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საქართველოსთვის
The European Union for Georgia

Ministry of Environmental Protection and Agriculture of Georgia

UNDP

REPORT ON DATA COLLECTION, DRIVERS AND METHODOLOGICAL ASSUMPTIONS FOR DEVELOPMENT OF BASELINE AND MITIGATION SCENARIOS

UNDER THE STAGE 1 OF THE TASK 2 'REPORT ON BASELINE SCENARIOS AND LOW-EMISSION DEVELOPMENT PATHWAYS' OF THE GEORGIA'S LT LEDS PROJECT IMPLEMENTATION

TBILISI
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Content

List of Tables

List of Figures

Introduction

This report is elaborated by Rec Caucasus in the frame of ‘Long-Term Low Emission Development Strategy of Georgia (LT-LEDS)”. LT-LEDS of Georgia is being developed in the scope of the EU4Climate project. The EU4Climate project is a regional initiative, funded by the European Union and implemented by the United Nations Development Program (UNDP) in six Eastern Partnership countries. National implementing partner of the EU4Climate project in Georgia is the Ministry of Environmental Protection and Agriculture of Georgia (MoEPA). Development of LT-LEDS of Georgia will be executed by the Regional Environmental Centre for the Caucasus (REC Caucasus).

The Report reflects the process of sectoral data collection for Energy, Buildings (Residential), Transport, Agriculture, LULUCF and Waste. The data for each sector have been determined according to the required input data and parameters of the modelling tools envisaged for projection of baseline and mitigation scenarios, to be undertaken at the Stage 2 of the Task 2 implementation of the LT LEDS.

The activity has been undertaken by sectoral experts, for each selected sector, in parallel, in the following order / sequence:

1. Identification of sectoral data necessary for calculation / projection of baseline and mitigation scenarios.
2. Identification of relevant sectoral stakeholders and other sources of data;
3. Collection of the data.
4. Presentation of the data in a suitable (common) format and reporting on the data collection process.

At the initial stage of this activity, the Team Leader has disseminated, among the team of the Project experts, the most important national CC policy papers (EC LEDS 2030, National Communications, latest GHG Inventory and Biennial Update Report, NEAP3, CSAP (draft) and updated NDC (draft), containing climate-change-related information and sectoral data.

Identification of sectoral data : The sectoral data packages have been identified by sectoral experts, responsible for projections in their respective sector, based on necessity of the sectoral models for projection of their respective baseline and mitigation scenarios.

- The sets of data for Energy, buildings (residential) and transport sectors have been identified by Modelling Expert as these sectors are subject to modelling together with TIMES tool for entire energy.
- For LULUCF the data set followed requirements of Exact FAO model,
- In Waste – IPCC Waste Model (for solid waste disposal on land),
- The remaining sectors: Agriculture and Industrial Processes, - local sectoral experts identified the data sets based on their own considerations regarding projections.

Based on the identified data sets, relevant sectoral stakeholders and other sources of data have been identified by local sectoral experts. This involved relevant sectoral papers, data sets, statistical information and, in some case, outcomes of relevant projects and unpublished yet data. Lists of the most relevant stakeholders from local experts, governmental agencies, academia and/or CSOs with appropriate expertise in the sector have been identified too.

Collection of data for each sector has been conducted from electronic and other sources of information, including national reports (GHGIs, BURs, draft CSAP) and GeoStaT, for years since

2016, as a preliminary step (stage 1) for the implementation of the Task 2; missing data and information will be completed, to the extent possible, with data and information obtained from interviews with relevant experts and representatives of the corresponding fields and agencies. These data are to be reflected in another Report on analysis of interviews and their results. Nevertheless, later on, the necessity of additional data may emerge, in the course of Task 2 implementation.

The collected sectoral data have been presented in suitable for each sector format and reported. The Reports of the sectoral experts with corresponding sectoral data are presented in corresponding chapters below.

1. Collection of Data for energy sector (by Nick Javshanashvili, Energy Sector Expert)

1.1. Background

The EU4Climate project helps governments in the six EU Eastern Partner countries (Armenia, Azerbaijan, Belarus, Georgia, the Republic of Moldova and Ukraine) to take action against climate change. It supports countries in implementing the Paris Climate Agreement and improving climate policies and legislation. The objective of the project is to support the development and implementation of climate-related policies by the Eastern Partnership countries that contribute to their low emission and climate resilient development and their commitments to the Paris Agreement on Climate Change. EU4Climate is funded by the European Union (EU) and implemented by the United Nations Development Programme (UNDP). The overall goal of the project is to assist the Ministry of Environmental Protection and Agriculture of Georgia (MoEPA) in developing a mid-century (long-term) low emission development strategy (LT-LEDS). Regional Environmental Centre for Caucasus (RECC) is the national implementer of the project.

1.2. Duties and Responsibilities of the Energy Sector Expert

Energy Sector Expert has responsibility for analysis of policy documents, providing input data requested by Deputy Team Leader, and contributing to the preparation of the energy-related paragraphs of the LT LEDS. Collection of the national data is required for the development of baseline scenario(s) and intended future emission reduction/decarbonization trajectories/pathways to achieve Georgian LT-LEDS vision per each sector for the period 2020 to 2050 according to national guidelines for policy and strategy documents development and other national and sectoral mid-term 2030 targets. One of the deliverables of the Energy Sector Expert is a Report on data collection, drivers and methodological assumptions for the development of baseline and mitigation scenarios.

1.3. Data collection

The data on energy was collected considering the requirements defined by the modeling expert and necessary for the modeling software for the development of the baseline scenario and the forecast. Introduction of the existing strategic documents of the energy sector, generation facilities related issued, future plans and the data gathering was carried out from statistical papers (energy balances), other electronic sources, national documents and also, in close consultations with the representatives of the relevant Ministries, sectoral experts and stakeholders in November 2020 and distributed to the modeling expert.

1.3. Analysis of the Collected Data

The data required for the modeling expert was provided by the Ministry of Economy and Sustainable Development of Georgia (MOESD) in cooperation with the relevant organizations such as Georgian Oil and Gas Corporation (GOGC) and Electricity System Commercial Operator (ESCO). It must be noted that the energy data was collected for 2016-2019 years but all these years won't be used while forecasting due to the structural specification of the modeling software TIMES which requires data for 2016 as a base year to establish a baseline scenario and forecast. The rest of the years 2017, 2018 and 2019 will be used to compare actual data to the forecast for these years and calibrate it properly.

The national data on energy required for the modeling software is presented in the table below:

Sector/Category	Unit	Year			
Electric Energy	TWh	**2016**	**2017**	**2018**	**2019**
Electricity Generation					
Hydro Power Plants	TWh	9.329	9.2104	9.9493	8.9317
Wind Farm	TWh	0.0090	0.0878	0.0843	0.0847
Thermal Power Plant	TWh	2.2355	2.2330	2.1149	2.8404
Total:	TWh	11.5737	11.5312	12.1485	11.8568
Electricity Consumption					
Delivery to customers	TWh	11.027	11.875	12.595	12.774
Electricity Losses					
Losses	TWh	0.2579	0.2519	0.2581	0.2361
Electricity Import					
Import	TWh	0.4789	1.4972	1.5088	1.6265
Electricity export					
export	TWh	0.5590	0.6857	0.5886	0.2434
Natural Gas Production, Transportation & Distribution					
Production	million m^3	6.6	8.5	10.2	N/A
Gas enter into transportation system	million m^3	4127	4439	4226	N/A
Losses	million m^3	24	35	30	N/A
Transit in Armenia	million m^3	1867	1996	1940	N/A
Transported in Georgia Import	million m^3	2236 2255	2408 2335.4	2256 2398.1	N/A
Direct consumers	million m^3	991	1106	997	N/A
Distribution	million m^3	1245	1302	1259	N/A
Distribution losses	million m^3	112	60	80	N/A
To residential	million m^3	789	884	849	N/A
To commercial	million m^3	344	358	330	N/A

The data on energy presented above has been distributed to the modeling expert for the development of the baseline scenario and the forecast.

Note that the data in red is provided by the National Statistics Office of Georgia (GEOSTAT) and the data in blue is taken from the Georgian National Energy and Water Supply Regulatory Commission (GNERC) but the difference is less than 3%.

2. Data for Collection for Building (Residential) sector (by Levan Natadze, Building Sector Expert)

Report on building sector-related data collection, drivers and methodological assumptions for development of baseline and mitigation scenarios.

Deliverable 1, Building sector

The Report provides and describes the data on building sector of Georgia, requested for the TIMES model for projection of baseline and mitigation scenarios:

Demand drivers

Population series and population growth for the years 2016-2050.

Number of persons per household by year for years 2016-2050.

Building destruction rate per year for the years 2016-2050

old and new dwellings quantity for the years 2016-2050

Technologies

List of technologies in use in the residential, commercial and institutional sectors (buildings sector). For each technology, information on: Type, Fuel, Capacity, Investment costs, Variable costs, Fixed costs, Efficiency, Starting year and Lifetime.

Policies and Measures

Policies, programmes, strategies and plans in the country related to the future evolution of the sector.

2.1. Energy demand/use per building typologies

Types of buildings in Georgia

Georgia is a country with 3500 year of statehood, having its own ancient and medieval traditions of construction. This section focuses on three main historical periods of construction practice: historical (ancient, medieval and pre/industrial period), Soviet (1921-1990), and post-Soviet (1991-ongoing). The sections below describe specific characters of each period:

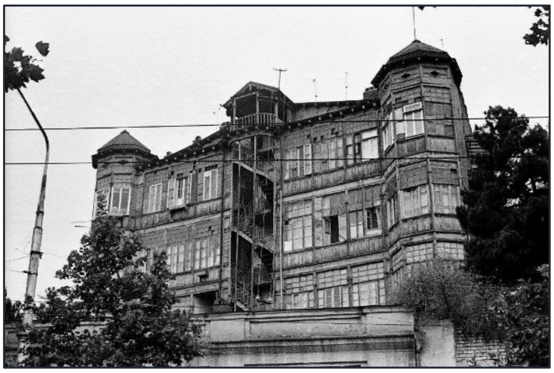
Historical

The buildings developed before 1921 have the following features - Excess thermal *mass* of the bearing and non-bearing structures: thick walls of stones or bricks which accumulate heat or coolth during one daily peak and release it during the other; *half-cave space concept*: construction

of the dwelling of other building which has vegetated roof; the spaces are surrounded by soil or rock from 5 sides, and the 6th side is used for access and daylight; *cellars*: deep cellars under residential or public buildings were used to have constant temperature; this was applied for storage of food, producing and storage of wine.

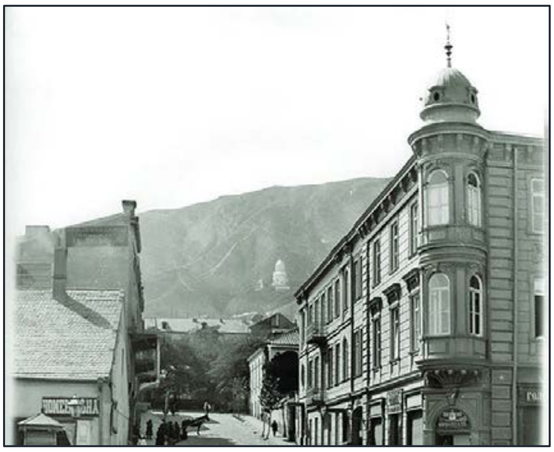
Development of the hill slopes: for defense and security reasons, most of Georgian medieval developments were located in mountains; In compact settlements houses were built on the slopes facing to south, and sharing building envelopes of each other to minimize heat loss – part of the ceiling of the house was the floor or balcony for the next upper house; *inner yards:* this included concept of inner yard, surrounded by building, sometimes with water basin; the heated yard surface or evaporant surface provided some stuck effect, making hot air go up from the center of the building, supporting natural ventilation in no-wind condition.

Early Soviet period: 1921-1937



In this period no unified approach was formed yet. Most of buildings were designed individually without any unified style. Main environmental features are: building basements, bricks used for load- bearing walls and the envelope (mainly 38 cm), timber beams and flooring, timber bearing structures for low-rise developments, timber/glass conservatories, attic, sloped roofs, single timber glazing, enclosed or open type staircases, mainly low-rise concept applied.

Stalin period: 1937-1956



In this period there was already formed the unified approach, most of buildings were designed in the same way, underlining the strength of the empire by means of a single style in all locations.

The main environmental features are: design and construction according to regulations, building basements, bricks used for load bearing walls and the envelope (minimum 38 cm, in some cases 50 cm), reinforced concrete floor/ceiling slabs, reinforced concrete framed conservatories, attic, sloped roofs, single timber glazing or double timber glazing in colder areas, enclosed staircases average and high rise development concept applied

So called Khrushchov period of typical buildings development (1956-1969).

The main feature of this period is low-cost and minimalism, caused by industrialization of the country and demand for more and cheap buildings. In this period the approach was standard design for thousands of houses, use of the structures pre-fabricated in factories.

Main environmental features are: design and construction according to regulations (putting target of minimum building envelope thickness, equivalent to 38 cm brick layer), building basements, diversification of the building envelope and load bearing structures: bricks, light concrete panels, reinforced concrete floor/ceiling slabs, reinforced concrete frame with non-bearing panels, reinforced concrete framed or light concrete blocks conservatories, single timber glazing or double timber glazing in colder areas, mainly open, in some cases - enclosed staircases, mostly high rise concept, attics with horizontal roofing.

Developed socialism period: 1969-1990:

The main feature of this period is the same as Krushchov period, with difference that ceiling height increased from 2.40-2.50 m to 2.7-2.80 m. Wall insulation materials decreased bit in insulation properties and building height increased from 5-8 to 9-16 floors.

Post-Soviet (Current)

The post-soviet era resulted in cancelling of enforcement of environmental regulations. The standardized construction was/is diversified and many new architectural concepts are brought up. The vast majority of buildings are designed as reinforced concrete frame and slabs with small block

filling.

