Approved by Batumi City Council on 27th March, 2014
Resolution #54

Batumi Sustainable Energy Action Plan

Batumi, 2014

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1 Introduction – Covenant of Mayors and Batumi City

In October 2010 the conference dedicated to the Covenant of Mayors was held in Georgia highlighting the importance of cities as of complex system in mitigation of emissions of greenhouse gases. The municipality was determined as key player in development and implementation of Sustainable Energy Action Plan (SEAP), within the frame of energy efficiency priority defined by EU.

In 2011 Batumi joined this initiative by signing the Covenant of Mayors, which aims at mitigation of the emissions of greenhouse gases at least by 20% in 2020 – the goal which should be achieved together with social and economic development of the city.

In purpose to achieve mentioned goal the city hall of Batumi elaborated Sustainable Energy Action Plan which uses the materials of simplified action plan prepared by UNDP/GEF project – "Third National Communication to the UN Framework Convention on Climate Change" (hereinafter Third National Communication), as well as of Economic Development Strategy of Batumi city [1]. Sustainable Energy Action Plan comprises as following:

- Greenhouse gases emission inventory in the sectors of transport, buildings, street lights, waste and greening;
- Preparation of Business As Usual Scenarios of the emissions of greenhouse gases, for these sectors;
- Definition of the measures for mitigation of the emissions of greenhouse gases and their reduction by 2020 in these sectors;
- The monitoring plan;
- Local capacity building and awareness strategy

The rate of economic growth of Batumi, population trend and GDP growth per capita provided grounds for development of BAU scenario and planning particular activates for reduction of energy consumption in the city and mitigation of CO_2 by 2020. Implementation of the activities provided in this plan ensures at least 22% of greenhouse gas emissions are mitigated in the sectors discussed for Batumi by 2020, compared to BAU scenario.

2 Batumi City – Brief Overview

Batumi is administrative center of Autonomous republic of Adjara. It is self-governing city since 2006. Territory of Batumi compiles 6494,31 hectares. It is located on 2-5 meters above sea level, on Kakhaberi lowland and has shape of crescent. The city is spread from north east to south west on 7 kilometers. Main part of Batumi borders with the bay form south and is developed in the north section of Kakhaberi lowland; from the north east it is developed alongside with the rivers Bartskhana and Korolistskali. It is situated in 368 kilometers from Tbilisi.

Function of Georgia as of transport corridor was significantly increased (Europe, Caucasus, Asia) since 90s. Along with development of close economic relations with neighboring countries and in general deepening regional cooperation, the role and function of Batumi as of land and sea gate of Georgia, with its marine and railway transport was increased naturally.

[1] Economic development strategy of Batumi city was elaborated for the period of 2012-2015 by Economic Policy Development Department of Batumi City Hall, in 2011.


Batumi is big transport node of the country, where marine, railway and motor communications are accumulated. Big marine transport operations are implemented here. Batumi as the last point of Baku – Batumi railway and pipeline, is the oldest and the most important port, for transportation of oil in Caucasus, on whole coast of the Black Sea. It is equipped with modern equipment and provides services to big ocean tankers.

The cargos of the city and its surroundings have significant share in total turnover of transit freight. Loading – unloading processes for dry freight are fully mechanized. The turnover of dry freight terminal is increased since 2000 to 2012 in 78%[2]. New marine station is constructed. Passenger transportation to far and local routes is also important. Modern highways connect Batumi with the most important centers of Georgia, with internal regions of Adjara and Turkey. International airport, opened in 2007 serves the city as well as whole region. It is to be mentioned that one of 2 check points between Georgia and Turkey - Sarpi is located in 18 kilometers from Batumi and the freights to other regions of Georgia, Azerbaijan and Armenia are transported through Batumi.


Recently, Batumi became one of the most demanded tourism locations in Georgia. It is popular not just in the country, but in the region as well. Bog flows of tourists come from Europe and America. The highest figure was recorded in 2009 - 400 000 persons. Construction of modern hotels and entertainment centers is intensive in Batumi. Dolphinarium was opened in 2010. In

[2] Source – Batumi port official website www.batumiport.com

2009 also the boulevard of Batumi was extended in 1,5 kilometers and now is more than 7 kilometers. The hotels of Sheraton, Radisson and other brands are operating in Batumi.

With its climate Batumi is subtropical, humid district (humid climate zone, with warm, mild winter and hot summer). According to meteorological service of Batumi airport, average annual temperature on this territory is 14.3°C (1947-1960), average temperature of the coldest month (January) is - 6.50°C, and of the hottest one – (August) - 22.6°C. Absolute minimum is minus 9°C and absolute maximum is 40°C. The sum of active temperatures (higher than +10°C) is 4340 degrees. Average annual relative humidity of the air is 75%. Heavy showers are quite frequent in Batumi, total of precipitations is 2532mm, the most of which fall in September and compiles 322mm, and the least of them come in September and compile 86mm. Average annual speed of wind on territory of Batumi airport compiles 4.6 m/sec. South east and south west winds are prevailing.

As demonstrated by Figure 1, total population size had been increasing systematically until 1989. In 1989 – 2004 due to complex political and socio economic condition, developed in Georgia, the population migrated intensively abroad as well as to other regions of Georgia, especially to capital city. Unprecedented increase of Batumi city population in recent years can be explained by improved demographic condition, social economic development of the region and extension of Batumi city territory (the boundaries of Batumi and Khelvachauri municipalities were changed and 4 territorial units were added to Batumi); according to the data of 1 January 2013, the population of Batumi compiled about 170 thousand persons.

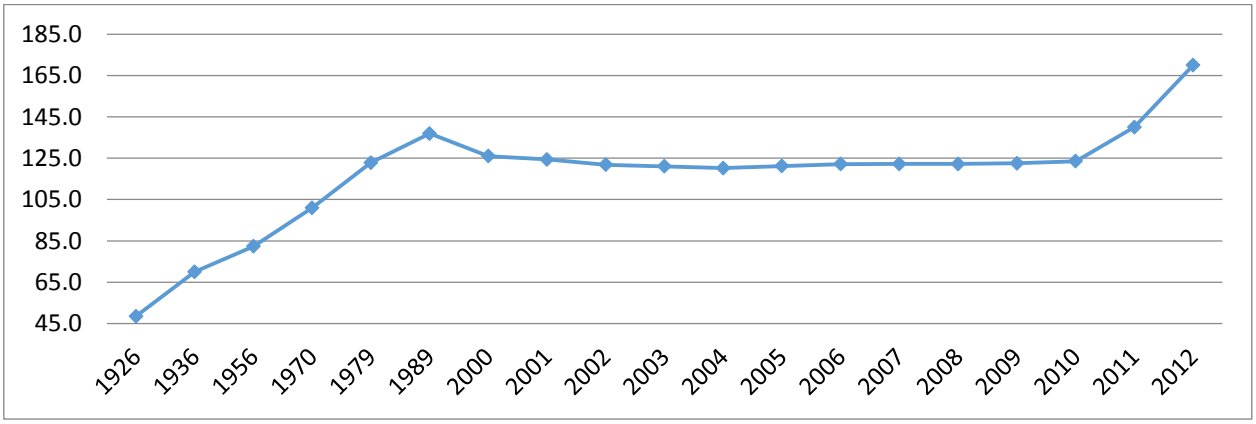


Figure 1. Batumi population size (thousands)[3]

Population of Batumi is quite young. 24% of Batumi population compile children, while working population - 63% and pensioners - 13%. See image **Error! Reference source not found.**.

[3] *Source – Batumi city hall*

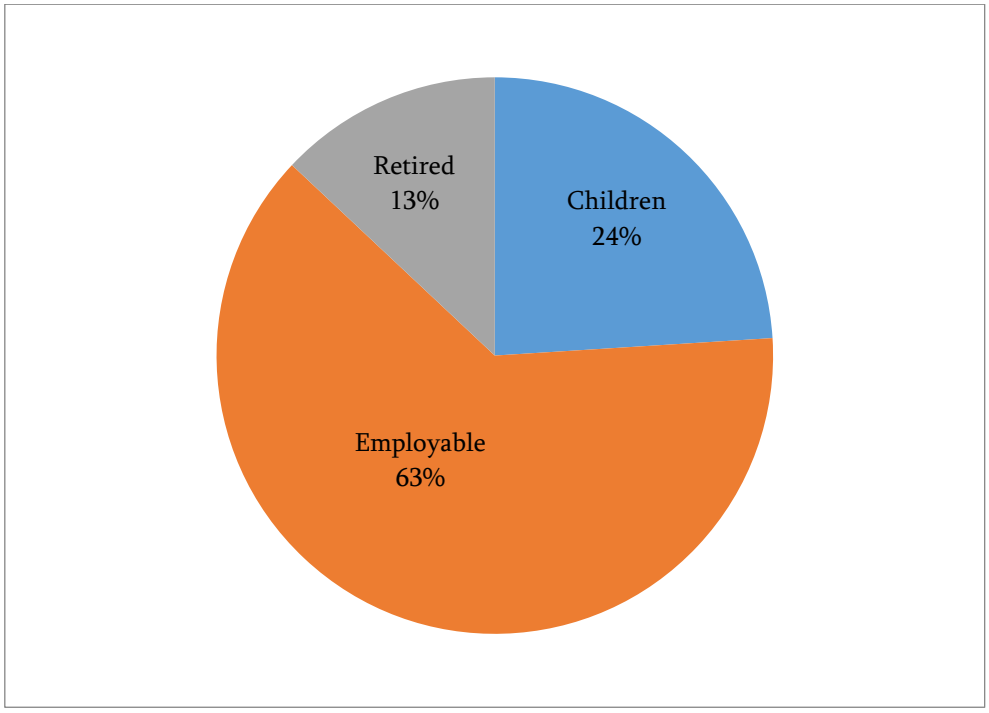


Figure 2. Structure of the population of Batumi city according to Population Census 2002.

No statistical data are available on employment in Batumi; however based on general data of Adjara the trends could be identified. As provided by Figure 3, after 2007 positive dynamic in terms of the increase of economically active and employed segments is obvious.

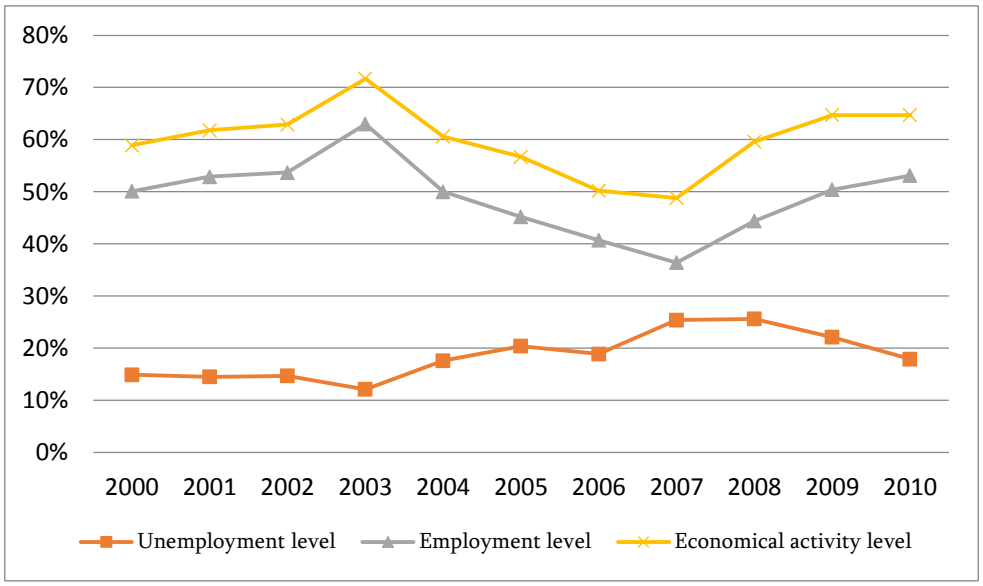


Figure 3. Employment unemployment rates in Adjara 2000-2010

Figure 4 demonstrates the growth of gross added value in the region up to 2012 and the same indicator for Batumi city up to 2010. Since no dramatic changes took place in the region in 2011 – 2012, we can assume that the growing trend of added value of Batumi was identical during

this period. This means that the indicator of gross value added and GDP level respectively, exceeded almost twice to respective indicators of 2006.

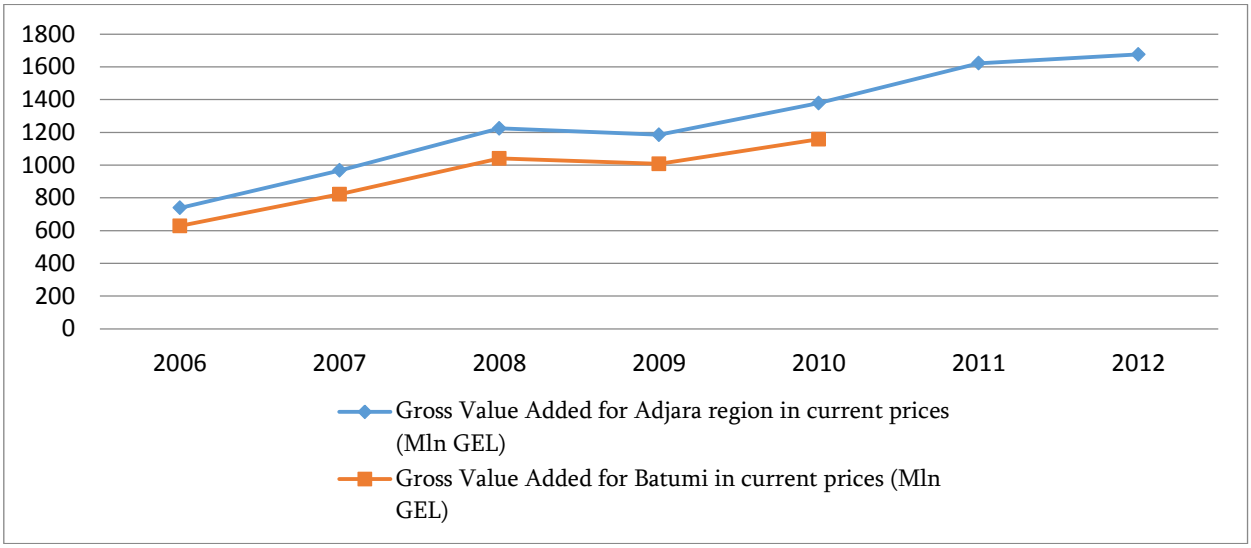


Figure 4. Gross Value Added of Adjara and whole region

In 2010 "Other services" had the biggest share in the structure of GDP produced in Batumi city (main part of which is tourism) – 19%, public governance field – 17% and trade – 12%.

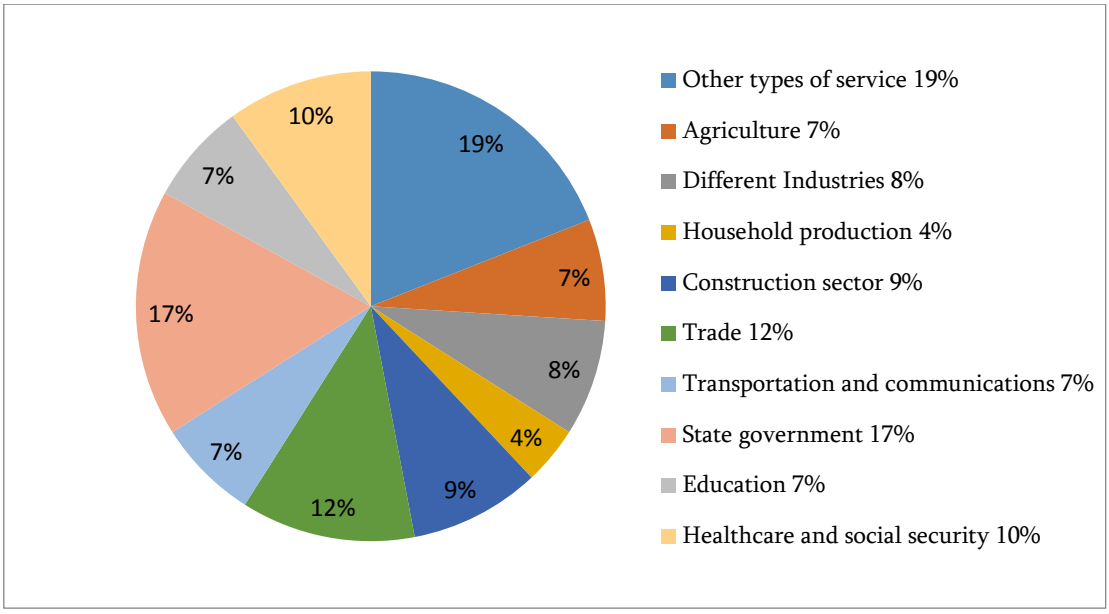


Figure 5. GDP of Batumi city by sectors 2010

During this period Batumi city budget was significantly increased compared to previous years (see Figure 6), which is associated with transformation of Batumi into one of the most important cities of Black Sea region.

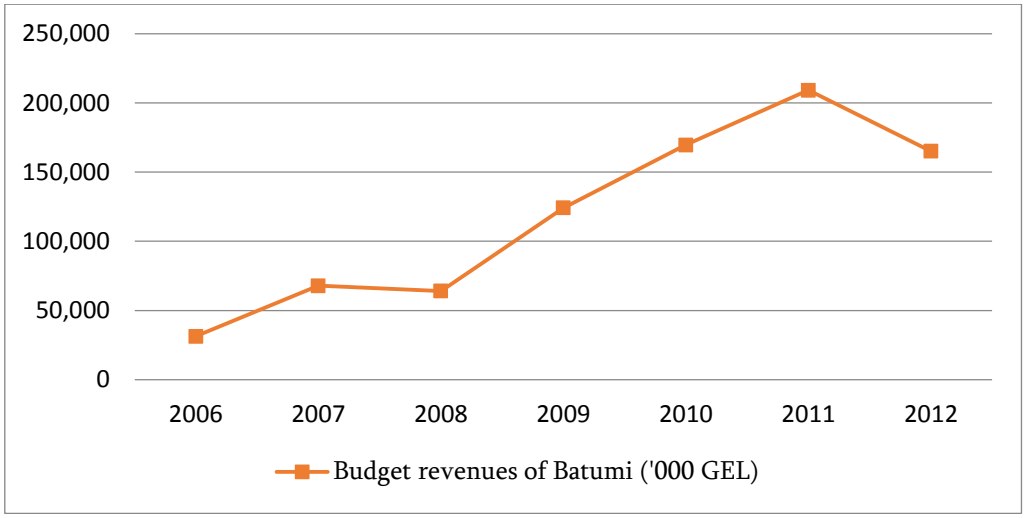


Figure 6. Revenues for Batumi city budget

Main part of financial resources is directed to development of tourism, transport and utilities infrastructure, economic activities, culture and sport as well as to protection of environment. Distribution of the budget of Batumi city for 2012 is given on the Figure 7, in program profile, while Figure 8 describes annual dynamics. It is to be mentioned that great part of the budget is dedicated to implementation of the activities, which are in compliance with Sustainable Energy Action Plan. This will significantly simplify the task of implementation of SEAP and achievement of desired results.

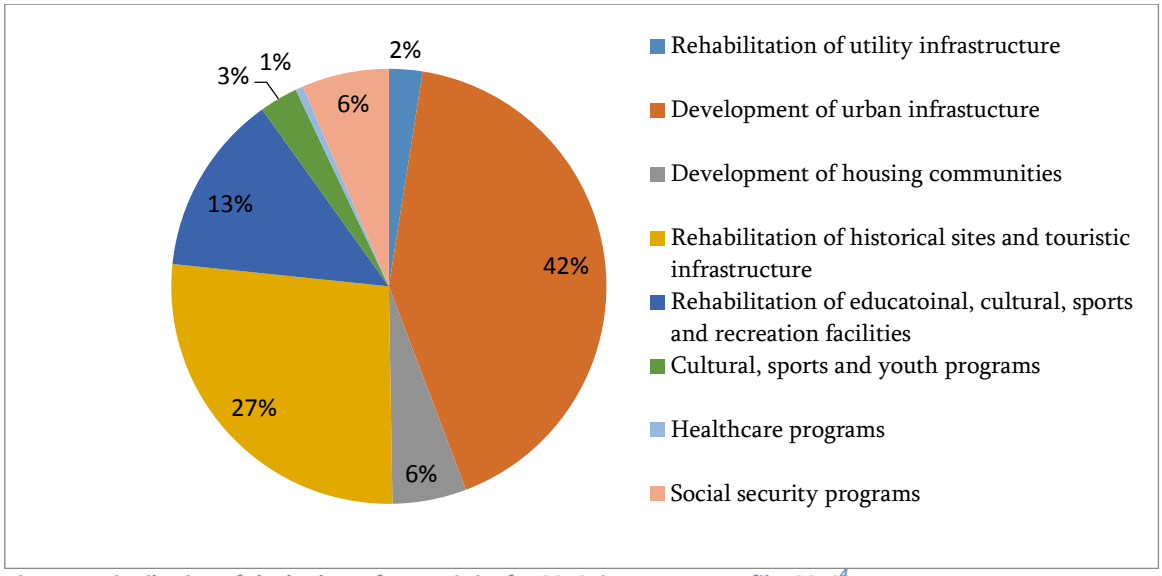


Figure 7. Distribution of the budget of Batumi city for 2012, in program profile 2012[4]

[4] *Source: Economic policy service of Batumi city hall*

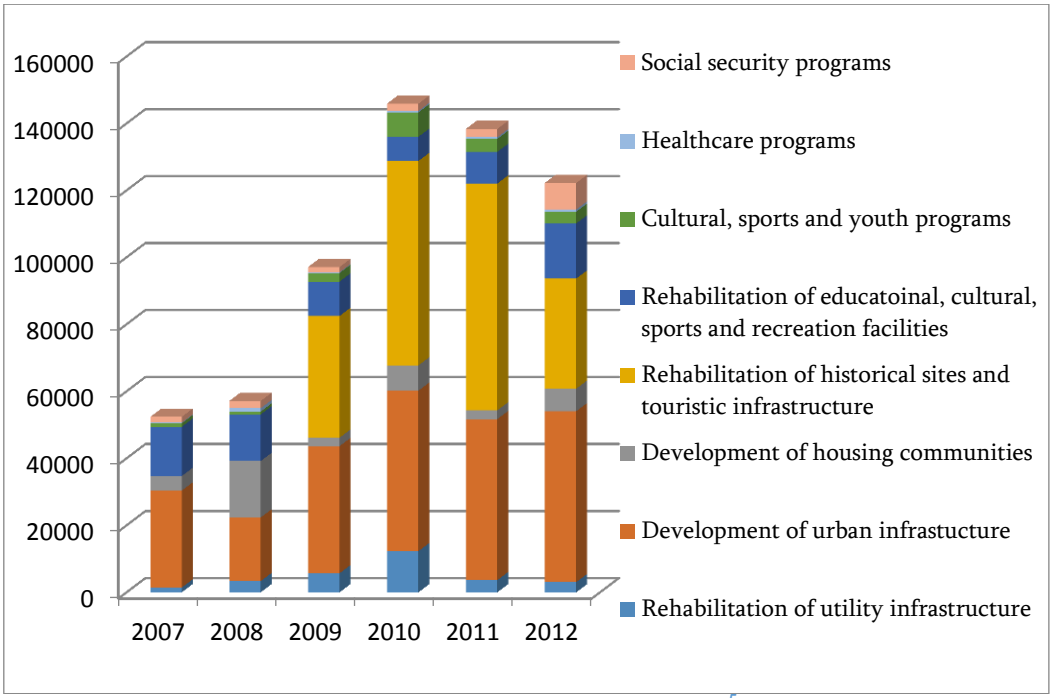


Figure 8. Distribution of the budget of Tbilisi city by years (thousand GEL)[5]

3 Sustainable Energy Development Strategy

Although not the largest city of Georgia, Batumi is distinguished with its high economic growth, ambitious infrastructure projects and unprecedented measures for the touristic development. A dingy and impoverished corner of the former Soviet Union just a decade ago, Batumi now is a glitzy Black Sea resort, with sparkling lights, dancing fountains and vibrant night life.

Despite significant achievements, Batumi still faces many of the problems characterized for a developing country, namely, low salaries, barrack-type settlements and a lot of buildings and infrastructural facilities that need to be renovated.

With the ambition to grow farther and foster its economy and a challenge to solve its social problems, Batumi sets a new, even more ambitious goal – to grow and prosper as a sustainable city - a city that is inhabited by people that care about environment and about the future. With this vision in mind, this Sustainable Energy action Plan (SEAP) has been developed.

The main goals of Batumi SEAP are to:

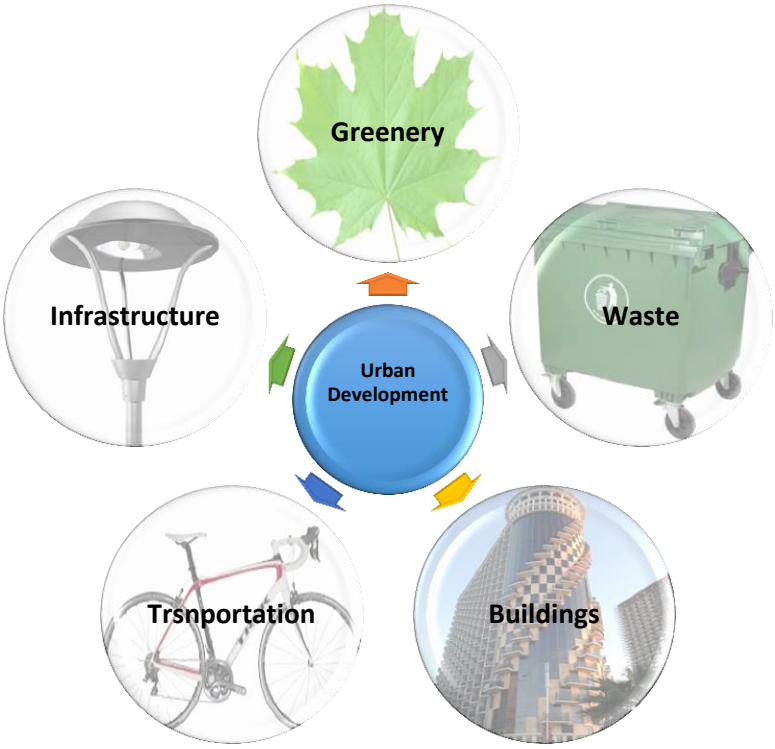
- Improve the living conditions in Batumi and conditions for developing tourism.
- Promote development of tourism and economy.
- Improve the local environment and this way to contribute to the solution of global environmental problems.

Sustainability is important to ensure that the social, environmental and economic systems that make up our community are providing a healthy and meaningful life for residents and visitors. As for every developing and enlarging city, urban development has an important place among the

[5] *Source: Economic policy service of Batumi city hall*

priorities of Batumi and influences the city population, as well as the tourists. Activities planned in this direction can impact the population, as well as contribute to the mitigation of greenhouse gas emissions produced by the tourist activities. This is why this SEAP was immediately developed together with the identification of this priority.

By taking into account the principles of sustainable urban development, the main sources of greenhouse gas emissions in Batumi are discussed, namely, buildings, transportation, waste and infrastructure, emission mitigation and greenery measures. Planned and implemented urban planning will have a long-term impact on the sustainability of the city.



Urban Development | Transportation

The strategy envisages the following activities for mitigating emissions of greenhouse gasses from the transportation sector:

1. Promoting active movement. Active forms of movement, for example, bicycle and foot movements, which are useful both for the environment and health of human being. Giving a priority to the pedestrians and cyclists in the urban planning will also increase attractiveness of the city. The activities in this direction include:

- Propaganda of the foot and bicycle movement as the healthy lifestyle among the population and tourists (short-term strategy).
- Arranging biking trails. Ensuring the possibility of hiring the bicycles for the tourists and planning the tourist routes (short-term strategy).
- Arranging walking and pedestrian streets, where car transportation will be banned (long-term strategy).

2. Decreasing the necessity of the movement. The necessity of the population is determined by the fact that residential districts are separated from the districts where offices, commercial services, schools and other important infrastructural facilities are located. This is why it is important to use the mixed type of urban planning, which will significantly reduce the necessity of movement. The following is discussed in this direction:
    - Designing the districts of mixed use, when commercial, entertainment and other types of services are accessible in all districts (short-term strategy).
    - Promoting electronic service, when many necessary services can be received by the population and tourists via internet. This mainly concerns state services, issuance of various notifications, taxation service etc. (short-term strategy).
3. Setting limits for the use of high-emission cars. Private cars represent one of the largest sources of emissions in Batumi, as well as other towns of Georgia. Despite the fact that the private cars are one of the important transportation means, in large quantities they deteriorate the quality of life and hinder creation of a pleasant environment for the tourists. Decreasing the use of the private cars has many positive effects, namely: decreasing financial expenditure of the population and the tourists, decreasing the noise, improvements of air pollution indicators, and mitigation of greenhouse gas emissions. The main activities in this direction are:
    - Improving the infrastructure of public transportation, which includes accessibility to transport categories, planning of routes and stops so that the public transportation is available from all places of the city (short-term strategy), developing the categories of the public transportation (in the long-term category), which includes tramway, electric taxi, rope-way etc.
    - Promoting the use of public transportation, which includes dissemination of information among the population and organization of promotional events (short-term strategy).
    - Transition to the energy efficiency technologies, at first stage, using natural gas in the private, as well as municipal transportations (short-term strategy), and afterwards electric transportation (long-term strategy). Special attention should be paid to the development of electrical transportation (tramway, electric taxi, and rope-way). Also, it is expected that in the future the electricity grid emission factor will be

substantially mitigated in Georgia, because according to the national policy of the government, it is planned to significantly increase the share of the hydroelectricity power stations in the total volume of electricity generation.

- Organization of centralized parking places at the entrance of the city, which would allow the tourists to leave their cars at the special parking places and use the public transportation in the city (long-term strategy).

Urban Development	Buildings

Strategy used when discussing mitigation of the emission of greenhouse gasses from the sector of the buildings

1. Increasing energy efficiency in the municipal residential buildings. Energy efficiency is one of the most economical ways to mitigate emissions. Energy efficiency often means changing the style of the construction, which includes changes in the design, building materials and components. It is noteworthy that this could have relatively low cost, although in the cases when decisions about the energy efficiency are made at the early stage of design and planning. In this direction, the following projects are reviewed:
    - Adding energy efficiency criteria to New House, the new project of Batumi City. The goal of this project is to offer cheap houses to the population, according to their prime cost. The energy efficiency criteria will be added to the existing construction criteria for these houses.
    - In the municipality buildings, where construction works are planned (kindergartens, new municipality buildings), works for improving the insulation of the building will be added to standard construction work.
    - Promotion of energy efficiency devices (lighting devices) in the residential, as well as the municipality buildings.
    - Mitigation of the urban heat island effect, selection of the building designs and reflective colours during the urban planning of the city, the urban planning of the city in order to improve natural ventilation.
    - Elaboration of new construction norms ensuring the use of energy efficiency measures in the new buildings (long-term strategy).
2. Increasing energy efficiency in the commercial sectors. Inclusion of the commercial sector is one of the prerequisites for achieving energy sustainability of the city. This is why it is important to plan the activities for cooperating with the private sector.

Awareness raising campaigns, as well as technological exhibitions and seminars will be organized. Special attention will be paid to raising energy efficiency in the touristic buildings, because tourists are considered as one of the strategic directions for the development of Batumi's economy.

Urban Development | Infrastructure

Strategy of the mitigation of greenhouse gasses from the infrastructure sector considers:

1. Rehabilitation of Batumi outdoor lighting system according to the modern standards. The following directions are discussed here:
    - Full rehabilitation of Batumi outdoor lighting system to bring it to the modern standards.
    - Designing the audit system of Batumi outdoor lighting and its development.
    - Equipping the outdoor lighting poles with modern energy efficient and energy saving light bulbs.
    - Establishment of a computerized lighting system with a single control.
    - Introduction of external lighting system management and monitoring software.
    - Elimination of energy losses in the external lighting system.

Urban Development | Waste

Strategy of mitigation of methane from the waste sector includes:

1. Installing the methane gas extraction system on the old landfill of Batumi and wastewater treatment plant and using for electricity generation. The old landfill and the wastewater treatment plant are located so close to each other that it is possible to collect methane

generated at both places and use it for electricity generation, which will be used for highway lighting in the vicinity.

2. To install methane gas extraction and flaring or utilization on-site systems at Kobuleti new landfill.

Urban Development Greening

Batumi's Greening Strategy considers:

1. To conduct annual regular planting works in Batumi. The planting plan will be a part of the urban development plan, under which the works will be designed and implemented with the purpose of an annual increase of urban greening and green cover.

The results of SEAP

The Batumi SEAP methodology does not involve the use of a fixed base year, which contains very high risks for the process of the city development and makes almost impossible to fulfil the city's commitments. The method, which is used, envisages perspectives for the city development and necessary growth in emissions (energy demand) for 2020.In particular, for the growth trend for 2020, the forecast of the emissions on the territory of the city is made by taking the following parameters into account: population, GDP, elasticites, population revenues and other parameters. The traditional development scenario (BAU) is considered, mitigation is planned as a results of the implementation of a variety of events and projects. Assumptions and projections for each sector made when designing the traditional development scenario are described in the relevant sections. Here, total inventory results for 2012 and 2020 are discussed and mitigated emissions as a result of SEAP activities are evaluated.

Table 1. Greenhouse gas emissions in Batumi in 2012 (tonnes of CO2 equivalent.)

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]						
	Electricity	Natural gas	Liquid gas	Diesel	Gasoline	Other biomass	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:							
Municipal buildings, equipment/facilities	2 832.3	292.0	21.8	127.6	0.0	5.5	3279.31
Tertiary (non municipal) buildings, equipement/facilities	13 115.8	5 430.1	0.0	0.0	0.0	0.0	18545.89
Residential buildings	21 621.7	26 348.9	14 797.5	0.0	0.0	7 068.8	69836.84
Municipal public lighting	1 959	0	0	0	0	0	1959.32
Subtotal buildings, equipments/facilities and industries	39 529.1	32 071.1	14 819.3	127.6	0.0	7 074.2	93 621.4
TRANSPORT:							
Municipal fleet	0.0	0.0		16.0	69.2		85.2
Public transport	0.8	672.0		61 525.8	6 382.4		68 581.1
Private and commercial transport	8.0	1 358.0		19 849.3	38 633.7		59 848.9
Subtotal transport	8.8	2 030.0	0.0	81 391.1	45 085.3	0.0	128 515.2
OTHER:							
Waste management							14910.0
Waste water management							22743.0
Total	39 537.9	34 101.1	14 819.3	81 518.7	45 085.3	7 074.2	259 789.6

Table 2. Greenhouse gas emissions in Batumi in 2020 (tonnes of CO2 equivalent.)

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]						
	Electricity	Natural gas	Liquid gas	Diesel	Gasoline	Other biomass	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:							
Municipal buildings, equipment/facilities	3 194.7	536.8	26.6	124.4		4	3886.5
Tertiary (non municipal) buildings, equipment/facilities	14 793.9	9 981.6					24775.5
Residential buildings	28 674.8	62 968.3	13 293.0			5950.3316	110886.5

Municipal public lighting	2 222						2221.6
Subtotal buildings, equipments/facilities and industries	48 885.1	73 486.7	13 319.6	124.4	0.0	5 954.2	141 770.1
TRANSPORT:							
Municipal fleet	0.0	0.0		3.5	104.5		108.0
Public transport	1.5	104.3		86 467.7	6 101.7		92 675.2
Private and commercial transport	9.2	384.9		31 014.8	99 724.5		131 133.4
Subtotal transport	10.7	489.2	0.0	117 486.0	105 930.7	0.0	223 916.6
OTHER:							
Waste management							30036.3
Waste water management							42560.91
Total	48 895.8	73 975.9	13 319.6	117 610.4	105 930.7	5 954.2	438 283.9

Table 3. Emission savings in various sectors according to Batumi SEAP

Sector	Savings (tonnes of CO2 EU)
Transport	26 375
Buildings	19 641
Lighting	1 215
Waste (solid waste and wastewater)	49 067
Greenery	680
Total:	96 977

As the table demonstrates, the priority is the implementation of measures in the waste sector (especially in the wastewater sector). Iintroduction of the public transport working on electricity and compressed natural gas are the priorities.

