, develop, blend finance, and exit from its investments and programs, the Green Bond market could prove to be an interesting source for the GGIB re-capitalization. An alternative Green Bond issuance strategy would involve the issuance of Green sovereign debt – following the example of Poland. Both issuance strategies would probably require support from international MDBs or other institutions, either in terms of process support or as guarantee providers.

2. **Domestic: Excise taxes, fees, tariff reform and elimination of subsidies:**

   The National Energy Efficiency Plan included reference to suggestions as to how domestic finance resources can be mobilized for the implementation of the LEDS Energy Efficiency mitigation measures. These include various differential taxes, including funding from a line item in electricity/natural gas bills; funding from an increased excise tax or other fee on cars which have larger engine sizes/fuel consumption; a levy related to energy usage of industrial companies if they do not meet their commitments for energy efficiency, etc. In addition, the tariff reforms recommended as policy measures in the various LEDS are likely to create new sources of domestic financial resources which – if structured well – will focus more on elimination of over-subsidies rather than on tax increases.

3. **Domestic: Optimization of State and Municipal Budgets:**

   One of the conclusions from the extensive Capacity Building and LEDS questionnaire- which included interviews with 23 civil servants from all relevant ministries- is that ministries currently lack the capacity to produce a rough estimate of the climate related expenses in their respective budgets. Given the importance of the government of Georgia as a domestic Climate Finance source, it is recommended that a detailed review of ministries' and local governments' climate related expenses and revenues is performed.

4. **Domestic: Involvement of Georgian banks in Climate Finance transactions**

   One of the Georgian-specific mandates which were recommended for the Georgian Green Investment Bank was to structure its investments and programs with a planned exit strategy at the inception stages of program development. A prime candidate for such an exit strategy should be the Georgian capital market with the vision being that one or two years after successful program and project operations, and once exposure to construction and technical risk had been removed, local Georgian banks and other financial institutions would purchase the projects and programs as financial products.

   In addition, the GGIB as the government's implementing arm could promote the use of domestic banks as loan providers in Blended Climate Finance transactions which include MDBs and DFIs. The Georgian banks could provide financing to such projects as senior debt or regular debt providers for a portion of the transaction which is at market-level rates. Additionally, the banks could provide financing in GEL, if such loans are required by project sponsors.

5. **Issuance of retail Green Premium bonds ("Green Lottery Bonds")**

   A more innovative approach towards the domestic market can also assist in the optimization of domestic finance sources and their integration in Blended Climate Finance transaction. It would include the issuance of domestic retail Green Premium Bonds also known as Green Lottery Bonds. Premium Bonds are a popular financial instrument in the UK. The bonds are issued by the UK government and sold to the retail market in Post Offices all over the country.

   The Premium Bond mechanism can also be described as "participating in the lottery without losing your money." The government pays an interest on the bond which is lower than the interest it can receive in the capital markets.

   The interest on the bonds does not go to the holder of a bond. Instead it goes to a monthly prize draw. Each month, a lottery draw takes place – and the revenues from the interest rate is disbursed to the winners of the lottery. All bonds' issuance numbers are registered in a database and an electronic algorithm is used to select a random set of winning bond issuance numbers. The winning bonds "win" the monthly interest rate paid by the UK government. A holder of a bond can sell the bond back at the Post Office at any time and receive back its nominal value of 1 GBP. Alternatively, he can hold the bond and as long as he or she does they will have the right to participate in the bond lottery draw.

Another advantage of the Premium Bond mechanism is that it does not require any issuance support from investment banks and issuance costs are equal to the cost of maintaining the accounting and lottery prize system. Finally, the retail market for bonds in Georgia is still in the early stages of development. The issuance of retail Green Premium Bonds could have a dual impact - increasing awareness to bonds as a retail savings instrument and serve as a source of capitalization for the Green Investment Bank.

6. **Integrating the Georgian Diaspora - Issuance of Diaspora Bonds**

The Government of Georgia makes an effort to keep strong ties between the Georgian Diaspora and their country of origin. The Georgian Diaspora also has an important role in the country's economy as it is responsible for remittances estimated annually at over 1 billion USD, about 7% of the annual GDP. Further integration of the Georgian Diaspora with the domestic market could be achieved through the issuance of Diaspora Bonds which have successfully been used as a source of finance both in Israel (since 1951) and in India.

The case of the Greek Diaspora Bond issuance has not been as successful- as it was done at a time of crisis. It is therefore recommended to take a long-term approach that seeks to integrate Diaspora Bonds into the Georgian state's capital resources pool. This in order to avoid sending a crisis signal to the investment community. Furthermore, a bond structure that would reflect the risk exposure preferences of the Georgian Diaspora would increase the success of the Georgian Diaspora Bonds issuance. More analysis on how to structure and market such bonds is recommended.

2.6 RECOMMENDATION 4: ADDITIONAL RECOMMENDATIONS AND ACTION ITEMS

Additional functional recommendations which would have to be carried out in order to achieve the Roadmap's strategic vision and goals are described below[101]:

1. **Full Investment Plan for the recommended LEDS mitigation measures:**

The output of the EC-LEDS project had been, inter-alia, the identification of recommended mitigation measures in a wide range of sectors of the Georgian economy including Power, Energy Efficiency in Buildings, Industry, Forestry, Agriculture (large scale and household), Waste Management, etc. Several types of mitigation measures have been identified in the process including regulatory, structural, management systems and technologies to be implemented at a large scale.

The full-scale implementation of the technologies and measures will require the establishment of national-level programs. These will aggregate small projects in a manner that will reduce technology and project-specific risks and their associated investment barriers.

While programs' conceptual structure is understood on a high level, program establishment and implementation requires a much deeper and detailed understanding of technologies' performance, the program's overall impact (both in terms of GHG emission reduction and other development impacts), the segment of the population/economy in which the technologies would be used optimally, synergistic and antagonistic impacts, investment and maintenance costs etc.

101 For more details about these recommendation and their proposed scope, see Full report.

The recommended Full Investment Plan for Georgia will allow for the detailed design of Blended-Climate-Finance ready and implementation-ready national-level programs, and allow decision makers to prioritize programs based on their full development impact. The analysis of programs' full development impact will require the quantification of their impact (in USD/GEL) and the assessment of each program's alignment with the Georgian Government's Development Goals. For more information about the proposed scope of the Investment Plan, see Full Report.

2. **Detailed review of Georgia's state andmunicipal climate related expenditures and revenues:**

One of the conclusions from the extensive Capacity Building and LEDS questionnaire-which included interviews with 23 civil servants from all relevant ministries- is that ministries currently lack the capacity to produce a rough estimate of the climate related expenses in their respective budgets. Given the importance of the government of Georgia as a domestic Climate Finance source, it is recommended that a detailed review of ministries' and local governments' climate related expenses and revenues is performed.

Currently, the government's climate related expenditures are not tracked, and as a result – the Georgian government does not have a clear indication of what these are, and by what means they can be reduced or used in a more optimal manner. In addition, Tax Revenues' vulnerability to climate change is non-linear and can have severe consequences if climate change risks materialize in strategic sectors or industries. Given the non-linearity of such risk exposure, relatively low cost "insurance" solutions which can increase a sector's or industry's climate change resilience could then be identified and implemented, reducing state budget vulnerability to future climate related shocks.

For more details about such a review, see the proposed scope of such activity in the Full Report. It could be performed by the proposed Climate Intelligence Taskforce together with international consultants.

2.7 PROPOSED TIMELINE FOR RECOMMENDATION IMPLEMENTATION

One of the current report's main conclusion is that the window of opportunity for positioning Georgia as a Blended Climate Finance leader is closing, and that timing is of critical importance. The proposed timeline for recommendation implementation takes this important factor into account. Timeline definitions are as follows:

1. Short-Term: Up to three months from receipt of final version of current report
2. Mid-Term: six to nine months from receipts of final version of current report
3. Long-term: Over nine months from receipt of final version of current report

The figure below includes a proposed implementation timeline for recommendations 1 and 2 - the establishment of the Georgian Green Investment Bank and the establishment of the Climate Intelligence Taskforce. Recommendations 3-4 will be integrated into the timeline as more clarity relating to the institutional and structural arrangements is attained.

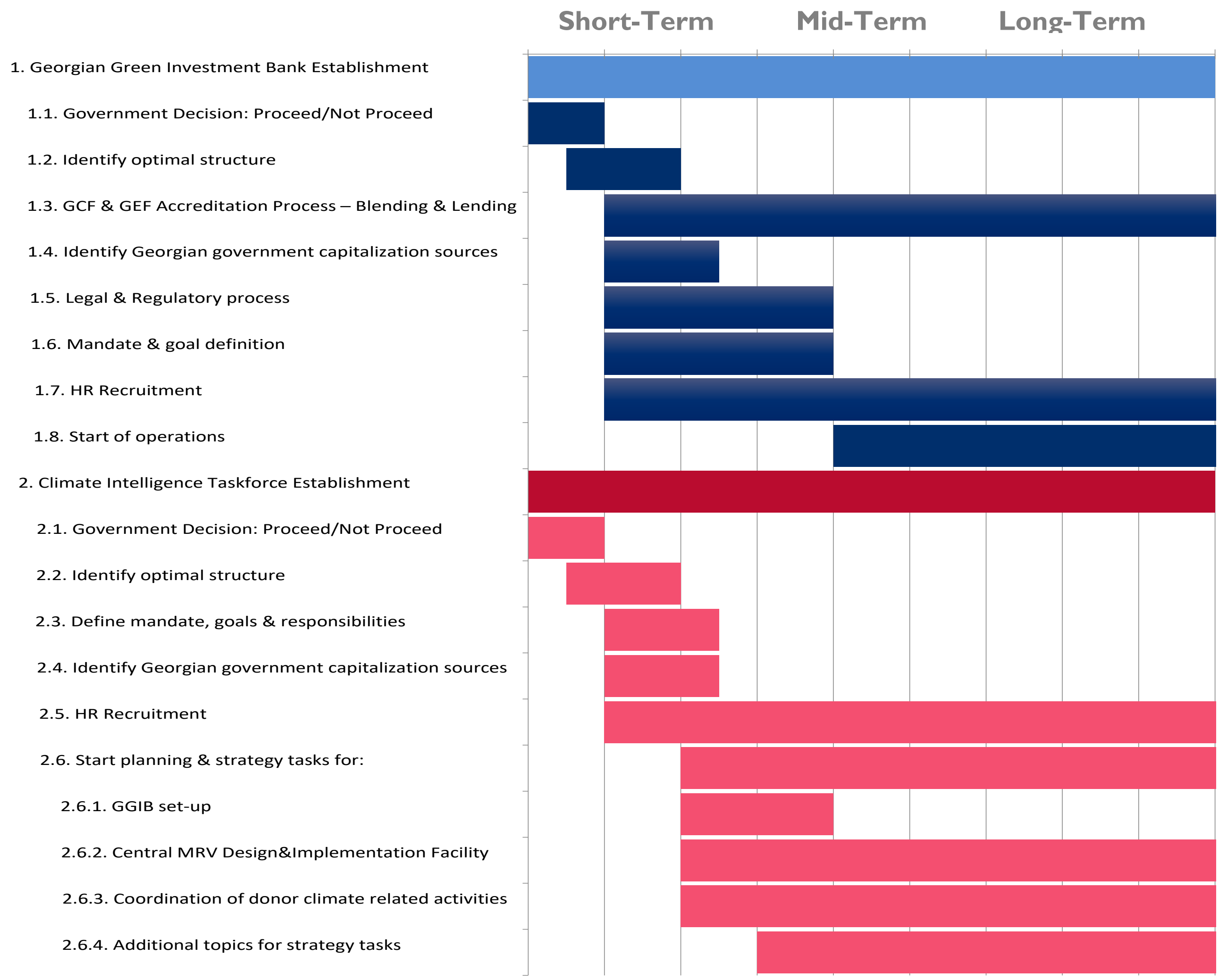


Figure 77. Proposed Implementation Timeline

3.D. MEASURING, REPORTING, AND VERIFICATION (MRV)

SECTION ONE: BACKGROUND INFORMATION

This section of the Low Emission Development Strategy (LEDS) document describes the conceptual framework and the main set-up of the Measurement, Reporting and Verification (MRV) system for monitoring the implementation of the strategy. Suggested MRV framework is based on already existing MRV elements in LEDS related programs and projects in the country, identifies all institutions to be involved in the system, describes their respective functions and provides a clear mechanism for an effective information flow among those institutions as well as options for data archiving and analysis.

At this stage, an effective and comprehensive MRV system for greenhouse gas (GHG) emissions and mitigation measures does not exist in Georgia. However in the framework of its international commitments and participation in various global, regional, or national climate change-related initiatives, such as: United National Framework Convention on Climate Change (UNFCCC), Clean Development Mechanism (CDM), Covenant of Mayors (CoM), etc. the country gained experience in GHG emissions inventories and monitoring of mitigation measures, identified the main players and institutions that can have specific roles at different phases of the MRV process, developed, and tested formal or informal formats of cooperation and coordination among those institutions and pinpointed the main needs and gaps. So far, those existing elements of the MRV process have not been transformed into a well-defined and structured domestic MRV system that will be sustainable, practical, and at the same time flexible and simple enough to be effectively coordinated by the country. Also, all existing MRV related initiatives still hugely depend on international support financially and in some cases, technically in the framework of different projects and programs that partially defines the unsystematic and poorly coordinated nature of an entire MRV process.

By the ratification of the United National Framework Convention on Climate Change (UNFCCC) in 1994, Georgia undertook the commitment to report on climate change related conditions in the country on an international level. As a non-annex I country, in 1999 Georgia submitted its First National Communication report that covered the first ever attempt of GHG emissions inventory based on the data from 1987-1996, also the mitigation measures and detailed project proposals to support the implementation of those measures. The Second and the Third National Communication reports were submitted in 2009 and 2015 respectively. Both of them undertook the national GHG inventories and significantly, all sectoral data underwent the Quality Control and Quality Assurance process, which is an important MRV element introduced and applied in the country. In addition, both inventory reports underwent international review of applied methodologies and final inventory results. This international review was voluntarily requested by the country.

In light of further clarified and formalized MRV mechanisms for non-annex I countries after the 13th and 16th Conference of Parties of the UNFCCC, in 2015 Georgia launched the preparation of the first Biennial Update Report (BUR) that was submitted to the Secretariat of the Convention in 2016. In the BUR, the inventory for 2012-2013 was conducted, the inventory for 2010-2011 was recalculated and information on the status of ongoing mitigation activities in the country was reported. The BUR also made the first attempt to formalize and systematize the MRV process in the country and suggested the possible structure for its effective operation. [1]

In addition to the National Communications and the BUR, the earliest experience that Georgia had with the MRV process on a project basis was through the implementation of GHG emission reduction projects under the CDM. Although, some knowledge on the type of data to be gathered and experience in measurement, reporting, and verification were accumulated within the existing CDM projects (in total seven projects, two sectors: hydropower generation and natural gas distribution systems), they could not create a solid basis for a systemized and formalized MRV structure on a larger scale, such as on the sector or sub-sector level.

Georgia also gained experience in designing MRV systems for Nationally Appropriate Mitigation Measures (NAMAs). So far, two internationally and one domestically supported NAMAs have been expanded in Georgia with the support of German and Austrian companies. GHG MRV elements designed within the internationally supported NAMA for the building sector are sector-based and can serve as a foundation for standards of the respective sectoral components of the domestic MRV system in Georgia. However, since none of these NAMAs has been implemented yet, no practical experience with sectoral MRV has been accumulated at this stage. [2,3]

The other important initiative that further advanced the country's experience in MRV processes is the CoM[102]. Ten Georgian municipalities that signed the CoM undertook the responsibility to develop the Sustainable Energy Action Plans (SEAPs) in order to achieve at least 20% reduction of GHG emissions by 2020 in the territories of their respective municipalities. With the support of international and national partner organizations, in the framework of SEAPs the municipalities conducted municipal level GHG inventory of different sectors of the economy, projected the Business as Usual (BAU) scenario for 2020 and elaborated the mitigation measures. Each SEAP document was accompanied with the detailed list of parameters for monitoring the implementation status and measuring the progress of GHG emissions reductions by means of planned mitigation measures. Tbilisi City Hall took a step forward and in 2015 prepared the monitoring report for 2009-2014 of the implementation of its first SEAP document that created the precedent of the MRV process at a municipal level, and identified huge gaps and the importance of an institutionalized MRV system to support implementation of strategic priorities and programs by the municipalities. As a follow-up to this institutional gap identified almost for all CoM municipalities, Akhaltsikhe municipality created the Sustainable Development Centre that was mandated to collect and analyze data and information for monitoring the implementation of SEAP and other strategic documents. The model of Sustainable Development Centre is easily replicable in other municipalities and can serve as one of the main pillars in the domestic MRV structure on a municipal level.

In parallel to the expansion of the LEDS MRV framework, the country is working on development of coordinated information and knowledge management system to support an effective implementation of three Rio Conventions[103] by Georgia. In a nutshell, the so-called coordinated Information and Knowledge Management System (hereafter, IKMS) will be an electronic/digital platform for knowledge and information flow around three Rio Conventions and for enhanced participation of various stakeholders in data collection, analysis and sharing that should increase the capacities for evidence-based policy making and management. [4] The coordinator of this system will be the Ministry of Environment and Natural Resources Protection of Georgia (MoENRP)[104] as the focal point of the Georgian government for those three Rio Conventions while the administration of the system will be conducted by the Environmental Information and Education Centre (EIEC) that is the Legal Entity of Public Law under the Ministry. Since the LEDS MRV framework will widely utilize all the possibilities that will be created by this electronic system for monitoring, the latter will be referred to in the description of the LEDS MRV system technicalities provided below.

Based on the situation described above, it is obvious that the MRV experience in Georgia remains fragmented, unstructured and very much dependent on individual initiatives by various projects, institutions and donor initiatives. However, it should also be noted that many very important elements for an effective domestic MRV system have already been created and tested to be used in the design of LEDS MRV conceptual framework presented below.

102 The Covenant of Mayors is a European co-operation movement involving local and regional authorities. Signatories of the Covenant of Mayors voluntarily commit to increasing energy efficiency and the use of renewable energy sources on their territories. 16 self-governing units form Georgia joined the CoM, out of which 11 already developed the Sustainable Energy Action Plans (SEAPs) that serve as the roadmap for the signatories to fulfil its commitment on GHG reduction.

103 UNFCCC, Convention on Biological Diversity and United Nations Convention to Combat Desertification

104 There is another alternative discussed according to which the coordination will be done by the committee established by 3 (several) ministries that are in need to have the similar monitoring system.

SECTION TWO: LEDS MRV CONCEPTUAL FRAMEWORK

LEDS MRV Concept

The philosophy behind the suggested LEDS MRV conceptual framework is that it becomes an integral and crucial element of the sustainable development of Georgia, which is a lengthy and reiterative process. The current LEDS document is the first attempt to present the main initial strategic directions of the low emission pathway of Georgia, but it is not the final and only representation of the entire process. LEDS is a living document that will be regularly revised and updated according to the changing realities and priorities of the country. LEDS MRV is to feed this process with important data and information to show whether the process is developing in the right direction, where there is the need for additional effort and support, what turned out to be the most cost-effective and what failed to bring real results. The information gathered and analyzed through MRV processes should update the LEDS or other relevant policy or strategic documents supporting sustainable development of the country. In addition to this primary function, the LEDS MRV process will greatly support the monitoring and reporting on GHG emissions reductions in the framework of international commitments of the country towards UNFCCC and other related agreements.

As the domestic monitoring system, the LEDS MRV will be designed to meet the following three objectives to certain degree:

- **Tracking achievement of existing policy targets:** Georgia, pursuing emissions reduction targets (after 2020 in accordance with Paris agreement) needs to know if it is taking appropriate actions and meeting its own policy objectives with respect to GHG emissions;
- **Informing future policymaking:** Policy operates within a dynamic environment; even a well-designed policy portfolio will need to be adjusted over time. Emissions data and policy tracking can inform the adjustment of current policies and influence the design of future measures by providing an accurate picture of performance and trends. Good data can also help identify where additional mitigation support may be required, both across countries and at the sub-national level;
- **Informing domestic and international stakeholders:** To guide their own decisions, stakeholders at both the domestic and international levels need to have confidence in a country's emissions data and claimed policy outcomes. [5,6]

As was already mentioned above, the suggested MRV system for the implementation of LEDS will reflect and take into consideration all existing MRV elements, established systems and procedures, accumulated experience and knowledge in the country. In order to avoid the creation of multiple domestically operational MRV processes, the presented LEDS MRV will reflect and take into consideration the concept of a domestic MRV system suggested under the first BUR and further extend its scope by adding structural elements for overall coordination, feedback to sustainable development processes, monitoring of financial support received by the country for mitigation actions and so-called horizontal issues under the LEDS, such as capacity building, awareness raising, technology transfer, institutional arrangements and financial mechanisms for the implementation of LEDS.

It is suggested that the results of the monitoring of LEDS implementation in regard to all the elements listed above (inventory, mitigation measures, financial support, capacity building etc.) will be reported annually, or once in every two years after the implementation starts. The report should be detailed and comprehensive enough to help the policy and decision makers to better analyze the reasons of successes and failures in order to identify new trajectories and next steps for the low emission development pathway, also to contribute to the international reporting of the status of fulfillment of the national commitments. In addition to technical part (inventory, mitigation measures etc.), the monitoring report should highlight lessons learned and analysis of LEDS implementation process. The idea behind strengthening the analytical part in the LEDS implementation report is its application for an update and revision of the LEDS document once every four or five years that will be the subject to availability of financial and technical resources. The graph below presents the LEDS implementation, monitoring and update cycle.

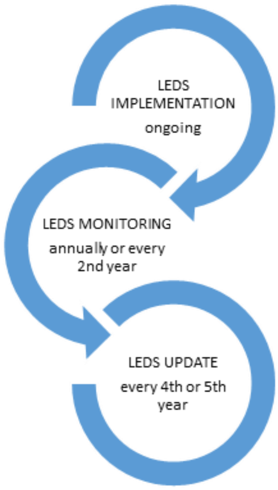


Figure 78. LEDS implementation, monitoring and update cycle

It is also envisioned that the LEDS monitoring report and results are used and reflected in the BUR and National Communication Reports once every two and four years respectively. Therefore, synchronizing the LEDS monitoring phases with BUR and National Communication to UNFCCC (NC) timetables is recommended. It is also expected that LEDS MRV will fertilize the monitoring and reporting of the implementation of National Determined Contributions (NDC) although the format and frequency of NDC reporting are not determined yet. In order to avoid the creation of multiple domestic MRV processes in relation to GHG emissions and low emission development pathway, it is suggested that the M (measuring) part of the MRV process is unified and shared by LEDS, BUR, NCs and any other related initiative of the country, including the National Energy Action Plan (NEAP) and Renewable Energy Action Plan (REAP). Basically, it is recommended that the GHG inventory and monitoring of all ongoing mitigation actions and financial support, are conducted by the domestic MRV system almost independently from any concrete reporting obligation (whether it's LEDS monitoring, BUR, NCs, NEAP monitoring or any other). As the result, the so-called repository of data and information (see more description of the IKMS below) is being created from which respective data and information is retrieved and analyzed by LEDS monitoring report, BUR, NCs, NEAP etc. to the extent as needed and authorized. This holistic approach is visualized in the graph below:

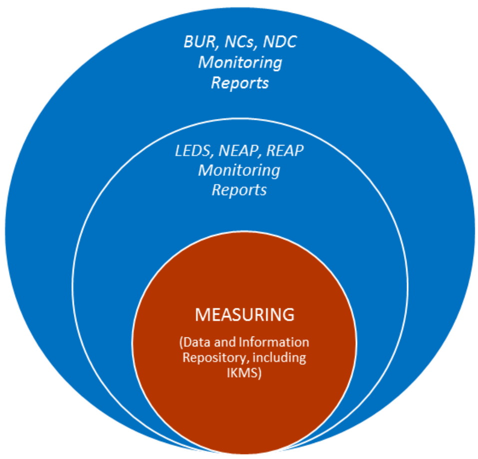


Figure 79. Domestic MRV holistic approach

The synchronization of all other MRV elements (verification, quality assurance and quality control, etc.) with the suggested holistic approach will be discussed below while presenting the institutional arrangement (architecture) and information flow mechanisms of LEDS MRV system.

LEDS MRV Institutional Arrangement

Since the sustainable development pathway of Georgia goes beyond the scope of individual sectors and beyond the responsibility of individual governmental entities, the intra-governmental committee that will have decision-making authority will be created to provide overall supervision and political support to the entire pathway, including the LEDS implementation, MRV and update processes. To reflect its scope, the suggested title for the committee is National Contributions Committee (NCC)[105] that will be composed of high level representatives (mainly deputy ministers) of respective line ministries. The NCC should have a mandate and the capacity to link and harmonize the ongoing and projected sustainable development processes in different sectors of the economy: energy, environment and natural resources, agriculture, waste, forest and land use change, etc. It will be the decision-making body that will have the mandate to consider and approve such documents as LEDS, BUR, NCs, NEAPs, REAPs, NDCs, etc. The Committee should be composed of, but not necessarily limited to, the representatives of following line ministries: the Ministry of Environment and Natural Resources Protection (MoENRP), the Ministry of Energy (MoE), the Ministry of Economy and Sustainable Development (MoESD), the Ministry of Finances (MoF), the Ministry of Regional Development and Infrastructure (MoRDI), the Ministry of Agriculture (MoA).[106] As suggested in the BUR document, the existing LEDS Steering Committee can serve as the basis for the NCC in case its functions, composition and mandate are updated and extended to cover the supervision and political support for the initiatives related to low emission development, including but not limited to LEDS implementation, MRV and update processes.

The NCC will have the following functions in relation to LEDS implementation, monitoring and update[107]:

- Provide political support to LEDS implementation, MRV and update processes;
- Review and formally approve LEDS monitoring reports and updated LEDS documents formally submitted by the MoENRP;
- Identify strategic directions and priorities for LEDS update.

Under the overall supervision and political support of the NCC, the MoENRP will play the role of coordinator and technical supervisor of the entire LEDS implementation, MRV and update processes. The MoENRP, more precisely its Climate Change Unit (CCU), will play an intermediary role between the NCC and the MRV Technical Support Unit (TSU, to be discussed below). On the one hand, it will be the main focal point for and accountable to NCC for LEDS, BUR, NCs, NDC etc. On the other hand, the MoENRP will guide the development of methodologies and standards for MRV, approve them and closely supervise information/data collection and analytical activities undertaken by the TSU.

The ministry, as the LEDS MRV and update coordinator, will have the following tasks:

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105 Low Emission Development Intra-Governmental Committee (LEDIC) was another possible name for the committee, however in order to include the component on adaptation to climate change as well the title National Contribution Committee (NCC) is suggested for an approval.

106 The issue whether the representatives of self-governing units/municipalities and private sector should be seated in the NCC and whether they should have the voting power is open and needs further discussions and consultations.

107 As already mentioned in the main text, LEDS will not be the only strategic document the NCC will supervise and provide political support to. However, within this document the main focus will be done on its role towards LEDS related processes.

- Play the role of coordinator for the NCC in the review and approval process of the LEDS monitoring report, also BUR, NCs, NDC monitoring reports;
- Provide guidance and technically supervise the work of the MRV TSU (to be described below);
- Ensure the Quality Control (QC) of the draft reports produced by the MRV TSU;
- Compile the final technical monitoring reports (LEDS report, NCs, BURs, etc.) and send them to the NCC for formal approval and, when appropriate, to the Secretariat of the UNFCCC after NCC's formal approval;
- Play the role of the main contact unit during the International Consultation and Analysis (ICA) process[108] and coordinate the update of the reports when appropriate;
- Approve methodologies, guidelines, standards and templates for inventory, monitoring of and reporting on mitigation measures;
- Coordinate the process of LEDS update as needed based on the results of the monitoring and the political guidance from the NCC.

The MoENRP will be technically supported by the EIEC. The Centre will take up the role of the TSU for the LEDS MRV process subject to the respective capacity and mandate of the Centre. The main reasons why the EIEC is the most suitable existing entity to fulfil this role are the following : a) it already has an official mandate to support the environmental policy development and implementation processes by means of providing data and information in a digestible manner; b) according to its statutes, one of the functions of the EEIC is "to create a unified data base on environmental protection and support its publicity" [7]; c) to fulfil this function the EIEC will own and manage the information and knowledge management system (IKMS)[109], that will collect and to certain degree analyse the data and information collected from different available sources (such as National Statistics Office of Georgia (GeoStat), line ministries, private sector etc.) to support the implementation of three Rio Conventions by the country. The architecture and technical details of the IKMS are still under development. However, the system should have the technical capacity to reach out and withdraw the data and information from existing national and sectoral data sources and databases. According to the description of the IKMS, the big part of the data and information needed for LEDS MRV (for GHG inventory, measuring emission reductions from mitigation measures, financial support etc.) will be obtained, validated and more importantly, analysed by the system. The functions that are not presently considered in the system can be added at a later stage, therefore the IKMS is very important and promising tool in the hands of EIEC that can be very effectively used for LEDS MRV. As was already mentioned above, the system will allow the EIEC to create the regularly updated data and information repository that can be used by LEDS, BUR, NC, NDC, NEAP, REAP and other sustainable development processes to the extent as needed in each individual case.

In relation to LEDS MRV, the following tasks will be fulfilled by the MRV TSU:

- Collection of data for national GHG emissions inventory;

108 International consultation and analysis (ICA) is a process adopted at the sixteenth session of the Conference of the Parties as part of the measurement, reporting and verification arrangements under the Cancun Agreements. It applies to biennial update reports (BURs), which are prepared by Parties not included in Annex I to the Convention (non-Annex I Parties). ICA aims to increase the transparency of mitigation actions and their effects, along with other information reported in BURs. It commences within six months of the submission of BURs from non-Annex I Parties and is conducted in a manner that is non-intrusive, non-punitive and respectful of national sovereignty. Discussion on the appropriateness of domestic policies and measures is not part of the process. The ICA includes two main steps: a technical analysis of BURs from non-Annex I Parties and a facilitative sharing of views among Parties.

109 The information and knowledge management system is being created under the project "Harmonization of Information Management for Improved Knowledge and Monitoring of the Global Environment in Georgia" supported by UNDP/GEF.

- Preparation of drafts of national GHG inventory reports;
- Collection and analysis of data on mitigation activities;
- Collection and analysis of data on financial support received for mitigation activities;
- Drafting data/information collection templates, also methodologies for inventory and mitigation monitoring as needed;
- Coordination and communication with implementing agencies as needed;
- Drafting monitoring reports (LEDS, BUR, NC etc);
- Ensure quality assurance mechanism is functioning during the monitoring process.

Other important players in the LEDS MRV institutional arrangement are the implementing agencies of various mitigation activities, including governmental, municipal, non-governmental or private bodies. The monitoring reports and data/information archived by the implementing agencies will be verified by internationally accredited verifiers who will be nominated by the MoENRP and selected by the NCC.

Below is the graphical representation of the LEDS MRV institutional arrangement:

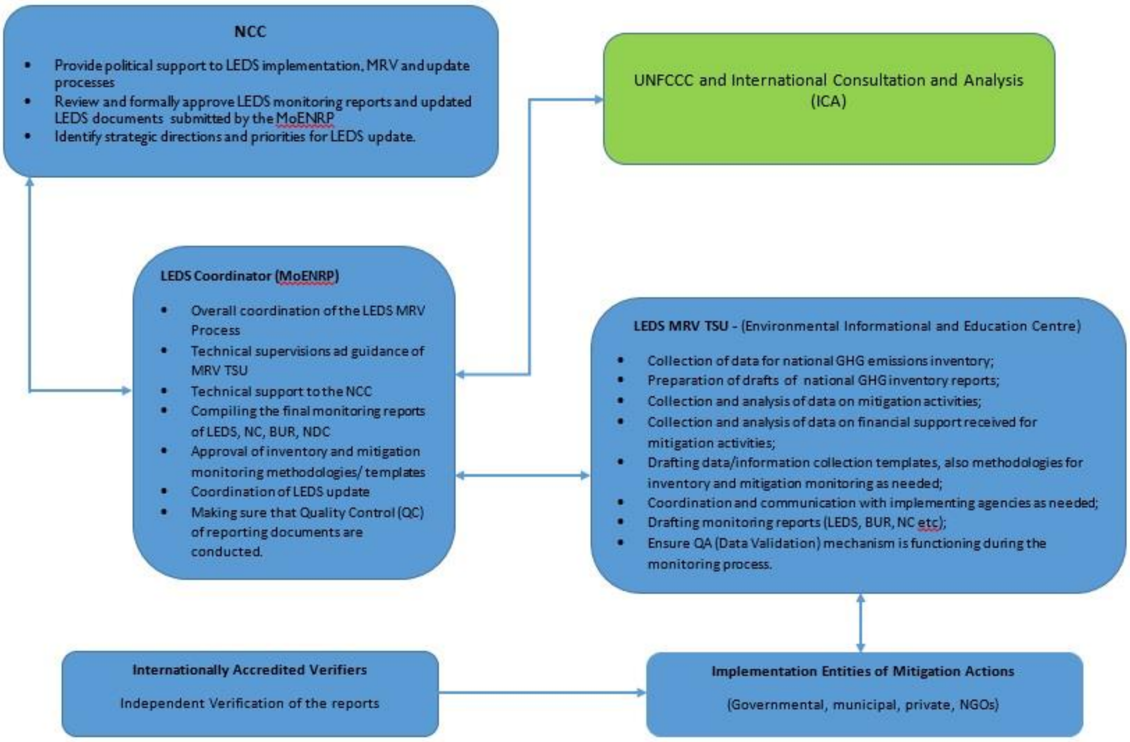

Figure 80. LEDS MRV Institutional Arrangement

Data and Information Flow

As already explained above, the IKMS that will be established and operational at the EIEC (suggested TSU for LEDS MRV) will play the major role in the process of collection and analysis of the data and information needed to monitor the implementation of low emission development processes, including the implementation of the LEDS. The IKMS will be directly linked to the existing national databases and will have access to the information that is important to track the implementation of three Rio conventions which automatically covers the monitoring of all mitigation actions implemented in the country, including the ones planned under the LEDS. Therefore, the TSU of the LEDS MRV will have the capacity to automatically retrieve the data and information on LEDS related issues and activities from different available data sources. More precisely, the IKMS will be linked to the information from the GeoStat, sectoral and municipal databases, such as the database of the

National Environmental Agency (NEA), the National Forest Agency or Air Protection Unit of the MoENRP, different line ministries and their respective subsidiary bodies. The data and information from the governmental entities at any level (national, municipal, local) as well as the private sector will be directly obtained by the system due to the envisioned cooperation between the IKMS and governmental agencies to exchange data and information on a regular basis[110]. More precisely, project managers or other authorized individuals representing the private sector or different ministries, their subsidiary bodies, municipalities and other public institutions will be responsible to fill out online forms integrated into the system and thus will provide the requested data to the IKMS on a regular basis. Importantly enough, the IKMS will have the technical capacity to not only collect and archive, but also to analyse the collected data and information by means of analytical models and tools integrated within the system. A detailed description of how the system will function, the information it will obtain from different data sources, the frequency and format of the information exchange and other technicalities are provided in technical reports produced the IKMS project team[111].