Marked driven approach resulted in the following prevailing environmental features: 20 or 30 cm thickness building envelope, mainly cavity blocks made of thermal conductive concrete, - double glazed PVC doors/windows, - no attic, - no conservatory, - horizontal roofing, - basement used as garage, without thermal insulation of permanently occupied space from bottom, - open type staircase, - high rise development, - overshadowing of the buildings, - blocked clear sky access for daylight.

All these types of buildings are still in use in Georgia.

Homes/residential buildings (All Periods)

Home buildings are the major type of building in rural areas and old parts of towns and cities of Georgia. Vast majority of them is constructed in Soviet era, after WW2. There can be separated several dominant types of homes with following structures and features:

Type of Houses	Features
Timber 	Timber bearing structures and building envelope, without basement, with single glazed windows, with attic.
Brick 	Brick, small block or concrete bearing structures and building envelope, with or without basement, with single or double glazed windows, with attic.
Stone 	Stone bearing structures and building envelope, mainly without basement, with single glazed windows, with attic.
Other or Complex type	Combination of all above

The table shows typical energy performance of the above types of the buildings and their approximate share in Georgian building stock (dwellings).

Type	Performance	Stock volume	Energy demand	Percentage in the building stock
Multi story buildings	kWh/ m²/year	m²	kWh/year	%
Old (including up to 1921)	90-150 (average consumption 110)	3 811 128	666 947 370	11.7
Early Soviet period: 1921-1937	150-250 (average consumption 200)			
Stalin period: 1937-1956	150-200 (average consumption 175)			
So called Khrushchov period (1956-1969)	230-260 (average consumption 250)	24 984 060	6 495 855 652	76.7
Developed socialism period: 1969-1990	250-300 (average consumption 275)			
Current (post-soviet) period	320-350 (average consumption 340)	3 778 554	1 265 815 618	11.6
Sub-Total / Average	***259***	***32 573 742***	***8 428 618 640***	***100***
Traditional House	kWh/ m²/year	m²	kWh/year	%
Timber	Weighted average consumption 365	74 116 450	27 075 402 928	
Brick				
Stone				
Other or Complex type				
Sub Total		*74 116 450*	*27 075 402 928*	***100***
GRAND TOTAL / AVERAGE	**333**	**106 690 192**	**35 504 021 568**	**n/a**

Note: share of the traditional houses (homes) from the total stock is 69.5%

The Baseline average energy performance of the buildings (kWh/m2) are based on GIZ-supported research Energy Efficiency in Construction[1], with consideration of minimum required comfort level in each type of the building. According to the provided share of heating areas by types of buildings are based on Report of ENERGY CONSUMPTION IN HOUSEHOLDS 2017[2] developed by NATIONAL STATISTICS OFFICE OF GEORGIA. According to the annual average specific energy consumption and identified heating area final annual energy demand was identified for each type of buildings (in total 35 504 021 568 kWh/year).

2.2. Energy efficiency potential per building typologies

Range of energy efficiency measures for the existing building stock:

Current Georgian legislation will require, after 2022, achievement of minimum energy performance of the buildings. This means fulfilling of the following two requirements: (a) minimum performance of structures and systems; and (b) minimum annual energy use for 1 m^2 of conditioned area. Below there will be described minimum (minimum required), good (average) and excellent (exemplary performance) scenarios of renovation measures. The range of measures apply to all of them, and level of achievement depends on their combination and application.

Energy Efficiency (EE) Measure	Description
Insulation of the roof (attic floor) and basement	External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials or XPS, EPS
Insulation of the walls	The mineral or rock wool insulation other “breathable” materials, composite façade systems, EPS and XPS systems
Installation of the new EE windows and doors	Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing
Ventilation	Installation of Prana type or equivalent heat recovery ventilation units.
Heating	Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps, application of whole building heating/cooling or district systems.
Cooling	Use of efficient individual cooling units, application of building or district chillers.
Lighting	Substitution of incandescent and fluorescent light emitters with LEDs, optimization of interior and exterior lighting design, reduction of light pollution (excess lighting).
Various/other	Upgrade of elevators, and other process-related energy consumers
Renewables	Application of PV, DHW systems, ground heat pumps, biomass (where applicable)

[1] Energy Efficiency in Construction – in Georgian, 2017 ISBN 978-9941-0-9612; Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Registere offices Bonn and Eschborn, Germany Private Sector Development and Technical Vocational Education and Training South Caucasus 31a, Griboedov Street, 0108 Tbilisi, Georgia T + 995 322 201833 F + 995 322 201831 www.giz.de Authors: Brigit T Mayer, Khatuna Sichinava, HolgerReif, Nani Meparishvili

[2] For more details please see the annex 1

2.3. Measures/applicability by types of buildings

Type / Scenario/Level	Measures to satisfy Minimum requirements and predicted solutions	Additional measures for "Good"	Additional measures for Excellent
Multi story buildings			
Ancient (including up to 1921)	Insulation of the roof (attic floor) and basement External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials, or EXPS, EPS Insulation of the walls (mainly from internal side) The mineral or rock wool insulation other "breathable" materials, composite facade systems, EPS and XPS systems Installation of the new EE windows and doors Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing Ventilation Installation of Prana type or equivalent heat recovery ventilation units (where applicable). Heating Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps. Cooling Use of efficient individual cooling units. Lighting Substitution of incandescent and fluorescent light emitters with LEDs. Various/other Upgrade of process energy consumers Renewables Application of PV, DHW systems,	Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Optimization of interior and exterior lighting design.	Reduction of light pollution. Ground heat pumps, biomass (where applicable) Application of whole building heating/cooling or district systems
Early Soviet period: 1921-1937	Insulation of the roof (attic floor) and basement	Enhanced measures (e.g. more wall or	Reduction of light pollution.

	External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials, or EXPS, EPS Insulation of the walls The mineral or rock wool insulation other "breathable" materials, composite façade systems, EPS and XPS systems Note: in many cased only internal insulation can be applied due to façade decorative elements <u>Installation of the new EE windows and doors</u> Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing <u>Ventilation</u> Installation of Prana type or equivalent heat recovery ventilation units. <u>Heating</u> Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps. <u>Cooling</u> Use of efficient individual cooling units. <u>Lighting</u> Substitution of incandescent and fluorescent light emitters with LEDs, <u>Various/other</u> Upgrade of elevators, and other process energy consumers <u>Renewables</u> Application of PV, DHW systems	attic insulation or more efficient boiler) Optimization of interior and exterior lighting design.	Ground heat pumps, biomass (where applicable) Application of whole building heating/cooling or district systems
Stalin period: 1937-1956	<u>Insulation of the roof (attic floor) and basement</u> External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials, or EXPS, EPS. Insulation of the walls The mineral or rock wool insulation other "breathable" materials, composite façade systems, EPS and XPS systems	Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Enhanced measures (e.g. more wall or attic insulation or more efficient boiler)	Reduction of light pollution. Ground heat pumps, biomass (where applicable) Application of whole building heating/cooling or district systems

	Note: In most cases façade walls insulation will be installed from interior side due to façade decorations. Installation of the new EE windows and doors Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing Ventilation Installation of Prana type or equivalent heat recovery ventilation units. Heating Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps, application of whole building or district systems. Cooling Use of efficient individual cooling units, application of building or district chillers. Lighting Substitution of incandescent and fluorescent light emitters with LEDs, pollution. Various/other Upgrade of elevators, and other process energy consumers Renewables Application of PV, DHW systems,	Optimization of interior and exterior lighting design.	
So called Khrushchov period (1956-1969) *Developed socialism period: 1969-1990* *Current (post-soviet) period*	Insulation of the roof (attic floor) and basement External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials, or EXPS, EPS. Insulation of the walls, the mineral or rock wool insulation other “breathable” materials, composite façade systems, EPS and XPS systems Note: In most cases façade walls insulation will be installed from interior side due to façade decorations. Installation of the new EE windows and doors	Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Optimization of interior and exterior lighting design.	Reduction of light pollution. ground heat pumps, biomass (where applicable) Application of whole building heating/cooling or district systems

	Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing <u>Ventilation</u> Installation of Prana type or equivalent heat recovery ventilation units. <u>Heating</u> Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps, application of whole building or district systems. <u>Cooling</u> Use of efficient individual cooling units, application of building or district chillers. <u>Lighting</u> Substitution of incandescent and fluorescent light emitters with LEDs, pollution. <u>Various/other</u> Upgrade of elevators, and other process energy consumers <u>Renewables</u> Application of PV, DHW systems,		
Traditional Houses (homes)			
All types: Timber, Brick, Stone, Other or Complex type	<u>Insulation of the roof (attic floor) and basement</u> External (preferred) or internal insulation such as the rock wool or mineral wool, Perlite powder, other breathable materials, or EXPS, EPS. Insulation of the walls The mineral or rock wool insulation other "breathable" materials, composite façade systems, EPS and XPS systems Note: In most cases façade walls insulation will be installed from interior side due to façade decorations. <u>Installation of the new EE windows and doors</u> Double or triple glazed PVC, aluminum or wooden doors/windows with air sealing	Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Enhanced measures (e.g. more wall or attic insulation or more efficient boiler) Optimization of interior and exterior lighting design.	Reduction of light pollution. ground heat pumps, biomass (where applicable) Application of whole building heating/cooling or district systems

	<u>Ventilation</u> Installation of Prana type or equivalent heat recovery ventilation units. <u>Heating</u> Replacement of boilers, re-design of the system to low temperature heat carrier to allow condensation boilers, replacement of inefficient wooden stoves, insulation of pipes, use of invertor type water circulation pumps, application of whole building or district systems. <u>Cooling</u> Use of efficient individual cooling units, application of building or district chillers. <u>Lighting</u> Substitution of incandescent and fluorescent light emitters with LEDs, pollution. <u>Various/other</u> Upgrade of elevators, and other process energy consumers <u>Renewables</u> Application of PV, DHW systems,		

2.4. State Policy

Georgia has taken responsibility to harmonies its legislation with European one. Association Agreement signed between Georgia and EU implies transposition of European building Performance Directive (EPBD). In 2020 Georgia has adopted law on “Energy Performance of Buildings”. Starting from 2021 gradually there will be introduced the following changes:

Existing buildings:

- All buildings sold or rented out must have energy performance certificate.
- All advertisements must declare the building’s energy performance class
- Building owners must periodically inspect building systems (mostly boilers) in order to keep rated efficiency parameters of installed equipment.
- At least 2% of existing public buildings must be renovated according to new energy performance norms.
- Buildings going under major renovation must comply with energy performance norms.
- New buildings over 50m2 (heated area)
- Must show minimum energy performance (KWh/m2 of heated area)
- Must conform to minimum requirements of separate building systems and building fabric (boiler, envelope, renewables, heat pump etc.)

Currently there are developed minimum performance standard, national calculation methodology, as well as climate zoning, based on updated climate data. Calculation will be based on monthly data, and the software is under development.

2.5. Other data

2.5.1. Population growth

Table 1 shows the average annual number of population in Georgia.

It shows that overall number of population have decreased in Georgia from 2010 to 2019 with average annual reduction rate of 0.2%. There is slight intermittent growth from 2014 when last official census has been performed. Since the population numbers had to be corrected before 2014 due to the census, it was decided to use 5 year growth rates for population in TIMES-Georgia, which equals to annual growth of 0.004%

Table 1. Population numbers in Georgia (2010-2019)

Year	Population (thousand)*	Annual Growth (%)
2010	3786.7	
2011	3756.4	-0.80%
2012	3728.9	-0.73%
2013	3717.7	-0.30%
2014	3719.4	0.05%
2015	3725.3	0.16%
2016	3728.6	0.09%
2017	3728.0	-0.02%
2018	3726.5	-0.04%
2019	3720.2	-0.17%
Average 10 year growth (2010-2019)	-0.20%	
Average 5 year growth (2014-2019)	0.004%	

*The population numbers correspond to the mid-year values and thus differ from the GeoStat data provided for 1 January for annually.

Although there is a decrease of population, the number of households is increasing because the number of persons per household is decreasing. GeoStat doesn't provide the number of persons per household for different years, however the statistical yearbooks provides the information on incomes per household and incomes per person enabling us to calculate the person per household data. Table 2 below shows the calculation of the person per household numbers and the average annual change in this parameter which equals to 0.47% per year.

Table 2. Calculation of the person per household parameter

Year	Income per household	Income per person	Persons per household
2009	505	137.1	3.683443
2018	1005	284.7	3.530032
Average 10 year change			-0.47%

Driver			2016-2018	2018-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Population	**1000 persons**	3,729	3,727	3,727	3,728	3,728	3,729	3,730	3,731	3,731
Number of persons per household		3.60	3.53	3.50	3.42	3.34	3.26	3.18	3.11	3.03
Number of Households	**1000 hh**	1,036	1,056	1,066	1,091	1,118	1,145	1,172	1,201	1,230
Population growth			**-0.03%**	0.004%	0.004%	0.004%	0.004%	0.004%	0.004%	0.004%
Number of persons per household			**-0.98%**	-0.47%	-0.47%	-0.47%	-0.47%	-0.47%	-0.47%	-0.47%

Note: The average growth of the population (0.004%) and number of persons per household (-0.47%), kept constant since 2020, will be changed based on economic development strategy and the sector development tendencies and plans that are subject to further exploration.

2.5.2. Building replacement

Average life cycle of buildings is 50-100 years

Replacement rate of the building stock is 1-2% (average – 1.5 %)

2.5.3. Existing building stock and new developments

Number of new buildings (please visit GeoStat page):

https://www.geostat.ge/en/modules/categories/621/information-about-permissions-granted-for-construction-and-completed-objects

Existing building stock (heated area):

Verified total area of public schools - 3.8 Mln m2

Total building area per capita - assumed 10 m2 X 3.8 Mln = 38,000,000 m2

From this – assumption is that 2.5 mln people leave in buildings (blocks-of flats), and 1.3 Mln-in traditional houses (homes). Ratio between per capita area is assumed as 2/1 building dwellers Vs Homeowners.