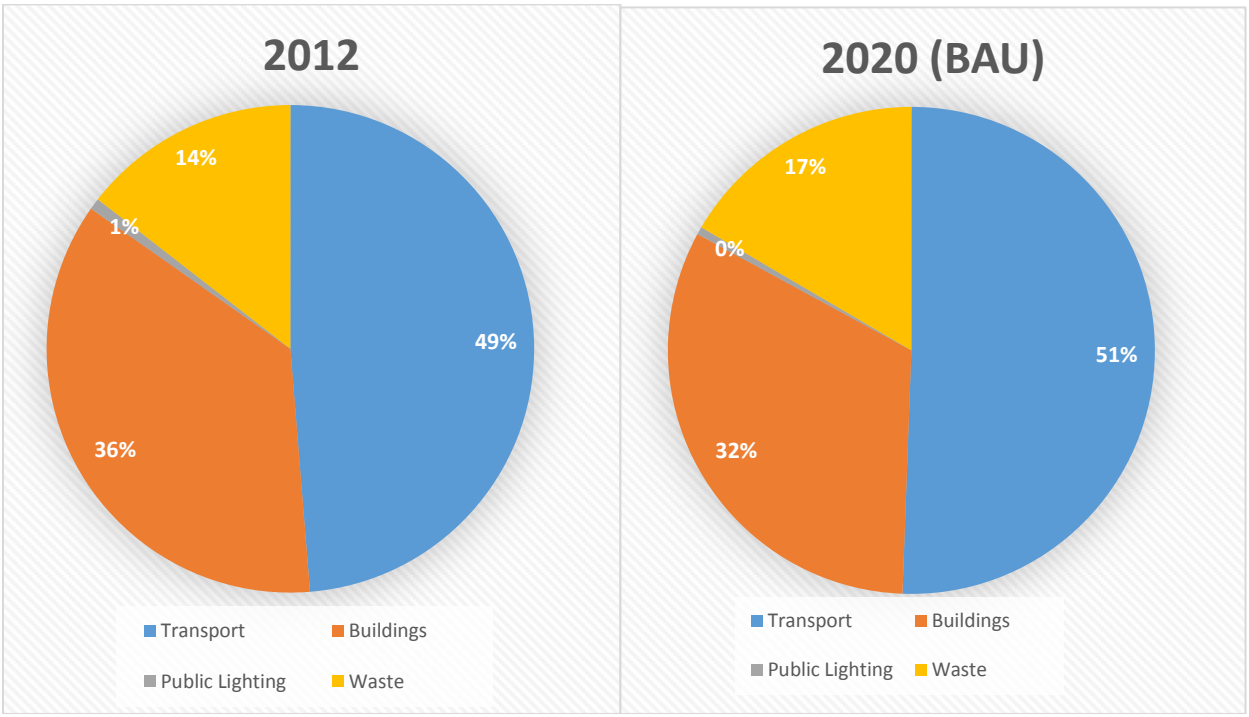


Figure 9. Distribution of emissions by sector for 2012 and 2020 years.

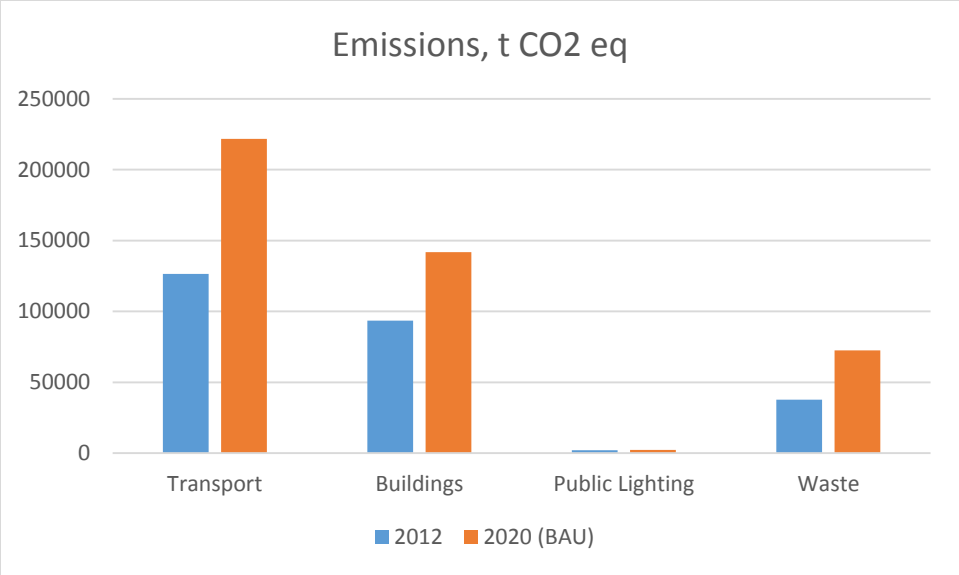


Figure 10. Emissions growth in various sectors

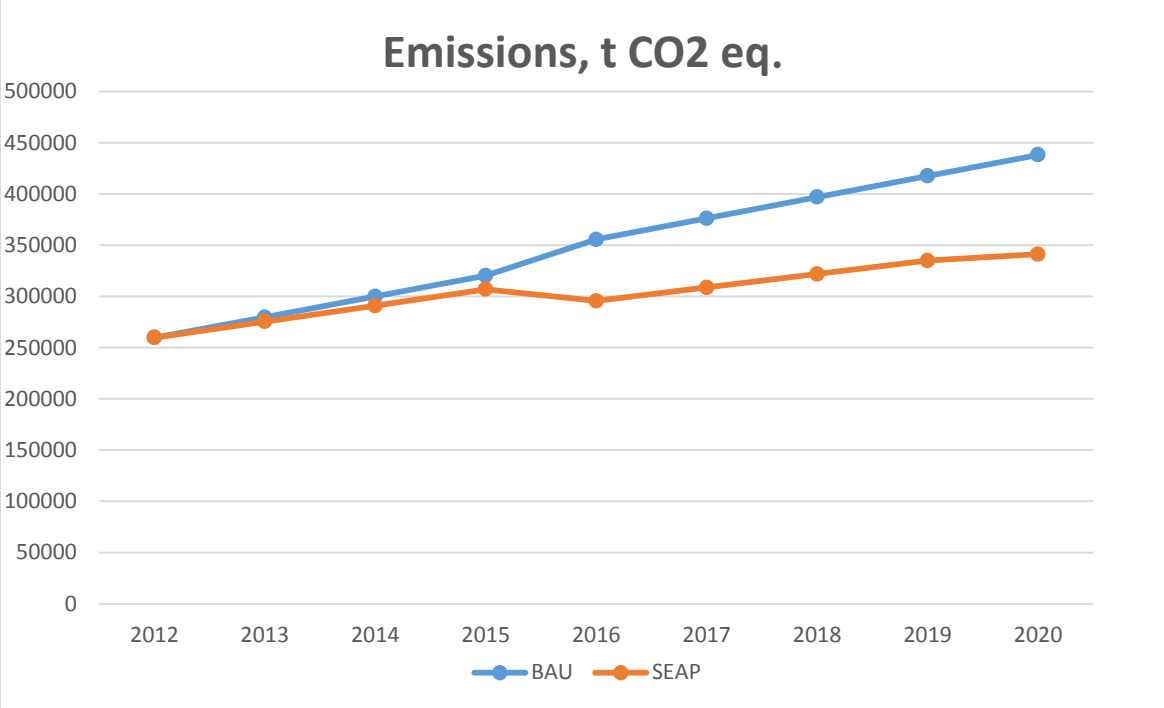


Figure 11. Emission savings in comparison with the traditional development scenario in SEAP

4 Transport

4.1 Sector Overview

Batumi is one of the most densely populated and fastest growing cities in Georgia. According to the Department of Statistics, its population was recorded as 121.0 thousand people in 2003. This number reached 140.0 thousand for the year 2010 and 170 thousand for 2012 that is partially due to newly joined territories of Batumi. Based on the regional allocation principles, the city is divided into 13 territorial units/districts: Old Batumi; Rustaveli, Bagrationi, Aghmashenebeli, Javakhishvili, Tamari, Khimshiashvili, Boni-Gorodok, Airport;

4 more territorial units/districts were added in 2011: Kakhaberi, Batumi Industrial, Gonio-Kvariati and Green-Cape.

Dynamic development of the city and closeness to the separate populous settlements of the neighboring municipalities, required territorial growth of the city to ensure their rapid and continuing development. So borders of the city changed twice:

- Up to 2009 the city's territory was 19.5 km2;
- In 2009-2011 – 25 km2;
- From 2011 – 64.94 km2;

The grid of streets is primarily based on the planning decisions made in the second half of the XIX century. The road network has been formed as a rectangular grid in accordance with the functional differentiation of the streets. Longitudinal axis of the streets are inclined towards the sea and are mostly oriented on the North - West - South - East and South - West - North - East direction. Step of the rectangular grid change close to the oldest part of the city near the port. Network of the city becomes more frequent here. There are open drainage channels along the streets. In terms of vertical planning, slopes of the longitudinal profiles are small equaling to 0,005 and in some cases only 0,003. A transverse profile of the streets is quite well-designed. Their width between the development lines is 20-25 meters. In designing of Batumi the main attention was paid to the frontal area development – the streets width ratio in full compliance with the normative requirements and aesthetic preferences. Mentioned approach ensures attractiveness and unique character of the developed urban environment of the city.

One of the distinguishing features of the city is that it is constructed on roman planning. It is accurately divided into squares by parallel streets (pic.12) that significantly facilitates the traffic.

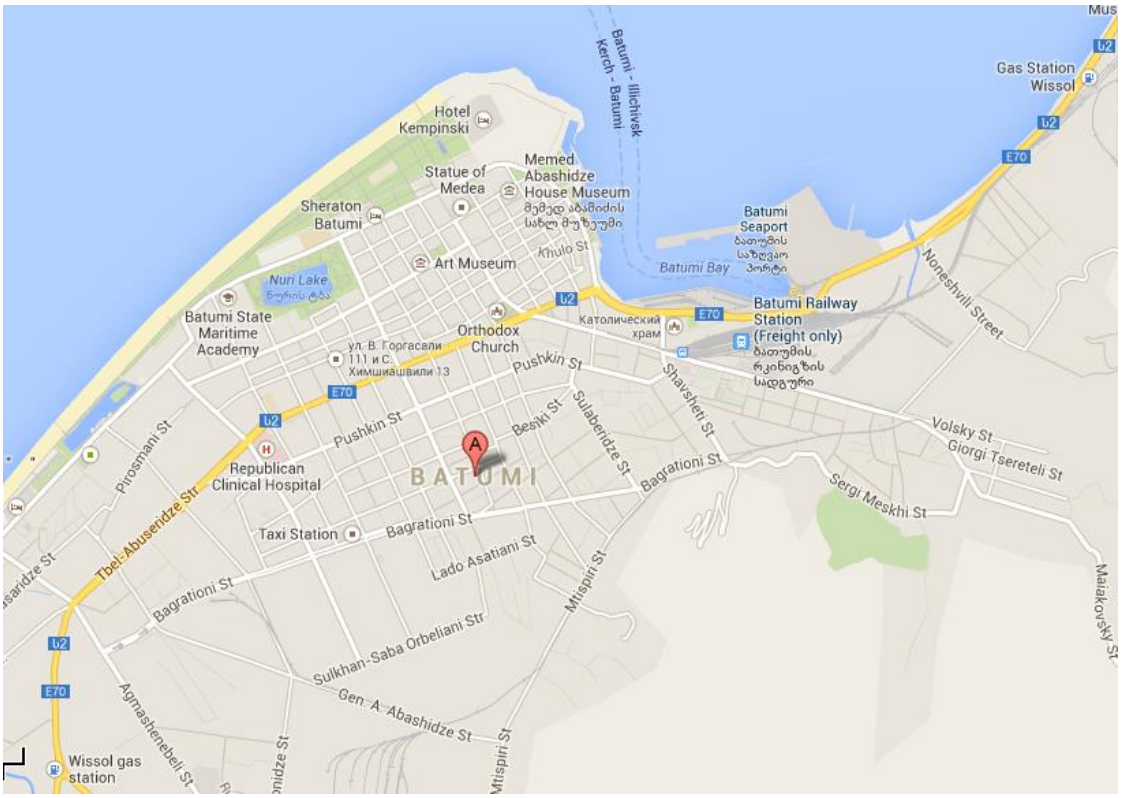


Figure 12.Batumi streets structure

An increase of the city's population have led to the significant growth of the traffic flow causing the rise of CO_2 emissions from the transport sector and as well as other related factors - overloaded traffic conditions, green line loss, environmental pollution and excessive noise.

In 2011 the greenhouse gas emissions of the energy sector of Adjara amounted to 276.4 thousand tons in CO_2 equivalent, 53% of which goes to the transport sector. The largest part (86%) of emissions from the transport sector is being spread from the territory of Batumi.

Development of the transport sector is basically linked to the growth of the city itself and an internal migration of the population.

In accordance with the data of 2012, an average number of vehicles moving around the territory of Adjara was 650000, the main load was on Batumi of course. It is also worth mentioning the role of Batumi as the tourist city, where the demand on transport services increases significantly during tourist seasons.

Table 4 shows conditions of vehicles by fuel types being in the permanent ownership in the years of 2009-2012 in Batumi.

Table 4. Transport being in permanent ownership in Batumi (cars)

Vehicles	**Cars (except for taxi and municipal transport)**				**Transport of Batumi municipality**			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline vehicles	15 400	16 355	18 200	24 700	40	45	60	78
Diesel vehicles	1 500	1 700	2 100	4 800	4	3	2	15
Electric vehicles	1	3	15	25	0	0	0	0

Natural Gas vehicles	68	102	356	1 450	0	0	0	0
Total	**16 969**	**18 160**	**20 665**	**30 970**	**44**	**48**	**62**	**93**

Table 5. Vehicles being in permanent ownership in Batumi (public transport)

Vehicles	**Taxi**				**Buses**				**Minibuses**			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline vehicles		458	360	650	120	118	85	85	120	118	85	110
Diesel vehicles	210	260	420	510	800	1 100	1 568	1 660	800	1 100	1 568	1 600
Electric vehicles	0	0	0	25	0	0	0	0	0	0	0	0
Natural gas vehicles	5	4	17	100	11	5	3	12	11	5	3	15
Total	**545**	**722**	**797**	**1 285**	**931**	**1 223**	**1 656**	**1 757**	**931**	**1 223**	**1 656**	**1 725**

Table 6. Vehicles being in permanent ownership (commercial transport)

Vehicles	Small Trucks (up to 2 tons of cargo)				Big Trucks			
Fuel Type	**2009**	**2010**	**2011**	**2012**	**2009**	**2010**	**2011**	**2012**
Gasoline vehicles	15	12	25	50	2	3	0	0
Diesel Vehicles	150	241	305	425	95	158	230	310
Total	**165**	**253**	**330**	**475**	**97**	**161**	**230**	**310**

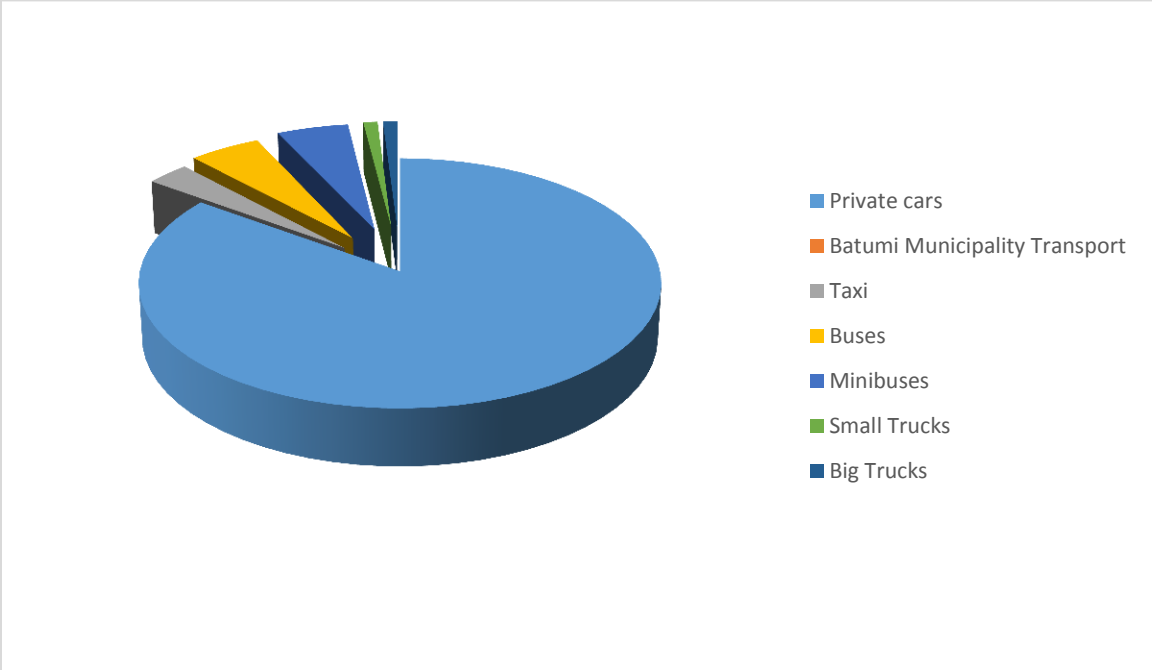


Figure 13. Number of vehicles in the city in 2009-2012

Traffic intensity in Batumi, as in the tourist city is divided into 2 phases - seasonal and non-seasonal. The Season includes about 3-month period when the intensity of traffic is 100-150% higher than the non-seasonal one. The main load falls on cars.

Table 7. Dynamics in the number of visitors to Adjara Autonomous Republic (years 2004 – 2012)

Title	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of visitors: Total	83 000	147 000	250 000	352 085	285 000	554 150	974 563	1 218 204	1 522 755
Among them: internal visitors	75 000	120 000	182 523	239 786	208 782	392 091	662 288	827 860	1 034 825
Foreign visitors	8 000	27 000	67 477	112 299	76 218	162 059	312 275	390 344	487 930

As table 7 shows, tourist flow in Adjara increases year by year, therefore their movement is ensured by different vehicles that are leading to growth of the general rate of the transportation flow.

4.2 Methodology

Long-range Energy Alternatives Planning System /LEAP1) Software has been used for the inventory of CO2 baseline (2012) emissions from Batumi City Transport Sector, projection of future trends (by 2020) and assessment of mitigated emissions. The LEAP is widely used software for the analysis of energy policy and assessment of climate change mitigation developed by the Stockholm Environment Institute.

The LEAP is approved by hundreds of organizations in more than 150 counties around the world. It is used by the government sector, the scientific-research and educational institutions, non-government organizations, consulting companies and energy institutions. It is utilized in many different levels on city, state, national, regional and global planning purposes.

The LEAP will soon become the de-facto standard for those counties that are implementing an integrated management of resources and assessing the reduction of greenhouse gas emissions, especially in the developing part of the world. According to the recent info from the United Nations, more than 85 countries have already chosen the LEAP Climate Change Framework of the UN to perform their obligations under the Convention.

The LEAP is not a specific energy system model but rather a tool that can be used for development of different models of the energy system each system of which requires its own unique data structure. The LEAP modeling allows usage of the wide range of different methodologies. It helps a user to create the best structure for its goals and decide which sectors or sub-sectors should be the parts of analysis.

The LEAP is designed for the long-term scenario analysis. The scenarios include a description of the energy system development. The LEAP enables the policy analysts to create and evaluate alternative scenarios in accordance with their energy requirements, social expenditures and benefits and influences on the environment. The LEAP scenario management system can be used to describe certain political measures, which could be united in alternative scenarios in different combinations. This approach allows politicians to evaluate the efficiency of specific policies and expected results of the combined implementation of different policies.

LEAP is a bottom-up model, based on energy demand. The Structure of the energy sector here includes 3 subsectors:

- Energy demand
- Energy transformation and distribution/delivery
- Energy Resources

The first step in the development of a model for any energy sector is working out a structure of the system with its basic data – current structure. Then may follow modeling and comparison of different scenarios on development and environment influence mitigation.

4.3 Base year inventory

Transport sector of Batumi and the base year inventory is based on 2012 data and considers the following vehicles:

- Private cars
- Municipal Service Cars
- Public Transport (Buses, Minibuses and Taxis)
- Commercial Transport and Trucks

Table 8 shows data concerning fuel consumption of different type vehicles and passenger - cargo turnover:

Table 8. Batumi transport characteristics

Vehicles	Cars (Except for Taxis and Municipal Cars)	Taxi	Municipal Service Cars of Adjara and other Government Structures	Buses	Minibuses	Small Trucks (up to 2- ton- cargo)	Big Trucks
Annual mileage (km/car)	7 000	15 000	5 000	103 680	61 200	21 600	43 200
Number of passengers carried (passenger)	9 894 402	950 279	92 405	65 826 000	31 000 320		
Annual passenger-turnover (passenger-km)	288 586 725	24 746 850	641 700	460 782 000	217 002 240		
Volume of freight transported (t)						2 334 420	12 519 360
Freight turnover (t-km)						43 186 770	231 608 160
The average fuel consumption for 1 gasoline running car (L/100 km)	15	14	12	20	13.5	14	30
The average fuel consumption for 1 diesel running car (L/100 km)	12	9	10	25	13.5	14	35
The average fuel consumption on electric energy (kWh/100 km)	30						
The average fuel consumption on the natural gas (m^3/100 km)	7	6.5					

In 2012 the fuel consumption in the transport sector in Batumi was around 498 thousand megawatt hours.

Table 9. Final energy consumption of Batumi Transport Sector (megawatt hours) – 2012

Subsector	Electricity	Natural Gas	Diesel	Gasoline	Sum
Municipal fleet	0.0	0.0	60.3	277.9	338.2
Public transport	5.0	3 281.1	232 172.9	25 617.1	261 076.1
Private and commercial transport	52.5	6 629.9	74 902.9	155 063.8	236 649.1
Total	**57.5**	**9 911.0**	**307 136.1**	**180 958.8**	**498 063.3**

The emissions in Batumi was around 128 thousand tons of CO_2 eq. in 2012.

Table 10. Greenhouse gas emissions CO2 eq. (t)_-2012 from the Batumi Transport Sector

Subsector	Diesel	Electricity	Gasoline	Natural Gas	Sum
Municipal fleet	0.0	0.0	16.0	69.2	85.2
Public transport	0.8	672.0	61 525.8	6 382.4	68 581.1
Private and commercial transport	8.0	1 358.0	19 849.3	38 633.7	59 848.9
Total	**8.8**	**2 030.0**	**81 391.1**	**45 085.3**	**128 515.2**

4.4 Greenhouse Gas Emissions BAU Scenario (2013-2020)

Description of the "existing structure" of Batumi transport sector reflects conditions of 2012. It's very important to take into account expected changes in energy consumption during future scenario building processes. The BAU scenario is the possible development of the initial status if energy-saving measures and programs that are not implemented. The reference scenario is also known as "Traditional Business Development (Business as Usual – BAU) Scenario". It shows the development of initial status, without implementation of any energy-saving initiatives. There are 3 main factors for the BAU Scenario of Batumi energy consumption sector affecting energy demand change:

Population growth. Mentioned factor has a direct influence on the energy consumption and/or the turnover of passengers and commercial freights. Future dynamics of the population growth is shown in Table 11.

Table 11. Population growth forecast in Batumi (except for tourists)[6]

Territorial unit	2012 year forecast	2015 year forecast	2020 year forecast
	Constant population	Constant population	Constant population
Batumi	169 400	195 000	200 000

Gross Domestic Product (GDP) and GDP/population growth. As various studies have shown[7,8], growth of the GDP (and the GDP to population ratio)directly affects the energy

[6] *Source – Batumi City Hall*

[7] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Passenger_transport_statistics

[8] Ghanadana R, Koomey J.G, Using energy scenarios to explore alternative energy pathways in California. Energy Policy, 33 (2005), 1117–1142.

consumption and population mobility rate. As income growth, people, industrial and commercial organizations consume more power and start moving more. GDP - growth forecast in Batumi is given in Table 12.

Table 12. Growth forecast of the Gross Domestic Product (constant prices) in Batumi[9]

Year	2011	2012	2013	2014	2015	2020
Gross Domestic Product of Batumi (constant prices, mln GEL)	790.92	849.45	919.95	979.75	989.17	1 197.70

According to the BAU Scenario, the transport sector's energy consumption for all fuels will rise in future. The demand will reach 871.3 thousand Mwh by 2020.

Table 13. Final energy consumption in Batumi transport sector (Mwh) - 2020

Subsector	Electricity	Natural Gas	Diesel	Gasoline	Sum
Municipal fleet	0.0	0.0	13.3	419.3	432.6
Public transport	10.0	508.5	326 483.9	24 493.8	351 496.2
Private and commercial transport	60.0	1 876.9	117 105.5	400 322.6	519 365.0
Total	70.0	2 385.4	443 602.7	425 235.7	871 293.8

Table 14 shows the BAU Scenario emissions by 2020

Table 14. Greenhouse Gas Emissions CO_2 eq. (tone) from Batumi Transport Sector –2020

Subsector	Electricity	Natural Gas	Diesel	Gasoline	Sum
Municipal fleet	0.0	0.0	3.5	104.5	108.0
Public transport	1.5	104.3	86 467.7	6 101.7	92 675.2
Private and commercial transport	9.2	384.9	31 014.8	99 724.5	131 133.4
Total	**10.7**	**489.2**	**117 486.0**	**105 930.7**	**223 916.6**

4.5 Action Plan for Emissions Reduction from Batumi Transport Sector

Existing environmental, social and economic problems in the world require avoiding the use of the transport and start walking or just using bikes, electric vehicles etc. for transportation and thinking more about territorial planning. The starting point in overcoming the mentioned problem varies depending on country. For example, in highly developed countries there is necessary to overcome the habit of dependence on cars and moving from the low-density and fragmented urban planning schemes to the mixed planning ones. In developing countries the public transport utilization rate and the density of population is relatively high and the land-planning form is mixed that is a better starting point for the sustainable development of this sector. Unfortunately, there are other problems with transport sector in developing countries such as traffic overload, air pollution and poor quality of the transport infrastructure and service. Consequently, these problems are considered as priority ones in developing countries and despite the fact that abundance of vehicles is not such a severe problem in developing countries as in developed ones,

[9] *Source – Batumi City Hall*

rapid economic growth of the developing world and increased number or the private vehicles threaten their future. So without taking appropriate actions against them, the traffic overload, noise, air pollution and the greenhouse gas emissions will make such cities less attractive for investors, pushing them to transfer their capital to other cities.

Batumi is between these two realities. There are 120 privately owned cars per 1000 persons; this rate is approximately three times lower than in Western European cities and half the rate of Tbilisi. Similar to other parts of the world upward trend in using private cars for transportation in Batumi is noticeable. Besides traffic overload and air pollution problems precede the problems with greenhouse gas emission growth. Therefore, the action plan about reducing greenhouse gas emissions from the transport sector shall include measures on improving the traffic flow, transport infrastructure and public transport services and for more distant future there should be considered actions aiming at development of more efficient technologies.

The Sustainable Energy Action Plan of Batumi includes three types of measures. The first group contains issues on the traffic overload and the road infrastructure efficiency growth. As mentioned above, it is one of the high-priority directions that have to precede other measures. The second group includes measures aiming at improving public transport sector services and enhancing alternative transportation. Mass/group movement is a key element of sustainable, low-carbon emissions future of cities and villages of both developing and developed world. It combines 3 types of the public transport – railway (trains and the subway), trams and buses (minibuses). Efficient mass transportation system shall ensure timely, prompt, punctual, safe, comfortable, clean and affordable services for customers to reach the desired destination. The Public transport also gives customers a variety of choices. The action plan of Batumi contains a number of measures to achieve this goal. The third group combines measures aiming at losing interest in using of private cars and stimulating the usage of low-emission vehicles. Taking into account the fact that private cars are characterized by higher level of greenhouse gas emissions per a passenger, than public transport, the importance of sharp reduction of the private vehicles in developed countries and prevention of their widespread use in developing world is very high. This approach will allow the city to attract more tourists and residents to live and work because the traffic overload has become a chronic problem for the heath and economy. Using of the public transport instead of the private ones significantly reduces the overall level of traffic. Therefore, the action plan contains measures that might not be able to reduce the use of private cars but will definitely be effective in limiting them if the other types of transport, the public transport in particular will become well-developed and easily accessible for the population. So these measures are only a part of a wider transport strategy discussed under this document.

Table 15. Measures to be taken in transport sector of Batumi

Sectors and Fields of Action	Key measures per sector	Responsible Department, Person or Company (If any third party is involved)	Start/Finish Date	Cost	Expected Energy Savings per Action (MWh)	Expected CO2 Reduction per Action (tone)
Public Transport	Electric-transport Development (electric-taxis, tram, cableway)	Batumi Municipality	2015-2020	Electric-taxis 7.5 mln GEL. Tram cost will be clarified after technical-economic assessment	10478	3112

	Support and development of Compressed Natural Gas-powered Public Transport and Fleet Renewal	Batumi Municipality	2014-2017	950000 GEL in the first stage. 14.25 mln GEL complete update	-9458	11075
	Route Planning and Optimization	Batumi Municipality	2013-2015	25000 a year	4 500	520
	Public Transport Services Improvement and the Information Campaign	Batumi Municipality	2013-2015	100000 USD per year	2214	296
Private and Commercial Transport	Restrictive Measures on Private Cars and Encouragement of Low Emission Vehicles	Batumi Municipality	2016-2020	will be based on feasibility technical economic study per a project	24918	6332.7
Transport and Traffic Planning	Restoration and Development of the Transport Infrastructure	Batumi Municipality	2014-2017	60 mln GEL	8 713	2 239
	Encourage mobility of bicycles and pedestrians	Batumi Municipality	2014-2020	1 mln GEL	18 000	2 800
Total					**59 365**	**26 375**

As a result of implementation of measures under Sustainable Energy Action Plan of Batumi, in comparison with the BAU Scenario, CO_2 emissions from the transport sector will reduce by 26.4 thousand tons $CO_{2\ eq.}$ by 2020.

More detailed description of the Actions is given below:

1. Restoration and Development of the Transport Infrastructure includes the following measures:
   - Rehabilitation and improvement of the road surface (Table 16)
   - Planning and Development of bypass routes (Table 16)
   - Construction of tunnels and bridges to reduce the travel distance between 2 points

Realization of opportunities to reduce the greenhouse gas emissions related to the traffic management (as well as the improvement of the road infrastructure) is complex and controversial process. Reducing traffic overload (by such measures as traffic lights control, green line etc.) will result the decrease in greenhouse gas emissions from individual cars, as they will run more efficiently. But this measure may not lead to overall reduction in emissions as the reduced traffic is an attractive factor for movement with private cars causing an increase in emissions. One of the measures is to ensure movement of vehicles with moderate speed, which may be more effective that regular "stop-start" the car, but such motion will lead to increase the amount of cars and therefore greenhouse gas emissions. Therefore, if traffic reduction is combined with private car restriction measures the greenhouse gas emissions will actually reduce. Taking into account all abovementioned facts, these measures and reduction of emissions related to them could be considered only as a part of the wider transport strategy along with other activities listed in this document.

According to the emissions reduction assessment studies[10] , implementation of abovementioned measures will lead to the 1% reduction of a distance annually covered by the transport and therefore reduction of emissions by 2239 tons for 2020.

[10]Assessments are made based on planned measures in Tbilisi SEAP by comparison with their asessments

2. Improvement of the public transport services and choosing of low emission technologies include the following actions:

- Development of the electric transport (electric taxis)(Table 16)
- Development of a cableway tram lines in long-run perspective
- Support and development of compressed natural gas-powered public transport (Table 16)
- Improvement of the public transport services (comfortable public transport (Table 16) electronic boards, regular technical inspection, improved ticketing system, planning/optimization of routes etc.)
- Public transport popularization campaign (information campaign, marketing and branding, informing residents and tourists about routes)

Electric transport development measures include replacement of fossil-fuel taxis and deployment of electric ones so that their total shares by 2020 is 70%. This event will reduce emissions by 3112 tons of CO_2 eq by 2020 compared to the BAU Scenario. However, as the gas-powered engine is less effective that the gasoline-powered, the estimated energy consumption will increase and not decrease. Estimated project cost is 5 455 000 USD.

Support and development of compressed natural gas-powered public transport includes switching buses and minibuses from fossil-fuel to compressed natural air so that the share of the latter is 60% by 2020. Mentioned action will reduce greenhouse gases by 11076 tons CO2 eq by 2020 compared to the BAU Scenario. Estimated project cost is 950 000 USD.

Other actions aim at improvement of the public transport services. They will not have a direct impact on reduction of emissions, but will increase the efficiency of those measures implementation of which is planned as a next step. (e.g. restrictive measures on private cars). According to the preliminary assessment, the adequate measures taken in this direction will raise demand for the public transport by 5% by 2020 causing the additional 296 ton-reduction of CO_2 eq compared to the BAU Scenario.

3. Restrictive measures on private cars, high emission transport and various actions to encourage low-emission vehicles.

- Traffic restriction in some of the city's central districts (Environmental Islands)
- Development of cycle routes (Table 16)
- Encouraging low-emission vehicles by recusing parking tariffs or other similar encouraging measures
- It is foreseen that the technical inspection of vehicles will become mandatory from 2015. This will help to implement different encouragement measures for new eco-friendly cars replacing the highly polluting gasoline and diesel vehicles. There have to be added other measures designed to reduce environmental impact like no or low parking tariffs for eco-friendly vehicles lower tariffs for their technical inspection etc.

- To calculate reduction of emissions after development bicycle and walking routes there have been assumed that they will reduce the necessity in motorized transport by 1.3%, which will save about 2800 tons of emissions.
- Thorough feasibility studies must be undertaken for these actions before their implementation. Though it is hard to determine their effect without them, it was estimated[11], that these actions will decrease the share of private transport by 3%, increase the share of natural gas-powered transport by 20% and reduce fuel consumption by private cars by 5% for the year 2020. Adequate planning and implementation of the reference measures will reduce greenhouse gas emissions by 6332 tons of CO_2 eq compared to the BAU Scenario.

Part of these measures have already been initiated by Batumi City Hall and is being implemented – e.g. the road rehabilitation project started in 2005 and the project "Batumvelo" began in 2011. Projects listed in Table 16 is planned to be fully activated by 2020.

