Sustainable Energy Action Plan for the city of Akhaltsikhe

October 2015

Enhancing Capacity for low Emission Development Strategies (EC-LEDS)/ Clean Energy Program

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Prepared for: US Agency for Internation Development USAID/Georgia

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Table of Contents

Tables

Figures

Pictures

Abbreviations

BAU	Business As Usual
C	Carbon
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon dioxide
CoM	Covenant of Mayors
Clima East	EU program on adaptation to climate change in Eastern Europe
EC -LEDS	Enhancing capacity for low emission development strategies
EU	European Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEL	Georgian Lari (currency unit)
GHG	Greenhouse gas
Gg	Gigagram (10^9g= 10^3t)
GIZ	(Die Deutsche Gesellschaft für Internationale Zusammenarbeit)German Society for International Cooperation
GW	Gigawatt (10^9 Watt)
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KW	Kilowatt (10^3 watts)
LEPL	Legal Entity of Public Low
LLC	Limited Liability Company
LPG	Liquified Petroleum Gases
MW	Megawatt (10^6 Watt)
Mg	Megagram (10^6g=1 ton)
NG	Natural Gas
N_2O	Nitrous oxide
SEAP	Sustainable Energy Action Plan
USAID	United States Agency for International Development
UNFCCC	United Nations Framework Convention to climate change in Eastern Europe

1 Introduction

The city of Akhaltsikhe is the administrative center of the Samtskhe-Javakheti Region of Georgia. It is situated in the Akhaltsikhe Hollow, at both banks of River Potskhovi, at the altitude of 1 000 m above sea level. Akhaltsikhe was proclaimed as a city in 1 840. The climate in Akhaltsikhe is temperate humid with moderate cold winter and warm summer, the mean annual temperature being 9 ^{0}C and annual sums of precipitation 508 mm.

Stages of development

The history of the city of Akhaltsikhe begins in the IX century, though in ancient sources this city is referred to as Lomisa. According to Ancient Georgia's history the city was built in IX century by the ruler of this Region Gwaram Mamphali. The left bank of R. Potskhovi is hilly and is occupied by the old part of the city, consisting of the district of Rabati and the large fortress, where the rulers of Akhaltsikhe used to live. The right bank of the river is flat and had been settled only in XIX century. This part of the city is also surrounded by hills. Some districts of the city are disposed at the slopes of these hillocks.

Picture 1. Akhaltsikhe, the Rabati Fortress

In Akhaltsikhe, apart from the Fortress and remaining inside it some constructions, old monuments by now actually do not exist. St. Mary's old church (in Rabati) has been rebuilt in 1865. In the new part of the city (at the right bank of R. Potskhovi), old-style houses are remarkable (some of them built one hundred years ago), notable with their flat roofing. These

houses are one-storey, undersized, with specific construction using wooden beams and broken stone walls inside.

Currently the city of Akhaltsikhe is an important transportation junction, being the industrial, agricultural and cultural center. In the old section of the city the fortress, palace, mosque, synagogue are preserved, as well as the Jakeli Landlords fortress (XIII-XIV centuries), St. Mary Church, the Samtskhe-Javakheti Historical Museum and the Akhaltsikhe Cathedral.

Socio-economic development and culture

Population and employment

According to the Akhaltsikhe City Hall information, the population of the city as of January 2014 made 20.5 thousand. At this stage Georgia's National Statistics Office has no specific data on Akhaltsikhe, as this city has acquired the self-governing status only since 2014. However, judging upon the information given by the Akhaltsikhe City Hall, number of population for recent years is more or less stable. Yet there is no official statistics on the employment in the city. According to the City Hall approximate data, the percentage distribution of employment among the city population is as follows:

- Non-production sector (financial, state management and self-governance)- 5-7%;
- Production sector (agriculture, hunting, construction, trade, hotels and restaurants, transport, etc.)- 23-30%;
- Self-employed- 7-13%;
- Unemployed- 41-21%[1]

At present 8 public schools and 8 kindergartens are functioning in Akhaltsikhe.

The refugees from Abkhazia and South Ossetia also live in the city. According to the Georgia's Ministry of Refugees[2] and Social Services Agency[3], as of September 2014 the number of refugees in Akhaltsikhe made 264 and 92 families. Table below demonstrates the distribution of social aid recipients by groups in Akhaltsikhe Municipality, having total number of population equal to 39 000.

Table 1. Number of social assistance recipients by groups in the Akhaltsikhe Municipality

[1] Rest of population- Pensioners- 15-20%; Children- 9-10%.
[2] http://www.mra.gov.ge/
[3] www.ssa.gov.ge/

#	Types of social assistance in Akhaltsikhe	Number of recipients
1	Pension assistance	6 988
2	Social assistance	1 975
3	Livelihood assistance	1 714
	Total	**10 677**

Economy

The budget of Akhaltsikhe Municipality in 2015 made 11 085 973 GEL. Distribution of total budget according to programs is given in Table 2, which demonstrates the priority given to infrastructure development, making about 89% of overall spendings (see Figure 1).

Table 2. The Akhaltsikhe Municipality 2015 budget and its program distribution

#	Programs	GEL
1	Financing of representative and executive bodies	2 181 918
2	Defense, public order and security	104 856
3	Infrastructure development, rehabilitation and running	**5 959 009**
4	Education	1 269 500
5	Culture, religion, youth support and sporting	1 053 900
6	Public healthcare and social security	516 790
	Total	**11 085 973**

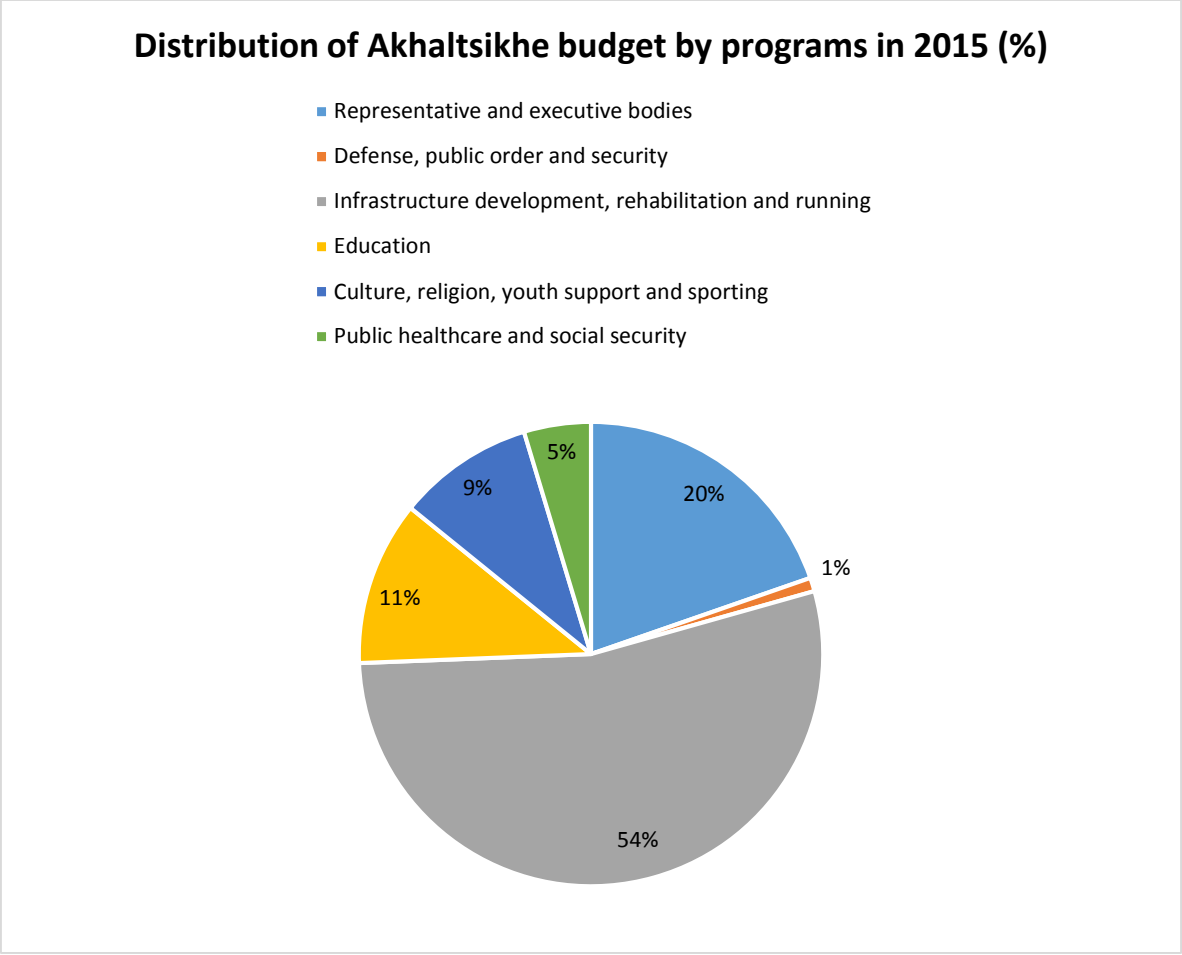


Figure 1. Percentage distribution of Akhaltsikhe Municipality budget by programs in 2015

As it has been mentioned above, Akhaltsikhe has obtained the self-governing status in 2014 and at this stage the volume of its GDP in not defined. Although, in this case as well, judging on statistics about Samtskhe-Javakheti Region as a whole, since 2009 the GDP of this Region has grown significantly: in 2009 its GDP constituted 477.4 million GEL, while in 2013 it made up 693.8 million GEL.

For Akhaltsikhe City Hall tourism represents a prospective sector of economy.

Picture 2. The restored street in the downtown Akhaltsikhe

The majority of tourists are interested with the fortress of Rabati and other historical monuments. Large portion of visitors is arriving from Germany, the Ukraine, Russia, France, Poland, Israel and the United States.

According to information provided by the Akhaltsikhe City Hall, in 2012-2014 the number of tourists in Akhaltsikhe varied within the following limits:

- 2012- 83 955 visitors, among them 7 300 foreigners
- 2013- 132 072 visitors, among them 17 866 foreigners
- 2014- 117 548 visitors, among them 14 803 foreigners.

Transport infrastructure. Against the background of globalization process going on in the world and thanks to Georgia's geostrategic location, the development of country's economy is directly linked with the orderly and efficient functioning of the transportation sector. In this respect the city of Akhaltsikhe plays an important role. Akhaltsikhe is connected by transportation lines with Georgian capital, using which the freight turnover is performed. Akhaltsikhe is the transit traffic city as well. In particular, transport coming in from the territory of Armenia gets across to Ajara via the Goderdzi Pass. Trailers guiding towards Azerbaijan and Armenia are coming in from Turkey, while transport directed to Turkey through the Vale custom-house has to cross the territory of the city.

Correspondingly, one of the main priorities of Akhaltsikhe City Hall is the development of transportation branches, their coordinated functioning, modernization and construction of transport infrastructure in compliance with the country jurisdiction and in harmony with international low. According to City Hall information 364 989 GEL has been allotted from the budget in 2015 for the road infrastructure development.

Akhaltsikhe- self-governing city, subscriber party to the CoM

According to the new Code on Self-governance statute, approved by the Parliament of Georgia[4], the city of Akhaltsikhe has acquired the status of self-governing city. The gaining of this status brings important changes in the form of city governance concerning its rights and responsibilities and mandate. The management of the city gets more freedom from the central government in decision-making process and in planning and developing the city within the limits of its own possibilities.

[4] https://matsne.gov.ge/ka/

Picture 3. Administrative building of Akhaltsikhe City Hall

After obtaining the status of self-governing city, the city of Akhaltsikhe has signed the CoM on 31 October 2014 and thus has taken a voluntary obligation to develop and implement within its administrative borders the SEAP, aimed at the reduction of GHG emissions to 2020 by at least 20%[5].

At the present stage Akhaltsikhe has no Strategic Development Plan.

2 The Energy Sustainable Development Strategy

The SEAP for the city of Akhaltsikhe includes measures in the sectors of Transportation, Buildings, Street lighting, Waste collection and Greening. This Plan presumably will serve as a basis for the Strategic Plan of Akhaltsikhe Development, which yet has to be worked out because Akhaltsikhe has become the self-governing city not long ago, only in 2014.

The presented version of Akhaltsikhe SEAP is prepared in 2015 and covers 4 years till 2020. It is to be taken into account that due to the short span remaining till 2020, the possibility remains for Akhaltsikhe not to be able to achieve the 20% emissions reduction goal and hence the reaching of this objective will be shifted to 2025.

Proceed from this, for main sectors discussed in the SEAP (Buildings, Transport) the emissions reduction strategy has been defined for two periods of time: short-term (2016-2018) and long-range (2019-2025) periods. Measures planned for the short span are concrete and detailed, while the activities projected for the long period are discussed in a more strategic sense and

[5] http://www.covenantofmayors.eu/about/signatories_en.html?city_id=4592

require additional survey, planning and technical and economic grounding. Such approach is in full compliance with the SEAP development Guidelines.

Based upon the 2014 base year GHG emissions inventory and CO_2 emissions projected growth parameters to 2020, in the frame of Akhaltsikhe SEAP the GHG emissions reduction sectorial strategy has been worked out for all sectors and main directions were defined.

Transport sector

In the Transport sector a number of strategic directions are discussed. These are:

- Creation of municipal public transport
- Improvement of road and transport infrastructure
- Working out of parking policy
- Encouragement of walking and cycling in the city.

In the short-term perspective the city plans to create the municipal transport enterprise, serving the town with well-planned routes and comfortable buses. It's anticipated that these buses will serve as an effective alternative to the travel on relatively long distances by private vehicles. For Akhaltsikhe putting in good order roads and the transport infrastructure is an important issue as well.
Apart from this, in the nearest future the City Hall plans to develop the parking strategy, establishing tariffs for private cars and taxis.
At the same time Akhaltsikhe City Hall will continue encouragement of walking in the city by improving walkable lanes, pavements and arranging more comfortable crossings.
In the long-range perspective the strategic vision of Akhaltsikhe Transportation sector focuses on the encouragement of cycling, being a healthy alternative to trips by taxis and private cars in case of short distances. Besides, it is important to transfer the transit road out of the city to avoid passing vehicles traffic at the territory of the city.

Buildings sector

According to Akhaltsikhe 2014 GHG inventory results, the share of emissions from Buildings sector makes 68% of total emissions, from which 67% belong to residential houses. Therefore, to achieve the 20% reduction of emissions it is of utmost significance to work out programs for residential sector, which will promote the application of energy efficiency measures and the use of renewable energies. At the same time it should be taken into account that as it is, the consumption of energy in Akhaltsikhe is low, the buildings are not warmed completely and majority of population are living in the state of energy poverty. Consequently, such programs require significant preparatory work to be done, including activities to identify outside financing from donors, specification of legislative basis and regulations to permit the Municipality to work

directly with the population. The Akhaltsikhe City Hall foressees that only 4 years remain from the development of this plan till 2020 and hence, to 2020 it may be impossible to accomplish all these programs and for this task more realistic seems to be 2025.
In the coming 4 years the Akhaltsikhe City Hall strategy considers the greatest support to the use of energy saving and renewable energies in municipal buildings to demonstrate their advantages for population and other commercial buildings. In addition to this, the popularization and facilitation of energy saving measures is planned for residential buildings which are relatively more organized and are engaged in the City Hall co-financing programs. To such buildings belong the dwellers cooperatives in the buildings.

At the same time, to achieve the emissions reduction targets it is highly valuable to conduct the energy efficiency and renewable energy introduction measures in private houses as well. The City Hall will elaborate specific programs for this task and will collaborate with state structures, as well as different funds and private organizations. In a long-run prospective the City Hall will care of to provide the city population and construction organizations with building standards based upon the local climate conditions and explain their importance in securing the heat/budget savings.

According to the SEAP strategy for the city of Akhaltsikhe the following measures will be implemented.

In the municipal buildings:

1. Thermal insulation of roofing in the library and kindergartens;
2. Application of solar collectors in kindergartens.

In the residential sector in a short-run perspective the City Hall will collaborate with the flat-owners cooperatives for the adoption of following measures:

1. Installation of sensory lighting in the entrances;
2. Thermal insulation of common areas in residential buildings.

In a long-run perspective the City Hall will work out programs and schemes to collaborate with the owners of private houses in introducing the following activities:

1. Facilitating in private houses such energy efficiency measures as the thermal insulation of roofs and decrease in infiltration;
2. Promoting the use of renewable energy sources (solar, biomass) in residential buildings;
3. Establishing of building standards (in cooperation with the Ministry of Economy and Sustainable Development of Georgia) relevant to Akhaltsikhe Region's climate conditions and raising awareness of general public and construction organizations on that matter.

In addition, there is another sector, no less important in the process of GHG emissions reduction- that is the city Street lighting sector.

Street lighting sector

In the outdoor illumination sector the arrangement of remote control and energy efficient consumption systems is planned, providing the saving of about 40% of energy.

Other sectors

Apart from listed above directions, the Plan also discusses the measure on the separation of paper from the solid waste collected in the city and the extension of greenery areas.

Summary of the SEAP

The methodology to work out Sustainable Energy Action Plan for the city of Akhaltsikhe does not imply the use of a baseline year, which can create obstacles for the process of city development and may hamper the city to fulfill its commitments.

The used methodology in the presented document provides envisaging the development perspective of the country and the selected city as well as inevitable growth of emissions to 2020 resulting from the increased demand on energy carriers. This increase is considered in the BAU scenario, in comparison to which the reduction of emissions is evaluated as a sequel of implementation of different measures and project proposals. The methodology for the development of BAU scenario is discussed in more detail in the Transportation Sector.

The GHG inventory summary results for 2014 and BAU projections for 2020 as well as savings resulted from the implementation of SEAP in Akhaltsikhe are presented in Table 3 and Table 4.

Table 3. Emissions of GHGs in Akhaltsikhe in 2014 and 2020 (tCO_2eq)

Sector	2014	2020 (BAU)
Transport	6 593	8 967
Buildings	14 110	19 189
Street lighting	68	111
Total	20 771	28 267

Table 4. GHG emission savings in different sectors according to Akhaltsikhe SEAP

Sector	Saving (tCO_2eq)	%

Transport	445	7
Buildings	5 019	81
Street lighting	67	1
Waste collection	520	9
Greening	135	2
Total	6 186	100

As it could be seen from these Tables, according to the Akhaltsikhe SEAP 6 186 tons of emissions in CO_2eq may be saved in 2020, making 29.8% of 2014 emissions and 21.9% of BAU scenario in 2020. It comes from the Table 4 that major part of savings (81%) is related with Buildings sector.

Figure 2 shows the distribution of sectorial emissions in 2014 base year, and Figure 3, Figure 4 and Figure 5 demonstrate the growth of emissions from different sectors in accordance with the BAU and SEAP scenarios.

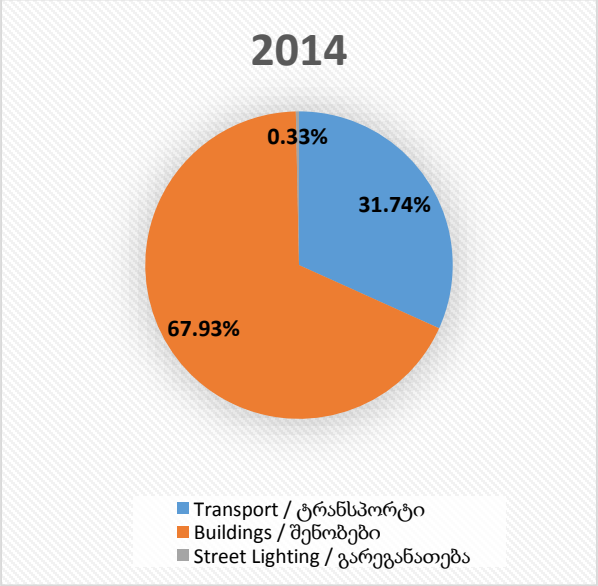


Figure 2. Distribution of sectorial emissions in 2014

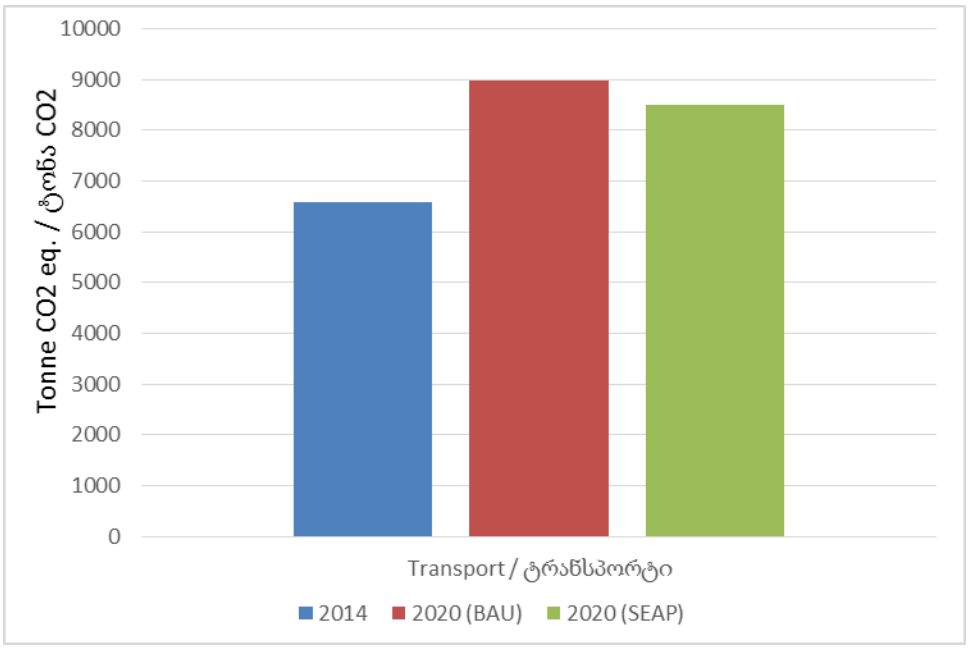


Figure 3. Growth of emissions according to BAU and SEAP scenarios in the Transport sector