So, the buildings' Gross Floor area (GFA) = 18.6 Mln. m2, Traditional houses /Homes Gross Floor area' (GFA)=19.4 Mln m2.

Public buildings' GFA is assumed at 15% of dwellings, in total 5.7 Mln m2. From that 3.8 Mln m2 are school buildings, the rest – 1.9 Mln m2 – other buildings (including municipal and central, also privately owned non-residential buildings).

Total table of assumption on existing building stock looks as follows:

Type	**Sq.m. GFA**
Buildings, residential	18.600,000
homes	19,400,000
Schools	3,800,000
Other non-residential	1,900,000
Total residential	38,000,000
Total non-residential	5,700,000
Grand Total	**43,700,000**

2.5.4. Building technology

Technology	Type	Fuel	Capacity	Investment costs	Variable costs	Fixed costs	Efficiency	Starting year	Lifetime
Building shell, Thermal Insulation	Active or passive systems With constant and variable properties	No fuel used on-site	Averagely U=0.25 W/m2*h	Approximately USD 30 per 1 sq. m of the GFA	n/a	n/a	n/a	n/a – for existing buildings 2022 – for new buildings and major renovations	50-100 years
Space Heating and Cooling	The following types: With hot water boiler and water heat carrier With radiators With fan-coils With floor heating system With channel type conditioned air supply (heated from boiler, calorifere or heat pump) Connected with ground heat pump, other renewable energy systems or not connected.	Gas, Electricity Coal Bio mass Heavy residue oil	0.5 KW – 1.5 MW per unit of equipment	n/a	n/a	n/a	10-300%	n/a	10 years for heat pumps 15-25 years for combustion devices and distribution network
Water Heating	With gas boiler Solar concentrator Heat pump	Gas, Electricity Coal	0.5 KW- 100 KW per unit	n/a	n/a	n/a	50-250%	n/a	10 years for heat pumps

	Electrical heater Biomass boiler Residue oil boiler With or without buffer tank Connected or not connected with renewable energy system	Biomass Heavy residue oil							15-25 years for combustion devices and distribution network
Lightings (Residential & Commercial)	LED type luminaries (traditional incandescent luminaries will be phased out die to new custom's policy)	Electricity	10-20 W/m2 (for new developments), 10-200 W/m2 for existing buildings	n/a	n/a	n/a	n/a	n/a	1-5 years 5-10 years (starting from 2022)
Cold Appliances (Res & Comm)	With heat pumps, with or without cooling tower	Electricity	1-5 KW installed power per dwelling unit	n/a	n/a	n/a	250-300%	n/a	10 years
Cooking	Gas or biomass stoves Electrical cookers	Gas, Electricity Bio mass	1-5 KW installed power installed power per dwelling unit	n/a	n/a	n/a	50-70-%	n/a	5-10 years
Washing Machines (residential)	Domestic / commercial	Electricity	1.5-5 KW installed power per dwelling unit	n/a	n/a		n/a	n/a	5-10 years

Dish Washing Machines	Domestic / commercial	Electricity	1.5-5 KW installed power per dwelling unit	n/a	n/a	n/a	n/a	n/a	5-10 years
Dryers	Domestic / commercial	Electricity	1.5-5 KW installed power per dwelling unit	n/a	n/a	n/a	n/a	n/a	5-10 years
Other electric appliances	Domestic / commercial	Electricity	various	n/a	n/a	n/a	n/a	n/a	5-10 years
Electronic devices	Domestic / commercial	Electricity	various	n/a	n/a	n/a	n/a	n/a	5-10 years
Solar heating and cooling (Res & Co mm)	With buffer tank and without it.	n/a	From 0.5 KW	n/a	n/a	n/a	n/a	n/a	10-25 years

2.5.5. Sources of energy supply

Energy type	Comment
Non-electricity sources:	
Conv. Oil and Gas Production	Gas is used for heating in vast majority of buildings
Coal Mining and Logistics	Coal is used in only negligible part of public buildings, e.g. in some schools
Biomass Production & Logistics	Mainly demonstration projects. No wide use.
Biogas Production	Mainly demonstration projects. No wide use.
ELECTRICITY & HEAT PRODUCTION, TRANSMISSION AND DISTRIBUTION	
Gas Fired Power Plants	Electricity is used for all purposes mainly in winter it comes from burning gas.
Nuclear Power	Is used only when power is imported from Armenia (mainly in winter season)
Combined Heat and Power (CHP)	Is used in Rustavi area mainly.
Biomass for Heat & Power	Mainly demonstration projects. No wide use.
Hydro	Mostly used in buildings
Geothermal	Mainly demonstration projects. No wide use.
Wind Energy	Mainly demonstration projects. No wide use.
Concentrating Solar Power	Used in some sites, mostly on the sea side
Photovoltaic Solar Power	Used in some sites,
Renewable Energy Integration	Used in some sites,
District heating systems	Used in very few sites
Thermal Energy Storage	Mainly demonstration projects. No wide use.
Heat Pumps	Used in some sites for cooling

3. Report on Collection of data for transport sector (by Grigol Lazrievi)

Report on Data Collection, Drivers and Methodological Assumptions for Development of Baseline and Mitigation Scenarios in transport sector

The sources of the data have been national data on motor transport (fleet, type, fuel consumption), already reflected in TIMES -Georgia model, CAP, GHGI and BUR. In case of adding new source-categories to the sector, additional data may be required.

3.1. Road transport data

3.1.1. Number of the road transport in thousands

Ministry of Internal Affairs of Georgia provides road transport statistics. During 2007-2018 years number of road transport permanently increased. In table road transport distribution by type during 2011-2018 years is presented (for 2007-2010 years road transport distribution by types is unavailable) https://info.police.ge/page?id=196&parent_id=121

In the table 1 term "Heavy car" corresponds to "off-roader".

Table 3. Number of road transport in total and its modes in thousands during 2011-2018

Year	Light car	Heavy car	Busses	Trucks	Motorcycle	Trailer	Agricultural	Special	Total
2011	489,617	130,416	49,185	73,033	3,924	12,565	18,064	8,636	785,440
2012	523,304	149,976	51,605	78,213	4,235	13,570	19,530	9,346	849,779
2013	564,508	175,192	51,909	84,352	4,635	14,831	21,320	10,196	926,943
2014	616,941	204,285	53,114	90,907	5,107	17,364	22,471	11,236	1,021,425
2015	667,741	226,634	53,065	96,181	5,528	18,794	24,322	13,266	1,105,531
2016	727,116	247,148	53,728	99,098	5,970	20,297	26,267	14,327	1,193,950
2017	773,364	256,530	54,073	100,600	7,545	21,378	28,923	15,090	1,257,502
2018	819,373	266,957	52,863	101,761	8,590	23,524	30,793	17,709	1,321,569

Table 4. Distribution of road transport by modes (percentage)

Year	Light car	Heavy car	Busses	Trucks	Motorcycle	Trailer	Agricultural	Special	Total
2011	62.3	16.6	6.3	9.3	0.5	1.6	2.3	1.1	100
2012	61.6	17.6	6.1	9.2	0.5	1.6	2.3	1.1	100
2013	60.9	18.9	5.6	9.1	0.5	1.6	2.3	1.1	100
2014	60.4	20.0	5.2	8.9	0.5	1.7	2.2	1.1	100
2015	60.4	20.5	4.8	8.7	0.5	1.7	2.2	1.2	100
2016	60.9	20.7	4.5	8.3	0.5	1.7	2.2	1.2	100
2017	61.5	20.4	4.3	8.0	0.6	1.7	2.3	1.2	100
2018	62.0	20.2	4.0	7.7	0.7	1.8	2.3	1.3	100

3.1.2. Distribution of passenger cars by age

Table 5. Distribution of road transport passenger cars by age https://info.police.ge/page?id=196&parent_id=121

Year	Age									
	1–3		4–6		7–10		11–20		>20	
	%	Production date	%	Production date	%	Production date	%	Production date	%	Production date
2011	1.5	2008-2010	3	2005-2007	4.5	2001-2004	46.9	1991-2000	44.1	Before 1991
2012	1.9	2009–2011	2.7	2006–2008	4.5	2002–2005	46.7	1992–2001	44.2	Before 1992
2013	1.9	2010-2012	2.1	2007-2009	5.1	2003-2006	46.7	1993-2002	44.2	Before 1993
2014	1.8	2011-2013	1.7	2008-2010	6.2	2004-2007	45.6	1994-2003	44.7	Before 1994
2015	1.4	2012-2014	2.1	2009-2011	5.6	2005-2008	45.5	1995-2004	45.4	Before 1995
2016	1.3	2013-2015	2.3	2010-2012	5.4	2006-2009	45	1996-2005	46	Before 1996
2017	1.2	2014-2016	2.5	2011-2013	5.4	2007-2010	43	1997-2006	47.9	Before 1997
2018	1.9	2015–2017	3.9	2012–2014	6.4	2008–2011	42.3	1998–2007	45.5	Before 1998

3.1.3. Motor fuels consumed by road transport

National Statistics Office of Georgia. Energy balances of Georgia for 2013-2018 years. https://www.geostat.ge/en/modules/categories/328/energy-balance-of-georgia

Table 6. Motor fuels consumed by road transport

	2013	2014	2015	2016	2017	2018
Gasoline, 1000 tones	374	381	423	562	570	539
Diesel oil, 1000 tones	385	498	576	581	587	519
LPG, 1000 tones	2.1	2.1	0.3	0.7	2.8	3.6
NG, million m3	261	350	364	276	251	229

3.1.4. Energy used by road transport in TJ

Table 7. Energy used by road transport in TJ

Fuel	2013	2014	2015	2016	2017	2018	NCV	
Gasoline	16,546	16,861	18,730	24,879	25,264	23,869	44.3	TJ/1000 tone
Diesel oil	16,555	21,405	24,755	24,983	25,254	22,308	43.0	
LPG	99	99	14	33	132	170	47.3	
NG	9,239	12,390	12,886	9,770	8,885	8,107	35.4	TJ/million m3
Total	**42,440**	**50,755**	**56,385**	**59,665**	**59,536**	**54,454**		

3.1.5. CO2 emissions from road transport in Gg CO2

Table 8. CO2 emissions from road transport in Gg CO2

Fuel	2013	2014	2015	2016	2017	2018	Emission coefficient	
Gasoline	1,147	1,168	1,298	1,724	1,751	1,654	0.0693	Gg CO2/TJ
Diesel oil	1,226	1,585	1,834	1,850	1,870	1,653	0.0741	
LPG	6	6	1	2	8	11	0.0631	
NG	518	695	723	548	498	455	0.0561	
Total	**2,897**	**3,455**	**3,855**	**4,125**	**4,128**	**3,773**		

3.1.6. Motor fuel prices

In 2014-2018, an average share of five major motor fuel importer companies stood at 73%. These companies are: JSC Wissol Petroleum Georgia (Wissol); Sun Petroleum Georgia Ltd (Gulf); Rompetrol Georgia Ltd (Rompetrol); SOCAR Georgia Petroleum LLC (SOCAR); Lukoil Georgia Ltd (Lukoil).
In table motor fuel prices of “Lukoil Georgia” as of 1st January of each year are presented.

http://www.lukoil.ge/?m=328&date_from=08.10.2020&date_to=07.11.2020

Table 9. Motor fuel prices in GEL/litre as of 1st January of each year

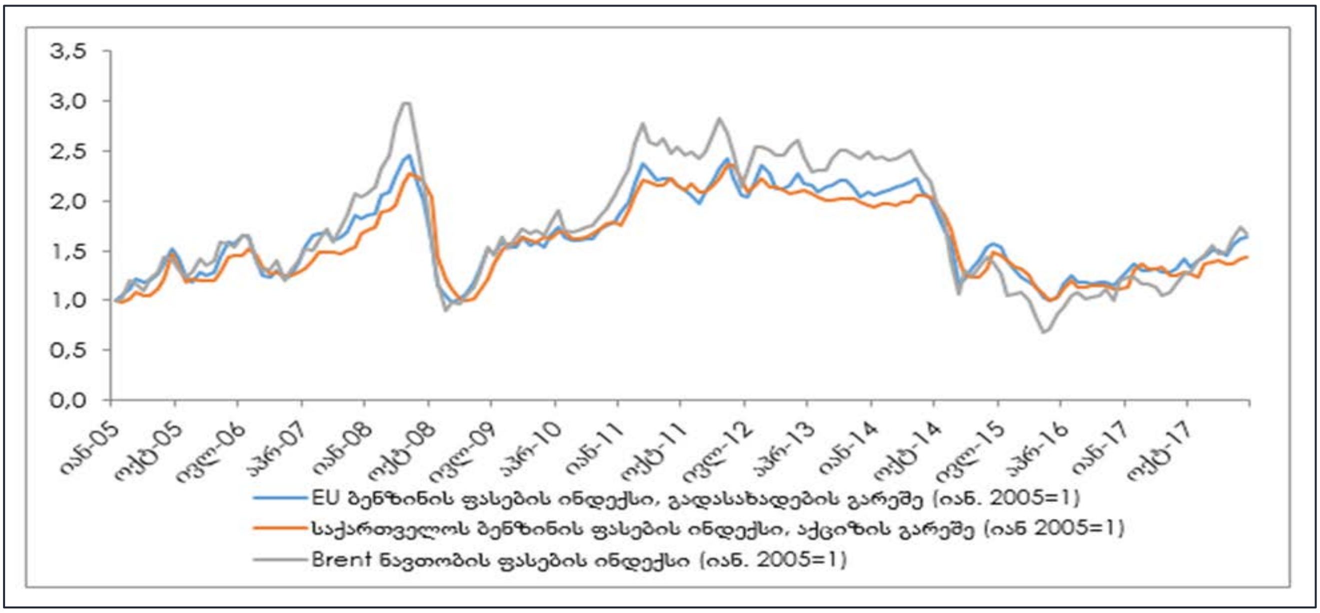
	Motor fuel	2012	2013	2014	2015	2016	2017	2018	2019	2020
Euro 5, Octane number 98	Euro super	2.25	2.22	2.22	2.04	1.82	2.04	2.43	2.55	2.66
Euro 5, Octane number 95	Premium Avangard	2.20	2.17	2.12	1.94	1.72	1.94	2.33	2.44	2.55
Octane number 92	Euro regular	2.05	2.05	1.97	1.79	1.53	1.74	2.23	2.29	2.40
Euro 5, Cetane number 51	Euro diesel	2.30	2.21	2.17	1.94	1.72	1.79	2.33	2.49	2.62

Table 10. Motor fuel prices in USD/litre as of 1st January of each year
https://www.nbg.gov.ge/index.php?m=582&lng=eng

Exchange rate	USD / GEL	1.666	1.657	1.738	1.878	2.415	2.648	2.590	2.675	2.867
Motor fuel		**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Euro 5, Octane number 98	Euro super	1.35	1.34	1.28	1.09	0.75	0.77	0.94	0.95	0.93
Euro 5, Octane number 95	Premium Avangard	1.32	1.31	1.22	1.03	0.71	0.73	0.90	0.91	0.89
Octane number 92	Euro regular	1.23	1.24	1.13	0.95	0.63	0.66	0.86	0.86	0.84
Euro 5, Cetane number 51	Euro diesel	1.38	1.33	1.25	1.03	0.71	0.68	0.90	0.93	0.91

Transparency International Georgia studied price fluctuations of Euro Regular petrol sold by Gulf and Lukoil (only they published prices of previous four years) in 2014-2018, and compared their change with the price fluctuations of crude oil and Brent oil. In 2014-2018, Georgian petrol retail prices and the world oil price has been changing in the same direction.