[11] Assessments are made based on planned measures in Tbilisi SEAP by comparison with their assessments

Table 16. Ongoing projects initiated by the self-government of Batumi

#	Measure	Implementation Timeframes	Brief Description	Investment cost	Which parameter is affected on and how	Data Source
1	Reducing of minibuses – withdrawal from usage	2012 - 2014	A tender is announced in March 2014 with respect to the optimization of the line routes of the City aiming at reduction of the number of minibuses, measure of the crossing terminals and planning of the alternative (trams, trolleybuses) transport.	**Reduction is planned though the contest no investment is required**	Easing the city traffic reduction of emissions from old minibuses	Self-government of the city
2	Rehabilitation of the urban streets, construction of the new ones	2005-2014	Rehabilitation works of the urban streets have been conducted since 2005. A part of the existing streets has already been repaired. Most of them will be rehabilitated before 2014. Now 23 streets of the city with total length of 64km are repaired. There have been constructed and improved 4 new streets with a total length of 11,5 km. There has been constructed a street connecting Khikshiashvili and Leonidze streets. Reconstruction-development of Bagrationi steet with a total length of 6,6 km has been started	**100 mln GEL**	New streets will ease the traffic in the city, replacing of the old asphalt with a new surface will reduce emissions in the air, improvement of the road surface in the historical part of the city and its narrowing will limit transport use in this territory and after a certain period, the old Batumi streets will be intended for non-polluting transport and walkers.	Self-government of the city
3	Construction of the bypass road of Adjara	2011 - 2016	The bypass road with a total length of 30 km will connect Sarpi-Choloki section bypassing the city. The 1st phase of works in progress that includes Ochkhamuri and Chaqvy - Makhinjauri sections with total length of 15.4 km	**0.5 bln GEL**	The bypass road will maximally reduce the internal and external transit traffic across the city will reduce the time and distance of movement	Ministry of the Regional Development and Infrastructure of Georgia. Asian Development Bank. Companies: **Engconsult, kanada; Sambo, korea, Transproject,** Government of the Autonomous Republic of Adjara
4	Repair of the Batumi Fleet	2014 - 2020	Buying of the average size natural gas-powered buses (20 units) is planned for 2014 which will be equipped with high-quality filtration system. This will continue in future years.	**14, 25 mln GEL**	The old fleet of vehicles is equipped with outdated buses. That filtration system is corrupted and exhaust 2 times greater emissions than defined. Replacing them with new ones will partially solve this problem	Self-government of Batumi "Batumi Avtotransporti"LTD

5	Implementation of the electric vehicles system	2015 - 2020	Implementation of the municipal electric taxi system. The project has been initiated by the Batumi municipality although works is under way to attract donors.	**7, 5 mln GEL**	This initiative is directly linked with the formation of Batumi as a "Smart" and Green city. Introduction of environmentally friendly city transport.	Government of the Autonomous Republic of Adjara Self-government
6	Implementation of the transport system "Batumvelo"	2011 -2020	From 2011 bike lines are open in the city. About 300 bikes are placed in special terminals. There is planned to add terminals throughout the whole city in future. 8 more bicycle terminals will be added for 2014	**1 mln GEL**	Implementation of environmentally friendly transport. Maximal restriction of the use of cars. Reduction of emissions	Government of the Autonomous Republic of Adjara Self-government "Batumi Avtotransporti"LTD
Investment in total				**5.1 bln GEL**		

5 Buildings

5.1 Sector overview

Batumi territory now covers an area of 6 494,31 hectares (pic 14). The city grew in size twice. In 2009 due to adding a part of khelvachauri municipality of about 25 m^2 and the population reached 125 000 residents. And in 2011 by adding significant parts of Khelvachauri and Kobuleti municipalities leading to population growth up to 170 000 residents.

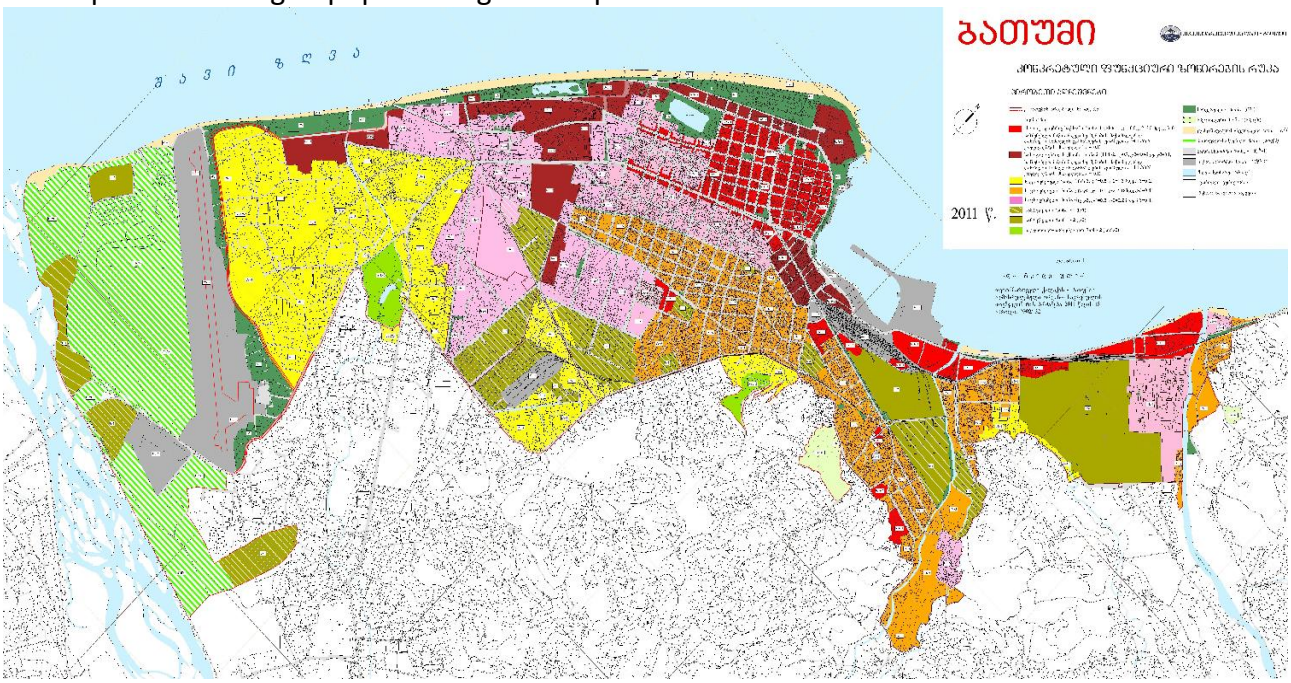


Figure 14. Batumi Map

Growth of the city and its population increased the number of residential buildings and administrative and commercial facilities.

Over the last decade, the territory of Batumi grew almost 3.5-fold compared with 1963 due to the intense nature of urban development as well as accession of neighboring municipality territories.

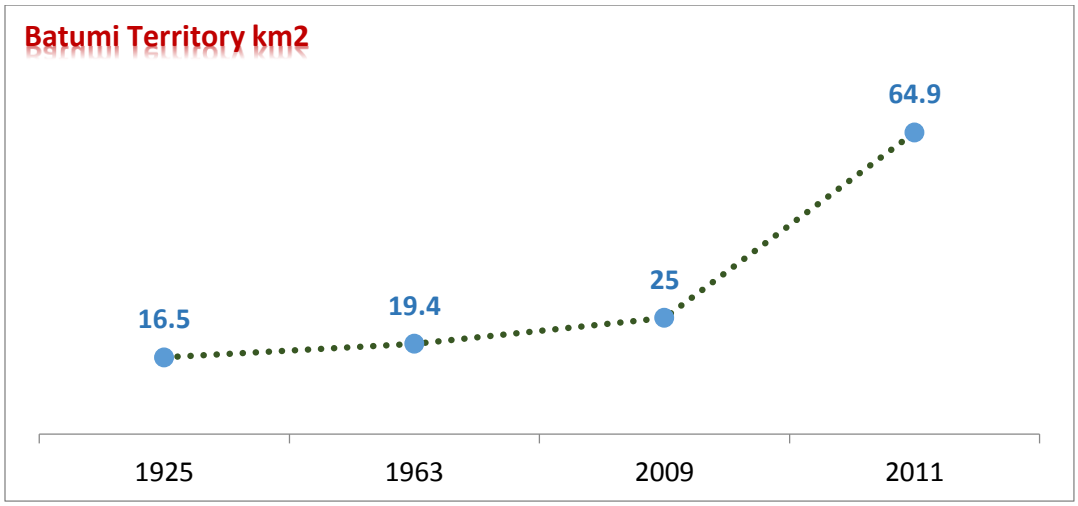


Figure 15. Dynamics of Batumi territorial growth

In 2013, Batumi self-government together with the USAID developed the city's urban development strategy that outlines ways of spatial-territorial plan of the municipality, preparation of norms and rules for intended fields, urban planning documents - Including land use general regulation plan, use of urban areas and preparation and approval processes for the development.

This document will help to carry out ongoing and planned activities in the city correctly and purposefully, however, until 2013 the construction processes were chaotic and such important details as modern technologies and equipment of the administrative and private commercial facilities with energy saving systems were completely ignored.

Currently, only a few buildings in the city are equipped with the energy efficient technologies. A total of 10 private residences - including 7 three- story and 3 two-story dwelling houses and 4 hotels – 2 five-story and 2 four-story ones. There are mainly used solar cells, being directly proportional to the current cost reduction. There are also some construction companies using packaging technology of buildings with energy efficient materials.

Figure 16. Energy-efficient buildings

5.1.1 Current Situation

As there has not been made any description of existing buildings of the city in recent years neither by the governmental organizations nor any research institutes, it is quite difficult to determine the condition of buildings accurately. Self-government of Batumi plans to conduct full inventory throughout 2014, though there are some preliminary data making it possible to process data about the most of the buildings of the city. (Table 17)

There are full data in the following sectors:

- State Institutions;
- Organizations under Subordination of the State;
- Hospitals and Polyclinics;
- Schools;
- Kindergartens;

- Large Shopping Malls and Business Centers;
- Libraries;
- Large Hotels;
- Educational Institutions;
- Damaged Houses;
- Barrack-type residential houses;
- Industrial facilities;

There are incomplete data in the following sectors:

- Apartment buildings;
- Commercial facilities;
- Small family-type hotels;
- Other objects (no information about them currently)

Table 17. Classification of buildings in Batumi

№	Building type	Quantity	Space m^2
	Recreational Facilities		
1	Outdoor swimming pools	2	1 800
2	Playgrounds	3	4 500
3	Botanical Garden	1	1 110 000
4	Squares	40	105 600
5	Parks	5	215 000
6	Children's playgrounds	50	4 000
7	Boulevards	1	1 050 000
	Buildings		
8	State Kindergartens	22	11 440
9	Multifamily and single-family houses	16 959	1 800 000
10	Individual commercial and non-commercial workshops	350	35 000
11	Other preschool institutions	7	1 680
12	Schools	35	87 500
13	Pharmacies	150	4 500
14	Fast-moving consumer goods shops	1 200	54 000
15	Grocery stores	1 500	75 000
16	Postal offices, communication departments	3	330
17	Bank Branches/Divisions	30	5 100
18	Open ground and/or underground parking lots, separate multilevel parking lots	250	105 000
19	Greenhouses	10	2 000
20	Polyclinics	40	4 400
21	Gyms	10	1 500
22	Cinemas	1	750
23	Information centers	25	50
24	Exhibition halls	2	200
25	Dance clubs	25	3 750

26	Bars, cafes	65	5 200
27	Fast food restaurants	30	660
28	Utility services	48	480
29	Kiosks, temporary pavilions, retail outlets	55	385
30	Notary offices	20	700
31	Liturgical objects	25	
32	Police departments	20	4 000
33	Large and medium size hotels	50	
34	Utilities and engineering – technical facilities	35	1 925
35	Petrol stations and/or vehicle service facilities	50	20 000
36	Training Institutions	1	2 500
37	Individual economic and technical facilities	15	2 250
38	Shelters	2	1 300
39	Hospitals	10	9 100
40	Indoor swimming pools	5	6 500
41	Theatres	4	4 800
42	City libraries	2	2 500
43	Archives	1	3 200
44	Museums	5	2 250
45	Restaurants	25	5 000
46	Offices	480	21 600
47	Courts	1	2 250
48	Fire Depots	4	6 000
49	Public toilets	15	38
50	Water facilities (ports, harbor etc)	13	15 000
51	Changing rooms, showers, public toilets	20	40
52	Open stores of beach equipment	10	300
53	Rescue Service Stations	15	750
54	Slot machine halls, billiard halls etc	20	4 400
55	Zoos	1	1 000
56	Administrative buildings	85	19 000
	Total	**21 851**	**4 824 428**

The city is divided into 13 administrative units. Despite the fact that they are roughly equal in size, newly added territories of Batumi are distinguished by nonstandard dwelling houses (low-rise private houses)

Table 18. Private Houses in Batumi

Low-rise houses	Number of Buildings	Dwelling Space m^2	Land Space m^2
Standard Private Residential Buildings	15 917	1 627 370	1 477 950
One-storey	5 850	438 750	438 750
Two-storey	6 817	749 870	681 700
Three-storey	3 250	438 750	357 500

As for an old territory, tall residential buildings are mostly located in the coastal area of the city. The eastern part of Batumi is also loaded by low-rise nonstandard houses. The north-

western area belongs to so-called historic Batumi territory where the houses were built at the end of the 19th and the beginning of the 20th century.

Table 19. Residential buildings built before 2000

Residential Ho	Number of Buildings	Dwelling Space m^2	Land Space m^2
3-storey	52	52 000	26 000
4-storey	81	131 625	56 700
5-storey	175	341 250	122 500
8-storey	1	2 800	1 500
9-storey	110	586 300	143 000
10-storey	1	6 000	1 500
12-storey	35	91 000	17 500
16-storey	1	6 000	1 200
Total	456	1 216 975	369 900

90% of the residential buildings of the city were built during the Soviet period (before 90s) and are of a uniform standard. Some of them (about 10-15%) are depreciated or their operational period is over. Newly built residential buildings belong to the multistoried category.

Table 20.Residential buildings in Batumi according to the data of 2013

Residential building	Number of buildings	Dwelling Space m^2	Land Space m^2
2-storey	278	41 700	41 700
3-storey	59	59 000	29 500
4-storey	90	175 500	63 000
5-storey	196	548 800	137 200
6-storey	11	30 800	8 800
7-storey	6	18 600	7 200
8-storey	5	14 000	7 500
9-storey	126	671 580	163 800
10-storey	6	36 000	9 000
12-storey	42	109 200	21 000
13-storey	1	2 600	1 300
16-storey	3	18 000	3 600
16-storey and more	8	32 000	12 000
Total	**831**	**1 757 780**	**505 600**

As for the administrative or other facilities, most of them are located at the central area of the city but it is expected to place nonresidential buildings on the entire territory that is quite effective idea in the urban context.

Industrial and manufacturing facilities are mainly found in the suburbs of the city and most of them have middle or low production capacity.

City buildings inventory revealed three main types of constructions: residential buildings, commercial facilities and administrative buildings;

Residential buildings category includes all dwelling houses, commercial facilities involve all buildings for commercial activities and administrative type buildings includes all constructions of administrative purposes. E.g. government offices, kindergartens, schools, hospitals, etc.(pic.17)

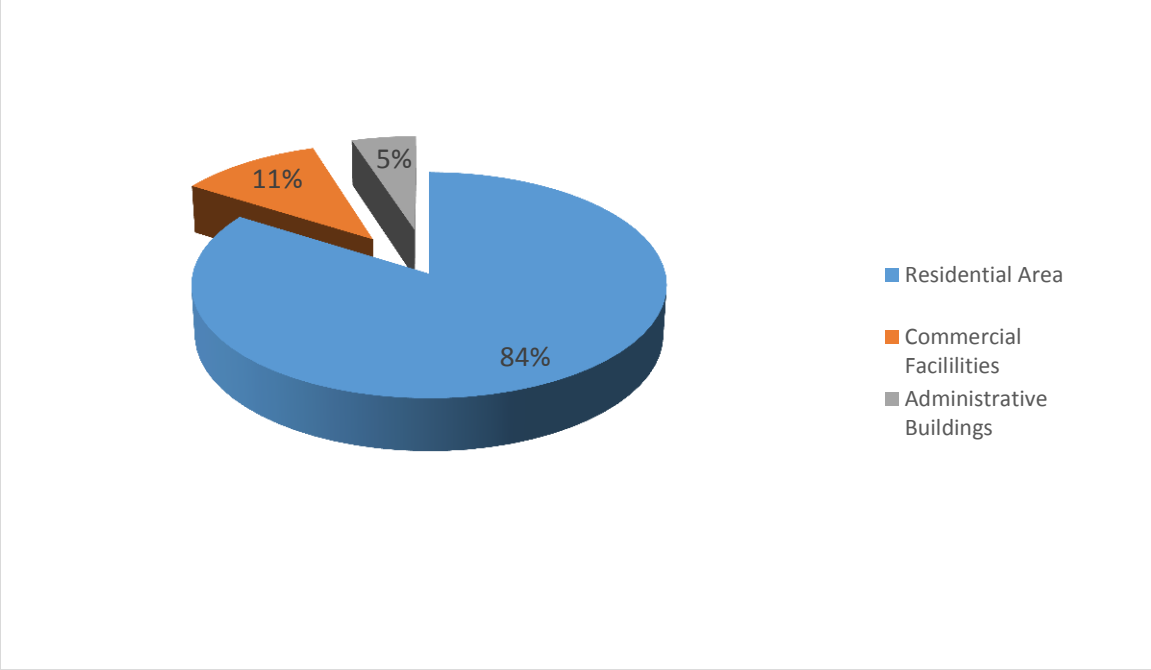


Figure 17. Distribution of the buildings by enlarged categories

Distribution of buildings located in the administrative units of the city by functionality is shown in Table 21. The highest percentage 95% of residential blocks is found in 3 administrative districts of Batumi: Aghmashenebeli, Tamari and Old Batumi. Aghmashenebeli is characterized by its high-rise apartment blocks indicating a lack of commercial facilities (just 3%) and administrative buildings (2%).

Table 21. Distribution of buildings by functionality and administrative units

№	Territorial unit/district	Functionality	Percentage by quantity
1	Bagrationi	Residential Area	85%
		Commercial Facilities	10%
		Administrative Buildings	5%
2	Boni-Gorodok	Residential Area	80%
		Commercial Facilities	15%
		Administrative Buildings	5%
3	Javakhishvili	Residential Area	90%
		Commercial Facilities	7%
		Administrative Buildings	3%
4	Rustaveli	Residential Area	75%

		Commercial Facilities	20%
		Administrative Buildings	5%
5	Aghmashenebeli	Residential Area	95%
		Commercial Facilities	3%
		Administrative Buildings	2%
6	Gonio-Kvariati	Residential Area	90%
		Commercial Facilities	5%
		Administrative Buildings	5%
7	Tamari	Residential Area	95%
		Commercial Facilities	1%
		Administrative Buildings	4%
8	Industrial	Residential Area	60%
		Commercial Facilities	35%
		Administrative Buildings	5%
9	Khimshiashvili	Residential Area	90%
		Commercial Facilities	5%
		Administrative Buildings	5%
10	Old Batumi	Residential Area	95%
		Commercial Facilities	4%
		Administrative Buildings	1%
11	Green-Cape	Residential Area	80%
		Commercial Facilities	10%
		Administrative Buildings	10%
12	Airport	Residential Area	75%
		Commercial Facilities	15%
		Administrative Buildings	15%
13	Kakhaberi	Residential Area	80%
		Commercial Facilities	10%
		Administrative Buildings	10%

5.1.2 Apartment Blocks

Table 22. Distribution of apartment blocks by administrative units shows quantity of residential blocks by administrative units.

Table 22. Distribution of apartment blocks by administrative units

#	Territorial Unit/District													private sector	
		2nd floor	3rd floor	4th floor	5th floor	6th floor	7th floor	8th floor	9th floor	10th floor	12th floor	13th floor	16th floor	16th floor and more	Standard Residential House	Barrack type Housing
1	Bagrationi	31	7	10	40				21		3			1	7779	
2	Boni-Gorodok	25	5	2	13	1		1							903	92
3	Javakhishvili	5	1	8	42		2		5		1			1		6
4	Rustaveli	3	2	20	23	4	3	2	12	6	7	1	1	1	183	
5	Aghmashenebeli	5	2	1	15	2			37		6		1			
6	Gonio-Kvariati	7	1		1	2			2						772	4
7	Tamari	7	8	19	11			1	8						500	8
8	Industrial	27	1	10	8				6						500	1
9	Khimshiashvili	9	3	5	28				29		5		1	4	37	
10	Old Batumi	91	25	10	13	2	1	1	3		5				183	32
11	Green Cape	32	2	2	1				1		3				1096	17
12	Airport	23	1	1					2		12			1	2109	12
13	Kakhaberi	13	1	2	1										1855	39
	Sum	**278**	**59**	**90**	**196**	**11**	**6**	**5**	**126**	**6**	**42**	**1**	**3**	**8**	**15917**	**211**

Note: 395 Barrack type buildings are not included in this Table . The overall number of such buildings in the city is 606

Batumi self-government encourages comradeship programs of residential buildings that include roofing, yards improvement, water and sewerage pipes replacement and rehabilitation of elevators. Based on 2013 data roofing works are accomplished in 353 out of 831multi-storey apartment blocks, yards improved for up to 450 territories.

A multi-storey (10-storey) building located in 800m^2 land. Living space 6 000 m^2, total space 7500 m^2, roof space 700 m^2. Roofing works are carried out for such residential buildings where it is necessary to replace the roof but insulation works are not conducted. Approximately 50 new roofing works are planned in 2014.

Mentioned program does not include roofing of the private and barrack type houses but there are exceptions as well.

Table 23 contains information on roofing and yards improvement activities:

Table 23. Works accomplished in 2007-2013

Apartment block	Quantity of blocks	Roofing	Yards Improvement Activities
2-storey	278	75	100
3-storey	59	20	14
4-storey	90	40	43
5-storey	196	95	150
6-storey	11	3	5
7-storey	6	4	7
8-storey	5	4	5
9-storey	126	83	80
10-storey	6	3	6
12-storey	42	25	12
13-storey	1		1
16-storey	3	1	3
16-storey and more	8		8
Standard Private Residential Buildings	15 917		
Barracks	606		
Total	**17 354**	**353**	**434**

Note: Self-government of the city does not take responsibility on roofing private houses

According to the data of 2014, there are 60 houses under the threat of collapse in the city, many of which are 2-4-storey buildings. Repair of the most of such houses is planned during 2014-2015 from Batumi budget.

Table 24. Accomplished infrastructure projects and planned measures

	Tytle	Total amount	Newly built	Old (built before 2000)	Accomplished Infrastructure Projects	Budget	Done by	Planned Measures	Budget (GEL)
1	State Institutions (Ministries, Self-government buildings)	85	35	50	12 State institutions were repaired and rehabilitated in 2010-2013	1200000	State budget	Repair of a new building of the City Hall with a total space of 1250 m^2 is planned for 2015	125000
2	Buildings of Organizations Being under Control of the Government	145	110	35	10 of such buildings were repaired and rehabilitated in 2010-2013	1350000	Self-government	Repair of 2 buildings and full rehabilitation of 1 new one is planned for 2014	150000
3	Hospitals	10	5	5	In 2011 - finished the construction of the private hospital – "Medina". 2012 – finished the construction of a new referral hospital	4500000	Private Investment	Finishing of the construction of 1 hospital is planned for 2014	4500000
4	Polyclinics	40	7	33	2 polyclinics repaired	250000	Private Investment		
5	Schools	35	4	31	20 schools were rehabilitated in 2008-2013	9400000	Ministry of Education	Construction of 2 new schools and rehabilitation of 3 old ones is planned for 2015-2017	1500000
6	Kindergartens	29	5	24	10 kindergartens were rehabilitated and 2 new ones were built in 2010 - 2013	2500000	Self-government	Construction of 2 new kindergartens is planned for 2014	500000
7	Large Shopping Malls and Business Centers	35	10	25	4 large business and shopping centers were built in 2008 - 2013	11000000	Private Investment	Opening of 2 new business centers is planned for 2014	
8	Libraries	2	1	1	City division's public library was fully repaired in 2012	80000	Self-government	Repair of the main library of the city is planned for 2014-2015	125000
9	Large Hotels	30	12	18	10 large hotels with a total number of rooms – 1200 were built during 2008-2013	75000000	Private Investment	Opening of 2 largest hotels the Kempinsky and Hilton is planned for 2014 - 2015	
10	Barrack type Housing	606		606	150 barrack type houses were	750000	Self-government	Probably 77 memorandum	2500000

					demolished in 2009 - 2013			owned residents will be satisfied in 2014. Complete demolition of barrack-type houses if planned for 2015-2017	
11	Commercial Facilities	3568	180	3388					
12	Family type Small Hotels	150		150	There is no statistical data about family hotels. According to the tourism department the number of such type of hotels increases by 7-8% a year			Inventory of the family type hotels is planned for future	
13	Residential Houses	16128		15878	About 10 residential blocks are built each year. 35 new blocks of flat with a total space of about230 000 m^2 were built in 2005-2013	87500000	Private Investment	Construction of 25 new residential blocks and 5 new 150 - flat"cheap" buildings is planned in 2015 – 2020 (done by self-government)	74750000
14	Houses under the Threat of Collapse	60		60	12 of such houses were repaired in 2010 – 2013. 1 of them was demolished. Most of them are 4-5- storey-buildings	1390000	Self-government	Full repair or demolition of Houses being under the threat of collapse is planned for 2014 - 2015	6600000
15	Industrial Manufacturing Facilities	165		80					
16	Other	1000							
	Sum	**22088**	**619**	**20384**		**194920000**			**90750000**

Barracks belong to the category of substandard facilities, inadequate for living, most of which was built spontaneously. There are 606 barrack- type-housing in the city. Batumi self-government developed a program - “Batumi without barracks” in 2009. This program had been successfully implemented over the years, but in 2012 it changed and was distributed in various target programs being in compliance with this program.

Approximately 250 barrack type buildings were destroyed in 2009-2013 and the dwellers were placed in apartment blocks. Barracks are usually taken because of emergency situations, territory improvement works or due to memorandum issued by the government. Measures planned for 2014 is described in Table 24.

Figure 18. Typical barrack type building

70-75% of the multi-storey residential buildings have 2, 3, and 4 porches 25% of which are open-ended that is a hindering circumstance in terms of the heat preservation.

In the years of 2008-2010 comradeship support program was running in the city that in addition to roofing and basement works also included installation of the main entrance doors. Up to 100 comradeships installed the entrance doors within the framework of this program.

One of the most important initiatives is a project “Cheap House” that aims at providing residents with affordable and adequate quality housing. This goal will be achieved through creation of the long-term buy-out mechanisms.

As planned, minimum amount of floors for residential buildings to be built will be 5-6. And the main focus will be on the energy efficiency issues and intelligent use of resources that is closely connected to the Sustainable Energy Action Strategy.

5.2 Methodology

This sector also uses the LEAP (Long-range Energy Alternatives Planning System) detailed description of which is given in the "Transport" chapter.

As already mentioned, flexibility of the LEAP allows to study the energy demand only for the buildings sector and the household subsector. Structuring this sector in the LEAP is quite flexible. The first step in developing of any model of the energy sector is elaboration of structure of the sector in which the initial information about the state of the sector is being entered for processing. Then follows modeling and comparison of different scenarios on development and reduction of emissions of the sector.

5.3 Base Year Inventory

Structure of the buildings sector of Batumi is based on statistical data of 2012.

Energy consumption details for the Buildings sector in presented in Table 25.

Table 25. Final Energy Consumption by the Building Sector of Batumi -2012

Subsector	Diesel	Electricity	LPG	Natural Gas	Wood	Sum
Municipal buildings	480.9	18 520.1	96.0	1 449.9	202.1	20 749.0
Commercial buildings	0.0	85 761.6	0.0	26 958.7	0.0	112 720.3
Residential buildings	0.0	141 380.1	65 097.7	130 813.4	260 437.5	597 728.8
Total	**480.9**	**245 661.8**	**65 193.7**	**159 222.0**	**260 639.6**	**731 198.1**

Greenhouse gas emissions from buildings in 2012 was around 91 662 tons of CO_2 eq.

Table 26. Greenhouse Gas emissions (t) CO_2 eq. from the building sector of Batumi-2011

Subsector	Diesel	Electricity	LPG	Natural Gas	Wood	Sum
Municipal buildings	127.6	2 832.3	21.8	292.0	5.5	3279.3106
Commercial buildings	0.0	13 115.8	0.0	5 430.1	0.0	18545.887
Residential buildings		21 621.7	14 797.5	26 348.9	7 068.8	69836.843
Total	**127.6**	**37 569.8**	**14 819.3**	**32 071.1**	**7 074.2**	**91 662.0**

5.4 Greenhouse Gas Emissions BAU Scenario (2013-2020)

The driving parameters of the energy demand and consumption of the Building sector are the population growth, the country's GDP growth and GDP-per capita growth, forecast of which is shown in the "Transport" chapter. While estimating this sector an **additional assumption** is made about gasification, according to which 75% of the residents of Batumi will be gasified by 2030.

According to the BAU Scenario, the energy consumption by the Household and Municipal sectors is expected to increase by 32.4% and will reach more than 605 MWh.

Table 27. Final energy consumption by the building sector of Batumi (MWh) - 2020

Subsector	Electricity	LPG	Natural Gas	Diesel	Wood	Sum
Municipal buildings	20 889.7	2 662.4	117.0	469.6	143.2	24 281.9
Commercial buildings	96 734.6	49 504.6				146 239.2
Residential buildings	187 499.5	312 296.1	58 479.1		219 231.0	777 505.7

Total	**305 123.7**	**364 463.2**	**58 596.0**	**469.6**	**219 374.2**	**948 026.8**

Greenhouse gas emissions will increase by 56%. This mismatch between the consumption of the energy and emissions growth rates is caused by gasification that extruded the wood.

Table 28. Greenhouse Gas Emissions $CO_{2\,eq}$ (tons) from the Buildings Sectors of Batumi -2020

Subsector	Electricity	LPG	Natural Gas	Diesel	Wood	Sum
Municipal buildings	3 194.7	536.8	26.6	124.4	4	3 886.4
Commercial buildings	14 793.9	9 981.6				24 775.5
Residential buildings	28 674.8	62 968.3	13 293.0		5950.3	110 886.5
Total	**46 663.4**	**73 486.7**	**13 319.6**	**124.4**	**5 954.2**	**139 548.4**

5.5 Emissions Reduction Action Plan from the Buildings Sector of Batumi

Buildings in Batumi were built with the "Soviet Approach" assuming that the energy is cheap and thinking of its efficiency is not necessary. In addition, during that period, the global warming and greenhouse gas emissions trends were not the topics of global interest.

According to experts[12], a potential of reduction of the energy consumption in the buildings of Batumi is quite significant. So reduction of the level of emissions from the building shall be one of the aims of the Sustainable Energy Action Plan.

All measures in the buildings sector have been selected based on their sustainability potential, i.e. the potential of extension and development after 2020. This criterion is based on the sustainable development principle, the fundamental one in the energy development plan. The measures also include cooperation with the stakeholders, raising public awareness on energy saving and energy efficiency issues and actions to strengthen public monitoring that will not only build the necessary conditions to implement the measures outlined in the plan but continue the long term policy of the greenhouse gas reduction as well.

Planned measures in the buildings sector mainly means to increase the energy efficiency on the basis of the energy savings and implementation of the renewable energy. Measures are selected in compliance with Batumi Development Plan and the real capabilities. The main emphasis is made on municipal buildings (kindergartens, sport and cultural buildings), but there is considered significant actions for the housing sector as well.

Energy consumption in the buildings sector is distributed on heating, lighting and electro-technics, but a certain part of the energy is just lost due to various reasons such as negligence, low efficiency of techniques and poor insulation of buildings. Measures under the Sustainable Energy Plan were chosen based on the common strategy of reducing the energy dissipation. The following measures have been selected considering availability and cost-effectiveness criteria:

In the municipal buildings sub-sector:

- Thermal insulation of the buildings and complete overhaul;
- Replace the heating system with heat pumps;

[12] Field Specialists

- Replace fuel with low emission fuel;
- Using energy-efficient bulbs;
- Installation of the solar collectors;
- Energy usage and savings control;

In the residential buildings sub-sector:

- Thermal insulation and renewal of the buildings (co-financing by the inhabitants);
- Using energy-efficient bulbs;
- Using of the "Cheap House" concept for sustainable development facilitation;
- Encouraging initiatives of the Government for energy efficient buildings and their inhabitants;

Non-municipal buildings and equipment of the service sector

- Promotion of the energy efficiency measures in tourist buildings;
- Energy efficient measures in schools and other public institutions (Ministries, Hospitals etc.);
- Implementation and promotion of the green buildings concept.

Besides, the works are carried out at local and national-legislative level to elaborate the building code taking into account the energy efficiency requirements.

Actions planned for the building sector are divided into 2 groups. The first one includes the Pilot Measures for specific buildings, that shall start as soon as possible and the second one involves other measures that acquired relatively mass character.

Table 29. Planned pilot measures in the buildings sector

Actions and measures	Measures	Description of the measures	Quantitate Characteristics
		1.Municipal Buildings	
Measure 1.1.	Improving of Insulation		6 buildings before 2020. Kindergartens (Administrative, City Hall) buildings (partial and full package)
1.1.1		Replacing roofs, doors and windows with the modern materials. Insulation of the wall/facade	Administrative building of the municipality (on Lermontov street)
1.1.2		Replacing roofs, doors and windows with modern materials	5 Kindergartens
Measure 1.2.	Solar Energy Use	Installation of the solar panels for water heating that will replace the use of the fossil fuels for this purpose	3 buildings (in kindergartens 10 batteries per a building)
Measure 1.3	Installation of Energy Efficient Bulbs	Replacing bulbs with modern energy efficient ones	4 buildings
1.3.1			Adm. building of the City Hall (Lermontov St)
1.3.2			3 Kindergartens
Measure 1.4	Complete Overhaul and Implementation of the Energy Consumption Management to Ensure the Energy Efficiency	Control of the energy consumption/climate control	1 Administrative building of the Municipality (Lermontov street)
Measure 1.5	Changing of the Heating System	Replacing diesel-powered heating system with heat pumps	Existing heating system will be replaced with 2 the air-water type heat pumps
Measure 1.6	Gasification	Diesel and Wood will be replaced with the Natural Gas	5 kindergartens will be gasified and start using the natural gas
		2.Residential Buildings	
Measure2.1.	Closure of Porches	Porches will be closed (by doors, glazing) with co-financing of residents	Probably 7 apartment blocks before 2020. One building a year. Depend on wishes of residents
Measure 2.2.	Installation of the Energy Efficient Bulbs in the Pilot Buildings	Old incandescent bulbs will be replaced with the modern energy-efficient ones.	In 7 buildings (blocks of flats). 1 old incandescent bulb will be replaced with the modern energy-efficient bulb in each flat.

Measure 2.3	Use of the Project “Cheap House” for the Sustaineble Energy Actions (Popularization, Support and Implementation)	the “Cheap House” concept will become popular and implemented	the most relevant contingent will be chosen for realization of this concept

Description of the pilot measures

1. Energy efficiency securing measures at municipal and dwelling buildings

In order to accomplish the Sustainable Energy Action Plan the municipality might carry out various measures for raising of the energy efficiency of kindergartens and other municipal buildings, such measures are those of thermal insulation (replacement and repair of the external framework of the building: heating of façade/walls, repairing of the roofs and caulking up and/or replacement of doors and windows, closing of porches), replacement of the old incandescent bulbs with the energy efficient ones and replacement of the mineral fuel with the renewable energy sources, as well as the measures for energy demand and saving control. Special attention shall be paid to the concept of "Cheap House", which has the great potential of spreading.

Thermal insulation improvement

Thermal insulation of buildings is a relatively affordable measure saving quite a lot of heat energy despite the fact that most of the buildings were constructed to old, Soviet standards or even below them.

Heat insulation products include replacement of roofs, façade / wall insulation, replacement of windows with modern plastic ones or sealing them up with special insulating tapes and closing the porches. These measures in various combinations are planned for residential and municipal sectors on the basis of the budgetary resources.

Due to lack of the budgetary funds, the present plan about insulation works includes only 6 municipal (5 kindergartens and 1 municipality administration building) and 7 residential buildings. Thus, all the above- mentioned insulation works in various combinations will be conducted only in municipal buildings. In residential ones the mentioned works include just closure of porches in case of 10% co-financing from the tenants.

Calculation of the potential emissions savings from insulation measures are based on expert evaluations of the listed facilities available in Georgia. So, in case of a complete package for thermal insulation (thermal insulation of windows, roof, walls, entrance) estimated potential savings is around[9] 32-40%. According to the conservative estimation 30% has been taken for maximum heat insulation (measure 1.1 1), minus roof insulation 25 %, replace only door, windows and roof – 20% and in case of the porch closure – 10%.

Effect data: the number of consumed energy (electricity and the natural gas) for the complete list of municipal buildings was collected by the working group of the municipality. The municipality has also provided electricity and the natural gas consumption data of the whole residential sector along with the description and composition of this sector.