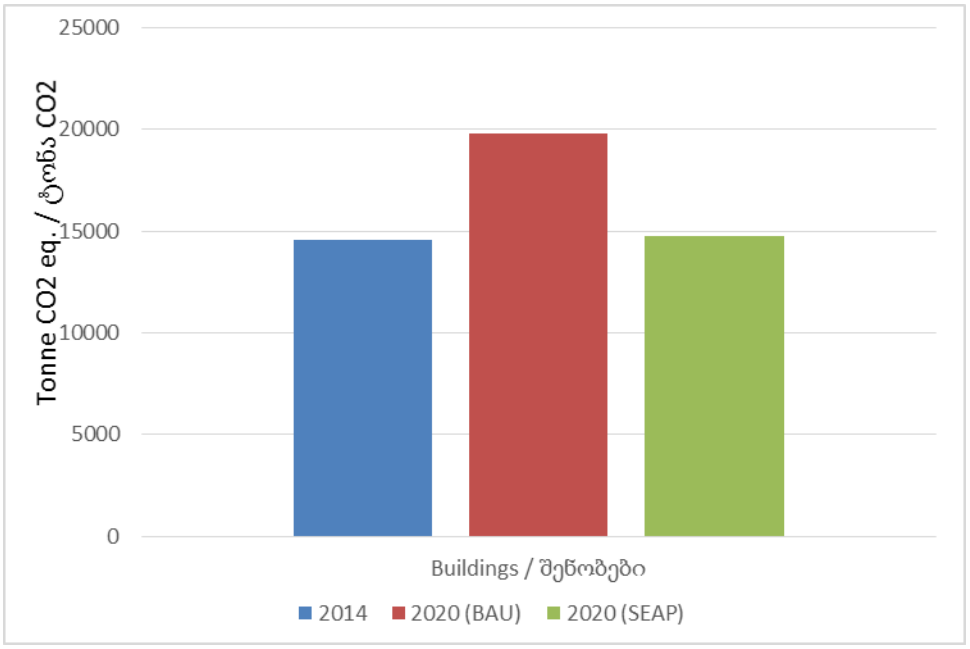


Figure 4. Growth of emissions according to BAU and SEAP scenarios in the Buildings sector

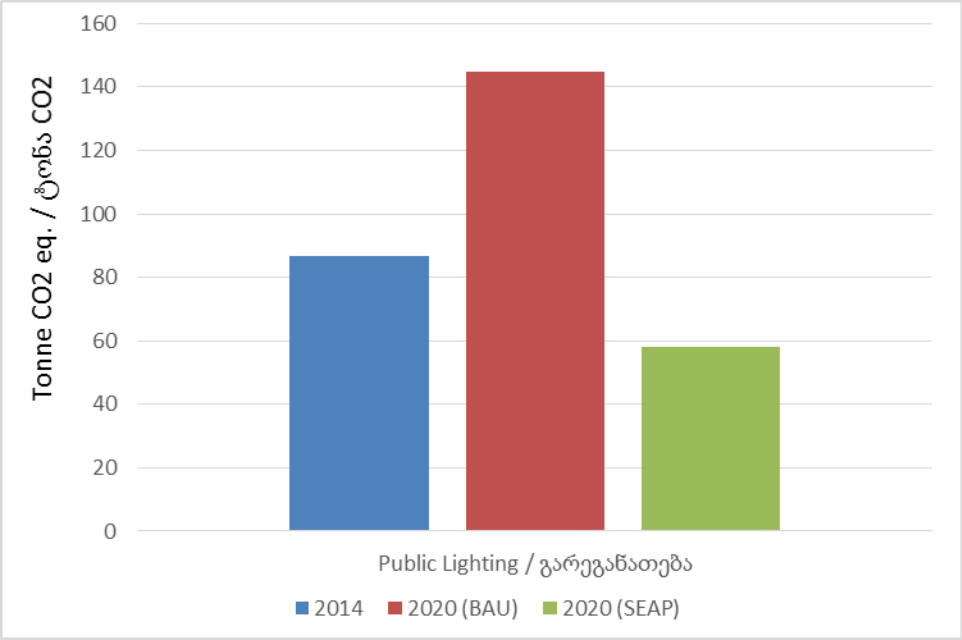


Figure 5. Growth of emissions according to BAU and SEAP scenarios in the Street lighting sector

3 Transportation

3.1 Overview of the sector

As it was mentioned above, the city of Akhaltsikhe is administrative, economic, political and cultural center of the Samtskhe-Javakheti Region. This is conditioned by convenient geographic location of the city, being at the crossroad between Kartli, Javakheti, Ajara-Imereti and Tao-Klarjeti. The highways coming from Turkey and Armenia are joining in Akhaltsikhe, making this city an important transportation junction. The city is permanently overloaded with the local or transit vehicles. The city is divided into 4 territorial units, presented on Figure 6.

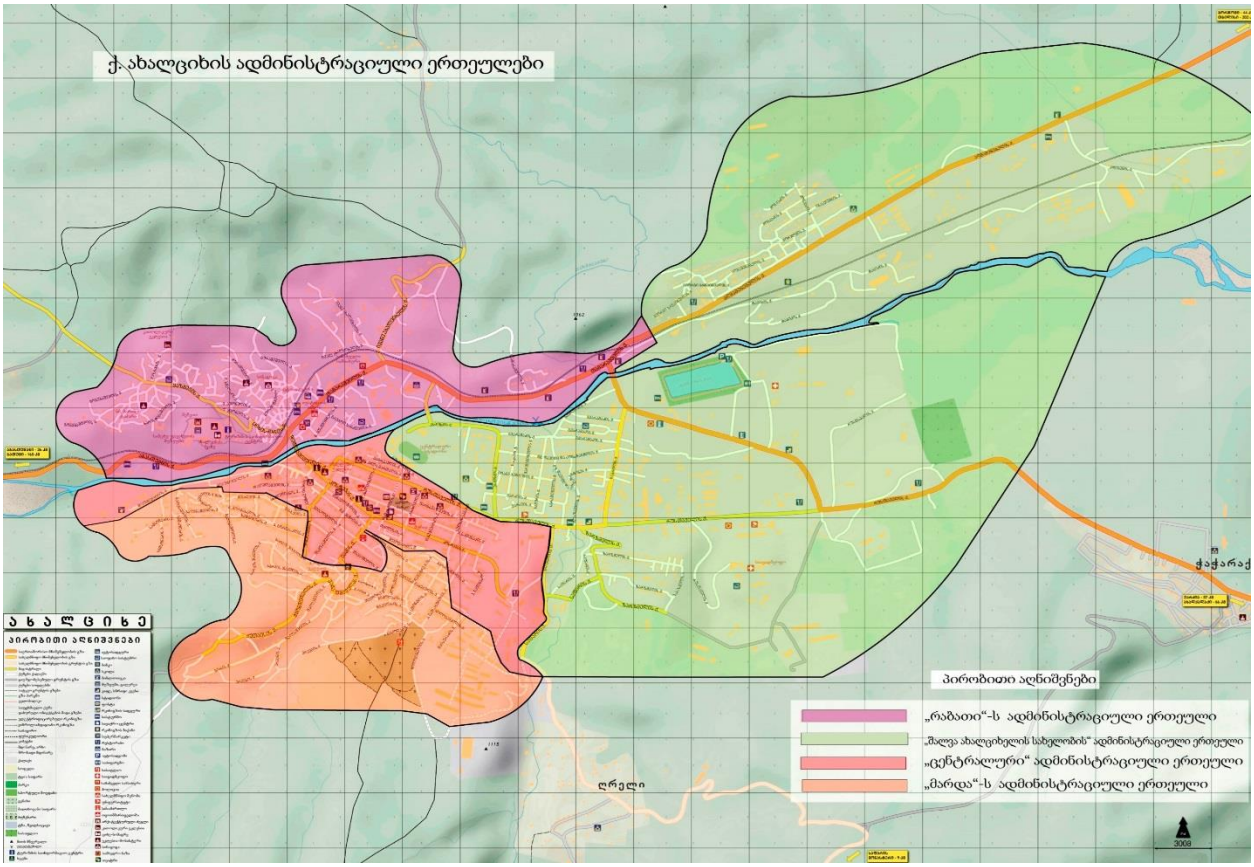


Figure 6. Administrative units of Akhaltsikhe

The disposition of the city, being at the crossroad of region's central and the state highways, and the lack of circuit road causes the daily traffic of vehicles riding through the Region at the territory of the city. Due to the proximity of Armenia, Turkey and Ajara the number of vehicles is always significant, additionally increasing on Sundays at the expense of farmers trading agricultural produce at the market.

Presently there are 95 streets, side-streets, blind lanes and highways at the territory of the city with the total length of 51.994 km, from which 49.35% (25.660 km) are coated with asphalt, 6% (8.92 km) are under rehabilitation and 26 km (19%) are planned to be restored.

Nowadays the majority of city population is travelling by taxi or private cars that is conditioned by the scarcity of public transport and small number of routes. Ensuing from the tourist potential of the Region and location of the city, the role of Akhaltsikhe as a tourist center of the Region is significant and in this context the unloading of the city from additional vehicles is of urgent necessity. Today a motorcar is not a luxury article, it is an object of everyday use. The number of cars has significantly increased since 2010. The earth and metal roads existing in the city and the growing number of vehicles are causing rising emissions in the city, pollution of the environment and the noisy discomfort in the streets.

According to 2014 data about 6 000 vehicles are driving daily at the territory of the city (including the transit automobiles).

17 petroleum filling and 2 gas charging stations are functioning at the city territory. At each large fuel filling station (Gulf, Rompetrol, Wissol, Lukoil, Socar) 1.5-2.0 tons of diesel and 2.5-3.0 tons of gasoline are sold daily, while during the tourist season (July, August, September) 2.5-3.0 tons of diesel and 3.5-5.0 tons of gasoline are put up for sale in a day. Hence, nearly 550-730 tons of diesel and 900-1 000 tons of gasoline are marketed annually in the city. At the same time small filling stations are trading in annually 100-150 tons of diesel and 250-450 tons of gasoline. However these data were not applied in the inventory because the merchandise fugues do not sufficiently reflect the traffic inside the city and part of the fuel sold is used for riding outside the city.

In the SEAP the movement of transport, registered at the territory of the city is discussed only. The detailed information on operating vehicles according to fuel type as of 2014 is given in Tables below. It should be mentioned that getting the required information turned out to be a complex task, as the Ministry of Internal Affairs possesses only summary data on vehicles registered in the whole Akhaltsikhe Municipality (including the Akhaltsikhe Community Municipality) and has no information concerning solely the city of Akhaltsikhe, as well as the data on the distribution of vehicles by fuel types. Therefore the Akhaltsikhe City Hall, under the assistance of EC-LEDS project experts undertook the survey of this sector for the whole territory of the City of Akhaltsikhe Municipality.

Nearly 6 100 families are living at the territory of City of Akhaltsikhe Municipality. The State and local authorities' bodies are concentrated at the city territory. The information has been gathered on the basis of questioning among bus stations, population, state institutions and fuel-filling stations at the territory of Akhaltsikhe City and Akhaltsikhe Community Municipalities.

Table 5. Permanently owned vehicles in Akhaltsikhe as of 2014

Type of vehicles	Passenger cars (except taxi and municipal transport)	Vehicles serving Municipality	Motorcycles	Minibuses (passenger)	Taxi	Light-duty trucks (capacity<2t)	Heavy-duty trucks

Number according to fuel type							
Gasoline operated	1 912	37	32	172	126	130	29
Diesel operated	1 327	7	0	168	31	112	73
NG operated	473	0	0	25	30	65	16
Total	3 712	44	32	365	187	242	118

Source: Questionings conducted by Akhaltsikhe City Hall and EC-LEDS project

The majority of cars belongs to models of OPEL, MERCEDES, BMW, MITSUBISHI, TOYOTA, SKODA, ZHIGULI, NIVA, UAZ, etc. Most largely consumed fuel is gasoline (51%), next comes diesel (37%) and finally- natural gas (NG) (12%) as an alternative fuel.

The public transport fleet at the territory of Akhaltsikhe City consists of 3 minibuses. The city transportation includes 3 inside the city, 54 intercity and 61 inside the Region routes.

Mentioned above 3 minibuses are operating daily from 9 a.m. till 6 p.m. with a half-hour interval. The length of the route makes 4.2 km. The cost of the trip equals to 0.20 GEL and another 0.20 GEL is subsidized by the City Hall. 1 shuttle minibus operates by turn.

To calculate fuel consumption by minibuses registered in the city only the vehicles driving inside the city on internal routes were used. The remaining transport operates outside the city, or is obsolete and is out of use. Number of minibuses operating in the city as of 2014 is given in the next Table.

Table 6. Public transport operating in the city in 2014

Vehicles	Buses	Minibuses
Operating on diesel	0	3

Source: Akhaltsikhe City Hall

The distribution cars (the route micro transport, refrigerators, etc.) are entering into the city and are driving to supply shops with different commodities. About 27 cars are driving daily in the city to distribute various products.

The data on fuel consumption by different types of vehicles and distance traveled by them, used to assess the fuel consumption are presented in Table 7.

Table 7. Features of the transport in Akhaltsikhe

Types of motor vehicles	Passenger cars (except taxi and municipal transport)	Vehicles serving Municipality	Minibuses (passenger)	Taxi	Light-duty trucks (capacity<2t)	Heavy-duty trucks
Annual run (km/vehicle)	4 138	17 317	12 045	17 280	28 235	3 613
Average fuel consumption per 1 vehicle Gasoline (l/100 km)	10.0	11.0	16.0	11.0	15.0	25.0
Average fuel consumption per 1 vehicle Diesel) l/100 km)	8.0	12.5	16.0	10.5	10.0	18.0
Average consumption of natural gas (m^3/100 km)	5.0			6.5	7.0	10.0

Source: Questionings conducted by Akhaltsikhe City Hall and EC-LEDS projects

3.2 Methodology

Same as for other sectors, the baseline year for the Transportation sector was chosen to be 2014.

The GHG emissions are calculated using formula adapted for the IPCC methodology Tier 1sectoral approach for the local level, which is based upon actual fuel consumption data:

Carbon Dioxide emissions $_j$ ($GgCO_2$)=

$\square\square_i$ {Actual fuel consumption ji (unit) x caloric value of fuel i(MWh[6]/per unit) x carbon emissions factor (TC/MWh)/1 000 x oxidized carbon portion i} x 44/12,
Where lower index refers to sector and lower index i - type of fuel.

Emissions for other gases with sector approach were calculated via following formula:
GHG emissions (GgGas) =

[6] Basic energy unit in IPCC methodology is Terajoule, while in the SEAP methodology it is MW/h, that is why MW/h is used in the text

☐☐i {Actual fuel consumption ji (unit)
x caloric value of fuel(MWh/per unit)
x Gas emissions factor ji(TGas/MWh)/1 000].

The IPCC typical values of carbon emission factors (carbon emission per energy unit) and transfer coefficient (fuel's heat of combustion, i.e. caloricity) have been considered for calculations since 1996.

Table 8. Transfer Coefficients and Carbon Emissions Factors for Different Types of Fuel

Type of Fuel	Unit	Transfer Coefficient (MWh/unit)	Carbon Emission Factor (Ton C/ MWh)
Gasoline	1000 liters	0.00950	0.247
Diesel	1000 tons	0.01070	0.267
Liquid Gas	1000 tons	0.01320	0.227
Natural Gas	1 million m^3	0.00935	0.202
Firewood	1000 m^3	0.00210	--

The average emissions factor for the electricity grid was applied equal to 0.104 $kgCO_2$/KWh according to 2014 data. A small portion of carbon in fuel is not oxidized during combustion but most is oxidized later in the atmosphere. It is assumed that non-oxidized carbon is stored indefinitely. Typical values of oxidized carbon recommended by the IPCC and used for 2006-2011 inventory are given in Table 9.

Table 9. Portion of Oxidized Carbon for Different Fuels

Fuel	Portion of Oxidized Carbon
Oil and Oil Products	0.990
Natural Gas	0.995

Different gas emission factors for the transport sector are given below in Table 10.

Table 10. Methane and Nitrous Oxide Emission Factors for Transport Sectors (kg/MWh)

GHG	Gasoline	Diesel	Natural Gas
CH_4	0.072	0.018	0.180

N_2O	0.0020	0.0020	0.0004

Global warming potential values (GWP) of these gases for converting methane and nitrous oxide into carbon dioxide equivalent are presented in Table 11.

Table 11. Global Warming Potential of Methane and Nitrous Oxide

Gas	Life Expectancy, Years	100-year GWP
CH_4	12±3	21
N_2O	120	310

A guidance document[7] has been developed by the Joint Research Centre (JRC) for the MGCe Eastern Partnership member cities, according to which these cities are given a choice to determine mandatory reductions of emissions through three alternative approaches:

1. Reduction for full emissions of fixed base year;
2. Per capita emissions reduction for fixed year emissions;
3. Reduction by Business As Usual (BAU) scenario for prospective emissions of 2020.

The Akhaltsikhe SEAP uses emissions reduction calculations for the BAU scenario. There are two options of scenario construction described by the guidance document:

1. The city can develop its own methodology, which will be evaluated by the JRC later;
2. The city may use national ratios indicated in the guidance document, developed for the Global Atmosphere Research (EDGAR) project CIRCE[8] employing an emissions database. The POLES (Prospective Outlook for the Long-term Energy Systems)[9] method has been used, which considers intensification of energy consumption due to population and economic growth. According to the baseline year, the BAU scenario calculates the level of emissions for 2020 assuming that current trends of

[7]HOW TO DEVELOP A SUSTAINABLE ENERGY ACTION PLAN (SEAP) IN THE EASTERN PARTNERSHIP AND CENTRAL ASIAN CITIES" — GUIDEBOOK, European Commission Joint Research Centre, Institute for Energy and Transport, Luxembourg: Publications Office of the European Union © European Union, 2013

[8] U.M. Doering, G. Janssens-Maenhout, J.A. van Aardenne, V. Pagliari (2010), CIRCE report D.3.3.1, Climate Change and Impact Research in the Mediterranean Environment: Scenarios of Future Climate Change IES report 62957. - A. Pozzer, P. Zimmermann, U.M. Doering, J. van Aardenne, H. Tost, F. Dentener, G. Janssens- Maenhout, and J. Lelieveld, Effects of business-as-usual anthropogenic emissions on air quality, Atmos. Chem. Phys. Discuss., 12, 8617-8676, 2012, doi:10.5194/acpd-12-8617-2012

[9]Russ, P., Wiesenthal, T., van Regenmorter, D., Ciscar, J. C., 2007. Global Climate Policy Scenarios for 2030 and beyond. Analysis of GHG Emission Reduction Pathway Scenarios with the POLES and GEM-E3 models, JRC Reference report EUR 23032 EN. http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1510

population, economy, technologies and human behavior will continue, and that no national measures will be taken towards a reduction of emissions[10].

For the city of Akhaltsikhe the second approach has been applied, i.e. JRC ratios, according to which the 2014 emissions will grow by 36% to the year of 2020.

Applying this method, an Excel-based software program, muni-EIPMP (municipal emissions' inventory, projection and mitigation measures planning), has been developed by the USAID funded "Enhancing Capacity for Low-Emission Development Strategies Clean Energy Program", which has been used for the development of Akhaltsikhe SEAP. Applying this program it is possible to produce the baseline scenario on the basis of JRC ratios as well as using any other national factors. Since at the time of Akhaltsikhe SEAP preparation the BAU national scenario has not been generated yet, the JRC coefficients were applied.

3.3 Base year (2014) inventory of Transportation sector and Baseline Scenario of the GHG emissions (2015-2020)

The structure of Akhaltsikhe Transport sector and the baseline year inventory are founded on 2014 data and include the following types of transportation:

- Municipal service vehicles;
- Public transport (minibuses and taxis);
- Private and commercial transport.

According to the SEAP development methodology, fuel consumption by navigation, air traffic and railway is not considered since travelling by above mentioned facilities is not within the city's territorial limits.

Energy consumption in the Akhaltsikhe Transport sector has reached about 26.1 thousand MWh in 2014 (Table 12).

Table 12. Final Energy Consumption of Akhaltsikhe Transport Sector (MWh) – 2014

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	0	159	649	808
Public Transport	320	650	2 307	3 277

[10]JRC Report, "An approach with a Business-as- Usual scenario projection to 2020 for the Covenant of Mayors from the Eastern Partnership", 2012. http://edgar.jrc.ec.europa.eu/com/JRC-IES_CoM-East_report_BAUprojections2.pdf

Private & Commercial Transport	984	8 412	12 624	22 021
Total	1 305	9 221	15 581	26 106

Emissions of GHGs from the Transport sector reached about 6.6 thousand tons of CO_2 equivalent in 2014.

Table 13. GHG Emissions from Akhaltsikhe Transport Sector in CO_2eq – 2014

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	0	42	162	204
Public Transport	66	172	575	813
Private & Commercial Transport	202	2 229	3 145	5 577
Total	267	2 402	3 720	6 593

As it has been mentioned above, according to JRC factors, in comparison to baseline year 2014, the GHG emissions to 2020 will increase by 36%. Correspondingly, in line with the BAU scenario, in 2020 emissions of GHGs from the Transport sector will nearly amount to 8.97 thousand tons in CO_2eq.

The growth of emissions from the Transportation sector is shown on Figure 7.

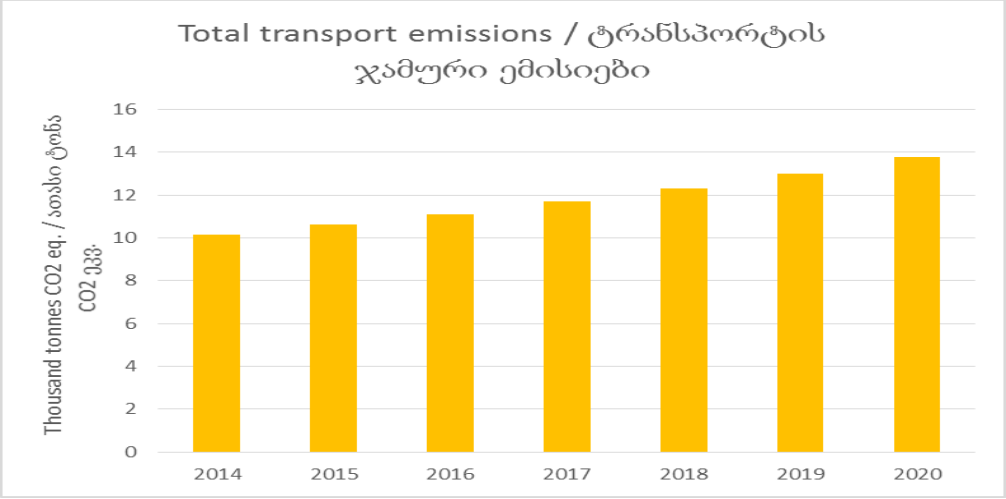


Figure 7. Trend of GHG emissions from Transportation sector according to BAU scenario.