In November 2018, the National Bank of Georgia also studied the correlation between local petrol prices in Georgia and the world oil prices . According to the study, the price changes of oil on international markets are fully reflected on local petrol prices (excluding taxes) in a long term - 3-month period. In the short-term, one-month period, a change of world oil price by USD 1 causes change of local petrol prices by USD 0.35. If in next three-four months, other important factors (for example, the exchange rate, taxes, transportation costs, etc.) remain same, the world oil price fluctuations are fully reflected on domestic prices.



4. Report on Collection of data for Industrial Processes sector (by Kakha Mdivani, Industry Sector Expert)

Report on Data Collection, Drivers and Methodological Assumptions for Development of Baseline and Mitigation Scenarios

Introduction

This report includes information on industry sector overview describing the current situation and level of GHG emissions. The report also includes information on not estimated categories as targeted areas for estimation approximate emissions.

The data necessary for launching the emission estimations for calibration of future trends are described in a chapter of data collection. **Due to the confidentiality purposes the information provided in the Table 1 the report is only internal use.[3]**

Furthermore, the report describes the drives supporting the identification of future trends for industrial processes in Georgia. Moreover, in case of high level of correlation several drives would play a role of surrogate data for estimating GHG emissions in new source categories.

In addition, the report includes information on methodological assumptions used as foundation for baseline and mitigation options analysis.

In annex of the document the interview sample for data request is presented.

[3] in case of public sharing the data presented in Table 1 is a subject of change with notation key "C"

4.1. Industry Sector Overview

In 2016 the total GHG emissions from the industry sector was estimated as 15% (2738 Gg CO_2 eq.) of total national GHG inventory.

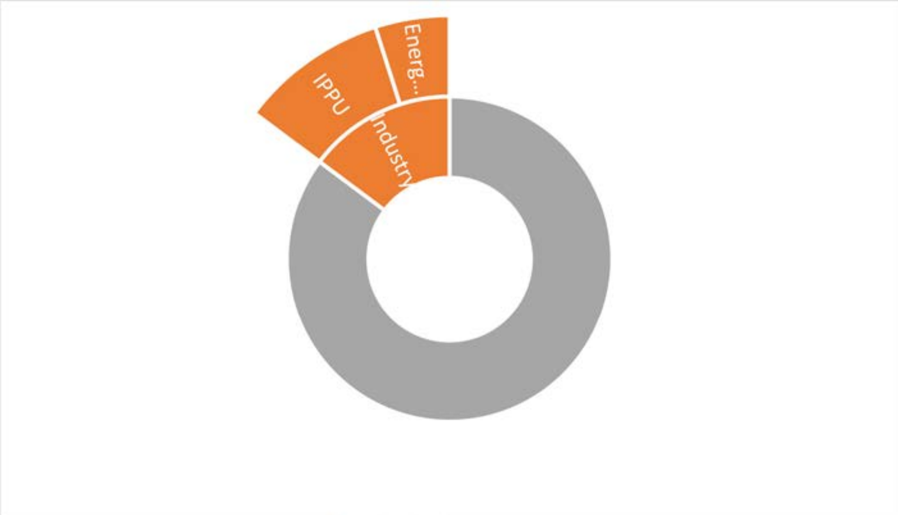


Figure 1. Industry sector emissions share in national total GHG inventory

The estimation of GHG emissions from the industrial processes is related to the activities taken place during the manufacturing. The IPCC 2006 Guidelines used by the Government of Georgia for national GHG inventory reporting, considers energy consumption related GHG emissions and non-energy related emissions from industry sector.

In accordance to Georgia's National GHG inventory report the energy related emissions are grouped within the category of Manufacturing Industries and Construction (1A2) consisting of following sub-categories: iron and steel production, chemicals, food products, non-metallic minerals and other. In 2016 the energy related emissions from industry sector were about 33% (916 Gg CO_2 eq.).

In case of non-energy related emissions, the following categories are taken into consideration: Mineral Products (2A), Chemical Industry (2B), Metal Production (2C), Non-Energy Products from Fuels and Solvent Use (2D), Electronics Industry (2E), Product Uses as Substitutes for ODS (2F) and Other Product Manufacture and Use (2G). Correspondingly, higher share of the emissions within the sector is from non-energy related industrial processes – 67% (1822 Gg CO_2 eq.).

Furthermore, in national GHG inventory report it is stated that several categories as not estimated, considering actual emissions appearance with limited capacity of data processing necessary for GHG emission estimations. The related source-categories are solvent use (2D3), Foam Blowing Agents (2F2), Fire Protection (2F3), Aerosols (2F4), Solvents (2F5), and SF6 and PFCs from Other Product Uses (2G2). Hence, the share of the emissions related to activities from these source-categories is not considered at the estimations.

4.2. GHG emission trends from industry sector

The Industry sector is considered as one of the most GHG types intensive sector. Consequently, for the period of 1990-2016 period the emissions trends are presented by categories and GHG types.

4.3. GHG emissions form industry by sectors

The GHG emissions from both energy related and non-energy related industry processes were declined within the period of 1990-2016. By the end of the accounting period the emissions from energy related activities was 12% of the emission level estimated for the year of 1990. The same value for the IPPU sector was 47% since the decline was not as vast as it was in case of energy related emission trend.

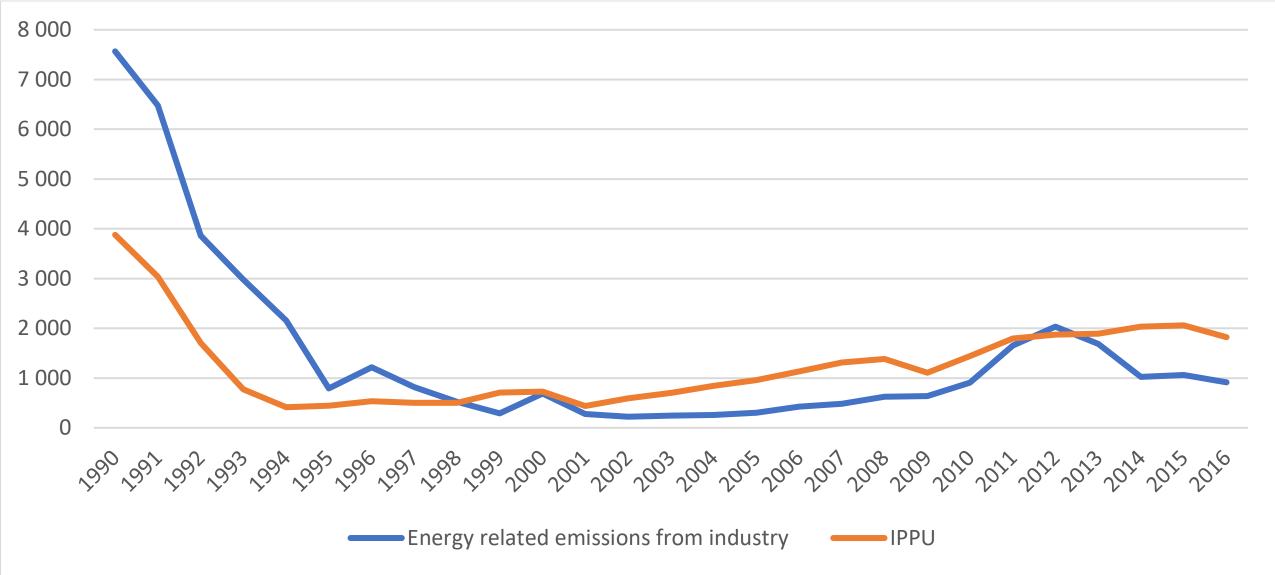


Figure 2. GHG emissions trends from industry sector from 1990 to 2016 (Gg CO2 eq.)

Several key major factors have influenced to the GHG emission trends for 3 decades of estimation.

Firstly, the political instability at the beginning of independence period of the country;

Secondly, the economic crisis induced by global market changes;

Thirdly, industry market competition within the region;

Fourthly, increase the renewables share in the energy generation causing lowering the grid emission factor.

4.4. GHG emissions from Industry Sector by Gases

The types of greenhouse gases estimated under the industry sector are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) and sulphurhexaflouride (SF_6).

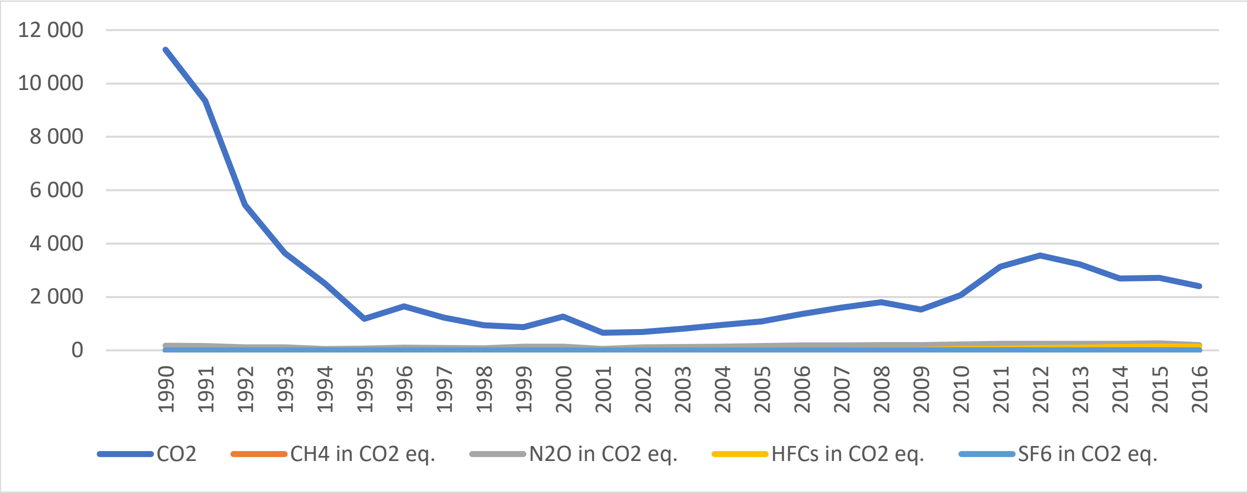


Figure 3. GHG emission trend by Gases from 1990 to 2016

Comparing to carbon dioxide (CO_2) other greenhouse gases estimated emissions are very low. Nevertheless, accounting all gases are a matter of completeness and accuracy.

4.5. Data Collection

The data necessary for estimation the emissions for unrecorded years by the national GHG inventory are presented in a tabular format below () as requested by the project team leader

Table 11. Data collected

Sub-Category	Data Types	Unit	Amount	Assumption/Comment
Mineral industry	Clinker produced (wet method)	ton	142,876	official data for 2017
	Clinker produced (dry method)	ton	1,122,824	official data for 2017
	Limestone in raw materials	ton	1,034,124 454,836 168,151	official data for 2017
	Sand in raw materials	ton	8,007 23,492 39,389	official data for 2017
	Ferro materials in raw materials	ton	9,614 11,319 2,711	official data for 2017
	Clay in raw materials	ton	38,323 107,010	official data for 2017
	Lime production	ton	78,712.30	official data for 2018
	Pulled glass	ton	76,970.88	official data for 2018
	Cullet	ton	2,665.07	official data for 2018
Chemical Industry	HNO_3 produced	ton	395,991	official data for 2018
	Ammonia produced	ton	227,782	official data for 2018

	Natural gas consumed	ton/per t of ammonia	968.9	official data for 2018
Non-Energy Products from Fuels and Solvent Use	Lubricants used	ton	300	official data for 2018
	Oil Bitumen	ton	106,600	official data for 2018

4.6. Drivers

The drivers for each source-categories in industry sector is derived based on the process characteristics. Accordingly, the following list of table shows common and activity specific drivers for industry sector.