In addition to that the IKMS will have the technical capacity to automatically collect the information on cross cutting issues of the LEDS implementation, such as capacity building and awareness raising, institutional and legal set-up, technology transfer and financial mechanisms.

As for the collection of LEDS related information from the non-governmental entities (NGOs, research institutes and centres etc.) it will require an extra effort from the LEDS MRV TSU to conduct the inventory of all implemented and ongoing mitigation actions, their respective mitigation impact as well as financial support received. The TSU will work on creating incentives for non-governmental and academia communities to collaborate with the IKMS and thus contribute to monitoring processes ongoing in the country. Therefore, in addition to the IKMS the MRV TSU will need a technically strong team capable to reach out to different stakeholders (especially those that are not linked to IKMS), bring them on board and generate draft reports based on the analytical results produced by the System.

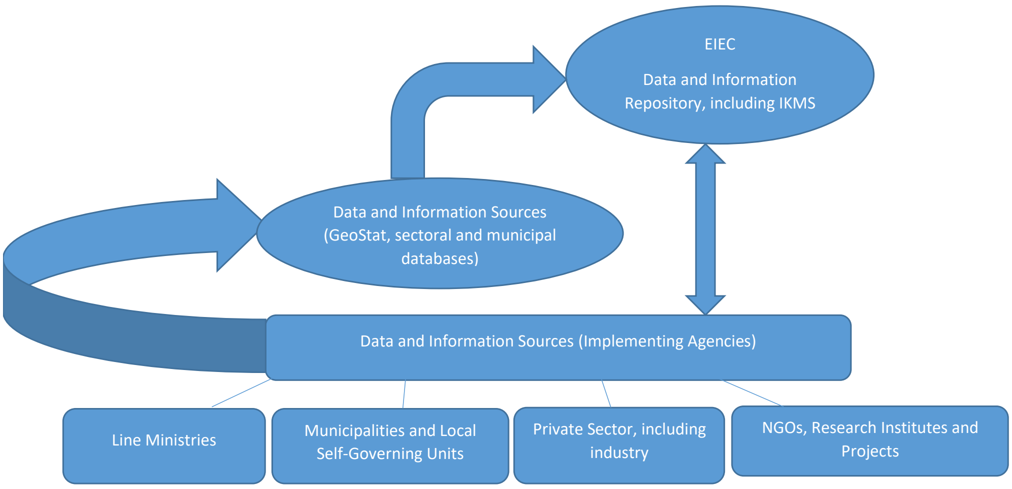

Figure 81. Data and Information Flow Chart

110 A special Decree will be issued that will oblige the governmental entities as well as the private sector to cooperate with the IKMS and provide the system with requested information.

111 These technical documents are currently under development and no referenceable version exists yet.

It is envisioned that other related MRV processes happening in the country will greatly benefit and at the same time contribute to the LEDS MRV process. For example, the Ministry of Energy developed a National Energy Efficiency Action Plan (NEEAP) and is now working on a Renewable Energy Action Plan (REAP); the implementation and monitoring of which will be coordinated by the MoE, MoESD, and MoE respectively. Although no MRV systems are elaborated for either NEEAP or REAP yet, it is assumed that there will be a great deal of cooperation, exchange and coordination between these processes and LEDS MRV system.

SECTION THREE: STEPS TOWARDS EFFECTIVE LEDS MRV FRAMEWORK

In order to support the described LEDS MRV system to function properly the following immediate steps need to be taken:

- Formal establishment of NCC– the mandate, detailed Terms of Reference (ToR) and composition of the NCC should be defined. The Decree on the establishment of the NCC should be approved by the Prime Minister;
- Capacity building of the MoENRP, more precisely its CCU – additional staff member (preferably two staff members) should join the CCU whose major role in the unit will be the coordination of low emission development processes, including LEDS (implementation, monitoring and update). Alternatively, already existing staff members of the CCU can be tasked to coordinate the process if their ToRs are revised accordingly and if relevant trainings and capacity buildings activities are provided as necessary;
- Establishment and capacity building of LEDS MRV TSU – LEDS MRV TSU should be composed of dedicated and technically skilled professionals (at least four persons) whose work will be focused on GHG inventory, analysis of information on mitigation measures, communication and coordination with different governmental, non-governmental and private institutions, drafting methodologies and monitoring templates, prepare draft monitoring reports. At this stage, it might be difficult to ensure that such TSU is financed from the state budget. It is more realistic to think that the TSU will be established and developed in the framework of internationally supported project(s). However, in order to ensure its sustainability and sense of national ownership the funding from the state budget should be increased gradually to cover at least 50% of the costs of TSU.

3.E. CAPACITY BUILDING

SECTION ONE: TAKING A LOOK AT THE CURRENT STATE

Capacity is a state's resource abilities and competencies to address the vital issues among its strategic objectives. Capacity building is a long-lasting process involving stakeholders from the government, non-government organizations (NGOs), the private sector, etc. and implies the strengthening of existing capacities and creating new knowledge and expertise in the process of LEDS implementation.

As part of the LEDS implementation strategy, the Capacity Building sub-chapter is designed to analyze and identify capacity barriers and gaps of the government of Georgia and develop recommendations to this effect. The report builds on the data obtained from the LEDS Capacity Building Gap Analysis Survey, which was implemented in the period from March to May, 2017. The respondents were selected from the following six ministries:

- Ministry of Environment and Natural Resources Protection
- Ministry of Energy
- Ministry of Agriculture
- Ministry of Regional Development and Infrastructure
- Ministry of Economy and Sustainable Development
- Ministry of Finance

The total number of respondents was 23 civil servants.

The survey questionnaire was developed by EC-LEDS staff in collaboration with the EC-LEDS International Low Emission Adviser and the EC-LEDS International Finance Expert in English and translated into the Georgian language for implementation purposes.

The survey questionnaire consists of three parts:

- *Part 1. Low Emission Development Strategy* – an overall assessment of the knowledge and understanding of the LEDS process: the LEDS purposes on domestic and international levels, key elements and success factors of the LEDS, and the most important sector in terms of the GHG emissions.
- *Part 2. Public Awareness* – assessment of the most efficient means of communicating climate change information, the most important target audiences, barriers to climate change awareness raising, and known national or regional outreach networks and surveys.
- *Part 3. Financial Issues* – assessment of the costs by sector: buildings, industry, energy, waste, economic development, food and agriculture, transportation, outdoor lighting, water, health, natural catastrophes, and infrastructure.

Each part of the questionnaire requests several answers be filled out in accordance with priorities that are rated from 1 (the most important) ascending to the lowest figure (the least important) that corresponds to the number of questions in the section.

The analyses of the survey shows that the representatives of the ministries and the GoG, who are the major stakeholders of the EC-LEDS program, possess adequate and relevant overall knowledge and understanding of the LEDS process. On the whole, the ministries and GoG in general have acquired solid knowledge and understanding of the LEDS process.

The majority of the respondents, on the national level, ranked merging LEDS to climate change actions with national development and supporting sector transformation through a national, economy-wide approach as the most important option. This option was followed by the ability of LEDS to help identify and prioritize nationally appropriate mitigation actions (NAMAs) by providing a comprehensive analysis of mitigation potentials, costs, and co-benefits. The third place in the proposed priority scale was given to the option that LEDS is a country-driven policy instrument for national decision making toward the EU Associations Agreement.

As per prioritization of LEDS purposes on the international level, the majority of the ministries demonstrated a clear understanding that LEDS supports the global goal of GHG emissions reduction. The respondents assessed the two following answers as less important: LEDS may help to attract international support (finance, capacity building, and technology transfer) and contribute towards recognition of NAMAs that are being planned and implemented by developing countries; and LEDS contribute towards recognition of NAMAs that are being planned and implemented by developing countries.

The vast majority of the respondents identified LEDS' long-term strategic vision based on and integrating national development priorities as the most important key element of global agreements. The other six indicators received far less priority.

The most important LEDS success factors, according to the survey, out of the offered seven options, were the following two: integration into development planning, cross-cutting approach and strong data basis & scientific analysis.

The awareness of LEDS essentials by the GoG was quite high and the definition of a Low Emission Development Strategy (LEDS) as forward-looking national economic development plans or strategies that encompasses low-emission and/or climate-resilient economic growth, was agreed by all representatives of the ministries.

It was interesting to analyze the answers in which respondents were asked which sector is the most important in terms of GHG emissions for Georgia. According to the survey, the transport sector was named as the most important sector, followed by energy supply. On the whole, the answers reflect a relevant and adequate understanding of country-wide and global processes in terms of reducing GHG emissions.

As the survey has shown, the ministries and GoG on the whole have acquired adequate and profound knowledge regarding the LEDS process and are well informed about LEDS' basic components. There are, however, some recommendations and suggestions to improve further understanding of the LEDS program in order to fill some gaps, which the survey analyses revealed.

According to the survey results, the majority of the respondents think that the central target audiences in raising awareness and understanding of the climate change issues and its impacts are policymakers (ministries, committees, work groups, etc.) followed by businesses and NGOs. Media took fourth place, followed by the general public and youth. Academia is deemed the least important audience in climate change mitigation efforts.

Most of the respondents consider the government of Georgia as the central institution to raise awareness on climate change. Media and NGOs share second and third place respectively among respondents, followed by academia in last place.

Social media, TV, and internet media share the first three places, respectively, as the most efficient and important means of communicating climate change related information. In the respondents' opinion, awareness campaigns and training also play a role in raising awareness, followed by radio and print media. Printed promotional materials are in last place among the respondents.

Part of the respondents were unaware of the regional or national organizations conducting climate change public awareness campaigns. Among the named organizations, the most popular ones are

NGO Green Alternative, Caucasus Environmental NGO Network, and the Ministry of Environment and Natural Resources Protection. Respondents also mentioned Integrated Natural Resources Management in Watersheds (INRMW), World Bank, United Nations Development Program, Biodiversity Conservation and Research Center Nakresi, Biological Farming Association Elkana, Energy Efficiency Center, Greening Economies in the Eastern Neighborhood, Covenant of Mayors, Greens Movement of Georgia – Friends of the Earth and the World Wildlife Fund.

Most of the respondents were unaware of any survey on the level of public awareness on climate change. The respondents who gave positive answers named: National Communications and Reports, Climate Change Adaptation Roadmap, Cost-Benefit Analysis Clean Air Policy Proposal by INRMW, CBA Plastic Bag Consumption Reduction Policy Proposal by US Agency for International Development, Research on Thermal Waves, Building Resilience to Climate Change in South Caucasus Agriculture, National Environmental Action Plan and Financing Climate Action in Eastern Europe, Caucasus and Central Asia by the Organization for Economic Co-operation and Development.

Among the barriers to climate change awareness raising, most of the respondents consider the lack of funding, information, and human resources as the most important obstacles. The lack of political will is the least significant barrier to climate change awareness. Two of the respondents added ignorance of everyday problems and complexity of the topic as barriers to awareness raising.

SECTION TWO: TOWARDS BETTER CAPACITIES

Following the survey results, the recommendations are offered to strengthen the capacities of the GoG in implementation of the LEDS:

- According to the survey, the most adequate and comprehensive understanding of LEDS was received from the Ministry of Environment and Natural Resources Protection and the Ministry of Energy, the least from the Ministry of Agriculture and the Ministry of Finances, therefore these two ministries should receive more attention and they should be more actively involved in the LEDS process.

- According to the respondents, one of the less important in terms of GHG emissions was forest (LULUCF), however LULUCF plays an important role to curb GHG gases and this sector should be considered much more important. Therefore, the LULUCF sector needs more detailed coverage while working with the GoG.

- The GoG needs to pay more attention to LEDS' contribution towards identification of NAMAs being planned and implemented by developing countries.

- While Georgia can benefit from the financial support from international donors, the survey shows that the respondents did not put LEDS' role to attract international support (finance, capacity building, and technology transfer) as a high priority. Therefore, the GoG needs to receive more details and clarification on why this option should be considered as one of the important factors, and the Ministry of Finances should play a more active role to emphasize this possibility.

- One of the less important factors named for LEDS success was the inter-ministerial coordination structure including key ministries (finance, economy, energy, etc.). However, as the LEDS process has shown, the coordination and integration of various stakeholders are very important for the overall success, therefore the ministries and the top management of the ministries should pay more attention to the inter-ministerial coordination and integration issues.

- Given the political will and central role of the GoG in implementation and promotion of LED, it should develop a long-term LED awareness program to ensure involvement of different stakeholders and groups in the awareness raising process.

- The GoG should establish instruments for a continuous collaboration between business groups, particularly, decision makers and implementers, in sharing and practicing LED.

- Including mass media representatives in targeted events and high-level meetings on LED is recommended.

- Involvement of private sector and NGOs in the LEDS implementation process by providing information on beneficial technologies, offering programs on cooperation between public and private/NGO sectors.

- Introduction of the relevant LED curricula in secondary and higher educational institutions.

- Creation of initiative groups in the private sector, NGOs and academia to facilitate the involvement of these sectors in the LEDS implementation process.

- The central information outlets of LED awareness campaign should be television, social media, and internet media to ensure countrywide coverage of the topic.

- Promotion of LED should be incorporated in the everyday lives of specific target groups via television and internet media mainstreaming the topic in TV series, TV talk shows, news programs, news agencies, and through public service announcements.

- Extensive media coverage of LED/LEDS implementation process and all activities related to Georgia's commitments towards climate objectives.

- Targeted social media campaigns should focus on diverse age, gender, and interest groups to ensure that all users are involved.

3.F. COMMUNICATION AND AWARENESS RAISING STRATEGY

SECTION ONE: OBJECTIVE AND SCOPE

LED is a framework for the development of short- and long-term development goals with national and subnational objectives, and it is supported and implemented by high level political leadership of the country. The successful low emission development process should be driven in accordance with the clearly defined objectives to ensure that LED objectives are in line with domestic development goals and stakeholder involvement.

As part of the LEDS implementation strategy, Communication and Awareness Raising Strategy (the Strategy) is designed to meet Georgia's LEDS development priorities to reach target audiences nationwide, national development priorities and trends related to LEDS goals and opportunities. The **overall** objective of the Strategy is to raise Georgian citizens' awareness of the opportunities of low emission development, threats of climate change and behavior change focusing on key stakeholders and promoting advocacy to the general public regarding the costs and benefits of low emission development, energy conservation, climate change mitigation, and alternative energy resources.

The **specific** objectives of the Strategy are as follows:

1. To assist the Georgian Government in development of the long-term low emission development awareness programs.
2. To support the Georgian Government in establishing instruments for a continuous collaboration between different groups and stakeholders in sharing and practicing the low emission development.
3. To create awareness and understanding of low emission development, benefits of reducing GHG emissions and associated environmental impacts.
4. To raise household awareness about eco-friendly options and technologies in order to turn them into daily habits and, ultimately, change their behavior and increase awareness towards low emission development.
5. To raise awareness of different groups: media, private sector entities, Non-Government Organizations (NGOs), universities and schools, and construction businesses on low emission development, climate change impact, mitigation strategies and for them to contribute to the reduction of emissions through their activities and/or production.

SECTION TWO: BARRIERS TO COMMUNICATION OF LED

Behavior change is a complex process involving participatory and uninterrupted communication, and depends on widespread knowledge and awareness of the benefits from low emission development. Preparation of the Georgia LEDS document revealed barriers to low emission development in various sectors. Box 1 presents a summary of barriers, which are taken into account when developing the Strategy.

- Lack of clear and effective state policy on emissions reduction; lack of a unified vision and policy of Georgia's transport development and construction standards; non-conformity of energy infrastructure, construction and operation, technical regulations and norms with international standards; risks of financial deficiency generated in result of politicizing tariff regulation activities;

- Lack of modern, resource-saving technologies and a low level of using the existing local energy efficiency/renewable energy potential; vulnerability of the existing energy infrastructure to natural disasters caused by climatic and geographical features and due to lack of technological reliability of the outdated systems;

- Lack of information and knowledge on emissions reduction opportunities; Lack of trained personnel for introducing modern, low emission technologies;

- There is no target fund to facilitate the co-financing of low emission measures, or a national body from international funds to introduce the investments in low emission development; ***lack of disposable capital even for such measures, payback periods of which are relatively small;***

- Prevalence of smallholder agriculture across the country, lack of finance and awareness, as well as the lack of dissemination of technologies, best practices, and materials in agriculture sector;

- Lack of regulations for multipurpose and effective application of forest resources; inadequate utilization of valuable forest resources and functions; lack of information concerning local and international market demands for timber products, timber and forest non-wood products produced in Georgian forests;

- Lack of consideration of low-emission development in strategic planning of economic development.

Box 1. Summary of Barriers to Low Emission Development of in Georgia

The communication gap on LED in Georgia is a result of lack of awareness and education, access to data and information, exchange of lessons learned or/and good practices about low emission development among policy-makers and public. Only those who are directly involved in these activities are aware of the low emission development concept and processes.

A qualitative assessment[112] of the level of awareness indicated a low level of awareness in the Georgian population on issues related to LED, clean energy, and GHG emissions. According to the organizations interviewed, no nation-wide energy conservation campaigns have been conducted in Georgia. However, a number of previous projects - including the US Agency for International Development (USAID)-sponsored New Applied Technology Efficiency and Lightning Initiative **(***NATELI***)-**1 and NATELI-2 projects - included outreach activities that raised public interest in clean energy issues. The Energy Bus Program[113] was named as the most effective outreach instrument used to date in Georgia. The Energy Bus traveled the country raising awareness about energy efficiency and clean energy among a wide variety of audiences including students, residential populations, and professionals (e.g., engineers and builders).
In spring 2017 the USAID Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) Clean Energy Program conducted the Capacity Building Gap Analysis[114] to identify the capacity gaps of the GoG. The survey revealed that the majority of public servants questioned were unaware of any surveys on the level of the awareness among Georgians. Part of the respondents were unaware of the regional or national organizations conducting climate change public awareness campaigns. Regarding barriers to awareness raising, most of the respondents consider the lack of funding, information and human resources the most important obstacles. The lack of political will is the least significant barrier to the LED awareness.

SECTION THREE: TARGET AUDIENCES

Given the variety and large number of groups to be covered by the Strategy, audience targeting should be done by combining broad, nationwide outreach efforts addressing issues of energy efficiency, clean energy and climate change mitigation, with distinct sub-campaigns devoted to specific technical topics of interest to select groups.

Prioritizing of Strategy target groups builds on the results of the Capacity Building Gap Analysis Survey (see reference 3). The majority of the respondents think that the central target audiences to raise awareness and understanding of the climate change issues and its impacts are policymakers, followed by businesses and NGOs. Media is in fourth place, followed by the general public and youth. Academia is deemed the least important audience in climate change mitigation efforts.

Target groups of this Strategy are:

- Government of Georgia: GoG has a political will and central role in the implementation of LEDS and promotion of low emission development.

[112] A preliminary assessment was performed to guide the development of the EC-LEDS Clean Energy Program National Communications Strategy in 2014 and was based on interviews with leading sub-contractors and stakeholders of the EC-LEDS Clean Energy Program, including the Energy Efficiency Center of Georgia (EEC), the Sustainable Development and Policy Center (SDAP), and the Green Building Council of Georgia (GBC-G).

[113] The Energy Bus Project was financed by the Organization for Security and Co-operation in Europe (OSCE) Mission to Georgia, USAID, BP, and other partners. The energy efficiency and energy education program was implemented in Georgia during 2009-2011. It focused primarily on rural communities, and its goals were to raise awareness among consumers on the effective and safe usage of energy, improve access to renewable energy sources through practical information about alternative energy resources, and help communities find cost-effective and environmentally friendly solutions/applications. Approximately 75,000 people visited the Energy Bus and its exhibitions during the two-year period it was active. The Energy Bus Project was awarded the Energy Globe National Award in 2011.

[114] The report was designed to identify capacity gaps of the Government of Georgia. The respondents were selected from the ministries of Regional Development and Infrastructure, Economy and Sustainable Development, and Finance. The survey questionnaire consists of three parts: Low Emission Development Strategy, Public Awareness and Financial Issues. Participants were invited to fill out the multiple-choice questionnaire in accordance with the priorities.

- Businesses and NGOs: Businesses and institutions make decisions about their energy use, including equipment purchases and building operations, company policies, and decisions to purchase or lease buildings. The campaign will influence their knowledge and promote investments towards low emission development.

- Mass Media: Media is a powerful tool to impart information and knowledge to a specific target audience, and mainstream the LED issues through extensive media coverage.

- Households: The public awareness campaign is targeted to households that make decisions about purchasing and upgrading their homes, purchasing equipment for the homes, purchasing cars, options of transportation, use of fuels for heating and cooking, etc. This is the primary target for the public outreach campaign to influence their knowledge and attitudes and instigate behavior change.

  Schools: Bringing up educated and aware youth will facilitate the behavior change among future generations.
- Academia: Universities and students (engineers, architects, and others) are interested in becoming up to date on new technologies and building techniques. The awareness building program provides them opportunities to learn and apply new knowledge in implementing practical projects.

In summary, the target groups for the Strategy are actors involved in achieving the LEDS goals including government, private sector entities, media, schools and universities, NGOs, construction businesses, households, etc. However, for the successful communication of the LED, targeting of the audiences for a specific result should be done in accordance with a specific campaign objective.

SECTION FOUR: IMPLEMENTING ACTIVITIES

Specific objectives of this Strategy build on the overall goal to raise awareness of private sector, NGOs, mass media, youth and the general public of the essence and benefits of low emission development and motivate behavior change. The GoG holds a central role in development and implementation of the long-term LED awareness programs to ensure that LED is on the top of the political agenda, to acquire trained and skilled personnel and ensure the involvement of business groups and stakeholders in sharing and practicing LED.

The Strategy seeks to achieve five objectives, which were set in result of analysis of barriers to and target groups of LED communication. The breakdown of the specific objectives and relevant implementing activities are given in the table below.

Table 27. Implementation of Communication and Awareness Raising Strategy

Objective 1.	**Implementing Activities**
Assistance of the Georgian Government in development of the long-term LED awareness programs	• Capacity Building of the policy-makers to address the LED challenges to ensure that LED considerations are mainstreamed into decision-making • Enhancing capacity of employers to contribute to clear policies and efficient programs towards low emission development • Enhancing capacity of the personnel to perform qualified work and produce recommendations for successful implementation of LEDS process • Training of technical personnel, which will be able to introduce modern, energy efficient technologies and assist different target groups in preparing energy efficient project proposals and their implementation • Providing the involvement of private sector in the implementation of LEDS by supplying them with information on energy efficient and economically beneficial technologies, offering programs on cooperation between public and private sectors • National workshops for LED negotiators
Objective 2.	
Support of the Government of Georgia in establishment of instruments for a continuous collaboration between business groups and stakeholders, particularly, decision makers and implementers, in sharing and practicing LED	• Development and implementation of awareness raising and stimulating programs for decision makers and implementers • Informing decision makers and implementers on successful and ineffective international practices • Participation of decision makers and implementers in international processes related to LED
Objective 3.	**Implementation Strategy**
Create awareness and understanding of LED, its benefits and associated environmental impacts	• Creating awareness among Georgian citizens about the need for low emission development and the importance of starting with individual action, as well as practical steps that consumers can take to conserve energy • Sharing of the best LED practices experienced by developed countries worldwide to illustrate the feasibility of the task
Objective 4.	**Implementation Strategy**
To raise awareness of the households about eco-friendly options and technologies in order to turn them into their daily habits and, ultimately, change their behavior and increase awareness towards low emission	• Highlighting the social and economic benefits of LED domestically to reduce energy bills, increase home comfort, reduce reliance on imported fuel, and achieve the targeted reduction of GHG emission • Ensuring continuous and uninterrupted process of informing and consulting households on technologies available on the market and especially on their introduction and the best world practices in this field

development	• Development of information materials on measures and technologies, which will improve the living environment of population and ensure behavior change • Raising awareness among target groups by means of the most efficient communication channels to ensure the widest coverage nationwide
Objective 5.	**Implementation Strategy**
To raise awareness of different groups - media, private sector entities, NGOs, universities and schools on LED, climate change impact, mitigation and adaptation strategies to make them contribute to the reduction of emissions through their activities and/or production	• Development and implementation of awareness raising and stimulating programs for different target groups to provide the unimpeded introduction of standards, technologies, etc. • Inclusion of mass media representatives in the high-level meetings on the LED • Involvement of private sector and NGOs in the LEDS implementation process by providing information on energy saving and beneficial technologies, offering programs on cooperation between public and private/NGO sectors • Introduction of the relevant LED curricula in secondary and high educational institutions • Creation of initiative groups in private sector, NGOs and academia to facilitate the involvement of these sectors in the LEDS implementation process

SECTION FIVE: COMMUNICATION METHODS

Messaging

One of the reasons for the lack of public response to environmental threats is the scientific and technical language, i.e. scientific and technical terms and acronyms, in which the scientists, experts and government officials are explaining the approaching disaster. In order to achieve maximum public response, these terms should be translated into more intelligible synonyms. When only a scientific or technical term is available for making sense of an issue, it should be thoroughly defined to the audience.

Table 28. Illustrative Example of Alternative Wording

Scientific Term	Alternative Word
CO_2	*Carbon Dioxide*
Anthropogenic	*Man-made*
GHG	*Greenhouse Gas*
Emission	*Discharge, Release, Emanation*

To motivate action toward low emission development, the communication should also be “localized” at a personal level. In other words, though it is a global issue, LED should be felt “at home” and acted on at home. The research[115] suggests that relating local events to LED may have behavioral impact to make the issues less distant and more tangible. One of the reasons that people may not take action to mitigate climate change is that they lack first-hand experience of its potential consequences.

One of the most important steps towards a nation-wide low emission awareness campaign is a proper *messaging*. A guiding principal for framing a message should be a knowledge-based, scientifically proved communication translated into intelligible language. In other words, a message should be set within an appropriate context to achieve a desired interpretation or perspective to make credible climate science more accessible to the public, not to deceive or manipulate people[116].

A typical established message about low emission development should be broken down into several sub-messages for different target groups to make sure that a core message is delivered to everyone targeted.

Broadcast Media

One of the central communication tools in the National Communications Campaign should be broadcast media, particularly television, since as shown in The Knowledge, Attitude and Behavior Study[117] survey and Capacity Building Gap Analysis survey, television is one of the most popular source of information in Georgia. Broadcast media plays a significant role in spreading information and educating on a specific topic. It is able to influence and change public opinion and behavior. They can give a basis for public discussion and the reconsidering of norms. Past experience shows that the media can have an immense educating impact on public opinion and behavior.

Public Service Announcements (PSA) are a vital tool in generating awareness for critical issues while dispensing important information for many non-profit organizations. PSAs are short messages produced as films. They can be done in a simple way with a celebrity delivering a message or commitment, or show a scene with music, dramatic story or visual effects. PSAs tend to be effective at encouraging the audience to take an action, e.g. turn of the lights when not in use to save energy and money, and raise awareness of a specific issue.

Education via TV programs is an efficient tool to impart information to a specific target group. Maibach et al[118] suggest that TV weathercasters, having a tremendous reach, are trusted sources of information about climate change, because they are trained in meteorology and relevant sciences, not political, and can deliver a complex scientific phenomenon in an intelligible and popular language.

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115 A. Spence, W. Poortinga, C. Butler and N. F. Pidgeon3. *Perceptions of climate change and willingness to save energy related to flood experience.* NATURE CLIMATE CHANGE | VOL 1 | APRIL 2011 | https://www.nature.com/nclimate/journal/v1/n1/pdf/nclimate1059.pdf

116 Center for Research on Environmental Decisions (CRED). Columbia University. *The Psychology of Climate Change Communication* (p. 6). Retrieved at: http://guide.cred.columbia.edu/

117 A Knowledge, Attitudes and Behavior (KAB) study was performed in 2014 by EC-LEDS Clean energy Program aiming to gain baseline information on energy consumption practices and knowledge and attitudes towards EE measures. The survey methodology was designed to obtain statistically reliable information nationwide.

118 EDWARD MAIBACH, BERNADETTE WOODS PLACKY, JOE WITTE, KEITH SEITTER, NED GARDINER, TERESA MYERS, SEAN SUBLETTE, AND HEIDI CULLEN. *CLIMATE CHANGE COMMUNICATION.* OXFORD RESEARCH ENCYCLOPEDIA OF CLIMATE SCIENCE.

ONLINE PUBLICATION DATE: AUG 2016. DOI: 10.1093/ACREFORE/9780190228620.013.505

Social Media

Another leader in dissemination of information is social media. Facebook and Twitter provide "real-time" social networking to reach a wide audience, establish awareness, and are among the best sources to stay updated with current news, events, and developments. It also offers an excellent platform to promote events, achievements, news releases, and media highlights (video, audio, pictorial), with an engaged, active target audience. In terms of social marketing and outreach, Facebook and Twitter in Georgia offers opportunities to connect with a distinct audience of tens of thousands of engaged and active people who have shown an appetite for following trends, brands, and initiatives to connect and discover new information and current developments. It also allows users and operators to determine the success of events, messages, and outreach campaigns via "likes," "trends," and "hits."

The content of social media pages should be adjusted to Georgian citizens, which will enhance public understanding and awareness about low emission development, energy efficiency/clean energy, identify measures and solutions the public can undertake to change behavior, engage the public in discussions and deliver core messages of the campaign through education, articles written in popular language, sharing experience, video tips, information on options where to get/buy EE/RE appliances and technologies, announcing events/contests, etc.

Tips for users should be created in simple visual forms. In addition to tips, pages should also share news and interesting facts about energy efficiency and/or renewable energy (e.g. information about energy efficient homes).

Outdoor Advertising

The purpose of outdoor advertising as a mass communication tool is to convey the desired massage to the target group in an effective and lasting way with short and bold messaging to support and reinforce the overall message of the National Communications Campaign.

There are several traditional media options for outdoor advertising:

- Posters
- Banners
- Billboards
- Hoardings
- Unipole Signs

In addition, there are non-standardized signs such as roadside signs, highway advertising and innovative mediums like digital outdoor displays, airport displays, mall displays, mass transit displays that all fall under the outdoor domain. Target audiences are exposed to outdoor advertising from the moment they go outside and provide total reach:

- Broad coverage and outstanding reach
- The most visible media exposed to everyone who goes outside of the home to work, study, shop or play
- The only type of media that has constant exposure: it can' t be thrown away or turned off
- Allows for targeting specific communities, ethnic groups, ages, income levels, etc.
- Effective for communicating short messages and simple concepts

Public Events

Any event that is a one-time or periodic, free or ticketed, cultural, charitable or cause-related, and conducted for the purpose of attracting revenue, support, awareness, and/or for entertainment purposes, and created by and/or for the general public is generally referred to as a public event. There are numerous forms of open public gatherings such as exhibitions, expositions, fairs, festivals, entertainment, cause-related, fundraising, and leisure events. The advantage of public events is the opportunity to increase people's awareness and engage people in discussion and pass on information in person.

SECTION SIX: YOUTH, GENDER AND PWD

The Communication and Awareness Raising Strategy should address the issues of gender, youth and people with disabilities (PWD) in its outreach efforts. The campaign should produce specific promotional/educational materials for people with disabilities using sign language for the hearing impaired, and Braille for blind children and adults.

SECTION SEVEN: ASSESSMENT OF COMMUNICATION CAMPAIGN

To better ground the Communication and Awareness Raising Campaign and provide before- and after-action assessments, the recommended approach should include the following activities:

- Conduct continuous media monitoring throughout the campaign to supply the LEDS implementation process with information to help direct the communication and outreach tasks and provide data for ex-post evaluation.
- Publish before-and-after success stories featuring behavior change/low emission development measures as a result of LEDS awareness efforts.
- Hold focus groups in different target groups to inform the LEDS implementation process on the progress and gaps of awareness efforts.

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none

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3.F. COMMUNICATION AND AWARENESS RAISING STRATEGY\

none

2.A. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY ENERGY SUPPLY

Mitigation measure	EPOL1: Membership of the Energy Community (EC) and meeting its requirements.
Type	Political.
Implementing entity	Ministry of Energy of Georgia.
Implementation year/period	2016-2020.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	It has not been calculated since this is the measure of policy covering the entire energy sector and its effect is considered in all the measures described in all chapters related to energy emissions, including transport, industry and buildings
Description of the Measure	The measure is joining the Energy Community and complying with its requirements, including developing energy efficiency and renewable energy action plans, liberalization of energy markets and developing the necessary supporting strategies.
Assumptions and assessments	This is the overarching policy for emission reductions in the energy sector.
Progress indicators	The progress in meeting the requirements of EC
Estimated investments	This measure requires technical assistance to support the developments of the required plans or legislative amendments. The size of the assistance has not been assessed.
Financing aspects	This measure focuses on technical assistance, policy and economic/market capacity building and strategy formulation with the aim of integration and compliance with the EU led Energy Community rules and requirements. As such, the most relevant Climate Finance sources for co-financing are the following: **Intl Sources** • International Donors Development Agencies – with a focus on European ones • IFIs and Bilateral Development Banks • Multilateral Development Banks **Domestic Sources** • Georgian Government Most relevant financial instruments are Technical Assistance Grants

Mitigation measure	EPOL2: Refinement of tariff policy
Type	Political.
Implementing entity	Ministry of Energy of Georgia, GNERC.
Implementation year/period	2020-2025.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	This is the policy measure that supports implementation of energy efficiency measures in demand sectors and its effect is included in the estimates of those measures. Thus the emission reductions for this particular measure has not been estimated.
Description of the Measure	When analyzing the barriers to energy efficiency in Georgia (mainly in the buildings sector) it is evident that one of the main barriers is low tariffs on energy carriers, due to which the payback periods of measures are significantly increased and investing in energy efficiency becomes less feasible. Thus it is important to refine the current tariff system in such way that tariffs support implementing energy efficiency measures instead of hindering them (especially for natural gas) and helps the optimal distribution of load curve (for electricity). Seasonality, day slices, quantitative or other characteristics can be considered in tariffs to achieve this.
Assumptions and assessments	The measure removes barriers for other energy efficiency measures.
Progress indicators	Change in electricity and gas tariffs
Estimated investments	The measure requires technical assistance to develop reasonable tariff policy; the size of the assistance has not been assessed.
Financing aspects	This measure – updating of the electricity tariff is a combination of Technical Assistance and Electricity Market Capacity Building. As such, the most relevant Climate Finance sources for co-financing are the following: **Intl Sources** • International Donors Development Agencies • IFIs and Bilateral Development Bank • Multilateral Development Banks **Domestic Sources** • Georgian Government Most relevant financial instruments are Technical Assistance Grants

Mitigation measure	EMEA1: Increasing the share of hydroelectricity in domestic electricity consumption through the improvement of the existing transmission grid and optimization of dispatching.
Type	Technological.