3.4 Action Plan for the reduction of emissions from the Akhaltsikhe Transportation sector

The car ownership index in Akhaltsikhe is not high and makes 181 vehicles per 1 000 persons, being an average value for Georgia. Walking is relatively often in the city. At the graph below the results of questioning undertaken by the EC-LEDS project in different cities of Georgia are presented (Figure 8). The graph indicates number of respondents, who answered "Once a week or more" to the question: "How often do you walk in the city to working place, shopping or other everyday matters?"

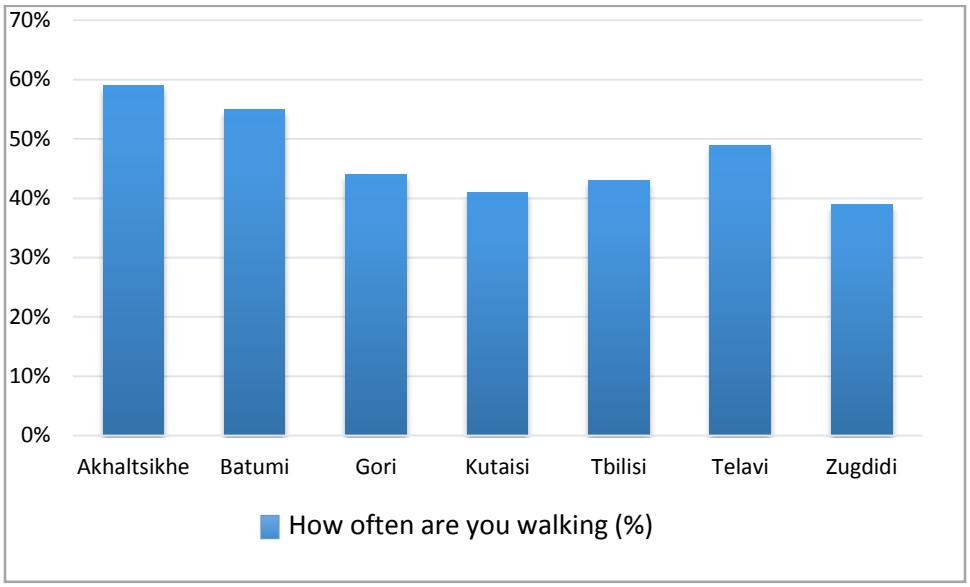


Figure 8. Assessment of walking on daily cares in different cities of Georgia.

The use of taxi is popular as well, because due to short distances it is relatively cheap. Hence, in case of Transport sector the strategic view considers the restriction of private cars driving in the city that could be achieved by creation and promotion of alternative means of travel including the development of public transport and providing its comfortability, encouragement of walking and cycling in the city.

Akhaltsikhe became a self-governing city in 2014. Until then it was the part of Akhaltsikhe Municipality and it had no right to regulate public transport on its territory. The public transport was controlled by private sector, establishing the routes and other issues of transportation policy. After obtaining the self-governing status the city of Akhaltsikhe was entitled to regulate public transport on its territory and therefore this direction has gained highest priority in the SEAP.

Resulting from the implementation of measures envisaged by the Akhaltsikhe SEAP the emission of CO_2 from Transport sector, compared to baseline scenario, will be reduced by 445 tons in

CO_2eq to 2020. All measures will be executed by the Akhaltsikhe Municipality City Hall Urban Planning and City Economy Department.

Table 14. Action Plan of Transportation sector

Sectors and activity areas	Main measures in separate sectors	Responsible Department, person or company (in case of third party involvement)	Dates of start and ending	Cost	Expected energy saving (MWh)	Anticipated CO_2 emission reduction (ton)
Public transport	Activity PT1: Creation of municipal public transport network and planning of routes	Akhaltsikhe City Hall Urban Planning and City Economy Department	2015-2017	295 000 GEL	550	136
Transport and road infrastructure	Activity UP1: Restoration and development of transport and road infrastructure	Akhaltsikhe City Hall Urban Planning and City Economy Department	2015-2020	---	355	90
Private transport	Activity PRT1: Encouragement of cycling and walking	Akhaltsikhe City Hall Urban Planning and City Economy Department	2015-2020	---	654	164
	Activity PRT2: Arrangement of parking system	Akhaltsikhe City Hall Urban Planning and City Economy Department	2015-2016	29 000 GEL	218	55
Total					**1 777**	**445**

3.5 Detailed description of measures

Activity PT1: Creation of municipal public transport network and planning of routes. The measure considers the purchase of buses to replace the shuttle taxis. At the same time the bus stop-stations will be arranged and public transport popularization campaign will be conducted.

The anticipated planning of routes is given in Table 15.

Table 15. Planning of bus routes

Destination of route	Length of the route, Km	Number of stops	Average duration of trip (min)
Central streets	9	9	30

The required number of buses and anticipated cost of purchase are presented in Table 16.

Table 16. Number and cost of buses

Number of routes	1
Frequency of bus arrival	Once in 30 min
Working hours	08:30- 18:30
Number of buses at the single route	2
Total number of buses (basic)	2
Approximate cost of 1 bus (GEL)	50 000
Expected total cost of buses (GEL)	100 000

Details of bus stops arrangement are given in Table 17.

Table 17. Arrangement of bus stops

Number of routes	Total number of stop-stations	Approximate cost of arranging one stop	Expected total cost of stop-stations arrangement
1 route	5 stops are to be arranged	6 500 GEL	32 500 GEL

It should be mentioned that out of 9 stops 4 stations are already being arranged. The picture below demonstrates passenger transport stop-station at the territory nearby the Akhaltsikhe bus station, constructed with metal framework having ornamental concrete plating at the floor.

Picture 4. Passenger transport stop-station at the Akhaltsikhe bus station neighboring territory

To calculate the emissions reduction it has been assumed that by this measure the movement of private transport (including taxis) will be decreased by 3% and the driving of public transport will correspondingly grow, providing the reduction of emissions compared to baseline scenario by 164 tons to 2020. At the same time the shuttle minibuses will be excluded, additionally discounting emissions by 16 tons, while emissions from buses will count for 44 tons, giving in total saving of 136.42 tons annually.

Activity UP1: Restoration and development of transport and road infrastructure

This Activity contains the following measures:

- Rehabilitation of road infrastructure
  - A number of infrastructure projects are being implemented at the territory of the city: The asphalt cover is being laid at the streets of Kutaisi, Takaishvili, Mikutishvili, Gogebashvili, Guramishvili and Ivane Akhaltsikheli (in total 4 637 m). The rehabilitation of streets all in all costs 1 796 423 GEL. The coating of streets with asphalt will continue further.
  - At the same time the restoration of damaged part of asphalt coating at the territory of the city is going on. The cost of repair works on filling the pits as of 2015 makes 140 000 GEL.
- Inventory and setting up of road signs and traffic lights

  - In this direction first of all should be resolved the problem of management- which body will be responsible for running these works and following this the inventory and control of traffic lights and road signs will be undertaken.
- Study of problematic streets (most frequently jammed by overloading) in the city and identification of alternative routes, setting up of new passages.
  - The existing in the city routes and roads will be re-examined and modified to alleviate traffic in the city and decrease traffic jams. E.g. some streets will be transformed to one-way movement (Manvelishvili Street) and the transport will drive in opposite direction on the parallel street.
- Construction of new streets and bridges
  - In 2015 the construction of a new bridge (costing 122 000 GEL) is planned, connecting the Gvaramadze street with the center, which shortens by 1.5-2 Km the route, joining the April 9 Settlement with the market-place.

The realization of GHG emissions reduction potential, directly related with the traffic management and the improvement of road infrastructure is a complicated and contradictory process. The curtailing of traffic will result in the lessening of GHG emissions from individual vehicles as they will be able to move more efficiently. However this may not result in the reduction of overall emissions, because the downsizing of traffic makes the use of private cars more attractive that from its part again causes the rising of emissions. Thus, these measures and related with them reduction of emissions may be discussed in the context of wider transportation strategy coupled with other measures discussed in this document.

According to the performed assessment of emissions reduction, it was assumed[11] that as a result of introduction of all listed above measures the distance covered annually by all types of motor-cars could be decreased to 2020 by 1% that will bring the cutback of emissions by 90 tons in CO_2 equivalent.

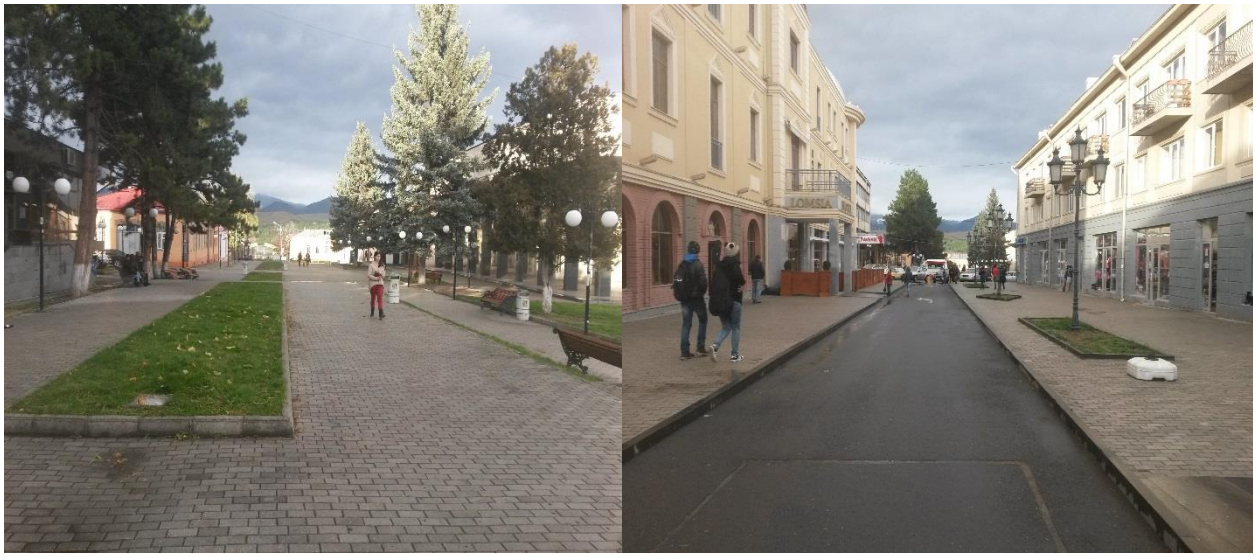
Activity PRT1: Encouragement of cycling and walking

In small cities cycling and walking is one of the most effective and, that is more important- healthy alternative to road transportation. However, it faces significant barriers, one of the main obstacles being the affection of population towards the motor-car and its perception as a criterion for social status definition. Therefore it is momentous to surmount this stereotype and demonstrate more vividly the advantages of walking and cycling. For the popularization of this kind of travelling the conduction of campaigns is essential, in which it should be performed as an up-to-date, European and effective approach to taking a trip, as well as to preserve the healthy environment in the city.

To facilitate pedestrians the Akhaltsikhe City Hall will continue taking measures for the arrangement of pavements and crossings to ensure comfortable and safe conditions for walking.

[11] The assumptions are obtained by comparing with measures planned in the Tbilisi SEAP and their assessments.

The improvement of running for disabled persons will be taken in account as well. Some streets will be closed to traffic and transformed into walkable areas. The model for this is the Queen Tamar Street, banned for road traffic.



Picture 5. The Queen Tamar Street

In a longer-term perspective the encouragement of cycling is examined not only for local residents, but for tourists as well. Relevant to cycling at this stage the arrangement of cycling tracks is planned in the vicinity of Mikutishvili Street Park and the lake. In the initial phase these tracks will be of recreational destination only. As to integration of cycling lanes in the city as a whole, this issue requires preliminary study, because the streets in the city are narrow and cycling tracks will contract them for transportation. Hence, these lanes should be strategically planned.

For the successful implementation of these measures the conduction of programs aimed at the modification of behavioral norms among the population is essential. In the frames of these programs the advantages of walking and cycling by motor-bike against the driving of car should be explained. One of steps taken in this direction is the cycling contest, organized at the territory of Akhaltsikhe City Hall LEPL "Akhaltsikhe Lake" in summer 2015, aimed at the popularization of cycling among the youth and introduction of healthy way of life.

Picture 6. Competitors of cycling race

To calculate the emissions reduction resulting from these measures it has been assumed that the walking and cycling measures will reduce the necessity of private car and taxi use by about 3%, that should provide the saving of nearly 164 tons of emissions.

The cost of the measure is not assessed here, as expenses on the parts of these measures are included in other activities. As to the inaction of programs on behavioral changes, the estimation of their cost is to be performed separately.

Activity PRT2: Arrangement of parking system

At present the development of parking policy for the city of Akhaltsikhe is being elaborated. Its main objective is relieving of the city (especially its central districts) from motor vehicles.

The arrangement of 29 parking grounds is planned, rated at about 500 automobiles. Parking sites will be located mainly at the central streets with the major traffic flow. These parking grounds also include parking sites for taxis. The parking system will include both subscription permits and an hourly payment. The parking payment for tourists will be higher than for local residents. The parking system will be managed by the LLC "Akhaltsikhe Municipality's Akhaltsikhe Lake".

The City Hall has allocated 29 000 GEL for the arrangement of parking system.

It is difficult to assess the efficiency of parking policy separately, without taking into account other measures. Although, according to the Guidelines on Mitigation measures in Transport

sector[12], the increase of expenses on car maintenance by 10% causes the decrease in the number of car owners by nearly 3%. Thus, as a conservative assumption it has been supposed that the parking policy would lessen the number of car owners only by 1%, that could save roughly 55 tons of emissions in CO_2eq annually.

4 Buildings

4.1 Overview of the sector

One of the most important parts of Akhaltsikhe SEAP is the Buildings sector which also includes municipal and other commercial buildings (offices, shops, hotels, etc.). One of the significant preconditions for the reduction of GHG emissions is the downsizing of energy consumption in these buildings and thus special attention should be given to measures directed towards the planning in them energy efficiency and renewable energy application measures.

Total fund of Akhaltsikhe buildings

Same to other cities, several types of buildings are disposed at the territory of the city of Akhaltsikhe- these are municipal, state and residential (individual houses and multi-storey) buildings. Residential constructions include two, three, four, five-storey structures, one eight-storey and one nine-storey building under construction. Buildings are mainly constructed in 1950-1970es. Private residential houses are predominantly one and two-storey. 10-12% of private houses belong to the beginning of XIX century construction. After the establishment of Soviet rule in 1920-es most part of these buildings were transferred to the city authorities and since 1992 their privatization has started.

The information on the Akhaltsikhe residential buildings is presented in Table 18.

The data were obtained on the basis of Public Register statistics and survey and inventory of city territory.

In Akhaltsikhe the walls of private residential houses are usually built of stones, bricks and blocks with wooden beams inside them, while tin-plates and slate are used for roofing.

Table 18. The Akhaltsikhe residential buildings

Specification of buildings	Number of storeys	Numeric value	Number of entrances	Number of flats	Total area (m^2)
Multi-storey buildings	2	1	1	4	1 600

[12] Technologies for Climate Change Mitigation – Tranport Sector, UNEP Risoe Center, 2011. http://tech-action.org/

	2	46	2	370	36 800
	2	1	3	12	1 000
Total		**48**		**396**	**39 400**
	3	7	2	137	15 228
	3	1	3	10	1 800
	3	1	4	25	2 220
Total		**9**		**172**	**19 248**
	4	1	2	21	2 600
	4	5	3	152	30 132
	4	8	4	311	35 892
Total		**14**		**484**	**68 624**
	5	2	1	39	10 950
	5	15	2	348	97 970
	5	17	3	721	57 510
	5	13	4	616	142 580
Total		**47**		**1 724**	**309 010**
Gross Total buildings		**118**		**2 776**	**436 282**
Private residential houses	1	1 227		1 227	147 240
	2	2 097		2 097	482 310
Total private houses		**3 324**		**3 324**	**629 550**
Overall total		**3 442**		**3 442**	**1 065 832**

In residential buildings concrete blocks are used. The staff members of military subdivisions were living at the territory of the city. In 1950-1960-es the barrack-type two and three-storey buildings were constructed for them (the Vardzia, Danielashvili, P. Iberi, Zarzmeli, Adigeni streets), later privatized since 1992 and continues till now. In 1960-1970-es the 5 and 3-storey buildings were constructed of tuff (Kostava and Rustaveli streets) for generals, officers and frontier guards, being later privatized. In 1970-es the erection of cooperative residential buildings has begun using large-block construction technology, being privatized since 1992 as well. The second phase of private flats building was accomplished in 1980-es in the districts of so called "Cargo station", New settlement and the district of 9-th of April. These private 2-storey houses were made of tuff and stony material. It should be mentioned that in Buildings constructed in 1970-es and later the centralized heating systems were mounted, disintegrated after the collapse of the Soviet Union.

Since then the roofs of residential building had been replaced, but they have to be thermally insulated as well as the entrances, which have no doors and windows. In the apartments 40% windows are substituted with metal-plastic ones. As to individual private residential houses, the

roofs are to be replaced and thermally insulated, and nearly 50% of windows should be substituted by metal and plastic ones.

In 2014 the questioning of population has been conducted in the frames of USAID EC-LEDS/Clean Energy Program[13], the results of which are given below.

In Akhaltsikhe only 7.4% of population are heating their dwelling space completely. The rest of the population are heating the space only partially. At most 55% of existing dwelling areas in Akhaltsikhe are heated at the average rate. Majority of population uses firewood for heating. Information on the use of different energy sources for various purposes by the population is presented in Table 19.

Table 19. Energy sources applied for different purposes by Akhaltsikhe population

Applied energy sources		Electricity (%)	Natural gas (%)	Firewood (%)
Totally (%)		100	63	67
For heating (%)		2	32	65
For hot water supply (%)				
For cooking	Cold season (%)	24	55	54
	Warm season (%)	41	63	20

The same family may use for cooking several sources, so totals of relevant percentage exceed 100%.

The most popular scheme of heating consists of independent heating of one or several rooms with different means: stove, chimney-corner, electric heater, etc. (84%).

Only 4% of Akhaltsikhe population keep the heating all-day-round. Those who operate the heating system in "on-off" regime, are warming the space daily for 10 hours on the average.

99% of population in Akhaltsikhe own a TV set, 86%- a fridge and 79%- a washing machine. According to 23% of respondents, in winter season they are switching off the fridges for saving expenses.

[13] "EC-LEDS Knowledge, Attitude and Behavior Baseline Survey", USAID's "Enhancing Capacity for Low Emission Development Strategies (EC-LEDS) Clean Energy Program", prepared by Winrock International Georgia, August 2014.

In Akhaltsikhe the average family uses 7 bulbs, the majority of which are of ordinary (incandescent) type, and only 5% of them managed to transfer to energy efficient lamps. Nearly the third of population (27%) simultaneously uses both the traditional and energy efficient lamps.

Apart from residential buildings, the state and municipal constructions are disposed at the territory of the city, as well as commercial buildings of different type (restaurants, café-bars, hotels, shops, salons, fuel-charging stations, banks, bus-station, covered market, bakeries, pharmacies, various workshops and factories, etc.).

The Akhaltsikhe Municipality owns 20 buildings with the total area of 21 945 m^2, including 8 kindergartens. The list of kindergartens is given in Table 20 and that of remaining buildings- in Table 21.

Table 20. List of kindergartens under the authority of Akhaltsikhe Municipality

No of kindergarten	Plot area (m^2)	Area of building (m^2)	Number of storeys	Total area (m^2)
1	548	503	1	503
2	1 024	220	1	220
3	2 911	435	2	870
4	3 163	649	1	649
5	5 151	519	2	1 038
6	1 648	357	1	357
7	3 888	835	2	1 670
8	2 246	509	1	509
Total				**5 816**

Table 21. Other constructions under the authority of city of Akhaltsikhe

Name	Plot area (m^2)	Area of building (m^2)	Number of storeys	Total area (m^2)
Music school	1 070	936	2-3	3 210
Sports school	10 257	1 200	1	1 200
Palace of culture	192	385	1	385
House of rituals	813	352	1	352
Commissariat building	943	659	1	659
Administrative building	3 102	1 120	3	3 863
Administrative building	3 696	1 622	3	2 754
School (temporarily inoperative)	4 089	1 038	1	1 038

Fire-brigade	2 380	428	1	428
Fire-brigade	2 881	494	2	989
Non-residential	34 096	266	2	532
Library	280	252	2	720
Total	**63 799**	**8 753**		**16 128.8**

From kindergartens three of them are in good state: the roof is replaced, window and door frames are of metal and plastic, buildings are repaired, heated by centralized systems, supplied with hot water. From the remaining 4 kindergartens three are in a breakdown state and require complete rehabilitation and one could be repaired. The attics and entrances of kindergartens and other municipal buildings have to be thermally insulated, window and door frames partially need to be replaced.

Besides, there are state- owned buildings (e.g. schools, medical institutions) and commercial structures in Akhaltsikhe, the list of which is given in Table 22.

Table 22. Incomplete list of functioning in Akhaltsikhe state-owned and commercial buildings

№	Name of realty	Number	Area, m^2
1	Public school	8	44 346
2	Medical institution	14	17 775
3	Hotel	27	86 367

Commercial buildings of other type, due to lack of information, are not cited here.

Energy consumption by Buildings sector in Akhaltsikhe

The distribution of electric energy in Akhaltsikhe is performed by the company "Energo-Pro Georgia" and of natural gas- by the company "Inter Gas". From 2014 the gas distribution company "Socar" also began functioning in the city. The information on energy consumption in buildings was gathered by the Akhaltsikhe City Hall under the assistance of EC-LEDS project experts. The obtained information is presented in Table 23.