Table 12. Drivers for industry activities

№	Driver	Description
1.	Real estate activities in GDP	*The information on trends of these data is requested from economic expert for the available period at lead 10 years.*
2.	Construction in GDP	
3.	Manufacturing in GDP	
4.	Population	
5.	Expectations of construction industry development in the region	*The information on trends of these data is necessary for clinker, lime and steel production projections*
6.	Drink and beverages in GDP	*The information on trends of these data is necessary for glass production projections since Mina produces the bottle glasses*
7.	Drink and beverages market in Georgia	
8.	Drink and beverages exporting trends	
9.	Fertilizers utilization in Agriculture	*The information on trends of these data is necessary for ammonia production*
10.	Expectations of regional market of Ammonia	
11.	International market trends in Fluorinated gases	*The information on trends of these data is necessary for F-gases consumption*
12.	HFCs and PFCs trends in countries with similar population and climate conditions	

The legislative activities under the EU Association Agreement has a indirect influence to the climate related matters. Particularly the following directives are considered within this loop:

- **Directive 2008/50/EC** on ambient air quality and cleaner air specifies clear targets and limit values for local air pollutant concentrations, including an annual mean limit for particulate matter (PM10) in any given location of 40 μg/m3. This will directly support the reduction of local air pollutant concentrations.

- **Directive 2010/75/EU** of the European Parliament and of the Council of 24 November 2010 on industrial emissions, which requires the preparation of transitional national plans to reduce total annual emissions from existing plants.
- **Article 314 of the Association Agreement** specifies the need to facilitate the modernisation and restructuring of the EU and Georgian industry in sectors, where appropriate; and to develop and strengthen the cooperation in the area of mining industries, and production of raw materials, with the objective of promoting information exchange and cooperation in the area of non-energy mining, in particular metallic ores and industrial minerals.

4.7. Methodological Assumptions

The GHG emissions estimation for industry sector will consider the methods applied during the latest national GHG inventory (Table 3). The envisaged upgrades or appearance of new source categories are the subject of description of used methods for such activities as an annex. New tier methods applied will be in line with 2006 IPCC guidelines as defined by the Government of Georgia for the key reporting methodology for the country.

Table 13. The methodological tiers used in the IPPU sector

GHG Source and Sink Categories	CO_2		CH_4		N_2O			
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor		
2.A Mineral industry	D,T2	D						
2.B Chemical industry	D,T2	D,PS	NA,NO	NA,NO	D,T2	D		
2.C Metal industry	D,T2	PS	D,T1	D	NA,NO	NA,NO		
2.D Non-energy products from fuel and solvent use	D,T1	D	NA,NO	NA,NO	NA,NO	NA,NO		
2.E Electronic industry								
2.F Product uses as ODS substitutes								
2.G Other product manufacture and use								
2.H Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO		
GHG Source and Sink Categories	**HFCs**		**PFCs**		**SF_6**		**NF_3**	
	Method applied	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**
2.A Mineral industry								
2.B Chemical industry								
2.C Metal industry								
2.D Non-energy products from fuel and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2.E Electronic industry								
2.F Product uses as ODS substitutes	D,T1	D	NE	NE	NE	NE	NE	NE

2.G Other product manufacture and use	NA,NE	NA,NE	NA,NE	NA,NE	D,T1	D	NA, NE	NA,NE
2.H Other	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO

In case of the estimation future projections the driver analysis will be used for setting up the future trajectory for non-energy related emissions from categories of industry sector.

The forecast methods will be applied for identifying emission trends for 2050 period.

4.8. Conclusions and Following Steps

With this deliverable the key categories and sub-categories of industry sector has been defined. The data for checking the future trends of projected data has been gathered for mineral, chemical and non-energy products from fuels and solvent use categories was gathered. The key drivers for assessment of baseline emissions projections and mitigation options are defined. The methodological improvements and potential of appearance of new source-categories with approximate estimations are defined.

In December, the data for drives, new sources categories and mitigation possibilities will be gathered. Due to the COVID-19 restrictions the additional data gathering from the manufactures is under threat of delay.

Apendix

The sample of the interview with Heidelberg cement factor is attached below to this report.

კლინკერის წარმოების ხელშეწყობა თანამედროვე გამოწვევებთან გასამკლავებად

საქართველოში ინფრასტრუქტურის განვითარებასთან ერთად, **მოსალოდნელია ცემენტსა და ბეტონზე მოთხვნის ზრდა**, რაც შესაბამისად გაზრდის მოთხოვნას კლინკერის მიწოდებაზე. მსოფლიოში კლინკერის ყველაზე მსხვილ მწარმოებლებს შორისაა ჩვენი გეოგრაფიული არეალის ქვეყნები: მე-5 ადგილზე ირანი, ხოლო მე-7 ადგილზე თურქეთი. აღნიშნულის გათვალისწინებით მნიშვლელოვანია ადგილობრივი წარმოების პოზიციების განმტკიცება და წარმოების გაფართოება. თანამედროვე ყოფაში კლიმატის ცვლილება და მასთან დაკავშირებული რისკები მსოფლიო ეკონემიკური ფორუმის ანგარიშით ბიზნესის მდგრადი განვითარების უმნიშვნელოვანეს გამოწვევას წარმოადგენს. არსებული საპროგნოზო მონაცემებით მსოფლიოში ცემენტის წარმოება მოსალოდნელია გაიზრდოს 12-23% 2050 წლისთვის, რასაც CO_2-ის პირდაპირი ემისიების 4-10%-იანი ზრდა მოჰყვება, იმ შემთხვევაში თუ წარმოება არსებული პრაქტიკით გაგრძელდება.

ცემენტის საერთაშორისო ბაზარზე უკვე ჩნდება ახალი ნიშა, რომელსაც **კლიმატგონივრული ტექნოლოგიით მწარმოებლები** იკავებენ. მათი პროდუქცია ეკოლოგიურად სუფთა პროდუქციის გამოშვებასთან, ენერგიის მინიმალურ დანახარჯებთან და უნარჩენო წარმოებასთან ასოცირდება. საშუალოვადიან პერსპექტივაში ცვალებადი ხარჯების ეკონომია, პროდუქციის თვითღირებულების შემცირების საშუალებას იძლევა, რაც აღნიშნულ ნიშაში ოპერირებადი მწარმოებლების კონკურენტუნარიანობას ამაღლებს. გარდა ამისა, ასეთ მწარმოებლებს საშუალება ეძლევათ მონაწილეობა მიიღონ ემისიების საერთაშორისო სავაჭრო ბაზარზე.

მიმდინარე წელს ევროკავშირისა და გაეროს განვითარების პროგრამის მხარდაჭერით საქართველოსთვის მზადდება კლიმატის ცვლილების სამოქმედო გეგმა. ვინაიდან საქართველოში მრეწველობის სექტორის განვითარება ერთ-ერთ პრიორიტეტულ მიმართულებას წარმოადგენს, მნიშვნელოვანია აღნიშნული სექტორის მხარდაჭერა დაბალემისიიანი განვითარების ფარგლებში. ცხილში მოცემულია ის სარეკომენდაციო ღონისძიებები, რომელიც საერთაშორისო გარემოს დაცვის სააგენტომ შეიმუშავა კლიმატის ცვლილების პარიზის შეთანხმების ხელმომწერი მხარეებისთვის.

მოხარული ვიქნებით, თუ აღნიშნულ საკითხების განხილვას შევძლებთ შეხვედრაზე და თქვენთვის საინტერესო მიმართულებებს გამოვკვეთავთ.

შესაძლო რესურსეფექტური ღონისძიებები

სამრეწველო ობიექტები	ხელშემწყობი თანმდევი ღონისძიებები
ენერგოეფექტური ტექნიკის წახალისება	
სველი მეთოდით წარმოების ჩანაცვლება მშრალი მეთოდით	*შემუშავდეს სექტორის ენერგოეფექტურობის განვითარების სამიწე პროგრამა*
არაეფექტურ ხანგრძლივი მოქმედების საშრობი ღუმელების წარმოების ტექნოლოგიური ხაზიდან ამოღებადა	
ალტერნატიული ენერგიის ათვისების წახალისება	
საწარმოო ნარჩენის ენერგეტიკული პოტენციალის გამოყენება ნაგავსაყრელზე განთავსების ნაცვლად	*წახალისდეს ნარჩენის გადამუშავება მის დაწვასა და ნაგავსაყრელზე განთავსებასთან შედარებით*
ნარჩენების ოპტიმალური მართვის შესახებ ცნობიერების ასამაღლებელ საქმიანობაში საწარმოს პერსონალის მონაწილეობა	*ნარჩენების ოპტიმალური მართვის შესახებ ცნობიერების ასამაღლებელ საქმიანობაში საზოგადოების მონაწილეობა*
ცემენტში კლინკერის წილის შემცირება	
ცემენტის მინარევების წილის ცვლილება წარმოებისას ემისიების შემცირების მიზნით	*ცემენტისა და ბეტონის სტანდარტების შემუშავება*
	სამშენებლო მასალების მარკირება
ცემენტის მინარევების შესწავლის შესახებ კვლევების წახალისება	*ცემენტის მინარევების შესწავლის შესახებ კვლევების წახალისება*
ახალი, ინოვაციური ტექნოლოგიების დანერგვის მხარაჭერა	
სუფთა ენერგიის წარმოება	*სხვადასხვა საერთაშორისო საფინანსო საშუალებებიდან სახსრების მოზიდვის შესაძლებლობის გაძლიერება ინოვაციური ტექნოლოგიების დასანერგად*
	ემისიების საერთაშორისო ბაზრზე ოპერირების წახალისების საკითხი

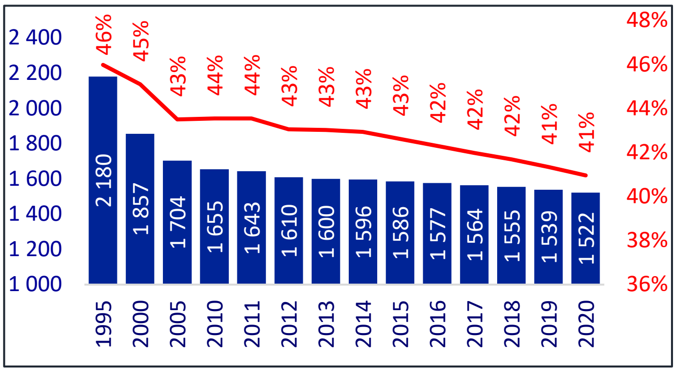
Annex 5. Report on Collection of data for **Agriculture sector** (by Grigol Lazrievi, Agriculture Sector Expert)

5. Report on data collection for Agriculture sector

Georgia's agricultural sector plays a key role in the country's economy. Georgian farmers are going to play a principal role in providing one of the fundamental needs of society: a safe, secure, and affordable food supply.

As of 1st January of 2020 Population of Georgia constituted 3,716 thousand people, 41% of which (1,522 thousand people) lives in rural areas[41]. Rural population of Georgia has tendency to decrease. Compared to 2000, in 2020 population decreased by 18% (from 1,857 thousands to 1,522 thousands). According to the forecast of the UN World Urbanization Prospects, the share of rural population in Georgia will decrease up to 27% by 2050[25].

According to the "Agriculture census 2014", in Georgia 73.1% of farms manage up to 1 ha, 25% from 1 ha to ha and only 1.5% of the farms manage more than 5 ha. The agricultural area of Georgia comprises 2.55 million hectares that is a share of about 37% of the total territory (forestry about 41%, other area about 22%).



Georgia has favorable climatic and natural conditions conducive to development of agriculture. However, nowadays agriculture sector is characterized with low productivity. During 2010-2019 the share of agriculture in GDP at constant 2015 year prices fell from 9.6% in 2010 to 7.4% in 2019 and share in GDP at current prices from 9.1% in 2010 to 6.3% in 2019.

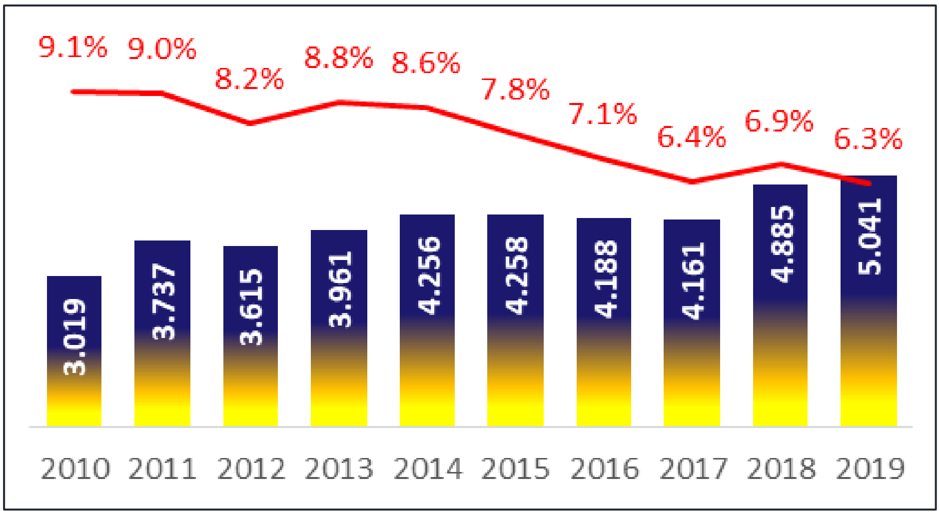


Figure 4. GDP from Agriculture, forestry and fishing in current prices in billion GEL and value added (% of GDP)

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1 https://www.geostat.ge/en/modules/categories/41/population

2 http://enpard.ge/en/wp-content/uploads/2015/05/ARDSG-FINAL-version-_ENG.pdf

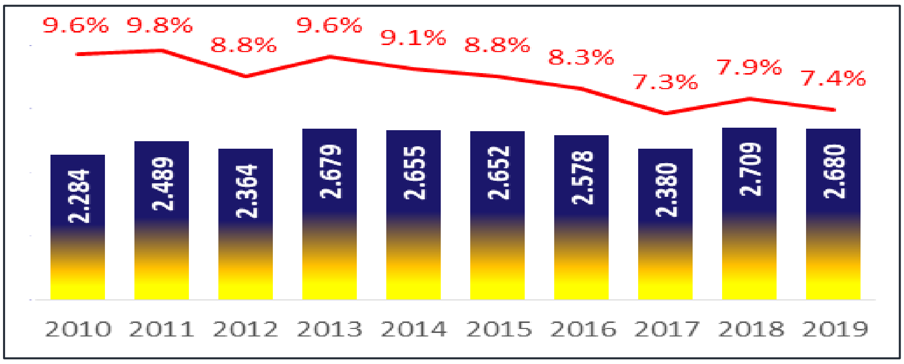

Figure 5. GDP from Agriculture, forestry and fishing at constant 2015 year prices in billion GEL and value added (% of GDP)

5.1. State policy

Ministry of Environment Protection and Agriculture of Georgia

Up to date, Georgia has no integrated agriculture and rural development policy document. However, according to *Chapter 10: Agriculture and Rural Development* of the Association Agreement between Georgia and the EU signed on June 27, 2014, Georgia has an obligation to adopt an agriculture and rural development policy that is compliant with EU policy and European best practices. Georgia also has an obligation to harmonize the country's legislation with European legislation and expand the power of the central and local governments in order to comply with policy planning and evaluation frameworks that meet European standards. "The Parties shall cooperate to promote agricultural and rural development through the progressive convergence of policies and legislation" (Article 333, Association Agreement).