Measure 1.1 - Improvement of thermal insulation in municipal buildings and
Measure 2.1 - Improvement of thermal insulation in apartment buildings

According the action plan, capital repair of 6 municipal buildings is foreseen (1 municipality administration building and 5 kindergartens) with the thermal insulation measures: as the result of replacement of doors and windows with the metal-base laminate modern doors and windows in the whole building and by closing the entrances, by means of other repair works, in order to achieve better storage of the accumulated warmth and according to the expert's appraisal, approximately 20-30% will be spared.

As for the apartment (dwelling) sector, closing of porches is foreseen (**Measure 2.1**) starting from 2014 up to 2020, for each block of flats per year, in the conditions of co-financing by the inhabitants. The municipality considers such calculation as real, though, only after the preliminary explanatory works and the works for rising of consciousness, which should precede implementation of such measures, in order to explain to the population significance and economic benefits of the thermal insulation. Implementation of such consciousness rising works is foreseen into this plan. It shall be indicated that the thermal insulation measures will be carried out in the same apartment houses, in which the measure 2.2 of distribution of the energy efficient bulbs will be done.

Saving potential is different for municipality administrative buildings, kindergartens and apartment houses, due to the completeness of the pack of thermal insulation works foreseen for them. The most complete pack is considered for the municipality administration building (replacement of doors and windows and of roof, heating up of the façade), where now the huge loss of electricity is verified due to the low energy efficiency of the building, and for all the five kindergartens - replacement of doors and windows and of roof; for the apartment houses the measure of closing of the porches is foreseen.

Measure 2.1 – Improvement of thermal insulation in apartment houses

This measure means closing of porches in the selected 7 residential buildings. For the measures to be carried out, 9-floor buildings were selected based upon the opinion that first of all the number of such houses increases fast and they are the representative group for the apartment sector, besides, the effect of the measures is reflected onto more people, which afterwards will play the role of popularizers for spreading of the initiative over other block of flats.

In order to calculate the average annual consumption of one typical 9-floor block of flats distribution of the inhabitants of the city was applied for in various types of dwelling houses, taking into account the number and the complexity, and the total apartment sector annual energy consumption data in the city.

Taking into account the fact, that as the result of evaluation, the action data are as follows:

Population of the city is 169.4 thousand people.

Total consumption by the population of the city: electricity 141114.815 MW, natural gas 14596150.72 m^3 = 114346.23 MW/hr.

The population dwelling in the 9-floor blocks of flats occupies 38.2 % of the total dwelling area of the population of the city. According to that calculation, total consumption of the population dwelling in such blocks of flats has been assessed as 38.2% of the total consumption of the city: electricity 53914.533 MW, natural gas – 43687.294 MW/hr.

Therefore, taking calculation for one such block of flats (in total, number of such blocks of flats is 126), energy consumption per year is the following: electricity 427.893 MW, natural gas – 346.7245 (MW/hr.) (According to the data as of 2012)

It is obvious, that there are the data, according to which in the residential blocks of flats as well as in the other dwelling apartments and houses, other fuel is consumed as well, in particular, diesel and wood. According to the data as of 2011, for heating in the residential sector wood and kerosene are used in active mode. However, it should be reasonable to propose that the fuel of that type is used more typically in small sized (one and two floors) houses and rarely in 9-floor blocks of flat. Even in such case, implementation of the measure of thermal insulation will facilitate to driving out of use of such fuel for heating, incompatible with the city.

In order to calculate the spared energy, the presumption was made that consumption of the natural gas for heating would have been diminished. Such presumption is quite conservative as the other fuels (wood and kerosene) are characterized with the high emission rate.

Taking into account all the above said and supposing that the measure will be held once per year for each block of flats, and for the heating purposes mostly the natural gas will be used, 10% saving of the gas used for heating, achieved as the result of closing of the porches, in all the 7 blocks of flats during 7 years (2014–2020) will be the following: (7+6+5+4+3+2+1)* 346.7245/10 (MW/hr.) = 28*34.67245 = **970.8286 (MW/hr.),** which makes **196.10737 tCO2e** emission.

Measure 1.1.1) Improvement of thermal insulation in municipal buildings and

Measure 1.4 – Energy sparing control and climate control in the municipality administration building

The municipality administration building in Batumi stands out for great amount of energy demand and great losses, due to absence of the proper energy efficiency. Especially great are losses of electricity.

According to **the Measure 1.1** implementation of heating up is planned in the city hall administration building (in Lermontov Street), which means the complete pack of the thermal insulation: replacement of the roofs, the doors and the walls, heating up, closing of the entrances. Such pack spares energy losses up to 32%–40%[13]. Necessity of implementation of such measures often incurs with the city hall administration buildings, which is caused due to the dimensions of such buildings as well as the oldness and the high ceilings there. At the same time, these buildings are characterized with the large load, and people often stay longer than the working hours, there are many visitors and guests, the official meetings are arranged often. Such busy schedule together with the energy losses increases the costs significantly and is the heavy burden for the local budgets.

City halls of the signatory cities under the Sustainable Energy Action Plan shall, first of all, care about promotion of the energy saving idea and therefore the administrative buildings

[13] Holistic Strategies for Energy Efficient Refurbishment of the Housing Stock and Renewal of the Related Energy Supply System – URBEnergy - Energy Efficiency and Integrated Urban Development Action, WP4, Transnational Manual, -German Association for Housing, Urban and Spatial Development (DV) e.V. Germany http://urbenergy.eu/fileadmin/urb.energy/medias/partners_section/Partner_Outputs/main_results/Energy_Efficient_Refurbishment_WP4_manual.pdf

shall be a model to other institutions and citizens. Heat insulation measures are cheap and effective way to reduce heat losses. At the same time, the reduction in losses is a prerequisite for the other expensive measures to avoid financial damages. So it is economically feasible and reasonable to take these measures before implementation of any, more expensive ones, because it will significantly increase profitability. This approach is used in such cases when other, more expensive measures are planned to be taken for the same buildings. (e. g. in case of kindergartens).

A complete overhaul of buildings with heat insulation measures is planned for 2014-2016, which will reduce energy losses starting from 2017, i.e. annually reduced losses for 4 years. The potential energy reduction was chosen to be 35% conservatively.

Types of consumed energy are only electricity and diesel. The Action Plan along with other measures (insulation measures, bulb replacement) also identifies other activities such as complete overhaul of the administration buildings and remodeling them as energy-efficient ones, which means their equipment with climate control system under the measure 1.4 and ensure control of the energy expenditure. As the practice of developed countries shows, this is an affordable and effective method to save energy. According to the preliminary calculation and experts' evaluation, these measures result two-fold reduction of the power consumption that saves carbon dioxide emissions and the budget as well. Experts also calculate that the savings will be overcompensated from the savings on the electricity bills. These calculations were performed for internal use in Gori Municipality and then this measure has been reflected in the Sustainable Energy Action Plan of Gori.

The thermal insulation measure 1.1 aims for decrease of the heat losses, which is reflected onto the natural gas and diesel fuel consumption, which now are used in the administration buildings. In complex those to measures will decrease consumption of electricity and mineral fuel (diesel) in the building. Those decreases and emissions of the relevant carbon dioxides per year and in total up to 2020 are given on the table:

Table 30. Reduction of the consumed electricity and the carbon dioxide emissions in the municipality administration building of Batumi as the result of implementation of the measure of thermal insulation and introduction of the system for climate control and regulation of the energy demand

Consumed electricity (MW/hr.)		Sparing potential	Annually saved energy (MW/hr.) and emission		2020 Energy (MW/hr.) saved and emission (tCO_2) before	
Electricity	101.88	50%	50.94	7.79	203.76	31.16
Diesel	100.35	35%	35.12	9.22	140.48	36.88
In total					**344.24**	**68.04**

2) Kindergartens – Kindergartens were selected according to allocation of their buildings: kindergartens #1, #8, #12, #13, #21, which according to the expert's appraisal require the capital repair. By means of the indicated thermal insulation measures, assessment of the emission decrease potential was carried out based upon the amount of the energy consumed for heating by the particular municipality buildings in 2012 and the sparing interest rate, taking into account the specifics of the kindergartens.

Table 31. Energy consumption (MW/hr.) by the selected kindergartens and the greenhouse gas emissions according to the fuel in 2012

	Annual consumption	Electricity	Diesel	Wood	Emission (tCO2e)
Kindergarten 1	22.83	5.82	0.34	16.67	1.47
Kindergarten 8	66.24	17.45	0.86	47.90	4.29
Kindergarten 12	132.03	35.26	96.77	0.00	30.81
Kindergarten 13	65.33	29.22	0.69	35.42	5.68
Kindergarten 21	49.45	17.77	0.43	31.25	3.74

As it is obvious from the table, not a single of the selected kindergartens has the natural gas. For heating, they use diesel and wood, except for the 12th kindergarten, which for heating uses diesel and electricity only, and the 1st kindergarten, which for heating uses the wood only.

The heating measures to be implemented (replacement of doors and windows and of roof), at least by 20% will diminish the heating energy consumption because of decrease of the thermal losses. In terms of the Sustainable Energy Action goals there will be needed to conduct explanatory works with the management of kindergartens about which fuel is better to be reduced after heat insulation measures. Otherwise it might lead to reduction of electricity use rather than wood and diesel. In the 12th kindergarten there should be recommended to reduce consumption of diesel while in the rest of the kindergartens recommendation shall be about firewood reduction.

As the result of implementation of these measures, the decrease is foreseen during the first three years only, leaning upon the city gasification plan, which secures transferring of the kindergartens to the gas consumption – the presumption was made that will be carried out starting from 2017.

Taking into account that sparing of the energy consumption with the selected kindergartens will be calculated for three years only, during 2015–2017, and the emission has been calculated due to the presumption that the spared 20% will count for diesel for the 12th kindergarten and woods for all the rest.

Table 32. Energy and emission saving with the selected kindergartens for 2015–2017

	Energy consumed for heating per year		Sparing %	Sparing per year (MW/hr.)	Number of years	Energy sparing, total for 2014–2016, MW/hr.	Spared emission tCO2
	Type	Amount (MW/hr.)					
Kindergarten 1	Wood	16.67	20%	3.33	3	10.00	0.29
Kindergarten 8	Wood	47.90	20%	9.58	3	28.74	0.84
Kindergarten 12	Diesel	96.77	20%	19.35	3	58.06	15.25
Kindergarten 13	Wood	35.42	20%	7.08	3	21.25	0.62
Kindergarten 21	Wood	31.25	20%	6.25	3	18.75	0.55
Total		**228.01**		**45.60**		**136.80**	**17.54**

As for the period after 2017, in the same kindergartens **the measure 1.6 Fuel "replacement"** shall be carried out – the amount of diesel and wood used for heating, which remains by 2017 as the result of the above indicated measures, will be replaced with the less emitting natural gas, which will already be available for the indicated kindergartens. That will decrease the emissions of the greenhouse gases.

Measure 1.6 - "Replacement" of the fuel

With the purpose to calculate the amount of the gas required for complete satisfaction of the goal for heating, the annual amount of the remaining fuel (diesel and wood) used for heating was calculated by 2017, and for convenience the amount was expressed in usual for natural gas volumetric unit ($m^{3)}$). The relevant emissions were calculated leaning upon the gas emission rate and saving (decrease) – by means of difference between diesel and woods on one hand, and their equivalent heat (MW/hr.) bearing gas emissions. It was taken into account that for 2017, the energy used for heating will be only 80% of the amount used before.

Table 33. Emissions decreased as the result of replacement of the heating types with the natural gas for 2017–2020

	Energy consumed for heating per year		Relevant emission (tCO2 e) per year	Same amount (MW/hr.) gas relevant volume (m^3)	Gas relevant emission (tCO2 e) per year	Differenc e (tCO2 e)	In total, in 4 years (2017–2020) spared emissions tCO2
	Type	Amount (MW/hr.)					
Kindergar ten 1	Wood	13.33	0.39	49.58	0.08	0.31	1.24
Kindergar ten 8	Wood	38.32	1.12	142.53	0.22	0.89	3.57
Kindergar ten 12	Diesel	77.35	20.32	2 593.19	4.09	16.23	64.90
Kindergar ten 13	Wood	28.41	0.83	105.68	0.17	0.66	2.64
Kindergar ten 21	Wood	25.00	0.73	92.99	0.15	0.58	2.33
In total		**182.41**	**23.38**	**2 983.98**	**4.71**	**18.67**	**74.68**

As we can see, this measure has quite significant savings potential. Generally, heat insulation and fuel substitution measures in both kindergartens, carried out one after another, gives a total of 17.54 +74.68 = 92.22 tons of CO2 reduction potential from 2014 to 2020.

Measure 1.2 - Application of the sun batteries in the municipal buildings (3 kindergartens)

The kindergartens belong to the field of special care by the City Hall, and in them, besides the other measures intended for the municipal buildings in the framework of the Sustainable Energy Action Plan implementation of one more additional measure is planned, which means application of the sun batteries with the purpose of supply of 3 kindergartens with hot water. This at the same time will spare the energy consumption and the relevant emissions.

For implementation of the measure kindergartens #3, #10 and #14 were selected due to the intensity of the natural gas consumption.

It is obvious that in the kindergartens there is the special demand for consumption of hot water due to the necessity for washing of the children. The great share of the energy consumed by these institutions after heating and cooking, counts for heating of water, in particular.

Installation of the solar panels in kindergartens is not just for heating of water or reduction of the greenhouse gas emissions under the Sustainable Energy Plan, it also promotes introduction of the non-conventional renewable energy. Implementation of the solar panels is not popular in population because of the high cost and the low power but this measure seems adequate for kindergartens for heating of water taking into account demand coverage. Besides, the greenhouse gas emissions reduction goal of this action plan is an additional motivation for promotion and popularization of this energy.

Energy savings was calculated from the substitution of the natural gas used for water heating, as the natural gas is mainly consumed for heating of water.

Solar energy in Georgia, in particular in Kartli region, is estimated as 1200-1500 kWh per year. This energy is even higher in Batumi. By conservative estimation, in case of the optimal design of solar panels and the solar energy collectors with 70% efficiency, there may be adopted 1500 * 0.7 = 1050 kWh for 1 m^2 per a year. This is 10500 kWh for 10 m^2, which is quite enough to meet a medium size kindergarten's demand on hot water. This amount of solar energy will save the same kWh of natural gas that is equivalent to 2,121 tons of CO2 per year from each Kindergarten. Taking into account the relative sizes of kindergartens, there will be enough to install40 m2 panels in this 3 buildings which is 8,484 tons of CO2 per year. Taking into account that installation of the sun collectors in the kindergartens will be carried out in 2015, 2016 and 2017, during the term of action of the collectors (before 2020), the emissions will be decreased by (6+5+4)* 8.484 = 15*8.484 = **127.26 tCO_2**, and the relevant consuming = 1050 KW/hr. *40*15 = **630 MW/hr.**

Installation of the energy efficient bulbs: Measure 1.3 and Measure 2.2.

This measure means replacement of the non-efficient incandescent bulbs popular in the country with the modern energy efficient bulbs, with the purpose of saving of the consumed electricity and accordingly, for decreasing of CO_2 emission.

Common incandescent light bulbs, being very power-consuming because of the low level energy efficiency and having short lifespan are unprofitable for the population but still energy efficient bulbs are not popular due to their relatively high cost. Even simple calculation shows their profitability in long-term outlook but because of low purchasing power of people and partly the traditional practice, extra motivation is needed to implement them widely.

Measure 2.2 aims to distribute one energy efficient bulb to each family in the pilot apartment buildings (seven 9-floor building) taking into account, that in all the families such bulbs will be applied in the most lit rooms used often, where the family gets together in the evenings and spends most of their time.

The taken measures must be accompanied by explanatory works with residents of the pilot buildings about characteristics and economic and environmental benefits of energy efficient light bulbs. It is worth mentioning that this measure will be taken for the same apartment blocks where the closure of entrances is planned (measure 2.1.) in. Educational works will also facilitate implementation of both measures. Distribution of lamps for free will

play a stimulating role for tenants to show interest in co-financing the closing works of entrances.

In order to calculate the energy saving potential, the difference between the efficiency rates of the incandescent bulbs and the energy efficient bulbs was used, and for calculation of the spared emission – the national electronic networks rate (for 2012 = 0.15293 kg CO2/KW/hr. = 0.15293 tCO2/MW/hr.).

To calculate the number of flats of an average residential block, an example of a 9-storey, standard, two-entrance block of apartment is used with 9 * 3 * 2 = 54 apartments. So there will be distributed 54 energy efficient light bulbs in each residential block.

Electricity savings are calculated based on the difference in energy consumption between standard 60 - watt incandescent light bulb and an energy efficient (low-emitting) compact fluorescent lamp (CFL) and is equal to 68.5% of the total consumed energy.

Energy consumption of 1 incandescent bulb in 1 hour= 60 watts = 0.06 kW. If assumed that the bulb is burning an average of 6 hours (in the longest- used room) , then the consumed energy will be equal to 0.06 x 6 = 0.36 kWh per day and 0.36 x 365 = 131.4 kWh per year. While 68.5 % of energy savings equal to 90,009 kWh, it will be 4860,486 kWh per year in case of 54 bulbs (for each blocks) which corresponds to 0.7433 tons of saved CO2 emissions (according to the rate as of 2012)

If this measure is carried out in all those dwelling blocks of flats, in which the measure 2.1 of closing of porches will be implemented, according to the scheme: heating up of each block of flats and replacement of the bulbs annually (starting from 2015 up to 2020), then in the end of the action plan the total sparing of the dwelling blocks of flats due to such measure only is 4860.486 KW/hr.*(7+6+5+4+3+2+1)=4860.486*28=1 360 936.68 KW/hr.=**136.0936 MW/hr.,** and therefore - **20.812794 tCO_2.** It shall be indicated, that due to various reasons, in the electricity network of Georgia in the last years the mineral fuel (gas) share increase is verified. Taking into account this trend, the emission rate of 2012 shall be considered for conservative assessment before 2020).

Similarly will be calculated savings of electricity and carbon dioxide emissions from the measure 1.3 that will be implemented in selected municipal buildings. More precisely, some incandescent lamps will be substituted by energy efficient light bulbs in kindergartens (1.3.2) and in the city hall administrative building (1.3.1). There have been selected 3 kindergartens with satisfactory conditions and intensive power consumption (# 3, # 10 and # 14). Number of lamps was determined based on the quantity of busiest rooms and the number of lamps in such rooms, namely 30 bulbs per kindergarten.

Amount of the saved electricity and carbon dioxide emission are calculated due to the number of the bulbs to be replaced and the years passed.

Having considered the above calculated saving of one bulb per year (4860.486 KW/hr. = 4.860486 MW/hr. electricity and emission 0.743314 tCO_2), the total saved electricity before 2020 for all those buildings in which the measures 1.3 and 2.2 will be implemented, makes as it is given on the table:

Table 34. Savings of electricity and carbon dioxide emissions in the buildings as the result of application of the energy efficient bulbs

Building	Measure implementation year	Energy spared as the result of one bulb (MW/hr.)	Number of years	Number of the bulbs to be replaced	Saving of the electricity (MW/hr.)	CO_2 emission sparing (t)[14]
Kindergarten #3	2014	0.09	6	30	16.20	2.48
Kindergarten #10	2014	0.09	6	30	16.20	2.48
Kindergarten #14	2014	0.09	6	30	16.20	2.48
In total in kindergartens					48.60	7.43
In total from municipality buildings					210.62	32.21
Dwelling block of flats (7)	2014–2020		7+6+5+4+3+2+1=28	54*7	136.09	20.81
In total in buildings					**395.33**	**60.47**

Measure 1.5 – Change of the heating system – replacement of the diesel-working system with thermal pumps

This measure is for the administration building of the municipality as one of the actions taken for complete rehabilitation of this building. The goal is to remake the old-fashioned, diesel-powered, non-energy effective heating system of this construction into energy saving one. This measure is carried out after thermal insulation and installation of the energy efficient light bulbs in the same building that generally ensures a complete renovation and maximum energy efficiency of the building.

Thermal pumps receive the energy from the environment and supply the transformed heat to the building. For their functioning the minimal expenditures are required in form of the electricity, and the feedback is rather big: the thermal pump of air and water type, installation of which is foreseen in the administration building of Batumi City Hall, approximately, as the result of consuming of approximately 1 KW/hr. might produce 5.5 KW/hr.

In the framework of the measure installation of 2 thermal pumps is foreseen (Model IS 120 of Sweden production) each of the capacity of 20 KW/hr. and with the annual thermal generation of 90 000 KW/hr. The building area, which require heating and cooling, is 1007 sq. m., with 6 bathrooms and kitchen, in which water is heated with the electricity, and its consumption makes approximately 100 000 KW/hr. per year (see the **Error! Reference source not found.**), with the growth perspective.

Together with the electricity, the building consumes together with the electricity the diesel fuel, which is used for heating only. Total annual consumption (for diesel seasonal) is given on the table:

Table 35. Electricity consumption by the administration building of Batumi Municipality (in Lermontov Street) in 2012

	Electricity	Diesel	In total

[14] **Electricity network emission rate for 2012 was 0.15293 tCO_2/MW/hr.**

	(MW/hr.)	(l)	(t)	(MW/hr.)	
Consuming (MW/hr.)	101.88	5 822	5.25	100.35	202.23
Emission (tCO2)	15.58			26.36	41.94

As the table shows, heating is diesel powered and seasonal (6 months, November – April). Also, electricity is used for heating the building since the number of radiators in not enough for complete heating. Electricity is used also to get hot water and cool the building in summer. For additional heating in winter and conditioning in summer three powerful (7 kW) air conditioners are used.

As the result of implementation of this measure consumption of diesel fuel for heating shall be totally excluded (which makes approximately 6000 l = 5.41 t per year) and consumption of the electricity shall be diminished, which now is used for compensation of the incomplete heating (approximately 50% of the total annual consumed electricity).

Implementation of a similar project in one of the kindergartens in Tbilisi saved at least 40% of energy and consumption of the natural gas was completely eliminated.

To implement such strong energy efficient measures the loss of energy should be completely excluded. Therefore, it is advisable this measure to be carried out along with other measures (here with thermal insulation ones) in order to reduce energy losses.

If considered that in the first place (in 2015) Measure 1.1 of thermal insulation is implemented, then in the subsequent 2016 consumption will make electricity of 50 MW/hr. and diesel of 65 MW/hr. Then by means of implementation of the indicated measure (1.4) electricity of 90 MW/hr. will be received with both pumps, which totally excludes consuming of diesel fuel and will diminish to minimum consumption of electricity network.

In order to generate electricity of 90 MW/hr. for the proper use the pump consumes 90/5.5=16.36 MW/hr. Therefore, while implementation of this measure, that is while installation of the pump the building will have 50 (electricity) and 65 (diesel) MW/hr. consumption necessity for the purpose of proper heating, and if for functioning of the pump 16.36 MW/hr. electricity is used, then the pump will produce 90 MW/hr., which makes 90–16.36=73.64 MW/hr. electricity, and the building requires 115–73.64=41.36 MW/hr. only. Therefore, upon installation of the pump, 73.64 MW/hr. energy will be saved per year, which starting from 2017 up to 2020 makes 294.56 MW/hr., corresponding to 45.047 tCO2e before 2020 (11.26 tCO2e annually).

Measure 2.3 –Application of the project of "Cheap House" for the purposes of the Sustainable Energy Action Plan (popularization, facilitation and implementation)

The concept of the "Cheap House", which aims to facilitate availability for the population in general while providing them with the dwelling facilities of the proper quality, is the initiative of the self-government of Batumi. The program means providing opportunities to the families with middle income and those in need – to live in the conditions appropriate for the human dignity, and in case of meeting of the conditions required according to the program,

to become owners of the dwelling facilities after the definite term. Financial securing of the program totally depends on attracting of the required investments by the self-government.

This project has a great potential to promote and implement energy efficient construction activities in the city under sustainable energy development perspective that have to be used. This potential means the fact that the cheapness of housing is connected to implementation of the energy efficiency and resource savings principles during its construction and functioning. In other words, the cheapness of housing is achieved though energy and resource savings.

Taking into account these circumstances, the indicated project of the “Cheap House” might play decisive role for facilitation of the sustainable development of the city. Therefore, it is considered to be appropriate at this starting stage of the program to elaborate on and to develop such principles of construction and functioning of the cheap dwelling facility, which would facilitate to popularization of the idea for sustainable development in the city and would help while implementing the liabilities foreseen due to the “Covenant of Mayors” in the framework of the Sustainable Action Plan.

The concept of the program requires a tenant of the “cheap house” to pay the rent periodically for a certain period of time before full coverage of the cost. This is a necessary condition to acquire and possess the property. The rent also includes other expenses such as bills. The measure/project proposal aims at minimization of such expenses – through energy efficiency and resource savings.

The first component of the measure deals with the requirements to be introduced into the process of construction of the dwelling facility, and which shall secure energy efficiency for the dwelling facility.

In particular, the project of construction of the dwelling area shall include closing of the porches, works for caulking up (thermal insulation – the caulking layer in the wall) of ceiling, doors, windows and walls (or of one the coldest wall only), installation of the temperature control device in all the apartments, installation of the sensor lights in the porches. For heating of the apartments the thermal pump might be installed of air or water type, which due to the small amount of self-consumption produces the energy. All that technical material is in the framework of the available prices and in the shortest term will earn its keep by means of sparing of the energy. The concept shall maximally foresee the European standards of “Green Houses”, and the optimal set shall be selected taking into account the local specifics (market availability, enabling/facilitating environment, regulations, etc.). It shall be indicated that the project (USAID) of the low emission development strategy being carried out in the country currently means certification component of “Green House” also, and the concept of “Cheap House” has good prospect – from the point of view of getting the indicated project in the framework of the indicated component, – in case of proper development and directing of the concept.

The second component means requirement for preserving of the particular conditions by the lessee, which are included into the Agreement, e.g. on non-utilization of wood or any other cheap mineral fuel; condition for utilization of the energy efficient bulb in the room used most frequently. The lessee shall be encouraged by means that in case of standing for the energy efficient lifestyle, decrease of the costs via energy saving and advance payment of the

defined rent fee the latter could accept the apartment into the proprietorship before the verified term, which makes 10 years.

The agreement for renting of the dwelling facility shall be drawn before construction of the latter, and the future lessee shall be entitled by means of the proper physical nature to participate into its building and therefore to work out the bonus, e.g. any card, which might be cashed out with the free of charge energy efficient bulbs, after construction of the house is complete.

Before construction of the dwelling facility, after selection of the lessee the particular consciousness rising work shall be carried out with the latter about significance of the energy efficiency, energy saving, decrease of losses and rational use of resources, and according to the results about the life style; it shall be explained also, how it is possible to receive the material benefits from it. This work might be carried out in the city hall by the work group responsible for elaboration and implementation of the sustainable development plan, in the frameworks of the measures for rising of the consciousness of the population as foreseen by the plan. The same group shall monitor implementation of the obligations for protection of the environment by the lessees as foreseen by the agreement.

The program of "Cheap House" keeps evolving in fast mode, and at the same time has great impact on success of implementation of the Sustainable Energy Action Plan, and not only from the point of view of rising consciousness of the population but due to saved energy consumption and decrease of the relevant emissions, which might be calculated leaning upon the energy demand of the 9-floor block of flats (see the Measure 2.1) and with minimum 50% of sparing potential, as follows:

Table 36. Saved energy and emission of the first building of the "Cheap House" (on basis of the typical 9–floor block of flats)

Electricity annual consumption (MW/hr.) for one block of flats	Annual consumption of the natural gas (MW/hr.) for one block of flats	Annual saved energy[15] (MW/hr.)	Accordingly spared emissions **[16] (tCO2e)
427.89	346.29	213.9465 + 173.147= 387.09	32.7188+34.975694=67.69

Presuming that at least one such building will be constructed in 2015, then in 2016–2020 the saved energy will be 387.0935 * 5 = 1935.4675 MW/hr., and the emission – 67.6945 * 5 = =338.4725 tCO2e.

As the result of the pilot measures to be carried out in the sector of the buildings the summarized saved energy and CO_2 emissions by 2020 are given on the following table:

[15] **50% spare of the energy of both types together**

[16] **With electricity and natural gas rates**

Table 37. Saved energy and CO2 emission mitigated as the result of the pilot measures planned in the buildings sector (before 2020)

Type of the measures	Saved energy in total (MW/hr.)	Spared CO_2 emission (t)
Thermal insulation measures (1.1 and 2.1)		
Measure 1.1: Thermal insulation in municipal buildings		
1.1.1) Municipality administration building	140.48	36.88
1.1.2) 5 kindergartens (2014–2016)	136.80	17.54
Measure 2.1. Thermal insulation in residential buildings (seven residential blocks of flats (9-floor))	970.83	196.11
Measure 1.2. Installation of sun batteries (three kindergartens)	630.00	127.26
Installation of the energy efficient bulbs (Measures 1.3 and 2.2)		
Measure 1.3,1) City Hall administration building	162.02	24.78
Measure 1.3.2) Three kindergartens	48.60	7.43
Measure 2.2. Seven residential blocks of flats (9–floor)	136.09	20.81
Measure 1.4. Climate-control / Energy demand administration (City Hall administration building)	203.76	31.16
Measure 1.5. Installation of the thermal pumps (City Hall administration building)	294.56	45.05
Measure 1.6. Fuel replacement (gasification – five kindergartens) (2017–2020)	18.67	74.68
Measure 2.3. Application for the concept of "Cheap House" for facilitation of the sustainable energy actions		
(One building per year)	387.09	67.69
(One building in 5 years: 2016–2020)	1 935.47	338.47
Sparing in the sector of the building, in total ("Cheap House" 5 years including)	**4 677.28**	**920.17**
Among them:		
5 kindergartens (## 1,8,12,13,21): 1.1.2) + 1.6	**155.47**	**92.22**
City Hall administrative building: 1.1.1+1.3.1+1.4+1.5	**800.82**	**137.86**
7 units 9–floor blocks of flats: 2.1+2.2	**1 106.92**	**216.92**
Three kindergartens (##3,10,14) : 1.2 + 1.3.2	**678.60**	**134.69**

The pilot measures shall give a push to implementation for more large-scaled measures in the long-termed prospect. These measures are the following:

- Spread of energy efficiency measures over other residential buildings. Revoking interest among the population for the energy efficiency by means of various incentive measures.
- Spread of the energy efficiency measures over the buildings being in the state proprietorship, such as schools, ministries, etc. The work will be carried out with the relevant state organizations.
- Elaboration on the new regulatory standards of the construction, which provide applying for the energy efficiency measures for the new constructions.
- Decrease of the city urban heat island effect while urban planning of the city, selection of the heat reflecting colors and building designs, city planning in the way to improve the natural ventilation.
- Increase of the energy efficiency in tourism and commercial sectors. Involvement of the commercial sector is one of the most significant prerequisites in order to achieve the city sustainable development. That is why especially the measures of working with the private sector and the works for rising of the private sector consciousness are planned, and the technological exhibitions and the seminars will be held. Special attention shall be paid to increase of the energy efficiency in the touristic buildings, as tourism is the strategic direction for development of economy of Batumi.

All in all, the measures foreseen according to this plan are given in table 38

Table 38. Measures planned in the buildings sector

Sectors and Fields of Action	Key measures per sector	Responsible Department, Person or Company (If any third party is involved)	Start/Finish Date	Cost	Expected Energy Savings per Action (MWh)	Expected CO2 Reduction per Action (tone)
Municipal buildings and equipment	Heat insulation measures of municipal/ budgetary buildings	Batumi Municipality	2013-2015	80000 USD per building 10 buildings 800000 USD	3 442.21	556.46
	Implementation of renewable energy technologies (heat pumps, energy efficient biomass) in municipal buildings with wood or diesel powered heating systems	Batumi Municipality	2013-2015	120000 USD per building 10 buildings 1200000 USD	2 409.55	476.60
Non municipal buildings and equipment of the service sector	• Promotion of energy efficient measures in tourist buildings • Green building concept promotion	Batumi Municipality	2015-2020	100000 USD per year on advertising and arranging other events	20 000.00	5 000.00
	Energy efficient measures in schools and other state buildings	Ministry of Education and State institutions	2013-2015	70000 USD per building 20 buildings 1400000 USD	6 100.00	1 030.00
Residential buildings	"Affordable House" Energy efficiency	Batumi Municipality	2014-2018	120000 per building	5 000.00	1 500.00
	Promotion of heat losses reduction measures, energy efficient and renewable energy technologies. The government's incentives measures for energy efficient buildings and their occupants	Batumi Municipality	2016-2020	100000 USD per year on advertising and arranging other events	20 000.00	5 000.00
	Selection of pilot buildings and taking thermal insulation measures to ensure their popularization	Batumi Municipality		USD70,000 per 1 building, USD1,400,000 per 20 buildings	9 851.0	1027.4
Requirements/standards of the energy efficiency	Development of energy efficiency standards in new buildings	Batumi Municipality along with legislative bodies of Adjara AR and Georgia	2016-2020	About 200000 USD on hiring external experts and raising awareness	27 500.0	5050.00

6 Public lighting

6.1 Overview of the Sector

Batumi is impressive at night, it is impossible not to be attracted by its beauty, the rhythm of this small city the most of all is felt in night boulevard. In recent years significant resources were spent for lighting all tourism districts, as well as noteworthy buildings and new infrastructural sites.

Figure 19. Batumi at night

In 2012 new territories were added to Batumi, due to that the demand for street lighting and respective expenses got increased. There are still many districts in newly added area, where additional lighting points are required.

In 2012 electricity also was spent on fountains, traffic lights and lighting of different buildings.

Table 39. Energy consumption and spending of street lights sector of Batumi in 2012

Infrastructural sites	Electricity consumption (kilowatt hours)	Financial expenses (GEL)
Fountains	348 725.24	55 798.86
Traffic lights	38 998.00	6 239.69
Lighting Sport Palace	947 584.00	119 305.92
Lighting mother tongue tower	200 292.01	32 048.31
Lighting tower fountains	4 743.30	758.96
Advertisement monitors	68 371.10	10 939.93
Street lights of Batumi	10 007 413.00	1 601 262.22
Street lights in newly added areas	1 194 531.88	191 134.64
Total	12 810 658.53	2 017 488.53

As demonstrated by the table in 2012 Batumi city consumed 12.8 million kilowatt hours of electricity, to which annual expenditures in amount of 2 million GEL were in compliance.[17] In total 12887 light are distributed, types and energy consumption of which is provided in the table below:

[17] The source Infrastructure service of Batumi city hall

Table 40. Types of bulb and energy consumption

Type of bulbs	Number of bulbs	Energy consumption per each	Total kilowatt hour
Diode	441.00	0.03	11.85
Economic	22.00	0.02	0.35
Halogen	68.00	0.07	4.76
Metal halogen	566.00	0.06	35.00
Meta halogen	2 313.00	0.16	364.55
Light diode economic	2 082.00	0.00	6.25
Sodium	7 255.00	0.24	1 735.45
Spiral	140.00	0.10	14.00
Complete	12 887.00		2 172.21

6.2 Methodology

Methodology is the same as for the buildings and transport sectors.

6.3 Inventory of Baseline Year

In 2012 energy consumption of street lights sector compiled 12810658 kilowatt hours.
In 2012 emission for street lights was 1959 tones equivalent of CO2.
In 2012 the factor average emission of electricity network - 0.153 tones CO2/megawatt hour, is taken as the factor of electricity emission.

6.4 Greenhouse Gas Emissions BAU Scenario (2013-2020)

In BAU scenario it was assumed that the increase of the points of public lighting points will depend on the extension of the city, which depends on increase of population size respectively. Thus, main drive of this sector is population growth.

- The growth of Batumi city population is demonstrated on the image 2
- Number of bulbs will be increased in compliance with population growth
- Added bulbs are non effective sodium bulbs
- It seems that the factor of emission of electricity network will not be changed

According to BAU scenario, energy consumption of the street lights will be increased in future and will achieve 14.5 thousand kilowatt hours by 2020, while CO2 emissions will reach 2.22 thousand tons by 2020.