Table 23. Energy resources consumed by Buildings in Akhaltsikhe residential and non-residential sectors in 2014

Buildings subsector	Electricity (KWh)	Natural gas (thousand m^3)	Firewood (m^3)
Residential	9 680 640	3 710	24 450

Municipal	328 400	128	210
Other state and commercial buildings	3 555 700	2 011	1 930
Total	13 564 740	5 849	26 590

4.2 Methodology

The methodology for calculating CO_2 baseline (2014) emissions and future trends (up to 2020) for the Buildings sector is the same to methodology described in the Transport sector, including carbon dioxide emission factors and transfer coefficients, as well as methane and nitrous oxide emission factors resulting from incomplete combustion of fuel. They are taken from IPCC 1996 and are given below (Table 24).

Table 24. Methane and Nitrous Oxide Emission Factors for Buildings (kg/MWh)

GHG	Natural gas	Oil products	Firewood
CH_4	0.01800	0.036	1.080
N_2O	0.00036	0.002	0.014

As to the emissions reduction potential, resulting from the application of energy measures, its assessment was performed by selecting typical for Akhaltsikhe buildings, conducting energy audit for them and estimation of energy efficiency measures, then transposing these results to other buildings.

The energy audit of Akhaltsikhe typical buildings was undertaken using "Key Numbers" of the ENSI software. A Norwegian Consulting Company ENSI, founded in 1992, developed simple software "Key Number" for a quick calculation of energy characteristics that can be applied both for design rates of new buildings and reconstruction activities and for assessing energy-saving measures in existing buildings.

Today the actual running conditions of buildings in Georgia differ substantially from design/normative conditions. Thus, measured energy consumption may be higher than the one calculated e.g. due to water leakage or improper operation of a heating system; may be lower, e.g. due to heating or ventilation system shutoffs. Additionally, along with energy-saving measures, an owner might need to improve the microclimate in the building by installing a

forced air ventilation system or improving the existing system. All these will lead to an increase in energy consumption.

Due to the fact that in most cases "measured energy consumption" does not coincide with "estimated energy consumption", for getting the correct value of power saving it is necessary to use calculated values of energy consumption as a "baseline", which describes the building's energy consumption in comfort/smart conditions.

The estimation of energy consumption and based on it the assessment of CO_2 emissions from the Buildings sector can be performed by 3 different scenarios (E_1=E_2=E_3). First of them (E_1) is based upon obtaining annual data on energy consumption by Buildings sector from different sources (electricity, gas, firewood providers). The second scenario (E_2) is based on power consumption per unit of area, rated as a result of auditing buildings of different type, and the third (E_3)- is founded on per capita energy consumption defined as a number of population. Comparing the results obtained with these 3 scenarios the precision of acquired data could be established.

In line with the first scenario the statistics of consumed annually natural gas, electricity and firewood is got from the suppliers of these energy sources.

Values supplied in natural units (KWh, m^3, l) are transferred to KWh-s for executing mathematical operations (comparing, adding, etc.) with them (E_1, KWh/yr).

The **second scenario** (E_2) needs a detailed energy audit of different types of pre-selected "typical" buildings and an estimation of specific power expenditures (energy consumption per m^2, kWh/m^2yr) on heating, cooking and electricity use. An energy audit carried out with the ENSI method and the software format would allow us to determine the actual potential of energy-savings, involves a situational analysis and other measures to reduce energy consumption and CO_2 emissions.

To work out the SEAP for Akhaltsikhe, the detailed energy audit has been conducted in 2015, for which 8 different energy consuming buildings were selected. These are:

Akhaltsikhe No. 1 kindegarten

(14, Vardzia blind alley)

Akhaltsikhe No. 2 Public school

(18, Aspindza st.)

Akhaltsikhe clinic "Imedi"

(3, Akhalkalaki Highway blind alley)

Hotel "Prestige"

(76, Rustaveli st.)

Main Library

(1, Queen Tamar lane)

Private residential house

(2, Manvelishvili st.)

Two-storey residential building

(13, Vardzia st.)

Three-storey residential building

(37, Tamarashvili st.)

Four-storey residential building

(1, Shalva Akhaltsikheli st.)

Five-storey residential building

(42, Aspindza st.)

After identifying specific energy consumption in buildings the annual energy consumption (E_2, KWh/yr) on heating, hot water supply, cooking and use of electric appliances was defined for different types of buildings.

The third scenario of methodology (E_3) is based on statistical data about the number of population living in the selected dwelling area. Determination of per capita energy consumption (KWh/yr per capita) permits to calculate the annual energy consumption by the population (E_3, KWh/yr) in the area.

4.3 Base year (2014) inventory in Buildings sector and GHG emissions baseline scenario (2015-2020)

According to the SEAP development manual the Akhaltsikhe Buildings sector structure considers 3 subsectors: municipal buildings, residential buildings and other (commercial buildings).

Energy consumption by the Buildings sector in 2014 is given in Table 25.

Table 25. Final Energy Consumption in Akhaltsikhe Buildings Sector (MWh)-2014

#	Subsector	Electricity	Natural Gas	Firewood	Total
1	Municipal Buildings	328	1 218	438	1 984
2	Other (commercial buildings)	3 555	19 107	4 021	26 683
3	Residential buildings	9 681	35 243	50 933	95 857
	Total	13 564	55 569	55 392	124 524

Correspondingly, in 2014 GHG emission from the Buildings sector amounted to 14.5 tons in CO_2eq.

The emission factor for electricity is taken equal to 0.104 tCO_2/MWh that is grid average value in 2014.

Table 26. GHG Emissions from Akhaltsikhe Buildings sector (tCO_2eq) in 2014

#	Subsector	Electricity	Natural gas	Firewood[14]	Total
1	Municipal Buildings	34	245	12	291
2	Other (Commercial buildings)	370	3 850	109	4 328
3	Residential buildings	1 007	7 100	1 383	9 490
	Total	1 411	11 195	1 504	14 109

[14] From firewood only methane and nitrous oxide emissions resulting from incomplete combustion are examined.

According to BAU scenario calculations using JRC factors, to 2020 GHG emissions in the Buildings sector will grow by 36% and reach 19.2 thousand tons in CO_2eq. (Figure 9).

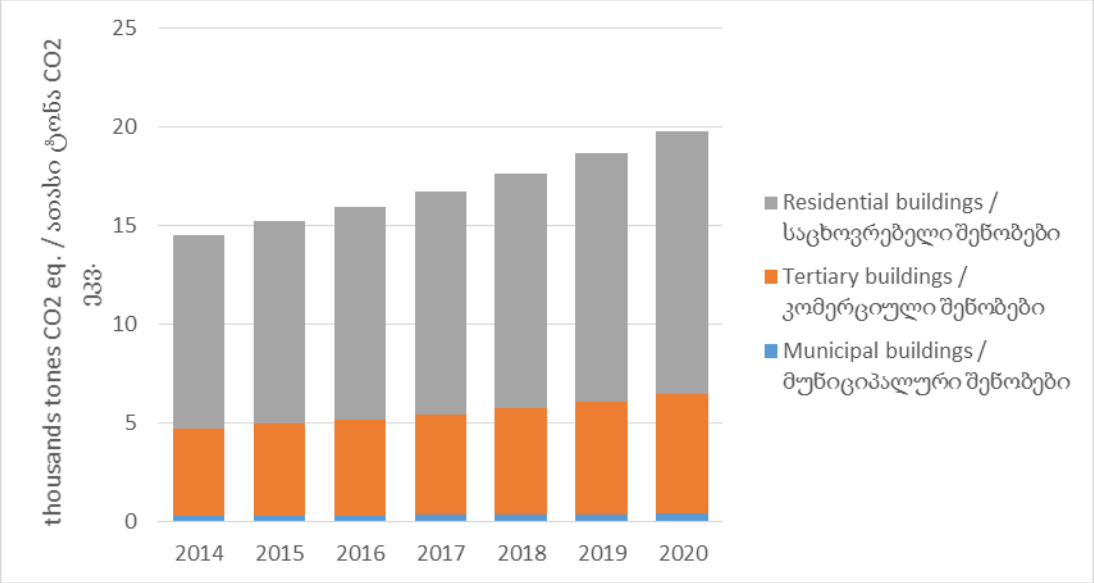


Figure 9. BAU scenario for Akhaltsikhe Buildings sector till 2020

4.4 GHG emissions reduction Action Plan for Akhaltsikhe Buildings Sector

As it could be seen from Table 26, 67% of GHG emissions from Akhaltsikhe buildings are released from residential houses. Therefore to achieve the 20% mark in emissions reduction, it is of utmost importance to develop in the residential sector programs, facilitating the introduction of energy efficiency and renewable energy adoption measures. At the same time it should be considered that as it is, the energy consumption in Akhaltsikhe is relatively low, the buildings are not completely heated and large part of population lives in energy poverty. Thus, such programs require carrying out of serious preparatory activities, working with donors in search of external financing, specification of legislative basis and regulations to enable the City Hall to work directly with the population. The Akhaltsikhe City Hall takes into consideration that in time of the preparation of this plan only 4 years remain till 2020 and hence it is possible that by 2020 all these programs could not be utterly operational. In this case the achievement of emissions reduction targets will be postponed till 2025. Nevertheless in the nearest 4 years the strategy of Akhaltsikhe City Hall envisages maximal substantiation of energy saving and use of renewable energies in municipal buildings to demonstrate the advantages of this approach to the population and other commercial groups. At the same time the energy saving measures will be popularized and promoted for the residential buildings, that are more organized and the co-financing programs to which the City Hall has already prepared – that is the building

cooperatives. At the same time the Sustainable Development Agency will be set up, one of the main functions of which will be the elaboration of energy efficiency and renewable energy programs for the population. The Akhaltsikhe City Hall has already considered in the 2016 budget necessary co-financing for the creation of this Agency.

Ensuing from this, according to the short-term (2016-2018) SEAP strategy for the city of Akhaltsikhe the implementation of following measures is planned.

In municipal buildings:

1. Thermal insulation of attics (in Library and kindergartens);
2. Application of solar collectors in kindergartens.

In the residential sector in a short-run perspective the City Hall will collaborate with cooperatives for the adoption of following measures:

1. Installation of sensory lighting systems in the entrances of residential buildings;
2. Thermal insulation of common areas in residential buildings;
3. Enhancing local capacity for the successful implementation of energy efficiency measures in the Buildings sector;
4. Setting up the Sustainable Development Agency, which will work on the development of special energy saving and renewable energy programs for the owners of private flats and houses and on the provision of co-financing from donors and state agencies.

In the long-range prospective (2019-2025) the Municipality will enact programs for introducing following measures in residential buildings:

1. Energy efficiency measures (thermal insulation of roofs, reduction of infiltration from the windows, etc.);
2. Encouraging application of renewable energy sources (heaters operating on biofuel).

The Action Plan for the reduction of GHG emissions from existing buildings is presented in Table 27.

Table 27. Action Plan for reducing GHG emissions from Akhaltsikhe Buildings Sector

Sectors and Activities	Key Measures in Activities	Responsible Department, Person or Company (if a third party is involved)	Implementation Period (Start and End Dates)	Expected Energy Saving from each Measure (MWh/yr)	Expected CO_2 Reduction (t/yr) from each measure	Cost of each Measure (GEL)
Municipal Buildings (MB)						

Activity MB1	Improving thermal insulation in Municipal buildings					
MB 1.1	Thermal insulation of attic in municipal building (the library)	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	26.9	5.4	3 555
Activity MB 2	Reducing infiltration in municipal buildings					
MB 2.1	Reducing infiltration in municipal building (the library)	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	44.2	8.9	8 000
Activity MB 3	Renovation of municipal buildings					
MB 3.1	Thermal insulation of attics in kindergartens (8)	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	361.6	72.8	67 560
Activity MB 4	Application of renewable energy resources for hot water supply					
MB 4.1	Application of solar collectors in kindergartens (8)	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	201.6	40.8	124 800
Residential buildings (RB)						
Activity RB 1	Installation of efficient lighting systems					
RB 1.1	Sensory lighting of entrances in residential buildings	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	204.7	26.8	10 590

Activity RB 2	Renovation of residential buildings					
RB 2.1	Thermal insulation of common areas in residential buildings	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	1 872	378.1	121 785
RB 2.2	Thermal insulation of attics in residential buildings	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	4 880	986	759 645
RB 2.3	Reducing infiltration from windows in residential buildings	Akhaltsikhe City Hall Economic Policy Agency	2016-2020	4 752	960	71 470
RB 2.4	Thermal insulation of ceilings in typical private houses	Investor and the owner	2016-2020	1 886	380	300 000
RB 2.5	Reducing infiltration from windows in typical private houses	Investor and the owner	2016-2020	587	120	8 400
Activity RB3	Application of renewable energy (biofuel) for heating in the Buildings sector					
RB 3.1	Application of high efficiency heat generator operating on bio-waste in private houses	Akhaltsikhe City Hall Economic Policy Agency	2015-2020	10 068	2 040	120 000
Total				24 884	5 019	1 595 805

Activity MB 1.1: Thermal insulation of attic in municipal building (the library)

The implementation of the measure is considered in the building of library, located at No. 1 Queen Tamar lane.

The expected energy saving as a result of enacting this measure makes 26 937 KWh, being an equivalent to 26 937/ (9.4*0.9) = 3 184 m^3/yr of natural gas. Accounting for natural gas tariff (0.81 GEL/m^3), the annual saving of expenses would be equal to 3 184*0.81 = 2 579 GEL. Consequently the reduction of CO_2 emission from the building will make 26 937*0.202/1 000 = 5.4 t/yr.

The required investment for thermal insulation of garret amounts to 237*15 = 3 555 GEL, where 237 m^2 stands for the ceiling area.
The profitability parameters of measure MB1.1 are given in Table 28.

Table 28. Profitability parameters of measure MB 1.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Thermal insulation of attic	3 555	1.5	65.3	5.26	5.4

Activity MB 2.1: Reducing infiltration in municipal building (the library)

The implementation of the measure is considered in the building of library, located at No. Queen Tamar lane.

The entrance door of the building opens arbitrarily even is case of rain, perceptibly affecting the temperature of the room as a result of infiltration. The arrangement of additional door in the entrance is envisaged with reservation of interim space.

The expected energy saving as a result of enacting this measure makes 44 249 KWh/yr, being an equivalent to 44 249/(9.4*0.9) = 5 230 m^3/yr of natural gas. Accounting for natural gas tariff (0.81 GEL/m^3), the annual saving of expenses would be equal to 5 230*0.81 = 4 236 GEL. Consequently the reduction of CO_2 emission from the building will make 44 249*0.202/1 000 = 8.9 t/yr.

The required investment for the measure amounts to 8 000 GEL.

The profitability parameters of measure MB 2.1 are given in Table 29.

Table 29. Profitability parameters of measure MB 2.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Reducing infiltration	8 000	2.1	47.6	3.57	8.9

Activity MB 3.1: Thermal insulation of attics in Kindergartens

The saving of energy resulting from this measure has been calculated using the ENSI software for the No. 1 kindergarten building located at the No. 14 Vardzia blind alley and turned to be 45 207 KWh/yr, bringing the consequent reduction of CO_2 emission by 45 207*0.202/1 000 = 9.1 t/yr.

In case of using natural gas as a source of energy, its annual consumption/expenditure will be 45 207/ (9.4*0.9) = 5 343 m^3/yr. Accounting for the cost of gas the annual expenses will make 5 343*0.81 = 4 328 GEL.

The investment required for the thermal insulation of garret is 563*15 = 8 445 GEL.

The profitability parameters of measure MB 3.1 are given in Table 30.

Table 30. Profitability parameters of measure MB 3.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Thermal insulation of attic in one kindergarten	8 445	2.2	45.1	3.33	9.1
These measures are considered for 8 kindergartens	67 560	2.2	45.1	3.33	72.8

Activity MB 4.1: Application of solar collectors in kindergartens

The solar energy collectors convert solar radiation into heat transferred then to water, which could be supplied to the building. The proposed measure aims to use solar collectors for supplying hot water to such municipal buildings as the kindergartens are. In kindergartens the daily expenditure of hot water makes on the average 4 000 liters, the heating of which requires 24 907 KWh of energy annually.

In Akhaltsikhe the solar collector produces annually 1 050 KWh/m^2 of energy. In case of using solar energy vacuum collectors, mounted at the roof of the building, from the total roofing area of 24m^2 annually could be obtained 25 200 KWh of energy.

The surface are of a standard solar collector equals to 2m^2 and it costs 1 300 GEL. In our case 12 collectors are needed, making the investment cost equal to 15 600 GEL.

To get the above mentioned energy (25 200 KWh/yr) from combusting the natural gas, its required volume will be 25 200/ (9.4*0.9) = 2 978 m^3 or in monetary calculation 2 978*0.81 = 2 412 GEL. The saving of CO_2 emission resulting from the transfer from natural gas to solar energy will amount to 25 200*0.202/1 000 = 5.1 tons annually.

The profitability parameters of measure MB 4.1 are given in Table 31.

Table 31. Profitability parameters of measure MB 4.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Application of solar collectors in 1 kindergarten	15 600	7.2	12.6	0.33	5.1
The same measure considered for 8 kindergartens	124 800	7.2	12.6	0.33	40.8

Activity PB 1.1: Sensory lighting of entrances in residential buildings

The data on Akhaltsikhe residential buildings are given in Table 32.

Table 32. Data on Akhaltsikhe residential buildings

#	Number of storeys	Number of buildings	Number of entrances	Number of sensors
1	2- storey buildings	24	48	48
2	3- storey buildings	7	15	30
3	4- storey buildings	11	40	120
4	5- storey buildings	44	127	508
	Total	86	230	706

According to monitoring results conducted in Tbilisi, electricity saving per one sensory lantern makes on the average 290 KWh/yr and the saving of emission- 38 kg/yr. These indices could be used for Akhaltsikhe as well.

Total number of entrances in the Akhaltsikhe Buildings sector makes 230 and the number of lanterns- 706.

Accounting for the number of sensors, total energy saving in Akhaltsikhe entrances will amount to 290*706 = 204 740 KWh/yr, being an equivalent in monetary expression to 204 740*0.16 = 32 784 GEL. The concominant reduction of emission will be equal to 709*38/1 000 = 26.8 t/yr.

The price of sensory appliance is 15 GEL and hence the total investment cost will make 15*706 = 10 590 GEL.

The profitability parameters of measure RB 1.1 are given in Table 33.

Table 33. Profitability parameters of measure RB 1.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Sensory lighting in entrances	10 590	0.3	309	11.25	26.8

Activity RB 2.1: Thermal insulation of common areas in residential buildings

The specific values of thermal savings from the common areas of residential buildings entrances makes approximately 2 000 KWh/yr per each cell of a storey.

Corresponding energy savings accounting for the number of residential buildings and entrances are presented in Table 34.

Table 34. Energy savings through the thermal insulation of entrances

#	Number of storeys	Number of buildings	Number of entrances	Energy savings KWh/yr
1	2- storey buildings	24	48	192 000
2	3- storey buildings	7	15	90 000
3	4- storey buildings	11	40	320 000
4	5- storey buildings	44	127	1 270 000
	Total	86	230	1 872 000

Total amount of energy savings makes up 1 872 000 KWh/yr, being an equivalent to 1 872 000/(9.4*0.9) = 221 277 m^3 of natural gas. In monetary expression this equals to 221 277*0.53 = 117 277 GEL annually. At the same time the emissions will be cut by 1 872 000*0.202/1 000 = 378.1 t/yr in CO_2eq.

The thermal insulation considers the insertion of metal-plastic windows into entrance frames at each storey. According to this measure mounting of 1.5 m^2 metal-plastic windows should be performed at 706 staircases, making in total an area of 706*1.5 = 1 059 m^2. The investment on windows will be tantamount to 115 GEL/m^2*1 059 m^2 = 121 785 GEL.

The profitability parameters of measure RB2.1 are given in Table 35.

Table 35. Profitability parameters of measure RB 2.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Thermal insulation of common areas in residential buildings	121 785	1.2	86.1	7.26	378.1

Activity RB 2.2: Thermal insulation of attics in residential buildings

Saving of thermal energy attained through the thermal insulation of garrets in residential buildings are taken from the results of conduced audits and are given in Table 36.

Table 36. Energy saving due to thermal insulation of attics in the buildings

#	Number of storeys	Number of buildings	Energy savings in one building, KWh/yr	Energy saving in all buildings, KWh/yr	Area of attic in one building, m^2	Area of attic in all building, m^2
1	2- storey buildings	24	26 622	638 928	268	6 432
2	3- storey buildings	7	35 829	250 803	368	2 576
3	4- storey buildings	11	41 736	459 096	425	4 675
4	5- storey buildings	44	80 251	3 531 044	840	36 960
	Total	86	-	4 879 871	-	50 643

Total amount of savings makes 4 879 871 KWh/yr of energy, resulting in the reduction of CO_2 emission by 4 879 871*0.202/1 000 = 986 t/yr.

The relevant saving of natural gas equals to 4 879 871/ (9.4*0.9) = 576 316 m^3, amounting to 576 816*0.53 = 305 713 GEL annually in monetary terms.

The demanded corresponding investment will be 50 643 m^2*15 GEL/m^2 = 759 645 GEL.

The profitability parameters of measure RB 2.2 are given in Table 37.

Table 37. Profitability parameters of measure RB 2.2

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Thermal insulation of attics in residential buildings	759 645	2.8	35.9	2.45	986

Activity RB 2.3: Reducing infiltration from windows in residential buildings

Due to the draughts the room is cooled quickly and for its heating a large amount of energy is needed. The cool air flows into the room from gaps in doors and windows, while warm air is pouring out. Therefore, the hermeticity of doors and windows must be provided, allowing to save about 25-30% of energy necessary for heating the room. The application of relatively simple and inexpensive methods are available to coat the gaps and crack on the doors and windows, or to fill them with silicon, scotch or putty. The consolidation of window frames with poloron, silicon or rubber has also proved to be effective.