One of the EU's, six priorities addresses climate change issue in relation to agriculture. *Priority 5: Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors.*

Approved in February 2015 (by decree N167 of the Government of Georgia) *Strategy for Agricultural Development in Georgia 2015-2020* declared that as agricultural production is tied to climate change, it is important to promote Climate Smart Agriculture approach that simultaneously addresses three intertwined challenges: ensuring food security through increased productivity and income, adapting to climate change and contributing to mitigation of climate change.

In the past two decades the Government policy has paid little direct attention to the agriculture sector particularly since the Rose Revolution of 2003. Priority was given to sectors requiring urgent reform, such as good governance and the promotion of free trade. Agriculture has become a development priority in Georgia since 2012.

Table 14. State budget allocated to Agriculture sector (in million GEL) in 2009-2020

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Budget allocated to agriculture, MGEL	75	31	85	228	227	266	314	330	235	275	308	317

5.2. GHG emissions

5.2.1. GHG emissions in 2016

According to the Georgia's National GHG Inventory Report prepared in frames of Georgia's Fourth National Communication under the UNFCCC, GHG emissions from Agriculture sector in 2016 constituted 3,798 Gg CO2eq, about 20% of national GHG emissions. Main source of methane is enteric fermentation while main sources of Nitrous Oxide are agricultural soils - direct emissions (*Synthetic fertilizers, Animal waste applied to soils, Crop residue decomposition and Manure from grazing animals*) and indirect emissions (*Atmospheric deposition and Nitrogen leaching & run off*).

On figure 6 GHG emissions from agriculture sector by sources in Gg CO2eq in 2016 are given.

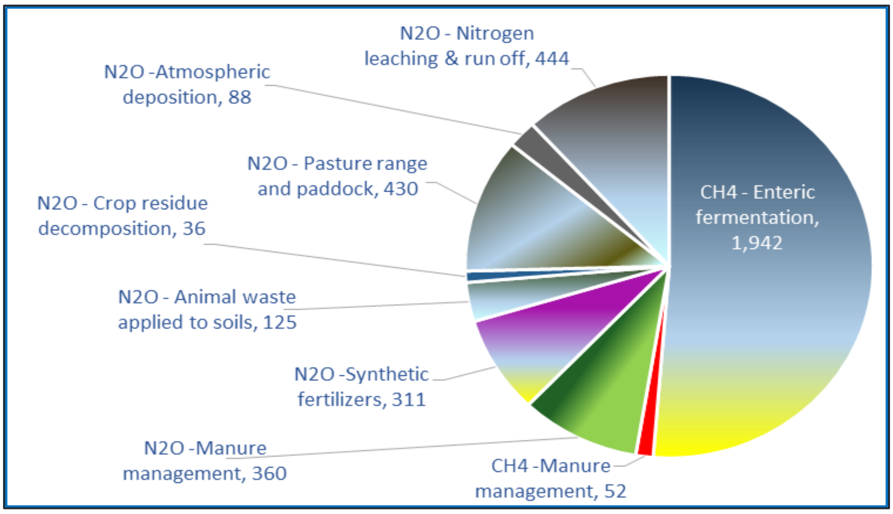

Figure 6. GHG emissions (in Gg CO2eq) from agriculture sector by source-categories in 2016

During 1990-2016 years, GHG emissions from agriculture sector varied from 2,683 Gg CO2eq in 1994 to 4,101 Gg CO2eq in 1990. Sector share in National GHG emissions varied from 9.0% in 1990 to 36.2% in 2001. On figures 5.4 and 5.5GHG emissions from agriculture sector and their share in national GHG emissions in 1990-2017 are given.

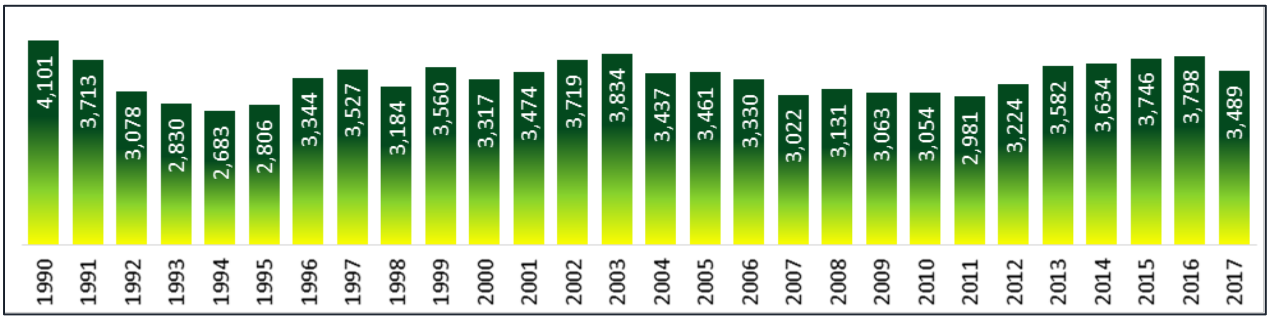

Figure 7. GHG emissions from Agriculture sector in Gg CO2eq and sector share in National GHG emissions

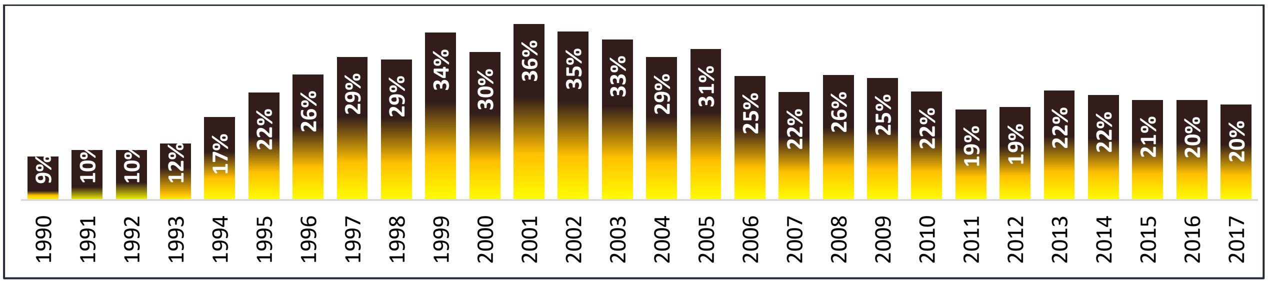

Figure 8. GHG emissions from Agriculture sub-sectors in Gg CO2eq and their share in National GHG emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
GHG National	45,813	36,385	30,118	24,397	15,745	12,696	12,963	11,993	11,019	10,356	10,923	9,592	10,754	11,616
GHG Agriculture	4,101	3,713	3,078	2,830	2,683	2,806	3,344	3,527	3,184	3,560	3,317	3,474	3,719	3,834
Share of Agriculture	9%	10%	10%	12%	17%	22%	26%	29%	29%	34%	30%	36%	35%	33%

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG National	11,707	11,168	13,099	13,624	12,203	12,203	13,688	16,027	16,927	15,964	16,861	18,214	18,534	17,766
GHG Agriculture	3,437	3,461	3,330	3,022	3,131	3,063	3,054	2,981	3,224	3,582	3,634	3,746	3,798	3,489
Share of Agriculture	29%	31%	25%	22%	26%	25%	22%	19%	19%	22%	22%	21%	20%	20%

Main drivers of GHG emissions from agriculture sector are number and distribution by breeds of cattle, manure distribution by manure management system and amount of applied N fertilizers.

Number of cattle and swine in different years are given in the presented on below graphs and table. Maximal number of cattle was fixed in 1985. Since 1990, during 1991-1995, number of cattle drastically decreased. Last several years cattle number has tendency to decrease, cattle number decreased by about 12% in 2019 compared to 2016.

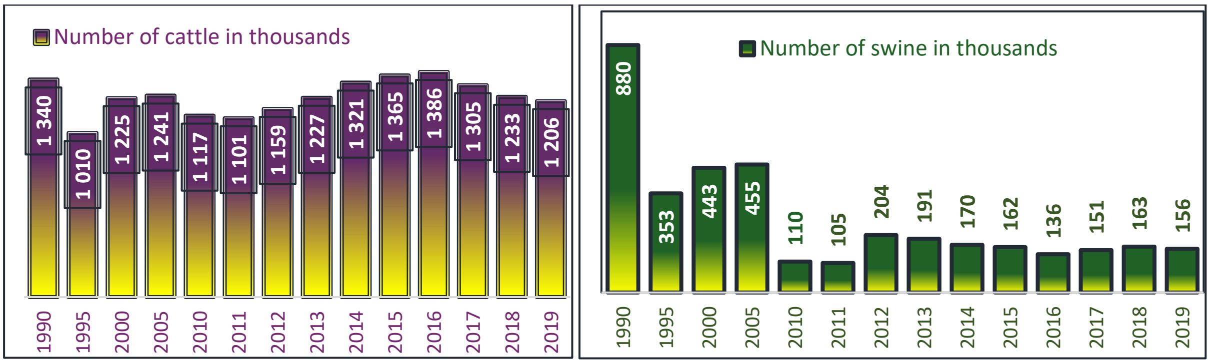

Figure 9. Number of cattle and swine (in thousand heads)

		1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cattle		1,340	1,010	1,225	1,241	1,117	1,101	1,159	1,227	1,321	1,365	1,386	1,305	1,233	1,206
Swine		880	353	443	455	110	105	204	191	170	162	136	151	163	156

5.3. Beef and milk products

More than 25% of consumed beef and about 20% of consumed milk products is imported in Georgia.