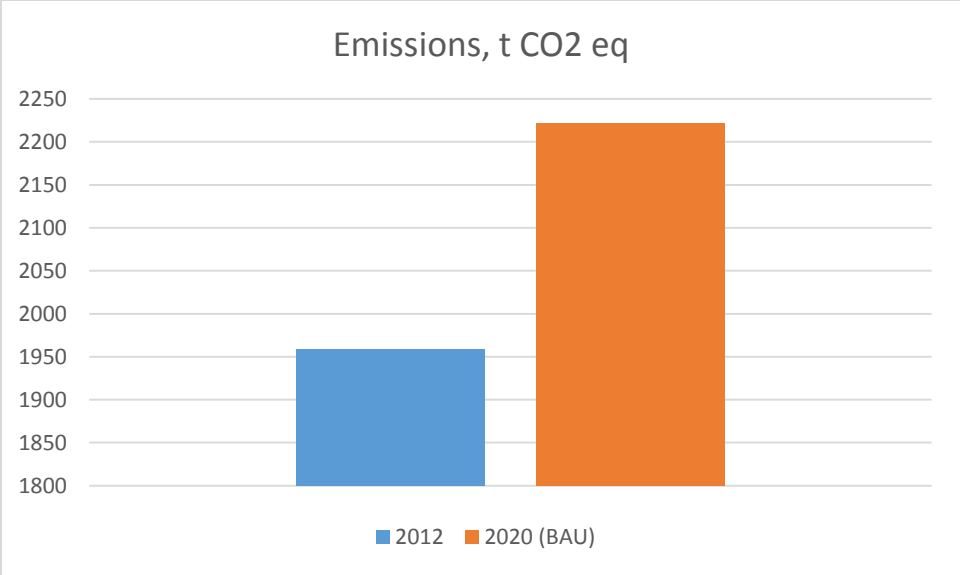


Figure 20. Emissions from the street lights sector in 2012 - 2020

6.5 Action Plan for Mitigation of the Emissions from Batumi Public Lighting

Following activities are envisaged in the action plan for the street lights sector:

- Development of the master plan for auditing and development of Batumi street lights system;
- Equipping street lights poles with modern, effective, energy saving bulbs (Installation of 7300 diode bulbs by 2020);
- Establishment of entire computerized unit in the street lights system;
- Development of the software for management and monitoring of the street lights system
- Eradication of energy losses in the street lights system

Substitution of non effective bulbs with energy efficient bulbs (LED) will have the most significant effect out of mentioned activities. Diode light is one of the most efficient, modern technologies.

LED lights have several advantages, including:

- High brightness and high level of colors;
- Waterproof and dust sustainable structure;
- Rational use of energy;
- Operation term of LED bulbs is long.

Operation term of LED bulbs is not less than 50 000hours, while halogen and luminescence bulbs operate just 4 000 hours and though initial investment for procurement of

LED bulbs is high, the expenses for procurement of bulbs and energy cost are significantly reduced later.

Within the frame of this activity it is planned that 65% of bulbs will be diode by 2020, which means installation of 7300 new diode bulbs. As a result of this activity about 11.3 thousand megawatt hours and 1.7 tones of the emissions of greenhouse gases are saved. If we take into consideration that procurement and installation of one such bulb costs about 270 GEL, total cost of the activity will compile about 2 million GELs Of course this substitution should be implemented gradually during 8 years and the annual expenditure will be 250 thousand GEL respectively.

The diagram given below demonstrates the emissions of greenhouse gasses in cases of BAU scenario and equipping the streetlights poles with energy efficient bulbs, which is the most important priorities of Sustainable Energy Action Plan in this sector:

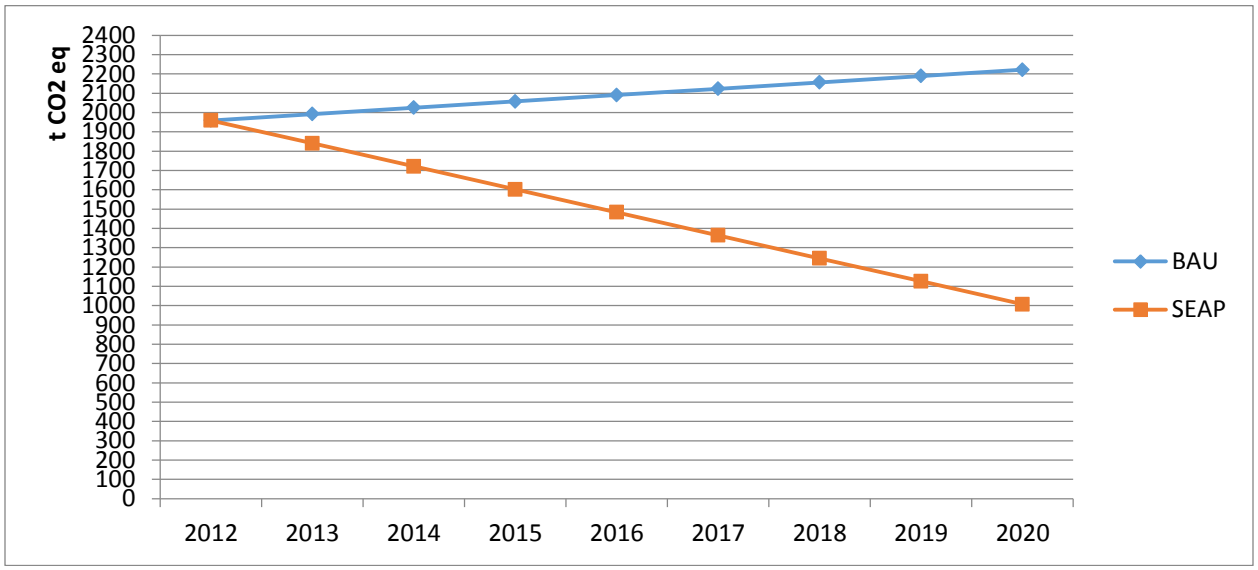


Figure 21. Energy consumption by city streetlights by BAU scenario and in case of implementation of the activities envisaged in SEAP

It is assumed that other above mentioned activities will also impact energy consumption reduction and mitigation of emissions, but this was not evaluated at this stage.

7 Solid waste and wastewater

7.1 Overview of the sector

In recent years the construction, tourism and trade boom in Ajara creates favorable conditions for the economic growth in the region. Consequently the region is facing the necessity to transform infrastructure and services sector to follow the accelerating rate of demand.

From the standpoint of sustainable development of energy landfills and wastewater obviously are representing one of the priority spheres for such transformation in the region.

The increasing number/amount of municipal, commercial and industrial waste and wastewater requires the rehabilitation, re-equipment and modernization of landfills and wastewater handling facilities along with optimizing the management practices. First steps in this direction already have been taken, but this process needs to be hastened to achieve the proper level of services in this sphere.

7.1.1 Solid waste

The Batumi landfill operates since 1965. It occupies 19.2 ha in Batumi Adlia settlement 300 m away from the Batumi Airport and premises of local residents. The landfill also borders petrol service station and Duty-free Administration building, River Chorokhi and the Black Sea. Dominant winds dissipate emissions from the landfill towards the sea, creating discomfort to tourists.

The landfill is used for dumping waste from residential districts of Batumi and Khelvachauri municipalities.

At the entrance of the landfill there is a control station equipped with a bar. One part of the landfill is allotted to dispose remains of animals (cattle and pigs). The landfill has no waterproof system neither has it wastewater treatment and gas collection systems. The height of solid waste in some places exceeds 6 meters.

In the Soviet period a waste-processing mill was constructed near the highway but it never was operational due to political turmoil in 1989.

The company “Sandasuptaveba Ltd” registers waste transported to the landfill since 1990. About 700-850 m3 of trash is delivered daily at the landfill, making 250 000-300 000 m3 of waste annually. The waste is only rammed at the site that often causes its self-flaring up and consequent fires. Based upon the average amount of annually disposed waste (254 883 m3), in the period of 1990-2012 (22 years) total amount of waste transported to the solid waste disposal site (SWDS) can be estimated as 5 607 419 m3. Till 1990 collection of solid waste in Batumi was not properly organized and daily amount of gathered waste varied in the range of 400-500 m3. Assuming the average daily amount of waste equaled to 450 m3, the annual amount of waste made 165 000 m3, and total volume of accumulated waste in the first period of SWDS operation (1965-1989) equaled to 3 800 000 m3, resulting in the overall amount of waste at the landfill to be 9 407 419 m3.

The existing SWDS is used for heaping of harmful toxins and inert waste as well. No environmental protection measures are taken at the landfill and this transforms it into active pollutant of the environment. Its functioning causes the contamination of atmosphere, water reservoirs and soil.

During the handling of the waste sanitary and hygienic terms are being violated. Outsiders are conducting prohibited activities at the landfill such as collecting metal scrap, glass, and different domestic articles. During 1993-1997 part of the landfill was washed off by R. Chorokhi without impacting major dumping area. In 1998-1999 under the financial assistance of World Bank, a flood protection wall was constructed at the strip dividing landfill from the river and the wall partly held up the erosion of - 234 -

landfill bank. In 2009, under the initiative of the Ministry of Environment, a 1 040 m long dam has been erected on the side of landfill along river Chorokhi, completely eliminating the risk of washing down the SWDS. In the nearest 2 years further consolidation of the bank down

to the mouth of the river is planned in connection with the construction of a new bridge over the river. The landfill is located at the terrain having complex geological structure that hampers wastewater control. The only way of solving this problem is to close down the landfill and reconstruct the landscape at the earliest possible date.

For that reasons it's planned by the Ajara Government and Batumi Municipality to close down the Batumi operational landfill to 2015.[18] For the reason it's planned by the Ajara Government and Batumi Municipality to close down the Batumi operational landfill to 2015. Instead of this landfill the arrangement of a new landfill or solid waste disposal site (SWDS), equipped according to EU standards, is planned 500 m away from the village Tsetskhlauri of Kobuleti municipality, at the territory of abandoned cattle-breeding farm. The design for the construction of new SWDS is drawn up by Ajara AR Ministry of Finance and Economy (Batumi Municipality is represented in the Ruling Comity of the project by the Mayor of the city).

The new SWDS is not intended to dispose harmful waste and will function in accordance with EU directive 1999/31/EC related to the establishment of environmental standards. New SWDS, in addition to the sanitary landfill, will include relevant buildings, weighing bridges, wastewater collection and treatment system, processing, sorting and storing facilities, and necessary operational machinery. It is also planned to introduce methane recovery system, which will be able to collect gas after 3-5 years from putting the landfill into operation.

After weighing and registration of waste and other materials at the entrance, they will be graded and piled on the special territory, where the harmful waste will be sorted out and placed into special containers outside the territory in order to transport them for obliteration or processing at the allotted site. Materials intended for processing mainly include metal, plastics, glass, paper, wood and other economically valuable stuff.

The area of the new landfill occupies 32 ha and has the depth of 12 m. Total permissible volume of disposed solid waste equals to 3.4 million m3, and the duration until complete filling up – 35 years. The area of each cell of SWDS is 10 ha. According to the preliminary estimations, the landfill initially will take annually 42 000 tons (115 tons daily) of domestic waste collected in Batumi and five Ajara municipalities and will gradually increase received waste up to 80 000 tons per annum.

[18] After the 2013 elections, the new government may, presumably, once more postpone this issue, since the new authority is not yet determined on the implementation of this project. The revision of all initiated and planned projects is going on in order to assess their expediency.

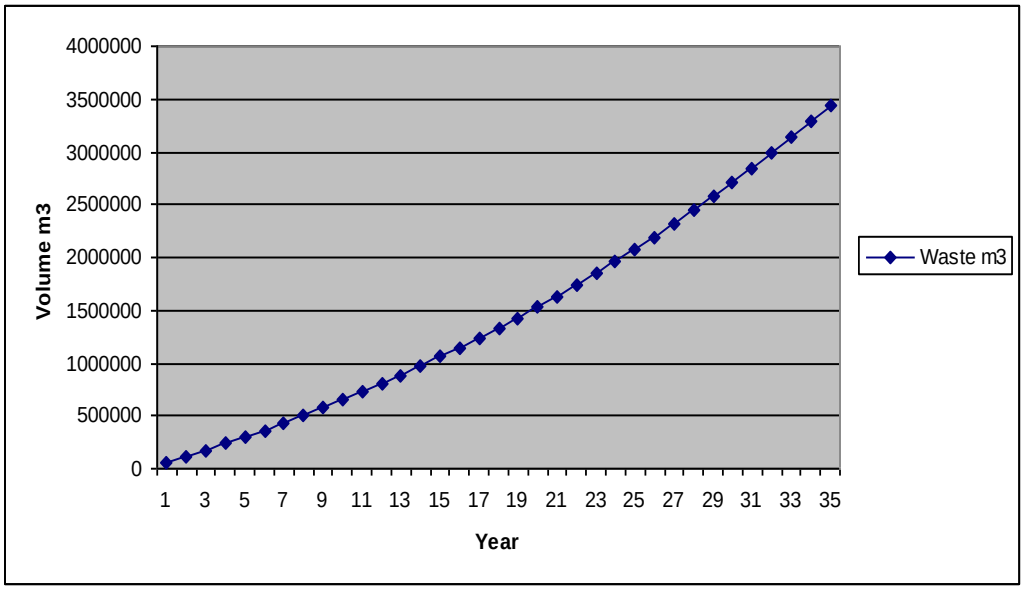


Figure 22. Anticipated trend of waste generation at the Ajara's new landfill

The waste will be disposed at 10 ha cells to bring to the minimum regularly accommodated waste area. Step by step, when pile of waste reaches permissible height, the interim cover will be laid for pouring off the surface waters and mitigation of wastewater origination.

The covering of waste will be performed at 3 different levels with alternative methods: daily covering, creation of interim layer and final coverage.

Daily covering will be executed at the end of each day and will consist of laying 5cm or deeper stratum of soil or other relevant material. It is aimed at weakening direct impact on organic materials, which causes unpleasant smell and risk of pollution by light trash, such as plastic and paper.

The interim layer consists of about 50 cm wide waterproof soil stratum that prevents spreading of polluted surface water out of waste cell. This type of coverage is used for surfaces that were not subject to waste dumping for six months. The layer must be put before the mounting of gas wells that makes it possible to use a sub-pressure system for landfill gas extraction system without intrusion of oxygen into the core of the waste.

After the complete filling of the cell, according to existing regulations, it will be covered by the final layer.

Each cell of waste will be gradually filled up to the prescribed final level. The surface will have an inclination of not more than 1:3 (vertical: horizontal) to provide corresponding working conditions and to create a possibility for laying final coverage at the closing up of the landfill. Maximum inclination is used also in order to decrease the slope erosion risk.

After reaching the maximum height of the pile, its slope will be slightly inclined towards a small ridge in the center of landfill, supporting the pouring down of surface waters. Minimal inclination should be 1:20 to prevent flooding of the territory. Surface waters must be transferred to avert the washing off of the waste and to protect the environment from pollution.

7.1.2 Wastewater

As it is known, the wastewater handling facility gets waste waters from residential, commercial and sometimes from industrial utilities. These waters contain many toxins, which are to be removed before the water is released into the defined area of water keeping to the established by country's legislation order for the protection of ecological safety in rivers, seas and other natural reservoirs. That is the function of water handling facilities which purify wastewater to provide its conformity to required norms. The handling procedures may include mechanical, biological and chemical levels of purification. Mechanical refining step ensures removing of heavy metals and other solid substances from the entering waterfowl, chemical step provides the removal of various chemical compounds (this kind of purification is especially important in case of collecting industrial wastewater which may be polluted with different chemical substances), while biological cleaning implies the removal of organic matters from wastewater.

Despite the fact that up to now 137 wastewater units are operating in Ajara with 92 849 m3 design capacity, virtually in all districts of the region the handling of wastewater is in poor condition and the amount of harmful compounds drained into reservoirs (rivers and the sea) is increasing from year to year: e.g. in 2011, according to official data, 4691. 6 tons of different unhealthy substances were released into Ajara's reservoirs. Majority of wastewater handling units are absolute and do not provide adequate level of purification. Most painfully the problem of water cleaning was left in Batumi, where the Adlia water handling facility, constructed in 1977 was unable to purify the wastewater got from the collector, which practically unhandled was being drained into the sea. After the survey, carried out in 2008, it has been decided to rehabilitate the Adlia wastewater facility and construct a collector to gather wastewater from all settlements along the seashore from Batumi to the border with Turkey and transport in to the Adlia facility. In the project proposal for the rehabilitation of wastewater handling facility different cases for its improvement have been studied and optimal option has been selected on the basis of cost-benefit analysis. As a result in April 2012 the facility was put into operation and currently is functioning normally. At the same time the rehabilitation of collectors is going on and, according to the schedule, this work should be completed in 2 years at the most.

The facility is rated at 200 000 people (projected population in 2028 including maximum loading in summer).

Rehabilitated unit performs mechanical and partly biological purification functions, so that released water mainly confirms to the acting requirements on the quality of cleaned water. The design of the unit is not intended on the recovery of methane; hence the biodegradable matter removed from the water is left to decompose in anaerobic pools. The deposited silt periodically is pumped out from the bottom of the pool and is dryed at special sites. As a result of the desay this mass, as the alluvion in the pool, in certain conditions (temperature and PH) produces "wastewater gas"-methane which dissipated in the atmosphere and contributes to the increase of GHG s concentration. At the same time, the unpleasant smell, accompanying the decomposition process, spreads over surrounding territory and intensifies with the growth of piled mass.

In practices of all countries the main purpose of biological purification at the wastewater handling unit is to remove the methane generating mass from the given amount of

wastewater. According to international practices the best way to deal with this problem consists of the recovery of generated methane and its utilization as an energy resourse to produce heat and electric energy for its own consumption at the unit or its supply to the gas network/electricity grid, or as a fuel in transport. After the extraction of methane the remaining mass of decomposed silt could be used as a fertilizer in agriculture and in planting of trees and gardens. Such approach is an example of environmentally friendly attitude to the problem, beneficial both from the standpoint of climate change and for economic reasons as well.

7.2 Methodology

7.2.1 Solid waste

Landfills produce 3 types of greenhouse gases: methane (CH4), carbon dioxide (CO2) and non-methane volatile organic compounds (NMVOCs). Major GHG generated at the solid waste disposal site (SWDS) is methane. According to IPCC methodology CO2 produced by organic matter is not considered as a pure CO2 emission. There is no methodology to calculate CO2 and NMVOCs emissions.

Methane emissions from Batumi SWDS is calculated using First Order Desay (FOD) method, regarded by the IPCC as a good approximation for the revealing of main sources of methane emission. The FOD method implies that: (a) methane from the piled waste is not produced insantly, but is emitted gradually along with the decomposition of masses of waste, and (b) degradation and generation of methane fits the exponential low. The parameter describing decay period is to be selected taking into account specific conditions of the country and composition of the waste.

According to this methodology methane emissions from the landfill are calculated using this formula:

Tier 2: First Order Decay (DOC)method

$$M^{G}_{CH4}(t) = \sum_{x=1}^{x=t} [(A \bullet k \bullet MSW_T(x) \bullet MSW_F(x) \bullet MCF(x) \bullet DOC(x) \bullet DOC_F(x) \bullet F \bullet 16/12)] \bullet e^{-k(t-x)},$$

$$M^{E}_{CH4}(t) = [M^{G}_{CH4}(t) - R(t)] \bullet (1 - OX), \qquad (2)$$

There:

$M^{G}_{CH4}(t)$ = Methane generated in year t , ***$M^{E}_{CH4}(t)$*** Methane finally emitted to the atmosphere;

MSW_T =Pop • GR.

Pop =Number of population which MSW is desposed at the landfills;

GR =Per capita waste consumption;

$MSW_T(x)$-Total municipal solid waste (MSW) generated in year x (Gg/yr)

***MSW_F* (x)**= Fraction of MSW disposed at SWDS in year x;

MCF (x) = Methane correction factor in year x (fraction);

***DOC* (x)** = Degradable organic carbon (DOC) in year x (fraction) (Gg C/Gg waste);

DOC_F = Fraction of DOC dissimilated;

F = Fraction by volume of CH4 in landfill gas;

R (t) = Recovered CH4 in inventory year t (Gg/yr);
OX = Oxidation factor (fraction);
t = year of inventory;
x = years for which input data should be added;
$k=ln(2)/t_{1/2}$ - Methane generation rate constant; $t_{1/2}$ - decay to half its initial mass;
$A=(1-e^{-k})/k$ - normalisation factor which corrects the summation;

Emissions were calculated according to the amount of actually heaped waste. Values of other factors were taken as follows:

- Methane emission correction factor (MCF): 0.8;
- Degradable organic carbon (DOC): DOC default values according to waste composition;
- Actually degraded part of DOC - 0.5;
- Share of methane in landfill gas (F) - 50%;
- Oxidation index (OX) - 0.

Values of remaining factors were taken as default values for similar to Ajara conditions , recommended in the IPCC Methodology.

7.2.2 Wastewater

The amount of "recovered" methane was calculated as a difference between amounts of methane emitted in case of project implementation and in case if it is not implemented.

Baseline emission for 2014-2018 has been calculated according to actually measured activity data and based upon following assumption: 1) All sewage water collectors will become operational in 2016 (on the complete rehabilitation of collectors will be over) and 2) loading of wastewater handling facility will increase up to 200 000 (present loading makes about 80% of that) to 2028. (To provide the gradual accommodation of collector system to growing population, its number was extrapolated between 2014and 2028). The amount of emitted methane was estimated according to IPCC Methodology for the calculation of methane emissions from wastewater (Tier 1), recommended to be used by UNFCCC Parties in preparing the GHG National Inventories (IPCC Revised 1996 Guidelines for National GHG Inventories, reference manual, vol.6; IPCC Good Practice Guidance, Ch.5).

The method recommends a formula to calculate methane emission, which takes into account degradable organic matter contained in the given amount of wastewater as an activity data and emission factor, being a combination of a number of indices, characterizing the possibility of degradable matter transformation into the methane considering the treatment conditions (degree of anaerobility). The amount of "recovered" methane is subtracted from emitted methane:

Emissions = (Total Organic Waste x Emission Factor) – Methane Recovery

The first part of this formula implies amount of emitted methane from certain treatment system before it's "recovery". For the calculation of "saved" or reduced as a result of project activity methane, the difference between the amount of degradable matter in difference between the amount of degradable matter in wastewater contained in flowing into and discharging out of anaerobic pools (serving as disasters) is used. This value corresponds to the degradable mass, remaining in the pool. Default emission factors, selected according to local conditions, were used as well.

In particular:

_ The amount of degradable matter is described by the factor called BOD (Biochemical Oxygen Demand) which is measured (5 day measurement method is used, called BOD5) at the entry and outlet of anaerobic pools of the handling facility. This factor is measured both in concentration (mg/l) and in total capacity (kg). The difference between the amounts of degradable matter at the entry and outlet gives the amount of degradable matter, from which "saved" or "recovered" methane is calculated using appropriate indices.

_ The values of maximum potential for methane transformation (Bo) is taken equal to 0.6 (KgCH4/kgBOD);

_ The methane correction factor (MCF) characterizes the part of degradable matter (BOD) which finally is transformed into methane, or what part of Bo is realized in given conditions. This factor takes maximum value during the anaerobic, controlled processing and is equal to zero in completely aerobic conditions. Ensuing from local terms and according to IPCC-2006 recommendations the value of 0.8 was chosen for open anaerobic pools and 1.0 after their covering (Table 6.3, Chapter 6, vol. 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

7.3 Baseline year inventory and GHG emissions baseline scenario (2012-2020)

7.3.1 Solid waste

According to the result of GHG inventory carried out in the framework of Georgia's Thirs National Communication to the UNFCCC, using the FOD Tier 2 method it has been derived that in 2011 from the Batumi SWDS 0.71Gg of methane has been emitted equaling to 14 910 tons in CO2 equivalent.

Corresponding to the BAU scenario in 2015 the Batumi SWDS will be closed down and methane emissions will start to decrease. Table 41 shows the forecast for the methane emissions slow-down from Batumi closed SWDS.

Table 41. Methane annual production from Batumi old SWDS after its closure

Year	Gg/yr	Kg/yr	M3/yr	M3/day
2014	0.67	665 476.00	924 272.20	2 532.25
2015	0.58	576 745.40	801 035.30	2 194.62
2016	0.50	501 650.20	696 736.40	1 908.87
2017	0.44	437 965.30	608 285.10	1 666.53
2018	0.38	383 836.90	533 106.70	1 460.57
2019	0.34	337 720.00	469 055.50	1 285.08
2020	0.30	298 326.60	414 342.50	1 135.18
2021	0.26	264 582.50	367 475.70	1 006.78

2022	0.24	235 591.30	327 210.10	896.47
2023	0.21	210 604.70	292 506.50	801.39
2024	0.19	188 997.60	262 496.70	719.17
2025	0.17	170 247.60	236 455.00	647.82
2026	0.15	153 917.70	213 774.50	585.68
2027	0.14	139 641.90	193 947.10	531.36
2028	0.13	127 113.80	176 546.90	483.69
2029	0.12	116 076.20	161 216.90	441.69
2030	0.11	106 313.30	147 657.40	404.54

Instead of this a new SWDS will be opened, predicted emissions from which, in case of constant amount of heaped waste (42 000 ton/yr), is given Table 42

Table 42.Methane generation from new SWDS in case of constant annual piling of residential waste amounting to 42 000 ton/yr

Year	Gg/yr	Kg/yr	M3/yr	Year	Gg/yr	Kg/yr	M3/yr
2014	0.00	0.00	0.00	2032	1.82	1 815 507.00	2 521 538.00
2015	0.27	270 361.90	375 502.70	2033	1.84	1 839 964.00	2 555 505.00
2016	0.50	500 378.10	694 969.60	2034	1.86	1 862 132.00	2 586 295.00
2017	0.70	696 557.60	967 441.10	2035	1.88	1 882 295.00	2 614 299.00
2018	0.86	864 327.50	1 200 455.00	2036	1.90	1 900 692.00	2 639 850.00
2019	1.01	1 008 215.00	1 400 299.00	2037	1.92	1 917 528.00	2 663 234.00
2020	1.13	1 131 999.00	1 572 221.00	2038	1.93	1 932 980.00	2 684 694.00
2021	1.24	1 238 834.00	1 720 603.00	2039	1.95	1 947 198.00	2 704 442.00
2022	1.33	1 331 356.00	1 849 105.00	2040	1.96	1 960 313.00	2 722 657.00
2023	1.41	1 411 768.00	1 960 789.00	2041	1.97	1 972 437.00	2 739 496.00
2024	1.48	1 481 915.00	2 058 216.00	2042	1.98	1 983 670.00	2 755 097.00
2025	1.54	1 543 341.00	2 143 529.00	2043	1.99	1 994 095.00	2 769 576.00
2026	1.60	1 597 340.00	2 218 528.00	2044	2.00	2 003 788.00	2 783 039.00
2027	1.64	1 644 998.00	2 284 720.00	2045	2.01	2 012 815.00	2 795 577.00
2028	1.69	1 687 228.00	2 343 372.00	2046	2.02	2 021 233.00	2 807 269.00
2029	1.72	1 724 796.00	2 395 550.00	2047	2.03	2 029 094.00	2 818 187.00
2030	1.76	1 758 349.00	2 442 152.00	2048	2.04	2 036 443.00	2 828 394.00
2031	1.79	1 788 433.00	2 483 934.00	2049	2.04	2 043 321.00	2 837 946.00

Proceed from these Tables, in 2020 methane emission from both SWDS will make 1.43 Gg equally to 30 036.9 tons in CO2 equivalent.

7.3.2 Wastewater

Base year emission is calculated from 2013 mass of total biodegradable matter, which remained (was not overlown for consequent treatment) in anaerobic pools (1806.19 ton of

BOD)ს, using the following factors: Bo= 0.6, MCF= 0.8, correction factor for industrial inflow current = 1.25 (Chapter 6, vol.5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories), that result in 1354.6 tons of methane emission annually. This situation will continue in 2014-2015, giving a total of 2709.28 tons of methane through these two years.

From 2016, separately from the project, total rehabilitation of collectors is planned, that will increase the BOD loading by at least 30%. The gradual joining of population to collectors (or handling facility) will begin in such a way that to 2028 this number will reach 200 000 (the design capacity of the project). According to this calculation, in the period of 2016-2028 methane emission will have a rising trend.

In case of project implementation (starting in 2016) the value of index MCF, featuring the degree of anaerobic treatment, will become equal to 1 that corresponds to the ideal anaerobic conditions in closed anaerobic pools. In terms of 80% removal of produced methane (conservative approach), only 20% of generated methane will remain to be emitted. It should be noted that as a result of carried out reconstruction, in 2016 sharp reduction of methane emission will occur, and in following years the amount of produced methane and of its recovered and remained parts (80/20) will gradually increase only according to joined population and utilities. The dynamics of this process is described in Table 43.

Table 43. Baseline emissions of methane (BAU scenario) in 2015-2020 from the Batumi (Adlia) wastewater handling facility

Year	Population connected to the system	Generated methane (ton) baseline BAU	Year	Population connected to the system	Generated methane (ton) baseline BAU
2013	148 000.00	1 083.71	2021	173 782.00	2 067.81
2014	151 000.92[19]	1 105.69	2022	177 305.69	2 109.74
2015	154 062.69	1 128.11	2023	180 900.83	2 152.52
2016	157 186.54	1 870.34	2024	184 568.86	2 196.16
2017	160 373.74	1 908.27	2025	188 311.27	2 240.69
2018	163 625.56	1 946.96	2026	192 129.57	2 286.12
2019	166 943.31	1 986.44	2027	196 025.28	2 332.48
2020	170 328.34	2 026.71	2028	199 999.99	2 379.77
Total	972 520.17	13 056.22	Total	2 465 543.66	17 765.29

7.4 Action Plan for the reduction of emissions from Batumi solid waste and wastewater sector

Measures are discussed aimed at the reduction of GHG emissions from the Waste sector:

[19] Number of population is interpolated

- Arrangement of gas extraction system at the Batumi operation landfill
- Arrangement of methane extraction and *in situ* flaring or utilization system at the new Ajara landfill
- Perfection of biological purification stage at the Batumi wastewater handling system with addition of methane recovery component.

It should be noted as well that the proximity of Batumi operation landfill and the wastewater handling facility makes it possible to combine measures directed towards the conversion of collected from this two utilities methane into clean energy and consequently unite them under one project. Collected methane could be used to generate electric energy or to be supplied to consumer as a natural gas.

As it is generally known, the burial of organic or partly organic waste is always followed by its decomposition resulting in the emission of greenhouse gases, mainly of methane (CH_4) and carbon dioxide (CO_2). In order to reduce the GHG emissions, as it is requested by the UNFCCC, Party to which is Georgia, in many countries methane is being collected and flared, or used as a source of energy (electricity, gas). Otherwise, if methane is not collected, the unpleasant smell spreads over the area and GHGs are emitted into the atmosphere. As a rule, the origination of GHGs from organic waste begins in few months after burial and continues through the whole period of landfill functioning, that may last about 70 years.

As it was mentioned above, the approximate amount of waste accumulated up to now at the Batumi SWDS is about 9 407 419 m^3. According to 1990 Handbook data, 1 m^3 of waste corresponds in mass units to 0.22-0.24 tons. Hence, the total mass of waste at the Batumi landfill can be estimated as 9 407 419 m^3. 0.22 t/m^3=2 069 632 t. In line with the IPCC recommendations, which implies the generation of 100-200m^3 of biogas from 1 ton of waste (depending on its composition and climate conditions), it can be assessed that during the full period of waste decay (70 years), no less than 206 963 200 m^3 of biogas will be emitted to the atmosphere. From this quantity a minimum 50% is methane which can be used to get electric energy or delivered to consumer as natural gas.

For 15-20 years after the shutting down of the landfill, the emissions of GHGs actively goes on. Thus, to reduce these emissions, it is expedient to arrange a gas recovery system (gas wells, gas collecting pipes, gas pump station, insulating trap, gas motors and gas flare) for the collection of originating gas and its application as an energy resource. However, it should be mentioned that if there is no interested consumer or relevant infrastructure nearby, it is cheaper to burn the gas at the site, thus reducing its emission into the atmosphere, eliminating its smell around the site and decreasing the risk of self-flaring. One of the complications of this project is the correct assessment of daily production of gas that sometimes significantly differs from theoretical calculations. Theoretical calculations show (Annex VII) that for the first 10 years the minimum amount of methane gas, which could be used for energy generation, is 800 m3 per day.

The closing of existing landfill is planned to the end of 2015, immediately after the opening of the new SWDS.

According to the design of the landfill closure. At the existing landfill the waste will be collected and disposed in two piles, at the flanks of which the water can freely pour down and they should not be eroded. The piles must be rummed to reduce their volume and further, it is

planned to cover them with 0.5 m thick layer of waterproof ground. The upper part of the ground, consisting of a least 20 cm deep drainage stratum and 0.6 m thick ground layer, should promote the development of vegetation cover.

The total budget of landfill conservation, methane collection and recovery, and electricity generation equals to 2 544 000 USD. This sum includes 471 000 USD on expenses for methane collection, flaring at the site and arrangement of monitoring system. Depending on the amount of flared gas (total amount of 109 000 tons in CO2 equivalent) and considering the price of 1 ton of certified CO2 (minimum 5 USD), during 20 years the income of the project will make 545 000 USD. However, the generation of methane lasts more than 20 years and will provide additional income in case of registering it as a CDM project.

Arrangement of methane extraction and in sute flaring or utilization system at the Ajara new landfill.

The primary concept implies mounting perforated gas wells at the piles of waste after the coating relevant territory with insulating interim cover. Sub-pressure for gas recovery will be produced at the gas pump-station by wind machines. From the environmental viewpoint, the final result will be burning gas (methane) at the site of landfill, accompanied by emission of carbon dioxide in small quantities. Often, according to local needs, the recovered methane is delivered to the heat supply system or is transformed into electricity. In this specific case, with great probability, the gas will be supplied to local population or facilities/enterprises.

As it was mentioned above, the approximate amount of waste that will be accumulated at the new SWDS during 35 years of its operation, can reach about 3 400 000m^3, which is equivalent to 748 000 tons in mass units (conversion factor: 1m^3= 0,22 ton). According to IPCC recommendations, 1 ton of waste, depending on its composition and climate conditions, generates 100-200 m^3 of biogas. In this project proposal, the most conservative assumption is made, that implies extraction of 100 m^3 of biogas from 1 ton of waste. Therefore, it can be assessed that during the complete period of waste decay (70 years), 74 800 000 m^3 of biogas will be emitted into the atmosphere from the total amount of delivered waste. From this quantity, at least 50% is methane, which can be used to get electric energy or supplied to consumer as natural gas.

At this time substitution of other types of fuel (in some cases more carbon rich) will take place. Total budget of the new landfill arrangement, creation of methane collection and extraction, as well as of monitoring system equals to 501 000 USD. This sum does not include the expenses required for the lay-out of infrastructure necessary for the delivery of gas to local population. Tentatively, in 20 years the amount of emission, saved from diffusion into the atmosphere will make 531 900 tons in CO2 equivalent. Accounting for the price of 1 ton of certified CO2eq (minimum 5 USD), in 20 years project will get 2.7 million USD that 5.3 times exceed overall expenses on the project.

To assess the efficiency to 2020 of measures connected with both landfills if we assume that this year it would be possible to recover 50% of methane emissions from solid waste, that will make it possible to save about 15 thousand tons emissions in CO2 equivalent.

Modernization of Batumi wastewater handling system

The objective of the project is to improve the functioning of the Batumi wastewater handling facility up to modern standards level, that implies the perfection of biological purification stage with the addition of methane recovery component which, on the one hand, will provide better quality of wastewater cleaning and on the other hand-will increase the economic efficiency by reducing expenses on energy consumption and delivery of useful produce (methane, electricity) at the same time ensuring the deodoration of surrounding territory and contributing to the reduction of GHG emissions.