Savings of thermal energy achieved by the reduction of infiltration in residential buildings are taken from the results of conducted audits and are given in the following Table:

Table 38. Energy saving by reducing infiltration in the buildings

#	Number of storeys	Number of buildings	Energy saving in one building, KWh/yr	Energy saving in all buildings, KWh/yr	Window areas in one building, m^2	Total area of windows, m^2
1	2- storey buildings	24	11 718	281 232	55	1 320

2	3- storey buildings	7	23 797	166 579	210	1 470
3	4- storey buildings	11	36 908	405 988	307	3 377
4	5- storey buildings	44	88 601	3 898 444	672	29 568
	Total	86	-	4 752 243	-	35 735

Overall saving of energy, acquired through the reduction of infiltration for the buildings, given in the Table, reaches 4 752 243 KWh/yr, being an equivalent to 4 752 243/ (9.4*0.9) = 561 731 m^3 of natural gas. In monetary expression this saving gives 561 731 m^3 of natural gas. In monetary expression this saving gives 561 731*0.53 = 297 717 GEL per annum and in emissions reduction 4 752 243*0.202/ 1 000 = 960.0 t/yr.

With this measure nearly 35 735 m^2 of windows area should be sealed up with corresponding investment 2 GEL/m^2*35 735m^2 = 71 470 GEL.

The profitability parameters of measure RB 2.3 are given in Table 39.

Table 39. Profitability parameters of measure RB 2.3

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Reducing infiltration	71 470	0.3	372.4	34.7	960

Activity RB 2.4: Thermal insulation of ceilings in typical private houses

The saving of thermal energy procured by thermal insulation of ceilings in typical private houses is taken from the results of conducted audits and it makes 9 429 KWh/yr, resulting in the reduction of CO_2 emissions by 9 429*0.202/1 000 = 1.9 t/yr per one house.

The consequent saving of natural gas will be equal to 9 429/ (9.4*0.9) = 1 114 m^3, being an equivalent to 1 114*0.53 = 590 GEL annually in monetary terms:

The required investment will be 100 m^2*15 GEL/m^2 = 1 500 GEL.

The profitability parameters of measure RB 2.4 are given in Table 40.

Table 40. Profitability parameters of measure RB 2.4

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Thermal insulation of ceiling in a typical private house	1 500	2.8	35.3	2.39	1.9
Thermal insulation in typical private houses (200)	300 000	2.8	35.3	2.39	380

Activity RB 2.5: Reducing infiltration from windows in typical private houses

This measure is the same to the Activity 2.3 described above. The energy saving attained with this measure in a two- storey private residential house (No. 2 Manvelishvili st.) was computed using the ENSI software and turned out to be 2 937 KWh/yr, giving the CO_2 emission reduction by 0.6 t/yr.

The corresponding saving of natural gas per one house approximately equals to 2 937/ (9.4*0.9) = 347 m^3, making 347*0.53 = 184 GEL annually.

Under this measure about 21 m^2 of windows should be sealed up with putty. The investment on windows will be 2 GEL/m^2*21 m^2 = 42 GEL.

Total saving of energy from decreased infiltration from Akhaltsikhe private houses windows (200 private houses, being 6% of Akhaltsikhe private houses) makes 587 MWh/yr, and the corresponding emission reduction- 120 t/yr. The required investment equals to 200*42 = 8 400 GEL.

The profitability parameters of measure RB 2.5 are given in Table 41.

Table 41. Profitability parameters of measure RB 2.5

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr

Reducing infiltration	42	0.3	381	35.54	0.6
Private houses (200)	8 400	0.3	381	35.54	120

Activity RB 3.1: Application of high efficiency heat generator operating on bio-waste in private houses

The average energy demand on heating of typical two-storey private house in Akhaltsikhe equals to 50 338 KWh/yr. The reduction of CO_2 emission in case of the transfer from natural as to biomass amounts to 50 338*0.202/1 000 = 10.2 t/yr.

The implementation of this measure requires the investment of 600 GEL to purchase the energy efficient stove. In monetary expression the annual saving will make 50 338*0.06 = 3 020 GEL (0.09-0.03 = 0.06 GEL/KWh stands for the difference between prices of firewood and the gas).

Presumably, the results of the pilot project should be extended to 200 two-storey private residential houses. This will increase he share of renewable energy in overall energy consumption. The profitability features of the measure are presented in Table 42.

Table 42. Profitability parameters of measure RB 3.1

Measure	Investment cost, GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 reduction t/yr
Heating with biomass of one private house	600	0.2	503	47.2	10.2
Heating of 200 houses	120 000	0.2	503	47.2	2 040

5 Street lighting

5.1 Overview of the sector

In Akhaltsikhe there are 95 streets, 4 squares, Central Park, man-made lake, 5 small stadia, bridges, all of them requiring lighting. Besides, many sights are in Akhaltsikhe (Akhaltsikhe Historical Museum, Akhaltsikhe Fortress, Akhaltsikhe Theatre, etc.), which are illuminated from outside. As of 2014, 49.35% of Akhaltsikhe streets are gleamed.

Picture 7. Illuminated sights of Akhaltsikhe

Energy consumption and related expenses in the Akhaltsikhe Street lighting sector in 2014 are given in Table 43.

Table 43. Energy consumption and expenses on street lighting in Akhaltsikhe in 2014

Infrastructure facility	Electricity consumption (KWh)	Monetary expenses (GEL)
Akhaltsikhe street lighting	657 557	105 186.85
Total	657 557	105 186.85

As it comes from the Table, the energy consumption on street lighting in Akhaltsikhe in 2014 made a little bit less than 0.66 million KWh, costing more than 105 thousand GEL a year. The

number of streetlights in the city makes 1 496, the types and energy consumption of which are presented in Table 44.

Table 44. Parameters and features of lanterns, applied for street lighting and illumination of buildings in Akhaltiskhe

#	Lantern applied	Features	
		Capacity, W	Number
Street lighting			
1	Sodium- 4	45	300
2	Sodium- 70	70	510
3	Sodium- 85	85	175
4	Sodium- 150	150	481
5	Sodium- 400	400	30
	Total		1 496

5.2 Methodology

In 2014 the number of lanterns in the city made 1 496 units. The baseline scenario describes actual number of lamps in 2014, while considering the lighting of dark streets as well (up to 80% in total). Under this assumption the total number of streetlights will be 2 425. The baseline scenario assumes that additional lamps should be also inefficient sodium bulbs.

5.3 Base year (2014) inventory and GHG emissions baseline scenario (2015-2020) in street lighting sector

In 2014 the electric energy consumption in street lighting sector amounted to 657 557 KWh, being an equivalent to 68.4 tons in CO_2eq.

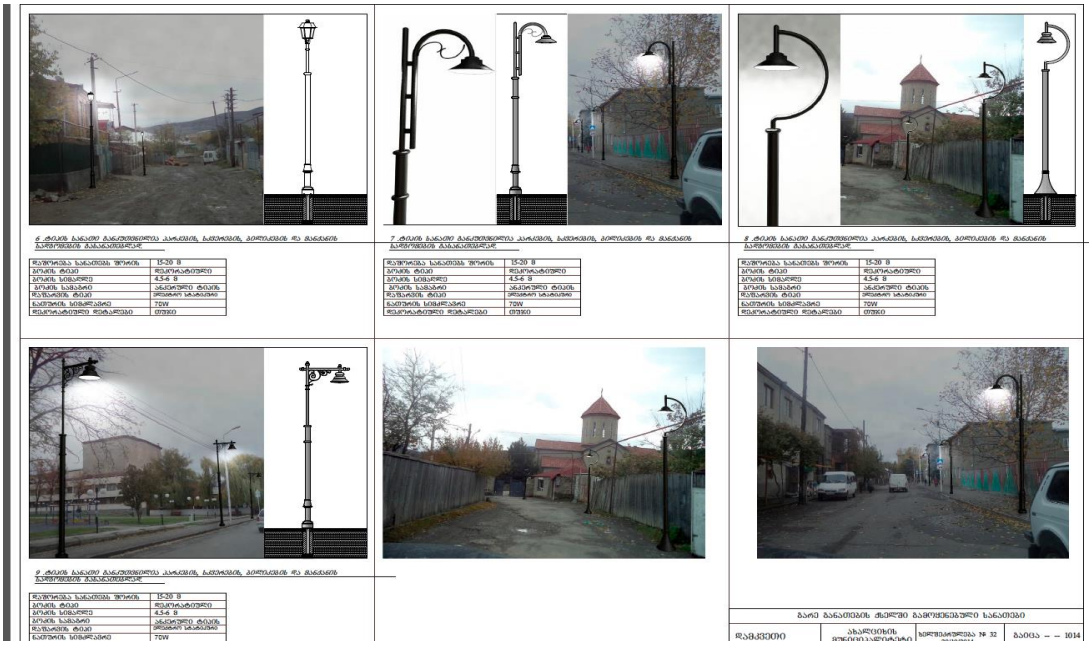
The value of emission factor for electricity is taken equal to 0.104 tCO_2/MWh, that is grid average emission factor for 2014.

According to baseline scenario the energy consumption by street lighting will grow in future and by 2020 will make up 1. 066 GWh, accompanied by the annual emission of CO_2 to 2020 equal to 111 t.

5.4 Emissions Reduction Action Plan for the Akhaltsikhe street Lighting Sector

At the present stage only one measure is planned in the Akhaltsikhe Street lighting sector, which considers rising energy efficiency by means of grid regulation. Apart from this, in the frames of EC-LEDS programme the project proposal has been developed on the increase of energy efficiency in the illumination of Rabati Fortress, which is not included in the SEAP and represents an additional measure.

Activity S1: At the territory of city of Akhaltsikhe Municipality the street lighting remote control and efficient consumption system will be set up, the implementation of which requires about 2 million GEL. The City Hall in 2015 has accomplished activities costing 450 thousand GEL on the replacement of street lighting network at the central streets of the city (Didimamishvili, Natenadze, Kostava, Nebieridze, Ketskhoveli, Sulkhan-Saba, King Parnavaz streets). In the frames of this project the saving of energy will be calculated on these streets, the results will be recalculated for the entire system and the substitution of old system by the new one will continue. The project also includes the arrangement of lighting in places, which were not illuminated earlier. During the implementation of this measure the saving of energy will be performed by regulating the street lighting system using the remote control technology. For running the street lighting system the Control Centre will be set up at the City Hall: The lighting will be lessened in night-time hours, the switch-offs will be enacted by turns, etc.



Picture 8. The Akhaltsikhe lighting remote control and efficient consumption system

It is assumed that the measure will continue till 2020 and the system will embrace both already illuminated streets (49.35% of total number of streets) and yet dark streets, as to lighten 80% of all streets by 2020.

In other countries the same measure provides the saving of energy consumption by 40-60% on the average.

The graph below (Figure 10) demonstrates the GHG emissions baseline scenario and emissions reduction in case of arranging the remote control and efficient consumption system, representing most priority measure of the SEAP in this sector. The following graph (Figure 11) clearly indicates benefits which could be obtained by Akhaltsikhe Municipality through the introduction of this measure in the energy consumption branch.

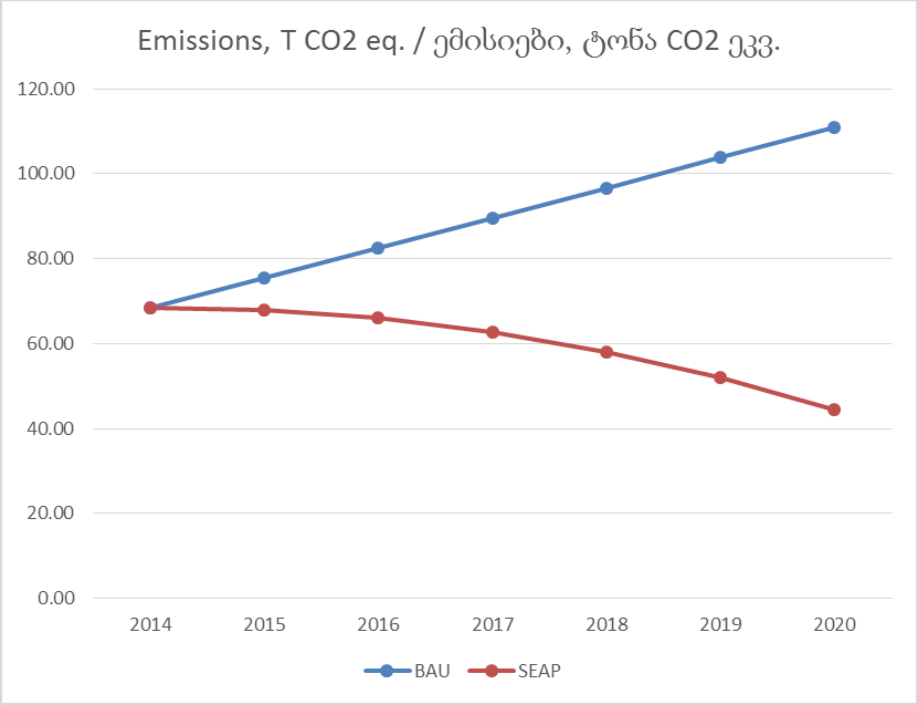


Figure 10. Emissions from the city Street lighting sector in case of BAU scenario and under the SEAP implementation

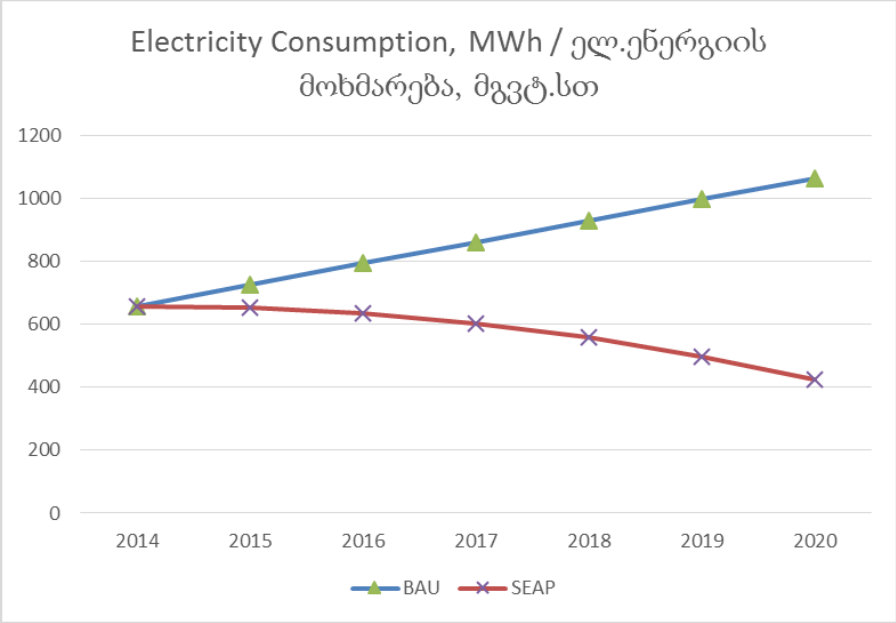


Figure 11. Energy consumption by the city Street lighting sector in case of BAU scenario and under the SEAP implementation

As a result of undertaken measure 640 MWh of energy and 67 tons of emission in CO_2eq will be saved by 2020.

6 Waste

6.1 Overview of the sector

In the Samtskhe-Javakheti Region, including the city of Akhaltsikhe, waste management represents one of the important environmental problems. In 2013 the Samtskhe-Javakheti Region's 2014-2021 Development Strategy has been approved, one of the strategic objectives of which is the introduction of waste management standards and provision of population and ecosystems safety, arrangement of landfills at the appropriate level and setting up of waste processing regional facility, adoption of waste registration and sorting management system[15].

In Akhaltsikhe the waste management more or less effectively runs since 1940-es. At that time part of waste in the city was incinerated by the population and the remainder thrown out into the river. Later the situation has gradually improved. Approximately till 1960-es the collection of waste in the city and its piling at the landfill was conducted by the City Council. The waste was delivered to the landfill twice a week. This old, 30-40m deep landfill with an area of 3-4 ha

[15] https://matsne.gov.ge/ka/document/view/2024564

now is closed down. In 1960-1970-es the official municipal landfill has started to operate in Chacharaki village and it remains there up to now. The village is located in 7 km to the south-east of Akhaltsikhe, surrounded with the arable land of population. For many years the landfill was not fenced, the waste was heaped chaotically at the open place and was scattered over the crops. The percolated water and diffused gases never had been controlled at the landfill[16] [17].

The Akhaltsikhe residential waste disposal site in the Samtskhe-Javakheti Region was transferred to the Georgian Solid Waste Management Company on 10 July 2013. Aimed at the improvement of the landfill and safe disposal of the waste the competition has been won by the LLC "Alianci" and according to Georgia's Regional Development and Infrastructure Minister's No. 78/0 Decree of 4 July 2013 the reconstruction of old landfill was undertaken. At present the landfill occupies 2 ha of territory[18].

During the reconstruction the following activities have been carried out: The territory was fenced with iron posts and wire netting; the entrance gate and a watch-box, the fire-brigade stand and traffic signs were arranged; the foundation has been prepared and a 60- ton weighing-machine for trucks was mounted; the store-house for mechanisms was constructed; the inclination of existing slope has been reduced and stabilized; a water-draining collector has been arranged; the insulation clay layer has been laid at the bottom; the clay ground has been stored to be used for covering the layers of waste. At the same time the layers of waste and clay cover are rammed permanently using a vibrocondenser[19].

As it has been mentioned above, the landfill no longer belongs to the city of Akhaltsikhe and correspondingly it has no right to carry out any measure at the landfill independently. However, according to the enacted in 2015 in Georgia "The Waste Management Code", the Akhaltsikhe administration plans to introduce certain measures in the sphere of waste management, which will facilitate the mitigation of waste generation and creation of its decay products. At the initial stage the sorting of solid domestic waste (e.g. paper, glass, plastics) is planned and after this procedure carrying out of remaining useless waste at the landfill.

To calculate GHG emissions the methodology developed by the UNFCCC and IPCC has been used, according to which this sector discharges emissions from the following source-categories:

- Solid waste disposal (6A)
- Wastewater treatment (6B1, 6B2)

[16] http://nala.ge/uploads/akhaltsikhe.pdf

[17] https://9arkhi.wordpress.com/2013/05/20/%E1%83%91%E1%83%94%E1%83%A1%E1%83%98%E1%83%99-%E1%83%91%E1%83%9A%E1%83%98%E1%83%90%E1%83%AB%E1%83%94-%E1%83%AD%E1%83%90%E1%83%AD%E1%83%90%E1%83%A0%E1%83%90%E1%83%A5%E1%83%A8%E1%83%98/

[18] The Akhaltsikhe Municipal Service

[19] http://www.interpressnews.ge/ge/regioni/267326-akhalcikhis-ganakhlebuli-nagavsayreli-gaikhsna.html?ar=A

- Waste incineration (6C)
- Other waste (industrial, medical and hazardous) (6D).

For the city of Akhaltsikhe the assessment of Waste sector has been conducted only in one source-category "Solid waste disposal (6A). Sub-categories "Residential and Commercial wastewater treatment" (6B1) and "Industrial wastewater" (6B2) were not considered, as there is no wastewater treatment facility in Akhaltsikhe and large industrial enterprises do not function here. The IPCC source-categories "Waste incineration" and "Other waste" were not examined as well, because waste is not incinerated in Akhaltsikhe and other kinds of waste (industrial, medical and hazardous) are not registered and are not disposed at the proper site in the city.

6.2 Methodology and incoming parameters

There are two ways to calculate methane emissions from landfills, suggested by the IPCC guidelines: Default (Tier 1) and FOD (First Order Decay) (Tier 2). The main difference between these two methods is that FOD gives a time-dependent profile of emissions production, and better reflects waste degradation processes, while the typical default method is based on the assumption that waste production potential, as well as emissions, occur in the year of disposal. The default method can be successfully applied if there is a constant amount and composition of waste disposed to a landfill, or if the variations are insignificant over several decades. However, if there are important changes in the amount and composition of waste, the use of the Default method is not recommended.
To calculate methane emissions from the Akhaltsikhe landfill the FOD method (Tier 2) has been applied. Relevant formulas and parameters are given below:

Tier 2: First Order Decay (FOD) method

$$CH_4\ Emissions = \left[\sum_x CH_4\ generated_{x,T} - R_T \right] \cdot (1 - OX_T)$$

Where

$\Sigma\ CH_{4generated x,T}$ is amount of methane produced, equal to

$CH_4\ generated_T = DDOCm\ decomp_T \bullet F \bullet 16/12$, where ($DDOCm\ decomp_T$ – is decomposed mass ($DDOC_m$) of degradable organic carbon (DOC) that will decompose in year T, Gg; F – fraction of methane in landfill gas; 16/12 - CH_4/C is ratio between molecular masses,

$CH_{4\ Emissions}$ – amount of methane emitted into the atmosphere;

CH_4Gg, in the year *T*;

T-year of inventory;

x- fraction of waste/composition;

RT- collected from the landfill and rendered harmless CH_4Gg in the year T;

OX_T- oxidation factor in the year T.

Activity data

The main index of activity data is number of population which generates the waste that is delivered or was carried to the landfills[20].

As of 2014 the population of Akhaltsikhe Municipality made 48 500[21], among them in the city of Akhaltsikhe- 20 500[22], making 42.3% of the Municipality total population

The density of population in the city equals to 583 persons per km^2.[23] Regretably, the long-range population dynamics for Akhaltsikhe Municipality and the more so for the city of Akhaltsikhe is not available, and thus for the emissions inventory in the Waste sector, the number of population from 1960 to 2005 was taken invariable and equal to 2005 data, while from 2014 the annual growth by 0.5% has been assumed[24] (Table 45). According to Municipal Service information the Akhaltsikhe Cleaning Service also attends to 365 legal subscribers[25], the number of which is considered in computations.