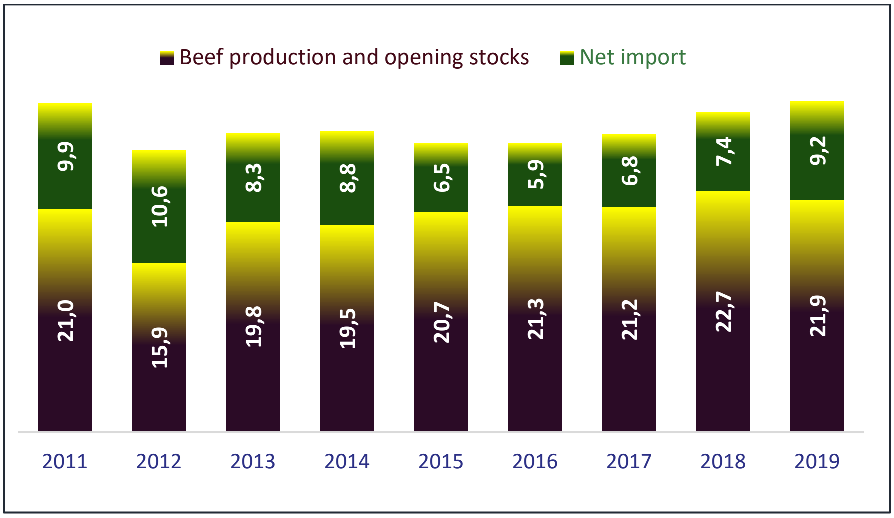

Figure 10. Beef balance in 2011-2019

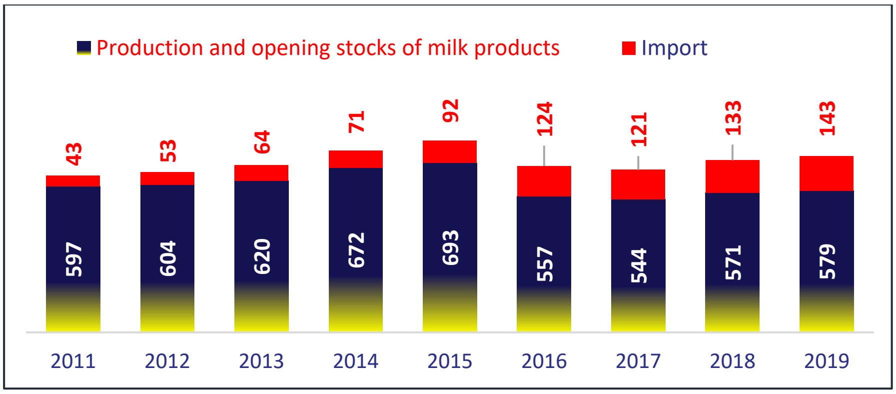

Figure 11. Milk products balance in 2011-2019

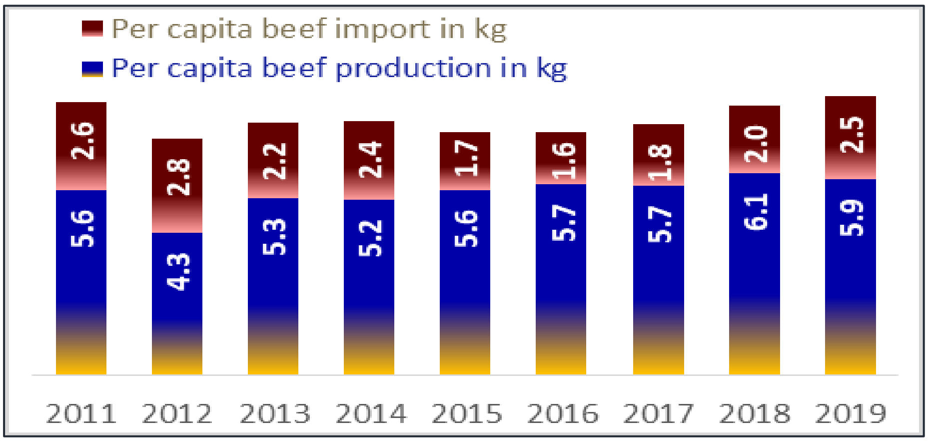

Figure 12. Per capita beef balance in 2011-2019

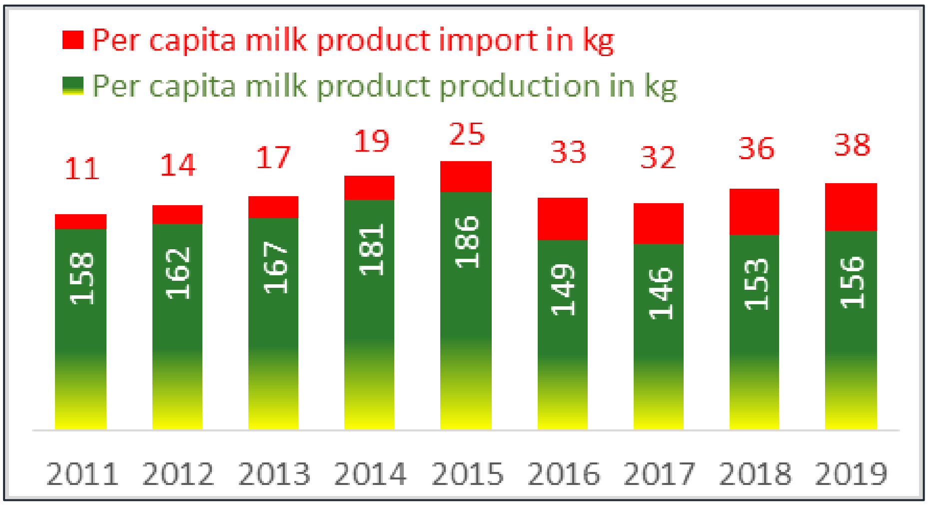

Figure 13. Per capita milk products balance in 2011-2019

On figure 5.9 Sown area and land occupied by permanent crops and Nitrogen fertilizer applied during 1990-2019 years are given. Amount of applied N fertilizers and average N fertilizer added per ha soil significantly was changed from year to year.

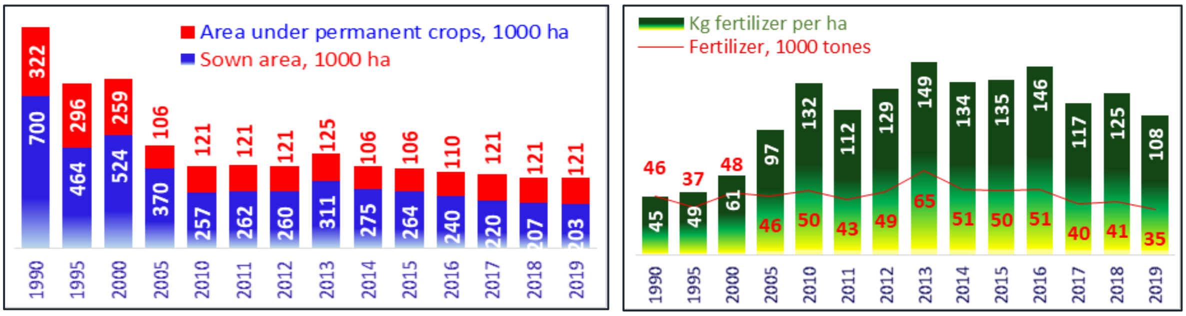

Figure 14. Sown area and land occupied by permanent crops and Nitrogen fertilizer applied during 1992-2019 years. http://www.fao.org/3/i1500e/Georgia.pdf

	1992	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Arable land, 1000 ha	700	464	524	370	257	262	260	311	275	264	240	220	207	203

Area under permanent crops, 1000 ha	322	296	259	106	121	121	121	125	106	106	110	121	121	121
Fertilizer, 1000 tones	46	37	48	46	50	43	49	65	51	50	51	40	41	35
Kg fertilizer per ha	45	49	61	97	132	112	129	149	134	135	146	117	125	108

Significant part of agricultural soil of Georgia is significantly degraded, mainly due to soil erosion. As a result, soil productivity, essential to agricultural growth, food security and support of the livelihoods of the poor is very low in Georgia. Last years, yield of strategic for country cereals, wheat and corn (maize) is in frames of 2.5 t/ha, which is much less than average yield in European Union (6.3 t/ha wheat and 8.8 t/ha maize)[6].

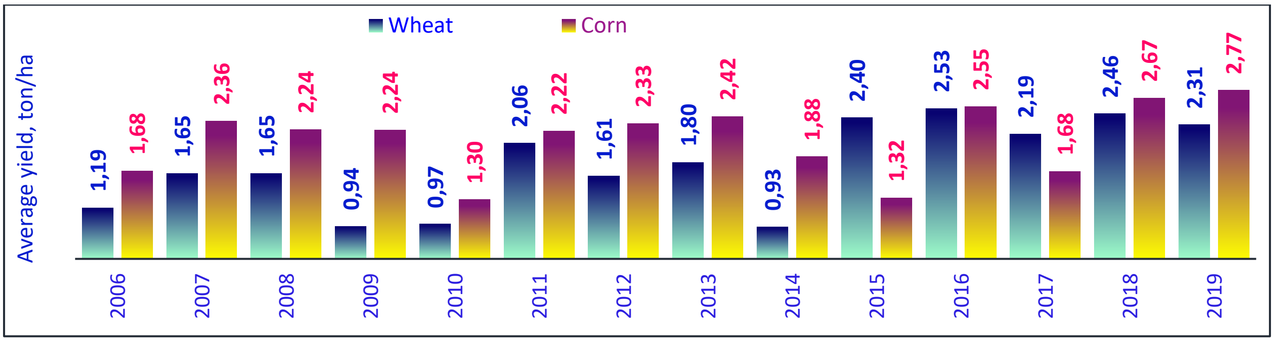

Figure 15. Cereals average yield in 2006-2019 years

[6] https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/fadn-cereal-report-2017_en.pdf

6. Report on Collection of data for LULUCF sector (by Koba Chiburdanidze, LULUCF Sector Expert)

Report on data collection in LULUCF Sector

6.1. Data collection: sources

Projections in the LULUCF sector is to be conducted using the FAO model EX-Ante Carbon balance Tool (EX-ACT). To obtain the data for projections in the field, identification of the sources of data was necessary (entities, statistics etc). These sources are:

Ministry of Environment Protection and Agriculture,

National Statistical Agency (GeoStat),

Ministry of Environment of Ajara AR.

Also, emissions factors (EFs) needed for higher tier calculations by the model have been identified.

The obtained data are shown below.

6.2. Strategic directions of development for Forestry sector (2021-2023)

- Rehabilitation of degraded lands:

Rehabilitation of 625 ha degraded lands (including fire-sites) using reforestation. Namely, the reforestation will be conducted in 250 ha and 375 ha degraded forest lands (including forests after fire) in 2021 – 2023. The areas will be selected by the end of the year.

2411 ha degraded forest land will be rehabilitated by supporting natural regeneration. Supporting natural regeneration degraded forest land area will be rehabilitated by various administrative entities, responsible for forestry sector. In particular, the activities are:

1) Rehabilitation of 800 ha degraded forest land (200 ha yearly)

2) Rehabilitation of 20 ha degraded forest land by Tbilisi municipality.

3) Rehabilitation of 600 ha degraded (sub-alpine) forest land by Ajara Forestry Agency;

4) Rehabilitation of 991 ha forest land area by Akhmeta municipality in 2021-2024.

- Forest management, under sustainable management principles:
    - Establishing sustainable forest management principles over 402109 ha forest land by implementation of sustainable forest management plan, elaborated and adopted for 11 municipalities (arrangement of infrastructure, maintenance, cutting, reforestation, sanitary cuts etc). Specifically, LEPL National Forestry Agency will establish sustainable forest management practice by implementation of sustainable forest management plan, elaborated and adopted for 8 municipalities (includes support to the following activities: arrangement of infrastructure, maintenance, cutting, reforestation, sanitary cuts etc).
    - enhancement of monitoring over the process of establishing sustainable forest management practice over 402109 ha forest land, support to sustainable wood production, stratngthening regulatory base, knowledge management and capacity enhancement, strengthening the measuring, reporting and verification (MRV) system;

- Protection and sustainable management of 643 100 ha forest area with special conservation importance under the emerald network (590 103 ha approved and 52 997 candidate area of emerald network) - till 2030;
- Sustainable management of forest land areas, approved an candidate under the emerald network, by the respective responsible administrative entities, according to sustainable management plans, elaborated and adopted (implying support to such activities as arrangement of infrastructure, maintenance, cutting, reforestation, sanitary cuts etc).

6.3. Strategic directions for development of protected areas (2021-2023)

- Enlargement of protected areas by means of widening their areas and establishing new protected areas:
  - Protection and/or sustainable management of 38 ha forest land under the enlarged PAs. The LEPL Agency for Protected Areas (APA) will undertake special protection and/or management of 29 ha forest land of Javakheti PA and 9 ha forestland of Kolkheti PA;
  - Protection and/or sustainable management of 162 895 ha forestland under new PAs. The LEPL Agency for Protected Areas (APA) will undertake special protection and/or management of forestland in newly established PAs. Namely:

    1) Special protection of 7 393 ha of forestland in newly established Erusheti National Park;

    2) Special protection of 17 230 ha of forestland in newly established Racha National Park;

    3) Special protection of 28 835 ha of forestland in newly established Rach-Lechkhumi PA;

    4) Special protection of 41 759 ha of forestland in newly established Aragvi Protected Landscape;

    5) Special protection of 22 325 ha of forestland in newly established Svaneti Protected Area;

    6) Special protection of 12 366 ha of forestland in newly established Samegrelo Protected Area;

    7) Special protection of 8 208 ha of forestland in newly established Trialeti Protected Area;

    8) Special protection of 16 571 ha of forestland in newly established Dzama Protected Area;

    9) Special protection of 8 208 ha of forestland in newly established Ateni Protected Area.

6.4. Strategic documents

- NEAP3 for 2017-2021 („2017-2021 წლების საქართველოს გარემოს დაცვის მოქმედებათა მესამე ეროვნული პროგრამა“).
- INDC, GEORGIA’S INTENDED NATIONALLY DETERMINED CONTRIBUTION

- SUBMISSION TO THE UNFCCC
- Georgia’s 2030 Climate Strategy and 2021-2023 Action Plan” (in progress);
- Georgia’s Low emission development strategy (EC LEDS) 2030

6.5. Reporting on GHG emissions from LULUCF

Georgia’s Greenhouse Gas Inventories 1990-2015, NIR, 2019

Georgia’s Second Biennial Update Report, 2019

7. Report on Collection of data for Waste sector (by Medea Inashvili, Waste Sector Expert)

7.1. Report on data collection for Waste sector

Waste sector is a significant source of the GHG emissions, as reported in National GHG emission inventories, however, the sector is under major reforms and the LT LEDS should reflect the changes in course of the sector's development path, determined in its policy documents.

National documents determining the national policy in waste sector are as follows:

- Law on Licenses and Permissions 2005 (2005),
- Environmental Assessment Code – adopted in 2017 and substituting Law on Environment Impact.
- Waste Management Code (2015)
- Number of Technical Regulations on electronic and electrical waste; waste oils; batteries; accumulators; tyres; landfills; types of wastes; municipal waste collection, processing and transportation; incineration; animal wastes etc.

7.2. Strategic documents

- National Environmental Action Plan 3 for 2017-2021
- Waste management strategy for 2016-2030 and Action Plan for 2016-2020
- Biodegradable waste management strategy (draft)

7.3. Reporting on GHG emissions from waste

According to the latest, 2006 IPCC Guidelines for reporting GHG emissions, the source categories for Waste sector emissions are identified as

A. Solid waste disposal

B. Biological treatment of solid waste
   - Composting
   - Anaerobic digestion at biogas facilities

C. Incineration and open burning of waste
   - Incineration
   - Open burning

D. Wastewater Treatment and discharge
   - Domestic and commercial WW treatment
   - Industrial WW treatment

So far, Georgia has been reporting GHG emissions only from solid waste disposal and Wastewater Treatment and discharge. However, composting and incineration are already taking place and for the LT strategy all possible sources of GHG emissions should be considered in projections. Therefore, the data should be collected for every source of GHG emissions from the sector.

7.4. Data collection

There are different data required for different source categories of the sector.

7.4.1. Solid waste disposal

The set of data, necessary for projection of GHG emissions, is conditioned by the IPCC Waste Model, envisaged for their calculation. The model is recommended by the IPCC for estimation of SWD emissions and used for Georgia's CSAP (still in draft). The data requires by the model are presented in the table below.