In case of project implementation it will make significant share in realizing the Batumi sustainable energy development plan. The benefits of project implementation consists of saving the amount of methane which otherwise was to be emitted into the atmosphere and of electronic energy, generated by this methane. This additional electricity could be supplied to the grid and in case of utilization of methane in transport it will substitute the imported diesel/LPG.

Table 44 shows annual data to 2020 and 2028 on the substitution by clean energy, obtained by the use of recovered methane from the Batumi water treatment facility, of electric energy in the grid and in city transport.

Technical implementation of the project is supposed in 2014-2015, when the technical re-equipment will take place, and the project activities will continue in 2015-2020 and even later. Results obtained under the project are calculated to 2020 and 2028 ensuing, on the one hand, from the dates agreed under the “Covenant of Mayors” and, on the other hand, from prognostic dates obtained under the handling facility technical documentation (2028).

Following Table represents the Adlia water treatment facility modernization plan with relevant budget, where join utilization activities connected with the old landfill and recovered methane are envisaged (Table 45).

Table 44. Forecast of methane recovery from wastewater and substitution with clean energy

Years	Adjoined population	Generated methane (t) baseline (BAU)	Project activity				
			Methane emission		Methane saving		
			Methane emission (t CH4)	Methane emission (t CO2e)	t CH4	m3 CH4	MW
2013	148 000.00	1 083.71	1 083.71	22757.96294			
2014	151 000.92[20]	1 105.69	1 105.69	23219.41478			
2015	154 062.69	1 128.11	1 128.11	23690.22324			
2016	157 186.54	1 870.34	374.07	7855.437867	1 496.27	2 086 853.39	21 838.92
2017	160 373.74	1 908.27	381.65	8014.718653	1 526.61	2 129 167.47	22 281.74
2018	163 625.56	1 946.96	389.39	8177.229096	1 557.57	2 172 339.54	22 733.53
2019	166 943.31	1 986.44	397.29	8343.034681	1 589.15	2 216 386.98	23 194.49
2020	170 328.34	2 026.71	405.34	8512.202224	1 621.37	2 261 327.55	23 664.79
Total 2015-2020	972 520.17	13 056.22	5 265.25	110 570.22	7 790.98	10 866 074.92	113 713.47
2021	173 782.00	2 067.81	413.56	8 684.80	1 654.25	2 307 179.36	24 144.63
2022	177 305.69	2 109.74	421.95	8 860.90	1 687.79	2 353 960.88	24 634.20
2023	180 900.83	2 152.52	430.50	9 040.57	1 722.01	2 401 690.97	25 133.70
2024	184 568.86	2 196.16	439.23	9 223.88	1 756.93	2 450 388.85	25 643.32
2025	188 311.27	2 240.69	448.14	9 410.90	1 792.55	2 500 074.16	26 163.28
2026	192 129.57	2 286.12	457.22	9 601.72	1 828.90	2 550 766.92	26 693.78
2027	196 025.28	2 332.48	466.50	9 796.41	1 865.98	2 602 487.54	27 235.03
2028	199 999.99	2 379.77	475.95	9 995.05	1 903.82	2 655 256.88	27 787.26
Total 2015-2028		28 632.12	6 628.91	139 207.08	22 003.21	30 687 880.48	321 148.67

[20] მოსახლეობის რაოდენობა ინტერპოლირებულია.

Table 45. Implementation stages and budget for the Adlia wastewater handling facility modernization project

No	Activity	Implementing agency	Budget (EUR)	Implementation dates
I	Selection of machinery, purchase and mounting			
1	Selection of equipment (pool covering membrane, heat generator, methane tank, pipes, etc) aacording to local features.		5 000 EUR	2014
2	Purchase of pool covering membrane		375 000 EUR = (22320 m2+25000 ∂2)* 15 EUR /m2)	2014–2015
3	Purchase of heat generator		180 000 EUR.	2014–2015
4	Purchase of methane tank		100 000 EUR.	2014–2015
5	Mounting of the equipment		10 000 EUR.	2014 – 2015
6	Arrangement, purchase, construction and preparation of buildings and control systems		150 000 EUR.	2014–2015
7	Other expences		80 000 EUR.	
8	Total : 1+2+3+4+5+6		700 000 EUR.	
II	Assessment of possibilities for recovered methane selling			
1	Connected of obtained landfill gas to the network (opt.1)		100 000 EUR.	2015
2	Selling of methane as transport fuel (opt.2)			2015
III	Permanent monitoring and measuring of the functioning of installed equipment and methane emission and recovery			2015–2028
	Total I+ II+ III		800 000 EUR.	

As it was mentioned above, methane recovered as a result of wastewater handling facility project implementation will be added to the amount of gas extracted from the old landfill disposed near the Adlia handling facility.

Annual quantity of recovered from the old landfill, according to most to 2020 conservative assessment would be 150 tons, which recovered from the Adlia water treatment unit – 6 142 tons (see the table 44) (the actual potential could twice exceed this figures). Eventually, from both units annually would be extracted 6 292 tons of methane, making 132 117 tons in CO2 equivalent.

Option 1. In case of generating electricity from the recovered methane, it would be possible to get 1922000 m3 * 10.4 KWh * 0.3= 5996 640 KWh of electronic energy. In 2012 the outdoor lighting system in Batumi has consumed in total 10 million KWh of energy. Correspondingly, it would be possible to provide 50% of street lighting in the city with the energy, produced by the collected methane.

Option 2. From 1383.7 ton of methane it is possible to produce 1.5 million m3 of compressed natural gas, that could provide annual operation of 36 municipal buses (with their total annual run of 103 680 Km and compressed natural gas consumption of 40 m3 per 100 Km run).

As the compression of 1384 tons of methane results in the emission of 1384 * 2.75 =3806 tons of CO2, it would be possible to avoid annually 29058 – 3 806 = 25 252 tons of CO2 emission, making 4.3% of planned to 2020 reduction value. At the same time, due to the reduced consumption of diesel fuel by Batumi buses, annual emission of CO2 will be additionally reduced by 70 tons of CO2.

For Batumi, which is one of the principal tourist centers in Georgia, the implementation of all three measures is the priority, aimed at the provision of high level of holiday making or living conditions for local as foreign tourists and local population.

Table 23. Demonstrates the difference between methane emissions in baseline scenario and in case of implementing discussed above all three measures.

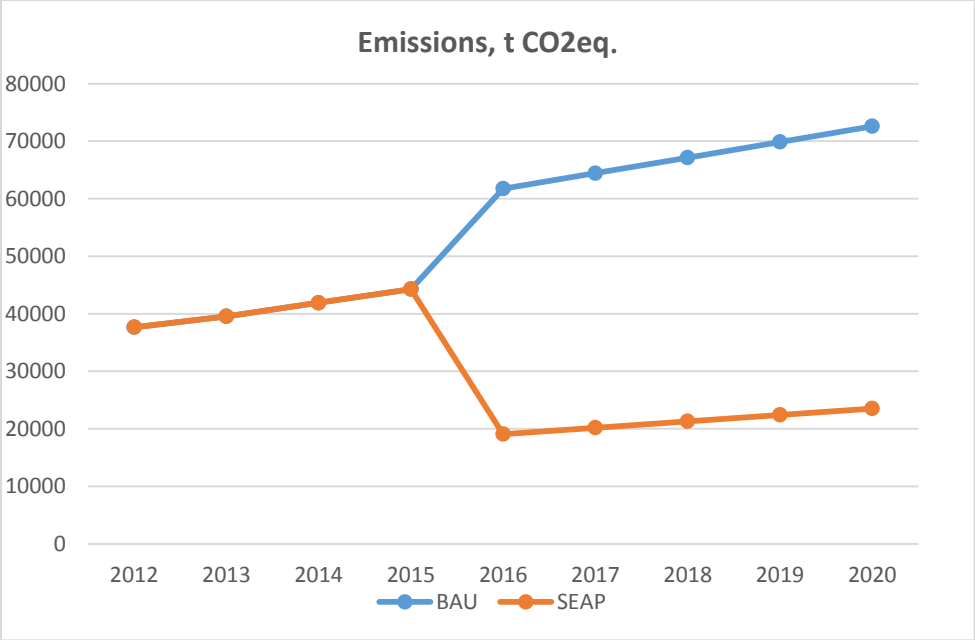


Figure 23 Comparison of methane emissions from the Waste sector for baseline (BAU) scenario and in case of project implementation.

8 Greening

8.1 Overview of the sector

Batumi's ecological condition has deteriorated significantly over the recent years. One of the reasons of for such deterioration is a decline in the city's green cover starting from the nineties of the last century. The reconstruction of the city centre in the recent years and chopping down of the green plantations has further worsened the picture.

Because of the abovementioned reasons, the city centre has been especially overloaded with the automobile traffic, which in turn led to the deterioration of the overall ecological situation in the city.

When reviewing the city's environmental problems it is interesting to determine a scale of the carbon accumulation by plants after the start of greenery works. Also, it is interesting to determine the carbon dioxide - greenhouse gas absorption capacity by the green cover of the Botanical Garden within the city's administrative boundaries.

8.2 Methodology

The carbon accumulation and absorption potential of the green cover in Batumi Botanical Garden and the Boulevard was assessed by the IPCC-2003 methodology. As for the city landscaping works in the later years, the carbon accumulation potential was evaluated using the CO2FIX model.

8.2.1 IPCC Methodology

Calculations were carried out by the IPCC-methodology in so called living biomass (including underground biomass). In particular, the calculation of the volume of carbon in the accumulated biomass and its subsequent increase area was carried out using the following equations:

The equation used to determine carbon reserves accumulated in the live (underground and above-ground live biomass) biomass:

$\Delta C_{F_{LB}} = [V \bullet D \bullet BEF_2] \bullet (1+R) \bullet CF$

where:

V_Wood volume, m3/ha;

D_Volume weight of the absolutely dry wood, tons of dry mass/m3;

BEF_2-Coefficient calculating determination of the total stock of the above-ground wooden plants of the commodity wood stock, for producing the aboveground live biomass.

R_Ratio of root mass to the tree sprout;

CF_ Carbon ration in dry substance, ton C/ton dry mass.

1. The equation for calculating annual increase in carbon resources in the biomass:

$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF$

where

ΔC_{F_G} is the annual increase in carbon stocks due to biomass growth, tonnes C/year;

A_An area covered by trees - plants;

G_{TOTAL}The average annual increase rates in the total biomass, tons dry weight/ha/year;

$G_{TOTAL} = G_W \cdot (1+ R)$,

Where R is a ratio of root mass to the tree sprout.

G_W - Increase in above-ground biomass. Tons/dry mass;

When G_W data is available, it is calculated with the following equation:

$G_W = I_V \cdot D \cdot BEF_1$,

where:

I_V is the average annual biomass increase, m3/ha/year;

D_Absolutely dry wood volume weight, tons of dry mass /m3;

BEF_1-The wood annual average area icnrease, the wood biomass to be calculated to the surface ratio.

8.2.2 CO2FIX V 3.1Model

CO2FIX model was elaborated within the CASFOR II project. CASFOR II was funded by the INCO2 Program of the European Union. In addition, Dutch Ministry of Agriculture, Nature and Food Quality, as well as Mexican National Council on Science and Technology (CONACYT) supported the project financially.

CO2FIX V 3.1 model determines carbon accumulation volumes in the nature by using the so-called carbon accounting methodology, namely, a model calculates changes in the carbon inventory in all carbon "reservoirs" of the forests within a specific period of time (carbon "reservoirs" are considered to be the part of the nature where the carbon is stored, such as live biomass, ground bulk, organic soils, and also produced wood resources).

Calculations in six main modules in the CO2FIX V 3.1 model are carried out for a scale of one year and one hectar:

1. Biomass module;
2. The soil module;
3. Production module received from wood resources;
4. Bioenergy module;
5. Financial module;
6. Carbon credits counting module (for CDM).

According to the model methodology the carbon accumulation volume (CTt) in each time (t) period, is calculated as follows:

$CT_t = Cb_t + Cs_t + Cp_t$ (Mg C/ha)

Where:

Cb_t - The total amount of carbon in ground and underground biomass of the plant (Mg C/ha);

Cs_t - Carbon stocks in the organic soils (Mg C/ha);

Cp_t - Carbon stocks in the wood products produced from forestry-agricultural works (Mg C/ha).

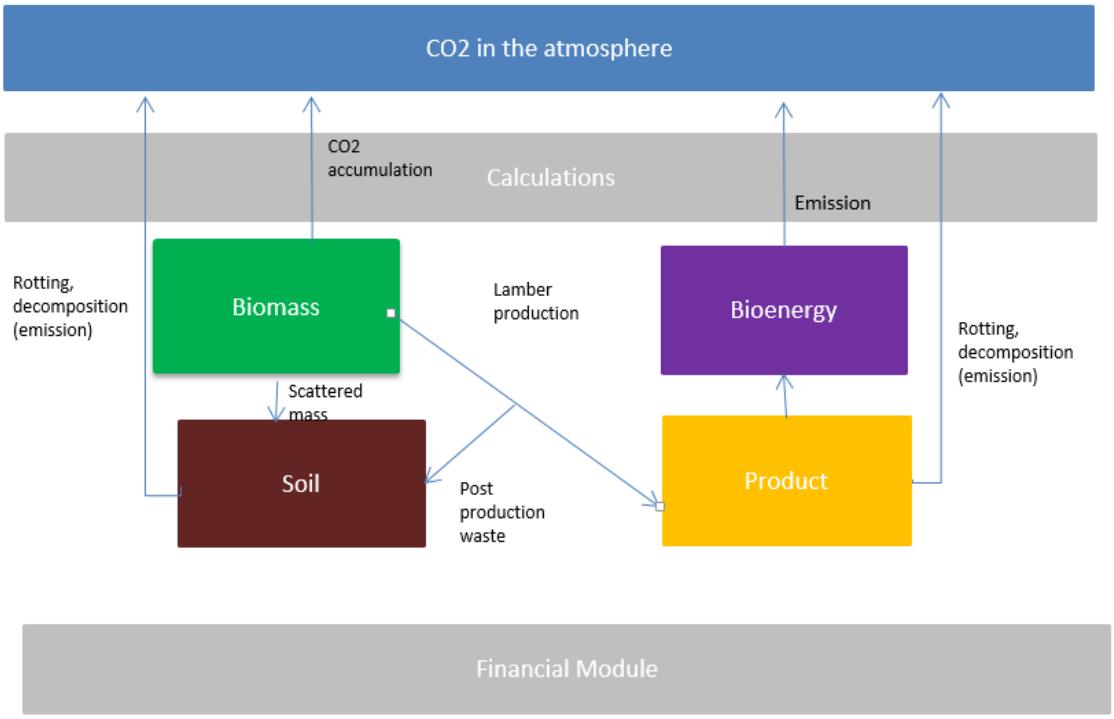


Figure 24. Schematic drawing of the model structure

8.3 The base year inventory

The green wood cover of Batumi is characterized by a diversity, which is primarily determined by the sub-tropical climate. The city covers 601 hectares of greenery, where parks consist of 5 215 ha, 40 squares of 105 ha, while the remaining 218 hectars in the city is represented by various fragmentations. 25 main species of trees and plants are widespread in the recreational areas, with an average age of more than 70 years. A total plant stock is more than 33 thousand cubic meters (see Table 46). Phyto mass stocks in the vegetation (including underground phyto mass) are more than 45 thousand tons, and the annual increase is 2 m3/ha.

Batumi's greenery service does not include the Seaside Park and Boulevard with a total area of 103.1 ha, where the green lawns occupy 34.8 hectares, the gardens - 27 ha, the beaches - 37.5 ha, and the Ardavani Lake - 3.8 ha. Currently, the green surface data of the Boulevard is limited to the species spread on the area and the indicators for their retail accounting. There are 33010 plant roots in the Boulevard, from these 6495 are trees-plants, 16282 - bushes, 2554 - bamboos, 3125 - palms, the remaining 3125 roots are flowers. The following trees are the dominant in the boulevard are: coastal pine, cypress, cedar, horse chestnut, cryptomeria, lime, maple, eucalyptus and 3 different species of the palm trees (date palm, coconut and rotational).

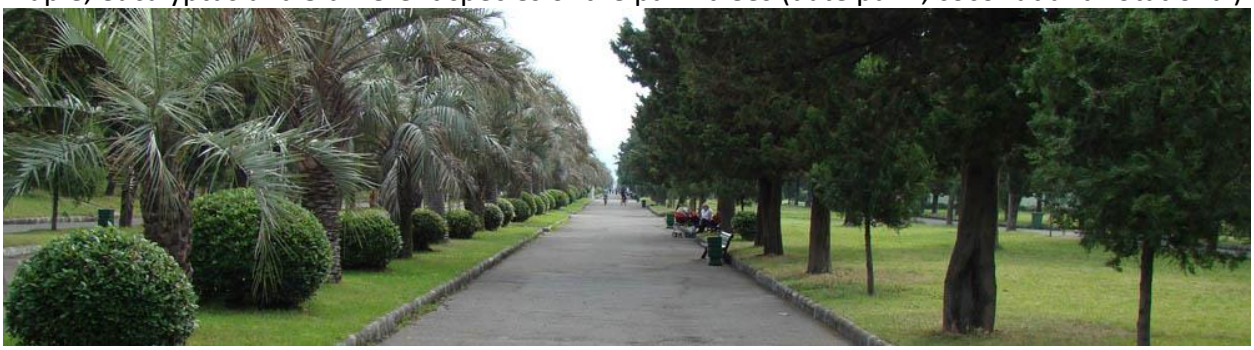


Figure 25. Batumi Boulevard

As for the Botanical Garden, its area covers 108 ha, 23 ha are occupied by well-organized parks (lower, upper and coastal parks), the floristic division is located on 33 ha, the collection division - 10 ha, the nursery garden on 6 ha, the citrus plantations on 6,5 ha, and the remaining 29.5 ha is the territory of the recreational zone. About 70 thousand trees-plants grow in the Botanical Garden. The orthophotograph on *Figure 26* shows the total area of the Botanical Garden, with approximately 85% covered by the forests (92 ha). In addition, the orthophotograph clearly shows that the forest cover is characterized by a high frequency. This

is confirmed by the fact that about 70000 trees-plants are concentrated on 92 ha, i.e. about 760 subtropical and tropical high wood plants are cultivated on 1 ha.

Since no inventory of the plants was performed in the botanical garden and therefore precise data is not available, we will be guided by a variety of sources when calculating the carbon stock in the botanical garden. Namely, by the Adjara forest inventory data for 2004, as well as by the greenhouse gas inventory materials in the forest sector of Adjara from the Third National Notification of 2013. The specific list of used indicators is given in Table 47.

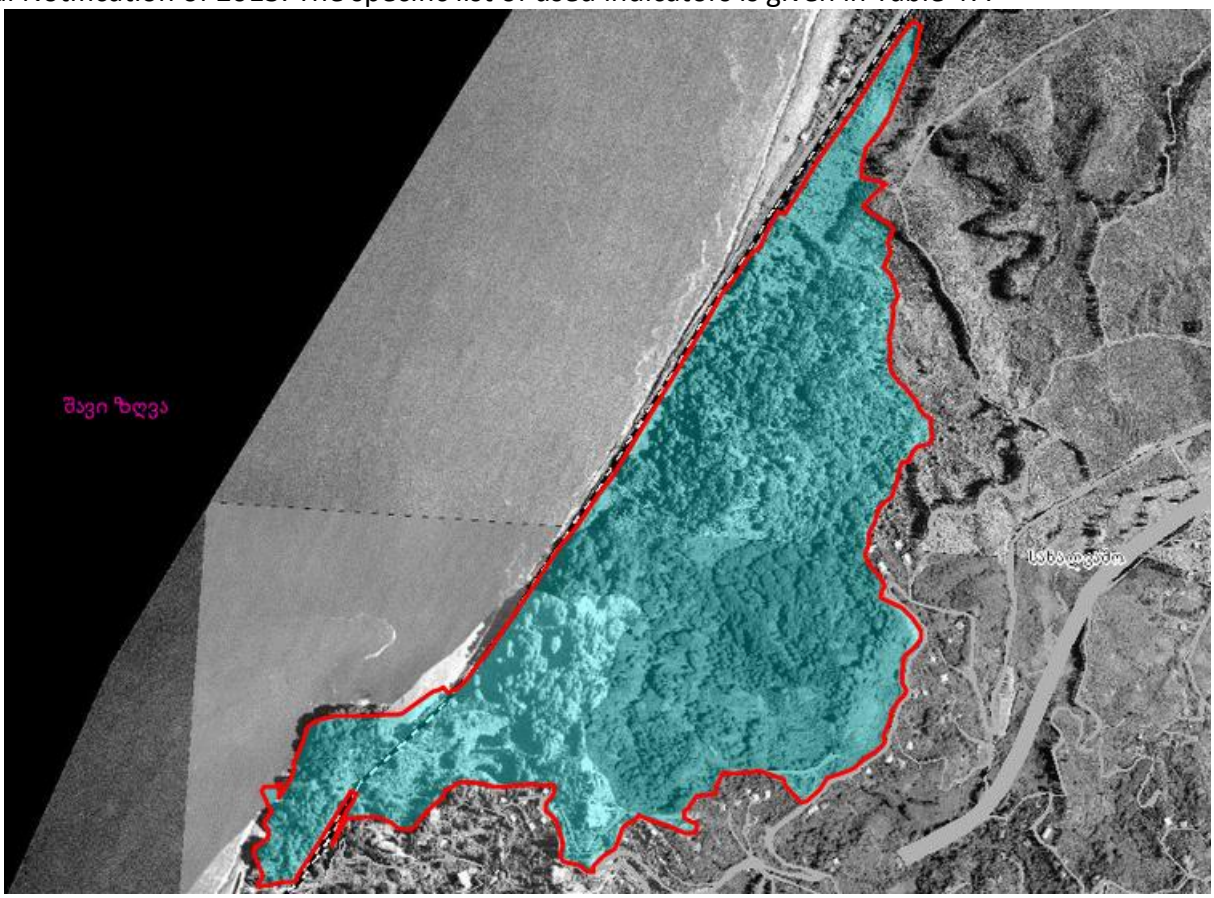


Figure 26. Orthophotograph - Botanical Garden

Table 46. Average-taxation data of the trees-plants for Batumi

Species	Area ha	Average age (years)	Average diameter cm	Average height m	Stock on 1 ha m3	Total stock m3	1 kg ha phyto mass storage X1000		Root	Average increase
							Total	Aboveground		
Trees-Plants										
Magnolia grandiflora	12.00	70-80	64	16	117.00	1 405	1 575.00	1 334.70	320	
Quercus acuta	18.90	60	24	15	21.16	400	448.40	380.00	930	
Eucalyptus viminalis	140.80	80	68	30	151.80	21 377	26 421.90	22 018.30	4 250	
Camellia japonica	132.00	60	16	3	2.66	351	3 917.20	3 264.30	1 300	
Acer japonicum	11.00	40	16	4	25.82	284	316.90	264.20	1 050	
Cedrus deodara	59.40	90	40	18	53.40	3 172	4 535.96	3 489.20	2 250	
Pinus	4.20	35	20	5	7.14	30	331.50	255.00	120	
Laurocerasus	1.10	15	16	4	1.09	1	1.78	1.32	50	
Osmanthus fragrans	2.20	90	16	4	0.68	2	1.80	1.39	70	
Lagerstroemia indica	26.40	40	16	3	2.84	75	96.19	71.25	2 300	
Ternstroemia japonica	2.20	50	12	4	0.91	2	1.07	0.91	50	

Cupressus sempervirens f. Pyramidalis	8.80	60	28	25	14.54	128	176.14	140.80	220	
Cupressus sempervirens f. Horizontalis	19.80	60	28	20	14.65	290	376.42	319.00	500	
Juglans regia	33.00	50	32	8	36.82	1 215	1 737.50	1 336.50	1 500	
Olea europaea									10	
Podocarpus									15	
Eriobotrya japonica	4.20	30	16	4	19.05	80	96.72	74.40	300	
Prunus cerasifera	11.00	30	16	4	15.91	175	211.57	162.75	700	
magnolia soulangeana	4.20	20	12	5	6.70	28	36.00	27.70	100	
Liriodendron tulipifera	1.10	100	44	20	16.40	18	21.80	16.70	10	
Paeonia arborea	4.40	20	4	3	1.10	5	6.00	4.60	300	
Pirakanta									20	
Michelia									25	
ღვია (საბაღო ფორმები) Juniperuc Sabina	2.20	ახალი	6	1		-			40	
ქაფურის ხე Cinnamonum camphora	8.90	90	64	15	103.40	920	1 136.20	874.00	200	
In all, trees-plants	508.80					29 957.70	41 446.05	34 037.02	16 560	

Palms										
Washingtonia filifera H. Wendl.	22.00	60	56	25	93.10	2 051	2 481.70	2 256.10	1 000	
Trachycarpus Fortunei	13.20	50	24	15	36.10	476	576.00	523.60	500	
Chamaerops humilis L.	2.20	70	24	4	1.40	3	3.60	3.30	30	
Phoenix canariensis	11.00	50	44	10	41.50	456	551.80	501.60	300	
Butia capitata	2.20	50	44	10	1.40	3	3.60	3.30	20	
Thuja	11.00	60	24	12	10.40	114	130.00	108.30	300	
In all, palms	61.60					3 103	3 746.70	3 396.20	2 150	
Bushes										
Abelia	4.40	25	6	1.50	6.40	28.00	39.90	26.60	300	
Ilex	2.20	20	3	0.50	0.90	2.00	2.80	1.90	50	
Euonymus	2.20	20	2	0.50	0.90	2.00	2.90	2.00	60	
Chaenomeles japonica	2.60	30	8	2.00	1.20	3.00	4.30	2.90	50	
Photinia	2.20	20	2	0.50	0.90	2.00	2.80	1.90	50	

Spiraea, *kalistemoni*, Leptospermum, Gardenia, Forsythia, Hibiscus, Mutabilis, Nandina domestica, Rhododendron catibiense.	17.00	0-20	4	1.00	3.20	55.00	78.40	52.20	1 100	
In all, bushes	30.60					92.00	131.10	87.50	1 610	
In all, Batumi	601.00					33 152.70	45 323.85	37 520.72	20 320	2

By using the equations mentioned in the methodology, carbon stocks and increases were calculated for the green zones within the area of Batumi City Hall, *LLP Batumi Boulevard* and the Botanical Garden separately.

Table 47. Coefficients used in the calculations and their source

Main indicators used in calculations	Green Cover of Batumi City	Batumi Boulevard	Batumi Botanical Garden
A-Area of Green Coevr, ha[21]	601.00	27.00	92.00
V- Tree - plant supplies, m 3 / ha [22]	55.00	55.00	266.00
D Volume weight of the absolutely dry wood, tons of dry mass/m3[23]	0.41	0.41	0.55
I_V- Average annual biomass increase, m3/ha/year[24]	2.00	2.00	4.00
BEF_1- The wood annual average area icnrease, the wood biomass to be calculated to the surface ratio[25]	1.15	1.15	1.05
BEF_2- Coefficient calculating determination of the total stock of the above-ground wooden plants of the commodity wood stock, for producing the aboveground live biomass. [26]	1.30	1.30	1.30
R - Ratio of root mass to the tree sprout [27]	0.24	0.24	0.24
CF- Ratio of root mass to the tree sprout [28]	0.50	0.50	0.50

Some of the coefficients required for the calculations were taken from Table 47. In particular, the green cover area, 1 hectare, the average annual increase and trees-plants supplies. In order to determine the weighted index for the wood volume weight (D), the prevailing wood plant supplies was used. The parameters for the remaining coefficients (BEF1, BEF2, R, CF) were taken from the IPCC methodology, in particular, from the list of the standard indicators acceptable for Adjara's climate.

As Batumi Seaside Park (Boulevard) unlike the Batumi city is characterized by a lack of vegetation data and in order to increase the accuracy of the data for the Boulevard, the relevant data for the city were used, especially when taking into account that the composition of the city and the boulevard green cover is not very different from each other.

As for the Botanical Garden, here we are again dealing with a scarcity of data. Since the landscape of the Batumi Botanical Garden is significantly different from the park landscapes located in Batumi and is identical to the typical subtropical forest landscape characterizing Adjara region, including the involvement of many different species of tropical and subtropical vegetation, the calculations are taken from the materials of the 2004 forest management plan. In particular, different characteristics for the forest stand covered with particular subtropical plants. Also, the greenhouse gas inventory materials of the forest sector in with the Third National Notification (2004) were used. It should be noted that by taking dissemination of various plants in the botanical garden into account, the absolutely dry wood volume weight (weighted) index for the plants of the Botanical Garden was determined.

[21] The greening service of Batumi, Administration of "Bulvari" .

[22] Administration of the city of Batumi, Inventory of Adjara forests 2004.

[23] "Global Wood Database" http://datadryad.org; Makhviladze S.E. "Merkanmtsodneoba" Tbilisi 1962; Боровиков А.М., Уголев Б.Н.. Справочник по древесине. "Лесная Промышленность", Москва, 1989;

[24] The characteristics of Batumi trees and plants, Inventory of Adjara forests 2004

[25] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;

[26] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;

[27] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.8;

[28] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003).

The indicators derived from the calculations in the recreational zones within the project facilities are given in the following table:

Table 48. The carbon dioxide accumulation and expenditure figures on project facilities

Project facilities	Total accumulation of carbon stocks, TC	Accumulation of carbon on 1 ha TC	Carbon/carbon dioxide annual deposition			
			Annual increase in carbon storage TC	Annual absorption of carbon dioxide, CO2GG	Increase in carbon storage on 1 ha, TC	Annual absorption of carbon, CO2GG
Batumi City Recreation Area	10 938.00	18.20	361.00	1 324.00	0.60	2.20
Green cover of the Boulevard	491.00	18.20	16.00	59.00	0.60	2.20
Batumi Botanical Garden green cover	10 856.00	118.00	129.00	473.00	0.70	2.60

Below is shown the calculation course for each project facility according to the results:

Carbon reserves accumulated in the recreation zones of Batumi

$\Delta C_{F_{LB}}$ = [V●D●BEF_2] ●(1+R) ●CF=[55●0.41●1.3] ●(1+0.24) ●0.5= 29.3●1.24●0.5=**18.2ტC/ჰა,**

Respectively, 10938 tons of carbon are accumulated in the vegetation of Batumi. Storage collected annually in recreational areas:

$\Delta C_{F_G}=(A \cdot G_{TOTAL}) \cdot CF= 601 \cdot 1.2 \cdot 0.5=$**361ტC**

$G_{TOTAL} = G_W \cdot (1+ R)=0.94 \cdot 1.24=1.2$

$G_W = I_V \cdot D \cdot BEF_1=2 \cdot 0.41 \cdot 1.15=0,94$

1 hectare of Batumi recreation area annually collects 0.6 TC/ha

The accumulated carbon storage in vegetation of the Boulevard and the annual increase rate are identical to the relevant indicator for Batumi, the only difference is in the annual rate of carbon resources:

$\Delta C_{F_G}=(A \cdot G_{TOTAL}) \cdot CF= 27 \cdot 1.2 \cdot 0.5=$**16.2ტC.**

The accumulated carbon storage in the Botanical Garden:

$\Delta C_{F_{LB}}$ = [V●D●BEF_2] ●(1+R) ●CF=[266●0.55●1.3] ●(1+0.24) ●0.5= 190●1.24●0.5=**118ტC/ჰა,**

Consequently, 10856 tons of carbon is accumulated in the green cover of the Botanical Garden.

The annual accumulation of carbon in the vegetation resources of the Botanical Garden:

$\Delta C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF = 92 \cdot 2.8 \cdot 0.5 = \mathbf{129}$ ტC

$G_{TOTAL} = G_W \cdot (1 + R) = 2.3 \cdot 1.24 = 2.8$

$G_W = I_V \cdot D \cdot BEF_1 = 4 \cdot 0.55 \cdot 1.05 = 2.3$

Consequently, 1 hectare area of the Botanical Garden annually collects 0.7 TC/ha.

8.3 Batumi Greening Action Plan

In 2014, planting of 22 plant species is scheduled in Batumi, 4 of which are tree-plant species (cedar, cypress, pine, maple) and 3 palm species, while the rest of the species are bushes and flower vegetation. In total, planting of 3380 saplings are planned on around 1 ha of land.

Carbon dioxide absorption and carbon accumulation capacities after 70 years of planting are calculated according to co2fix model.

According to the scenario envisaged by the project (recovery-cultivation of plants), calculations were used for selecting the model of two modules, namely: biomass and soil modules.

1. Biomass module

For calculations in the biomass module so called "cohort" system is used. The cohorts include one or various groups of wood plant species.

The species unified in each cohort are characterized in the module separately - by the following characteristics: growth, drying up and other features.

Table 49. Required and used characteristics in the biomass module according to the project scenario

Characteristics listed in the biomass module	Indicators of the characteristics
Carbon content in biomass	0.5 tons. C/T. Dry mass
Wood density/ T. Dry mass	
Cedrus	0.58
Cypress	0.54
Pinus contorta	0.48
Maple	0.48
Catalpa	0.75
Inicial carbon storage	0 ტC/ha
Growth correction factor	1.00
Phyto mass turnover rate (Branches, roots) the annual rate of natural death	
Coniferous:	
Needles	0.30
Branch	0.04
Root	0.03

Leafy:	
Leaf	1.00
Branch	0.05
Root	0.08

1. Soil Module

The Yasso-model used to determine soil carbon dynamics (http://www.efi.fi/projects/yasso/). This model (model is included in the CO2fix system) describe dry soil carbon dissolution and its dynamics.

This model is calibrated the way to describe the total carbon stocks in soils, regardless of soil layers.

The model can be used for coniferous and deciduous forest. This model has been tested in the countries with various climatic zones to describe the effect of different climatic conditions on the decay of fill.

Table 50. Characteristics used in the soil module

Characteristics used in the soil module	**Indicators of the characteristics**
Resultative subtotal of the temperature during the year (zero above T)(Cºd)	5 310.50
Evapotranspiration (PET,mm)	628.60
Sediment volume during the vegetation period (mm);	1 654.00
The average monthly temperature indicators during the vegetation period	
March	8.80
April	12.20
May	12.20
June	20.20
July	22.50
August	22.80
September	20.00
October	16.20

According to the obtained and determined characteristics we got the following picture by the model calculations: the magnitudes of annual accumulation after planning of greenery planting in 2014 are shown in picture 27, and the accumulation dynamics for the next 70 years is shown in the table drawn up by the model (see figure 28).

From the summarizing table of the model we see that, for example, within 10 years from planting 1 ha of plantation accumulates 80.8 t C, consequently 296.5 GG CO2 will be deposited.

	Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...		Sequestered Carbon urban refor...	Sequestered Carbon urban refor...
year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...
0	0.00	0.00	21	158.70	581.91	41	250.16	917.24	61	310.96	1140.17
1	4.47	16.40	22	164.24	602.20	42	253.99	931.28	62	313.18	1148.34
2	10.10	37.04	23	169.57	621.76	43	257.74	945.05	63	315.35	1156.27
3	16.96	62.18	24	174.71	640.61	44	261.43	958.56	64	317.45	1163.99
4	24.74	90.71	25	179.66	658.77	45	265.04	971.81	65	319.50	1171.50
5	33.43	122.56	26	184.44	676.27	46	268.58	984.81	66	321.49	1178.81
6	43.01	157.72	27	189.17	693.63	47	272.03	997.44	67	323.43	1185.91
7	52.93	194.06	28	193.87	710.85	48	275.35	1009.63	68	325.31	1192.81
8	62.56	229.40	29	198.53	727.95	49	278.56	1021.40	69	327.14	1199.51
9	71.88	263.57	30	203.17	744.96	50	281.67	1032.80	70	328.92	1206.03
10	80.87	296.52	31	207.77	761.83	51	284.69	1043.88			
11	89.58	328.45	32	212.32	778.49	52	287.64	1054.67			
12	97.88	358.88	33	216.80	794.93	53	290.51	1065.20			
13	105.81	387.96	34	221.22	811.14	54	293.31	1075.49			
14	113.40	415.80	35	225.57	827.11	55	296.06	1085.55			
15	120.70	442.56	36	229.86	842.83	56	298.75	1095.41			
16	127.72	468.32	37	234.08	858.29	57	301.35	1104.95			
17	134.40	492.81	38	238.21	873.44	58	303.87	1114.18			
18	140.82	516.35	39	242.27	888.32	59	306.30	1123.11			
19	147.00	539.01	40	246.25	902.92	60	308.67	1131.77			
20	152.96	560.85									

Figure 27. The carbon accumulation and carbon dioxide absorption rates after the planned landscaping.