Implementing entity	Ministry of Energy of Georgia.
Implementation year/period	2016-2026.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	389 Gg.
Description of the measure	The goal of this measure is to increase the share of hydro power in domestic electricity consumption and this should take place in parallel with the development of sustainable hydro power projects in Georgia. The increase in hydro power will only occur after implementation of the following measures: • Developing and enhancing Georgia's transmission grid: priority growth of West-East transfer capacity; • Ensuring integration of hydro power plants into the regional grid and optimization of dispatching; • Ensuring synchronous development of transmission lines together with generation/supply facilities. The transmission network in Georgia is mostly in a latitudinal direction from western part of the country towards the east. The majority of generation units are located in the western part of the country, where the installed capacity of hydro power plants is 2,080 MW, while a large part of consumption is in eastern Georgia where 63.8%[119] of Georgia's population is concentrated. In the Ten-Year Grid Development Plan of Georgia[120] there is a planned expansion in the grid transmission from west to east, which has a positive impact on the share of hydroelectricity in internal consumption. This plan indicates the timeline of enhancement, expansion and modernization of Georgia's transmission system in such way that it is able to answer the growing demand. Among other goals, the plan also ensures the sufficient transmission capacity for integrating the renewable (solar, wind) energy sources. Plan also includes complete technical reconciliation of existing power plants and timely construction or regulating reservoir plants (such as Khudoni, Nenskra, Namakhvani, Tskhenistskali, and Mtkvari Cascade) so that the water accumulated during high water period of spring can be used to generate electricity in low water period in winter. Plan also includes enhancement of the possibility to trade energy with neighboring countries and improvement of electricity dispatching, which also supports increasing the share of hydroelectricity in domestic consumption.

119 According to the average population in 2015

http://geostat.ge/cms/site_images/_files/georgian/population/03%20saSualo%20wliuri%20mosaxleobis%20ricxovnoba%20TviTmmarTveli%20erTeulebis%20mixedviT.xls

120 The Ten-Year electricity Grid Development Plan for Georgia 2016-2026, approved by Order No 2840 of Georgia Government on 30.12.2015.

Assumptions and assessments	According to the projected balance under the Ten-Year Grid Development Plan of Georgia, the share of generation from hydropower plants in 2025-2026 varies between 83%-86%. Within the framework of the low emission development strategy a target was set that hydro power stations will provide at least 85% of the country's internal consumption by 2030.
Progress indicators	Share of electricity produced by hydro plants in country's internal electricity consumption.
Estimated investments	In total, the average investment cost of the projects scheduled to 2021 under the Ten-Year Grid Development Plan of Georgia reaches 814 billion EUR.
Financing aspects	This measure relates to infrastructure development of the Georgian grid with the aim of increasing its ability to integrate new hydro power plant while maintaining grid stability, and reducing the grid's dependence on seasonal variation in hydropower supply. Though a large Infrastructure project, it is unclear whether a PPP structure which would allow international and domestic infrastructure investors to invest in the project is relevant for the projects included in the measure- given the strategic importance of transmission lines. In the last five years, transmission line financing has been provided by EBRD, the European Investment Bank (EIB), the German development bank KfW, and the Georgian government. **Intl Sources** · Climate Funds · Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Banks In case, a PPP structure for such investments is developed the following sources could also be relevant: · Multi-Donor and PPP Funds · Private Infrastructure Funds · Green Bonds Most relevant financing instruments are grants, concessionary loans and market rate loans.

Mitigation measure	EMEA2: Replacement of the outdated thermal power plants with maneuverable and efficient combined (steam-gas turbine) thermal power plants.
Type	Technological.
Implementing entity	Ministry of Energy of Georgia.

Implementation year/period	2020-2026.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	364 Gg.
Description of the Measure	The measure implies the construction of two 250 MW modern and efficient natural gas power plants, which will be commissioned in 2020 and 2026 and will replace the Mtkvari and Tbilsreri thermal power plants.
Assumptions and assessments	It was assumed that the net efficiency of the new thermal power plants will be 52%.
Progress indicators	Commissioning new thermal power plants, total final net efficiency of new thermal power plants.
Estimated investments	The total investment cost of both thermal power stations is approximately 467 million USD.
Financing aspects	This measure includes design and construction of two 250MW CCGT power stations to be operational in 2020 and 2026. The work on the first of these (Gardabani 2) has already begun. Current investors and developers of Gardabani 1&2 power plant include the Georgian Oil & Gas Company and its parent company the Georgian Partnership Fund- a state owned investment fund. The Georgian Energy Development Fund was also involved in the design process at an early stage. It is possible that financing for the power plant expected to be operational in 2026 could also come from these sources. However, in the case Policy Measures (EPOL1, EPOL2, EPOL3) are implemented successfully, the following Climate Finance sources could be relevant as providers of equity and debt. **Intl Sources** · Multi-Donor and PPP Funds · Private Infrastructure Funds- Equity · Private Infrastructure Funds- Debt providers · Green Bonds issuers **Domestic Sources** · Georgian Government Financial instruments relevant for this measure are Equity, Debt (market rate, concessionary) In addition, guarantees and Risk Mitigation Instruments such as FOREX mitigation and political risk could also be relevant. In such a case, MDBs, IFIs, and the Government of Georgia could be relevant sources

	for these instruments.

Mitigation measure	EMEA3: Commissioning new renewable energy power plants.
Type	Technological.
Implementing entity	Ministry of Energy of Georgia.
Implementation year/period	2025.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	144 Gg.
Description of the Measure	The measure includes the construction of a 150 MW wind powered station in eastern Georgia by 2026. Preference is given to the construction of a wind power plant in east Georgia, where there is the higher demand for energy and less hydro potential than in western Georgia. For maximum integration of wind energy, it is also important: • To ensure the grid has the capacity to absorb the wind-generated electricity and ensure effective dispatching enabling substitution of thermal generated electricity and imports; • To set up local/joint enterprises which will provide service to the wind power plant and ensure maximum utilization of its capacity; • To create a legal base which, among other things, will regulate tariffs of wind plants.
Assumptions and assessments	For the assessment of emissions reductions, an assumption was made that the electricity generated by the wind power station will replace the energy generated by the thermal power plant. To assess the seasonal generation of the wind power plant, the averaged data on the potential wind power stations in eastern Georgia (Skra, Samgori, Yaghluja, Vaziani, Mukhrani, and Paravani) was used. According to this data, the average capacity factor of the wind power station during the period of December-March is 29%, in the period of April-July: 32%, August-September: 23%, and October-November: 26%[121]. The annual capacity factor is approximately 28%.
Progress indicators	Increase of capacity of installed wind power plants, electricity generated by wind power plants, seasonal capacity factors of wind power plants.
Estimated investments	Approximately 175 million USD.
Financing aspects	The measure includes several distinct parts. The first- infrastructural in nature- the development and construction of 150 MW wind farms in

[121] The months are divided in compliance with seasonal division by MARKAL-Georgia based on hydrological availability of water in rivers in Georgia.

	Eastern Georgia by 2026. The second- more policy/technical assistance in nature - This measure is comprised of the following: 1. Project-based: Development and construction of 150 MW wind farms in Eastern Georgia. 2. Technical Assistance: Development of domestic expertise in provision of wind power technical services and the establishment of companies capable of delivering this expertise 3. Policy Capacity Building: Creation of a legal base which will regulate pricing and other issues 4. Grid-related: Ensure Grid potential to integrate wind power into the generation mix Climate Finance sources for the Technical Assistance and Policy Capacity Building are similar to the ones described EPOL-1, EPOL-2 and EPOL-3. The first Wind farm in Georgia was developed by the GEDF, and debt finance was provded by an MDB – EBRD and a Multi-Donor PPP Fund (Finance in Motion). Depending on the success of the farm's electricity generation and connection with the grid, it is possible that more Private sector involvement (both international and domesti) could be relevant. Relevant Climate Finance sources for the development and construction of the wind farms are mentioned below. **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · Private Infrastructure Funds- Equity · Private Infrastructure Funds- Debt providers **Domestic Sources** • Georgian Government

Mitigation measure	EMEA4: Reduction of natural gas losses in distribution networks.
Type	Technological.
Implementing entity	Ministry of Energy of Georgia, SEMEK, Distribution Companies.
Implementation year/period	2016-2030.
GHG covered	CH_4.
Emissions reduction in 2030 [Gg CO_2-eq]	1,614 Gg CO_2 eq.

Description of the Measure	In recent years, the distribution losses have been significantly reduced, however they are still unacceptably high and exceed accepted norms. This measure reduces the losses from distribution pipelines by the rehabilitation and development of networks and equipping them with modern regulating, control and metering technologies.
Assumptions and assessments	Presently in Georgia technical distribution losses of natural gas distribution networks vary between 4%-11%, and the total distribution losses make 6.4% of the natural gas supplied to Georgia (according to the Energy Balance of 2014). The Energy and Water Supply Regulatory Commission of Georgia analyzed distribution network losses and technology in other countries. Gas distribution technological losses are as follows: Estonia: 1.1%, Romania: 1-2%, Azerbaijan: 2-3%, Armenia: 3-4%, Lithuania: 0.5-0.7%; Latvia: 2.3%, Poland: 2-3% of the consumed gas. Technological losses in the United States vary between 0% and 1%. The plan for Georgia is to reduce the share of distribution losses to at least 2% by 2030.
Progress indicators	Technological losses in natural gas distribution networks
Estimated investments	Approximately 5 million EUR (€5,535,000[122]).
Financing aspects	This measure is one of the most cost effective measures relating to both GHG Emission Reductions and energy savings. Given the technical losses in Georgian distribution companies vary between 4% and 11% and that according to GNERC's technical literature review, distribution losses in other former Soviet Union and Eastern European countries range between 0.5% and 4%, the potential for savings in this measure is high. Energy sector measure EPOL2: Perfection of tariff policy can – if implemented correctly- create a regulatory environment that would incentivize distribution companies to reduce gas losses in their networks. In addition, one distribution company Kaztrans has in the past implemented a CDM project for reducing fugitive emissions from its network, and as a result – some domestic expertise in this domain exists. Given the right incentive structure, it is very likely that distribution companies can finance the implementation of this measure from their budgets. However, if the goal is to maximize the potential of this measure and to ensure implementation of best available technology, it could be relevant to include a Private Sector training/Technical Assistance element to this measure for all the distribution companies in Georgia. Relevant Financing sources for the Technical Assistance/training include the following:

[122] Energy Efficiency Action Plan for Georgia – working version, Ministry of Energy.

	Intl Sources · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies **Domestic Sources** · Georgian Government Relevant Climate Finance sources for the implementation of the measure are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · Private Infrastructure Funds- Debt providers · Impact Investment Funds **Domestic Sources** · Georgian Commercial companies

Mitigation measure	EPOL3: Ensuring and promoting the use of geothermal resources
Type	Information / Legislative.
Implementing entity	Ministry of Environment and Natural Resources Protection of Georgia, Ministry of Energy of Georgia.
Implementation year/period	2016-2030.
GHG covered	CO_2.
Emissions reduction in 2030 [Gg CO_2-eq]	Has not been calculated.
Description of the Measure	Georgia must develop a long-term policy to ensure geothermal resource exploitation. To do this, the following actions have to be taken: • Assessing the present state of geothermal resources throughout Georgia. The purpose is to reveal new deposits and specify the stocks in old deposits; • Defining the possibility of exploiting existing deposits and identifying technologies suitable for this exploitation; • Carrying out the state supervisory control on the deposits, to ensure their environmentally and economically justified operation; To promote the use of geothermal energy resources the following actions can be taken: • Ensuring long-term preferential loans and promotions for

	those entrepreneurs who deploy modern technologies, or drill new wells; • Provide entrepreneurs in the field with training and modern technological portfolios for operating thermal deposits; • Define the most efficient exploitation methods with minimum environmental impact. All stakeholders should work together in a public private partnership to determine the role of the government and the private sector in this process.
Assumptions and assessments	Emissions reduction for this measure has not been calculated. To assess the emission reduction it is important to define the concrete sector and service in which the geothermal energy will be used, and the fuel that it will substitute. This requires additional feasibility studies.
Progress indicators	Amount of geothermal energy used for energy purposes.
Estimated investments	Technical Assistance (has not been assessed).
Financing aspects	This measure – optimal promotion of Geothermal resources is a combination of Technical Assistance, Energy Market Capacity Building and Policy and Strategy formulation. As such, the most relevant Climate Finance sources for co-financing are the following: **Intl Sources** • Climate Funds (UNFCCC- GCF, GEF etc; WB) • International Donors Development Agencies • IFIs and Bilateral Development Bank • Multilateral Development Banks **Domestic Sources** • Georgian Government Most relevant financial instruments are Technical Assistance Grants

2.B. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY BUILDINGS

Mitigation measures

Mitigation measure	Implement and enforce the new "Spatial Planning and Construction Code"
Type	Legislative
Implementing entity	Ministry of Economy and Sustainable Development
Implementation year/period	Since 2018
GHG covered	CO_2, CH_4, N_2O
Emissions reduction in 2030 [Gg CO_2eq]	**75**
Description of the measure	This measure implies that the new "Spatial Planning and Construction Code" will be enforced in Georgia. According to this code "Technical Regulations" on energy efficiency and use of renewable energy in the buildings sector should be approved by the government decree. It is assumed that after the approval (by 1 July 2019) and enforcement of the Technical Regulations (presumably in 2020), energy efficiency of all newly constructed buildings will be improved at a minimum by 20%, compared to buildings erected under the present technical norms, and by 50-60% compared to the rehabilitated buildings. This assumption is based upon the fact that in the buildings currently under construction the amount of energy for heating 1 m^2 of area is 100-130 W, while according to the new regulations, the maximum requirement for heat per 1 m^2 is anticipated to be 80 W.
Assumptions and evaluations	Enforcement of the new "Technical Regulations" is anticipated to start in 2020. To 2030, 11% of existing residential buildings and 20% of existing commercial buildings will be newly constructed structures.
Progress indicators	The new building code is adopted by the Parliament of Georgia and enforced by the Ministry of Economy and Sustainable Development of Georgia. Technical Regulations for energy efficiency and use of renewables in building sector are prepared, adopted and implemented. The number of buildings and area (in m^2) constructed in compliance of the new technical regulations. Measured energy consumption per sq. meter. Renewable energy share in energy consumption by new constructions.
Estimated investments	N/A
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building. As such, the most appropriate Climate Finance sources for this measure are below. The DANIDA/NEFCO project "Support to Energy Efficiency and Sustainable Energy in Georgia" includes in its scope providing support related to Construction Code development. **Intl Sources** • International Donors Development Agencies • IFIs and Bilateral Development Banks • Multilateral Development Banks **Domestic Sources** • Georgian Government

	In case this measure also includes financial incentives to contractors and developers who are interested in becoming early adopters of the standard or go beyond the requirements of the standards, the following financial sources are relevant: **Intl Sources** · Multilateral Development Banks: · Multi-Donor and PPP Funds: **Domestic Sources** · Georgian Government: · Georgian Banks:

Mitigation measure	**Renovate state buildings according low emission development strategy (NAMA)**
Type	Implementation of energy efficient technology
Implementing entity	Government of Georgia, Municipalities, relevant Ministries, ESCOs
Implementation year/period	2019-2030
GHG covered	CO_2, CH_4, N_2O
Emissions reduction in 2030 [Gg CO_2eq]	**25 Gg** from natural gas, reported in the buildings sector **38 Gg** from fire wood consumption, reported in the LULUCF sector
Description of the measure	The measure considers that at least 50% (maximum 100%) of state buildings existing in 2014 will be rehabilitated by 2030. As different audits have indicated, 80% of state and municipal buildings are to some extent rehabilitated, though the whole package of energy efficiency measures (except windows) is not implemented. After the implementation of all possible EE measures saving will make up 53% on the average.
Assumptions and evaluations	The average consumption of heat at present is 170 kWh/m^2/annually (based on buildings energy audit results conducted in ten municipalities in West and East Georgia. After EE renovation of buildings consumption will be 80 kWh/m^2/annually. After rehabilitation, 100% of heating area is heated. Rehabilitation cost per sq. m estimated in average 150 USD. 2019-2020 will be pilot phase of public buildings NAMA. 50% - 80% state buildings (including municipal structures) having already some rehabilitation will be renovated in 2020-2030 in Georgia. Program- maximum includes 100% of buildings to be rehabilitated. Calculations are done for 50%. According to the Energy Community Agreement Georgia must renovate 1% of public buildings annually.
Progress indicators	Number of public/municipal buildings by rehabilitation type (light, medium, hard) rehabilitated with energy efficient measures. Share of total rehabilitated areas (m^2) by rehabilitation type in total area of public/municipal buildings. Energy savings in kWh/annually measured or estimated through approved methodology. GHGs reduced in tCO_2eq.
Estimated investments	The cost of renovating a medium restorable building, taking into account energy efficiency measures, is calculated at 150 USD per sq. m. Total area of state buildings including municipal structures equals 5.9 million m^2, as 80% of them are medium restorable, the cost of rehabilitation of 50% of this 80% will amount to 354 million USD.
Financing aspects	This measure focuses on a programmatic approach in the rehabilitation of state owned

	buildings. This measure is likely to be implemented in phases – first with a design of a pilot programme, and its implementation on a limited amount of buildings. The programme's should have a robust MRV system which could include the development of a methodology to assess the expected savings from implementation of the Energy Efficient technologies and potentially real time measurement of energy consumption to verify the validity and accuracy of the expected savings methodology. The DANIDA/NEFCO project "Support to Energy Efficiency and Sustainable Energy in Georgia" includes in its scope providing support related to Renovation of public buildings in selected municipalities and supporting capacity building. The total estimated costs of the project are 1.416 billion USD until 2030. This is substantial and will require co-financing from various public Climate Finance sources which are listed below. In addition, depending on the accuracy and robustness of the programme's MRV Monitoring system, Private sector financing could also be relevant. **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · International Donors Development Agencies including the NAMA Facility which provides financing for NAMA implementation · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Government · Georgian Municipalities · Georgian Commercial companies operating as ESCOs · Georgian Banks The most relevant financial instruments are project development grant, project implementation grants, concessionary and non-concessionary loans.

Mitigation measure	**Renovate commercial buildings according to emission development strategy (NAMA)**
Type	Implementation of energy efficient technology
Implementing entity	Private sector with the support of Government of Georgia
Implementation year/period	2021-2030
GHG covered	CO_2, CH_4, N_2O
Emissions reduction in 2030 [Gg CO_2eq]	**83**
Description of the	The implementation of this measure assumes that 50% of medium restorable commercial

measure	buildings, existing in 2014 and without energy efficiency measures, will be completely rehabilitated by 2030. The execution of this program is possible only after implementing a low emission buildings NAMA for state and municipal buildings that will create the market of energy efficient materials, highly skilled constructors and workforce, and "ESCOs (Energy Service Company)," and when the Spatial Planning and Construction Code" as well as Technical Regulations of Constructions will already be adopted by the parliament and the Government Decree respectively and enforced by the Ministry of Economy and Sustainable Development.
Assumptions and evaluations	The total heating area of commercial buildings is estimated at 9.1 million sq. m (86% of total 10.6 million sq. m). Average consumption of heat at present is 170 kWh/m^2/annually (based on buildings energy audit results conducted in ten municipalities in West and East Georgia. After EE renovation of buildings consumption will be 80 kWh/m^2/annually. After rehabilitation, 100% of rehabilitated heating area is heated. Rehabilitation cost per sq. m estimated in average 150 USD. 2019-2020 will be the pilot phase of state buildings NAMA. 50% of slightly rehabilitated commercial buildings will be renovated with energy efficiency measures in 2020-2030. It was assumed that only commercial buildings using natural gas for heat supply will be included in this NAMA.
Progress indicators	Number of commercial buildings by rehabilitation type (light, medium, hard) rehabilitated with energy efficient measures. Share of total rehabilitated areas (m^2) by rehabilitation type in total area of commercial buildings. Energy savings in kWh/annually measured or estimated through approved methodology. GHGs reduced in tCO_2eq.
Estimated investments	The overall area of commercial buildings in the territory of Georgia in 2014 is assessed to be 10.6 million m^2. About 50% of the heating area (9.1 million sq. m) of commercial buildings in Georgia are relatively well maintained i.e. in a medium restorable condition. The area of medium restorable commercial buildings is 4.55 million m^2. The rehabilitation cost of such type of buildings will amount to 682.5 million USD (taking 1 m^2=150 USD).
Financing aspects	This measure's implementation is conditional on successful implementation of low emissions building for state and municipal building, on the successful introduction, adoption and enforcement of the Construction Code and on the development of a marketplace for Energy Efficiency related services, expertise and materials. As such, this programme's risk exposure will likely be lower than the exposure for the state and municipal building programme. Nonetheless, and similar to the case of the state building NAMA, the programme would need to be designed, a robust MRV monitoring system included, and a pilot programme implemented. The most relevant Climate Finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds **Domestic Sources** · Georgian Commercial companies operating as ESCOs · Georgian Commercial companies (asset owners) · Georgian Banks

Mitigation measure	Low emission development of residential buildings (NAMA)
Type	Implementation of energy efficient technology in buildings

Implementing entity	Government of Georgia in cooperation with homeowners' associations
Implementation year/period	2025-2030
GHG covered	CO_2, CH_4, N_2O
Emissions reduction in 2030 [Gg CO_2eq]	**394 Gg** from natural gas, reported in energy sector **67q Gg** from fire wood, reported in LULUCF
Description of the measure	This measure considers rehabilitation of half (55%) of the heating area (71 m²) of residential buildings stock in Georgia. Targeted buildings belong to the medium restorable residential buildings which are to some extent rehabilitated, though the whole package of energy efficiency measures (except windows) is not implemented. To achieve this goal the state program on Buildings Stock Renovation should first be set up and the implementation of state buildings NAMA should be in its active phase.
Assumptions and evaluations	Average consumption of heat at present is 170 kWh/m²/annually (based on buildings energy audit results conducted in 10 municipalities in West and East Georgia). After EE renovation of buildings consumption will be 80 kWh/m²/annually. After rehabilitation, all 100% of heating area rehabilitated is heated. Rehabilitation cost per m² estimated in average 150 USD. Residential sector NAMA will start only after piloting of state buildings NAMA, after 2025. A 55% of residential buildings having already some rehabilitation will be renovated in 2025-2030 in Georgia. This percentage is very high and less realistic but needed for achievement of 2030 target.
Progress indicators	Number of residential buildings by rehabilitation type (light, medium, heavy) rehabilitated with energy efficient measures. Share of total rehabilitated areas (m²) by rehabilitation type in total area of commercial buildings. Energy savings in kWh/annually measured or estimated through approved methodology. GHGs reduced in tCO_2eq.
Estimated investments	The rehabilitation of 1 m² of a medium rehabilitation required building, accompanied with energy efficient measures, estimated as about 150 USD on the average. The rehabilitation of 39,4 million m² area demands 5913 million USD.
Financing aspects	See Comments related to EEBUILTEC2: Low emission development of commercial buildings (NAMA) and EEBUILTEC1: Low emission development of state buildings (NAMA)

Mitigation measure	**State program for the wide-spread utilization of solar water heaters and energy efficient stoves in private houses implemented** (In this direction at this stage the NAMA project is developed, which could be regarded as a pilot project of this measure)
Type	Implementation of energy efficient and renewable technologies in rural areas
Implementing entity	Non-governmental sector (the pilot NAMA project is developed by the NGO "Greens Georgia: Friends of the Earth"
Implementation year/period	2017-2020 pilot phase 2020-2030 Whole territory of Georgia lacking the gas supply
GHG covered	CO_2, CH_4, N_2O
Emissions reduction in 2030 [Gg CO_2eq]	**62**
Description of the	This measure implies the creation of favorable conditions by the state for the rural

measure	population, especially those who uses mainly firewood as fuel, for the application and dissemination of solar water heaters and energy efficient stoves. The objective of this measure is to reduce the natural gas consumption increase when promoting the country to transform firewood into a long-term energy resource under the conditions of efficient consumption and sustainable management of forests. The implementation of three components is planned in the pilot phase: **The first component** entails installing solar water heating collectors for about 15,000 families, or 13.2% of total number of householders (114 thousand) living in villages and boroughs. Surveys conducted under the preparation of the pilot project indicated that 12% of total heat supply is used for hot water supply in these regions. **The second component** means the installation of energy efficient stoves for 15,000 households living in rural settlements as well. **The third component** of the project implies thermal insulation of houses by different measures, among them: thermal insulation or substitution of windows, thermal insulation of doors, thermal insulation of ceilings and walls. The 15% energy savings per household is expected as a result of these measures, in which at this time only 12-15% of total area (one or two rooms) are actually heated.
Assumptions and evaluations	It's assumed that by 2030 this program will cover 80% of rural families (91,200 households) and 30% (188 thousand families) of households living in one to two story houses in urban settlements. Energy efficient stoves (having about 70% efficiency) will cover 80% of rural population. In BAU scenario the increased demand in heating in rural areas is covered by gas or by LPG since the amount of biomass is limited. Due to the effect of this measure some biomass will be saved which is used to cover increased heating demand instead of gas and LPG, thus reducing LPG and gas consumption relative to BAU scenario.
Progress indicators	Number of households in rural areas having solar collectors for hot water production. Number of households in rural areas having energy efficient wood stoves. Efficiency of new wood stoves. Measured/estimated reduction of annually consumed fire wood (in m^3) per household. Daily consumption of hot water per household and share of solar heated hot water in annual consumption.
Estimated investments	The cost of installing solar collectors on one house is on average 500 USD. Correspondingly, the necessary sum for 15,000 houses will be 7.5 million USD and for 279,200 houses, 140 million USD. A large variety of ordinary firewood stoves are produced in Georgia and the cost varies in the range of 10- 42 USD, while the cost of energy efficient stove is about 250 USD that requires in total 4 million USD at the first stage and 22.5 million USD at the second stage. The cost of thermal insulation works substantially vary depending on the condition of area to be insulated and the degree of insulation. On the average, the cost of thermal insulation of two rooms (heating space) could vary from 85 to 1,460 USD. Taking on the median for thermal insulation works 835 USD, it would require 12.5 million USD for the first stage and 233 million USD at the second stage. Through 2020, the piloting of the program for 15,000 families requires 24 million USD and total program through 2030-406 million USD.
Financing aspects	This measure focuses on a programmatic approach the introduction of Energy Efficient technologies (solar water heaters, efficient cookstoves, insulation) to the rural population in Georgia. In addition to GHG Emission Reductions and Energy Efficiency impacts, the programme is expected to have positive development impact on poorer households through savings, and reduce the likelihood of internal air quality from the

	use of wood stoves. Given the programmatic nature and NAMA structure of this measure, and the positive Sustainable Development benefits to rural population, the programme is likely to be attractive to Impact Investment Funds – in addition to public Climate Finance sources. This under the condition that robust MRV framework (which would include non-GHG Sustainable Development parameters) is designed and put in place. The following Climate Finance sources are relevant: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies including the NAMA Facility which provides financing for NAMA implementation · Impact Investment Funds **Domestic Sources** · Georgian Government – could include providing financial incentives instead of social wood cutting programme (a current subsidy) · Georgian Banks · Georgian households The most relevant financial instruments are project development grant, project implementation grants, concessionary loans (Microfinance).

Mitigation measure	**Solar water heaters in commercial and state buildings (NAMA)**
Type	Introduction of renewable technologies
Implementing entity	Private sector (ESCO)
Implementation year/period	2020-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2eq]	**17** (in generation sector)
Description of the measure	Per information and data gathered from several sources, in all five zones there are 86,400 commercial and state buildings. This measure implies application of solar heaters in commercial and state structures. It includes as well, the installation of water heaters in municipal buildings under the SEAPs.
Assumptions and evaluations	To estimate the cost of the measure, it's assumed that 20% of commercial buildings (hotels, restaurants, etc.) and 30% of signatories to the CoM Municipal Buildings (Kindergartens, municipal hospitals, and sporting schools) will use solar water heaters by 2030.
Progress indicators	Number of commercial and public/municipal buildings having solar water heaters. Annual water consumption by buildings in baseline and the project situation. Share of solar heated water in whole hot water consumption by buildings.
Estimated investments	To assess the related financial implications, it's assumed that one building will require a solar collector of at least twice the area (4.4 m^2) and in this case one building will cost on average 1,000 USD, while the supply of 50% of commercial and state buildings

	(43,000 buildings) with solar collectors will cost 43 million USD.
Financing aspects	Similar to EEBUILTEC2: Low emission development of commercial buildings (NAMA) and EEBUILTEC1: Low emission development of state buildings (NAMA). Could be integrated as part of these measures.

Mitigation measure	**Mandatory labeling of electric appliances**
Type	Promotion, adoption, and dissemination of energy efficient technologies
Implementing entity	Ministry of Energy, Private sector
Implementation year/period	2022-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2eq]	**52** (in Generation sector)
Description of the measure	The measure implies that the EE labeling of electric appliances will become obligatory by 2022 for those electric appliances, which are defined by the Association Agreement.
Assumptions and evaluations	To assess the efficiency of the measure, it's assumed that 50% of electric appliances will become more efficient by 2030.
Progress indicators	Law/Government Decree making the EE labeling of electric appliances obligatory is enforced. Share of labeled EE electric appliances in the market and among sold product comparing with the baseline situation. Survey of population on use of EE labeling systems in their purchasing policy.
Estimated investments	N/A
Financing aspects	The measure for Energy Efficiency labeling of electric appliances is part of the requirements stated in the European Association agreement. Its related expenses would include the following: • Policy development, implementation and capacity building of the entities charged with inspection and enforcement of its implementation • Technical assistance of national and international experts for defining the policy, training the inspection agencies, and supporting the implementation of the policy in its beginning • Development of a methodology to monitor the implementation of the policy and its impacts. The methodology recommended by the European Commission involves the development of a Top Down methodology which assesses the market penetration of Energy Efficient appliances before and after the implementation of the policy and tracking of appliances based on their Energy Efficiency rating. • Additional work with regards to monitoring the impacts of the policy could include long term sampling the actual energy performance and savings of the appliances relative to the appliances' Energy Efficiency ratings through the installation of energy consumption monitoring equipment

	• Yet additional Capacity Building for this measure could include raising of Public Awareness Given the focus of this measure is Capacity Building of policy, Technical Assistance and the development of a robust Monitoring Methodology, the most relevant Climate Finance sources for financing the measure are listed below. The DANIDA/NEFCO project "Support to Energy Efficiency and Sustainable Energy in Georgia" includes in its scope providing support related to Product labelling. Intl Sources • International Donors Development Agencies – with a focus on European ones • IFIs and Bilateral Development Banks • Multilateral Development Banks Domestic Sources • Georgian Government In case this measure also includes incentives to purchasers of Energy Efficient appliances, the financing for such incentives could include the following: · Multilateral Development Banks: For example, EBRD EnergoCredit Georgia programme · Multi-Donor and PPP Funds: For example, Finance in Motion collaboration with Georgian Banks to encourage retail purchase of Energy Efficient appliances · Georgian Government: For example, partial or full rebate of VAT and/or customs taxes · Georgian Banks: As domestic managers of programmes to encourage Energy Efficiency appliance in the retail sector through collaboration with EBRD and Finance in Motion

Mitigation measure	**Replace incandescent lamps with energy efficient bulbs in the consumer market**
Type	Promotion, adoption, and dissemination of energy efficient technologies
Implementing entity	Ministry of Energy, Private sector
Implementation year/period	2020-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2eq]	**125** (in Generation sector, calculation of emission done by MARKAL)
Description of the measure	This measure is the same as in NEEAP. The measure involves the replacement of incandescent bulbs with energy efficient bulbs in residential and commercial buildings (including public buildings) - increasing over time to cover 100% of these buildings by the end of 2030. The measure would be implemented through the introduction of regulations to discourage the import and/or sale of non-efficient bulbs. This could involve banning the import and sale of bulbs that do not meet certain efficiency requirements or – more likely – via an increased excise tax on inefficient bulbs. Additionally, upon clearance

	through customs, bulbs would be categorized according to their efficiency. Already, the Custom Department of the Revenue Service of Georgia has developed a classification code for imported incandescent light bulbs (versus CFLs of LEDs), which was initiated by the Ministry of Energy.
Assumptions and evaluations	In the framework of this measure, it has been assumed that the replacement of incandescent bulbs with energy efficient bulbs in residential and commercial buildings - increasing over time to cover 100% of these buildings by the end of 2030.
Progress indicators	Share of incandescent bulbs in the market before and after legislation is enforced; share of incandescent bulbs among sold product in the baseline and the project/measure situation.
Estimated investments	Cost calculation directly taken from NEEAP. The measure will prove to be more economical, if by this time in Georgia, local enterprises are producing energy efficient lamps, conforming to European standards and quality. It is also assumed that the quality of electricity will be improved in the coming years via grid and distribution improvements to allow the bulbs to reach their lifetime of usefulness. 90,411,198 USD in total for 2020-2030.
Financing aspects	The nature of this measure- prohibition of incandescent lamps from the Georgian market by 2030 - is mainly Legislative, and in itself will not require much financial support for defining it. As mentioned above, a requisite for this measure to be effective is an increase in the stability of the grid, as variations in the grid frequency can harm Energy Efficient lamps and reduce the energy saving potential from the measure

Mitigation measure	**Increase energy efficiency in geothermal hot water supply**
Type	Promotion, adoption, and dissemination of energy efficient technologies
Implementing entity	Private sector
Implementation year/period	2020-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2eq]	**6**
Description of the measure	Maximize utilization of geothermal heat supply potential in Tbilisi both in residential and commercial buildings. Presently, only 49% of heat produced by six wells located in Tbilisi is used. This measure should increase the utilization coefficient up to 80-90% of existing potential
Assumptions and evaluations	It is assumed that by 2030 the total technical and economic potential of existing geothermal wells will be utilized.
Progress indicators	Number of families having geothermal hot water. Number of families having geothermal heating system. Total consumption of geothermal heat in baseline and the project/measure situation. Temperature and amount of geothermal water supplied to the population.
Estimated investments	12-15 million USD including the installation of GCS (Geothermal Circulation System).