Table 15. Data for IPCC Waste model for Solid Waste Disposal

Data, parameter, coefficient	Description	Availability, value	Note
MSW*	Municipal solid waste (mass)	Can be calculated from Total MSW landfilled, divided by MSWf.	In Georgia's case, only landfilled waste is available, not generated.
MSWf	Fraction of MSW landfilled	Either available (in some cases (e.g. for new modern regional lanfdfills should be 90%), or calculated from real masses of landfilled MSW and population, connected to this landfill.	In case of unavailability of real MSWf values, it is to be calculated from landfilled waste real values and population connected
Total MSW landfilled	Total mass of the generated MSW landfilled (=MSW*MSWf)	Available from Solid Waste Management Company (SWMC) at the MRDI	Weighed masses of existing landfills are available each year.
Composition	Percentages of different MSW fractions	Default fractions comprise: food, garden, paper, wood, textiles, nappies, plastics/ other inert, sewage sludge.	The fractions may be changed according to country-specifics
DOC	Degradable Organic Carbon contained in every fraction	DOC_i - Weight fractions corresponding to each fraction, default values are provided by the model	In national GHG inventories, CS values have been used for large cities and default values for regions. However, the model provides different values for each fraction.
DOCf	Fraction of DOC dissimilated	For each fraction, default values are provided by the model	In national GHG inventories, CS values have been used for large cities and regions. The model provides different values for each fraction.
K coefficient (k=ln2/t1/2(half-time)	Methane generate rate constant (t^{-1})	The model provides k_i default values for each fraction, based on chosen region (climate regime).	For Georgia, South-Eastern Asia is recommended. The values may be selected (for each fraction) from the recommended ranges. In Georgia's GHGI, single k coefficients were used for West and East Georgia.

			Namely, k=0.09 and k=0.06 have been used for West and East Georgia respectively.
F	Fraction of CH4 in generated gas	Default value = 0.5	In Georgia's GHG inventories individual values for large cities and regions have been used.
OX	Oxidation factor	Default value = 0, however, if the landfill is covered with ground material, OX may equal to 0.1. Should be justified	When the management practice of landfill considers covering it with ground(soil), the OX may be 0.1 (2006 IPCC GLs).
MCF	Methane Conversion Factor	MCFi default values are provided for different types of MSW management practices: different values for managed, unmanaged, well-managed, aerobic, anaerobic etc practices are provided (subject to modification by user).	For each part of MSW (going to well-managed or poorly managed landfill), proper values should be selected based on its management level(practice). Thus, all parts of the MSW that are subject to different levels of management, can be reflected in model.
Population*	Number of population (in mln) living in local area	Taken from GeoStat, local population by cities, regions, etc.	Tourist flows should be added for touristic locations.
MSW generated per capita* (kg/cap/yr)	MSW generated per person a year.	Not available (not measured, nor adopted value).	Should be calculated from total generated MSW (to be calculated itself from MSW landfilled and MSWf) and the connected population number.

**Generated MSW, MSW per capita and population values are interconnected as total MSW=MSW per capita * population, connected with the concrete landfill. Thus, model user may input two available variables' values to get the third.*

When selecting the parameters, preference will be given to more detailed values that the Model provides, however, subject to availability, country-specific circumstances and new data will be taken into account.

<u>Construction and demolition (industrial) waste</u>: In Georgia, officially, there is no landfill for inert waste. In practice, construction and demolition (C&D) waste from Tbilisi is landfilled in a separate site (111,560 t/yr) while in regions it is landfilled in common local landfills together with municipal solid waste. There are no data on quantities of such type of waste in regions. Thus, the assumption should be made that:

- For Tbilisi city, the emissions from C&D waste should be considered as zero and not accounted in masses of MSW landfilled.

- For other locations (regions) the fraction of inert materials (in the model) should be taken in consideration from the real measured masses of MSW landfilled, annually provided by SWMC.

7.4.3. Biological treatment of solid waste

- Composting
- Anaerobic digestion at biogas facilities

From this category, only composting is taking place in Georgia. Nowadays, there are two composting facilities in the country: In Kutaisi and in Marneuli, both oriented on composting green (organic) waste mechanically. Data provided may be used for calculation of GHG emissions.

Table 16. Data for composting activities in Georgia

Composting entities	Mass of green organic waste (t/yr)	Produced compost mass (t/yr)	Note
Kutaisi compost centre	2040 t (=10200 m3)/yr	1020 t/yr	Projected after the building of the center (3024 m2) is completed in December 2020 and the center gets operational: In 2020 - 300 t was projected (not realized) In 2021 - 500 t compost is projected Since 2022 - 1020 t product per year.
Marneuli compost centre	410 t/yr	80 t	Operating on small quantities, no license yet.
Ltd Mamuli			Composting of sludge from Gardabani WWTP

What about anaerobic digestion at biogas facilities, it is expected to take place in future and this kind of activity should be encouraged at animal and chicken farms. There are cases of composting from manure and wastewater sludge but data on quantities and type of composting are hardly available (Subject to interview).

Emission factors for all types of composting should be selected (or calculated) based on the types of the activity (default from 2006 IPCC GLs or country-specific) when operating.

7.4.4. Incineration and open burning of waste

- Incineration
- Open burning

So far, this category has never been reported in GHG emissions inventories of Georgia, and the last National GHGI (2019, reflecting 2017 emissions) reports incineration as NO (not occurring) and Open burning of waste – NE (not estimated). However, nowadays several incinerators are already operating in the country, and open burning does also take place in the country and needs estimation.

Incineration takes place in small incinerators, incinerating mainly medical waste (including animal waste). There are no incinerators for municipal solid waste.

No data on energy recovery from incinerators are available in the country (Subject to interview).

The IPCC GLs for GHG emissions inventories considers reporting on emissions from incineration of medical waste and provides default emissions factors for them. Collection of activity data for these types of waste will enable Georgia to report from this category.

Table 17. Entities owning licenses for incineration of medical and animal waste

Incinerators/entities operating in Georgia	Type of waste incinerated	Amount of incinerated waste per year*
LEPL National Food Agency	Animal waste incinerator	
Ltd Expressdiagnostics	Medical waste incinerator	
Imereti regional public healthcare centre (Kutaisi)	Incinerator of waste from Emereti epidemiologic monitoring centre	
Ltd Environmental Technologies	Veterinary diagnostic and expertise – central laboratory - waste mini-incinerator	
Ltd Environmental Technologies	'Bacteriophag' waste incinerator	
Ltd 'Medical Support and technology'	Incinerator of medical waste	
Ltd 'Ecomedi'	Incinerator of medical waste	
Ltd 'Chirina'	Incinerator of animal waste	
Kutaisi regional veterinary laboratory	Incinerator of animal waste	
Ltd Academician Ghudushauri National Medical Centre	Incinerator of medical waste	
LEPL NCDC	Incinerator of medical waste	
Akhaltsikhe veterinary laboratory epidemiology monitoring centre	Incinerator of medical waste	
LEPL NCDC – Batumi, Controlling and monitoring centre for plague and extremely dangerous infections	Incinerator of medical waste	
LEPL NCDC Tbilisi, Asatiani st.	Incinerator of medical waste	
LEPL Ecomedi (Samtredia)	Incinerator of medical waste	

*To be interviewed

Hazardous waste is mainly stored in special sites, with some parts of them – processed or recycled in a few entities licensed for such activity. No incineration of hazardous waste takes place in Georgia.

Open burning of municipal waste is occurring in the country but there are no data on amounts of waste burnt in the open air. In many countries open burning of waste and agricultural residues is prohibited by law. It is expected that arrangement of large modern regional landfills and closing non-standard small official landfills and unofficial dumpsites will diminish the cases of open burning. So far, Open Burning as a source of GHGs is not estimated in the last national GHG emission inventory.

7.4.5. Wastewater Treatment and discharge

- Domestic and commercial WW treatment
- Industrial WW treatment

Georgia reports on both CH4 and N2O emissions from this category in its GHG inventories, both from Domestic &Commercial and Industrial WW.

<u>CH4 emissions</u>

The calculations for CH4 from <u>Domestic &Commercial WW and Discharge</u> are based on 2006 IPCC GLs' recommendations on dividing the population by location (urban and rural) and income, and default parameters.

The CSAP shares the estimations for 2014-2017 years but proposes some country-specific coefficients based on real data provided from the three operating WW plants: Tbilisi (Gardabani), Batumi and Kobuleti. Thus, these data will be used for further projections from these plants and the population connected to their collectors.

Under the ongoing reform of the sub-sector, 7 new WWT plants are being constructed and 14 more are planned in nearest future, to cover the whole country. When this work is completed, a country-specific emissions factors and activity data will be accessible and used for calculation of the emissions, but before this happens, the approach and parameters used in Georgia's last National GHG inventory will be used for the part of the population that is not connected to collectors.

Table 18. Data required for calculation of CH4 emissions for the category Domestic & Commercial WW and Discharge

Parameter/data	Description	Value/accessibility	Note
BOD	Biological Oxygen Demand – level of contamination of the WW with biological organic material (kg or kg/person/day).	For Georgia's WWT plants calculated (estimated) from real data – measured BOD at inlet and outlet (g/ml), and real WW volumes. For the remaining part of the population – taken Greece's BOD as a nearby comparable country (0.057 kg/person/day).	In existing plants this parameter is (to be) measured daily as concentration (g/ml), thus, the volume of the WW is also needed to calculate the whole amount of degradable matter.
Population		For existing plants, the population numbers from statistics for the corresponding locations are used; For the rest of the population, the division into rural and urban and corresponding numbers are used in formulae.	
MCF	Methane conversion factor (fraction from 0 to 1), characterizes	For urban and rural parts of the population, not connected to collectors, different values (0.5 and 0.1) are selected from recommended	

	the WW management practice	by GLs ranges; For WW treated in plants, this coefficient depends from type of treatment (in our case, aerobic lagoons, MCF=0.2-0.3).	
Bo	Maximum methane producing capacity	Default value: 0.6 kg CH4/kg BOD	
Coefficient I	Coefficient for industrial influent in the WW.	I=1.25 if industrial influent is added into the domestic WW (For Tbilisi and Batumi plants). In other cases, I=1.	
Tplant	Degree of utilization of each treatment system	Used in the last GHG inventory (=45 for urban and =1 for rural population) from recommended by GLs range (0.1-0.8). This coefficient won't be used as the parts of the plants-connected WW and the remaining WW will be calculated separately.	
S	Sludge removed (quantity)	Sludge is removed only in plants. Thus, in GHG inventories its quantity was not accounted (=0 by default). For plants, S should be accounted, however, no data are available so far.	Ltd Mamuli (license-owner) aims at sludge de-methanization and use from Tbilisi-Gardabani WWTP. May serve as a data provider.
R	Methane recovery	Does not take place so far. However, some existing and new plants are planning to extract CH4 for using it as energy.	Tbilisi, Batumi, Poti, Zugdidi – the measure is planned.

The projections from the sub-sector will follow the population statistics for connected to the collectors and remaining inhabitants.

Industrial WW is not treated in plants and the WW is released in common sewage system. CH4 emissions from IWW is estimated in Georgia's GHG inventories based on specific production data from main industries and default coefficients (Bo, MCF and COD) from 2006 IPCC GLs. In CSAP projection of these emissions are following the GDP growth projections.

However, in case of better statistical data, the reporting can be improved, and in course of changed type of treatment the approach to the calculations will be changed.

N2O emissions

These emissions are reported in Georgia's GHG inventory only for Domestic & Commercial WW. As mentioned above, industries do not treat their WW in plants and release it in common sewage. Thus, N2O emissions are calculated as N2O emissions from sewage sludge, based on the methodology from old Revised 1996 IPCC GL. The only country-specific parameter there is protein consumption per capita. Thus, in CSAP the projections are following the population projection driver.

However, the new 2006 IPCC GLs consider two types of N2O emissions: direct (through WW treatment plants) and indirect (without treatment). Such approach acknowledges that normally, modern WWTPs feature the WW treatment with nitrification & denitrification function. The formula considers removed N from effluent and because of it, direct N2O emissions in effluent WW are negligible. But this is not a case in Georgia where the existing WWT plants do not feature such ability. Hence, the only N2O emissions taking place are indirect emissions. The formula provided by the IPCC 2006 GLs for indirect emissions is:

N_2O Emissions = $N_{EFFLUENT}$ • $EF_{EFFLUENT}$ • 44 / 28,

where the recommended default value for $EF_{EFFLUENT}$ is 0.005 kg N_2O-N/kg N,

and

$N_{EFFLUENT}$= (P* Protein *F_{NPR} * $F_{NON\text{-}CON}$ * $F_{IND\text{-}COM}$) – N_{SLUDGE},

Where **P** is population number,

Protein – protein consumption kg/pers/yr (identified in the last GHG emissions inventory),

F_{NPR} = fraction of nitrogen in protein, default = 0.16, kg N/kg protein,

$F_{NON\text{-}CON}$ = factor for non-consumed protein added to the wastewater, for developing countries this fraction is 1.1 (default),

$F_{IND\text{-}COM}$ = factor for industrial and commercial co-discharged protein into the sewer system, the default for this fraction is 1.25,

N_{SLUDGE} = nitrogen removed with sludge (default = zero), kg N/yr. (Subject to interview)

The formula is based on mostly default parameters and only one country-specific activity data that is protein consumption per capita. This value should be taken from the latest GHG inventory until a new one is calculated and adopted.

In projections, the population data will follow the projected growth rate, until the new WWT plants are in place with nitrification & denitrification ability (if any). For industrial WW, there is no low to prohibit release of WW untreated. Until it is adopted, the coefficient FIND-COM = 1.25 should be used to reflect the industrial component in the WW.

<u>Further interviews with corresponding experts and agencies will be held to complete the information on data necessary for calculation of GHG emissions from the sector.</u>