Table 45. Actual number of Akhaltsikhe Municipality population (2005-2014) and actual (2012) and theoretical (2005-2011 and 2013-2014) values for the city of Akhaltsikhe

Year	Thousand persons	
	Akhaltsikhe Municipality	City of Akhaltsikhe
2005	45.4	19.2
2006	46.9	19.8

[20] http://geostat.ge

[21] http://geostat.ge

[22] Akhaltsikhe Municipal Service

[23] http://droa.ge/ckfinder/userfiles/files/%E1%83%90%E1%83%93%E1%83%9B%E1%83%98%E1%83%9C%E1%83%98%E1%83%A1%E1%83%A2%E1%83%A0%E1%83%90%E1%83%AA%E1%83%98%E1%83%A3%E1%83%9A-%E1%83%A2%E1%83%94%E1%83%A0%E1%83%98%E1%83%A2%E1%83%9D%E1%83%A0%E1%83%98%E1%83%A3%E1%83%9A%E1%83%98%20%E1%83%9D%E1%83%9E%E1%83%A2%E1%83%98%E1%83%9B%E1%83%98%E1%83%96%E1%83%90%E1%83%AA%E1%83%98%E1%83%98%E1%83%A1%20%E1%83%AC%E1%83%98%E1%83%9C%E1%83%90%E1%83%93%E1%83%90%E1%83%93%E1%83%94%E1%83%91%E1%83%94%E1%83%91%E1%83%98.pdf

[24] This assessment for 2015-2020 is in line with the general (MARKAL) model and is the same for other sectors as well.

[25] Akhaltsikhe Municipal Service

2007	46.9	19.8
2008	46.8	19.8
2009	46.9	19.8
2010	47.7	20.2
2011	48.2	20.4
2012	48.6	20.6
2013	48.4	20.5
2014	48.5	20.5

Features of waste generation and disposal processes

Currently the collection, registration and disposal at the site of waste in Municipality is executed by the LLC "Ketilmotskoba". In the city of Akhaltsikhe on the average 24 000 m^3 of domestic garbage is collected annually. 10 years ago this value was under 7 000 m^3/yr and has been growing gradually[26]. The residential and construction waste is delivered to the Akhaltsikhe landfill not only from the city of Akhaltsikhe, but from the settlements of Akhaltsikhe Municipality (Vale and Skhvilisi) and Adigeni Municipality (Abastumani). In the Adigeni Municipality the waste management is performed by special service- LLC "Jony" attending to the local authority under the contract. The company conducts partial collection and disposal of waste. On the average in Adigeni Municipality about 400m^3 of trash was gathered annually and in the last decade this value has increased by 190 m^3/yr. However, the actual volume of waste generated in the municipality and the fraction delivered to the Akhaltsikhe municipal landfill is not yet assessed[27].

From both municipalities daily 12-14 refuse- trucks deliver on the average 30-40 tons of waste, being an equivalent of about 80-100 m3. Apart from this, usually 3-4 private cars are bringing daily approximately 6-8 tons of different domestic or construction refuse[28] to the landfill. 75% of delivered to the landfill waste comes from Akhaltsikhe (8-10 trucks with total 22-30t or 62-85 m^3) and 3 private cars (total 6t or 15-17 m^3 of refuse)[2930].

[26] http://nala.ge/uploads/akhaltsikhe.pdf

[27] http://nala.ge/uploads/adigeni.pdf

[28] Akhaltsikhe Municipal Service
[29]The LLC "Ketilmotskoba" uses 0.35 as a ratio between mass and the volume of trush.
[30] LLC "Ketilmotskoba"

In Akhaltsikhe about 1% of population incinerates various kinds of waste (e.g. paper, cardboard, sawdust, leaves, etc.); nearly 57% of population are using organic waste for feeding animals and poultry. For the time being the cleaning of the city is free and for this reason the number of physical subscribers to the cleaning is unknown. The cleaning is paid only for legal entities. The cleaning services are performed for 365 subscribers- legal entities and 98% of Akhaltsikhe population[31]. In 2002-2004 the placing of refuse-bunkers has started, that are disposed now only on asphalt-coated streets- covering about 25 km, that embraces nearly 50% of population. The remaining population twice a week is served by tip-up lorries, while small portion of waste is again throw out in river, ravines and at other illegal spontaneous "landfills".

Table 46. Annual amount of solid waste generated by 98% of Akhaltsikhe population and registered legal subscribers/entities, 2004-2014

Year	Municipal solid waste, total in the city m^3	Municipal solid waste, total in the city, tons	Number of Akhaltsikhe population and legal subscribers,[32] served by the cleaning service, persons	Annual amount of waste per capita, kg/person/yr
2004	17 000	5 950	19 185	310.14
2005	17 700	6 195	19 185	322.91
2006	18 400	6 440	19 807	325.14
2007	19 100	6 685	19 807	337.51
2008	19 800	6 930	19 765	350.61
2009	20 500	7 175	19 807	362.25
2010	21 200	7 420	20 139	368.45
2011	21 900	7 665	20 346	376.74
2012	22 600	7 910	20 512	385.63
2013	23 300	8 155	20 429	399.19
2014	24 000	8 400	20 455	410.66

For example, according to 2014 data in AKhaltsikhe annually was generated (population, enterprises and organizations) 8 400 t of waste, at the same time LLC "Ketilmotskoba" was

[31] LLC "Ketilmotskoba"

[32] Legal subscriber was taken as one person

serving 98% of population (20 090 persons) and 365 legal subscribers/contributors. Esuing from this, amount of refuse produced per capita in 2014 has been defined (Table 46)., from which it could be derived that the amount of generated waste is growing on the average by 2.8% annually. For years to come more reliable forecast for the increase of waste has been used, determined in the Tbilisi SEAP (2.5% annually).

Waste composition

There are no complete/accurate data on the composition of municipal waste in Georgia. The results of single surveys on this subject are available for Tbilisi (2003- GIZ, 2010- http://geocities-tbilisi.ge/failebi/2388-Introduction.pdf) as well as 2014 data, provided by the Georgian Solid Waste Management Company for the Norio landfill. As to the city of Akhaltsikhe, the information on waste composition is not available. Therefore, for the period of 1960-2014 the data concerning waste composition was taken from the Tbilisi SEAP (Table 47), while in 2015-2026 calculations the 2014 data on waste composition in Tbilisi was used. At the same time, this composition was considered to be relevant to only 42% of Akhaltsikhe population, because as it was mentioned above, 57% of residents are utilizing the food waste, and 1% are incinerating them. Concerning these cases, for 58% of population the franction of waste- the food waste was stricken off from the waste composition list (Table 47) and the waste composition has been recalculated for the whole population of Akhaltsikhe (Table 48).

Table 47. Composition of waste generated by 42%[33] of Akhaltsikhe population[34]

Waste fraction	Years					
	2009	2010	2011	2012	2013	2014
Food waste	71	71	70	69	68	67
Paper/ cardboard	6	6	7	8	9	10
Wood	3	3	3	3	3	3
Textile/ Leather	3	3	2	2	1	1
Hygienic waste	2	2	2	1	1	1
Plastic/ Inert material	15	15	16	17	18	18
Total	100	100	100	100	100	100

[33] Whose waste is completely delivered to the landfill

[34] Is taken from 2011 Tbilisi SEAP; 2010 and 2014 actual data are taken from following sources: "GEO-cities Tbilisi: Integrated environmental assessment of Georgia's capital state and trends" and 2014-Analysis of waste at the Norio landfill. For the remaining years the data were interpolated

Table 48. Averaged composition of solid residential waste applied to the Akhaltsikhe whole population[35]

Year	Averaged composition of waste, % by mass						
	Food waste	Paper/ cardboard	Wood	Textile/ Leather	Hygienic waste	Plastic/ Inert material	Total
2009	51.31	10.07	5.04	5.04	3.36	25.18	100
2010	51.30	10.08	5.04	5.04	3.36	25.19	100
2011	50.09	11.64	4.99	3.33	3.33	26.62	100
2012	48.91	13.18	4.94	3.30	1.65	28.02	100
2013	47.76	14.69	4.90	1.63	1.63	29.39	100
2014	46.62	16.18	4.85	1.62	1.62	29.12	100

Emission Factors

Different Emission Factors are used in the process of methane emissions calculation from solid waste.

Methane Correction Factor (MCF)

MCF depends on the landfill type- unmanaged landfills produce less methane than managed ones because decomposition of most waste in the upper layer is aerobic and releases carbon dioxide. The IPCC 2006[36] gives default values of MCF, presented in Table 49.

Table 49. Methane Correction Factor (MCF) Default Values for Different Types of Landfills

Type of Landfill/ Landfill	MCF
Managed[37]	1.0
Managed- thin (waste thickness < 5m)[38]	0.5

[35] Here it is considered that only 42% of Akhaltsikhe population generates the food waste

[36] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf (pg. 3.14)

[37] A managed landfill implies the disposal area is kept secure (waste is placed at specially prepared places, where the waste has an airing and is controlled against self-flaring). At the same time it is covered, rammed and layered.

[38] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl (pg.3.16)

Unmanaged- deep (waste thickness> 5m)	0.8
Unmanaged- thin (waste thickness <5m)	0.4
Uncategorized landfill	0.6
Akhaltsikhe landfill 1960-2013[39]	0.6
Akhaltsikhe landfill since 2014	0.5

Degradable Organic Carbon (DOC)

DOC is the waste component, decomposing biochemically and measured in GgC/Gg of waste.

The value of DOC depends on waste composition and country/ regional climate conditions. To calculate the value of DOC for waste components the IPCC 2006 methodology[40] has been used. The values of DOC according to waste composition are given in Table 50.

Table 50. Values of DOC according to waste fractions

Waste fractions	Value of DOC
Food waste	0.15
Garden	0.20
Paper	0.40
Wood and Straw	0.43
Textiles	0.24
Disposable	0.24

Fraction of Degradable Organic Carbon Dissimilated (DOC_F)

DOC_F is actually a dissimilated component of organic carbon. A certain of organic carbon is not decomposed at all, or decomposes very slowly. The IPCC 2 000 recommends DOC_F value in the range of 0.5-0.6 (assuming that the landfill is in an anaerobic conditions and lignin[41] carbon is

[39] The thickness of waste is not know

[40] 2006 IPCC Guidelines for National Greenhouse Gas Inventories http://www.ipcc-nggip.iges.or.jp/public/2006gl (p. 2.16)

[41] Plant cell consists of 3 important components: cellulose, lignin and hemicellulose. Lignin strengthens cell walls, binding them as well. Decomposition of lignin is an aerobic process; in anaerobic conditions lignin becomes extremely durable.

included in the DOC value). DOC_F depends on a number of factors such as temperature, moisture, pH, waste composition, etc.

The IPCC GPG recommends using national values, though they should be based on well-documented surveys. To calculate methane emission from the Akhaltsikhe Waste sector the IPCC default/typical value (0.6)[42] has been used.

Methane Content of Landfill Gas (F)

According to IPCC 2006, methane content by volume in landfill gas is up to 50%. Only oil and fat containing materials generate biogas with more than 50% of methane. To calculate methane emission from the Akhaltsikhe Waste sector the IPCC default/ typical value of 0.5 has been applied.

Oxidation Factor (OX)

Oxidation Factor reflects the amount of methane generated in waste cover material (soil, etc.). In case of managed landfill (where waste are covered by oxidizing materials- soil, compost) the OX value equals to 0.1, while in case of unmanaged and managed landfill (when waste are not covered with oxidizing material- soil, compost) it falls down to OX= 0.[43] As the Akhaltsikhe landfills are not covered by oxidizing material, the value of OX for the Akhaltsikhe landfill has been taken equal to zero.

6.3 Base Year Inventory and GHG Emissions Baseline Scenario (2014-2020)

In 2013 the Akhaltsikhe landfill has been rehabilitated and therefore since 2014 the methane emission growing tendency becomes apparent. At the same time, according to city administration in the near future the amount of paper, glass and polyethylene will be decreased in the incoming waste, as the City Hall has decided to separate, sort and process the waste.

Table 51 shows the projected values of methane emission from the Akhaltsikhe waste sector after the rehabilitation of the landfill in 2014. The calculations were performed without the assumption of waste being sorted and recycled.

Table 51. Methane emission from the Akhaltsikhe Waste sector in 2014-2026

Year	Emission, Gg

[42] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf

[43] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000, გვ. 5.10. http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html (pg.5.10)

	CH_4	CH_4 in CO_{2eq}
2014	0.21	4.34
2015	0.21	4.33
2016	0.21	4.33
2017	0.21	4.36
2018	0.21	4.39
2019	0.21	4.44
2020	0.21	4.50
2021	0.22	4.57
2022	0.22	4.65
2023	0.23	4.74
2024	0.23	4.84
2025	0.24	4.95
2026	0.24	5.06

It could be seen from this Table that if the waste is not sorted and processed/ recycled, in upcoming years (2017-2020) the emission of methane into the atmosphere from the Akhaltsikhe Waste sector will be featured by the rising tendency (about 1% per year) at the expense of growing population and increased amount of refuse. At the same time the reduction of methane emission in 2014-2016 is evident, resulting from the specification of landfill management system (the MCF value has been modified from 0.6 to 0.5).

6.4 Emissions Reduction Action Plan from the Akhaltsikhe Solid Waste Subsector

At the present stage the Akhaltsikhe City Hall has no concrete plans concerning Akhaltsikhe operating landfill (arrangement of biogas production system, methane collection and flaring/ utilization), aimed at the reduction of methane emission into the atmosphere. However the authorities are planning to sort the waste (e.g. paper and polyethylene) and damp the useless waste at the landfills.

Activity W1: The separation of paper fraction from the waste, generated in the city will reduce the amount of this fraction in the waste delivered to the landfill and correspondingly the

emissions (including of methane) released into the atmosphere as a result of its decay. At this stage the implementation date of this plan, as well as the amount and fractional composition of the waste is unknown. Ensuing from this it has been assumed that the sorting of waste will begin from 2017 and, in spite of annual increase in the amount of waste (by 2.5% on the average), the quantity of that kind of waste, disposed at the landfill, will lessen by 2% compared to the "no action" case due to the separation of paper and plastics. In particular:

- In 2017 the amount of paper in the waste will be reduced by 5%, reaching 10% by 2020;
- In 2017 the amount of plastics in the waste will be reduced by 5%, reaching 10% by 2020.

Table 52. Amount of methane saved from the Akhaltsikhe Waste sector in case of project implementation

Years	Project is not implemented		Project is implemented		Methane emission reduction due to execution of the measure	
	CH_4, Gg	CH_4, $GgCO_2eq$	CH_4, Gg	CH_4, $GgCO_2eq$	CH_4, $GgCO_2eq$	%
2015	0.2060	4.3265	0.2060	4.3265	0.0000	0
2016	0.2063	4.3330	0.2063	4.3330	0.0000	0
2017	0.2074	4.3556	0.2074	4.3556	0.0000	0
2018	0.2092	4.3928	0.2089	4.3865	0.0063	0.14
2019	0.2115	4.4421	0.2109	4.4282	0.0140	0.32
2020	0.2144	4.5028	0.2133	4.4793	0.0236	0.52
Amount of saved methane, total for 2017-2020					0.0439	0.33

In case of implementing this measure the methane emission from the Akhaltsikhe waste sector could be reduced to 2020 by 24 tCO_2eq (0.52%) and during the 3- year span (2018-2020)- by 44 tCO_2eq, making 0.33%.

Table 53. The Action Plan for Akhaltsikhe Waste Sector

Activity	Planned measure	Responsible body	Implementation period (start and end dates)	Cost of each measure (GEL)	Expected CO_2 reduction from the measure by 2020 (t)	Preliminary assessment of CO_2 reduction by 2020 (t)
1	2	3	4	5	6	7
W	Solid domestic waste and wastewater					24
W1	Separation of paper and plastic fractions from solid domestic waste for further utilization	Akhaltsikhe Municipality	2017		24	24

7 Greening

7.1 Overview of the sector

The hilly landscape surrounding the Akhaltsikhe Hollow mainly includes mountain steppe shrubby vegetation, characteristic to this Semi-arid district of Samtskhe-Javakheti Region.

The greening activities in and around city of Akhaltsikhe were primarily started in 1960-es. At present areas covered with plants include different zones of the city, among them city environs, cemeteries, recreation zones and other greened areas (personal plots of households, greenery around buildings, along the roads and streets, etc.) All in all area covered with greenery in the city makes 458 ha (Table 54).

Table 54. Green zones within the limits of Akhaltsikhe city

#	Green zones	Greenery area, ha		
		Total	Including fragmentary verdure	Joined canopy planting
1	Recreation zones (parks, squares)	2.2	2.2	-
2	Cemeteries	35.0	35	-
3	Different green sites in the city (personal plots, around buildings, along the roads, etc.)	173.0	173	-
4	Environs of the city, including slopes	248.0	115	133
Total green cover		458.2	325.2	133

Kinds of plants, making the listed above green zones, are different. E.g. plants around the city (Picture 9), mainly concentrated in the vicinities of TV tower, Rabati Fortress, hospital and the Sviri District are represented by black and ordinary pine, ash, acacia, soap-tree and wild pear. Currently a part of mentioned above area (248 ha) belongs to Forest Fund (141 ha) and another part- to the city territory (107 ha) (see Table 55). From the listed species the best state is typical for pine, followed by acacia, smoke tree and finally- by wild pear, ash and soap-tree.

Table 55. Areas covered by existing plantings within the Akhaltsikhe limits (ha)

Green zone	Green cover area	Forest Fund		Authorized by Municipality	
		Artificial planting	Natural origin	Artificial planting	Natural origin
Recreation zones (parks, squares)	2.2	-	-	2.2	-
Cemeteries	35.0	-	-	35.0	-
Different green sites in the city (personal plots, around buildings, along the roads, etc.)	173.0	-	-	173.0	-
Total in the city	210.2	-	-	210.2	-
Environs of the city, including slopes	248.0	123	18	107.0	-
Total greenery area	458.2	123	18	317.2	-

Picture 9. Greened environs of Akhaltsikhe city

It should be mentioned that the most part of greenery areas at the territory of the city are concentrated in the yards of private dwelling houses and of different destination buildings. The private houses yards are mainly planted with different kinds of fruit trees.

The least area in the city is occupied by recreation zones (2.2 ha, Table 56). In total there is 1 park and 4 squares in the city. This sole Central Park of the city is planted with linden, cypress, thuja, biota and pine trees (Table 57).

Table 56. Recreation zones of the city

Parks	Covered by greenery area, ha
City Central Park (crossroad of Queen Tamar and Natenadze streets)	1.0
Squares	
Shota Rustaveli Square (crossroad of Kostava and Natenadze streets)	0.4
Kostava st. Square (adjacent to No. 18 Kostava st.)	0.2
Tamarashvili st. Square	0.4
9 April st. Square	0.2
Total	2.2

Table 57. Dominant arboreal plants in the city green zones

Green zones	Dominant kinds	Average age, yr	%
Green cover around the city (planted slopes, wind belts, forest groves)	Pine	30-65	69
	Ash	30-35	12
	Acacia	30-45	14
	Soap-tree	40	5
	Smoke tree	40	7
	Maple	35	3

City recreation zones (parks, squares, pavements), recreation amenities zones	Pine	35-45	45
	Linden	50-60	20
	Cypress	40	15
	Thuja	35	12
	Horse-chestnut	30-45	3
	Silver spruce	45-60	8
Planted areas in the yards and around private houses and buildings (including hospitals and other state institutions) in the city	Pine	35-45	9.8
	Silver spruce	15-25	2.2
	Poplar	35-45	18.1
	Willow	40-50	14.6
	Walnut	40-45	8.7
	Apple	30-35	10.5
	Pear	20-25	4.2
	Cherry	20-25	11.8
	Plum	25-35	12.6
	Wild plum	20-30	6

The trimming activities and cutting of dried trees in the city are mainly conducted according to necessity. However, as this kind of works has not been undertaken in the city for a sufficiently long time, the trimming of trees was planned in 2015 and this task already has been achieved in part, purveying 5 m^3 of timber. This reduction in biomass is being considered in computations, as well as 10 m^3 of annual trimming, to be carried out in future.

Table 58. Plan for clipping of trees in 2015

Kinds of registered for clipping and cutting down arboreal plants	Average age of plants, years	Date of trimming. month	Volume of registered plants, m^3
Acacia	55	November	12
Poplar	45-60	November	25
Aspen	50	November	14

Platanus	35-45	August	5
Total			56

7.2 Methodology

The calculation of carbon accumulated in Akhaltsikhe green cover and its annual accretion was performed using the IPCC methodological Guidelines. The calculations were conducted for so called "Live biomass" (including the underground biomass). Carbon stocks in the green cover were calculated separately for joint canopy and fragmentary plants. The losses in biomass due to felling down and trimming are also considered in calculations. Namely, the following equations were used in computations:

1. Equation calculating carbon savings in live biomass (including the underground and above ground live biomass):

   $C_F = [V \bullet D \bullet BEF_2] \bullet (1+R) \bullet CF$

Where
V is the wood volume, m^3/ha

D_ Absolutely dry wood volume weight, tons of dry mass/ m^3;

BEF_2- Coefficient of converting commercial wood stock into the total stock of above-ground woody plants to get above-ground live biomass.

R_ Ratio of the trunk of a tree to its root mass;

CF_ Carbon content in dry substance/ ton C/ton dry mass.

2. Equations system to calculate annual increment in carbon stocks of biomass based upon the biomass accretion – decrease method (see Figure 12):

$$C_{F_{LB}} = (C_{F_G} - C_{F_L})$$

$$C_{F_G} = (A \cdot G_{TOTAL}) \cdot CF \qquad C_{F_L} = H \cdot D \cdot BEF_2 \cdot CF$$

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

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

Figure 12. System of equations to calculate carbon accretion in biomass

Where

$C_{F_{LB}}$ is annual variation in carbon stocks due to live biomass accretion, t C/yr.;

C_{F_G} –annual increase in carbon stocks due to biomass accretion, t C/yr.;

C_{F_L} –annual decrease in carbon stocks due to biomass losses, t C/yr.;

A- area covered by wood/plants;

G_{TOTAL}-average annual rates of total biomass increment, ton of dry mass/ha/year;

CF- share of carbon in biomass, t C/ton of dry mass;

G_W- aboveground biomass increment, t/dry mass;

I_V- biomass average annual increment, m^3/ha/year;

D- Absolutely dry wood volume weight, tons of dry mass/ m^3;

BEF_1- coefficient for converting average annual increment into the total aboveground biomass;

R-Ratio of the trunk of a tree to its root mass;

H- amount of annually purveyed timber volume, m^3/yr.;;

BEF_2- biomass increment coefficient for converting commercial wood stock into the total stock of above-ground biomass (including rind/bark).

Using the above given equations the carbon stocks in perennial plants of Akhaltsikhe green cover and the annual sequestration of carbon have been determined.