Financing aspects	The nature of this measure is a Capacity Building – with a combination of Technical Assistance, Policy support, Market Study and would fit in the context of a detailed Investment Plan for improved use of geothermal hot water. It could also include implementation of a portfolio of pilot projects and actions. The most relevant Climate Finance sources for this measure would be: **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Shift street lighting to LED lanterns**
Type	Promote adoption and dissemination of energy efficient technologies
Implementing entity	Municipalities
Implementation year/period	2019-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2eq]	**7 (in generation sector)**
Description of the measure	The measure implies the complete shifting of street lighting to LED lamps (existing and future SECAP[123] measure). The activity considers that in the scope of CoM, the Municipalities have already actively initiated the introduction of this measure, which has been sufficiently profitable for them. Here it should be mentioned as well that Municipalities need technical assistance for the installation of high efficiency systems. Sensor based and other remote-control systems as well as solar energy utilization in outdoor lightening are also envisaged.
Assumptions and evaluations	By 2030, 90% of street lighting systems will utilize LED lamps.
Progress indicators	Share of LED lamps in municipalities' street lightening. Savings in budget for street lightening.
Estimated investments	
Financing aspects	The implementation of this measure will require Financing for the widespread installation of the energy efficient street lighting lamps Technical assistance for the installation of high efficiency systems and monitoring and control systems, and for monitoring the impacts of the implementation of the measure. It is possible that Capacity Building on the Municipal level would also be required as the measure is likely to be implemented on the Municipality level.

[123] SECAP- Sustainable Energy and Climate Action plan, initiated by the Mayors of EU cities.

	The most relevant Climate Finance sources are the following: **Intl Sources** · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · International Donors Development Agencies **Domestic Sources** · Georgian Government · Georgian Municipalities · Georgian Banks

2.C. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY TRANSPORT

Mitigation measure	TPOL1: Road transport technical requirements
Type	Legislative
Implementing entity	Ministry of Economy and Sustainable Development of Georgia (initiator)
Implementation year/period	2018 – Introducing road worthiness tests for road transport (Directive 2009/40/EC); 2017 - limiting the speed for certain categories of motor vehicles (Directive 92/6/EEC) for new vehicles and for vehicles engaged in international transport; 2021 - limiting the speed for certain categories of motor vehicles (Directive 92/6/EEC) for vehicles engaged in national transport; 2017 – introducing maximum authorized dimensions (Directive 96/53/EC); 2020 - labeling of tires with respect to fuel efficiency and other essential parameters (Regulation 1222/2009/EC).
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	214 Gg (including the effects of TPOL2-4 measures)
Description of the measure	Road worthiness tests will become obligatory in Georgia for all types of road transport from December 31, 2017. The legislative amendment is related to the country's international responsibilities, environment situation in the country and outdated car fleet. Before the new law is adopted, road worthiness tests are mandatory only for more than 3.5 ton capacity trucks and for vehicles with more than eight seats excluding the driver. As for passenger cars, testing is voluntary. According to 3 January 2014 Georgian Government's Decree N30, from the beginning of 2018 more than ten components of vehicles will be tested: Braking system; steering and steering wheel; visibility; lamps, reflectors and electrical equipment; axles, wheels, tires, suspension; chassis and chassis attachments; cab and bodywork; CO emissions, etc. According to the "Road Safety" law, testing will be carried out by the Unified National Body of Accreditation accredited private company. For special type of newly registered vehicles and for vehicles engaged in international transport from 31 December 2017 the maximum speed will be limited. The same will be true for vehicles engaged in national transport from 31 December 2021. Legislative change is

	related to Georgia's international obligations, to the environmental state in the country and aims to increase the energy efficiency and road safety in transport sector. Depending on the type of transport, speed will be limited to either 100 or 90 km/h, while for the transportation of dangerous goods 85 km/h limit might be applied. From 31 December 2017 maximum authorized dimensions of road vehicles will be laid down. Legislative change is related to Georgia's international responsibilities and aims to protect the environment and road infrastructure. Limits will be applied to maximum weight, length, width, height, and to other essential parameters. The measure will increase transport effectiveness as the motor works more effectively while loaded reasonably. From 31 December 2020 labeling of tires with respect to fuel efficiency and other essential parameters will become mandatory. The legislative amendment is related to Georgia's international obligations and aims to increase road safety and transport efficiency, and reduce traffic noise as well.
Assumptions and assessments	The effectiveness of these measures, which increase road transport efficiency, are evaluated together with TPOL2-4. It is widely known fact that a well-maintained vehicle consumes 3-7% less fuel than a vehicle in bad condition[124]. Assumption for calculating emission reductions is that the efficiency of (non-electric, non-hybrid) road transport will be increased at most by 7% for 2030 as road worthiness tests as well as other factors (eco-driving, weight and speed limits, fiscal policy for purchasing new cars, etc.) given in measures TPOL2-4 affect efficiency. According to BAU assumptions, where LEDS measures are not implemented, energy efficiency of transport increases by 8% thanks to worldwide improvement of vehicle technologies[125]. Consequentially, cumulative effect will decrease the energy intensity of (non-electric, non-hybrid) road vehicles by 15% compared to 2014 figure[126].
Progress indicators	Adoption of corresponding legislation, reduction of average fleet energy intensity.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	A basket of new laws will be coming into force in the next few years starting in 2018. These include conduction of road worthiness tests, imposition of speed limits, tire labelling etc. The primary goals of

[124] Source: Technologies for Climate Change Mitigation, TNA Guidebook Series, UNEP, 2011

[125] Projections for the road transport technologies efficiency development in the baseline scenario are taken from the US Energy Department database.

[126] Information on 2014 data on the number of road transport, run, efficiency and other parameters is given in the "Overview of Transportation sector", Sustainable Development Centre "Remissia", 2016, EC-LEDS project Report.

	these legislations (with the exception of perhaps the tire labelling law) are not related to increasing energy efficiency and reducing emission reductions. As such, it is unclear whether Climate Finance sources are the most relevant sources for financing these measures. It is likely that ODA which is not related to Climate Finance is a more appropriate source of financing for these measures. In terms of the required assistance, it is likely that the needs of the country would mostly be related to implementing these new legislations, enforcing them, and monitoring their implementation. As a result, Capacity Building and Technical Assistance seem to be relevant The most relevant sources for financing Capacity Building and Technical Assistance for this measure are the following: · International Donors Development Agencies · IFIs and Bilateral Development Banks · Multilateral Development Banks · Georgian Government For the physical element of this measure – the building and operation of technical inspection centres, the financing would be coming from Georgian private sector and Banks in exchange for payment from car owners.

Mitigation measure	TPOL2: Fiscal policy in relation with old cars imports
Type	Legislative/Fiscal
Implementing entity	Ministry of Internal Affairs of Georgia (initiator), Customs Office (implementer)
Implementation year/period	2017
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	To avoid double counting of emissions reductions, these reductions are calculated in the measure TPOL1.
Description of the measure	Draft law prepared by the Ministry of Internal Affairs of Georgia envisages significant increase in excise tax for more than nine years old cars. The excise tax will be calculated according to the difference of car production and import years per 1 cm^3 of motor volume. For example, after the law is adopted, the excise tax for importing ten-year-old (non-hybrid) car with 2.0-liter motor will equal to 2,200 GEL, unlike the

	current figure of 1,000 GEL. The draft law is prepared according to the draft amendment to the "Road Traffic Law" and paired with other related drafts, is an essential part for implementing the road traffic safety action plan of the Ministry of Internal Affairs of Georgia.
Assumptions and assessments	See the description of TPOL1.
Progress indicators	Adoption of corresponding legislation, reduction of average fleet age.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The primary goals of this measure – a draft law for increasing excise tax on importation of old cars- is related to increasing road traffic safety. As such, it is unclear whether Climate Finance sources are the most relevant sources for assisting in the financing of this measures. It is likely that ODA which is not related to Climate Finance is a more appropriate source. In terms of the required assistance, it is likely that the needs of the country would mostly be related to assessing the impact of the law, enforcing it, and monitoring its implementation. As a result, Policy Capacity Building and Technical Assistance seem to be relevant The most relevant sources for financing Capacity Building and Technical Assistance for this measure are the following: · International Donors Development Agencies · IFIs and Bilateral Development Banks · Multilateral Development Banks · Georgian Government

Mitigation measure	TPOL3: Developing and implementing the legislative base for road transport eco-class awarding and labeling systems
Type	Legislative
Implementing entity	Ministry of Environment and Natural Resources Protection of Georgia (initiator)
Implementation year/period	2018-2022
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	To avoid double counting of emission reductions, these reductions are calculated in the measure TPOL1.
Description of the	The measure aims to develop and implement the legislative base for

measure	road transport eco-class awarding and labeling system, and calculating import tax with respect to transport eco-class. Prohibition the import of old cars is also a part of the project.
Assumptions and assessments	See the description of TPOL1.
Progress indicators	Adoption of corresponding legislation, reduction of average fleet energy intensity.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building with the main challenges being calculating the impacts of changes in the import tax on the purchase of high energy efficiency and low emission cars. As such, the most appropriate Climate Finance sources for this measure are below. **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) **Domestic Sources** · Georgian Government

Mitigation measure	TPOL4: Eco-driving courses for drivers
Type	Legislative
Implementing entity	Ministry of Economy and Sustainable Development of Georgia
Implementation year/period	2017-2020
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	To avoid double counting of emissions reductions, these reductions are given in the measure TPOL1.
Description of the measure	According to Georgia's international obligations, for the drivers of certain types of road transport, the requirements of initial qualification and

	periodic training will be introduced. Respective EU Directive (2003/59/EC) which should be adopted under the Association agreement, among other requirements, states that the driver should be able to use fuel, car inertia and gear shift more efficiently, and avoid the wearing out of car parts.
Assumptions and assessments	See the description of TPOL1.
Progress indicators	Adoption of corresponding legislation, reduction of average fleet energy intensity.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building with the main challenges implementation, training curriculum design, and enforcement. As such, the most appropriate Climate Finance sources for this measure are below. **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) **Domestic Sources** · Georgian Government · Georgian Commercial companies

Mitigation measure	TPOL5: Encouraging the purchase of electric and hybrid cars
Type	Legislative/Fiscal
Implementing entity	Parliament of Georgia (initiator)
Implementation year/period	2016-2017
GHG covered	CO2
Emissions reduction in 2030 [Gg CO_2-eq]	Cumulative effect - 69 Gg 83 Gg emissions reduction in transport sector, 14 Gg increase of emissions in electricity generation sector.
Description of the measure	According to the existing law, excise tax is nullified only for electric cars, while for hybrids it is calculated in compliance with the car age and motor volume. From 1 May 2016 excise tax on hybrid cars was reduced by 60%, that is a big step for improving the environmental situation in the country. In perspective, hybrid cars might be completely freed from excise tax as well.

	To encourage the use of electric cars, it will also be helpful to: 1. Work out financial schemes to encourage the purchase of electric (and hybrid) cars; 2. Initiate and implement infrastructure development strategy for electric cars. Abovementioned steps will increase the share of electric and hybrid cars to significant levels.
Assumptions and assessments	By 2015, 46 electric and 1,961 hybrid cars are registered in Georgia. Their respective shares in passenger car fleet are 0.005% and 0.02%. In the EU the share of electric and hybrid cars in car fleet equals to 3%, and in some countries this figure is even higher for newly purchased cars, though fossil fuel-run cars still dominate due to the low purchase and operational costs. Accordingly, financial schemes are needed to change the situation in the favor of eco-friendly cars, the share of which will increase significantly if they become cheaper and more perfect. To evaluate the effects of the measure, it was assumed that the share of hybrid cars will reach 5% and the share of electric cars will reach 1% of car fleet in Georgia by 2030. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Adoption of corresponding legislation, share of electric and hybrid vehicles in vehicle fleet.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure can be divided into two components: a Technical Assistance and Policy Capacity Building, and Infrastructure financing. Technical Assistance would come from the relevant sources (see TPOL3). Infrastructure development for electric cars would need to be financed for the measure to be implemented successfully. Payment for the infrastructure services could include in higher parking rates for non-electric cars in Municipalities, or from Car Battery sellers/leasers. **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Car Battery sellers **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	TPOL6: Improving fuel quality
Type	Legislative
Implementing entity	Ministry of Environment and Natural Resources Protection of Georgia / Atmospheric Air protection Service
Implementation year/period	2016-2020 (stage by stage)
GHG covered	-----
Emissions reduction in 2030 [Gg CO_2-eq]	Not estimated
Description of the measure	The measure aims to gradually synchronize national fuel quality standards to EU standards, and it is planned to adopt Euro-5 standards by 2020. The measure also includes the enforcement of state control system for fuel quality.
Assumptions and assessments	The use of cleaner and high quality fuel instantly reduces transport emissions, though the effect is strong for some local pollutants and not for GHG emissions. Nevertheless, if drivers and businessmen working in the field treat transport exhaust induced environment pollution with caution, GHG emission could also decrease. Also, focusing on fuel quality in the future will increase public responsibility regarding the GHG emissions. Increasing fuel quality and decreasing emissions of local pollutants lessens GHG emissions as well as public health costs and expenditures. Thus, improving fuel quality and adopting corresponding standards are one of important directions in the way of country's sustainable development.
Progress indicators	Adoption of corresponding legislation, quality characteristics of fuels sold in Georgia.
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building with the main challenges implementation, enforcement and impact assessment. As such, the most appropriate Climate Finance sources for this measure are below. **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks

	· IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Commercial companies

Mitigation measure	TPOL7: Working out integrated and coordinated tariff policy for freight transport
Type	Planning, Fiscal
Implementing entity	Ministry of Economy and Sustainable Development of Georgia, Ministry of Regional Development and Infrastructure of Georgia, Ministry of Finance of Georgia
Implementation year/period	2017-2020
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	Cumulative effect – 686 Gg 698 Gg CO_2 emissions will be saved in transport sector. CO_2 emissions will be increased by 12 Gg in electricity generation sector. Including the impact of the measure TMEA1.
Description of the measure	The measure aims to increase railway turnover using relevant tariffs policy. The survey of railway cargo turnover showed that the unfair fiscal policy in favor of road transport for either road or railway infrastructure use reduces road transport prices and railway turnover suffers. Railway covers its infrastructure damage costs, while road freight transport companies do not, and transit trucks pay less than the cost of damage they impose on road infrastructure. The primary aim of the measure is to create a level playing field for road and railway transport using fiscal policy. The country's ecology and Georgian Railway will benefit thanks to the measure, while the competition on the freight market will become fairer and the government will save important investments for road infrastructure improvement. The measure involves following activities: – Revising tariffs for transit road freight (possibly, according to tons-km and emission class of the truck); – Taxing trucks for using road infrastructure. Surveying freight transport flows and carrying out respective economic analyses to define optimal tariffs are necessary pre-conditions.

Assumptions and assessments	At present, railway transfers 35% of total freight, while 65% is moved by road. According to experts' assessment, this causes inefficiency and railway should be loaded to the higher extent[127]. To achieve the goal, fiscal policy paired with infrastructure policy of measure TMEA1 (increasing railway mobility and traffic capacity) are necessary. The assumption is that the above-mentioned steps will increase railway share in freight turnover to 50%. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Adoption of relevant legislation, share of railway in freight turnover
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building with the main challenges implementation and enforcement. As such, the most appropriate Climate Finance sources for this measure are below: **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Commercial companies

Mitigation measure	TMEA1: Improving railway infrastructure
Type	Infrastructural
Implementing entity	Georgian Railway
Implementation year/period	2015-2025
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	Emission reductions are calculated including the effects of TPOL7.
Description of the	At present, numerous projects are being carried out in Georgia to

127 „GEORGIA'S TRANSPORT AND LOGISTICS STRATEGY: ACHIEVEMENTS TO DATE AND AREAS FOR IMPROVEMENTS", Mustapha Benmaamar, Oceane Keou, Daniel Saslavsky ,World Bank 2015.

http://documents.worldbank.org/curated/en/623591468191346382/pdf/96577-REVISED-WP-PUBLIC-Georgia-Box391464B-Final-Jan2015.pdf

measure	improve and widen railway infrastructure and they aim to attract more freight. The two most important projects to achieve the goal and to decrease emissions are: 1. **Project "Fast Railway."** Rehabilitation and overhaul of 340 km railroad section on Tbilisi-Batumi route: renovation of rail and electricity supply systems, repair of bridges and tunnels, building 38 km bypass and a new eight km-long tunnel. The project will increase the capacity and the speed on problematic sections of the route and will decrease the duration of the trip by 30-40 minutes. At present, railway capacity is 21 million tons annually. According to the plan, this figure will reach 50 tons by 2019, and 120 tons after arranging all electric-engineering systems in post-2019 years. 2. **Baku-Tbilisi-Kars** is a new transport corridor that links the Azerbaijani, Georgian and Turkish railways to each other. The project will open the passenger and freight railway corridor Caspian Sea-Europe. Railway authorities believe that the new line will increase freight turnover (namely, the container traffic) and shift current freight routes (namely, dry freight, which is transported by trucks) between Turkey, the Caucasus region, Russia, and the Middle East Asian countries. In initial stage, new arterial line will be able to serve about one million passengers and five million tons of freight annually, and will increase its capacity to 15 million tons of freight for the second stage.
Assumptions and assessments	The measure is vital for increasing railway freight turnover. "Fast Railway" will at least double the railway capacity (and might increase it six times in the future), while Baku-Tbilisi-Kars will have a capacity of five million tons annually. Nevertheless, barriers discussed in TPOL7 will not automatically increase freight turnover and carrying out these two measures simultanously is necessary. Aggregated effects of these measures are given in TPOL7.
Progress indicators	Completion of infrastructure projects, share of railway in passenger and freight turnover.
Estimated investments	The approximate cost of "Fast Railway" is 250 million USD, while Baku-Tbilisi-Kars line will cost approximately 775 million USD, though the figures are expected to increase in the future.
Financing aspects	This measure includes substantial investment in railway Infrastructure. The most relevant financing sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Government · Georgian Municipalities

	· Georgian Railway company · Georgian Banks

Mitigation measure	TPOL8: Improving the quality of intercity passenger transport
Type	Institutional/Planning, Legislative
Implementing entity	Ministry of Economy and Sustainable Development of Georgia
Implementation year/period	2017-2020
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	33 Gg
Description of the measure	Well-connected and high quality public transport can compete with private cars and reduce emissions, while the lack of intercity transport means and its low quality hinder tourism development. Consequently, the availability of fast and comfortable intercity public transport is an important issue. To achieve this goal, the following activities should be performed: • Improving the accounting of passengers, incomes and transportation means. At present, information regarding the intercity routes, transportation means and passenger turnover is not available, but collecting this information on a regular basis is a necessary pre-condition for working out a respective development policy; • Carrying out profitability studies and identification of a respective financial stimuli system for intercity transport; • Defining service quality standards and monitoring them. Introducing regulations for service providers to renew and improve their bus fleet and test them regularly; • Developing information systems: unified data base regarding passenger transport service, respective web-pages, etc. On the other hand, governmental bodies (e.g., Georgian National Tourism Administration, Land Transport Agency) could select strategic routes and monitor the service quality on these routes; • The development of intercity transport infrastructure (perfection of intercity stations, choosing and improving parking sites in

	cooperation with municipality authorities). A detailed description of how the measure could be realized is given in the World Bank report: "A policy framework for green transportation in Georgia"[128].
Assumptions and assessments	Worldwide experience shows that despite the number of private cars increasing, there always exists cheaper and more convenient means of transportation over long distances. Furthermore, a well-managed and regulated bus service is statistically safer and more energy efficient. Experience also shows that good regulation and fiscal policy can increase public transport passenger turnover. For example, in the US, intercity public transport (bus) is the fastest growing segment of the transport sector — it increased by 22% from 2007 to 2010[6]. For Georgia, a conservative assumption was made that by 2030 passenger turnover of buses and minibuses will increase by 10%. As a result, just 2% of total passenger turnover will shift from private cars to public transport. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Share of public transport in passenger turnover
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building with the main challenges implementation and enforcement. As such, the most appropriate Climate Finance sources for this measure are below: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government

Mitigation measure	TPOL9: Taxi registration and regulation
Type	Legislative
Implementing entity	Ministry of Finance of Georgia (tax register) Local municipalities (licensing)

[128] *A policy framework for green transportation in Georgia : achieving reforms and building infrastructure for sustainability.* Washington, DC: World Bank, 2012.

Implementation year/period	2017-2020
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	109 Gg
Description of the measure	The measure covers two different directions: • Private taxi registration will be carried out by local authorities who will define minimum quality standards for safety, comfortability and other parameters; • Improving the accounting of taxis and the revenue they get, including their tax register and accountability.
Assumptions and assessments	At present the taxi sector is not regulated in Georgia and taxi registration is not required. Thus, the information regarding taxi fleets is not available. In the monitoring process of Tbilisi Sustainable Energy Action Plan (SEAP), experts assumed that about 20% of cars involved in Tbilisi traffic are taxis. For the whole country, the corresponding figure will be lower and is assumed to equal 10%. An additional assumption is that after the measure is realized, the share of taxis will decrease to 5% (in majority of European countries, the share of taxis is only 1%). Taxis cover five times more distance annually than the private cars[129], thus it was assumed that the distance covered by taxes that exit the market will decrease five times. Note, that the impact of this measure is partly included in other measures (developing public transport and improving its quality, supporting walking and cycling) because if a person does not use a taxi, he should switch to other means of transportation. As a result, this measure covers only one third of the time/distance the taxi covers, when it is not carrying a passenger. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Number of registered taxis
Estimated investments	Policy measure, costs not estimated.
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building. . As such, the most appropriate Climate Finance sources for this measure are below: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · International Donors Development Agencies

[129] Tbilisi SEAP Monitoring Report, Sustainable Development Centre “Remissia”, USAID EC-LEDS project, 2015.

	· Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian railway company · Georgian Municipalities The assessment of financing for the required infrastructure development is not included in this Comment. See World Bank report mentioned above.

Mitigation measure	TMEA2: Development of railway passenger railway transport
Type	Infrastructural
Implementing entity	Georgian Railway
Implementation year/period	Short-term (2017-2020) includes: • Feasibility study; • Baku-Tbilisi-Kars railway; • Increasing carriage fleet; • New metro station "University" in Tbilisi Long-term (2020-2030) includes: Renewal of passenger railway infrastructure and increasing carriage fleet (for example, to Kutaisi Airport, Kakheti and Akhalkalaki routes, etc.) in case if respective financial aid is identified.
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	162 Gg in total, including 186 Gg reduction of emissions in transport sector. 24 Gg increase of emissions in electricity generation sector.
Description of the measure	In the short-term, the measure covers increased turnover due to the opening of the Baku-Tbilisi-Kars line and the operation of newly purchased electric trains. In the long-term, the measure involves the renewal of passenger railway infrastructure and increasing train fleet towards strategic directions (e.g., Kutaisi Airport, Kakheti and Akhalkalaki routes, etc.). To achieve the goal, carrying out a feasibility study and obtaining respective financial resources in advance is necessary.
Assumptions and assessments	In 2006, railway passenger turnover reached 9% of total passenger turnover and this figure decreased to 5% in 2014. The cause of the decrease is the increased number of private cars, wearing out railway

	infrastructure and reduction of train fleet. According to the assumptions, after infrastructure and service quality is improved, railway passenger turnover will return to the 2006 level (9%) for 2030. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Share of railway in passenger turnover
Estimated investments	The cost of the Georgian section of Baku-Tbilisi-Kars equals 775 million USD and expected to increase in the future, while the contract price of building the metro station "University" is 83,000,670 GEL, and renewal of infrastructure or increasing carriage fleet requires further technical and economic study. Each carriage of the new electric train costs 1.5 million euros and there are four carriages in one train, thus the total price tag is six million euros per train.
Financing aspects	This measure includes substantial investment in railway Infrastructure. The most relevant financing sources are the following: **Intl Sources** · Multilateral Development Banks · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Railway company · Georgian Banks

Mitigation measure	TPOL10: Working out nationwide sustainable urban transport development policy
Type	Planning/Institutional (Vertical Nationally Appropriate Mitigation Action [VNAMA] measure might be adopted)
Implementing entity	Ministry of Economy and Sustainable Development of Georgia
Implementation year/period	2018-2030
GHG covered	---
Emissions reduction in 2030 [Gg CO_2-eq]	The measure is envisioned as a supportive activity for other urban development measures and emission reduction for this measure has not been calculated separately.
Description of the measure	To support municipal efforts the measure aims to carry out the following activities at national level: – Defining guidelines for sustainable urban transport

	planning and investment programs; – Defining technical and environment protections standards for sustainable urban transport development on municipal levels; – Processing urban transport data base and working out experience sharing mechanisms; – Financing municipal projects and/or supporting them to obtain funds.
Assumptions and assessments	---
Progress indicators	Adoption of sustainable urban transport development policy
Estimated investments	Policy measure, costs not estimated, might require technical assistance.
Financing aspects	The primary goals of this measure is not related to energy efficiency or reducing GHG Emission Reductions. As such, it is unclear whether Climate Finance sources are the most relevant sources for assisting in the financing of this measures. It is likely that ODA which is not related to Climate Finance is a more appropriate source. The most relevant sources for financing Capacity Building and Technical Assistance for this measure are the following: · International Donors Development Agencies · IFIs and Bilateral Development Banks · Multilateral Development Banks

Mitigation measure	TMEA3: Improving urban public transport
Type	Technological
Implementing entity	Municipalities
Implementation year/period	2015-2020 (for SEAPs prepared till 2016) 2021-2030 (for other municipalities)
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	55 Gg
Description of the measure	This measure incorporates all sustainable public transport development activities discussed in the SEAPs of CoM signatory cities. They are:

	• Increasing municipal transport fleet (in those municipalities where municipal transport enterprise already exist); • Setting up and developing municipal transport system (in municipalities where municipal transport system does not exist yet); • Improving public transport service quality, etc.
Assumptions and assessments	To evaluate the result of the measure, six Georgian cities (Tbilisi, Batumi, Kutaisi, Gori, Zugdidi, and Telavi) SEAPs were examined. Analysis showed that carrying out all measures of these six SEAPs will shift 2.3% of total passenger turnover from private cars to public transport. For Tbilisi and Batumi, where 53% of Georgia's total population lives and municipal transport enterprises already exist, respective figure equals to 1.5%, while in other four cities 0.8% is the case. As far as 2030 evaluations are concerned, it is assumed that for Tbilisi and Batumi the switching rate (1.5%) will remain the same, while in 30% of other cities new municipal transport enterprise will be set up and almost 85% of total urban territories will be covered. These steps will further increase the share of public transport by 1.5%, thus cumulative effect for switching of passenger turnover form private cars to public transport will reach 3.8% by 2030. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Share of public transport in passenger turnover
Estimated investments	Compared to BAU scenario, investment costs of purchasing new buses by the municipalities increase by 52 million USD (according to MARKAL-Georgia calculations). This amount does not cover additional costs of building bus stops and arranging bus parking sites.
Financing aspects	The nature of this measure is mainly Technical Assistance. As such, the most appropriate Climate Finance sources for this measure are below. . **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · IFIs and Bilateral Development Banks · Georgian Government · Georgian Municipalities Financial sources for increase in municipal transport fleet is identified in TMEA4.

Mitigation measure	TMEA4: Clean public transport
Type	Technological (substitution)

Implementing entity	Municipalities
Implementation year/period	2015-2020 (for SEAPs prepared till 2016) 2021-2030 (for other municipalities)
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	Total - 0.6Gg
Description of the measure	The measure aims to substitute diesel-run buses with either natural gas- or electricity-run buses in the cities. In addition, while purchasing a new bus, its lifetime fuel consumption and environment damage (caused by carbon dioxide, nitrogen oxides, non-methane hydro carbonates and particulate matter emissions) costs would be taken into account. This is a requirement of EU Clean Transport Directive (2009/33/EC), which is included in EU-Georgia Association agreement and should be enacted in six years' time.
Assumptions and assessments	Tbilisi SEAP measure planned for 143 buses shifts 11% of total bus passenger turnover from diesel-run buses to natural gas-powered buses. Furthermore, Batumi city authorities plan to purchase 20 new electric buses in the near future. To evaluate the measure, it was assumed, that for 2030 municipal bus fleet (60% of total bus fleet used for passenger transportation) will run on clean energy, while each vehicle's technology share was calculated by MARKAL-Georgia optimization tool. This tool takes into account prices and intensity and gives a green light to natural gas-run buses.
Progress indicators	Share of clean fuel vehicles in public transport fleet
Estimated investments	The investment costs increase by 11 million USD for the period of 2016-2030 (according to MARKAL-Georgia calculations) compared to BAU situation.
Financing aspects	This measure includes substantial investment in upgrading the public transport infrastructure. The most relevant financing sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds · Private Infrastructure Funds- Debt providers · Impact Investment Funds · Green Bonds issuers

	Domestic Sources · Georgian Government · Georgian Municipalities · Georgian Commercial companies · Georgian Banks

Mitigation measure	TMEA5: Supporting walking/cycling/moped traveling
Type	Awareness rising, infrastructural
Implementing entity	Municipalities
Implementation year/period	2015-2020 (for SEAPs prepared till 2016) 2021-2030 (for other municipalities)
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	157 Gg
Description of the measure	This measure incorporates walking/cycling/moped travel measures discussed in the SEAPs of CoM signatory cities. They are: • Creating corresponding infrastructure (pedestrian crossings, bicycle trails, pedestrian bridges, etc.); • Awareness raising campaigns and behavior modifying programs.
Assumptions and assessments	To evaluate the effects of the measure, six Georgian cities (Tbilisi, Batumi, Kutaisi, Gori, Zugdidi, and Telavi) SEAPs were examined. Analysis showed that carrying out of measures envisioned in these six SEAPs will reduce passenger turnover across the country by 1.5% and 0.05% of passengers will shift to mopeds (only Telavi SEAP foresees the moped measure). It is assumed that by 2030 the effect of the activity will increase further and will spread on other cities too (whole urban territory will be covered). As a result, private car passenger turnover will decrease by 3%, while mopeds' share will increase by 2.4% and they will cover 50% of total urban territories. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Share of trips performed by walking/cycling/two-wheelers
Estimated investments	The measure embraces the costs of developing pavements, ramps, road-crossings, bicycle-tracks and alike infrastructure. It will be carried out by municipalities and the costs will be calculated separately for each municipality according to their special needs and plans.

Financing aspects	The main challenges relating to this measure are urban and transport design, and financing the infrastructure upgrades required for successful implementation of the measure. ・ Georgian Government ・Georgian Municipalities ・Georgian private sector: companies operating in management parking fines systems

Mitigation measure	TMEA6: Parking policy and other restrictive measures
Type	Local regulations, fiscal
Implementing entity	Municipalities
Implementation year/period	2015-2020 (for SEAPs prepared till 2016) 2021-2030 (for other municipalities)
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	14 Gg
Description of the measure	This activity incorporates parking policy and other restrictive measures discussed in the SEAPs of CoM signatory cities. The measure aims to increase private car-owners expenses and reduce the incentives of using private cars. The measure includes: • Restricting parking spaces (in favor of walking areas); • Pricing parking spaces reasonably, etc.
Assumptions and assessments	To evaluate the effects of the measure, six Georgian cities (Tbilisi, Batumi, Kutaisi, Gori, Zugdidi, and Telavi) SEAPs were examined. Analysis showed that carrying out all measures of these six SEAPs will reduce private passenger turnover across the country by 0.11%. According to evaluations, the effect will increase for 2030 and will spread on other cities too, and result in the decrease of total passenger turnover by 0.5%. Emissions reduction is calculated by MARKAL-Georgia model in respective assumptions framework.
Progress indicators	Parking costs, reduction of annual distances traveled by private vehicles
Estimated investments	Not estimated
Financing aspects	The main challenges relating to this measure are implementation and enforcement. Relevant financing sources are domestic.**:** ・ Georgian Government ・Georgian Municipalities ・Georgian private sector: companies operating in management parking fines systems

To specify calculations and improve planned policies further, supporting/carrying out following studies is necessary:

Box 3. Surveys and research Necessary to Improve Transport Sector Policy in LEDS Framwork

- Research and regular monitoring of road transport passenger and freight turnover;
- Evaluation of road transport turnover across the country, assessment of its economic feasibility and competitiveness compared to railway;
- Feasibility study for passenger railway development;
- Study of biofuel commercialization prospects;
- Urban transport development strategy/recommendations and national support program (possibly VNAMA).