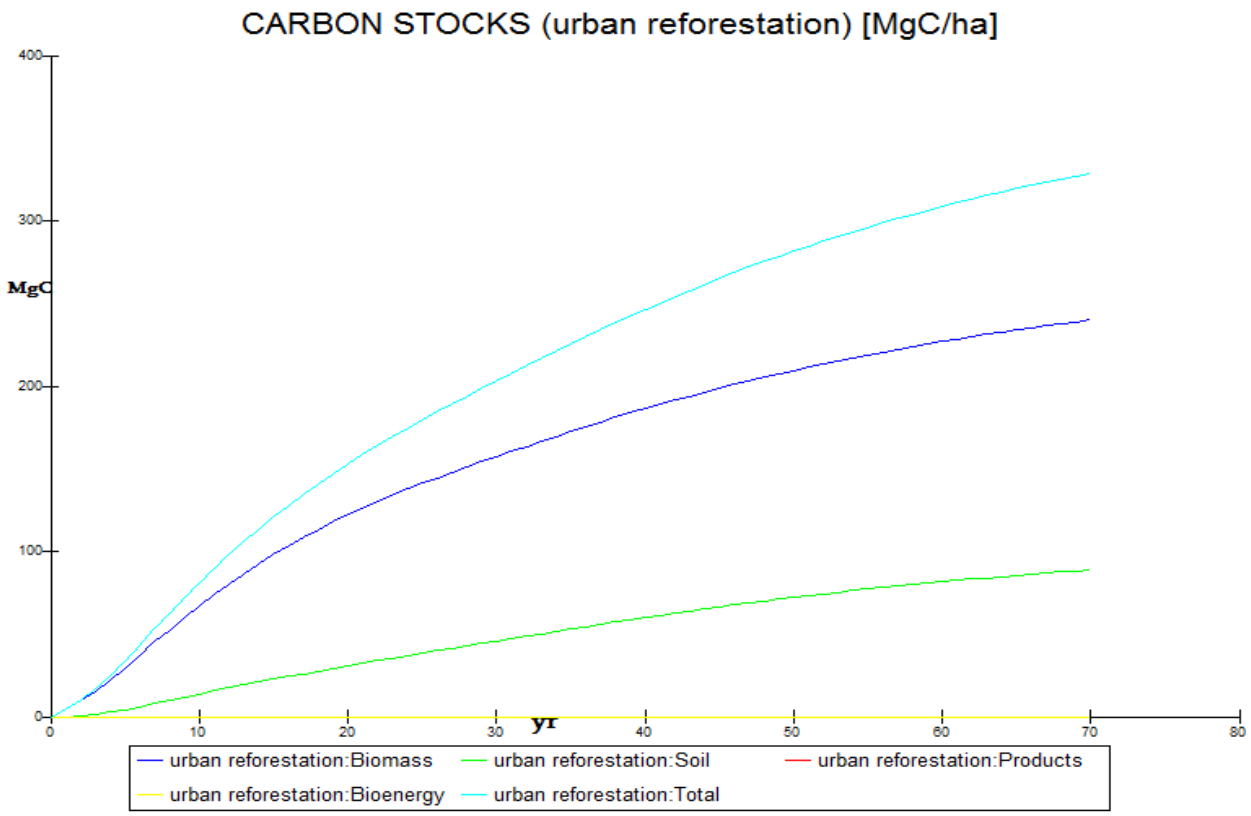


Figure 28. Accumulated carbon dynamics after cultivation.

For demonstrating carbon accumulation in the biomass as a result of urban development of Batumi in the next coming years, we made an assumption that each year, greenery planting is carried out on 1 hectare. The carbon accumulation annual volume from 2014 through 2019 is shown in the table 51.

Table 51. The annual carbon accumulation as a result of the greenery planting on 1 ha in 2014-2019, TC

Cultivation year and annual increase	2014	2015	2016	2017	2018	2019	2020
2014	4.50	10	17	25	33	43	53
2015		4.50	10	17	25	33	43
2016			4.50	10	17	25	33
2017				4.50	10	17	25
2018					4.50	10	17
2019						4.50	10
2020							4.50
Total	**4.50**	**14.50**	**31.50**	**56.50**	**89.50**	**132.50**	**185.50**

As a result of cultivation in total 185.5 TC will be accumulated, consequently absorption of the carbon dioxide is 680 GG CO2.

9 The strategy of raising awareness of the large segments of the society and target groups on the perspectives of sustainable energy development in Batumi and its economic and social results and personnel training

Sustainable energy development of a country or a region/municipality represents an area, where inclusion of the state and public structures is equally important and where both sides should be interested in achieving results. Raising public awareness on renewable energy, energy efficiency and energy savings requires a complex and multilateral approach. A relevant communication strategy represents one of the most important components of the Sustainable Energy Action Plan (SEAP).

The SEAP preparation process within the framework of the Covenant of Mayors (CoM) revealed main constraints, which could create significant threats to the implementation of the strategy. It is important to evaluate all the identified barriers and develop the strategies to overcome them.

The processes of evaluation revealed three main barriers, namely, barriers that exist generally in the country and are triggered by the remnants of the past practices (especially in the awareness raising area), existing socio-economic problems and a lack of knowledge related to the technologies. In addition, barriers particularly characterising Autonomous Republic of Adjara and City of Batumi and barriers related to specific project proposals and technologies exist.

The list of the barriers is enumerated in the following scheme:

Existing barriers to the process of the sustainable energy development in Georgia

1. **Wasteful approach to the energy sector**, inherited from the Soviet period by the general public, as energy was almost free and unlimited at that time.
2. **Lack of general awareness of the sustainable development processes.** Only a part of the society, which is directly connected to and interested in the issues have awareness of the concept.
3. **A lack of unified vision of the long-term development perspectives in the sustainable development of the energy sector** (various interest groups have divergent positions, which are not often based on real estimations).
4. **There is no single, well thought and formulated vision on the role of the energy efficiency and renewable energy resources and** the short- and long-term development perspectives of Georgian energy sector. This happens when there is annual 10% growth in energy demand. Consequently, the potential of this resource (except hydro) and its utilization directions are not defined. For instance, there are no appropriate legislative basis and goals set in the gasification or hydro-energy areas.
5. **The technological marker is incomplete and contains high risks.** Defeat of every new technology and pilot project seriously impacts perspectives of further developments in this

area. The long-term planning in the energy sector does not take into consideration accessibility to the technologies.

6. **Works undertaken by specific non-governmental organizations on energy efficiency and renewable energy (except hydro) are mainly non-coordinated and unreasonable.** The overall process of increasing energy efficiency in the country is chaotic. This is partly determined by the modern technological marker (household) and infiltration of the international energy standards on the territory of Georgia.

In the process of identifying these barriers one should take into account that the management of Batumi City Municipality is quite progressive and understands the future perspectives of the sustainable energy development and expresses huge interest in introducing clean, energy efficiency and renewable technologies.

Barriers to the sustainable energy development in Adjara and Batumi

1. Adjara and namely, Batumi municipality face all the barriers which are common for all regions and municipalities in Georgia, among others for the self-government towns similar to Batumi. This is their **full dependence on the centralized energy supply in the electricity sector**. This dependence on the centralized process is partial in the case of the gas supply sector. Here, the municipalities mainly depend on the processes developed with the planning of the central government. As for the petrol, diesel and other fuels, this sector is a prerogative of private importers.
2. Batumi municipality does not run an energy consumption statistics of the city, based on which an increasing energy demand of the city would have been planned. There is no vision or an alternative strategy of supplying the city in case of crashing one of the elements of city's current energy supply. Consequently, necessity in energy efficiency and its role in the sustainable socio-economic development of the city are not well thought. There is the lack of vision of potential problems in the increasingly growing tourism sector that could be caused by the energy deficits.
3. The municipality has no sufficient experience, knowledge nor personnel for planning and implementation of the energy sustainable process for Batumi.
4. It is important that there are no free additional financial resources for this area (the budgetary resources are concentrated on the infrastructure development, which is very important at this stage and also, on social projects).
5. The sector of energy consumption is uncontrolled and chaotic at the municipality level, as well as nation-wide.
6. In case of Batumi, all the barriers, which are common and characterizing for the whole country, are more or less valid.

In addition to the above-mentioned barriers related to the general development of technologies (local), import and dissemination, there are specific barriers connected to the

private technologies that should be taken into account when examining selected and utilized technologies in the process of SEAP implementation.

Barriers connected to the technologies are:

1. **A lack of knowledge of modern and affordable energy efficient and renewable technologies existing on the international markers.** Utilization and adaptation conditions and opportunities in Georgia are studied only for few technologies. This significantly increases the risks connected to their introduction. Neither private banks nor the private sector want to take the responsibility for these risks. Consequently, introduction and dissemination of these technologies is exclusively in hands of the non-governmental sector or those large investors, who are interested in the market utilization with their own technologies. Thus, high quality technologies, which reach Georgia in small quantities, are followed by a large part of poor-quality technologies. The process is further deteriorated by the fact that in the major cases the determining factor is a price of the technology and unfortunately, only in the short-term perspective.
2. **A lack of knowledge on the local environment, in which the technologies should operate** (for example, energy efficient bulbs are absolutely ineffective and economically unprofitable in the places where electricity network is old and inefficient. This type of studies becomes extra costs for the technologies.
3. **A lack of knowledge about environmental and social contraindications.** Studying technological risks requires good knowledge of the technology from the receiver side in order to assess and minimize the risk.
4. **A lack of experienced local staff** able to correctly select the technologies for the local conditions and their appropriate utilization. This problem especially exists at the level of the municipalities and self-government towns.
5. **Renewable technologies are often not sufficiently flexible and easily adaptable in a different environment.** Their majority does not have the market look and their adaptation to the local conditions requires additional money and knowledge.

The analyses of interested parties conducted within the framework of SEAP revealed the target groups for the awareness raising and vocational training. It is necessary to actively work with these groups in order overcome the majority of the abovementioned barriers. Although, it should be underlined that there still are the barriers existing country-wide, solutions of which will be very difficult without the involvement of the central government.

The present strategy reviews the following target groups: Personnel of the Batumi City Municipality, members of the Council (Sakrebulo), the population of Batumi and the private sector. When it comes to the private sector, particular focus should be put on the tourism service facilities and industrial sector.

In order to implement the plan, it is necessary to implement activities requiring a change in habits and behaviours of the population in Batumi. As a first reaction, such changes may often be accompanied with the feeling of discomfort and natural protest. In order to avoid negative public sentiments and on the contrary, for strengthening a positive opinion, it is necessary to clarify the reasons for designing SEAP and the goal of planned activities. For achieving support of the population at the maximum level it is necessary to involve them already in the process of SEAP elaboration. As practice demonstrates, the higher the participation of the population in the early process is, the easier is the implementation stage and the higher public support.

At the starting stage of the SEAP design, it is necessary to organize frequent meetings and consultations with the population and representatives of the different sectors (where the most changes will be possibly implemented) with the purpose of explaining the necessity of the project implementation and benefits to the city and its population. The consultation process may identify ideas for the new projects or the planned projects may be amended.

Meetings in the process of designing the SEAP for Batumi were already conducted with the relevant representatives of the appropriate department at the Batumi Mayor's office, with the municipal organizations in transportation, energy, tourism, urban development, greenery and cleaning sectors, energy supplier companies, potential investors for pilot projects and financial partners (banks, financial organizations), associations of businessmen, architects and other professional associations, private construction and transportation companies, non-governmental organizations, experts in this sector and other interested segments of the society. It is noteworthy, that exactly these interested persons have knowledge necessary for designing the plan and creating the basis which will determine success of the project.

The strategy of raising awareness on Batumi SEAP and personnel training consists of the following steps:

Short-term strategy (2014-2016):

1. Informing local authorities about advantages and perspectives of ensuring city's sustainable energy consumption and socio-economic profitability of the initiative.
2. Training of municipality workers and outside resources for ensuring successful implementation and monitoring of SEAP.
3. Ensuring the maximum level of inclusion of the city's population in the design and implementation of the pilot project proposals (related to the residential buildings). Demonstrating advantages of energy efficiency measures and technologies to the population.

Middle-term strategy (2017-2019)

1. Activities targeting the change of behaviours (lifestyle) among the population. Increasing inclusion of the residents in new technologies (energy efficiency of the buildings, private cars, waste generation etc.) by strengthening awareness raising process. Preparing informative and illustrative materials depicting the successful practice of behavioural change. Preparing informational materials on recommended technologies for the green development of the city and the healthy environment that would attract more tourists.
2. Increasing private sector inclusion in the SEAP implementation by providing information about energy saving and economically beneficial technologies, offering the public and private sector special cooperation programs.

Long-term strategy (2020 and after)

1. Intensification of consultations with the interested sides (city's population, private sector, non-governmental sector) about prohibitive measures and standards that should be implemented by the municipality in various sectors (construction, transportation, waste generation).
2. Identification of possible barriers accompanying the process of introducing prohibitive measures and various standards with the interested sides.
3. Designing and implementing different awareness raising and promotional programs for various target groups (for example, for ensuring the unimpeded introduction of energy efficiency).

For the successful implementation of the Batumi SEAP in the area of personnel training and awareness raising

Main strategic goals	Main target groups	Implemented activities	Potential leading organization (s)	Result	Potential donors
Short-term plans (2014-2016)	Batumi City Municipality and Council (Sakrebulo) The city population of Batumi	The goal of the short-term strategy is to facilitate raising awareness and understanding of the city authorities about the perspectives of energy efficiency and its socio-economic profitability, to include the city population in the process at the maximum level and assist them in selecting and training of relevant staff for ensuring implementation and monitoring of the Action Plan.	Batumi Mayor's office Coordinator of the Covenant of Mayors in Georgia (Ministry of Energy and Ministry for Environment Protection and Natural Resources). Various local and international programs implemented within the framework of the initiative of designing the strategy for the Covenant of Mayors and mitigation of emissions.	SEAP for Batumi is successfully implemented. Batumi Mayor's Office continues the same activities after 2020 too. The Batumi population has implemented a range of energy efficiency measures. The Batumi population understands and approves the initiatives of the city government related to this process.	Batumi Mayor's office Coordinator of the Covenant of Mayors in Georgia (Ministry of Energy and Ministry for Environment Protection and Natural Resources). Varmus local and international programs implemented within the framework of the initiative of designing the strategy for the Covenant of Mayors and mitigation of emissions. International donors working on mitigation of climate change and renewable energy, also on promoting processes related to energy efficiency and sustainable energy development.
Staff training					
Training of the technical staff, who will be able to undertake qualified work and provide recommendations for successful implementation of the technical process within the CoM.	Technical group of Batumi Mayor's Office Special Unit established under the Mayor's Office (this could be the Energy Efficiency Center, which will serve the Mayor's office, as well as the population and the private sector).	• Establishing the special technical group/unit at the Mayor's office or outside its competence, which will provide service to the Mayor's Office, also to the city population and the private sector in the process of SEAP implementation, and will propose introduction of new technologies. • Elaboration of the program for training the technical group. The program at the minimum level should include activities related to the energy efficiency, mitigation of the climate change measures, EU directives, demands of the CoM and analyses of modern technologies for the identification of barriers in the process of their introduction/implementation. • Preparing training manuals for the technical group. • Inclusion of the technical groups in the exchange programs and various	Batumi Mayor's office Ministry of Energy and Ministry for Environment Protection and Natural Resources CoM process representative in Georgia (at this stage, the Energy Efficiency Center).	Training program and manual for the technical group personnel of the Mayor's office is prepared. Personnel is trained and selected as a result of the competition. Their rights and responsibilities and working program are clearly designed. The program envisages cooperation with the Mayor's office, as well as with the private sector. Technical group is actively involved in the exchange programs and international networks for receiving up-to-date information about modern technologies and approaches in	Batumi Mayor's office EC-LEDS Project USAID GIZ EU

		information networks for receiving information on international experience. • The potential candidates of the technical group should be included in the SEAP design from the beginning.		the energy sector. Technical group is ready to train personnel of the private sector.	
Public awareness raising with the full public inclusion and provision of information					
Provision of information and inclusion of the public in the process at the maximum level for avoiding any misunderstandings among the public and the city authorities. The society should be a receiver of the socio-economic benefits achieved in the sustainable energy development process. At the first stage of the awareness raising, the main direction in Batumi will be consulting the city population about energy efficiency measures in the buildings, informing them about technologies existing on the market and especially, on best international practice.	Home-owners associations (condominiums) Non-governmental sector And other public unions	Preparing informational materials for the city population about the measures and technologies that improve the residential environment for the population and will save their expenses on energy consumption. Systematic meetings with the population and training agitators in the condominiums. Inclusion of the population in design and implementation of the pilot projects.	Batumi Mayor's office Non-governmental sector	TV advertisement and information booklets about technologies available on the market and advantages of their use prepared for the Batumi population. A pilot project is being implemented in several years (2 years) for ensuring inclusion of the population at the maximum level	Batumi Mayor's office USAID GIZ EU
Informing the representatives of Batumi City Municipality and Council (Sakrebulo)					
Informing local authorities about advantages and perspectives of city's energy efficiency and socio-economic profitability of this initiative.	Batumi Mayor's office Batumi Council (Sakrebulo)	Organization of information-sharing seminars for the representatives of Batumi Mayor's office Council (Sakrebulo) on advantages and perspectives of city's energy efficiency. Facilitation of staff participation at the Mayor's office and Council (Sakrebulo) in the national and international events and conferences within CoM. Inclusion of the mass media representatives in the high-level meetings within CoM to inform public about the on-going processes. Ensuring the process of making decisions in the framework of CoM through the consultations with the interested parties.	Batumi Mayor's office Batumi Council (Sakrebulo) Regional Energy Efficiency Center	• Illustrative materials for organizing informational meetings are prepared. • Minimum 2 meetings per year are conducted. • Experts on modern technologies and approaches from the EU and other donor countries are invited for organizing seminars. • Dissemination of the decisions, examined projects and measures in the media. • The representatives of the Mayor's office and Council (Sakrebulo) are fully involved in the	• EC-LEDS • USAID • EU-COM • GIZ • Partnership for mitigation • Projects on emissions of greenhouse gasses • The Third National Notification of Georgia on Climate Change

				processes both at the national and international levels. • Information on the projects and ongoing processes placed on the web-site of the Mayor's office is constantly updated.	
Middle-term goals (2017-2019)	• Residents of Batumi • Private sector in Batumi (with a focus on tourism development and service industry).	Activities targeting the change of behaviors (life style) among the population. Increasing inclusion of the residents on new technologies (energy efficiency of the buildings, private cars, waste generation etc.) by strengthening awareness raising process. Preparing informative and illustrative materials oriented on the successful practice of behavioral change. Preparing informational materials on recommended technologies for the green development of the city and on the healthy environment that would attract more tourists. Increasing private sector inclusion in the SEAP implementation by providing information about energy saving and economically beneficial technologies, offering the public and private sector cooperation programs.	Batumi Mayor's office Batumi Council (Sakrebulo) Regional Energy Efficiency Center		Government of Georgia Batumi City authorities Projects on climate change USAID EU-COM GIZ UNDP
Activities directed to behavioural changes of the Batumi population					
Activities oriented on the change of lifestyles among the population. Increasing their inclusion in the new technologies (energy efficiency of the buildings, private cars, waste generation etc.) by strengthening awareness raising process. Preparing informative and illustrative materials oriented on the successful practice of behavioural change. Preparing informational materials on recommended technologies for the green development of the city and on the healthy environment that would attract more tourists.	Home-owners associations (condominiums) Owners of the private cars Tourists Tourist service sector Various energy consumers and their associations Non-governmental sector	• Identification of specific target groups (kindergartens, private car owners, representatives of tourism industry, municipal facilities, population etc.) according to the priority areas and directions of the SEAP. • If we take into account that Batumi local government does not have an experience of implementing such communication processes, inclusion of the invited experts is desirable. • Designing promotional mechanisms for target groups (for example condominiums that save the energy the most).	Batumi municipality Mass media Non-governmental sector	• Interest groups are identified • Informational and illustrative materials about best practices are prepared. • Advertisement materials prepared about the barriers and mechanisms • Promotional mechanisms that would promote behavioural change in favour of energy saving and clean technologies for target groups prepared	• EU-COM andits various programs • Batumi Mayor's office • EC-LEDS process • Green Economy programs
Inclusion of the private sector in achieving SEAP goals					

Strengthening involvement of the private sector in the SEAP (through informing them about energy saving and economically beneficial technologies) and offering the public-private sector cooperation programs	• Private sector • Initiative group of the private sector	• Founding the annual exhibition/festival of innovation and technologies in Batumi. One of the goals of the event should be informing the private sector about the opportunities on the modern technological market. • Attracting the private sector with various promotional mechanisms in using innovative technologies (for example, certain tax benefits in the payment of local taxes for the companies which will implement energy saving and innovative technologies. • Creating a stimulus for research for the educational organizations and private sector. • Consultation service for the private sector for reducing the risks. • Establishing various funds for promoting implementation of the new technologies and decreasing the adaptation risks. • Promoting the establishment of the private sector initiative group, which will support inclusion of this sector in CoM processes.	• Batumi Mayor's office • Energy Efficiency Center • Private sector initiative group	• Supporting the annual exhibition/festival of innovation and technologies in Batumi. • Promotional mechanisms for using innovative technologies and attracting the private sector designed. • Center for Energy Efficiency and Technologies is established, which will consult the private sector on new technologies. • Various funds for promoting implementation of the new technologies and decreasing the adaptation risks established • Private sector representatives are included in the international processes, unions and professional networks.	Adjara government Batumi Mayor's office Private Sector EU COM GEF UNFCCC programs
Long-term strategic goals (2020 and after)	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector	Intensification of consultations with the interested sides (city's population, private sector, non-governmental sector) about prohibitive measures and standards that should be implemented by the municipality in various sectors (construction, transportation, waste generation). Identification of possible barriers accompanying the process of introducing prohibitive measures and various standards with the interested sides. Designing and implementing different awareness raising and promotional programs for various target groups (for example, for ensuring the unimpeded introduction of energy efficiency).	Adjara government Batumi Mayor's office CoM programs	• The authorities in Batumi is ready for the introducing new standards in the process of the approximation with EU directives and supporting CM initiatives • The population and the private sector understand the necessity of implementing these measures.	
Consultations with the interested sides on introducing prohibitive measures and standards					
Intensification of consultations with the interested sides (city's population, private sector, non-	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi	• Informing city's population, private sector, non-governmental sector and other target groups about prohibitive measures and	Batumi Mayor's office Regional Center of Energy Efficiency and Innovative	• Personnel systematically working with the target groups are prepared.	Adjara government Batumi Mayor's office Batumi Sakrebulo

governmental sector) about prohibitive measures and standards that should be implemented by the municipality in various sectors (construction, transportation, waste generation).	Representatives of private sector (with a focus on tourism and service industry) NGO sector	standards that should be implemented by the municipality in various sectors. • Preparing informational videos and programs to demonstrate the socio-economic benefits of these measures, for example, development of tourism etc. • It is necessary to train/prepare activities who will directly and on a daily basis work with the target groups.	Technologies NGO sector	• Clarifications and consultations on measures and standards, necessary for SEAP implementation, improving socio-economic conditions in Batumi and attracting more tourists, are systematic. • Non-governmental sector is actively working with the population and various target groups. • Mass-media is actively included in the activities and the socio-economic benefits are clarified (videos, talks etc.)	
Identification of the barriers together with the interested parties					
Identification of possible barriers accompanying the process of introducing prohibitive measures and various standards with the interested sides.	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector Hotels in the city	• Identification of barriers in the SEAP implementation for the sectors on implementing standards and prohibitive measures in consultation with the population. • Designing the measures for overcoming these barriers in consultation with various target groups (for example, prohibition of transportation on a street should not happen suddenly, it should be implemented step by step by introducing prohibitions in certain days, for example the days of pedestrians etc. Although implementation of some measures should take place at once, for example, technical examination of the cars should be made following the decision of the government etc.	Batumi Mayor's office Batumi Council (Sakrebulo)	• Groups are prepared (private sector initiative group, non-governmental sector, mass media) for conducting consultations • Barriers are identified for each sector in the SEAP • Activities for overcoming the barriers are planned together with the target groups	Batumi Mayor's office
Raising awareness of the decision-makers and the private and public sector representatives on the role of prohibitive measures and standards in ensuring sustainable energy efficiency					
Designing and implementing different awareness raising and promotional programs for various target groups (for example, for ensuring the unimpeded introduction of energy efficiency). For ensuring unimpeded implementation, this part will work on raising awareness of the decision-makers and the private	Batumi Mayor's office Batumi Council (Sakrebulo) Residents of Batumi Representatives of private sector (with a focus on tourism and service industry) NGO sector	Informing the decision makers and implementators about the best international practice. Including the decision makers and implementators in the international processes related to CoM and low emission development. Raising awareness of the decision-makers and implementators on the role of prohibitive measures and standards in ensuring sustainable energy efficiency, an attention should be paid to	Adjara government Batumi Mayor's office CoM programs and projects	Decision makers and implementators are informed about the international processes, Georgia's obligations on energy change and energy efficiency. Information packages are prepared, CoM is analyzedd thoroughly in the context of implementing EU directives.	Georgian government Adjara government EC-LEDS EU-CoM GIZ Clima East Other projects offered in the future

and public sector representatives and their preparedness of the processes		the necessity of energy efficiency consumption for Georgia for ensuring energy independence. When discussing the prohibitive measures and standards in the media attention should be paid to social and environmental issues, promotion of tourism. When informing private sector representatives about the prohibitive measures and standards, attention should be paid to social and environmental issues, promotion of tourism.		Manuals on best practices are designed. Inclusion of foreign experts in the process is necessary.	

Implementation structure

- This strategy is approved and monitoring of its implementation is undertaken by the Batumi City Council (Sakrebulo) as part of the Action Plan.
- Batumi City Mayor's Office is responsible for its implementation.
- Regional Center of Energy Efficiency and Innovative Technologies is responsible for the implementation and monitoring of the trainings of the local personnel. For this purpose, the international and local programs implemented within the CoM framework will be used.
- The awareness raising and information materials should be mainly designed with the outside resources (non-governmental sector).
- Organization of international conferences and technologies.

10 Monitoring, verification and reporting of implementation of Sustainable Energy Action Plan (SEAP) and mitigation of the emissions of greenhouse gases

While planning the activities within the frame of the monitoring over the implementation of Sustainable Energy Action Plan and mitigation of the emissions of greenhouse gases, great importance should be given to the responsibility of local authorities determined by the new code on local municipality, as a result of the amendments made to Georgian legislation on local self-governance. The Parliament approved new Code on Self Governance on 6 February 2014. Besides, the scarcity of financial and human resources and lack of relevant technical skills should be also taken into consideration.

Due to above mentioned the process of preparation of the monitoring plan should envisage several options of its fulfillment and at this stage proper distribution and strict distinction of responsibilities and duties might be the most effective, so between structural units inside of the municipality, as on external resources; otherwise this approach means joint use of internal and external resources of Batumi municipality for the monitoring purposes.

The process of elaboration of the action plan demonstrated that one of the key problems of Batumi, as well as whole Georgia is access to the data of energy consumption in different sectors, necessary for the emission inventory of baseline year. Often there is now system for data recording, in some cases the information is not presented in desired format, while in most cases significant time and human resources are spent for their collection, since the data collection system is not organized and there are no statistical offices on place, which significantly hinders to the process of elaboration of the SEAP and could be viewed as important obstacle for the monitoring process as well.

One of the key sectors of National Communications on Climate Change, is the greenhouse gases inventory, however in this document the emissions of the following sectors are considered: energy, transport, industry, agriculture, changes in land use and waste and waste water management all over the country, while the emissions from the sectors such as construction,

tourism, population and so on are not viewed; and the emissions disaggregated on municipal level are not considered and estimated as well. In the process of preparation of Georgia's Third National Communication on Climate Change (2012-2014) particular contribution was made with this regard and for 2011 the emissions were calculated as for baseline year for two municipalities (self-governing cities Batumi and Poti). Main focus in the process of disaggregation was made on transport, buildings and waste sector.

In purpose to mitigate the risk connected with data collection, the methodology for implementation of the monitoring plan should be developed in the SEAP, which will maximally reduce the obstacles. One of such activities is definition of the registry of the data required for baseline and reference scenarios, which will be regularly used, summarized and systematized by the employees of respective offices of Batumi city hall or the energy managers appointed particularly for this purpose by the city hall. Monitoring, reporting and verification (MRV) should be implemented without significant loss of time based on regular updating of available data.

For purposes of internal monitoring and analyses it is essential to provide respective office of Batumi city hall with software (easy to use, work with which is possible without comprehensive knowledge of respective branch), which based on BAU (Business As Usual) approach will calculate the emissions of baseline/reference scenario and quantity of mitigated emission so for different measures as in total. Training of local staff will be required for effective use of such software.

In the course of preparing periodical reports on implementation of the SEAP , committed under the initiative of the "Covenant of Mayors", it is envisaged the engagement of invited expert/s in the monitoring process, at least at first stage of preparation of the reports.

The key activities considered in the process of monitoring and reporting for Batumi city are:

1. Updating business as usual scenario
2. Estimation of the emissions mitigated through measures and projects implemented
3. Preparation of final reports

The agencies responsible for this process:

1. The municipality of Batumi city is responsible for collection of the data on general parameters leading the municipality's development process (GDP, population, incomes per capita, share of economic activities/sectors in GDP). As for calculation of BAU scenario it could be done by external resource, but this resource should be known and accredited for this activity by the municipality in advance. The methodology for calculation and further update of BAU scenario shall be provided to the city hall within the frame of preparation of "Low emission development strategy" by the government of Georgia and agreed by the the Covenant of Mayors technical support. The used emission factors should be agreed with the National Focal Point of the UNFCCC (UN Framework Convention on Climate Change) and low emission development process.
2. The information gathered in purpose to calculate the emissions mitigated by implemented activities and projects should be collected by a project/measure implementing unit/the project owner. The municipality ensures data collection methodology for these

implementers. The municipality is responsible for calculation and control of final emissions in this case also; however this also could be done by external resources accredited by the Covenant of Mayors. Periodic verification of the data provided by the project implementer is also the responsibility of municipality.

3. The city hall is responsible for preparation of final report of the monitoring, and the City Council (Sakrebulo) for its approval after which the monitoring report shall be submitted to EU.

This document provides the description of the elements of monitoring process: general parameters which should be monitored within the process of SEAP implementation, (QA/QC) procedure for the data on different activates and the emission factors, based on which the BAU scenario is updated for the next year and calculation of mitigated emission.

1. Responsible Unit in the Municipality

The Economic Policy Department is responsible for preparation and implementation of the Covenant of Mayors and SEAP, its systematic update, in compliance with new conditions and new plans for development. The same department is responsible for implementation of monitoring, analyses of its results and taking these results into consideration in the process of updating SEAP, verification of the monitoring data and preparation of final report, which shall be approved by Batumi "Sakrebulo" prior to submission to EU. The Economic Policy Department is also responsible for organizing the data collection process, facilitating to improvement of data quality, its systemic update and identification of new sources. In this process the economic policy department can use other divisions subordinated to the municipality as well certified outside resources.

Five key sectors are discussed within the SEAP: energy consumption of buildings, transport sector, street lightening, waste and waste water treatment and greening of city. Monitoring of the data of different activities described below, are required for evaluation of BAU scenario of each sector. Besides the data of these activities the monitoring will be necessary within the frame of each implemented project and activity, based on which the emission scenario will be assessed and total reduction will be verified against BAU scenario established before. The quantity of total mitigated emissions will be defined on the basis of analyses of the results of the comparison of above mentioned.

The responsibility for collection of statistical material required for monitoring of each sector, could be assigned to respective structures of the city hall, second option viewed by the city hall is that archiving and primary procession (QC) of the data could be done in regional centre for energy efficiency and innovations, which could be hosted by Batumi city. The divisions of the city hall and Ltd or to be responsible for data collection are provided on the drawing below:

The Economic Policy Department

Energy manager that will be responsible for collection of the data by sectors, ensuring their quality and archiving

Energy manager is directly responsible for finding and archiving key driving parameters of energy consumption

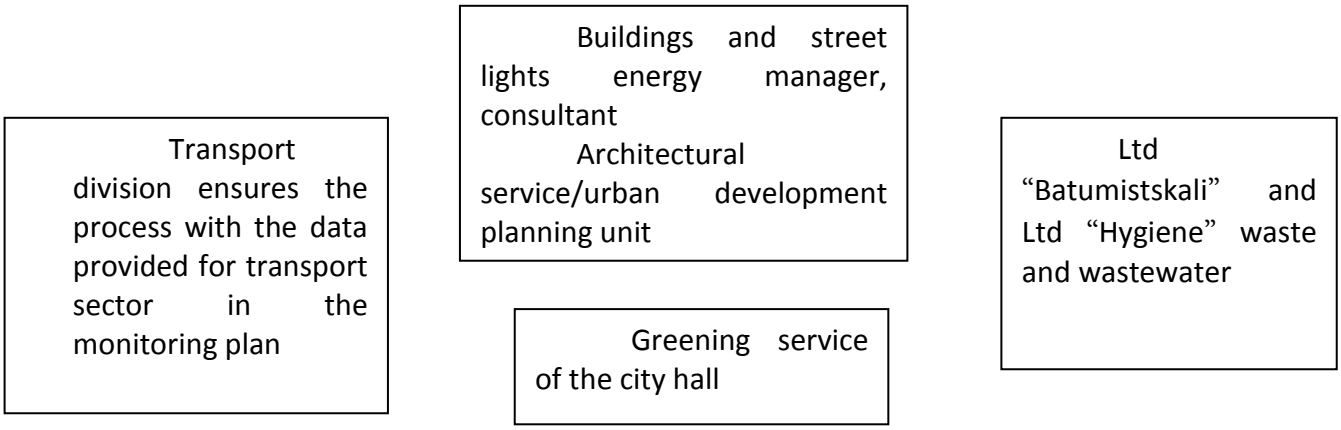


Figure 29. Managing the Monitoring Process

The data of four types shall be collected and assessed for preparation of monitoring report for each sector: annual emission in CO2 equivalents, the status of implementation of the activities and projects and saved emission, main driving parameters of BAU scenario (for example for transport sector these are: population, GDP or increase of revenues and distribution of passenger kilometers by transport modes) and economic and social effect of implemented activities.

SEAP monitoring group certified by Batumi municipality shall be responsible for preparation of annual monitoring report, which once in two years (compiled analyses of 2 years) shall be submitted to third party for verification. Presumably this third party will be provided with the Covenant of Mayors office. The structure of mentioned monitoring will be elaborated by the monitoring group and it should not contradict to the general format of monitoring elaborated and provided by the Covenant of Mayors.

It is expected that new approaches and methodology shall be implemented gradually for perfection of the monitoring. In this case wherever relevant, all monitoring should be revised by new methodology, in purpose to make monitoring on BAU scenario comparable by all years.

2. Monitoring of Reference Scenario Drivers[29]

These parameters are monitored in order to track the significant changes and reassess the impact of these changes on the reference scenario in the reporting period. In case of revision of SEAP and relevantly reference scenario updated driving parameters should be applied. Driving parameters of Business As Usual (BAU) scenario and different sectors

Data / Parameter: # 2.1	**Number of population in monitoring year**
Data unit:	Number of population
Description:	Primary data[30]; Monitored annually.
Source of data used:	Statistical yearbook (www.Geostat.ge)
Value applied:	169 400 (Municipality of Batumi city)

[29] This monitoring plan prepared for Batumi city SEAP used the monitoring format developed by the UNFCCC CDM (Clean Development Mechanism) secretariat.