Concerning the values of some coefficients used in calculations, as the perennial arboreal plants in city green cover are represented both in joined canopy and in fragmentary forms, corresponding to both cases indexes were applied in computations. In particular, for joint canopy plants, mainly occupying slopes of hills surrounding the city, the Akhaltsikhe Forestry taxation materials were used (e.g. in artificial plantings the wood stocks make 80 m^3/ha), while

for city greenery (represented mainly in the fragmentary form) the wood stocks and other data (average age 40 years) were taken from different reference sources relevant to dominant in the city kinds, such as Tables of growth rates and stocks[44] , etc. As a result average value of index has been obtained, permitting the approximate assessment of wood stock at 1 ha of fragmentary greening (50 m^3).

As it has been mentioned above, the perennial arboreal plants in the city 458.2 ha of green cover are represented both in joined canopy and in fragmentary forms, from which joint canopy groves are dominating mainly at 133.0 ha of suburban territories, and the remaining 115.2 ha are covered with fragmentary plantings. Therefore, emission factors, typical for both types of plantings were applied in computations. Here it should be mentioned as well that in Accretion Factor, used in calculations, the vegetation extension ratio due plantings, conducted in 2014 has been taken into account. Ensuing from this, the Accretion Factor was adjusted towards the growth rate.

More specifically, in calculations based upon the 2004 taxation materials, the data on average annual accretion and wood stocks of plants were applied (see Table 59), while to obtain the average wood volume weigh (D) the data on absolutely dry wood volume weight for dominant arboreal plants were applied, taken from different reference sources. The values of other parameters (BEF_1, BEF_2, R, CF) were conveyed from Tables, subjoined to the IPCC Guidelines, namely from the list of default indexes, typical for the region's climate conditions.

Table 59. Indexes used in calculations

Main indexes applied in calculations	Used value of indexes	
	Fragmentary plants	Joint canopy plants
V- Tree stock m3/ha	50	80
I_V- Woody plants (trees) mean annual increment, m^3	1.5	1.7
D - volume weight of totally dry wood, ton totally dry mass[45]	0.65	0.54
BEF_1- Coefficient for conversion of wood mean increment into total aboveground (including crown) mean increment[46]		1.15
BEF_2- Coefficient for conversion of commercial wood stock into the total stock of aboveground stock (including crown), for calculating aboveground living biomass[47].		1.3
R - Ratio of root mass to trunk[48]		0.24
CF-carbon share in dry wood[49].		0.5

[44] Mirashvili V., Kuparadze G. Forest Taxation Reference Book (in Georgian)
[45] "Global Wood Database" http://datadryad.org; მახვილაძე ს.ე. მერქანმცოდნეობა, თბილისი 1962; Боровиков А.М., Уголев Б.Н.. Справочник по древесине. "Лесная Промышленность", Москва, 1989;;
[46] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;
[47] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;
[48] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.8;
[49] Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003)

As to the carbon sequestration potential, resulting from the planned measures, for its assessment the model CO2FIX has been used, developed in the CASFOR II project. This project was supported by the EU INCO2 program and additionally was financed by the Netherlands Agriculture, Environment and Fishery Ministry and Mexican National Council on Science and Technology (CONACYT).

The CO2FIX V3.1 model defines the carbon sequestration amount using the so called "carbon accounting method", which calculates changes in carbon stocks of all forest "reservoirs" or "pools" during the concrete time interval (the carbon "reservoirs" are called to be those parts of forest ecosystem, where carbon is being deposited, e.g. live biomass, litter and woody debris, organic soils and produced woody resources.

In the CO2FIX V 3.1 model the calculations in 6 major modules are performed for one year and one ha scale:

1. Biomass module
2. Soil module
3. Woody resources produce module
4. Bioenergy module
5. Financial module
6. Carbon credits accounting module (for CDM)

According to model methodology the amount of sequestered carbon (CT_t) in each span (t) is calculated by the following equation:

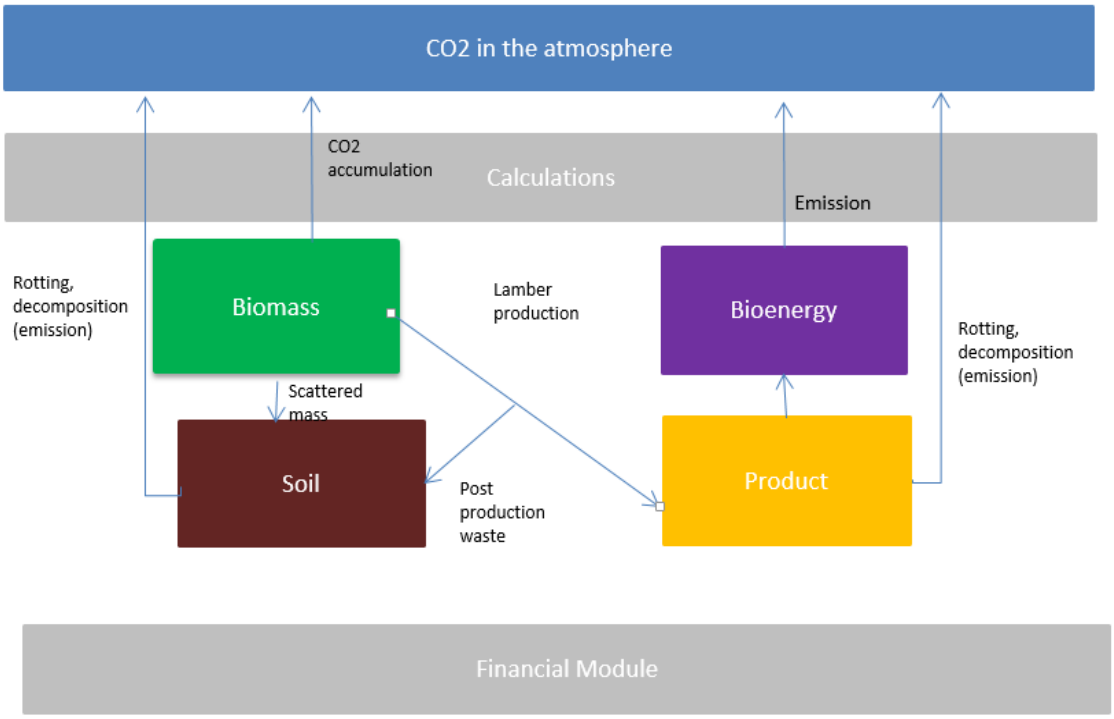
$CT_t=C_{bt}+C_{st}+Cp_t$ (MgC/ha),

Where

C_{bt} is the total amount of carbon in above ground and under ground biomass of the plant;

C_{st}- carbon stocks in organic soils (MgC/ha);

Cp_t- Carbon stocks in woody products, got as a result of commercial processing of wood stocks.



Picture 10. Schematic graph of model structure

According to the scenario considered in the project (reconstruction and planting of greenery), 2 computing models were used for the calculations- the Biomass and Soil modules.

Biomass module

In the Biomass module the "Cohorts" system is used for computations. Group of one or different kinds of arboreal plants are aggregated in cohorts.

Kinds united in each "cohort" are separately featured in the module by growth, drying and other characteristics. In line with the greening plans in Akhaltsikhe one "cohort" system is applied, consisting of species, listed in Table 59.

In calculations concerning activities after the planting, the following main coefficients were used (Table 60).

Table 60. Values of indexes used in the biomass module

Indexes used in the Biomass Module	Values of the Index
Carbon content in the biomass, tC/t dry mass	0.5
Wood density t dry mass/m^3	

Maple	0.655
Georgian oak	0.660
Ash	0.645
Smoke tree	0.560
Acacia	0.750
Initial carbon stocks, tC/ha	0
Growth correction factor	1
Turnover rate (phytomass natural dying annual index)	
Coniferous	
Needles	0.3
Branches	0.04
Roots	0.03
Deciduous	
Leaves	1
Branches	0.05
Roots	0.08

Soil module

For defining the carbon dynamics in the soil the Yasso model (http://www.efi.fi/projects/yasso) has been applied. This model, being included in the CO2FIX system, describes carbon dissolution and its dynamics in dry soil.

This model is calibrated to portray the overall stocks of carbon in soils, no matter of soil strata. The model could be used to assess the soils of both coniferous and deciduous forests. It is tested in different countries belonging to various climate zones to describe the impact of separate climate conditions on the decomposition of dead organic matter/litter.

7.3 Base year (2014) inventory and GHG emissions baseline scenario (2014-2020)

The amount of sequestered in base year (2014) carbon, computed using the IPCC methodology is given in Table 61, and the values of annual accretion of carbon- in Table 62.

Table 61. Carbon stocks deposited at the Akhaltsikhe planted areas in the base year (2014)

Plants in green zones	Area, ha	Stock, m^3/ha	D	BEF_2	(1+R)	CF	Total carbon stock, thousand tC
							2014
Fragmentary covered plants	115.2	50.0	0.65	1.30	1.24	0.50	3 017.7
Joint canopy plants	133.0	80.0	0.58				4 974.0
Total	458.2						7 991.7

Table 62. Annual accretion of carbon at the Akhaltsikhe planted areas in the base year (2014)

Planting coverage	Area, ha	Accretion m^3/ha	D	BEF_1	(1+R)	CF	Total accretion, tC
							2014
Fragmentary planting	115.2	1.5	0.65	1.15	1.24	0.50	80.1
Joint canopy planting	133.0	1.6	0.58				88.0
Total	458.2						168.1

In the baseline scenario (2014-2020) of carbon sequestration at the Akhaltsikhe planted areas the annual accretion in the biomass index has been taken into account, resulting in the assessment of carbon stocks' expected changes potential (see Table 63), which could be altered in future due to different causes of biomass decrease (biotic or abiotic).

Table 63. Baseline scenario (2014-2020) for the carbon sequestration and relevant carbon dioxide removal

Parameter	Annual sequestration						
	2014	2015	2016	2017	2018	2019	2020

Carbon annual sequestration, tC	7 991.7	8 159.8	8 327.9	8 496.0	8 664.1	8 832.2	9 000.3
Carbon dioxide annual removal, thousand tCO_2	29 302,9	29 919.3	30 535.6	31 152.0	31 768.4	32 384.7	33 001.1

7.4 Action Plan for the Increase of Carbon Dioxide Removal by the Akhaltsikhe Greening Sector

In the spring of 2015 the greenery activities have been conducted at 1 ha of area around the entrance of the city, resulting in the planting of different kinds of trees (Table 64). At present 60% of saplings have taken root. Following this measure the annual increase in biomass is expected and relevant growth of carbon sequestration potential has been considered in the CO_2 removal calculations.

Table 64. List of saplings planted at the 1 ha area in Akhaltsikhe in 2015

Planted arboreal kinds	Number of planted saplings	Age of saplings
Ash	2 600	3-5 years
Maple	250	2-3 years
Oak	150	3 years
Total	3 000	

At the same time, apart from activities already undertaken in the spring of 2015, the Akhaltsikhe City Hall plans to extend plantings around the city and to arrange a number of recreation zones, including the rehabilitation of existing squares adjoining the so-called 8-storey building (650 m^2) and at the Mikutishvili street (9 350 m^2)(Table 65).

As it has been mentioned above, in the frames of Action Plan the carbon sequestration upcoming potential has been assessed applying the CO2FIX model and the obtained results are given in the following section.

Table 65. List of perennial saplings, planned for planting in Akhaltsikhe in 2016

Planned for plating kinds of saplings	Number of saplings	Age of saplings

Trees planned to be planted at 1 ha area around the city		
Maple	1000-1150	3-5 years
Oak	900-1050	
Smoke tree	500-600	
Acacia	600-700	
Total	3000-3500	
Trees planned for planting in the city recreation zones (1 ha)		
Pine	250	5-6 years
Silver spruce	70	
Platanus	120	
Total	440	

Measures planned within the framework of the Action Plan

According to the Greening sector's Action Plan, annual planting of 1 ha greenery for 5 years (2016-2019) is planned around the city (in total 5 ha), as well as the completion of rehabilitation of 2 squares for 2016 in the city.

Planned Activity 1. As it is suggested above, the greening of 5 ha in the vicinities of Akhaltsikhe is being planned. While designing the planting of the area most part of the territory should be occupied by plants similar to the forest landscape where no less than 3 500 saplings will be planted at the 1 ha area (including the shrubby kinds of vegetation). As a result a perfectly featured carbon sequestration pool could be obtained, in which soils will be engaged in the carbon deposition process and the city will acquire green zone comparable to valuable forest ecosystem.

The selection of seedling material assortment plays an important role in securing the success of the measure. Ensuing from experience of past activities, some plants having poor features of development in Akhaltsikhe (ash, wild plum, soap-tree) were not included in the list of planned plantings. As to the remaining in the list kinds, they have successful growth record in the Akhaltsikhe climate zone and are featured by high potential of carbon uptaking.

It should be mentioned that for the implementation of described above activities the planting design must be developed, the necessary components of which are: schemes of planting, list of greenery selected for introduction and budget of all activities. The estimated spending related

with the conduction of planned measures at the project territory in the first year of activity are given in Table 66.

Table 66. Budget of scheduled activities per 1 ha

№	Description of expenditures	Unit	Price of unit (USD)	Total amount	Total price (USD)
I. Core expense					
1.	Field activities				
1.1	Cleaning of area (from shrubs, offshoots, etc.)	ha	100.0 0	1	100
1.2	Fencing of area	m	5.00	400	2 000
1.3	Marking of area and digging	Sapling/pit	0.08	3 500	280
1.4	Purchase of saplings	Sapling	2.00	3 500	7 000
1.6	Planting saplings	Sapling	0.11	3 500	385
1.7	Watering saplings	Sapling	0.09	3 500	315
	Total (USD)				10 080

Table 67. Features of annual carbon sequestration in the 5 ha plantings

	2016	2017	2018	2019	2020
Carbon sequestered, tC	2.0	4.0	5.9	7.8	9.7
		2.0	4.0	5.9	7.8
			2.0	4.0	5.9
				2.0	4.0
					2.0
Total annual sequestration, tC	2.0	6.0	12.0	20.0	29.4
Annual CO_2 removal, tCO_2	7.3	22.0	44.0	73.3	107.8

Planned Activity 2. The second planned activity includes the rehabilitation and greening of two squares in the city, namely the square adjoining 8-storey building (650 m^2) and at the Mikutishvili street (9 350 m^2) with total number of 440 seedlings.

It should be mentioned that before starting the field activities the design of park reconstruction must be developed, the necessary components of which are: schematic maps of arranging saplings planting and different infrastructure utilities (walking paths, lawns, etc.), list of greenery selected for planting and budget of all scheduled measures. At this stage the plan of main activities and relevant estimated budget, necessary to implement this project are given in this report (Table 68).

Features of carbon sequestration after planting the trees are given in Table 69.

Table 68. Budget of planned activities (per 1 ha of area)

№	Description of expenditures	Unit	Price of unit (USD)	Total amount	Total price (USD)
I. Core expense					
1.	Field activities				
1.1	Arrangement of infrastructure	m^2	3.00	7 000	21 000
1.2	Digging of pits	pit	0.08	440	36
1.3	Purchase of saplings	sapling	8.00	440	3 520
1.4	Planting saplings	sapling	0.11	440	49
1.5	Watering saplings	sapling	0.09	440	40
	Total expenses (USD)				24 645

Table 69. Features of annual carbon sequestration after planting the trees

Parameter	2016	2017	2018	2019	2020
Carbon sequestered, tC	1.7	3.1	4.5	6.0	7.4
Carbon dioxide removal, tCO_2	6.2	11.4	16.5	22.0	27.1

Obtained results

Table 70. Carbon deposition potential resulting from the planned in the frames of SEAP greening activities

Parameter	Annual sequestration of carbon, tC				
	2016	2017	2018	2019	2020
Carbon sequestration in the city green zones (unless the measures are taken)	7 991.7	8 159.8	8 327.9	8 496.0	8 664.1
Greening of 5 ha in the vicinities of Akhaltsikhe	2.0	6.0	12.0	20.0	29.4
Greening and rehabilitation of 2 squares in the city	1.7	3.1	4.5	6.0	7.4
Total	7 995.4	8 168.9	8 344.4	8 522.0	8 700.9
Consequent removal (sequestration) of carbon dioxide, tCO_2	29 316.5	29 952.6	30596.2	31 247.3	31 903.3

Table 71. Action Plan for the city Greening sector

Activity	Planned measure	Responsible body	Implementation period (start and end dates)	Cost of each measure (GEL)	Expected CO_2 reduction from each measure to 2020 (t)	Preliminary quantitative index of CO_2 reduction to 2020 (t)
1	2	3	4	5	6	7
G	Green zones					135.0
G1	Greening of 5 ha area around the city	Akhaltsikhe Municipality	2016-2020	24 192	107.8	-
G2	Greening and rehabilitation of 2 squares in the city	Akhaltsikhe Municipality	2016	59 148	27.1	-

8 Awareness Raising and Staff Training Strategy

The sustainable development of the energy sector is a field in which the national and local levels play equally important roles. Raising public awareness for renewable energy development and energy efficiency requires a complex and multilateral approach, and a relevant communications strategy. This is one of the most important components of the SEAP.

The SEAP preparation process for the city of Akhaltsikhe, recently adjoined to the CoM, clearly revealed potential barriers to the effective implementation of strategies. Therefore, an evaluation of all identified barriers and overcoming ways are necessary. An assessment has defined that in the process of strategy implementation mainly three types of barriers will be dealt with:

1. Country level barriers, linked to bad past practices (especially for public awareness);
2. Lack of knowledge related with technologies;
3. Barriers specific to Akhaltsikhe context, as well as concrete project proposals and technology related barriers;

The record of these barriers is given below on the scheme:

Barriers to Sustainable Energy Development Process in Georgia

1. Wasteful energy consumption. During Soviet times when energy was cheap, consumption was almost unlimited;
2. Lack of awareness or knowledge about sustainable development among local policy-makers and general public. Only a few people are aware of sustainable development concepts, which are directly engaged in these activities.
3. Absence of a common vision of the relatively long-term prospects of the energy sector development (different target groups have sharply contrasting positions, which often are not based upon real calculations);
4. There is no joint, well-considered and formulated vision of the role of energy efficiency and renewable energy resources in a short-and long-term perspectives of Georgia's energy sector while in recent years the 10% growth rate in energy demand is being recorded. Correspondingly the potential of these resources (except hydro) is not defined as well as the directions for the development of this potential, there is no relevant legislation and declared objectives similar to gasification of the country or hydro-energetics.
5. The technologies market is inferior and contains several risks. Each failure of a new technology and demonstration project is seriously damaging follow-up prospects of the development in this direction. The long-run planning of energy sector does not consider the availability of technologies;
6. Activities in the field of energy efficiency and renewable energies (except hydro) conducted by separate non-governmental organizations are mainly uncoordinated and non-purposeful. Though it should be mentioned that the raise in energy efficiency, despite its chaotic character, is going on in the country that is partly facilitated by the market of contemporary technologies (mainly of domestic profile) and intrusion in Georgia of energy standards existing on the international level.

While identifying these barriers it has been considered that the managerial team of Akhaltsikhe Municipality has a vision of sustainable energy development prospects, demonstrates great interest to the adoption of modern, clean, energy efficient and renewable technologies, but lacks relevant knowledge and experience in managing present-day technologies. However, often the support by the Municipalities is not fully reasoned out and lacks eyesight of what could be done at local level and how concrete measures could be realized effectively.

Barriers to the Akhaltsikhe Sustainable Energy Development

1. The Samtskhe-Javakheti Region and the Akhaltsikhe Municipality in particular are facing almost the same obstacles to sustainable energy development as other regions

or municipalities in Georgia, among them self-governing cities like Akhaltsikhe. From these barriers first of all their complete dependence on the centralized energy supply in energy sector and full reliance on the private sector concerning other energy carriers should be mentioned. This dependence on centralized processes partly deals with the gas supply sector, where municipalities mainly rely on the processes determined by plans worked out under the central government guidance. As to the gasoline, diesel and other kinds of fuel, this is the prerogative of private importers. Correspondingly, at this stage municipalities have no vision on their roles in the energy planning process, as well as on the risks related with centralized supply and do not plan measures to lessen these risks and hazards. This is especially characteristic to the new self-governing cities like Akhaltsikhe, which gained this status in 2014;

2. The Akhaltsikhe Municipality has no complete statistics on the energy consumption by the city that would serve as a basis for the planning growing energy demand of the town. There is no vision and strategy to foresee the energy supply of the city in case of failure of one of present rings of energy provision. Accordingly, the town has no sufficiently thought out energy efficiency substantiation, determining its role in the process of sustainable socio-economic development of the city. There is no vision of what problems the town could face in case of rapid growth of economy and number of population, as well as intensification of traffic. The situation is aggravated by rigorous climate conditions and city total dependence on firewood due to the unreliable supply of the region by other energy carriers;
3. The Akhaltsikhe Municipality has no relevant experience, knowledge and no sufficient expert potential to plan, manage and implement the energy sustainable development process. In particular, in the short-run strategy for the energy sustainable development process in Akhaltsikhe, one of the priority sectors is the transport sector. However, to secure the painless transfer to clean/low emission public transport a serious public awareness raising campaign should be undertaken to demonstrate advantages related with public transportation, setting up the parking system and introduction of some restrictions for private transport;
4. Very important is as well the absence of additional funds. Most of the budget resources are used for infrastructure growth and social projects, that hampers the development of long-term energy policies;
5. The energy resources consumption sphere, except hydro, is unmanaged and chaotic at the Municipalities level and entirely in the country as well.
6. In the case of Akhaltsikhe more or less all these barriers are acute, which are typical and general for the whole country;

One of priority sectors for Akhaltsikhe is the Buildings sector, which along with the Street lighting sector experience serious energy deficit, exacerbated by harsh climate conditions.

Apart from the discussed above barriers related with the general development of local technologies, their import and dissemination, there are specific barriers concerning each

concrete technology, which are to be envisaged in the process of SEAP implementation for the assessment of applied technologies.