2.D. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY INDUSTRY (ENERGY USE)

Policy Instruments:

Mitigation measure	IPOL1: Determination of legal mechanisms to regulate emissions from large, energy intensive industries of Georgia
Type	Information/legislative
Implementing entity	Ministry of Economy and Sustainable Development of Georgia, Ministry of Environment and Natural Resources protection of Georgia
Implementation year/period	2017-2023 (dialogue and research) 2024-2025 (preparation of the legislation), 2026-2030 (enforcement)
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	This action is an important and necessary measure to achieve reduction of emissions in specific technological measures. In order to avoid double counting of reduced emissions, emissions reduction values are not calculated for policy measures, but for specific technological measures.
Description of the measure	The measure considers determination of legal mechanisms for regulating the GHG emissions from large energy intensive industrial sectors of Georgia. Possible options being considered are as follows: • Conduction of mandatory energy audits and development of the energy management system (this measure may come into force before 2025 in accordance with the EU energy efficiency directive requirements); • Execution of a voluntary agreement and implementation of appropriate fiscal policy (energy or emission tax, income tax rebates or other) • Determination of upper cap for energy consumption and/or emissions • Inclusion of GHG emissions in environmental permit system • or any combination of these measures In the process of determining regulation mechanisms for emissions from large facilities of the industrial sector, it is important to ensure that these measures are acceptable both for the country as well as for these industrial facilities. Therefore, it will be essential to involve the enterprise representatives in the policy development process. First of all, dialogues and proper consultations with the industry are needed together with relevant discussions. Therefore, the measure includes the several stages: 2017-2023 – research and dialogues with the industry to plan state policy of emission reduction in the industry sector. At the same time, observations are carried out on incentives and their effects. 2024 – 2025 – Preparation of appropriate legislative framework and determination of emissions reduction target indicators. 2026-2030 – enforcement of regulation mechanisms. In addition to political/legal regulation mechanisms, carrying out several supporting measures (financial, awareness raising, etc.)

	directed to remove barriers of energy efficiency activities will be necessary. Such measures are listed in tables below.
Assumptions and assessments	This is one of the necessary measures to achieve reduction of emissions in individual technological measures.
Progress indicators	Development and enforcement of corresponding legislation
Estimated investments	Expenses of the measure by 2025 mainly include a detailed analysis of the industry sector (approximately 300,000 USD), organization of workshops (approximately 100,000 USD) and technical assistance to develop the legislative framework (approximately 200,000 USD), a total of 600,000 USD. After 2026, the expenses will be covered by industrial facilities and reflected in appropriate individual technological measures. The state would have to deal with annual monitoring expenses, about 100,000 USD a year (three qualified personnel).
Financing aspects	The nature of this measure is mainly a Technical Assistance and Policy Capacity Building. It is expected to be a long term project – with the legislative framework expected to be finalized by 2025, and its preparation and relevant stakeholder consultation process lasting for more than 5 years. As such, the most appropriate Climate Finance sources for this measure are below. **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Multi-Donor and PPP Funds **Domestic Sources** • Georgian Government

Mitigation measure	IPOL2: Financial instruments to support carrying out emissions reduction activities in the industry sector and monitoring on these instruments
Type	Financial
Implementing entity	Ministry of Energy
Implementation year/period	2017-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	This action is an important and necessary measure to achieve reduction of emissions in specific technological measures. In order to avoid double counting of reduced emissions, emissions reduction values are not calculated for policy measures, but for specific

	technological measures.
Description of the Measure	This measure is aimed to eliminate the initial investment capital scarcity/insufficiency barrier and consider the programs providing financial and technical support for industrial facilities to carry out emission reduction measures. Financial instruments may be the energy efficiency fund, which will partially finance energy efficient measures and/or energy audits, or such programs as the EBRD Energy Credit. It is noteworthy to mention that at present similar programs are going on but they are not coordinated, they are not widespread, and their results are not monitored, therefore their actual effect is not known. Therefore, this measure considers the study of energy credit or similar credit lines (in order to assess the final user's real interest rate and its feasibility), as well as, from the government's side, conducting continuous monitoring of the relevant funds and projects to evaluate the savings of the generated energy and emissions resulted from the allocated funds and the implemented projects.
Assumptions and assessments	This measure is an essential activity for carrying out emissions reduction during the implementation of individual measures.
Progress indicators	Development of financial mechanisms, amount of finances distributed.
Estimated investments	Expenses of the measure cover a survey of the existing financial mechanisms and recommendations (approximately 200,000 USD), which will reveal forms of financial mechanisms and the amount of funds to be allocated under these mechanisms.
Financing aspects	This measure -identification of monitoring of financial mechanisms relevant for increasing Industrial Energy Efficiency- is a Capacity Building and Technical Assistance project. It is likely that it would also include the design of new financial mechanisms to reduce the barriers identified in the study. **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · International Donors Development Agencies **Domestic Sources** · Georgian Government

Mitigation measure	IPOL3: Inventory of energy consumption and the GHG emissions at the enterprise level and identifying corresponding benchmarks
Type	Legislative/Information
Implementing entity	Ministry of Environment and Natural Resources Protection of Georgia
Implementation year/period	2017-2018

GHG covered	---
Emissions reduction in 2030 [Gg CO_2-eq]	Has not been calculated.
Description of the measure	The measure covers the collection of information from the industrial facilities about their energy consumption and emissions, and using this information for calculation of specific energy consumption and emission intensities, and for comparison with the examples of international good practices, or those existing in Georgia. In compliance with the Law of Georgia "on Ambient Air Protection" and "Technical Regulations for Self-monitoring and Reporting of Emissions of Harmful Substances from Stationary Sources of Pollution" (#413, ordinance of the Government of Georgia, as of December 31, 2013), state registration of emission of harmful substances into the ambient air from stationary sources of pollution is conducted by the Ministry of Environment and Natural Resources Protection of Georgia. State registration of emission of harmful substances is conducted through the state registration forms of emission of harmful substances which are filled-in by the activity performers at the end of the fiscal year before February 15 and submitted for approval to the state sub-department of the Ministry of Environment and Natural Resources Protection of Georgia – Department of Environmental Supervision and its corresponding territorial bodies other than Ajara, where the said forms are submitted to the board of Environment and Natural Resources Protection of Autonomous Republic of Ajara. Further, these forms are submitted to the Ministry of Environment and Natural Resources Protection. It should be noted that the form contains information about energy consumption and emissions of carbon dioxide. In order to facilitate the enterprises' reporting to the Ministry, from 2017 an electronic reporting system will be adopted. Accordingly, the enterprises should enter the corresponding data for the state registration form into the electronic system at the address: www.emoe.gov.ge (the changes about submitting the data in electronic version is included in the corresponding normative act). The measure also covers the improvement of the form in respect to the registration of GHG emissions and using the mentioned database for analysis and development of emissions reduction policy.
Assumptions and assessments	None
Progress indicators	Development of data collection and monitoring system
Estimated investments	The web-page www.emoe.gov.ge for the Ministry of Environment and Natural Resources Protection is overseen by the Ministry of Finance of Georgia. The expansion and improvement of the web-page may also be performed under the support of the Ministry of Finance of Georgia.

Financing aspects	This measure- is a Technical Assistance project focusing on defining training curricula, defining the scope of and guidelines relating to audits, and training of the energy auditors. One UNDP project is currently on-going focusing on some of these topics. Relevant financing sources: **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government

Mitigation measure	IPOL4: Carrying out energy audits and research on applicability of Best Available Techniques (BAT)
Type	Capacity building
Implementing entity	
Implementation year/period	2017-2023
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	This action is an important and necessary measure to achieve reduction of emissions in specific technological measures. In order to avoid double counting of reduced emissions, emissions reduction values are not calculated for policy measures, but for specific technological measures.
Description of the Measure	Best Available Technique (BAT) is defined by the directive of the EU on industrial emissions and means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and where that is not practicable, to reduce emissions and the impact on the environment as a whole. (a) “Techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned; (b) “available” techniques means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; (c) “best” means the most effective in achieving a high general level of protection of the environment as a whole. The measure covers preparing and training experts in industrial sector to conduct energy audit and research the introduction of the Best Available Technique in the industrial facilities (conducting such studies

	and introduction of Best Available Technique is also required in the frames of EU - Georgia Association Agreement).
Assumptions and assessments	None
Progress indicators	Number of certified energy auditors, number of enterprises with implemented BAT.
Estimated investments	The measure covers the expenses of preparing and certifying energy auditors, as well as the expenses related to preparing relevant guideline documents (approximately, 600,000 USD) and the expenses of conducting the energy audit themselves, which will partially or completely be covered by the industrial facilities. The audit expenses of the industrial facilities depend on the complexity of the industrial facilities themselves and the quantities of the equipment and processes, while in developed countries it varies between 10,000 USD and several hundred dollars.
Financing aspects	This measure- is a Technical Assistance project focusing on defining training curricula, defining the scope of and guidelines relating to audits, and training of the energy auditors. One UNDP project is currently on-going focusing on some of these topics. Relevant financing sources: **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government

Individual Technological Measures:

Mitigation measure	IMEA1: The transfer of clinker production from wet method to dry method in Kaspi and Rustavi Heidelberg Cement Plants
Type	Technological
Implementing entity	Heidelberg Cement
Implementation year/period	2020 for Kaspi Plant, and 2028 – for Rustavi Plant.
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	413 Gg
Description of the	Producing non-metallic mineral products in Georgia is characterized by the highest emissions among all industry subsectors, and within it

Measure	the majority of emissions come from clinker production in the Heidelberg Cement plants. Heidelberg Cement produces clinker in three plants. The largest plant is located in Kaspi, and two of them in Rustavi. In one of the Rustavi Plants the dry process of clinker production is used while in the other Rustavi plant and in the Kaspi Plant the wet process is used. In the wet process, it is necessary to evaporate an additional amount of water (30-50%) compared with the dry method, and because of this energy consumption is much higher than for dry method. In the Rustavi plant with the dry method of clinker production, intensity of coal consumption in 2014 was 2.34GJ/ton of clinker, in the Rustavi plant with the wet method- 4.55GJ/ton of clinker, and in Kaspi Plant– 5.82GJ/ton of clinker. The measure implies transferring the Kaspi and Rustavi plants from the wet method to a dry one and thus reducing coal consumption.
Assumptions and assessments	The measure assumes that by 2020 the Kaspi Plant will be completely transferred to the dry method and its annual production will be increased up to 1.1 million tons of clinker[130], and in 2028, the Rustavi wet plant will also be transferred to the dry method and the production will be increased up to maximum level – annually 475 thousand tons of clinker. According to the assumption, transferring to the dry method the intensity of coal consumption will be reduced in both plants by 50%. Consequently, in 2030 4.3PJ of coal will be saved.
Progress indicators	Energy intensity of clinker production at Heidelberg Cement Plants.
Estimated investments	Not Available.
Financing aspects	This measure a technology implementation measure in one facility: Potential providers of debt for this project can include the following: **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks

Mitigation measure	IMEA2: Other energy efficiency measures in producing non-metallic mineral products
Type	Technological
Implementing entity	Industrial Facilities ("Heidelberg Cement")
Implementation year/period	2017-2030

Information from the plant

GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	285 tons (only for additional measure in Heidelberg Cement)
Description of the Measure	Besides clinker production, manufacturing non-metallic mineral products also includes brick production, lime production, etc. Apart from the measures listed in IMEA1, possibilities of energy reduction may also be found in cement production. For example, in Heidelberg Cement 5.1TJ natural gas may be saved per year in secondary consumption of energy generated during clinker cooling process on drying the raw material before grinding it and in grinding mills of raw material.
Assumptions and assessments	This measure assumes implementation of single activity in Heidelberg Cement. It is necessary to conduct additional studies in other plants of the same category to identify the emissions saving potential there.
Progress indicators	Energy and emission intensities of enterprises in nonmetallic minerals products sector.
Estimated investments	Will be identified through the energy audit.
Financing aspects	This measure a technology implementation measure in one facility: Potential providers of debt for this project can include the following: **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks Financial incentives/subsidies could also be part of the financing structure of the measure. The company would also be responsible for financing a share of the measure.

Mitigation measure	IMEA3: Energy efficiency measures in chemical industry
Type	Technological
Implementing entity	Industrial Facilities ("Rustavi Azot")
Implementation year/period	2017-2030
GHG covered	CO_2

Emissions reduction in 2030 [Gg CO_2-eq]	Cumulative effect - 37.5 Gg 24.2 Gg emissions reduction in transport sector, 13.3 Gg emissions reduction in electricity generation sector
Description of the Measure	This measure implies implementation of different types of measures at the Rustavi Azot plant. The measures will be implemented both under the initiative of the industrial facility itself (Rustavi Azot), and using the above described political instruments. In the process of preparation of this strategy, under the EC-LEDS project the survey was carried out at Rustavi Azot plant representing the only largest energy consumer in this industrial sector (chemical industry). According to the information of the plant, a number of measures should be implemented at the plant, which may save the consumed energy and the GHG emissions. These are: • Implementing the energy management system • Rehabilitation of steam distribution system • Using technological process heat • Using high pressure steam to generate electric energy • Modernization of compressors existing in ammonia production • Substitution of burners in ammonia production • Purification of gases containing NO-NOx to receive N_2 • Using low potential steam to receive a coolant. According to the assessment of the plant representatives, as a result of implementation of the measure 12 million m^3 gas and 170 GWh electric energy may be saved, representing 10% of the gas consumed from the grid at the plant and 60% of the consumed energy (actually, 40% of electric energy is saved, and the rest of energy is produced locally by using high pressure steam in electricity generator).
Assumptions and assessments	An assumption was made that all the enumerated measures (or some other equivalent measures) will be implemented in the Rustavi Azot plant until 2030. The amount of the energy reduced by the measures has been calculated by the plant experts[131], and emissions reduction has been calculated using the MARKAL-Georgia model.
Progress indicators	Energy/emission intensities of ammonia and nitric acid production
Estimated investments	The estimated cost of implementation of the above-listed measures at Rustavi Azot is:

Rehabilitation of steam distribution system	275,000 USD (250,000 EUR)
Using technological process heat	2.2 million USD (2 million EUR)

131 "Report on "The planned and potential measures for reduction of energy consumption at "Rustavi Azot" Plant. Sustainable Development Center "Remissia", 2016.

	Using high pressure steam to generate electric energy	5,623,783 USD
	Modernization of compressors existing in ammonia production	9-10 million USD
	Substitution of burners	980,000 USD per unit
	Purification of gases containing NO-NOx to receive N_2	To be defined
	Using low potential steam to produce a coolant	2,320,280 USD
Financing aspects	This measure a technology implementation measure in one facility: Potential providers of debt for this project can include the following: **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** • Georgian Banks Financial incentives/subsidies could also be part of the financing structure of the measure. The company would also be responsible for financing a share of the measure.	

Mitigation measure	IMEA5: Energy efficiency measures in ferroalloys production
Type	Technological
Implementing entity	Industrial facilities which produce ferroalloys in Georgia
Implementation year/period	2020-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	Cumulative effect - 146 Gg 137 Gg emissions reduction in transport sector, 9 Gg emissions reduction in electricity generation sector
Description of the Measure	The measure implies implementation of different types of measures in ferroalloys production. The measures will be implemented both under the initiative of the industrial facilities themselves and using the above

	described political instruments. In the iron and steel subsector, about 88% of energy consumption comes from ferroalloys production (about 95% of coke consumption and 85% of electricity consumption). In Georgia, silico manganese (90% of the produced ferroalloys) is mostly produced. Under EC-LEDS project a survey of four plants from this category has been conducted, because of which it was identified that the intensity of both coke and energy consumption per production of one ton of product is higher than the internationally accepted norms. Particularly, the average intensity of coke consumption varies within the frames of 500-550 kg coke/kg of product, and electric energy intensity – 5,000-5,200 KWh/ton of product. International norms do not exceed 400 kg coke per kg of product and 4,800 KWh electric energy per ton of product[132] that allows reducing consumption of coke by 20-25% and the electric energy – by 4-8%.
Assumptions and assessments	An assumption was made that until 2030 the intensity of coke consumption will be reduced by 20% in ferroalloys production and electric energy consumption intensity by 5%. Values of emissions reduction have been calculated using the MARKAL-Georgia model.
Progress indicators	Energy and emission intensities of Ferro alloy production
Estimated investments	Will be identified through the energy audit.
Financing aspects	This measure is a technology implementation measure: Potential providers of debt for this project can include the following: **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks Financial incentives/subsidies could also be part of the financing structure of the measure. Each company would also be responsible for financing a share of the measure.

Mitigation measure	IMEA6: Energy efficiency measures in iron and steel industry
Type	Technological

[132] Olsen S.E., Tanstad M., and Lindstad T., "Production of Manganese Ferroalloys", Tapir, Trondheim, 2007.

Implementing entity	Reinforcing bar (rebar) producing industrial facilities
Implementation year/period	2017-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	10 Gg
Description of the Measure	The measure implies implementation of different types of measures in iron and steel industry (other than production of ferroalloys). The measures will be implemented both under the initiative of the industrial facilities themselves and using the above described political instruments. In the iron and steel industry the highest share of gas is consumed in production of rebar, where there are the possibilities to reduce this consumption. Some possibilities reduction of gas consumption in this industry has been identified by EC-LEDS project experts and are listed below. During rebar casting, the steel is heated in methodical furnaces where natural gas is burning at temperatures up to 1,250^{0}C. Considering this, the effective operation of the furnace is very important. In such furnaces, inner regeneration can be used which means preheating the air using the energy of flue gases. This measure will save about 10% of natural gas. In addition, in the methodical furnaces the operation of gas burners may be performed in automatic mode, which will ensure the required capacity for heating process, as well as complete combustion of natural gas. In this case the saving may make up 15-20%.
Assumptions and assessments	According to the experts' evaluation of the potential of the measures in the sector, an assumption was made that in the industrial facilities of this category gas consumption will be reduced by about 15%. The values of emissions reduction have been calculated under the MARKAL-Georgia model.
Progress indicators	Energy and emission intensities in iron and steel production
Estimated investments	Will be identified through the energy audit.
Financing aspects	This measure a technology implementation measure: Potential providers of debt for this project can include the following: **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks

	Financial incentives/subsidies could also be part of the financing structure of the measure. Each company would also be responsible for financing a share of the measure.

Mitigation measure	IMEA7: Energy efficiency measures in food, beverages and tobacco industry
Type	Technological
Implementing entity	Food products, beverages and tobacco producing industrial facilities
Implementation year/period	2017-2030
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	23 Gg
Description of the Measure	The measure implies the implementation of different types of activities in food products, beverages and tobacco industries. The measures will be implemented both under the initiative of the industrial facilities themselves and as a result of the above described political instruments. To prepare these measures, under the EC-LEDS project a survey of several enterprises of this category was conducted, in which several possibilities were identified of energy efficiency improvement. These are: • Substitution of the outdated steam boilers, or installation of modern burners on steam boilers at the Agara sugar plant. The measure can save 11-27% of the consumed heating energy (gas); • Reusing steam condensate. This measure has been implemented at Kobuleti fruit juice concentrate plant and as a result, 25% of the gas consumed by the steam boiler was saved; • At the dairy plants the combined generation of heating and cooling by using heat pump also significantly saves the natural gas consumption. Namely, 2.5-3 KWh equivalent natural gas is saved per consumed 1 KWh electricity.
Assumptions and assessments	During assessment of the measure, an assumption was made that the implemented political and financial instruments will cause implementation of energy efficiency measures in the enterprises of this sector, which, in total, are responsible for 30% of energy consumed by the sector. The values of emissions reduction have been calculated with the help of the MARKAL-Georgia model.
Progress indicators	Energy and emission intensities and food, beverages and tobacco industry

Estimated investments	Will be identified through the energy audit.
Financing aspects	This measure is a technology implementation measure in a large number of medium and small scale production facilities. As such, and given the financial and know how barriers facing such entities, a programmatic approach to financing could be an efficient manner to implement the measure and could include incentives/subsidies. Potential providers of Climate Finance can include the following : **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks Each company would also be responsible for financing a share of the measure.

Mitigation measure	IMEA8: Efficient motors
Type	Legislative/Technological
Implementing entity	Ministry of Energy of Georgia
Implementation year/period	2025
GHG covered	CO_2
Emissions reduction in 2030 [Gg CO_2-eq]	11 Gg
Description of the Measure	The measure implies implementation of eco-design requirements for electric motors (Regulation (EC) No 640/2009), which should be implemented during the six years after enactment of the EU-Georgia Association Agreement; The effect of the measure is also strengthened by the existence of the financial mechanisms, which should promote equipping the motors with frequency regulators.
Assumptions and assessments	For the electric motors, the above said regulation requires that after 2018 all engines put on the market are equipped with frequency regulators. The frequency regulator increases the efficiency of the engine by about 15%. To assess the measure, an assumption was made that by 2030 50% of the motors existing in the industrial sector will be substituted and equipped with frequency regulators.

Progress indicators	Enforcement of corresponding regulation, electricity consumption in enterprises
Estimated investments	Legislative measure covers preparation of the appropriate legal changes to implement mentioned regulation (approximately 100,000 USD). It will also include the investment expenses for installing new energy efficient motors, which will be fully or partially covered by the enterprises themselves.
Financing aspects	This measure is a technology implementation measure in a large number of medium and small scale production facilities. As such, and given the financial and know how barriers facing such entities, a programmatic approach to financing could be an efficient manner to implement the measure and could include incentives/subsidies. Potential providers of Climate Finance can include the following : **Intl Sources** · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · IFIs and Bilateral Development Banks · Private Infrastructure Funds- Debt providers **Domestic Sources** · Georgian Banks Each company would also be responsible for financing a share of the measure.

2.E. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY (INDUSTRY, NON-ENERGY RELATED EMISSIONS)

In this annex the proposed mitigation measures for each of the five industrial sectors are presented. Best Available Techniques (BAT) are presented as mitigation measures, where applicable in the relevant sectors worldwide, in order to bring down the air emissions associated with the various production processes of each sector to the lowest possible limits. Air emissions mean greenhouse gases (GHG), as well as some other pollutants which are emitted into the ambient air by each process and must also be minimized, e.g. NO_x, SO_2, dioxins, etc.

For the iron/steel industry two options are investigated:

A. The existing situation (use of secondary ferrous constituents as raw materials – scrap in electric arc furnaces)
B. The reactivation of primary steel production in the future.

There are various options which can be applied in each sector. They are prioritized according to their potential for a) GHG emissions reduction, b) reduction of other major air emissions and c) the probability for introduction into the industry due to their relative simplicity (compared to the other BAT). All the proposed measures will not necessarily be applied: the plant operators will decide which of them suit better in each particular case.

Mitigation measures

Measure to be Implemented	Adaptation of the national environmental legislation to the EU requirements (according to the EU/GE – Association Agreement) – Integrated permit
Type of the Measure	Legislative
The Implementing Body	MENRP + Industrial Sectors/Facilities (all)
Implementation years	2017-2030
GHG + other air emissions	CO_2 and all other emissions
Reduction of Emissions by 2030 (Gg)	According to prescribed Best Available Techniques (BAT)
Description of the Measure	The permitting procedure for industrial facilities, if adapted to the EU requirements as described in the Industrial Emissions Directive (IED), will bring into force the principle of pollution prevention (and the associated emission limits). That means that all industrial facilities concerned must link BAT with emission limit values (ELV). Issuing of integrated IED permits will oblige the industrial operators to apply the mitigation measures (presented below).
Assumptions and Assessments	The already approved Twinning project GE 14 ENI EN 02 16 (GE/24) on “Strengthening the administrative capacities of the Ministry of Environment and Natural Resources Protection of Georgia for approximation and implementation of the environmental ‘*acquis*’ in the fields of industrial pollution and industrial hazards” will become operational in 2017 (probably in autumn). One of its main components is

	exactly this approximation.
Progress indicators	• Legal act adopted • Number of integrated permits issued
Estimated investments	No investments needed
Financial aspects	

1. Cement industry

1.1.

Measure to be Implemented	Clinker substitution (Lime addition)
Type of the Measure	Technological
The Implementing Body	Industrial Facilities: Rustavi 1 + 2, Kaspi, Senaki
Implementation years	2017-2030
GHG + other air emissions	CO_2
Reduction of Emissions by 2030 (Gg)	Rustavi 1: 14 Rustavi 2: 9.4 Kaspi (wet/dry method): 32/23.6 Senaki: 26
Description of the Measure	The addition of up to 5% limestone to the clinker, thus reducing the need for clinker making/calcination (no negative impact on the performance of limestone cement). No negative impact on the performance of limestone cement. Limestone cement improves slightly in workability.
Progress indicators	Clinker substitution (% of lime addition) in Rustavi 1 + 2, Kaspi (2017 – 2019), Senaki (from 2021 onwards) introduced.
Estimated investments	Expected to be marginal: cost of limestone to be compared with the costs for the production of additional clinker quantity (5%).
Financial aspects	

1.2.

Measure to be Implemented	Clinker substitution (other materials)
Type of the Measure	Technological

The Implementing Body	Industrial Facilities: Rustavi 1 + 2, Kaspi, Senaki
Implementation years	2017-2030
GHG + other air emissions	CO_2
Reduction of Emissions by 2030 (Gg)	Depends on the level of clinker substitution
Description of the Measure	The clinker content for cement production (blended cement) can be substituted by other materials such as natural pozzolanic materials. These constituents and the level of their addition in the final cement product are defined in the European cement standard EN 197-1 "Cement – Part 1: Composition, specifications and conformity criteria for common cements": The standard specifies requirements for the following: • The constituent materials of concrete • The properties of fresh and hardened concrete • The limitations for concrete composition. The 27 cement products are grouped into five main cement types as follows: • CEM I Portland cement (clinker > 95 %) • CEM II Portland-composite cement (65 – 94 % clinker) • CEM III Blastfurnace cement (5 – 64 % clinker) • CEM IV Pozzolanic cement (45 – 89 % clinker) • CEM V Composite cement (20 – 64 % clinker). Having this or other standards in mind, the percentage of clinker substitution must be decided on-site by each cement operator. Level of clinker substitution must be carefully evaluated in order to avoid cement quality degradation. Natural pozzolans are available in limited areas and facilities using these must be in proximity to the source. Heidelberg Cement factories apply already this method.
Progress indicators	Clinker substitution (% of pozzolans addition) in Rustavi 1 + 2, Kaspi (2017 – 2019), Senaki (from 2021 onwards) introduced.
Estimated investments	Depends on prices for materials purchase, transportation costs. No additional investment costs expected.
Financial aspects	

1.3.

Measure to be Implemented	Lime substitution for clinker production (fly ash/steel slag addition)

Type of the Measure	Technological
The Implementing Body	Industrial Facilities: Rustavi 1 + 2, Kaspi, Senaki
Implementation years	2017-2030
GHG + other air emissions	CO_2
Reduction of Emissions by 2030 (Gg)	Rustavi 1: 42 (15%), 84.3 (30%), 140.5 (50%) Rustavi 2: 28.2 (15%), 56.4 (30%), 94 (50%) Kaspi (wet/dry method): 97/70.6 (15%), 195/141 (30%), 324/235 (50%) Senaki: 78 (15%), 158 (30%), 261 (50%)
Description of the Measure	Fly ash positively affects the operating characteristics of cement paste; the sulphate resistance improves, the "bleeding" in cement pastes reduces, corrosion resistance grows, and better behavior results with high temperature actions. The use of steel slag or fly ash can be considered for existing facilities due to the relatively minor modification required. Fly ash can replace up to 50% of the Portland cement clinker. Standards of a large number of countries allow the usage of fly ash in the amount of 15-30%. As a consequence, CO_2 emissions will be reduced accordingly. Level of existing fly ash/steel slag addition has to be checked. It must be examined whether the 50% level can be achieved. For the time being fly ash is not available in Georgia (power plants use natural gas instead of coal), therefore it is not used (Heidelberg Cement).
Progress indicators	Clinker substitution (% of fly ash/steel slag addition) in Rustavi 1 + 2, Kaspi (2017 – 2019), Senaki (from 2021 onwards) introduced.
Estimated investments	No major additional costs expected, eventually cost reduction (if fly ash and/or steel slag are not sold as "products": this can be the case if the Georgian steel/iron plants will commence their integrated production in the future).
Financial aspects	

1.4.

Measure to be Implemented	Process control optimization (clinker burning process)
Type of the Measure	Technological
The Implementing Body	Industrial Facilities: Rustavi 1 + 2, Kaspi, Senaki
Implementation years	2017-2030

GHG + other air emissions	NO_x, SO_2
Reduction of Emissions by 2030 (Gg)	30% (NO_x), 50% (SO_2)
Description of the Measure	Optimization of the clinker burning process is usually done to reduce the heat consumption, to improve the clinker quality and to increase the lifetime of the equipment (e.g. the refractory lining) by stabilizing process parameters. Optimization includes techniques such as homogenizing the raw material and improving the cooler's operation. Reduction of emissions, such as NO_x, SO_2 is a secondary effect of this optimization. Process control optimization is applicable to all kilns and can include many elements ranging from instruction/training of the kiln operators to the installation of new equipment such as dosing systems, homogenization silos, pre-blending beds and new clinker coolers. A combination of primary and/or process-integrated techniques can also be proposed such as • flame cooling • low NOx burners • mid kiln firing • addition of mineralizers (such as fluorine) to the raw material to adjust the clinker quality and allow the sintering zone temperature to be reduced. The effect of process control optimization on SO_2 emissions is considerable for long wet and long dry kilns, but marginal for preheater kilns.
Estimated investments	0.7 €/ton clinker (EU data) for modifications needed.
Financial aspects	

2. Ammonia production

2.1.

Measure to be Implemented	CO_2 solvent scrubbing
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	CO_2
Reduction of Emissions by 2030 (Gg)	517

Description of the Measure	The CO_2 formed in the gasification process and the shift conversion process is generally removed by scrubbing with a solvent. Conventional CO_2 removal applies a chemical absorption method using an absorbing liquid. The solvents used in chemical absorption processes are mainly aqueous amine solutions, such as monoethanolamine (MEA), or hot potassium carbonate solutions. An almost pure CO_2 stream is recovered, which is typically vented or can be used in other industrial processes, such as urea production. A potential additional advantage is that the reduction in energy consumption, by using improved solvents in the CO_2 capture process, may allow a reduction in the steam-carbon ratio in the primary reforming section. Conventional CO_2 removal applies a chemical absorption method; however, CO_2 can also be removed using physical absorption. Physical absorption processes use an organic solvent, which absorbs CO_2 as a function of the partial pressure. The high CO_2 loadings result in low circulation rates and less utility costs for this type of processes. Physical absorption solvents typically used in ammonia production processes include glycol dimethylethers (Selexol) and propylene carbonate. Regeneration of the solution is performed by vacuum flashing and air stripping and consumes significantly less energy than in chemical absorption. The solvent monoethanolamine (MEA) has been widely used in the ammonia production process, but has some significant drawbacks including the considerable amount of energy required for regeneration. Improved solvents, which require less energy for regeneration of the solution, include the Benfield process (HiPure and LoHeat) and BASF's two-stage activated diethanolamine (aMDEA).
Estimated investments	For a 300,000 tons/year plant, the investment costs for switching over to Selexol are reported to be around €10,200,000 providing yearly savings of €4,000,000 and resulting in a payback time of 2.5 years. The relevant figures for Azot can be estimated as follows: Investment costs: €12,852,000 Yearly savings: €5,040,000
Financial aspects	

2.2.

Measure to be Implemented	Low NO_x burners (advanced conventional process)
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030

GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	Up to 70%
Description of the Measure	NO_x emissions are reduced in the flue-gases from the fired primary reformers and auxiliary boilers by modification of the combustion section (advanced conventional process for steam reforming for H_2 production). Low NO_x burners (air-staged, flue gas recirculation, fuel staged etc.) reduce the formation of NO_x by controlling these factors through the staged addition of combustion air and/or fuel gas, they may also include partial flue-gas recirculation.
Assumptions and Assessments	The peak flame temperature, the availability of oxygen and the residence time in the combustion zone all influence the formation of NO_x.
Estimated investments	The cost of the burners can be estimated to the cost of standard configuration + 10 % or, if waste gas recirculation is realized, + 15 to 30%. The cost for retrofitting can be significant.
Financial aspects	

2.3.

Measure to be Implemented	Decreased firing in the primary reformer
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	Quantities of 0.6 – 1.3 kg NO_x/ton NH_3 can be reduced to 0.27 – 0.30 kg NO_x/ton NH_3
Description of the Measure	The transfer of some of the primary reformer function to the secondary reformer reduces the level of primary reforming that is carried out. The consequence of this is less firing and a correspondingly lower NO_x formation. The heat supply in the primary reformer is reduced and the process outlet temperature is lowered to approximately 700°C, the firing efficiency is increased, and the size and cost of the primary reformer are reduced. The milder operation conditions prolong the life of catalyst tubes and the outlet header. The extent of reforming is reduced according to the lower heat supply and lower temperature. NO_x emission levels in the range of 0.27 - 0.3 kg/ton NH_3 are achieved only if air preheating is carried out with waste gas from a gas turbine where low oxygen and high CO_2 concentrations exist. If considerable air

	preheating is applied and no gas turbine waste gases can be used, the NO_x emission is of the range of 130 mg/Nm³ or 0.39 kg/t NH_3. Applicable to new plants only.
Estimated investments	
Financial aspects	

2.4.

Measure to be Implemented	Selective non-catalytic reduction (SNCR) at the primary reformer
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	30 – 70%
Description of the Measure	SNCR process is a secondary measure to reduce nitrogen oxides already formed in the flue-gas of a combustion unit. Within the SNCR unit, the injection of the additive and the reaction of nitrogen oxides to nitrogen and water take place. It is operated without a catalyst at a temperature of between 850 and 1,100 °C. At ammonia plants, normally ammonia is used as the reducing agent, as it is available on-site. The temperature window is of considerable importance as, above this, ammonia is oxidized and so even more NO_x is produced, and below this, the conversion rate is too low and unconverted ammonia is emitted to air. To adjust the required temperature window with the ammonia injection, several levels of injection are necessary. The reaction of nitrogen oxides and ammonia/urea into water and nitrogen is strongly dependent on temperature and retention time within the required temperature range, as well as on the ammonia to nitrogen oxides ratio. A NH_3 to NO_x ratio between 1.5 and 2.5 has been found to be the optimum. Applicable to new and existing plants.
Estimated investments	
Financial aspects	

2.5.

Measure to be Implemented	Heat exchange auto-thermal reforming
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	> 50%
Description of the Measure	Heat for the reform reaction is supplied to the reforming tubes by hot process gas from the secondary reformer. In a heat exchange primary reformer, excess air must be supplied to the secondary reformer to ensure a heat balance between these two steps. A modified synthesis converter using an improved catalyst with a total resulting in a lower overall synthesis pressure further simplifies the process. NO_x emissions may be reduced by 50% or more, depending on the extent of auxiliary combustion in the plant compared to conventional steam reforming. Applicable to new plants.
Estimated investments	
Financial aspects	

2.6.

Measure to be Implemented	Low temperature desulphurization
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	

Description of the Measure	Using desulphurization catalysts with a lower operation temperature can utilize the low temperature steam to heat the feed gas, instead of direct firing. In this way, NO_x emissions from the desulphurization unit are avoided. It is an integrated technique applicable in the desulphurization section of new and existing auto-thermal heat exchange reforming plants.
Estimated investments	
Financial aspects	

3. Nitric acid production

3.1.

Measure to be Implemented	Optimization of the oxidation step
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O
Reduction of Emissions by 2030 (Gg)	• 91 – 98% (new plants): 4.76 – 5.13 • 72 – 98% (existing plants): 3.77 – 5.13
Description of the Measure	The aim of optimizing the oxidation step is to get an optimum NO yield. This means that the formation of unwanted side products such as N_2O is lower. The NO yield must be as high as possible within the technical and economical possibilities of the plant; however, the conversion to NO is limited to max. 98%, with the remaining conversion being to N_2O and N_2. The NO yield in the oxidation step is highest at an optimum NH_3/air ratio of 9.5 – 10.5% ammonia. A high NO yield is favored by low pressure (as low as possible) and optimum temperature (750 – 900 °C).
Estimated investments	
Financial aspects	

3.2.

Measure to be Implemented	Alternative oxidation catalysts
Type of the Measure	Technological

The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O
Reduction of Emissions by 2030 (Gg)	30 – 50% (improved platinum-based catalysts): 1.57 – 2.6
Description of the Measure	Improved platinum catalysts can lead to a higher ammonia conversion to NO and/or to a reduction in the production of N_2O. Catalysts produced by Heraeus or oxidation catalysts from Umicore can be used. Alternatively, cobalt oxide based catalysts can also be used. The lifetime of these catalysts is longer thus reducing the number of plant shut-downs and lower pressure drop is observed. • Alternative oxidation catalysts produce up to 80 - 90% less N_2O than platinum-based catalysts, however the benefits might be offset by a lower NO yield and hence increase NH_3 consumption. • The use of two-step catalysts reduces the amount of platinum used by between 40 – 50% and platinum losses are reduced by 15 – 30% under similar conditions. • As optimized platinum catalysts or alternative catalysts become available on the market, it can be anticipated that these catalysts will be suitable for all nitric acid plants, new and existing, operating at any pressure.
Estimated Cost	For new plants, alternative catalysts can be an option. For existing plants, retrofit costs are reported to be 1.5 – 2 million $. The lower NO yield should also be taken into account as it has a significant cost effect. Savings of €0.50 – €2.00 per ton of HNO_3 have been achieved (due to higher NO yield). That means for Azot plant: 388,000 – $1,552,000/year (2030).
Estimated investments	For new plants, alternative catalysts can be an option. For existing plants, retrofit costs are reported to be 1.5 – $2 million. The lower NO yield should also be taken into account as it has a significant cost effect. Savings of €0.50 – €2.00 per ton of HNO_3 have been achieved (due to higher NO yield). That means for the Azot plant: $388,000 – $1,552,000/year (2030).
Financial aspects	

3.3.