[30] Data considered as primary if it is not calculated by the "Monitoring Agency" but is derived from different sources.

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Finally population increase rate (%) should be calculated and monitored by the Agency as a reference scenario driver. Population increase rate for Georgia forecasted by different international organization (IPCC, WB) is low and equals to 0.5%. This value is applied in the Georgia's SNC. For Batumi city the future forecast of population increase was provided by the Municipality of Batumi city

Data / Parameter: #2.2	**GDP (Gross Domestic Product) in 2012**
Data unit:	Million GEL
Description:	Primary data; Monitored annually.
Source of data used:	Current value of GDP and future forecast is provided by local authorities, by the Ministry of Finance and Economy of Ajara. .
Value applied:	2012- 849.45
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #2.3	**GDP (Gross Domestic Product) forecast for 2020**
Data unit:	Million GEL
Description:	Primary data; Monitored annually.
Source of data used:	Current value of GDP and future forecast is provided by local authorities, by the Ministry of Finance and Economy of Ajara AR. .
Value applied:	2020- **1 197.70**
Justification of the choice of data or description of	

measurement methods and procedures actually applied :	
Any comment:	GDP increase rate (%) as a reference scenario driver should be monitored by the SEAP monitoring Agency through the National Statistics Office of Georgia or its local branch in Ajara. This parameter is mainly to monitor and revision of reference scenario. For Batumi SEAP this parameter was provided by the Ministry of Finance and Economy of Ajara AR. The National Statistics Office of Georgia should of be also involved in calculation of this parameter.

Data / Parameter: # 2.4	**Coefficient of elasticity (recalculation) by sectors and by parameters**
Data unit:	N/A
Description:	Elasticity is the ratio of the % change in one variable to the % change in another variable.
Source of data used:	For calculation of current baseline scenario in transport sector the EUROSTAT (Based on similarity with Eastern European countries in transition) data was used.
Value applied:	1.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter should be monitored and reassessed at least every 2 years.

Emission Factor (EF)

Data / Parameter: #2.5	**Electricity (Georgia's grid EF) CO2**
Data unit:	T CO2/MWh
Description:	Secondary data[31]. Should be calculated for whole country and provided to the municipalities.
Source of data used:	Calculated specially for this SEAP with simple average method when emission from generation of electricity is divided by whole electricity generation.
Value applied:	0.1529

[31] Data considered as secondary if it is calculated by the "Monitoring Agency".

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Could be taken also EF calculated by the CDM DNA (the Ministry of Environment Protection)

Data / Parameter: #2.6	**NG**
Data unit:	T CO_2/TJ, kg CO_2/TJ
Description:	Primary data
Source of data used:	IPCC default (for tier 1)
Value applied:	55.78 t CO_2/TJ; 5 kg CH_4/TJ; 0.1 kg N_2O /TJ.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be calculated.

Data / Parameter: #2.7	**Gasoline**
Data unit:	t/TJ, kg/TJ
Description:	Primary data; IPCC default (for tier 1)
Source of data used:	68.6 t CO_2/TJ; 20 kg CH_4/TJ; 0.6 N_2O kg/TJ.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be calculated.

Data / Parameter:	**Diesel**

#2.8	
Data unit:	t/TJ, kg/TJ
Description:	Primary data; IPCC default (for tier 1)
Source of data used:	73.3 t CO_2/TJ; 5 kg CH_4/TJ; 0.6 kg N_2O /TJ.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific factors will be calculated.

Data / Parameter: #2.9	NCV (for NG, gasoline, diesel)
Data unit:	
Description:	Primary data. This value should be acquired at the national level.
Source of data used:	Exporters and distributors of NG and fossil fuel.
Value applied:	NG- 33.59 TJ/million m^3; Petrol - 44.80 TJ/1000 t; Diesel -43.33 TJ/1000 t; Wood – 7.50 TJ/ 1000 m^3. (IPCC default values)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Will be systematically updated. When country specific values are available then country specific emission factors will be calculated.

3. Data to be monitored for transport sector of Batumi city

Data to be monitored for public buses

Data / Parameter: #3.1	Number of public buses (public transport) by type
Data unit:	vehicles (buses) in monitoring year
Description:	Primary data
Source of data used:	Buss service provider enterprise “Batumis Avtotransporti” Municipality of Batumi City, Department of transport (alternative source)
Value applied:	**427** (65 petrol, 350 diesel, 12 NG)

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual number of busses travelled in the city to the monitoring agency. Monitoring agency should independently verify (cross-check) these data based on fuel consumption received from the financial department of the Municipality.

Data / Parameter: #3.2	**Total annual distance travelled by one bus by bus type and fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Buss service provider "Batumi Avtotransporti" Municipality of Batumi City, Department of transport (alternative source)
Value applied:	**103 680** (for baseline scenario this value was provided by the transport unit of the municipality)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data from the bus service providers at the monthly bases. Monitoring agency should independently verify (cross-check) these data based on fuel consumption received from the financial department of the Municipality. Buss service provider "Batumis Avtotransporti" should submit data on annually travelled distance by each bus type and by fuel type. However, alternative is to submit total annual distance covered by all busses from an entity. This parameter could be randomly cross-checked through fuel talons issued per route per buss.

Data / Parameter:	**Average fuel consumption per 100 km by a bus using petrol**

#3.3	
Data unit:	Litre/100km
Description:	Secondary (calculated actual consumption through total fuel consumed and actually run distance) Primary (from manufacturer's specification)
Source of data used:	Calculated during the monitoring
Value applied:	20 (these figure was provided by the transport department of the Municipality and was used for assessment of baseline and reference scenario)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Actual meaning of this parameter will be calculated by the "Monitoring Agency" based on data provided by the bus service provider companies. Primary meaning will be derived from the manufacturer's specifications for further cross-checking.

Data / Parameter: #3.4	**Average fuel consumption per 100 km by a bus using diesel**
Data unit:	Litre/100km
Description:	Secondary (calculated actual consumption through total fuel consumed and actually run distance) Primary (from manufacturer's specification)
Source of data used:	Calculated during the monitoring
Value applied:	23 (this figure was provided by the transport department of the Municipality and was used for assessment of baseline and reference scenario)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Actual meaning of this parameter will be calculated by the "Monitoring Agency" based on data provided by the bus service provider companies. Primary meaning will be derived from the manufacturer's specifications for further cross-checking.

Data / Parameter: #3.5	**Total annual fuel consumption by fuel type (petrol, diesel, NG) by all buses operating in Batumi city**
Data unit:	Litre/year
Description:	Secondary (should be calculated by monitoring unit)
Source of data used:	For SEAP was provided by the Batumi municipality
Value applied:	1.3 million liter petrol, 8.05 million liter diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter will be cross checked against the data on fuel consumption provided by the bus service providers and data from the department of statistics and finance if available. Transport department of the municipality also monitor this parameter.

Data / Parameter: #3.6	**Total annual passenger turnover by buses**
Data unit:	passenger/year
Description:	Primary data
Source of data used:	Bus service provider company “Batumis Avtotransporti” Municipality of Batumii City, Department of transport
Value applied:	**65 826 000** (Municipality of Batumi City, Department of transport)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter has different independent sources listed above. It is monitored for different (particularly for economic activity) purposes. These sources will allow to cross-check the data provided by each source. One of the sources is annually sold tickets.

Data / Parameter: #3.8	**Total Annual Mobility of busses**
Data unit:	Passenger-km
Description:	Secondary data. In future it might be assessed by the department of statistics and in such case the data become primary for the “Monitoring Agency”.

Source of data used:	Was provided by the Municipality of Batumi city (transport department)
Value applied:	**460 782 000**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be calculated by the "Monitoring Agency" for monitoring the mobility share of each type of transport facility or by the service provider companies.

Mini Buses

Data / Parameter: #3.9	**Number of mini busses operating annually**
Data unit:	Vehicle/per year
Description:	Primary data
Source of data used:	Mini bus service providers. For this SEAP 7 different companies have provided this information which are considered as primary sources in future monitoring. Municipality of Batumi City, Department of transport could be considered as alternative source.
Value applied:	**1725** (110 petrol, 1600 diesel, 15 NG) (provided by the Municipality)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data monthly from the mini bus service providers and cross check with fuel.

Data / Parameter: #3.10	**Average annual distance travelled by one mini-bus by fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Mini bus service providers. For this SEAP 7 different companies have provided this information which are considered as primary sources in

	future monitoring. Municipality of Batumi City, Department of transport could be considered as alternative source.
Value applied:	**61 200** (provided by the Municipality o Batumi city)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Municipality of Batumi City, Department of transport will be responsible to monitor and provide annual data to the monitoring agency. Monitoring agency should independently collect these data monthly from the mini bus service providers and cross check with fuel.

Data / Parameter: #3.11	**Petrol consumption by a mini bus**
Data unit:	Litre/100 km
Description:	Primary data
Source of data used:	Mini bus service providers Transport Department of the Municipality of Batumi
Value applied:	13.5 l/100 km
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected monthly from the mini-bus service provider companies. Could be checked against the fuel receipts and the data available from the Transport Department of the Municipality gathering these data for economical purposes.

Data / Parameter: #3.12	**Diesel consumption by a mini bus**
Data unit:	Litre/ 100 km
Description:	Primary data
Source of data used:	Mini bus service providers Transport Department of the Municipality
Value applied:	13.5 l/100 km
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected monthly from the mini-bus service provider companies. Could be checked against the fuel receipts and the data available from the Transport Department of the Municipality gathering these data for economical purposes.

Data / Parameter: #3.13	**NG consumption by a mini bus**
Data unit:	m^3/100 km
Description:	Primary data
Source of data used:	Mini bus service providers Transport Department of the Municipality
Value applied:	40 m^3/100 km
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected monthly from the mini-bus service provider companies. Could be checked against the fuel receipts and the data available from the Transport Department of the Municipality gathering these data for economical purposes.

Data / Parameter: #3.14	**Annual fuel consumption by all mini busses (by fuel)**
Data unit:	Litre/year
Description:	Secondary data
Source of data used:	Calculated
Value applied:	908 000 l petrol, 13219000 l diesel
Justification of the choice of data or description of measurement methods and procedures actually applied :	

Any comment:	Calculated by the monitoring agency. Could be cross checked against the data from the Transport Department of the Municipality gathering these data for economical purposes and from the department of statistics.

Data / Parameter: #3.15	**Total annual passenger turnover(mini buses)**
Data unit:	Passenger/year
Description:	Calculated
Source of data used:	Municipality of Batumi City, Department of transport.
Value applied:	**31 000 320**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Companies provided mini-buses service should provided number of passengers based on sold tickets which could be later cross-checked against the information get from financial unit.

Data / Parameter: #3.17	**Annual passenger turnover of mini buses (mobility)**
Data unit:	Passenger-km
Description:	Primary data
Source of data used:	Batumi city municipality provided this data for this SEAP. In general mini buses operator companies should provide these data. Recently the city has 7 such operators.
Value applied:	**217 002 240**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Methodology for calculation should be certified/provided by the National Statistics Office (NSO) of Georgia. Mini-buses service companies (7) having contract with the municipality.

Private cars

Data / Parameter: #3.18	**Number of passenger cars (registered in Batumi) by fuel**
Data unit:	vehicle
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia, Patrol Department of Ajara. Batumi municipality provided data for this SEAP preparation.
Value applied:	**19250 petrol, 2800 diesel, 25 electricity, 1450 NG**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.19	**Average annual distance traveled per car**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Average annual distance driven per car. Average per day driving distance should be estimated through survey and by expert judgment. Survey should be statistically confident. This value applied in this SEAP is provided by the transport unit of the Batumi municipality
Value applied:	**7 000** (survey conducted during preparation of SEAP)
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	More carefull survey should be conducted during the SEAP implementation

Data / Parameter: #3.20	**Load factor**
Data unit:	pass-km/veh-km
Description:	Primary
Source of data used:	Different studies could be used. In parallel survey should be conducted by the monitoring Agency in accordance with the methodology provided by the National Statistic Office. This value applied in this SEAP is

	provided by the transport unit of the Batumi municipality.
Value applied:	1.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.21	**Total annual passenger turnover (mobility)**
Data unit:	Passengers-km/year
Description:	Secondary data
Source of data used:	Should be calculated by monitoring Agency or by the National Statistic Office of Georgia. For this SEAP was estimated by the transport unit of the Batumi municipality.
Value applied:	**288 586 725**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Calculated and monitored annually by the monitoring agency. Methodology should be certified by the National Statistic Office.

Data / Parameter: #3.22	**Total annual mobility of private cars**
Data unit:	Passenger-km/year
Description:	Secondary data
Source of data used:	Should be calculated by monitoring Agency or by the National Statistic Office. For this SEAP was estimated by the transport unit of the Batumi municipality.
Value applied:	**288 586 725**
Justification of the choice of data or description of	

measurement methods and procedures actually applied :	
Any comment:	Calculated and monitored annually by the monitoring agency. Methodology should be certified by the National Statistic Office.

Data / Parameter: #3.23	**Fuel Consumption per 100 km by type of car and type of fuel**
Data unit:	l/100 km m^3/100 km kWh/100 km
Description:	Primary data
Source of data used:	These data are mainly from technical passport of cars.
Value applied:	**Petrol-12 l/100 km** **Diesel -12 l/100 km** **NG -7 m^3/100 km** **Electricity - 30 kWh/100 km** Only average data are provided in this monitoring plan
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This data is cross-checked through surveys and data by type of fuel and by type of cars are archived in COPERT database.

Municipal cars and other cars used by governmental structures

Data / Parameter: #3.24	**Number of municipal cars and other cars used by governmental structures**
Data unit:	Number of vehicle
Description:	Primary data
Source of data used:	Transport department of the Municipality; Other departments of the Municipality owing municipal transport Ministry of Internal Affairs, Patrol Department of Ajara
Value applied:	**Petrol -78** **Diesel - 15**
Justification of the choice of data or description of measurement	

methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency.

Data / Parameter: #3.25	**Average annual distance travelled by one car by fuel type**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Transport department of the Municipality; Surveys conducted by different sources and among them by the monitoring agency
Value applied:	**5 000**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #3.26	**Fuel consumption on 100km per car by fuel type**
Data unit:	Litre/100 km
Description:	Primary data
Source of data used:	Transport department of the Municipality; Manufacturer's specification.
Value applied:	**Petrol -7.5** **Diesel – 7.5**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency and cross-checked with the manufacturer's specifications.

Data / Parameter: #3.27	**Total average annual fuel consumption by municipal cars by fuel type**
Data unit:	Monitored in Liter/year

Description:	Secondary data
Source of data used:	Should be calculated by monitoring Agency. For this SEAP it is estimated by the transport unit of Batumi municipality
Value applied:	5625 -Diesel 29250 - Petrol
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be calculated by the monitoring agency and cross-checked through fuel receipts.

Commercial transport (taxi, light-duty and heavy-duty vehicle)

Data / Parameter: # 3.28	**Number of commercial vehicle**
Data unit:	vehicle
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia and patrol department of Ajara. For this SEAP transport unit of Batumi municipality provided the data.
Value applied:	**taxi - 1285** **light duty -475** **heavy duty - 310**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency.

Data / Parameter: # 3.29	**Average annual distance run by commercial cars by types**
Data unit:	Km/year
Description:	Primary data
Source of data used:	Ministry of Internal Affairs of Georgia and patrol department of Ajara. For this SEAP transport unit of Batumi municipality provided the data.
Value applied:	**Taxi - 15 000** **Light duty - 21 600** **Heavy duty - 43 200**

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Verification of this data is the responsibility of transport unit of Batumi municipality.

Data / Parameter: # 3.30	**Annual turnover of passengers and goods**
Data unit:	passengers/year; tons/year
Description:	Primary data (for baseline calculation and assessment of reference scenario this data was calculated.)
Source of data used:	NSO of Georgia. Responsible for monitoring of this parameter is transport unit of Batumi municipality which has provided current data for SEAP preparation.
Value applied:	**taxi - 950 279 passengers** **Light duty - 2 334 420 tons** **Heavy -duty - 12 519 360 tons**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Was calculated as the difference between a total diesel consumption in Tbilisi and consumption by municipal and public transport cars.

Data / Parameter: # 3.31	**Total annual mobility of each type of commercial cars**
Data unit:	Passengers-km/year; tons-km/year
Description:	Secondary data (for baseline calculation and assessment of reference scenario this data was calculated.)
Source of data used:	NSO of Georgia. Responsible for monitoring of this parameter is transport unit of Batumi municipality which has provided current data for SEAP preparation.
Value applied:	**taxi - 950 279 passengers** **Light duty - 2 334 420 tons** **Heavy -duty - 12 519 360 tons**
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	If the parameter is not calculated/estimated by the NSO of Georgia and delivered to local branches or authorities the methodology used should be certified by the NSO.

Data / Parameter: #3.32	**Fuel consumption on 100 km per car by fuel type**
Data unit:	Litre/100 km m^3/100 km
Description:	Primary data
Source of data used:	Transport department of the Municipality; Ministry of Internal Affairs Manufacturer's specification.
Value applied:	**Taxi: petrol 7.5 l; diesel 7.5 l; NG 6.5 m3** **Light duty: petrol 14 l; diesel 14 l.** **Heavy duty- petrol 25 l; diesel 25 l.**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be collected annually by the monitoring agency and cross-checked with the manufacturer's specifications.

Data / Parameter: #3.33	**Annual fuel consumption by cars under monitoring**
Data unit:	Litre/100 km (MWh) m^3/100 km (MWh)
Description:	Secondary data
Source of data used:	Calculated by the monitoring team.
Value applied:	**2012 - 361 799.1 MWh**
Justification of the choice of data or description of measurement	

methods and procedures actually applied :	
Any comment:	Some sectors could be cross checked against the fuel reporting forms, others could be assessed jointly with the transport unit of Batumi municipality.

Data / Parameter: #3.34	**Annual fuel consumption in city Batumi by transport sector**
Data unit:	Litre/100 km (MWh) m^3/100 km (MWh)
Description:	Primary data
Source of data used:	NSO of Georgis and its Ajara branch.Transport department of the Municipality;
Value applied:	498063.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Very important parameter for establishment of balance.

4.1 Waste management and wastewater treatment

Data / Parameter: #4.1	**Amount of daily inlet wastewater**
Data unit:	m^3/day
Description:	Primary parameter (measured)
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	58 000 ∂^{3}/day in dry periods; 60 000-84 000 ∂ ^{3}/day in rainy periods.
Justification of the choice of data or description of measurement methods and procedures actually applied :	During preparation of SEAP this parameter was not applied for estimation of generated methane amount. General amount of COD (Chemical Oxygen Demand) and BOD (Biological Oxygen Demand) were already calculated and provided by "Batumis Tskali". In future, the monitoring of this parameter is obligatory for cross checking the data.
Any comment:	

Data / Parameter: #4.2	**COD and BOD in inlet wastewater (desirable to be measured both of these parameters for QC).**
Data unit:	mg/l
Description:	Primary parameter (measured).
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	250-300 mg/l (COD) 90 mg/l (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value/parameter is not applied during the preparation of Batumi SEAP. For this SEAP the daily load of wastewater concentration by COD/BOD measured periodically (5 times) during the day was provided by "Batumi Tskali".
Any comment:	

Data / Parameter: #4.3	**COD and BOD in outlet wastewater (desirable to be measured both of these parameters for QC).**
Data unit:	mg/l
Description:	Primary parameter (measured).
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	30-60 mg/l (COD) 10 mg/l (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value/parameter is not applied during the preparation of Batumi SEAP. For this SEAP the daily load of outlet wastewater concentration by COD/BOD measured periodically (5 times) during the day was provided by "Batumi Tskali".
Any comment:	

Data / Parameter: #4.4	**Wastewater COD and BOD concentration at the pumping stations (collectors A and B)**
Data unit:	mg/l
Description:	Primary parameter (measured monthly).
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.

Value applied:	300 mg/l COD in collector A (December 2013) 110 mg/l COD in collector B (December 2013)
Justification of the choice of data or description of measurement methods and procedures actually applied :	This parameter is not directly used in calculations but is necessary for cross checking of directly applied parameters. In addition this parameter is very important for establishment of BAU scenario in this sub-sector.
Any comment:	

Data / Parameter: #4.5	**COD and BOD in inlet wastewater (preferable both to be measured for cross-checking). Wastewater concentration load measurement approach.**
Data unit:	kg/day
Description:	Secondary parameter, calculated by multiplying the amount of daily received wastewater by 5 times per day measured COD/BOD concentration
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	**15 000** kg/day (COD) **6 046** kg/day (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Above values are provided by "Batumi Stkali" and are used for preparation of this SEAP.
Any comment:	

Data / Parameter: #4.6	**COD and BOD in treated outlet wastewater (preferable both to be measured for cross-checking). Wastewater concentration load measurement approach.**
Data unit:	kg/day
Description:	Secondary parameter, calculated by multiplying the amount of daily received wastewater by 5 times per day measured COD/BOD concentration
Source of data used:	"Batumi Tskali" IP of Batumi municipality which will be responsible for the monitoring of this parameter.
Value applied:	**2 400** kg/day (COD)

	1097 kg/day (BOD)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Above values are provided by "Batumi Stkali" and are used for preparation of this SEAP. This is total load measured once in 5 days. Preferable to measure both (COD and BOD) for cross-checking.
Any comment:	

Data / Parameter: #4.7	**Methane generation standard potentialმეთანად (B_0)**
Data unit:	kg CH_4/kg COD or kg CH_4/kg BOD
Description:	Primary parameter. IPCC default values are applied.
Source of data used:	IPCC, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000 (page. 5.24), http://www.ipcc-nggip.iges.or.jp/public/gp/english/5_Waste.pdf
Value applied:	**0.6 kg** CH_4/kg BOD **0.25 kg** CH_4/kg COD
Justification of the choice of data or description of measurement methods and procedures actually applied :	**0.6 kg** CH_4/kg BOD was applied in this SEAP.
Any comment:	

Data / Parameter: #4.8	**Methane conversion Factor (MCF)**
Data unit:	N/A
Description:	Primary parameter for which the IPCC default values are applied.
Source of data used:	Table 6.3, Chapter 6, vol.5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	**0.8** applied for Batumi wastewater treatment system with open sludge lagoons **1** will be applied when sludge lagoon will be covered making system with this more anaerobic.
Justification of the choice of data or description of	This SEAP used MCF= 0.8 because sludge lagoons are open with depth above 2 m. In case of pilot project implementation these lagoons will be covered and MCF=1 should be applied.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.9	**Annual generation of methane in the sludge lagoons of the Batumi city wastewater treatment system**
Data unit:	t CH_4
Description:	Secondary parameter
Source of data used:	Should be calculated by monitoring unit
Value applied:	**WM= Σ_i (TOW$_i$ • EF$_i$)** **WM** – total annual methane generated annually by wastewater treatment process kg CH_4; **TOW**$_i$ – kg BOD in i type (industrial, residential, etc) wastewater kg BOD/year; EFi – EF (emission factor) of i type wastewater, kgCH_4/kg BOD; **EF$_j$= Bo ·MCF$_j$** EFj – Emission Factor when treating water by j type of treatment system (kgCH_4/kg COD); j- type of wastewater treatment system; Bo – Maximum standard capacity of methane generation from wastewater, Bo=0.25 kgCH_4/kg COD. MCF$_j$ – Methane Correction Factor. MCF$_j$ for Batumi equals to 0.8.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.10	**Generated electricity or produced CNG (Compressed Natural Gas)**
Data unit:	kWh or m^3 relevantly
Description:	Primary parameter, measured at the point of generation or compressing. Parameter will be measured by “Batumis Tskali” . .
Source of data used:	
Value applied:	This parameter should be monitor in case of implementation of

	methane reduction proposal. Details of measurement equipment and calibration procedure will be designed in the proposal.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.11	**Consumed electricity or consumed CNG**
Data unit:	kWh or m^3
Description:	Primary parameter calculated at the delivery point. It should be measured and provided by the grid operator or fueling station operators. Monitoring of this parameter is responsibility of "Batumis Tskali". This entity has to cross-check provided data against financial operations (income, etc).
Source of data used:	N/A
Value applied:	This parameter will be monitored in case of project implementation and in case if captured methane is not only flared but used for generation of electricity or CNG and more carbon rich fuel is substituted. In case of replacement of power or other energy sources will be accounted by the Batumi city for SEAP implementation this parameter must be monitored or upon the request of donors.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #4.12	**Amount of waste (already disposed and daily delivered) Old landfill**
Data unit:	m^3 or tons
Description:	Primary parameter.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for

	monitoring of data. Recently "Hygiene" considered as potential project implementer, responsible for landfill management.
Value applied:	Monitoring of solid waste amount disposed on this existing landfill started in 1990. 700-850 m^3 SW is disposed daily. Total amount of SW disposed at the landfill by 2012 is estimated as 9407419 m^3.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This landfill is recently in operation and envisaged to be closed in 2015 when new landfill will be opened. Maximum future 30 years methane will continue to be emitted to the atmosphere. However, for the purpose of conservativeness the proposal prepared for methane capture and utilization from this old landfill considers only next 15 years. After the 15 years methane could be only flared because of insignificant amount.

Data / Parameter: #4.13	**Characteristics of existing landfill (area, depth, composition of waste)**
Data unit:	Area-ha Depth -m Composition of waste -%
Description:	Primary parameter. After closing the landfill monitoring of this parameters is not obligatory.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring of data. Recently "Hygiene" considered as potential project implementer, responsible for landfill management.
Value applied:	Area -19.2 ha Depth - 7 m (average) Waste composition: food product 63%, textile 11%, paper 8%, polyethylene - 7% and other 11%
Justification of the choice of data or description of measurement methods and procedures actually	This are necessary only for assessment of annual potential of methane generation.

applied :	
Any comment:	This landfill is recently in operation and envisaged to be closed in 2015 when new landfill will be opened. Maximum future 30 years methane will continue to be emitted to the atmosphere. However, for the purpose of conservativeness the proposal prepared for methane capture and utilization from this old landfill considers only next 15 years. After the 15 years methane could be only flared because of insignificant amount.

Data / Parameter: #4.14	**Annual delivery of solid waste to the new landfill**
Data unit:	m^3 or tons
Description:	Primary parameter.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for monitoring of data. Recently "Hygiene" considered as potential project implementer and responsible for landfill management.
Value applied:	It is tentatively estimated that initially daily delivery and disposal of SW to the landfill site will be 42 000 t annually, but later it should reach 80 000 tons annually.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This new landfill is planned to commence operation in 2015 when new landfill facility is constructed in compliance with 999/31/EC. Significant emission from this landfill will be starting most likely after 3-4 years when operation starts. It is envisaged to be started in 2019.

Data / Parameter: #4.15	**Characteristics of new landfill (area, depth, waste composition)**
Data unit:	area -ha depth -m waste composition -%
Description:	Primary parameter. Waste composition and density should be periodically monitored no less than biannually.
Source of data used:	For this SEAP data were provided by the Directorate of Environment and Natural Resources Protection of Ajara. In case of project implementation Ltd "Hygiene" will be responsible for

	monitoring of data. Recently "Hygiene" considered as potential project implementer and responsible for landfill management.
Value applied:	Area - 32 ha Depth - 12 m Composition of waste (recent composition): food product- 63%, textile- 11%, paper- 8%, polyethylene 7% and others 11%
Justification of the choice of data or description of measurement methods and procedures actually applied :	This parameter are necessary for calculation of annual methane generation
Any comment:	It is planned that this landfill will be in operation in 2015.

Data / Parameter: #4.16	**Calculation of generated methane**
Data unit:	m^3 or tons
Description:	Secondary parameter. Should be calculated by First Order Decay (FOD) model. Calculations under the responsibility of monitoring group/unit
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl (page. 3.36). This is software programme requesting the landfill characteristics as input parameters.
Value applied:	Parameters required for calculation: • Waste composition • Methane Correction Factor (MCF) -1 • Degradable Organic Carbon (DOC) Food waste 0.15 garden 0.20 Paper 0.40 Trees and grass 0.43 Textile 0.24 Hygienic papers 0.24 • Factually degraded part of DOC (DOC_F)-0.5-0.6 • Methane share in landfill gas (F)-50% • Oxidation factor (OX)-0.1 (for managed landfills)
Justification of the	

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	In case of implementation of methane capture and extraction project this generated amount of methane should be measured as well as energy generated from this methane (in case of generation).

5. Street lightening

Data / Parameter: #5.1	**Electricity annually consumed in street lightening**
Data unit:	kWh/year
Description:	Primary data
Source of data used:	Infrastructure development unit of the municipality of Batumi city. This unit is responsible for providing monthly/annual consumption of electricity in street lightening.
Value applied:	**12 810 658 kWh (in 2012)** **16 100 000 kWh (in 2020)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be cross-checked against the payments made for street lightening.

Data / Parameter: #5.2	**Number of old/ low-efficiency lamps replaced with (LED) lamps,**
Data unit:	Number of replaced lamps
Description:	Primary parameter
Source of data used:	Project/measures implemented unit
Value applied:	65% of existing lamps will be replaced by 2020 **7300 new LED lamps will be installed by 2020**.
Justification of the choice of data or description of measurement	

methods and procedures actually applied :	
Any comment:	Replaced lamps should be tracked. It should be very transparently monitored how the replaced lamps are used in future: are they destroyed in order to ensure that they are not any more used or they are installed somewhere else?

Data / Parameter: #5.3	**Energy saved by one LED lamp per hour**
Data unit:	kWh
Description:	Primary parameter
Source of data used:	Technical passport of LED lamp.
Value applied:	**0.236** kWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Could be cross checked against random measurements.

Data / Parameter: #5.4	**Emission reduced due to implementation of EE measure (LED)**
Data unit:	t $CO_{2eq.}$
Description:	Secondary parameter. Calculated annually by the monitoring unit.
Source of data used:	Estimated by the group working on SEAP
Value applied:	Estimated reduction in 2020 is **1700** t CO_2-ობ
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

6. Green spaces of Batumi city

Data / Parameter: #6.1	**Annual planting and survival of plants by species**
Data unit:	ha

	Area of plants by types
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Due to not availability of annual greening action plan for the city following assumption was made: 1 ha annual planting starting from 2014 with 90 % survival
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.2	**Annual cuttings by species**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Only carbon stock and annual removal by 2020 on the territory of Batumi city is estimated in this SEAP. Cuttings will be monitored after implementation during monitoring
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.3	**Annual fires and volume of trees (number of trees) damaged by other reasons (diseases, etc)**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Batumi city greening service and Batumi Boulevard greening service
Value applied:	Only carbon stock and annual removal by 2020 on the territory of Batumi city is estimated in this SEAP. Volume of trees reduced because of fires, diseases or other non-anthropogenic reasons will be monitored at the implementation stage.
Justification of the choice of data or	

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.4	**Monitoring on the territory of Botanical Garden**
Data unit:	ha
Description:	Primary parameter
Source of data used:	Authorities of Botanical Garden
Value applied:	108 ha Current status of carbon stock and annual removals are assessed for Botanical Garden territory in the SEAP and forecast by 2020 without cuttings. Actual cuttings will be monitored during implementation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	There is no planned cuttings on the territory of Botanical Garden.

Data / Parameter: #6.5	**Annual fires and volume of trees (number of trees) damaged by other non-anthropogenic reasons (diseases, etc) on the territory of Botanical Garden**
Data unit:	m^3
Description:	Primary parameters
Source of data used:	Authority of Botanical Garden
Value applied:	Current status of carbon stock and annual removals are assessed for Botanical Garden territory in the SEAP and forecast by 2020 without considering natural disturbances. Real changes in biomass caused by the natural disturbances will be monitored during implementation.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #6.6	**Annual calculation of carbon stock changes**
Data unit:	tCO2/year
Description:	Secondary parameter.
Source of data used:	Will be calculated by the SEAP monitoring unit
Value applied:	City Batumi has 628 ha green space (including Boulevard). Current CO_2 stock in this territory is 42 700 t and annual removal 1 382 t CO_2. Territory covered by forest is 92 ha from total 108 ha of Botanical Garden. Current CO_2 stock in this territory is 39 800 t and annual removal 239 t CO_2.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

7. Building sector

Data / Parameter: #7.1	**Annual consumption of electricity by municipal buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**18 520.1**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Data should be cross-checked against the source such as Energo-Pro (distributor company).

Data / Parameter: #7.2	**Annual consumption of electricity by residential buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)

Source of data used:	Energo-Pro (distributor company). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**141 380.1**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical residential buildings.

Data / Parameter: #7.3	**Annual consumption of electricity by commercial buildings**
Data unit:	MWh/year
Description:	Primary parameter (measured)
Source of data used:	Energo-Pro (distributor company). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**85 761.6**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical commercial buildings.

Data / Parameter: #7.4	**Annual consumption of NG and LPG by municipal buildings**
Data unit:	m^3/year, kg/year
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**NG- 1 449.9 (MWh)** **LPG- 96.0 (MWh)**
Justification of the choice of data or description of	

measurement methods and procedures actually applied :	
Any comment:	Data should be cross-checked against the data from distributor company.

Data / Parameter: #7.5	**Annual consumption of NG and LPG by residential buildings**
Data unit:	m^3/year, kg/year
Description:	Primary parameter (measured)
Source of data used:	Gas distributor company (Socar). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**NG- 130 813.4 (MWh)** **LPG- 65 097.7 (MWh)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	These data could be cross checked by survey of typical residential buildings.

Data / Parameter: #7.6	**Annual consumption of electricity by commercial buildings**	
Data unit:	m^3/year, kg/year	
Description:	Primary parameter (measured)	
Source of data used:	Gas distributor company (Socar). Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.	
Value applied:	**26 958.7 (NG in MWh)**	
Justification of the choice of data or description of measurement methods and procedures actually applied :		
Any comment:	These data could be cross checked by survey of typical commercial buildings.	

Data / Parameter: #7.7	**Annual consumption of diesel and wood by municipal buildings**
Data unit:	l/year; m^3/year
Description:	Primary parameter (measured)
Source of data used:	Financial unit of Batumi municipality. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**wood- 202.1 (MWh)** **diesel- 480.9 (MWh)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.8	**Annual consumption of wood by residential buildings**
Data unit:	m^3/year
Description:	Primary parameter (measured)
Source of data used:	Vouchers issued or population/households. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	**wood- 260 437.5**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Should be cross checked through periodic surveys of population. Recently, actual consumption is higher than official vouchers issued (illegal cuttings).

Data / Parameter: #7.9	**Annual consumption of diesel and wood by commercial buildings**
Data unit:	m^3/year, l/year
Description:	Primary parameter (measured)

Source of data used:	Survey of commercial buildings. Energy –manager appointed by the municipality of Batumi city will be responsible for QA/QC of these data.
Value applied:	Recently (in 2012), consumption of any of these fuels is not reported. This parameter should be anyway included in the monitoring plan.
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.10	**Monitoring of annual CO_2 emission from these three type of buildings**
Data unit:	t CO_2/year
Description:	Secondary parameter. Reported annually.
Source of data used:	Should be calculated by the monitoring unit/group
Value applied:	**2012- 93 621** **2020- 141 770**
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter: #7.11	**Energy savings from the measures implemented in the building sector**
Data unit:	MWh/per measure
Description:	Secondary parameter. Calculated per measure.
Source of data used:	Project/measures implementer (population. municipality, condominiums, manager of commercial building.
Value applied:	This parameter will be calculated or assessed for each project/measure implemented.
Justification of the choice of data or	For each project/measure specific monitoring plan should be developed for monitoring of energy savings and CO_2.

description of measurement methods and procedures actually applied :	
Any comment:	Reduction in energy consumption could happened by different reasons (technical cuts, commercial cuts, etc) and therefore very careful and transparent monitoring is required for demonstration that reduction in consumption is the result of implementation of saving measures and not due to technical artifacts. Details of monitoring will be described in measure specific monitoring plan.