Measure to be Implemented	Catalytic N_2O decomposition in the oxidation reactor
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O
Reduction of Emissions by 2030 (Gg)	75 – 85%: 3.93 – 4.45
Description of the Measure	N_2O can be decomposed just after being formed by a selective De-N_2O catalyst in the high temperature zone (between 800 and 950 °C). This is realized by placing the catalyst right below the platinum gauze. Most nitric acid burners are fitted with a basket filled with Raschig rings giving structural support to the gauzes, and the De-N_2O catalyst can be introduced by partial replacement of the Raschig rings. Hence, usually, no modification of the basket is required and the gauze pack can be installed as usual. A catalyst layer of 50 – 200 mm achieves a high decomposition rate with low additional pressure drop. Various catalysts are actually available, e.g. 1. Catalyst developed by Yara: • Cerium oxide-based catalyst with cobalt as the active component • Multi-cored cylindrical pellets 9 x 9 mm • Bulk density of 1.1 – 1.3 g/m^3 • Radial crushing strength >20 Newton • Increasing efficiency with increasing pressure and temperature • No losses in NO yield. 2. Catalyst developed by BASF: • Various types available, “O_3-85”-types • Composition (w/w): CuO 20%, ZnO 16%, plus Al_2O_3 and promoters • Various shapes • Operational for low, medium and high pressure oxidation • No measurable loss in NO yield. 3. Catalyst developed by Heraeus: • Precious metal deposited over ceramic • No measurable effect on NO yield • N_2O level adjustable by variation of the catalyst layer thickness. With increasing oxidation pressure, the pressure drop over the catalyst will increase. A NO_x abatement system is still required in

	most cases. In atmospheric pressure plants, the extra pressure drop in the reactor reduces the plant capacity. Depending on the case, limitations for the application of a N_2O decomposition catalyst might arise with respect to the following factors: • Some plants might require modifications to build in a basket • Basket design and actual basket condition • Available height in the burner basket for filling with a De-N_2O catalyst: heights might vary from about 5 – 14 cm • Potential for gas slip at the reactor wall • Gas temperature, pressure and velocity • Additional pressure drop, depending on the catalyst size and shape Additional load on the statics of the reactor through added weight and additional pressure drop. Applicable to new and existing plants.
Estimated investments	Easy and cost-effective to install, using the existing basket without any further modifications.
Financial aspects	

3.4.

Measure to be Implemented	N_2O decomposition by extension of the reactor chamber
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O
Reduction of Emissions by 2030 (Gg)	30 – 60%:1.57 – 3.14
Description of the Measure	An ‘empty’ reaction chamber of approximately 3.5 m extra in length is installed between the platinum catalyst and the first heat exchanger. Due to the longer residence time of one to three seconds, a N_2O reduction might be obtained, since N_2O is metastable at higher temperatures and decomposes to N_2 and O_2. A decomposition rate of 80% is predicted to be achieved by an extension of about seven meters. Applicable to new plants. Not applicable to low pressure plants.

	Retrofitting the technique in existing plants is not considered because of the excessive costs. The applicability is restricted to a maximum reactor diameter lower than four meters because of the lack of mechanical support of the oxidation catalyst.
Estimated investments	
Financial aspects	

3.5.

Measure to be Implemented	Oxidation catalyst performance and campaign length
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	Catalyst performance is negatively affected by: • Poisoning by air pollution and contamination from the ammonia • Poor ammonia-air mixing • Poor gas distribution across the catalyst. These factors may reduce the NO yield by up to 10%. To minimize these effects, some plants use magnetic filters to remove any rust from ammonia, static mixers to give a high-quality mixture and an additional filtration step applied to the ammonia/air mixture. Burner heads often contain a perforated plate or honeycomb grid to ensure good distribution. ***Gauze composition.*** Platinum is usually alloyed with rhodium to improve its strength and to reduce catalyst loss. In the past, rhodium was more expensive than platinum, increasing the cost. A rhodium content of 5 – 10% has been shown to be optimal. If a low reaction temperature, i.e. <800 °C, is chosen, a pure platinum catalyst should be employed. Otherwise rhodium (III) oxide could accumulate at the catalyst surface and decrease catalytic activity. Palladium is also used in catalyst alloys to reduce costs. Adding up to 5% palladium, resulting in no significant differences in the nitrogen monoxide yield, and has the benefit that palladium costs are lower than platinum or rhodium.
Estimated investments	

Financial aspects	

3.6.

Measure to be Implemented	Combined NO_x and N_2O abatement in tail gases
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O, NO_x
Reduction of Emissions by 2030 (Gg)	98 - 99% (N_2O): 5.13 – 5.21
Description of the Measure	The process comprises a combined N_2O and NO_x abatement reactor which is installed between the final tail gas heater and the tail gas turbine and operates at tail gas temperatures of approximately 420 – 480 °C. The combined N_2O and NO_x abatement reactor consists of two catalyst layers (Fe zeolite) and an intermediate injection of NH_3. Within the first catalyst layer (De-N_2O step) the decomposition of N_2O into N_2 and O_2 is carried out at full NO_x load, because the NO_x additionally promotes the decomposition of N_2O (co-catalysis). Within the second catalyst layer (De-N_2O/De-NO_x step) NO_x is reduced by injection of NH_3. Further decomposition of N_2O also takes place. **Operational data** Data of example plant: • Type: dual medium/high (M/H) plant (3.3/8 bar) • Capacity: 1,000 tons/day • Volume flow: 120,000 Nm^3/hour • NO_x in tail gas: k 500 ppm • N_2O in tail gas: 800 – 1,400 ppm, typically 1,000 – 1,100 ppm • The gauzes are changed approximately twice a year, absorption stage operated at 25 ^{0}C. **Applicability** Generally applicable to new plants. Applicable to existing plants with tail gas temperatures of approx. 420 °C without major reconstruction of the plant.
Estimated investments	€1,700,000 – €2,100,000 (for the example plant mentioned above).
Financial aspects	

3.7.

Measure to be Implemented	Non-selective catalytic reduction (NSCR) of NO_x and N_2O in tail gases
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	N_2O, NO_x
Reduction of Emissions by 2030 (Gg)	• Reduction of N_2O of at least 95% - < 50 ppm N_2O → 4.97 • Reduction of NO_x emissions to 100 – 150 ppm (205 – 308 mg/m^3)
Description of the Measure	NSCR of NO_x enables the reaction of a reducing agent (fuel) with nitrogen oxides, to produce nitrogen and water. Although developed as a De-NO_x system, NSCR also considerably reduces the emissions of N_2O. The most used fuels are natural gas or methane, hydrogen or ammonia plant purge gas (mainly hydrogen). An excess of reducing agent is required to reduce nitrogen oxides and nitrous oxide to nitrogen. Catalysts for NSCR are usually based on platinum, vanadium pentoxide, iron oxide or titanium; catalyst supports are typically made of alumina pellets or a ceramic honeycomb substrate. As the catalyst ages, the amount of fuel is increased to maintain the same NO_x and N_2O reduction values in the tail gas. The tail gas must be preheated before the reaction on the catalyst proceeds. The required temperature depends on the fuel selected, varying from 200 – 300 °C (hydrogen) to 450 – 575 °C (natural gas). Due to the exothermic reactions in the NSCR facility, the tail gas temperature can become very high (>800 °C), exceeding the maximum for admission to the gas expander unit. To deal with these high temperatures, two methods of NSCR are developed: single-stage and two-stage reduction **Single-stage** units can only be used when the oxygen content of the absorber tail gas is less than 2.8% (an oxygen content of 2.8% will result in a tail gas temperature of ±800 °C after the NSCR facility). The effluent gas from these units must be cooled by a heat exchanger or quenched to meet the temperature limitation of the gas expander unit **Two-stage** units with an internal quench section are used when the oxygen content is over 3%. Two systems of two-stage reduction are used. One system uses two reactor stages with an inter-stage heat removal. The other system involves preheating 70% of the tail gas to ±480 °C, adding fuel, and then passing it over the first stage catalyst. The fuel addition to the first stage is adjusted to obtain the desired outlet temperature. The remaining 30% of the tail gas, preheated to only ±120 °C, is mixed with the first stage effluent. The two streams, plus fuel for the complete reduction, are

	passed over the second stage catalyst. After the second catalyst, the tail gas passes to the gas expander. The tail gas needs a high preheat temperature, from ±50 °C to ±250 – 300 °C (H_2) or to 450 – 550 °C (natural gas). The energy to use this abatement technique can be obtained from the process, but reduces the possible amount of exportable steam. The high temperatures (T >800° C) reduce the lifetime of the catalyst to 3 – 5 years.
Estimated investments	The price of an NSCR catalyst varies between 106,000 and 143,000 $/m^3$ Technical and maintenance costs are excluded. A catalyst volume of 1.20 m^3 is required to treat a flowrate of 48,000 m^3/h.
Financial aspects	

3.8.

Measure to be Implemented	Optimization of the absorption stage
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	20 – 50%
Description of the Measure	Optimizing the absorption step results in an efficient formation of the nitric acid and it minimizes emissions of NO and NO_2 to air. 1. Pressure: The absorption step is carried out at pressures above atmospheric and at least medium pressure (1.7 – 6.5 bar) is preferred in modern nitric acid plants and is considered optimal. 2. Temperature: The absorption stage in particular nitric acid formation takes place in the lower third of the absorption column and is exothermic, so cooling is needed for heat removal. This is achieved by applying cooling before the absorption column to optimize absorption. 3. Optimal contact between NO_x, O_2 and H_2O: Optimal contact is mainly dependent on the absorption tower design. Several parameters contribute to an optimal design e.g. the volume, the number and kind of trays used, the distance between the trays and the number of columns. In addition, a long residence time will ensure a high

recovery of NO_x to form nitric acid and also minimize NO_x emissions. Most nitric acid plants have a single absorption tower with sieve or bubble cap trays.

Optimizing these parameters for nitric acid production minimizes the emission of non-oxidized NO and non-absorbed NO_2. Various systems are available, optimizing one or more of the specified parameters:

High pressure systems:

Absorption reactions are improved by optimizing nitric acid formation and reducing NO_x emissions. In mono-pressure processes, ammonia oxidation and NO_2 absorption take place at the same pressure. In general, three types of mono-pressure plants are possible: low pressure (<1.7 bar), medium pressure (1.7 – 6.5 bar) and high pressure (6.5 – 13 bar). Dual pressure plants, on the other hand, use a higher pressure for the absorption step than for the oxidation step. Most dual pressure plants use a combination of low and medium pressure or a combination of medium and high pressure.

Extended absorption:

It reduces NO_x emissions by increasing absorption efficiency. This is accomplished by either installing a single large tower, extending the height of an existing absorption tower or by adding a second tower in series. Increasing the volume and the number of trays in the absorber results in more NO_x being recovered as nitric acid and in reduced emission levels. Extended absorption is sometimes combined with variable cooling. The lower 40 – 50% of the absorber is cooled by normal cooling water. The balance of trays (50 – 60%) in the absorber use chilled water or coolant at approximately 2 – 7 °C. This is accomplished by either a closed-loop refrigeration system using a proprietary refrigerant or by refrigeration from the ammonia evaporation system.

High efficiency absorption (HEA):

The HEA process enables nitric acid to be made without the formation of NO. The gas-liquid contacts in the absorption column are designed to increase the oxygen loading in the circulating acid.

- High absorption pressures can reduce steam export
- Extended absorption with an adjusted form of cooling can be expected to use more energy. Cooling systems are necessary to reach the lower temperatures, hence heat losses to the environment may increase, discharge of warm water may have negative effect on receiving water bodies

Mono high/high systems show a lower NO yield and generate more N_2O.

Applicability:

High pressure systems: In existing plants, the pressure in the absorption unit can be raised within certain technical limits. Generally applicable for new plants, usually designed as a dual medium/high plant.

Extended absorption can be applied to existing and new plants. In

	existing plants, retrofit applications involve adding a second absorption column in series with an existing column, or replacing the old column(s) by a new design absorption column. New plants are generally designed with a single large column that is an integral component of the new plant design. The extended absorption abatement using a different form of cooling is only practical in nitric acid plants operating with an absorber pressure above nine bar. Also, refrigeration equipment and associated pipework will need additional expenditure. The HEA column can be applied both in existing and new nitric acid plants. In existing plants, the HEA column can be placed in series with an existing absorption tower.
Estimated investments	• Mono-pressure operation has been shown in the past to give special economic advantages. Capital costs are lower, because only one compression unit is required. When feedstock and energy prices are low: low investment costs ensure a quick payback. If feedstock and energy prices are high, yield and energy efficiency must be maximized, so higher investment costs are more acceptable. Plant size also plays an important role. For a large production capacity (>1000 tons/day) it is more realistic to build a dual pressure plant. • In a dual pressure system, stainless steel compressor units are necessary to compress NO_x. As a result, dual pressure plants need investments that are approximately 15 – 20% higher than the investment for a mono-pressure plant. On the other hand, a dual pressure plant optimizes the NO yield and energy recovery, thereby recovering the higher investment costs. As stated above, a dual pressure plant is more feasible if a large production capacity is desired (> 1,000 tons/day). • Total costs for NO_x removal using the HEA system were 0.6 $/ton nitric acid produced (based on a 365 tons/day plant).
Financial aspects	

3.9.

Measure to be Implemented	Selective catalytic reduction (SCR) of NO_X
Type of the Measure	Technological
The Implementing Body	Azot (Rustavi)
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	80 – 97%

Description of the Measure	Ammonia or (evaporated) ammonia solution is injected, in the required stoichiometric amounts, into the waste gas stream. The ammonia reacts preferentially with the nitrogen oxides in the tail gas using a catalyst to initiate the reaction. The tail gas needs heating to the operational temperature depending on the catalyst being used, i.e. between 120 and 400 °C. This is normally carried out by passing the tail gas through a heat exchanger using heat recovered from the ammonia oxidation unit. • Ammonia consumption depending on the amount of NO_x reduced • Ammonia slip, usually less than 10 ppm (7.6 mg/Nm^3) • Older catalysts in particular could produce some N_2O. **Operational data** • Optimum operating temperature varying from 200 to 350 °C • Pressure drop before the expander unit of 0.01 – 0.1 bar • The tail gas temperature after reduction of 200 – 360 °C is significantly lower than in the case of NSCR (650 – 800 °C), allowing the use of simpler, cheaper construction materials. **Applicability** Generally applicable. In principle SCR facilities can be applied in both new and existing nitric plants and can operate at all pressures.
Estimated Cost	Based on a dual mono/high plant with a production output of 1,000 tons 100% nitric acid/day and an operating time of 8400 h/year, the costs of an SCR are as follows: • Capital costs: €2,000,000 • Annual costs: €300,000 • Total costs: approximately 1.16 €/ton nitric acid produced • Catalyst price: 35,000 – 53,000 $/m^3$
Estimated investments	Based on a dual mono/high plant with a production output of 1,000 tons 100% nitric acid/day and an operating time of 8,400 h/year, the costs of an SCR are as follows: • Capital costs: €2,000,000 • Annual costs: €300,000 • Total costs: approximately 1.16 €/ton nitric acid produced Catalyst price: 35,000 – 53,000 $/m^3$

4. Ferroalloys production

4.1.

Measure to be Implemented	Energy recovery and utilization of CO from a closed electric arc furnace
Type of the Measure	Technological
The Implementing	Georgian Manganese, Chiatur Manganese, Rusmetali, GTM Group

Body	
Implementation years	2017-2030
GHG + other air emissions	CO, CO_2, SO_2
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	The main part of the process is a closed electric arc furnace, which generates a CO rich off-gas (70 – 90% of CO). The off-gas is cleaned by using a wet scrubber before it can be used as a secondary fuel. One possibility is the combustion with air in a stream boiler. The steam is fed to a set of high pressure and low pressure turbines. The energy is then recovered as electricity (13.5 % of the electrical energy input). Beside the production of electricity, the CO gas can also be transferred by means of pipelines in the plant area and used as a secondary fuel for many purposes. In the production of FeMn and SiMn CO gas can be used for drying of coke and other raw materials. Coal/coke used as reductants. Off-gas consists of CO (explosive and poisonous), therefore special care must be considered to avoid any leakages. **Applicability** New and existing SiMn/FeMn plants.
Estimated investments	Approx. €0.025 per kWh used.
Financial aspects	

4.2.

Measure to be Implemented	Energy recovery for a semi-closed electric arc furnace
Type of the Measure	Technological
The Implementing Body	Georgian Manganese, Chiatur Manganese, Rusmetali, GTM Group
Implementation years	2017-2030
GHG + other air emissions	CO, CO_2, SO_2
Reduction of Emissions by 2030 (Gg)	If the waste heat is utilized as electric power the recovery is up to 28 – 33% of the energy consumption respective CO_2 reduction. Alternately, the steam can be drained at mean pressure and be used for

	district heating and the recovery will increase to approximately 80 – 90%.
Description of the Measure	The hot off-gas of the furnace can be recovered in a waste heat boiler, which produces superheated steam. Relatively conventional water pipe boilers with super heater, economizer and condenser sections are used, combined with an efficient cleaning system to keep the heating surfaces clean in the heavily dust polluted flue gas. For energy recovery, the top hood may be cooled by unshielded high-pressure water piping, producing steam to the recovery boiler system. Such hoods exist and contribute substantially to energy recovery. The steam can be used in a back-pressure turbine in order to produce electricity. The recovery system can be designed also to produce hot water, which can be used by a local heating system. The recovery of energy from the hot off gas reduces the overall energy consumption of the process, which consequently minimizes the impact of global warming by emitting CO_2 from burning fossil fuel. The off-gas energy presented a large available, partly unexploited energy source that can provide new electricity without pollution and additional CO_2 emission. The off-gas energy can be used to produce electric power, heat energy or both. **Applicability** The technology is in general applicable to both new and existing plants.
Estimated investments	
Financial aspects	

5. Iron/Steel production

5.1. Existing situation (Electric Arc Furnace)

5.1.1.

Measure to be Implemented	Scrap preheating
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	CO_2, PCDD/F
Reduction of Emissions by 2030 (Gg)	

Description of the Measure	The scrap can be preheated to approximately 800 – 1000 °C with discontinuous systems and to 300 – 400 °C with continuous systems by utilizing the sensible heat in the off-gas prior to the electric arc furnace (EAF) melting process which reduces the total energy consumption by up to 100 kWh/t liquid steel (10 – 25% reduction). Such preheating is performed either in the scrap charging baskets or in a charging shaft (shaft furnace) added to the EAF or in a specially designed scrap conveying system allowing continuous charging during the melting process. A further modification is the double shaft furnace, which consists of two identical shaft furnaces (twin shell arrangement) positioned next to each other and serviced by a single set of electrode arms. The scrap is partly preheated by off-gas and partly by side wall burners. The continuity of the process allows for achieving a stable off-gas exit temperature between 800 and 1,100 °C, with an oxygen excess of 8 – 10%. High emissions of aromatic organohalogen compounds such as polychlorinated dibenzo-p-dioxins and furans (PCDD/F), chlorobenzenes, polychlorinated biphenyls (PCB) as well as polycyclic aromatic hydrocarbons (PAH) and other partial combustion products may occur from scrap contaminated with paints, plastics, lubricants or other organic compounds. These emissions can be minimized by post-combustion of the off-gas in a specially designed post-combustion chamber equipped with fossil fuel burners. Due to the high temperature reached in order to destroy the persistent organic pollutants that can be present in the off-gas, the amount of energy required is considerable and the order of magnitude of the energy savings provided by scrap preheating is also high.
Estimated investments	
Financial aspects	

5.1.2.

Measure to be Implemented	Reduction of PCDD/F by post-combustion and quenching
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air	PCDD/F

emissions	
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	Post-combustion in a combustion chamber aims primarily at the full combustion of CO and hydrogen remaining in the off-gas in order to avoid uncontrollable reactions in the gas cleaning equipment. When it is well optimized (i.e. when the temperature and the residual time are adequate) it reduces the emission of organic and organochlorine compounds such as PAH, PCB or PCDD/F. Post-combustion is followed by a rapid cooling (quenching) system of the fumes as soon as possible to a temperature of below 250 °C at which all risk of de novo synthesis is excluded. This cooling is obtained by water injection in a quenching tower. The quenching system must be placed near to the post-combustion chamber in order to avoid de nuovo synthesis of PCDD/F. The thermal combustion before quenching can be obtained with natural gas burners in post-combustion chambers. **Applicability** In principle, post-combustion can be applied to both new and existing plants but in existing ones the local circumstances and possibilities should be checked.
Estimated investments	The investment costs for a quenching tower are about €1.2 million.
Financial aspects	

5.1.3.

Measure to be Implemented	Reduction of PCDD/F by means of adsorbent materials in combination with bag filters
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	PCDD/F
Reduction of Emissions by 2030 (Gg)	

Description of the Measure	Adsorbents (e. g. activated carbon, pulverized activated lignite coke or mixtures of these with lime) can be dosed to the exhaust duct before the dust abatement device. The necessary amount depends on the type and size of the adsorbent. Usually it is between 20 and 150 mg/Nm^3 off-gas. The carbon to which the PCDD/F molecules are adsorbed is separated from the gas phase together with the EAF dust contained in the raw gas in the subsequent bag filters. Besides PCDD/F adsorption, activated carbon and pulverized activated lignite coke have shown a high efficiency of separation of heavy metals and certain efficiency in removing mercury from the gas phase. In order to prevent the risk of ignition, the carbon content of the EAF dust should stay below 4%. The amount of energy needed for pulverized activated lignite coke dosage is not considerable. **Applicability** New and existing plants.
Estimated investments	Investment costs for the total off-gas flow (primary and secondary off-gases) from an EAF plant producing about 1 Mt steel/year is about €500,000.
Financial aspects	

5.1.4.

Measure to be Implemented	Selection of scrap and of other raw materials
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	PCB, Hg
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	Scrap sorting must be performed in order to minimize the risk of including hazardous or non-ferrous contaminants, particularly polychlorinated biphenyls (PCB) and oil or grease. This is normally done by the scrap supplier but the facility's operator inspects all scrap loads. Special attention should be given to the removal of components which contain mercury from end-of-life vehicles, electrical waste and electronic

	equipment by the scrap processors by: • Fixing the absence of mercury in scrap purchase contracts • Refusal of scrap which contains visible electronic components and assemblies. Scrap loads must be classified in six categories: Old scrap, new uncoated scrap with low residuals, shredded scrap, steel turnings, high residual scrap and fragmentized scrap from incineration. The relevant EU specifications defining environmental, safety and health criteria can be taken into consideration. Scraps are qualified on the basis of their weight, size and chemical analysis.
Progress indicators	Certificates from scrap providers (scrap quality/quantity) collected by the plant operator.
Estimated investments	No considerable costs
Financial aspects	

5.2. Future situation (blast furnace, coke oven plant, pelletization/ sinter plant)

5.2.1. Blast furnace

5.2.1.1.

Measure to be Implemented	Recovery and use of blast furnace gas
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	CO_2
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	A typical blast furnace produces approximately 1,200 – 2,000 Nm^3 of BF gas per ton of hot metal. The BF gas consists of 20 – 28% carbon monoxide (CO) and of 1 – 5% hydrogen. The carbon monoxide is formed during the oxidation of carbon in the blast furnace. Much of the CO is further oxidized to CO_2 in the blast furnace. Carbon monoxide and hydrogen represent a potential energy source. Blast furnace top gas is therefore cleaned and buffered in gasholders for subsequent use as a fuel. Given the low energy content of BF gas per Nm^3, it is often enriched with coke oven gas or natural gas prior to use as a fuel.

	Total export from the blast furnace is approximately five GJ/ton hot metal, which equals 30% of the gross energy consumption of the blast furnace. BF gas cleaning is unavoidable and results in waste water and solid residues.
Estimated investments	
Financial aspects	

5.2.1.2.

Measure to be Implemented	Coal injection
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	CO_2, SO_2, NO_x
Reduction of Emissions by 2030 (Gg)	For every kg of coal injected approximately 0.85 – 0.95 kg of coke production is avoided $\longrightarrow$ reduction of CO_2 (approx. 20%)/NO_x/ SO_2 emissions.
Description of the Measure	Coke replacement through coal injection depends upon factors such as productivity, coke properties, desired hot metal quality, BF pressure, type (e.g. anthracite) and condition (humidity) of coal, etc. Depending on the carbon content of the pulverized coal, between 210 and 260 kg of coal per ton of hot metal are injected. The application of the oxy-coal injection has increased the injection rate by approximately 20% and correspondingly has decreased the coke rate. The performance of the electrostatic precipitator used for the BF gas cleaning has improved. Together with the improved positive effect on the permeability in the blast furnace and the improved coal distribution, the whole blast furnace performance has improved. **Applicability** The method is applicable at all blast furnaces equipped with pulverized coal injection and oxygen enrichment. Direct injection of reducing agents is applicable both at new and existing blast furnaces.
Estimated investments	There are economic incentives for using high rates of coal injection to achieve greater cost savings, particularly at plants which might otherwise face capital expenditure on rebuilding coke ovens or may have to purchase coke. Furthermore, coal injection can allow the use of coals of a

	lower quality compared to coking coals. This may also reduce costs.
Financial aspects	

5.2.1.3.

Measure to be Implemented	Injection of coke oven gas (COG)
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	CO_2, SO_2
Reduction of Emissions by 2030 (Gg)	The replacement ratio for COG is about 1 kg of gas for 0.98 kg coke. The replacement of a carbon-rich reductant like coke in the BF process by a carbon-lean reductant like COG leads to an absolute reduction of the CO_2 emissions from the BF process.
Description of the Measure	Injection of COG in the BF process. COG has a lower sulphur input than heavy oil or coke. The consumption of desulphurization agents (e.g. lime, CaC_2, Mg) at the pretreatment desulphurization process of the hot metal can then be reduced. COG input: 47 – 100 kg/ton hot metal (HM)
Assumptions and Assessments	**Applicability** COG injection is applicable both at new and existing blast furnaces. Highly dependent upon the availability of the gas that may be effectively used elsewhere in the integrated steelworks.
Estimated investments	
Financial aspects	

5.2.2. Coke oven plant

5.2.2.1.

Measure to be Implemented	Reduction of NO_x by primary measures
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel

Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	75%
Description of the Measure	The most effective way of reducing NO_x formation is to reduce the flame temperature in the heating chamber. The aim is therefore to burn with a cool flame. Three methods have shown to be effective: • Waste gas recirculation: the waste gas from the coke oven is admixed with fuel and combustion air. The lower O_2 and higher CO_2 concentrations reduce the flame temperature. However, the preheat effect of waste gas recirculation may counteract the temperature reducing effect • Staged air combustion: by adding the combustion air in several stages, combustion conditions become more moderate, and NO_x formation is reduced • Lowering coking temperatures: temperature has an influence on economics and the energy efficiency of the coke ovens. A lower coking temperature requires a lower heating chamber temperature, which results in less NO_x formation. Staged air heating in combination with internal waste gas recirculation generates a long and 'cool' flame which is a precondition for minimizing NO_x concentrations in the waste gas. Furthermore, the heating chamber temperature (and thus NO_x formation) can be reduced while a normal coking temperature is maintained by decreasing the temperature gradient over the refractory brick wall from the heating chamber side to the coke oven chamber side. This can be done by using thinner bricks and a refractory with a better thermal conductivity. Formerly, a heating chamber temperature of 1,320 °C would lead to a coke oven chamber temperature of 1,180 °C. Nowadays, a coke oven chamber temperature of 1,200 °C is achieved at the same heating chamber temperature due to thinner bricks. When the cooling capacity of the crude gas coolers is increased to improve desulphurization efficiency, the energy consumption increases and possible thermal emissions are increased. **Applicability** New plants
Estimated investments	
Financial aspects	

5.2.2.2.

Measure to be Implemented	Variable pressure regulation of ovens during the coking process
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	Polycyclic aromatic hydrocarbons (PAH)
Reduction of Emissions by 2030 (Gg)	60 – 70%
Description of the Measure	For conventional coke ovens one of the most difficult environmental problems is to avoid diffuse gaseous emissions, which mainly appear at coke oven closures such as coke oven doors, ascension pipe lids and at charging hole lids. The main cause and driving force of these emissions is the pressure in the oven chambers resulting from the raw gas generated during the carbonization process. Driven by this pressure, the raw gas penetrates the seals of the diverse coke oven closures. The oven bottom should be at atmospheric pressure. As a rule of thumb, the overpressure (in mm water column) in the collecting main is maintained at twice the height of the oven in meters. The conventional way for pressure regulation and emission reduction is to fix high or low pressure adjustment. To uncouple the collecting main pressure from the chamber, a novel collecting main valve (brand name 'FixCup') was developed that replaces the conventional mechanical flap at the individual ovens.
Assumptions and Assessments	**Applicability** The variable pressure regulation technique is applicable to new coke plants and can be an option for existing plants. The possibility of installing this technique in existing plants should be determined carefully and is subject to the individual situation of every plant.
Estimated investments	
Financial aspects	

5.2.2.3.

Measure to be Implemented	Reduction of SO_2 by coke oven gas (COG) desulphurization
Type of the Measure	Technological
The Implementing	Iberia Steel, Rustavi Steel, Geosteel

Body	
Implementation years	2017-2030
GHG + other air emissions	SO_2, HCN
Reduction of Emissions by 2030 (Gg)	SO_2: 70 - 99% (OxyClaus process)
Description of the Measure	Usually, (enriched) blast furnace gas or COG is used to fire the coke oven. If no desulphurization is applied the H_2S content can be as high as 8 – 12 g H_2S/Nm^3. Unpurified COG is not suitable for use in many industrial applications due to its H_2S content. When the gas has been desulphurized, however, its use for a variety of applications (COG selling) becomes viable. Desulphurization for commercial reasons coincides with the need to protect the environment from the effect of 'acid rain'. There are two main types of coke oven gas desulphurization processes: wet oxidative processes and absorptive processes with subsequent stripping. The absorptive processes combine H_2S and ammonia removal and processing. In Europe, the most commonly used process is the absorptive process using an ammonia liquor to scrub the H_2S from the coke oven gas (Carl Still, Diamex, ASK or Cyclasulf processes). The wet oxidative process shows better desulphurization efficiency; it also removes HCN. HCN can be removed prior to desulphurization in a pre-washer using a sodium polysulphide or ammonium polysulphide solution. For the OxyClaus process, energy is needed for cracking but a catalyst is not needed for removing ammonia. NO_x emissions are also reduced. **Applicability** Coke oven gas desulphurization of both the wet oxidative and the absorptive type can be applied at new and existing plants. The choice depends on the cleaned coke oven gas specifications, environmental considerations, integration within the gas cleaning plant, etc.
Estimated investments	Implementing the gas desulphurization technique costs around €30 million (capital cost) in a coke oven plant with about a hundred ovens (ArcelorMittal).
Financial aspects	

5.2.3. Pelletization plant

5.2.3.1.

Measure to be Implemented	Process-integrated NO_x abatement

Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	NO_x
Reduction of Emissions by 2030 (Gg)	>60%
Description of the Measure	The main factors for thermal NO_x formation are the high temperatures (1,300 – 1,400 °C) in the induration strand and the high availability of oxygen in the burner zone. The most important measure aims to reduce the formation of thermal NO_x. This can be achieved by lowering the (peak) temperature in the burners and reducing the excess oxygen in the combustion air. Additionally, lower NO_x emissions can be achieved by a combination of low energy use, low nitrogen content in the fuel (coal and oil) and by limiting the excess oxygen.
Assumptions and Assessments	**Applicability** New plants (design phase). Existing plants (retrofitting measures such as installation of extra burners in the recuperation hood to allow for lower flame temperatures in the burner hoods).
Estimated investments	The costs for new plants are considerably lower compared with retrofitting.
Financial aspects	

5.2.3.2.

Measure to be Implemented	Gas suspension absorber (GSA)
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	SO_2, HF, HCl
Reduction of Emissions by 2030 (Gg)	97 – 99%

Description of the Measure	Wet lime slurry is sprayed in the waste gas in a fluidized bed reactor. The water from the lime slurry evaporates and the slaked lime reacts with the impurities (HF, HCl and SO_2). A high concentration of dust in the waste gas enhances the performance of the GSA and as it increases the reaction surface, dust is coated with the slaked lime solution. After the fluidized bed reactor, the waste gases are led through cyclones. Part of the dry product (reacted lime and dust) is removed here and recirculated into the reactor, in order to maintain a high concentration of dust in the reactor. Final cleaning of the waste gas is performed using electrostatic precipitation. The rate of injection of slaked lime is proportional to the SO_2 concentration in the waste gas. An electrostatic precipitator must be added as the last cleaning stage. The dry precipitate from the ESP is deposited. **Applicability** New/existing plants.
Estimated investments	
Financial aspects	

5.2.4. Sinter plant

5.2.4.1.

Measure to be Implemented	Process optimization
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	PCDD/F
Reduction of Emissions by 2030 (Gg)	
Description of the Measure	PCDD/F are formed within the sinter bed itself, probably just ahead of the flame front as the hot gases are drawn through the bed and to some extent into the wind boxes and wind legs. It has also been shown that disruptions to flame front propagation, i.e. non-steady state operations, result in higher PCDD/F emissions. The solution therefore has been to operate the sintering process in as consistent a manner as possible in terms of strand speed and, in addition, to reduce variations in the bed composition (particularly consistent blending of revert materials and the minimization of chloride input) and in bed height. Furthermore, maintaining a stable rate of additions such as burnt lime, controlling mill

	scale oil content to a consistent level of <0.5% which might result in a raw mix oil concentration of <0.1% and keeping the strand, ductwork and dedusting devices air-tight to minimize, as much as possible, the amount of air ingress into the operation, can have beneficial effects on the emissions from the sinter strand. No single technique can be identified that enables relatively low PCDD/F formation, rather, it seems to be a combination of a number of the techniques mentioned above but especially a continuous strand operation. Advantages in terms of operational performance reflected in increased productivity, reduced energy demand and consistent sinter quality are reported. **Applicability** New/existing plants.
Estimated investments	There are no installation costs. The operational costs for maintenance and labor are balanced by the benefits of higher productivity and consistent sinter quality. Furthermore, a well maintained and smoothly run plant results in reduced fuel and energy consumption.
Financial aspects	

5.2.4.2.

Measure to be Implemented	Suppression of PCDD/F formation by addition of nitrogen compounds in the sinter mix
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	PCDD/F
Reduction of Emissions by 2030 (Gg)	40 – 60%
Description of the Measure	The formation of PCDD/F can be suppressed by the addition of substances which have an inhibiting effect on the formation of PCDD/F assuming that the formation of such substances takes place mainly in the sinter itself. In this case, an effective method for reducing PCDD/F is to add nitrogen compounds to the solid sinter mix in order to inhibit catalytic reactions on the surfaces involved. The addition of urea prills to the sinter feed upstream of the mixer and/or pelletizer has been applied on a full industrial scale in several plants. The urea prills are thereby homogeneously distributed throughout

	the raw sinter mixture prior to feeding it onto the strand. Urea addition has some distinct disadvantages: • The potential for a detrimental effect on the dust abatement performance of the ESP • The exhaust plume from the sinter plant tends to become highly visible, leading to complaints from the public • The use of urea leads to releases of ammonia • The dust and micro pollutant emissions actually increased, owing to a combination of several factors mentioned above. **Applicability** New/existing plants.
Estimated investments	There is a relatively low investment cost and low operating costs for applying this technique. The investment cost for a 4 million tons/year sinter plant is approximately €700,000 (brick shelter, humidity-controlled storage silo, dosing and control equipment). The operating costs are about 0.08 to 0.14 €/ton of sinter.
Financial aspects	

5.2.4.3.

Measure to be Implemented	Recycling of waste gas from part of the end sinter strand and use of waste from the sinter cooler
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030
GHG + other air emissions	PCDD/F, NO_x, SO_x
Reduction of Emissions by 2030 (Gg)	Decrease in energy consumption, up to 40% reduction in off-gas volume and a decrease in coke consumption can be achieved. Recirculation of sinter waste gas reduces the emissions of NO_x and PCDD/F due to their decomposition in the sinter bed. SO_x is also absorbed or filtered by the sinter layer and the CO is used as fuel. With this gas recirculation technique, not only is a significant reduction of waste gas volume achieved, but particulate and gaseous emissions reductions are also achieved and the abatement of diffuse dust emissions of the sinter cooler is also realized. Reduction: 25 – 30% for each pollutant.

Description of the Measure	Selective waste gas recirculation takes advantage of the fact that the release of particulate and other species from the sinter bed tend to be more concentrated in those wind boxes towards the discharge end of the sinter strand. To overcome the problem of oxygen deficiency in the recirculated gases, the hot exhaust gases from the sinter cooler are returned to the system via another fan, a gas mixing chamber and the recirculation hood. The additional electrical energy due to the additional fan is recouped through higher production and a decrease in the solid fuel requirement of 2 – 5 kg coke/ton sinter. Special attention should be paid to carbon monoxide (CO) in the recirculated waste gas in order to prevent carbon monoxide poisoning of employees. There have been no reported problems associated specifically with the process. Some operational advantages of this technique are an increased sinter production per Nm^3 off-gas and stable sinter quality and the capacity of existing sinter plants to be increased by approximately 40% (e.g. by lengthening the sinter machine) without any increase in the sinter off-gas volume. **Applicability** Waste gas recirculation with this technique can be implemented in new and existing sinter plants. In existing plants, it may not be possible to install a partial recycling of waste gas due to space restrictions.
Estimated investments	Investment costs for a suction area of 250 m^2 are about €15 million. A reduction in operating costs results from a decrease in fuel consumption of about 2 – 5 kg coke/ton sinter and a minimization of costs for waste gas cleaning due to a smaller gas volume, especially when using expensive gas cleaning systems such as fine wet scrubbers or bag filters with the addition of adsorbing agents. The application of this technique lowers the investment and operational costs for modern waste gas cleaning facilities.
Financial aspects	

5.2.4.4.

Measure to be Implemented	Recycling of waste gas from the end sinter strand combined with heat exchange
Type of the Measure	Technological
The Implementing Body	Iberia Steel, Rustavi Steel, Geosteel
Implementation years	2017-2030

GHG + other air emissions	SO_2, NO_x, HF, HCl, PCDD/F, CO
Reduction of Emissions by 2030 (Gg)	SO_2: 27 – 35% NO_x: 25 – 50% HF: 50% HCl: 50% PCDD/F: 75 – 85% CO: 50 – 55%
Description of the Measure	This technique collects all waste gases of the second half of the sinter strand. These gases are recirculated to the system across the entire length of the sinter strand. When the waste gas is recirculated, the dust content is filtered out in the sintering bed, PCDD/F are partially destroyed, and sulphur oxides as well as chlorine compounds are adsorbed. The oxidation of the carbon monoxide in the recirculated gas in the flame front provides heat to the system, displacing some of the heat derived from the solid fuel addition and allowing the solid fuel rate to be reduced. Due to the recirculation of the waste gas from the second section of the sinter strand, only the waste gas from the first half with the lower concentrations leaves the process through the stack. This significantly reduces the amount of waste gas and emissions. There is a slight increase in the use of electrical energy from the additional fan. Special attention must be paid to CO in the recirculated waste gas in order to prevent carbon monoxide poisoning of employees. **Applicability** Preferably in new plants. In existing plants, it may not be possible to install a partial recycling of waste gas due to space restrictions.
Estimated investments	With an investment of €14 million, solid fuel consumption is reduced by 5 – 7 kg solid fuel/ton sinter (12.5% of the fuel demand) with a corresponding savings in operational cost. This technique is operational in Hüttenwerke Krupp Mannesmann, Duisburg-Huckingen, Germany.
Financial aspects	

Climate Finance Comment: Given that the recommended non-GHG mitigation measures would likely have to be financed from commercial companies' corporate budgets, it is recommended to include them as conditions for the industrial companies participation in Climate Finance transactions. In other words, the Climate Finance investment will focus on improving companies' Energy Efficiency. The budget from the Energy Efficiency gains can then be used to implement some of the measures discussed in this section of the report.

2.F. ANNEX I: LOW EMISSION DEVELOPMENT PATHWAY AGRICULTURE

Mitigation measure	**Forage Quality Optimization, Feed Improvement**
Type	**Policy**/Legislative/ Regulatory/ Institutional/ Financial / **Technological**/**Capacity building**/ Awareness rising
Implementing entity	MoA
Implementation year/period	2017-2030
GHG covered	CH_4
Emissions reduction in 2030	Compared to BAU scenario, the quantity of emissions to be reduced by 303 CH_4 CO_2 equivalent in 2017-2030 period
Description of the measure	The objective of the measure is to maximize superior feed quality, leading to lower emissions from enteric fermentation in absolute terms. The first step of implementation of the measure is to support research in identifying locally available forage plants, which inhibit rumination while increasing productivity or maintaining at the current level. Research-based optimal feeding composition needs to be communicated to all dairy farmers. The second step of implementation is to undertake feasibility studies on using grape marc as a potential cheap dietary supplement that inhibits CH_4 emissions. If the feasibility studies are positive, an effort needs to be made to leverage the government's position as a subsidizer of the winemaking industry and establish supply chains that utilize maximal amount of grape marc for the benefit of the livestock producers. Given the successful establishment of working supply chains, grape marc should be made available country-wide for smallholders, tackling ruminant emissions at a larger scale.
Estimated investments	To be determined by feasibility studies
Assumptions and assessments	It is assumed that Georgia has sufficient diversity in terms of forage to adequately research and identify optimal feed mixes. It is also assumed that Georgian grape cultivars contain sufficient condensed tannins and other compounds to decrease enteric fermentation. It is assumed that in year 2021, 20% of dairy cattle will be in systems practicing a combination of mitigation measures discussed above, increasing up to 80% in 2030. For medium and small sized cattle kept in smaller farms, the adoption rate is 3% in 2021, growing to 12% in 2030. The emission reduction factor, based on the combination of research highlighted above and expert judgment is 15%.
Progress indicators	Developing a scientifically tested optimal feed structure suited to Georgian conditions; Conducting a comprehensive feasibility study and supply chain analysis on the usage of grape marc; implementing the findings of the feasibility study.
Estimated investments	This mitigation measure will be subsidized by the distribution of grape marc by the GE MoA to primarily cattle/diary operations and in general, to livestock producers. Pilot research and feasibility studies will be implemented to verify investment and operating costs.
Financing aspects	The measurement of the enteric fermentation measure's impact on GHG Emissions is one of the most complex of all mitigation measures. This due to a combination of inter-alia high variability in lab-results and low

geographical concentration.

The logistic challenge of establishing a supply chain for which the GHG ER results are variable is also significant. Nonetheless, the measure can have a strong development impact in improving feeding practices in commercial cattle and in providing smallholder farmers with access to new and improved feed.

The nature of the mitigation measure is thus a combination of Technical Assistance (Research & Feasiblity study with regards to expanding the feed supply chain), with physical implementation of the supply chain.

Given the required long term of such a project, its uncertain GHG ER outcomes and potentially high Development impact, it would be best implemented by securing finance from the following financial sources (All considered patient capital) below. In addition, it is important to state that all agricultural mitigation measures are a combination of mitigation and adaptation and as such should approach both mitigation and adaptation financial sources.

- **Intl Sources**
  - International Donors Development Agencies
  - Climate Funds (Adaptation Fund, GCF, various Adaptation programmes)
  - Impact Investment Funds
  - European Innovation & Agriculture research grants

  Domestic Sources
  - Georgian Government

It is very likely that most financing for the mitigation measure would be Grants (both for the Technical Assistance and the implementation), very concessional loans and Domestic Budget

Mitigation measure	**Supporting efficiency of animal waste management systems, setting stage for widespread adoption of biogas systems**
Type	Policy/Legislative/ Regulatory/ Institutional/ Financial / **Technological/Capacity building/ Awareness rising**
Implementing entity	Ministry of Energy, MoA, MENRP
Implementation year/period	2017-2030
GHG covered	CH_4, N_2O
Emissions reduction in 2030	Compared to BAU scenario, the quantity of emissions to be reduced by 4,047 CH_4 CO_2 equivalent in 2017-2030 period
Description of the measure	The primary objective of this measure is to identify ways to produce or import cheap impermeable covers for the lagoons in industrial livestock farms of Georgia. The second stage of the measure involves encouraging widespread adoption of biogas chambers to fully utilize methane produced in anaerobic lagoons. The secondary objective is to drive widespread adoption of biogas systems in rural Georgia, in order to effectuate a transition towards greener energy sources and provide natural gas to areas where it is scarce. This can be achieved by increasing awareness about the economic benefits of operating biogas systems, supporting local production of biogas systems and possibly subsidizing biogas systems in mountainous regions of Georgia.
Estimated investments	To be determined by feasibility studies
Assumptions and assessments	It is assumed that most industrial dairy farmers will operate the lagoon type of AWMS. It is also assumed that adequate covers for said lagoons are expensive, and most producers hesitate to upgrade their systems due to the cost. A conservative emission reduction factor of 80% has been used to project emissions. It was decided to keep the adoption factor level at 90%, since all commercial farms would benefit from lower leakage and should be willing to upgrade their systems if the price constraints were alleviated
Progress indicators	Achieving widespread adoption of covered lagoons and impermeable storage systems in commercial farming; Increasing the usage and utilization of biogas systems; making moderately priced and appropriate biogas systems available to smallholder farmers.
Estimated investments	The estimated investment in anaerobic digestion and bio gas systems beginning in 2022 will be 9.24 (EuroM). This initial investment will result in a reduction of operating cost/savings through 2040.
Financing aspects	Manure management through covered lagoons is a relatively established low carbon climate resilient technology- and is especially relevant for commercial farms with a relatively large number of cows. If the technology functions well in the different climatic regions in Georgia needs to be assessed. Installation of the technology is considered relatively inexpensive and simple, while its monitoring can be challenging. As such, the mitigation measure would require first a pilot programme in various regions, and once its impacts have been established, full scale implementation. During the feasibility/pilot stages, assessment of the

	electricity generation potential from covered lagoons is required. **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · Impact Investment Funds **Domestic Sources** · Georgian Government · Georgian Commercial Companies

2.G. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY WASTE

Mitigation measure	**Measure W1. Setup of paper, plastic, glass and metal separation system in municipalities**
Type	Legislative, capacity building, economic, technological, awareness raising
Implementing entity	Ministry of Environment and Natural Resources Protection (legislation), Ministry of Finance, Ministry of Economy and Sustainable Development, private sector (supporting the construction of treatment plants, source separation, and recycling) Municipalities (implementation of separation at source/control, awareness rising)
Implementation year/period	2017-2025
GHG covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	5.10 Gg CH_4 (107.19 Gg CO_2 eq)
Description of the measure	In compliance with the Waste Management Code [3], a gradual introduction and proper functioning of municipal waste separate collection system will be ensured, which implies a reduction of waste at landfills, as well as facilitation of their reuse and recovery, including recycling. In addition, if a separate waste collection system is introduced by a municipality, producers of municipal waste are obliged to use it. According to 2016-2030 National Waste Management Strategy and 2016-2020 National Action Plan, separation of waste shall take place at the source of generation, which will simplify its reuse or recycling. According to National Waste Management Action Plan, specific activities to be performed by 2020 include the following: • Introduction of practices of glass, paper, plastic and "other waste" separation at the source of generation; Introduction of separation in pilot municipalities (Tbilisi and other selected cities) - 2017-2020 • Elaboration of fiscal incentives measures for separation at the source (2018-2020) • Elaboration/introduction of alcoholic and soft drinks bottles and cans return system (2019-2021) • Creation of paper collection system and capacity building for processing facilities (2017-2020). According to 2016-2030 National Waste Management Strategy, following target indicators are to be achieved: • Paper - 30% (2020), 50% (2025), 80% (2030) • Glass - 20% (2020), 50% (2025), 80% (2030)

	• Metal - 70% (2020), 80% (2025), 90% (2030) • Plastic - 30% (2020), 50% (2025), 80% (2030)
Assumptions and assessments	For the purposes of assessing the measure, the assumption was admitted that separation target indicators defined by the 2016-2030 National Waste Management Strategy will be achieved. In order to calculate the emission decrement effects of the measures, the Intergovernmental Panel on Climate Change (IPCC) waste model [13] and baseline scenario (BAU2) [133] [11] assumptions (by which amounts of collected paper and inert material such as paper, glass, metal and plastic were reduced according to target indicators defined by strategy) have been used. Note that emission reduction will be achieved through the reduction of paper disposed at landfills.
Progress indicators	Reduction of waste in landfills, setup and proper functioning of collection system designed for different fractions of waste, putting the plants for processing different fractions, amounts of recycled paper, glass, metal and plastic in service.
Estimated investments	Estimated cost of activities to be performed by 2020 is presented in the 2016-2030 National Waste Management Strategy [2]: • Introduction of separation in pilot municipalities (including Tbilisi) – EUR 2.5 mln • Different incentives for separation - EUR 100,000 • Introduction of system designed for the return of bottles and cans by producer - EUR 250 000 • Introduction of paper collection system - EUR 200,000 Estimation of the full cost of the measure is difficult due to its dependence on many important factors such as population density, methods used for separation, distance from landfill etc. Assuming that the pilot municipalities determined for the first activity cover at least one third of the population (as they include Tbilisi), it can be said that implementation of separation throughout all municipalities will cost about EUR 7.5 million.
Financial aspects	The nature of this measure is a combination of Technical Assistance and Policy Capacity Building.(Elaboration of fiscal incentives measures for separation at the source, elaboration and design of soft drinks can and bottles' collection system), Market creation (creating a market for recycled goods) and implementation of pilot programs. As such the most relevant climate finance sources are the following: **Intl Sources** · International Donors Development Agencies · Multilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB)

[133] Which assumes that solid waste collection rates reach 100% by 2025.

	· IFIs and Bilateral Development Banks **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W2. Construction of solid municipal waste processing plant in Tbilisi**
Type	Technological (catalytic depolymerisation technology)
Implementing entity	Tbilisi municipality, KDV Georgia Ltd (on the basis of the memorandum signed between Tbilisi Municipality City Hall and KDV Georgia Ltd, 5.05.2016)
Implementation year/period	In case of a positive ecological examination report – Starting from 2017, over a 25-year period
GHG covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	14.57 Gg CH_4 (306.03 Gg CO_2 eq)
Description of the measure	The purpose of the measure is to enable processing of domestic solid waste generated all over Tbilisi. The measure includes following activities; 1. Daily delivery of domestic solid waste to the plant 2. Segregation of delivered waste (glass, ferrous and colored metal) 3. Catalyst depolymerization of waste organic fractions 4. Euro standard diesel EN 590, bitumen and oil production and export
Assumptions and assessments	In view of the fact that complete reprocessing of solid waste generated throughout Tbilisi is planned, from 2020 onward, only unusable, nontoxic, inert inorganic fractions (ceramics, stones, street dust and other inert ballast), which are not the source of methane emissions at landfills and account for around 10-12% of total waste volume generated in Tbilisi, will be allocated to the Norio landfill. Therefore, methane emissions will be lower compared with the scenario of placing all waste in landfill. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions were used to estimate the mitigation potential of the measure. Since the emission reductions from the separation of paper is already accounted in measure W1 and to avoid double accounting, emission decrement is calculated after the deduction of effects of measure W1. Note that emissions related to energy consumption at the plants are not considered, since they are not known at the moment.
Progress indicators:	Amount of processed waste, amount of produced diesel, oil and bitumen, improvement of air organoleptic parameters in the vicinity of the landfill.
Estimated investments	80 million USD
Financing aspects	The nature of this measure effectively a PPP – with private investment providing services usually provided by the municipal or state government.

	As such, the most relevant climate finance sources are the following: **Intl Sources** · Multilateral Development Banks · IFIs and Bilateral Development Banks · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Private Sector Sources of Climate Finance · Private Infrastructure Funds- Equity · Private Infrastructure Funds- Debt providers **Domestic Sources** • Georgian Government • Georgian Municipalities • Georgian private sector Georgian banks

Mitigation measure	**Measure W3. Setup of biogas flaring/utilization system on Tbilisi (Norio) landfill**
Type	Regulatory, technological
Implementing entity	Tbilisi municipality (owner), Tbvilservise Group (landfill operator)
Implementation year/period	Starting from 2018
GHG covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	Only at biogas utilization - 14.66 Gg CH_4 (307.92 Gg CO_2 eq); If the waste processing plant is commissioned in 2020, it will reduce the amount of waste delivered to the landfill (see Measure W2) – 3.00 Gg CH_4 (63.09Gg CO_2 eq)
Description of the measure	"Tbvilservise Group" Ltd plans considerable improvement of the parameters of the solid domestic waste landfill under its subordination, taking relevant measures for this purpose. In 2016, the company announced public procurement/tender for related construction/installation works. The winner, Dagi Ltd, will implement the project on the system of covering the landfill cells and intercellular space with geomembrane as well as produced biogas collection and processing. The project envisions optimization and further development of the existing gas removal system and gas collection through gas wells, its delivery to adjusting shafts, the removal of condensator as well as pumpout, allocation and proper utilization of active gas.
Assumptions and assessments	It is assumed that 80% of methane emissions from landfill will be captured. Based on the amount of collected methane, it could be possible to use it for energy purposes as well, although as at this stage no decision has been made regarding the specific area of its application and profitability of related infrastructure constriction. The assumption was made that methane combustion will take place in flare system. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions

	were used to estimate the emission decrement effect of the measure. The assumption was made that the waste will be allocated to a landfill after the implementation of separation and utilization measures (see measure W1). In case of the implementation of measure W2, unusable, nontoxic, inert, inorganic fractions (ceramics, stones, street dust and other inert ballast) will be allocated to the landfill after processing some fractions of waste in the plant. These fractions, accounting for 10-12% of total waste volume generated in Tbilsi, are not methane emission sources and therefore, only residual (allocated prior to 2018, generated by mixed waste) methane emissions will be left, which in turn will reduce the savings resulting from methane capture and combustion.
Progress indicators	Biogas collection and flaring system setup, improvement of air organoleptic parameters in the adjacent area, amount of collected and flared/utilized methane
Estimated investments	The total cost of the project is about GEL 8 million, out of which the implementation of the measures related to methane reduction costs GEL 4.5 million (includes the covering with geomembrane and cultivation works, collection of biogas from existing pipes and installation of flaring system)
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. Given that the installation of similar technologies is recommended (see mitigation measres 3-5) – a different approach can be a national level program to implement the technology. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W4. Biogas collection and flaring/utilization system setup in new Adjara landfills**
Type	Regulatory, technological
Implementing entity	Adjara Government ("Higiena 2009" Ltd under Adjarian Ministry of Finance)
Implementation year/period	Starting from 2018
GHG covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	3.38 Gg CH_4 (71.09 Gg CO_2 eq)

Description of the measure	The measure includes the following activities: • Construction of European standards-compliant, non-hazardous waste landfill (for solid domestic waste to serve the population of Adjara and Guria • Installation of landfill gas extraction system (in three to five years after opening) • Installation of landfill gas flaring system (at the initial stage) and in case of collection of a sufficient amount of methane, the landfill gas can be converted into electricity
Assumptions and assessments	The assumption is made that, starting from 2021, 80% of methane emissions from the landfill will be captured. Based on the amount of collected methane, it could be possible to use it for energy purposes as well, but as at this stage no decision has been made regarding the timing of its application, the assumption was made that until 2030 methane will be flared. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions were used to estimate mitigation potential of the measure. The assumption was also made that the waste will be allocated to the landfill after implementation of separation measures (see measure W1).
Progress indicators	Biogas collection and flaring system setup, amount of flared/utilized methane
Estimated investments	EUR 7 million (includes complete setup of the landfill)
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. Given that the installation of similar technologies is recommended (see mitigation measres 3-5) – a different approach can be a national level program to implement the technology. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W5. Biogas flaring/utilization system setup in Rustavi landfill**
Type	Regulatory, technological
Implementing entity	Waste Management Company
Implementation year/period	Starting from 2019

GHG covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	1.11 Gg CH_4 (23.35 Gg CO_2 eq)
Description of the measure	Gas extraction system is set up in the Rustavi landfill. Flare system installation and flaring is planned for 2019.
Assumptions and assessments	According to the assumption admitted for measure assessment purposes, 80% of methane emissions from the landfill will be captured. Based on the amount of collected methane, it could be possible to use it for energy purposes as well, although as at this stage no decision has been made regarding the specific area of its application and profitability of constriction of related infrastructure, the assumption was admitted that methane combustion will take place in flare system. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions were used to estimate mitigation potential of the measure. The assumption was also admitted that the waste will be allocated to the landfill after implementation of separation measures (see measure W1).
Progress indicators	Biogas collection and flaring system setup, amount of collected and flared/utilized methane, improvement of air organoleptic parameters in the adjacent area.
Estimated investments	The cost of installing the collection and flaring system is around 300 000 EUR per landfill cell (includes the covering with geomembrane and cultivation works, collection of biogas and installation of flaring system)
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. Given that the installation of similar technologies is recommended (see mitigation measres 3-5) – a different approach can be a national level program to implement the technology. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W6. Biogas collection and flaring/utilization system setup in Kutaisi, Telavi and Borjomi landfills**
Type	Regulatory, technological
Implementing entity	Waste Management Company

Implementation year/period	Starting from 2019
GHG Covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	1.65 Gg CH_4 (34.63 Gg CO_2 eq)
Description of the measure	Gas collection system with a flare system on ventilation pipe is set up in the Borjomi landfill. Presumably, flaring will start in 2019; For the purposes of reduction of greenhouse gases emissions from the Kutaisi and Telavi landfills, the gas extraction system will be arranged with a flare system on ventilation pipe (to burn the generated biogas).
Assumptions and assessments	It is assumed that 80% of methane emissions from the landfill will be captured. Starting from 2025 the above-mentioned landfills will stop functioning and no waste will be allocated there. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions were used to estimate the mitigation potential of the measure. The assumption was also made that the waste will be allocated to the landfill after the implementation of separation and utilization measures (see measure W1).
Progress indicators	Biogas collection and flaring system setup, amount of collected and flared/utilized methane, improvement of air organoleptic parameters in the adjacent area,
Estimated investments	The cost of installing the collection and flaring system is around 300,000 EUR per landfill cell (includes the covering with geomembrane and cultivation works, collection of biogas and installation of flaring system)
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. Given that the installation of similar technologies is recommended (see mitigation measres 3-5) – a different approach can be a national level program to implement the technology. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W7. Biogas flaring/utilization system setup in new regional landfills of Georgia**
Type	Regulatory, technological

Implementing entity	Solid Waste Management Company
Implementation year/period	Construction of regional landfills will start in 2018. According to the 2016-2030 National Waste Management Strategy and 2016-2020 National Action Plan [2], they should be fully constructed and commissioned by 2025.
GHG Covered	Methane
Emissions reduction in 2030 [Gg CO_2-eq]	7.01 Gg CH_4 (147.13Gg CO_2 eq)
Description of the measure	According to the 2016-2030 National Waste Management Strategy and 2016-2020 National Action Plan [2], setup of new modern regional landfills and waste transfer stations in compliance with European standards must be performed by 2025. The decision has already been made concerning construction of new regional landfills in Imereti and Kvemo Kartli. Feasibility studies designed for construction of regional landfills in Svaneti and Kakheti are underway. In addition, it is necessary to construct new regional landfills to serve Shida Kartli, Mtsketa-Tianeti and Samtskhe-Javakheti. Biogas collectors setup, methane collection and flaring are planned upon commissioning of landfills
Progress indicators:	Biogas collection and flaring system setup, amount of flared/utilized methane
Assumptions and assessments	It is assumed that 80% of methane emissions from 80% of new regional landfills will be captured in three to five years after their commissioning (the other 20% will undergo composting (measure W8). Based on the amount of collected methane, it could be possible to use it for energy purposes as well, although as at this stage no decision has been made regarding the specific area of its application and the profitability of constriction of related infrastructure, the assumption was made that methane combustion will take place in flare system. IPCC waste model [13] and baseline scenario (BAU2) [11] assumptions were used to estimate mitigation potential of the measure. The assumption was also made that the waste will be allocated to landfill after implementation of separation measures (see measure W1).
Estimated investments	The cost of installing the collection and flaring system is around 300 000 EUR per landfill cell (includes the covering with geomembrane and cultivation works, collection of biogas and installation of flaring system)
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. Given that the installation of similar technologies is recommended (see mitigation measres 3-5) – a different approach can be a national level program to implement the technology. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB)

	· Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** • Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W8. Reduction of biodegradable waste allocation - biodegradable waste composting**
Type	Legislative, technological
Implementing entity	Ministry of Environment and Natural Resources Protection, Ministry of Agriculture, Waste Management Company
Implementation year/period	Starting from 2025
GHG Covered	Methane, Nitrous oxide
Emissions reduction in 2030 [Gg CO_2-eq]	Decrement: 0.85 Gg CH_4, (17.86 Gg CO_2 eq) Increment: 0.013 Gg N_2O (4.04 Gg CO_2 eq) Total decrement: 13.82 Gg CO_2 eq
Description of the measure	According to the National Waste Management Strategy for 2016-2030, reduction of biodegradable waste allocation is to be performed by 2025, which includes carrying out the biodegradable waste composting facilitation campaign and the implementation of a pilot project in the area remote from waste management infrastructure [2]. Supposedly, the compost generated through above mentioned measure could be used in agrosector and planting of greenery. In order to facilitate the measure, the Waste Management Action Plan envisions the implementation of pilot projects: 1. Composting of municipal biodegradable waste 2. Composting of winemaking biodegradable waste 3. Composting of agricultural biodegradable waste 4. Implementation of pilot projects on composting the compostable waste generated in gardens and parks
Progress indicators:	Percentage of reduction of biodegradable waste landfill allocation, amount of compost
Assumptions and assessments	In order to assess the measure, the assumption was made that extraction (separation) of organic fraction (food and garden bulk) for the purpose of further composting will be performed in 20% of new regional landfills, similar to the target indicators for paper separation described in 2016-2030 National Waste Management Strategy: • Food waste and garden bulk - 50% (2025), 80% (2030)

	is used to estimate mitigation potential of the measure IPCC waste model [13], IPCC 2006 methodology [7] and baseline scenario (BAU2) [11] assumptions were used to estimate mitigation potential of the measure.
Estimated investments	Based on Eastern Europe experience, by 2030, on the basis of these assumptions, the estimated cost of implementation of measures in Georgia per year will approximately amount to 15-30 EUR /ton organic waste [14], amounting to EUR 650,000 – 1,300,000. Cost of pilot projects envisioned by Waste Management Action Plan: 1. Composting of municipal biodegradable waste - EUR 200,000 2. Composting of winemaking biodegradable waste - EUR 150,000 3. Composting of agricultural biodegradable waste - EUR 250,000 4. Implementation of pilot projects on composting the compostable waste generated in gardens and parks - EUR 250,000
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W9. Incineration and coinsineration**
Type	Legislative, technological
Implementing entity	Ministry of Environment and Natural Resources Protection
Implementation year/period	2019-2025
GHG Covered	Methane, Carbon Dioxide, Nitrous Oxide
Emissions reduction in 2030 [Gg CO_2-eq]	Emission reduction for this measure has not been calculated
Description of the measure	Waste incineration and co-incineration conditions are defined by the ordinance of Georgian government. That fraction of waste, the reuse and recycling of which is complicated, can be incinerated or co-incinerated, allowing for recovery of energy. Waste incineration or/and co-incineration imply minimization of allocated to landfill waste while recovering the energy. Combined heat and energy generation from waste is the most

	effective way of energy production. At incineration only heat production provides for 40% energy recovery whereas the above-mentioned combination results in recovery of 80-85% energy. Nevertheless, the investment cost of such combined energy recovery is quite high [2] and in Georgian reality this method is quite uncompetitive. In addition, application of incineration technologies is quite complicated. Waste combustion produces wide range (including toxic and carcinogenic) of gases, therefore the process requires installation of expensive treatment/filtering systems characterized by low operating potential and frequent breakdowns, negatively affecting human health [14]. Therefore, co-incineration measures, which could be used in large industrial facilities like Heidelberg Cement would be more expedient for Georgia. Co-incineration allows for the partial replacement of fuel used in industrial facilities (e.g. coal) with waste inert fraction (tires etc.).
Assumptions and assessments	Emission decrement calculation has not been performed for this measure. As for co-incineration, it should be considered that in case of inert fraction combustion (tires etc) GHG emissions from waste sector will increase, therefore potential of emission reduction caused by energy reduction should be assessed, which in its turn depends on specific plants, consumed fuel and calorific value of waste fraction (additional information on emission reduction possibilities from co-incineration of tires in cement industry is given in Annex of [14]).
Progress indicators	Reduction of waste deposited to landfills; Increase of number of incinerators/co-incinerators; Additional amount of energy/hit/reduction of fossil fuel consumption in plants
Estimated investments	Ordinance on incineration and co-incineration conditions EUR 40,000. Preliminary assessment and facilitation of pilot project implementation for the purpose of energy recovery by incineration plant EUR – 250,000 [2].
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

Mitigation measure	**Measure W10. Methane collection and application in Adlia water**

	treatment plant
Type	Technological
Implementing entity	Batumis Tskali Ltd (operator of wastewater plant)
Implementation year/period	By 2028
GHG Covered	Methane, CO_2 (energy emissions)
Emissions reduction in 2030 [Gg CO_2-eq]	1.12 Gg CH_4 (23.4 Gg CO_2 eq) from waste sector 0.176 Gg CO_2 – energy emissions Total GHG emissions – 23.6 Gg CO_2eq
Description of the measure	The Adlia water treatment plant is equipped by four anaerobic reservoirs where the primary silt precipitation and cold stabilization by bacteria takes place. For the purpose of GHG atmospheric emission decrement it is possible to cover anaerobic reservoirs with geomembrane during their exploitation, with subsequent capture of produced gases and energy generation. The captured methane will be more than enough to generate electricity covering the needs of the treatment plant itself. Remaining methane can be flared or utilized for other purposes (in transport, heat generation or other), which will require additional study. Covering of anaerobic reservoirs and further use of gas will complicate exploitation of the facility, additional manning and trainings on this specific issue will be required. Currently, the treatment plan is focused on phosphorus precipitation practical implementation and gentrification process introduction plans for the distant future, therefore anaerobic reservoirs covering and biogas capture should be considered as distant prospects.
Assumptions and assessments	To assess the effect of the measure it was assumed that 80% of methane generated at Adlia wastewater treatment plant will be captured. To calculate baseline emissions in Adlia, same methodology and assumptions were used as for BAU2 scenario. This gives the collection of 1.12 Gg of methane by 2030. It was assumed also that part of the collected methane will be used to generate electricity for the needs of the treatment plant itself. Currently Adlia treatment plant consumes around 1300 MWh of electricity from the grid and around 13 MWh from its own diesel generator. The collected methane will be enough to cover all electricity needs, which will give the plant economy of around 155 000 Gel annually (using current tariffs for electricity and diesel) and will consume around 50% of captured methane (assuming 30% efficiency of electricity generator and Net Calorific Value of 6kwh/cub.m of methane). For estimating the overall impact, it was assumed that remaining methane will be flared, although it can be used for other energy purposes as well. To calculate emission impacts associated with reduction of electricity

	consumption from the grid the average grid emission factor for 2030 from energy sectors BAU scenario was used, which equals to 0.1295 t CO_2/MWh. To calculate emission reduction from diesel consumption, the efficiency of diesel generator was assumed to be 30% and diesel's standard emission factors were applied. As a result, it was obtained that 164.3t CO_2 will be reduced from the grid and 11.4 tons of CO_2 will be reduced from diesel consumption.
Progress indicators	Amount of captured methane, amount of generated electricity
Estimated investments	Covering of reservoirs with geomembrane – EUR 500,000; Generator (Capacity - 220 kW considering peak requirements) – EUR 200,000; Installation of generator, cost of pipe laying, advisory costs - EUR 160,000 Total – 860,000 EUR.
Financing aspects	The installation of a first of its kind technology in Georgia could be considered a candidate for various international public sector "piloting" and technology transfer activities. The local or national government would also need to finance such activity. The most relevant climate finance sources are the following: **Intl Sources** · Climate Funds (UNFCCC- GCF, GEF etc; WB) · Multilateral Development Banks · IFIs and Bilateral Development Banks · International Donors Development Agencies · **Domestic Sources** · Georgian Government · Georgian Municipalities

2.H. ANNEX 1: LOW EMISSION DEVELOPMENT PATHWAY LULUCF

In accordance with the low emission development vision, the emission reduction capacity of Georgia's managed forests in 2030 should be maintained at the 2014 baseline level. To achieve this target, the declining trend in the LULUCF sector should be stopped, and the absorption capacity of the sector should be increased by 1,950.9 GgCO_2eq. by 2030. The key measures for maintaining the 2014 baseline situation are reflected in Georgia's INDC [1] submitted to the UNFCCC secretariat as the country's contribution to Paris Agreement. These measures center around the National Forest Agency's policy and programs planned to preserve and improve the quality of the country's forests through implementing new Forest Codes [5] and sustainable management practices. However, the measure planned against illegal felling could be implemented only in coordination with the Ministry of Energy and local municipalities through implementation of the state program on energy supply of the population[134]. Details of assumptions and calculations are available in EC-LEDS Technical Paper [34]. This part of the LEDS document provides detailed descriptions of the planned measures to be implemented in order to reach the LEDS 2030 target commitments.

Mitigation Measures for LULUCF Sector

Mitigation measure	**Forest restoration/ afforestation**
Type	Project implementation
Implementing entity	National Forestry Agency
Implementation year/period	2015-2016
GHG covered	CO_2eq
Emissions reduction in 2030 [Gg CO_2eq]	-0.16 (2030) -1.16 (2015-2030 in total)
Description of the measure	The goal of the measure is to create a forest rich in biodiversity and typical of local habitats on degraded areas. The measure was implemented in 2015-2016 in degraded areas of the forest fund. The total planted area is 32.9 ha (2015: Samtskhe-Javakheti (Borjomi) – 4.3. ha; Adjara – 7.0 ha; 2016: Mtskheta-Mtianeti (Didgori) – 2.4 ha; Guria – 19.2 ha)[135]. Afforestation took place using the following species: common ash, field maple, horse chestnut, sycamore maple, chestnut-leaved oak, Imeretian oak (Quercus imeretina), Caucasus pine, black pine, bot oleaster. One of the key criteria in selection of species to be planted was a good carbon accumulation quality and possession of a soil protection function.

[134] Draft of this program is already prepared.

[135] Official data provided by the National Forest Agency (NFA) through letter.

Assumptions and evaluations	
Progress indicators	Planted areas, ha; Status of planted trees[136].
Estimated investments	0.46 million USD ($13,900/ha)
Financing aspects	National Forestry Agency

Mitigation measure	**Forest restoration/afforestation**
Type	Project implementation
Implementing entity	National Forestry Agency, Adjara Forestry Agency, local municipalities
Implementation year/period	2017 and further
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-0.96 (2030) -6.89 (2017-2030 in total)
Description of the measure	The goal of the measure is to restore/plant a forest rich in biodiversity and typical of local habitats on the degraded areas. Measure implementation started in 2017 and is supposed to continue through the following years on the already selected and planned degraded areas of the forest fund. The total area planned for planting is 223.6 ha: Samtskhe-Javakheti (Borjomi) – 43.0 ha; Imereti (Kutaisi, Chiatura, Tkubuli)- 64.9 ha; Mtskheta-Mtianeti- 2.4 ha; Guria- 11.6 ha[137]; Adjara (Kobuleti, Keda, Khelvachauri)- 101.7 ha[138]. This measure was planned to fulfill the commitments undertaken within the Climate Change Convention and is included in the Intended Nationally Determined Contributions (INDC) document where restoration and rehabilitation of 1,500 ha is an unconditional obligation the country is to fulfill on its own. This obligation is already partially planned here. Afforestation will be implemented by seedlings of several local species of trees and plants (e.g., common ash, linden, hackberry, Caucasian fir, etc.). One of the key criteria in selection of species to be planted will be a good carbon accumulation quality, possession of a soil protection function and good adaptation to a local climate and biodiversity.
Assumptions and	

[136] Status should be assessed through verification of planted plots. Planted area considered as good if 65% of plants are survived and well grown; planted area is considered as not satisfactory if the rate of saplings survival is in between 30 -65% and some additional measures could save the plantation; and not survived if less than 30% of saplings survived only, such should be re-planted.

[137] Official data provided by the National Forest Agency through letter.

[138] Official data provided by the Forest Agency of Ajara through letter.

evaluations	
Progress indicators	Planted areas, ha; status of planted trees.
Estimated investments	1.72 million USD ($7700/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency
Mitigation measure	Forest restoration/plantation
Type	Project implementation
Implementing entity	National Forestry Agency, Adjara Forestry Agency, local municipalities
Implementation year/period	2018 and further
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-134.75 (2030) -891.44 (2018-2030 in total)
Description of the measure	The goal of the measure is restoration/plantation of a forest rich in biodiversity and typical of local habitats on the degraded areas. Implementation of the measure will start in 2018 and will continue through the following years in the degraded areas of the forest fund that have not yet been selected. Only the area subject to rehabilitation is known and comprises 36,242.7 ha. This measure, just like the previous one, was planned to fulfill the commitments undertaken within the Climate Change Convention and is included in the Intended Nationally Determined Contributions (INDC) document where restoration and rehabilitation of 1,500 ha is an unconditional obligation the country is to fulfill on its own (this has already been partially planned and is a part of the previous measure), while securing international funds/grants will be required for restoration and rehabilitation of 35,000 ha. Afforestation will be implemented by seedlings of several local species of trees and plants (e.g., common ash, linden, hackberry, Caucasian fir, etc.). One of the key criteria in selection of species to be planted will be a good carbon accumulation quality, possession of a soil protection function and a good adaptation to a local climate and biodiversity.
Assumptions and evaluations	Assumption done based on Georgia's INDS submitted for the Paris Agreement.
Progress indicators	Planted areas, ha; status of planted trees.
Estimated investments	1.72 million USD ($7,700/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency

Mitigation measure	**Cultivation of planted forest**
Type	Project implementation

Implementing entity	National Forestry Agency
Implementation year/period	Already implemented in 2015 and 2016 and planned in 2017
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-0.20 (2030) -1.53 (2015-2030 in total)
Description of the measure	The measure implies cultivation of a plantation on a free area of the forest fund comprising 51.0 ha, where 30.4 ha was already planted in 2015-2016 (2015: Kakheti – 6.6 ha; 2016: Kakheti – 23.8 ha), while plantation of 20.6 ha was planned in 2017 (Shida Kartli – 0.6 ha; Kakheti – 20.0 ha)[139]. The planned measure includes planting of acacia on the selected areas and sustainable obtaining of wood resource by means of the method of rotation of the cutting periods.
Assumptions and evaluations	
Progress indicators	Planted areas, ha; Status of planted trees.
Estimated investments	0.31 million USD ($ 6000/ha)
Financing aspects	National Forestry Agency

Mitigation measure	**Supporting natural regeneration of forest**
Type	Project implementation
Implementing entity	National Forestry Agency, Adjara Forestry Agency
Implementation year/period	2015-2016
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-1.19 (2030) -9.13 (2015-2030 in total)
Description of the measure	The measure implies supporting natural forest renovation on the area of 221.4 ha in 2015-2016 (2015: Samtskhe-Javakheti – 3.4 ha; Adjara – 118 ha; 2016: Adjara – 100 ha)[140]. The key measures that were implemented are: full enclosure of the selected area, rooting up the soil (on approximately one third of the whole area at the depth of 8-10 cm) and setting seeds of the desired breed on platforms and stripes within the enclosed

[139] Official data provided by the National Forest Agency through letter.

[140] Data officially provided by the NFA and Forest Agency of Ajara.

	area (on approximately one third or a larger section of the total area).
Assumptions and evaluations	
Progress indicators	Areas protected for natural regeneration, ha; result of measures implemented for facilitation of natural regeneration, which could be assessed after five years. Assessment of results should be carried out on pilot plots through verification of number and height of regenerated/grown plants[141].
Estimated investments	0.19 million USD ($ 872/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency

Mitigation measure	**Supporting natural regeneration of forest**
Type	Project implementation
Implementing entity	National Forestry Agency, Adjara Forestry Agency
Implementation year/period	2017-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-82.04 (2030) -529.29 (2017-2030 in total)
Description of the measure	The measure implies supporting natural regeneration of forest in the area of 136.9 ha already identified in 2017 (Adjara – 100 ha; Samtskhe-Javakheti (Borjomi) – 27.9 ha; Guria – 9.0 ha) and 18369.9 ha not yet identified. In total, the measure includes the area of 18506.8 ha[142]. Supporting natural regeneration of forest mainly includes the following measures: full enclosure of the selected area, rooting up the soil (on approximately one third of the whole area at the depth of 8-10cm) and setting seeds of the desired breed on platforms and stripes within the enclosed area (on approximately one third or a larger section of the total area).
Assumptions and evaluations	Areas protected for natural regeneration, ha; Result of measures implemented for facilitation of natural regeneration, which could be assessed after five years. Assessment of results should be carried out on pilot plots through verification of number and heigh of regenerated/grown plants.
Progress indicators	

141 Saplings grown from seeds and as vegetation sprouts should be accounted separately. Only viable saplings of two years or older should be accounted and grouped: low 0.5 – 1.0 m, medium 1.0 – 3.0 m and tall- above 3.0 m.

142 Data officially provided by the NFA and Forest Agency of Ajara.

Estimated investments	16.14 million USD ($872/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency

Mitigation measure	**Establishing temporary forest nurseries**
Type	Technology implementation
Implementing entity	National Forestry Agency, Adjara Forestry Agency
Implementation year/period	2015-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-0.19 (2030) -1.5 (2015-2030 in total)
Description of the measure	The measure implies establishing temporary nurseries in various forest sections on the area of 4.38 ha. From here, a nursery was established on the area of 0.5 ha in Samtskhe-Javakheti. In 2016, 2.58 ha of nurseries was already established (Kakheti – 0.4 ha, Satskhe-Javakheti – 0.08 ha; Kvemo Kartli – 1.2 ha; Shida Kartli – 0.9 ha). By 2017, establishing nurseries on the area of 1.3 ha is planned (Samegrelo-Zemo Svaneti – 1.1 ha; Kakheti – 0.2 ha)[143]. After removal of seedlings from the above areas and moving to main areas (which takes place in the fourth year), seeding takes place all over again. The purpose of the above activities is to establish temporary nurseries near the areas (mostly degraded) intended for afforestation, specifically cultivating seeds and seedlings (remarkable for good growth and development in local climate conditions) in the nursery using the seed material collected in local forestlands.
Assumptions and evaluations	For this particular measure, an assumption was made that by the end of 2017, almost every region will have such nurseries that will be re-planted once every five years. Establishing new nurseries is not envisioned by this measure. Opening of a new nursery is a bigger investment than its annual maintenance.
Progress indicators	Areas of established nursery, ha; number of saplings re-planted on the forest territories; number of survived/grown saplings[144].
Estimated	0.042 million USD (establishing a new nursery will cost $2300/ha). The cost of measure

143 Information provided by the NFA

144 Planted area considered good if 65% of plants survived and are well grown; planted area is considered not satisfactory if the rate of saplings survival is in between 30 -65% and some additional measures could save the plantation; and not survived if less than 30% of saplings survived, such should be re-planted.

investments	is estimated taking into view the cycles prior to 2030.
Financing aspects	National Forestry Agency, Adjara Forestry Agency, international donor organizations

Mitigation measure	**Increasing the areas of protected areas**
Type	Legislative/regulatory
Implementing entity	Government of Georgia
Implementation year/period	2017-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-390.00 (2030) -4,680.00 (2017-2030 in total)
Description of the measure	The measure implies increasing the areas of protected areas. Specifically, the area of protected areas will be increased from 0.52 million ha[145] (including the 0.33 million ha covered with forest) to 1.3 million ha (approximately 20% of the territory of Georgia). The increased area includes at least one million ha (including approximately 0.63 million ha covered with forest) of forested area. In other words, an additional area of 0.3 million ha will move from the category of forest management areas to that of protected areas (totaling to 0.63 million ha).
Assumptions and evaluations	As a result of this measure, an assumption was made to assess the additional quantity of CO_2 absorption. The assumption was that an increase of 0.87 m^3/ha of biomass will change the average norm of the current increment for protected areas of Georgia by – 2.2 m^3/ha per year. In other words, there will be biomass increment by more than 1.3 m^3/ha per year than it is now in managed forests.
Progress indicators	Increased territories of Protected Areas with forest cover, ha; annual increment of biomass m3/ha; crown cover of increased forest areas in %.
Estimated investments	19.5 million USD ($65.0/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency, Agency of Protected Areas, international donor organizations
Mitigation measure	Introduction of internationally accepted sustainable forest management
Type	Legislative and technological
Implementing entity	National Forestry Agency
Implementation year/period	2017-2030

[145] Intended Nationally Determined Contributions (INDC) document

GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-430.70 (2030) -4,504.10 (2017-2030 in total)
Description of the measure	The measure implies supporting sustainable forest management in the forest fund areas. Within these measures, introduction of sustainable forest management is planned on 295,000 ha (including forest sectors of 70,000 ha in Akhmeta and 45,000 ha in Borjomi-Bakuriani) prior to 2030. The above measures are announced in Intended Nationally Determined Contributions (INDC) document. Presently, National Forestry Agency is already introducing sustainable forest management in Borjomi-Bakuriani forest section (45,000 ha). Presently this is the only forest section where forest inventory has been conducted and there are some relatively reliable quantitative data on carbon emissions. The above areas are selected within forest areas and the measure will be implemented taking into consideration local/specific sustainable forest management criteria and indicators which will also contribute to gaining experience in order to support implementation of sustainable forest management criteria and indicators in the other forest lands. Sustainable forest management means forest management according to sustainable development principles. This approach means addressing a wide range of socio-economic and environmental issues. Hence, pilot forest areas for implementation of sustainable management practice should be selected based on the results of forest inventory conducted prior and main document for actions such as "Sustainable Management Action Plan (SMAP)" developed for each forest district. This SMAPs should, as minimum, comprises of sustainable forest management criteria identified for each particular district. SMAPs should take into consideration the interest/demand of direct consumers of forest products and should be in mutual satisfaction with ongoing programs, such as: programs and projects planned within the special planning process implementing by the municipalities, labeling the touristic routes implementing by the Ministry of Economy and Sustainable Development, Rural Development Strategy and other relevant to the time being programs. For instance, complex measures supporting sustainable management initiated in the forest land of Borjomi and Bakuriani include forest plantation and supporting natural renovation as well as reduction of illegal fellings, fire protection measures and thinning. As has been mentioned above, implementation of measures is first planned for the Borjomi-Bakuriani forestry section and 50,000 ha of forest will be further annually added from the forest fund areas (including the Akhmeta forest section). The aim of each activity planned within this measure is to improve various characteristics of wood (e.g. biomass supplies, annual increment) which will eventually cause the increase in carbon dioxide absorption on the renewed forest areas. Special mention should go to thinning which is aimed at retaining good potential for carbon collection on managed forest areas while using forest wood resources in the managed forest areas. First and foremost, the core of the above measure lies in conducting thinning for selected trees or groups of trees on various phases of development to support increasing the number of desired species and growing and development of highly productive trees. The types of thinning are: lighting cuts, cleaning cuts; thinning cuts and passage cuts that are mainly conducted in young forest stands.
Assumptions and evaluations	A strong condition for effective and successful implementation of this measure is to supply the local population with alternative, efficient, and low emission energy resources

	for heating, hot water and cooking. As of 2015, when annual fellings exceeded 2.5 million m^3, [2] the annual increment in the forest lands of Georgia does not exceed 0.87 m^3. A measure planned under such conditions will make it possible to dramatically increase forest regeneration capabilities, thus increasing carbon dioxide absorption potential. An assumption was made that annual biomass increment on forest areas as a result of the implemented measures will increase by at least 1.46 m^3/ha. The basis for this assumption is as follows: Considering current fellings, 1.3 m^3 of biomass that is cut annually per hectare will no longer be cut; as a result of fire protection activities, 0.007 m^3 of biomass will be saved (no longer burnt) per hectare annually and thinning will increase annual increment by approximately 0.15 m^3/ha.
Progress indicators	Area of forests managed in sustainable way, ha; annual increment, m^3/ha; annual fellings m^3/ha; wood stock calculated by the method of gain and losses m^3 in year X; verification of woody biomass stock should be verified through forests inventory.
Estimated investments	134.2 million USD ($455/ha)
Financing aspects	National Forestry Agency, Adjara Forestry Agency, international donor organizations

Mitigation measure	**Strengthening the legislative base and ensuring its enforcement in order to prevent illegal fellings in the forests**
Type	Legislative/regulatory
Implementing entity	Parliament of Georgia, Government of Georgia, National Forestry Agency
Implementation year/period	2018-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-848.89 (2030) -5,517.77 (2018-2030 in total)
Description of the measure	The measure implies tightening the legislative base related to illegal fellings and provision of its execution tool, which will reduce the fellings by at least 50%. Meanwhile, energy efficiency measures should be implemented in the energy consumption sector and the population should be provided with energy efficient fuel made of waste biomass. The measure will be conducted in the remaining areas not included in the measures: **Increasing the areas of protected areas and Introduction of internationally accepted sustainable forest management.** The two abovementioned measures in total cover 595,000 ha, which implies that there will be no fellings at all up to 2030.Therefore, reduction in illegal fellings is considered (1,863,300–595,000=1,268,300 ha) at the area of 1.268 million ha. The 1.34 m^3 per year established by the current statistical data will reduce by 1 ha and the annual fellings will diminish to 0.67 m^3/ha per year. In order to get tangible results the measure must be accompanied by ending the degradation of forests by climate change and other factors.
Assumptions and	As of 2015, when annual fellings exceed 2.5 million m^3, the average annual increment in forest

evaluations	lands of does not exceed 0.87 m^3 amid the current degradation. An assumption was made that as a result of the measures taken annual biomass cuttings will decrease by 50% which makes approximately 0.67 m^3/ha per year. Consequently, annual increment per one ha will increase by the same 0.67 m^3.
Progress indicators	Total annual fellings, m^3; annual fellings should be validated against energy balance and through the results of forests inventory.
Estimated investments	6.3 mln USD/annually ($5/ha/annum)
Financing aspects	National Forestry Agency, Adjara Forestry Agency, international donor organizations (preparation of energy efficient biomass fuel).

Mitigation measure	**Grassland rehabilitation**
Type	Technology implementation
Implementing entity	Ministry of Agriculture, local municipalities
Implementation year/period	2015-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-34.20 (2030) -177.10 (2017-2030 in total)
Description of the measure	The measure implies rehabilitation of 63,868.0 ha of degraded grasslands in Dedoplistskaro District. The main reason for degradation is overburdening of agricultural lands and using of one and the same grassland for a long period of time. This causes devastation of the grass cover and change in the structure of soil. Consequently, grasslands become the source of carbon dioxide emissions. Grassland improvement measures are planned to reduce emissions. These measures are based on the study "Surface Improvement of Grasslands" conducted by the Caucasus Environmental NGO Network (CENN), [3]. These measures are divided into two main groups: surface improvement[146] and fundamental improvement[147]. Fertilization of grasslands is not considered in this measure as a nitrogen emitting substance. This measure is important not only from the perspective of emissions reduction, but also from the perspective of the animal husbandry branch of agriculture as well as environment, since the degraded grasslands create conditions for erosion, formation of gullies and landslides.
Assumptions and evaluations	Since there are no measurements of current carbon dioxide absorption on degraded grasslands of Georgia, coefficients from IPCC guideline document degraded- F_{MG} = 0.7(dimensionless) and rehabilitated- F_{MG}= 1.0(dimensionless) were taken for grasslands.

[146] Surface improvements of grasslands (pastures, haylands) mainly consider improvement of vegetation, improvement of productivity and quality of pastures without touching/disturbing of grassland cord but use such soft measures as: seeding; regulation of irrigation and fertilization regimes; aeration; annihilation of weeds and poisonous grasses.

[147] Fundamental improvements consider full disassemble of low productivity and degraded grassland cord and creation of new grass cord through seeding the best perennial grasses.

	[4]
Progress indicators	Areas of rehabilitated pastures, ha; productivity of rehabilitated pastures t/ha.
Estimated investments	10,857.5 thousand USD ($170 /ha)
Financing aspects	Ministry of Agriculture, local municipalities, private companies, international donor organizations

Mitigation measure	**Increasing of areas of perennial plantations**
Type	Technology implementation
Implementing entity	Ministry of Agriculture, private sector (farmers)
Implementation year/period	2017-2030
GHG covered	
Emissions reduction in 2030 [Gg CO_2-eq]	-26.9 (2030) -139.9 (2017-2030 in total)
Description of the measure	The measure implies planting of perennial plantations on the area of 7,126 ha where seedlings were already planted on an area of 3,267.0 ha in 2015-2016 and more plantations are scheduled from 2017 on the area of 3,859 ha[148]. By the initiative of the Ministry of Agriculture, the Agriculture Projects Management Agency started implementation of the Plant the Future program in 2015. The program is aimed at planting perennial orchards within maximum support of the increase in proper use of agricultural lands in all municipalities of Georgia (except Tbilisi, Rustavi, Batumi, Kutaisi and Poti). The areas of perennial plantations on farmlands have been decreasing almost annual starting from the 1990s. Things have settled down for the last few years and the areas have started to grow within the frameworks of various programs.
Assumptions and evaluations	
Progress indicators	Increased areas of perennial croplands, ha.
Estimated investments	24.6 million USD ($3,450 /ha)
Financing aspects	Ministry of Agriculture, local municipalities, private companies

148 https://www.facebook.com/apma.ge/

Emissions saved as a result of implemented and planned measures by 2030

Planned measures	Reduced emissions in 2030, $GgCO_2$	Total reduced emissions in 2015-2030, $GgCO_2$
Afforestation	-135.87	-899.89
Supporting natural renewal of forest	-83.22	-538.42
Planting forest plantations	-0.20	-1.53
Establishment of temporary forest nurseries	-0.12	-1.50
Increasing protected areas	-390.00	-4,680.00
Development of sustainable forest management practice	-430.70	-4,504.00
Strengthening the legislative base and ensuring its enforcement in order to prevent illegal fellings in the forests	-848.89	-5,517.77
Grasslands rehabilitation	-34.20	-177.10
Increase of the areas of perennial plantations on farmlands	-26.90	-139.9
Total	-1,950.19	-16,459.79

LULUCF Climate Finance Comment

Out of the 12 recommended mitigation measures described in this chapter, 9 are under the full or partial responsibility of the National Forestry Agency (NFA). The total estimated budget of the NFA projects are approximately 230 million USD, approximately 80% of total LULUCF mitigation measures' budget (See tables below).

The 9 mitigation measures in which the NFA is expected to be an implementing entity are of different types. One of these – "*Introduction of internationally accepted sustainable forest management*" together with the Government of Georgia and the Georgian Parliament – is "Legislative and Technological" in nature and is expected to cost 135 million USD. An additional Legislative mitigation measure – "*Strengthening the legislative base and ensuring its enforcement in order to prevent illegal fellings in the forests*" has the same implementing entities and has an estimated cost of 6.3 million USD per year and for 12 years 75 million USD.

All the other 7 NFA related projects are "Project Implementation" in nature, and are expected to cost approximately 20 million USD. One of these projects is expected to cost 16 million USD. The other projects budgets are relatively small.

Implementing Entity	Estimated Budget(USD million)	No of Projects
National Forestry Agency (NFA)	230.742	9
Government of Georgia	19.5	1
Ministry of Agriculture	35.457	2
Total	285.699	12

Activity Type	No of Mitigation Measures	Estimated Budget
NFA- Legislative and technological	1	134.2
NFA- Legislative/regulatory	1	75.6
NFA- Project implementation	6	20.9
NFA- Technology implementation	1	0.042
Legislative/regulatory	1	19.5
Technology implementation	2	35.457
Total	**12**	**285.699**

Given the importance of the NFA in implementing the recommended mitigation measures, and the relatively low costs for most of the "Project Implementation" projects, it is recommended that the Government of Georgia seeks relevant international climate finance sources which would be interested in providing the budgets necessary of the Legislative measures. As part of obtaining financing for these, the Government should propose implementation components to the Technical Assistance budgets and use these to implement the "Project Implementation" mitigation measures proposed in this document. It is also suggested that as part of this proposed structure, the Government of Georgia also seek to integrate the Legislative/regulatory mitigation measure called "Increasing the areas of protected areas") for which the Government of Georgia is expected to be the implementing entity. The most relevant Climate Finance sources are the following:

Intl Sources

- International Donors Development Agencies
- Climate Funds (UNFCCC- GCF, GEF etc; WB)
- Multilateral Development Banks

- IFIs and Bilateral Development Banks

Domestic Sources

- Georgian Government
- Georgian Municipalities

Two mitigation measures are expected to have the Ministry of Agriculture as implementing agency. These are “Grassland rehabilitation” and “Increasing of areas of perennial plantations”. In both cases, additional stakeholders include local municipalities, and private companies operating in the agricultural sector (the first mitigation measure impacting livestock and the second farming activities). Both projects are expected to have additional Development and Adaptation-related impacts as well as economic outputs. The monitoring of GHG Emission Reductions are expected to be difficult for both measures. As a result, the measure will most likely be implementable only as national level programmes. These measures are likely to require Technical Assistance to reach implementation stage. Actual implementation would need government involvement on various levels, and financing from international public entities, and potentially Impact Investment Funds.

As a result of their profile the most relevant financial sources for the measures are the following:

Intl Sources

- Climate Funds (UNFCCC- GCF, GEF etc; WB)
- International Donors Development Agencies
- Private Sector Sources of Climate Finance
- Philanthropic Foundation and Trusts
- Impact Investment Funds

Domestic Sources

- Georgian Government
- Georgian companies
- Georgian Households

REFERENCES

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2. Energy balance of Georgia, National Statistics Office of Georgia, p. 44, 2014 http://www.geostat.ge/cms/site_images/_files/georgian/Energy/ENERGY%20BALANCE_GEO.pdf;
3. Surface improvement of grasslands (pastures), CENN, http://w3.cenn.org/wssl/uploads/Pastures%20management-K.pdf;
4. Good Practice Guidance for Land Use, Land-Use Change and Forestry, Chapter 3,GRASSLAND, Table 3.4.5. Page 3.118, IPCC 2003, http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf;
5. FOREST CODE OF GEORGIA, https://matsne.gov.ge/en/document/view/16228

3.E. ANNEX 1: CAPACITY BUILDING GAP ANALYSIS SURVEY QUESTIONNAIRE

LEDS Capacity Building Gap Analysis

Questionnaire

Each participant is kindly requested to complete the Questionnaire by May 31, 2017. Comments and questions can be forwarded to EC-LEDS Public Outreach and Awareness Manager Irina Sulava | isulava@winrock.org

Full Name:____

Position:____
_

Ministry/Agency:____
_

<u>Part 1. Low Emission Development Strategy</u>

1.1. Please prioritize LEDS purposes on the domestic level
(use the numbers from 1 (most important) to 3 (least important)):

___ The LEDS is a country-driven policy instrument for national decision making towards EU Associations Agreement

___ The LEDS merges climate change action with national development and supports sector transformation through a national, economy-wide approach

__The LEDS helps to identify and prioritize nationally appropriate mitigation actions (NAMAs) by providing a comprehensive analysis of mitigation potentials, costs and co-benefits

1.2. Please prioritize LEDS purposes on the international level (use the numbers from 1 (most important) to 3 (least important)):

___ LEDS support the global goal of GHG emission reduction

__ LEDS may help to attract international support (finance, capacity building, and technology transfer) and Contribute towards recognition of NAMAs that are being planned and implemented by developing countries

__ LEDS contribute towards recognition of NAMAs that are being planned and implemented by developing countries

1.3. Please prioritize key elements of a LEDS (use the numbers from 1 (most important) to 6 (least important)):

__ A long-term strategic vision based on and integrating national development priorities and global agreements
__ GHG emissions analysis and projections under a business as usual (BAU) scenario
__ Identification of mitigation policies and measures
__ Prioritization of key mitigation policies and measures and definition of targets
__ Contribution of LEDS for sustainable development
__ Mobilizing finances for LEDS

1.4. Indicate the most important LEDS success factors: (use the numbers from 1 (most important) to 7 (least important)):

__ Top-level commitment and leadership
__ Integration into development planning, crosscutting approach
__ Strong data basis & scientific analysis (GHG inventory, BAU, scenarios, etc.)
__ Stakeholder participation and engagement
__ Acceptance of technical assistance and use of peer-to-peer learning
__ LEDS viewed as a living and dynamic document
__ Interministerial coordination structure including key ministries (finance, economy, energy, etc.)

1.5. Are you aware of the three LEDS essentials?

• A LEDS is a policy instrument that identifies the sources of a country's GHG emissions and prioritizes options for their mitigation
__ Yes __ No

• A LEDS focuses on achieving development through mitigation actions__ Yes __ No

• A LEDS helps to improve framework conditions for private sector investment in mitigation actions__ Yes __ No

1.6. Do you agree with the LEDS definition?

A Low-Emission Development Strategy (LEDS) is generally used to describe forward-looking national economic development plans or strategies that encompasses low-emission and/or climate-resilient economic growth.

__ Yes
__ No

1.7. Which sector is the most important for Georgia on terms of GHG emissions?

(use the numbers from 1 (most important) to 7 (least important)):

__ Agriculture
__ Buildings
__ Energy supply
__ Forest (and LULUCF)
__ Industry
__ Transport
__ Waste

Part 2. Public Awareness

2.1. Indicate the most important target audience for the Government in raising awareness on climate change issues (use the numbers from 1 (most important) to 8 (least important)):

__ Policymakers (ministries, committees, work groups, etc.)
__ NGOs
__ Youth
__ Academia
__ Business
__ Press and media
__ General public
__ Other (please specify):____

2.2. Which institutions play the most important role in raising public awareness on climate change (use the numbers from 1 (most important) to 5 (least important)):

__ Government (specify ministries/departments):____

__ NGOs (specify):____

__ Institutes/universities____

__ Media____

__ Other (please specify):____

2.3. Indicate the most efficient/important means of communicating the climate change issues (use the numbers from 1 (most important) to 9 (least important)):

__ Social Media (Facebook, Twitter, etc)
__ Internet media (E-zine, E-newsletters, news sites)
__ Television
__ Radio
__ Print media (newspapers, journals)
__ Printed materials (leaflets, flyers, brochures, etc)
__ Workshops, trainings
__ Promotional campaigns/events
__ Other (please specify):____

2.4. Are you aware of any national or regional network/organization/institution conducting climate change public awareness campaign/promotion?

__Yes (please specify):____
__No

2.5. Are you aware of any national/local survey on the level of public awareness about climate change?

__Yes (please specify):____
__No

2.6. What are barriers to climate change awareness raising (use the numbers from 1 (most important) to 5 (least important)):

__Lack of funding

__Lack of human resources

__Lack of political support

__Lack of information

__Other (please specify):____

Part 3. Financial Issues

3.1. Does your Ministry have direct expenses related to the following? These include budget items, subsidies, grants, tax exemptions etc.

3.1.1. Extreme weather – Summer:

Floods	_____Yes	_____No	_____Doesn't Know
Heat Waves	_____Yes	_____No	_____Doesn't Know
Forest Fire	_____Yes	_____No	_____Doesn't Know
Rockfall	_____Yes	_____No	_____Doesn't Know
Insect Infestation	_____Yes	_____No	_____Doesn't Know
River Flood	_____Yes	_____No	_____Doesn't Know
Severe Wind	_____Yes	_____No	_____Doesn't Know

3.1.2. Extreme Weather – Winter:

Floods	_____Yes	_____No	_____Doesn't Know
Extreme Winter Conditions	_____Yes	_____No	_____Doesn't Know
Avalanche	_____Yes	_____No	_____Doesn't Know
Land Slide	_____Yes	_____No	_____Doesn't Know
River Flood	_____Yes	_____No	_____Doesn't Know
Severe Wind	_____Yes	_____No	_____Doesn't Know

3.2. Is your Ministry involved in any of the following activities? If so can you estimate the expenses related to these?

3.2.1. Buildings:

Activity	YES/NO/ Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Building Codes and Standards					
Building Performance Rating and Reporting					
Energy Efficiency/Retrofit Measures					
On-Site Renewable Energy Generation					
Switching to Efficient Fuels					
Compensation to Building Owners in Case of Natural Catastrophe					
Restrict Development in Risk Areas					
Resilience and Resistance Measures for Buildings					

Storm Water Capture					
Retrofit of Water Capture Systems					

3.2.2. Industry

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Reducing Carbon Emissions from Industry					
Reducing other Emissions from Industry					
Enhancing Energy and Resource Efficiency in Industry					
Monitoring Industry Pollution					

3.2.3. Energy Supply

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Supporting Low or Zero Carbon Energy Supply					
Optimizng Traditional Power/Energy Production					

Supporting Smart Grid					
Reducing Transmission and Distribution Losses					
Diversifying Power/Energy Supply including development and investment in Renewable Energy Projects					
GEDF operations					
Rehabilitation of existing electricity generation assets					

3.2.4. Finance and Economic Development

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Funds or other Financing Instruments (Loans, Guarantees) for Green Infrastructure Projects					

3.2.5. Food and Agriculture

Activity	YES/NO/Doesn't	Estimate Expenses	Estimate of one-off investment costs	Estimate of annual operational costs	Additional Comments

	Know	(million GEL)	(million GEL)	(million GEL)	
Encouraging Sustainable Food Production And Consumption					
Funds or other Financing Instruments for Rural Development					
Compensation for Farmers in Case of Natural Catastrophe					
Soil Retention Strategies					

3.2.6. Transportation

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Improving Bus Infrastructure, Services and Operations					
Improving Rail, Metro and Tram Infrastructure, Services and Operation					
Improving Fuel Economy of Private and					

Commercial Vehicles					
Introducing Smart Public Transport					
Improving Road and Transport Infrastructure					
Awareness rising and Education for Public Transport					

3.2.7. Outdoor Lighting

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Introducing LED/CFL/other Luminaire Technologies					
Supporting Smart Lighting					

3.2.8. Waste

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Introducing Waste Prevention Policies and Programs					
Landfill Management					

Improve the Efficiency of Waste Collection					
Recycling and Composting Initiatives					
Industrial Waste Management					
Agricultural Waste Management					

3.2.9. Water

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Wastewater Treatment					
Water Metering and Billing					
Improving Water Efficiency					
Supporting Wastewater to Energy Initiatives					

3.2.10. Health

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Treatment of Patients due to Natural					

Catastrophe					
Compensation of People Injured in Natural Catastrophe					

3.2.11. Natural Catastrophe (Adaptation Measures)

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Flood Mapping					
Landslide Risk Mapping					
Real Time Risk Monitoring					
Crisis Management including Warning and Evacuation Systems					
Public Preparedness (Including Practice Exercises/Drills					
Community Engagement/Education					
Projects and Policies Targeted at High Risk Areas					

3.2.12. Infrastructure

Activity	YES/NO/Doesn't Know	Estimate Expenses (million GEL)	Estimate of one-off investment costs (million GEL)	Estimate of annual operational costs (million GEL)	Additional Comments
Hazard Resistant Infrastructure Design and Construction					
Flood Defenses – Development and Operation & Storage					
Incorporating Climate Change into Long-Term Planning Documents					
Soil Retention Strategies					
Storm Water Capture Systems					
Cooling Systems for Critical Infrastructure					