Barriers related to Technologies

1. Lack of knowledge about modern energy-efficient and renewable technologies available at the international market. Only a few technologies are assessed and studied for their adaptation in Georgia that significantly increases risks related with their introduction in the country. Private banks and the private sector are not willing to take upon these risks. Consequently, the import of technologies, their dissemination and adoption is almost totally in the hands of non-governmental sector or those big investors who are interested in developing markets for their own technologies. Accordingly, high technologies, which are imported at the limited scale, are accompanied with large part of worthless technologies. At the same time this is mostly promoted by the cost of technology and unfortunately even for the short-time prospective;
2. Lack of knowledge about the local environment, in which certain technology should operate (e.g. energy-efficient bulbs become absolutely ineffective and economically unprofitable within old and improperly functioning electricity networks). Studies of these aspects bring additional burden to technologies;
3. Lack of knowledge and awareness on environmental and social counter-indications. The study of technical risks associated with technologies requires profound understanding of technology by the accepting party to insure relevant assessment of risks and their minimizing;
4. Lack of sufficiently trained local personnel which could be able to select correctly certain technology with respect to local conditions and provide its proper operation. This problem is especially acute at the municipalities and self-governing cities level;
5. Most renewable technologies are not sufficiently flexible and easily adaptable to different environment. Majority of them lacks market shape and their adaptation to local conditions requires additional funding and knowledge.

The analysis of stakeholders in the frame of Akhaltsikhe SEAP has identified target groups for awareness raising and retraining, active collaboration with which is necessary to overcome the majority of listed above barriers. However, it should be noted that there are common to the country obstacles, the overpassing of which will be extremely difficult without the serious intervention from the side of the central government.

The target groups engaged in the awareness raising process, to which this strategy is addressed, are as follows: Akhaltsikhe City Hall staff and members of Akhaltsikhe City Council/Assembly, persons/groups involved in the transportation business, city of Akhaltsikhe population and private sector representatives/developers participating in the Construction sector activity.

At the present stage the first priority for the Akhaltsikhe Municipality is the Heat supply and Buildings sector, therefore for the implementation of the SEAP it is necessary to plan and execute such measures, which require intense informing and awareness raising among

population and mentioned above target groups on heat supply and energy consumption in the buildings sector, as well as on the energy efficiency measures and prospect for the sustainable development of the sector.

The audit of buildings in Akhaltsikhe has revealed that the existing buildings (including the private houses) do not satisfy even minimum requirements on energy efficiency, significantly affecting the budget of population. The construction standards are very low, necessitating active work in this direction with the population and developers/builders.

In general, it is essential to explain to population the objectives of SEAP and the positive social and economic sequels, which could be obtained in case of its successful implementation. At a certain stage this will require to carry out some behavioral changes among the population, so to achieve maximum support from its side it is vital to provide its engagement in the process of SEAP development. Global practice has demonstrated that the higher is population's involvement at the early stage of the process, the stronger is the management on implementation stage and the public support.

At the initial stage of SEAP development the meetings and consultations with the population of Akhaltsikhe (among which, presumably, the most part of behavioral changes will be needed) will be necessary to explain the expedience and benefits of the project implementation. During the consultations new project ideas could arise or the necessity of making corrections in the planned projects may be revealed.

While developing the Akhaltsikhe SEAP the meetings with the Akhaltsikhe Administration were already held. It is to be underlined that just the stakeholders, acting in specific sectors, are owing the major part of information necessary to develop and carry out the SEAP and they represent the basis determining the success of the entire project.

In the process of Akhaltsikhe SEAP implementation the awareness raising and local staff training strategy consists of the following steps:

Short-term Strategy (2015-2018)

1. Constantly informing local authorities on the trends of energy consumption in the city, advantages of efficient use of energy, as well as the social and economic benefits of this initiative;
2. Training the Municipality personnel and external human resources to ensure successful implementation and monitoring of the SEAP;
3. Provision of Akhaltsikhe with technical staff which will guarantee the development of energy efficient/ low emission projects in Buildings and Transportation sectors;
4. Provision of population with minimal construction standards, explaining the follow up cutback of their energy expenses by introducing these standards;
5. Preparation of information/education/illustration materials about successful experiences and modern technologies that are recommended for the green development of cities; Demonstration to the population the advantages of the introduction in different sectors energy efficient measures and technologies;

6. Providing the involvement of private sector in the implementation of SEAP by supplying them with information on energy efficient and economically beneficial technologies, offering programs on cooperation between public and private sectors.

Long-range Strategy (2018-2020)

The introduction of regulations would be necessary in the long-term strategy requiring changes in awareness and more significantly – in behavioral norms of the population. The main directions of long-term strategy are:

1. Initiation of consultations with stakeholders (city population, private sector, non-governmental sector) on the introduction of energy efficiency standards relative to buildings, which should be gradually implemented by the Municipality in different sectors (Construction, Transport, Waste). On the basis of consultations with stakeholders the barriers should be identified, which could arise in the process of introducing the restriction measures and various types of standards;
2. Development and implementation of awareness raising and incentive programs to ensure the unimpeded introduction of standards and regulations (e.g. in energy efficiency sphere).

Akhaltsikhe Municipality Strategy on Awareness Raising and staff Training

Main strategic objectives	Main target groups	Measures to be implemented	Potential leading organization (s)	Outcome	Potential donors
Short-term strategic objectives (2015-2018). The major objective of the short-term strategy is to facilitate the awareness of city authorities on the prospects of sustainable development of city energy consumption and its social and economic benefits; Highest possible notification and awareness raising of target audience (flat-owners cooperatives and city population) on energy efficiency in buildings; Assisting city population and other stakeholders in getting advantages from this initiative and training appropriate personnel for implementing the Action Plan and provision of its monitoring.	• Akhaltsikhe Municipality and City Assembly; • Flat-owners cooperatives; • Stakeholders related with Transport sector; • Akhaltsikhe population		• Akhaltsikhe City Hall • Coordinators of CoM in Georgia (Ministry of Energy and Ministry of Environment and Natural Resources Protection) • Different local and international programs going on in the frames of CoM and EC-LEDS	• Implementation of Akhaltsikhe SEAP is advancing successfully • Akhaltsikhe City Hall continues the same activity after 2018 • Akhaltsikhe population is informed on initiatives undertaken by the City Hall in the frames of this process	• Akhaltsikhe City Hall • Coordinators of CoM in Georgia (Ministry of Energy and Ministry of Environment and Natural Resources Protection) • Different local and international programs going on in the frames of CoM and EC-LEDS • International donors contributing to Climate Change mitigation and renewable energy, energy efficiency and

					sustainable development process.
1. Staff training					
Training of technical personnel, which will be able to assist different target groups in preparing energy efficient project proposals and their implementation in the frames of co-financing allotted by Municipality	• Akhaltsikhe City Hall Technical Group • Special Department at the City Hall (it could be the Energy Efficiency Agency), which will serve both the City Hall and the private sector in preparing concrete project proposals on buildings' energy efficiency and enacting these measures.	• Under the support of Akhaltsikhe City Hall the "Energy Agency"/"Energy Manager" should be set up, serving both the City Hall and collaborating with city population, cooperatives and private sector in preparing energy efficient projects and offering modern energy efficient technologies. • Elaboration of Technical Group's training program. The program should include at least the analysis of contemporary technologies and barriers to their introduction, as well as the study of advantages of different energy efficiency measures. • Development of manuals for the Technical Group. • Involvement of Technical Group in exchange programs and various information networks for getting international experience.	• Akhaltsikhe City Hall • Representatives of different countries' private sector, engaged in this sphere.	• The program and manual are developed for training personnel of the City Hall Technical Group. • The staff is trained and selected in accordance with competition rules. • Technical Group is actively participating in exchange programs and international networks to obtain newest information on present-day technologies and approaches in energy sector. • Technical Group is actively collaborating with cooperatives population, private sector and	• Akhaltsikhe City Hall • EC-LEDS project • USAID • GIZ • EU

				Municipality in the process of energy efficiency measures' implementation	
Training for Akhaltsikhe the personnel which will be able to perform skilled work and produce recommendations for successful implementation of CoM process.	• Akhaltsikhe City Hall SEAP Group • Special Department at the City Hall (this could be Energy Efficiency Centre or Energy Manager) which will provide both the City Hall and the population as well as the private sector with recommendations	• Setting up of special group/Department at the Akhaltsikhe City Hall or outside it serving both the City Hall in the process of SEAP implementation and monitoring as well as working with city population and private sector on offering modern technologies. • Working out of training program for the mentioned group. The program should include at least issues on sustainable energy, climate change mitigation measures, EU Directives, CoM requirements and the analysis of contemporary technologies in view of barriers to their deployment • Preparation of manual for mentioned group • Involving the Group in exchange programs and different information networks for getting local and international experience.	• Akhaltsikhe City Hall • Ministry of Energy • Ministry of Environment and Natural Resources Protection • Focal Point of CoM process in Georgia (at this stage-the Energy Efficiency Center)	• The program and manual are developed for training the City Hall SEAP Group personnel. • The rights and obligations of this Group and its working program are formulated, envisaging both the City Hall assistance and the cooperation with citizens and the private sector. • The SEAP Group is actively involved in exchange programs and international networks to obtain newest information on modern technologies and approaches in energy sector.	• Akhaltsikhe City Hall • EC-LEDS project • USAID • GIZ • EU

		• Tentative candidates for this group as far as possible should be involved from the initial stage in the SEAP development process.		• Technical Group is ready to train necessary personnel for private sector.	
2. Public awareness raising and dissemination of information					
Widest possible dissemination of information and awareness raising among the general public. In this process the public should be well informed on social and economic advantages, which could be achieved as a result of energy sustainable development. The main direction of Municipality will be to inform the flat-owners cooperatives on energy efficiency measures, providing consultions and delivery newest information on technologies available at the market and especially on their introduction, on the best practice world over in this field.	• Flat-owners cooperatives • Non-governmental sector • Other public associations	• Development of information materials on measures and technologies, which will improve the living environment of population and save expenses on energy consumption. • Preparation of information materials for city population about the city of Akhaltsikhe (e.g. on its potential in developing energy efficiency and greenery, and how can the population contribute to these processes). • Preparation of information material for the city population on the energy efficiency measures undertaken by other cities-subscribers to the CoM and their outcomes. • Systematic meetings with population and training of propagandists to advocate the energy efficiency among cooperatives.	• Akhaltsikhe City Hall • Non-govermental sector	• The TV programs are prepared for local TV channel (The 9-th Channel) • Updating of information for the population of Akhaltsikhe is performed at the Municipality web-site (http://akhaltsikhe.ge/) and on Facebook page; • Inforamtion booklets are developed on the preferences of energy efficiency measures and their application. • Some pilot projects are implemented, providing maximal involvement of population.	• Akhaltsikhe City Hall • USAID • GIZ • EU

		• Involving the population in the process of pilot projects development and implementation			
3. Systematically informing Akhaltsikhe Municipality and City Assembly representatives					
Provision of informing local authorities on the advantages and prospects of sustainable energy consumption by the city, on the social and economic benefits of this initiative.	• Akhaltsikhe City Hall • Akhaltsikhe City Assembly	• Holding awareness raising workshops for City Hall and City Assembly representatives on the advantages and prospects of providing energy sustainable consumption. • Encouranging participation of City Hall and City Assembly staff at international meetings and conferences on the CoM process. • Inclusion of mass-media representatives in the high level meetings on the CoM issues and maximal public awareness raising by this way on the current processes. • Providing the decision making process in the frames of CoM via consultations with stakeholders.	• Regional Energy Efficiency Center • Ministry of Energy of Georgia • Ministry of Environment and Natural Resources Protection	• Illustratvie materials are prepared for holding information meeting; • Awareness raising meetings are being held (at least twice a year); • Experts from the EU and other donor countries are invited to carry out workshops on modern technologies and approaches; • The approved resolutions and discussed projects and measures are publisized by mass-media.	• EC-LEDS • USAID • EU-COM • GIZ • Partnership for mitigation • GHG emissions reduction projects • Georgia's National Communicatio ns on Climate Change

				• Representatives of City Hall and City Assembly are fully involved in processes going on both in the country and at the international level as well; • Constantly updated information on current processes and projects is available at the City Hall website.	
Long-range objectives (2018-2020) The major objective of the long-range strategy is to involve the private sector in achieving the SEAP goals, maximal awareness raising of population and the private sector on prohibition measures and standards, awareness raising on the role of banning measures and standards in providing the sustainable consumption of energy.	• Akhltsikhe City Hall • Akhltsikhe City Assembly • Population of Akhaltsikhe • Private sector • Non-governmental sector		• Akhltsikhe City Hall • Akhltsikhe City Assembly • Energy Efficiency Center • Private sector's initiative groups • CoM programs and projects		
1. **Involvement of private sector in achieving the SEAP goals**					

Strengthening of private sector involvement in the SEAP implementation by providing information on energy saving and beneficial technologies, offering programs on cooperation between public and private sectors.	• Private sector • Initiative groups of private sector	• Taking an interest of private sector using different stimulating mechanisms in the application of innovative technologies (e.g. establishing certain privileges in the frames of local taxes for companies, introducing energy efficient and innovation technologies); • Providing consulting services to private sector aimed at decreasing the risks; • Setting up of different funds, aiming the deployment of new technologies for the reduction of risks, related with adapting of new technologies; • Promoting the creation of private sector initiative groups, facilitating maximal involvement of this sector in the CoM processes.	• Akhltsikhe City Hall • Energy Efficiency Center • Private sector • Non-governmental sector	• Various measures are being held annually • Motivating mechanisms for private sector are elaborated to provide its involvement in processes of new technologies development and introduction; • The Energy Efficiency Agency/Energy Manager is set up, providing consultations on the deployment of new technologies; • Risk-insurance financial schemes related with technologies are created for the private sector; • Initiative groups are organized in different sectors, being the main connecting ring between the state and private sectors;	Akhltsikhe City Hall Private sector EU COM GEF UNFCCC programs

				• Representatives of private sector are incorporated in international processes, associations and professional networks.	
2. Strengthening of consultations with stakeholders in the process of introducing prohibitive measures and standards					
Intensifying consultations with stakeholders (city population, private sector, non-governmental sector) on the introduction of prohibitive measures and standards, to be carried out by Municipality in different sectors (construction, transport, waste)	• Akhltsikhe City Hall • Akhltsikhe City Assembly • Population of Akhaltsikhe • Akhaltsikhe acting private sector • Non-governmental sector	• Giving widest explanations on developed standards and prohibitive measures in different SEAP sectors to the population, private sector and other target groups. • Preparing the appropriate advocating materials, explaining the social and environmental benefits of undertaking the mentined above measures. • It would be necessary to prepare/train the activists, who will cooperate on a daily basis with the target groups.	• Akhltsikhe City Hall • Energy Efficiency Agency/ Energy Manager	• Staff members, who will systematically cooperate with target groups, are trained; • Explanations and consultations on restrictive measures and standards, the implementation of which is necessary to realize the SEAP, are systematially conducted. The non-governmental sector actively cooperates with the population and various target groups. • Mass-media is actively involved in explaining social and	Akhltsikhe City Hall Akhltsikhe City Assembly

				environmental benefits of discussed measures (clips, talks, etc.)	
3. Identification of barriers by consulting with stakeholders					
Identification of barriers via consultations with stakeholders, which may arise in the process of introducing prohibitive measures and different types of standards	• Akhltsikhe City Hall • Akhltsikhe City Assembly • Population of Akhaltsikhe • Akhaltsikhe acting private sector • Non-governmental sector	• Identification of barriers in the process of consultations with the population on the developed standards and restrictive measures for the SEAP sectors; • Working out of measures to overcome the determined barriers by consulting with different target groups (e.g. transportation in certain district or the street should be prohibited gradually, in defined days of the week. Yet, some measures, e.g. technical inspection of cars, should be taken simultaineously under the government decision, etc.).	• Akhltsikhe City Hall • Akhltsikhe City Assembly	• Groups are trained (private sector initiative group, non-govenrnmental sector, mass-media) to carry out consultations; • For each sector, discussed in the SEAP, barriers are indetified; • In cooperation with target groups the measures to overcome the barriers are revealed.	• Akhltsikhe City Hall
4. Awareness raising among decision makers, representatives of public and private sectors on the role of prohibitive measures and standards in providing sustainable energy consumption					
Development and implementation of awareness raising and stimulating programs for different target groups to provide the unimpeded	• Akhltsikhe City Hall • Akhltsikhe City Assembly	• Informing decision makers and implementers on successful and ineffective international practivies; • Participation of decision makers and implementers in international	• Akhltsikhe City Hall • The CoM programs and projects	• Decision makers and implementers are involved and well-informed on the current international processes, Georgia's commitments on	Government of Georgia EC-LEDS EU-CoM

introduction of standards (e.g. in energy efficiency). This section will be more effective in awareness raising among decision makers and implementers and for their preparedness to the mentioned processes.	• Residents of Akhaltsikhe • Akhaltsikhe acting private sector	processes related with CoM and low emission development; • While developing information materials for decision makers and implementers on restrictive measures and new strandards the emphasis should be made on the need for energy sustainable consumption to provide Georgia's independence in energy supply; • While dealing through the mass-media with questions on decisions concerning restrictive to the population measures and the new strandards, special attention should be paid to social and environmental issues, as well as to the encouragement of tourism; • While dealing through the mass-media with questions on decisions concerning restrictive to private sector measures and the new standards, special attention should be attributed to economic benefits in the long-range perspective.		climate change and energy efficiency; • Information portfolios are developed in which the CoM process is appropriately analised in the context of EU Directives implementation; • Good practice manuals are compiled; • The involvement of foreign consultants should be necessary in this process.	GIZ Clima East And other offered in the future programs.

The implementation structure

- This strategy, as a constituent part of the City Development Action Plan, is approved and its implementation is monitored by the Akhaltsikhe City Assembly;
- The responsible body on updating the Strategy and its performing is Akhaltsikhe City Hall;
- The responsible body for training local staff, necessary to execute the Strategy and monitor its implementation will be the "Energy Efficiency Agency"/"Energy Manager", setting up of which is one of priorities to the Akhaltsikhe City Hall and is planned to be established. To create the capacity for t his Agency the local and international programs, going on in the frames of CoM will be used.
- The development of awareness raising and onformation dissemination Materials at the initial stage mainly should be conducted using the outside resources (non-governmental sector).

9 Plan for the Monitoring, Verfication and Reporting on the Implementation of SEAP and GHG Emissions Reduction in Akhaltsikhe

To plan and carry out monitoring measures on the implementation of Akhaltsikhe SEAP and the reduction of GHG emissions, the way local government reforms are carried out is of significant importance. This is also true of the internal organizational structure of its executive body (compliance to legislative amendments). The effectiveness of local financial and human resource development and growth are of great importance to self-governing units, especially to those, which gained the self-governing status in 2014, e.g. the city of Akhaltsikhe. If these resources are lacking and appropriate technical skills and knowledge are not present, the successful implementation of SEAP is compromised.

That is why, in this transitional phase, the monitoring plan can include several options, however a distribution of functions and clear separation of rights and responsibilities between internal structural units of municipalities and external resources will be most effective. An effective approach uses both internal and external resources for monitoring. Creating the action plan showed that one of the most important problems of Akhaltsikhe and other cities in Georgia is obtaining data on energy consumption from the necessary sectors for the base year emissions inventory. In many cases, no data accounting system existed since they were not previously used to evaluate economic parameters. Sometimes the database needs additional processing, which can only be done by the owners of the source data because there is always additional commercial information that could be confidential. Generally, the collection of necessary data

requires significant time and human resources, but municipalities do not have well organized statistical/analytical tools or analytical departments.

With the exception of some larger municipalities, there are no municipal-level statistics offices in Georgia, and this impedes SEAP implementation and monitoring. To reduce the risks from a lack of data, the "Monitoring" section of the Akhaltsikhe SEAP offers a performance methodology that seeks to compensate for these lacunae. One measure is to create a data register for monitoring baseline scenarios that is updated regularly with systematic information from the Akhaltsikhe SEAP monitoring group[50]. Thus monitoring, verification and reporting will take a minimum of time, as they can use regular updates from available data.

For internal monitoring and analysis, the responsible department/divisions within Akhaltsikhe City Hall should have software that is easy to use for non-specialists that calculates baseline scenario emissions and quantities of reduced emissions for different measures or combined data from the BAU scenario. Local staff will undergo software training to ensure effective use of the program.

When periodic monitoring reports on the SEAP implementation are being created, based on conditions from the CoM, the involvement of invited experts should be considered, especially for the first mandatory reporting process.

Main activities included in the Monitoring and Reporting process of Akhaltsikhe are:

1. Regular updating of the Baseline Scenario (BAU);
2. Assessment of emissions reduced after taken measures and implemented projects;
3. Development of final report;
4. Determine how to simplify the monitoring system in future.

Under the current action plan the parties responsible for these activities are:

1. The Akhaltsikhe Municipality: responsible for obtaining statistical information about main parameters (GDP, population, per capita income, share of economic activities/economic sectors in GDP, etc.), and describing city development processes. To calculate the baseline scenario, external technical assistance could be approved by the municipality for carry out this work. The calculation of the baseline scenario and a renewal methodology plan as well as the simplified computer program (MUNI – EIPMP) will be sent to the City Hall under the LEDS by the Georgian Government and coordinated with the CoM. Emissions factors will also be aligned with the responsible authority of the UN Framework Convention on Climate Change in Georgia.

[50] Aimed at this task, while developing the SEAP, the City Hall has specially appointed responsible person who will continue to coordinate the monitoring process, while the main unit in statistics gathering will be the Akhaltsikhe City Hall Urban Planning and City Economy Departmnets. At the present stage the second option is also discussed, according to which a special group should be set up in the Akhaltsikhe Municipality (the Sustainable Develoment Agency), incorporated in cetain LLC, or a new LLC could be organized exceptionally for implementing and monitoring of the SEAP.

2. Implementing Unit/Project owners who will collect information needed to calculate reduced emissions. The Municipality will provide them with the data collection methodology and will ensure periodic verification. The Municipality is responsible for calculating and verifying final emissions, although the work can be done either by the Municipality, or by external expertise accredited by the CoM. Periodic verification of activity data provided by the project executor is the responsibility of the Municipality as well.
3. The City Hall, which is responsible for a final report that must be approved by the City Council, after which it will be submitted to the EU. The Report will include monitoring results, general parameters that have to be monitored during the SEAP implementation, quality quality assurance and quality control (QA/QC) procedures and emissions factors. Based on this, a specific year baseline scenario will be updated and reduced emissions calculated.

9.1 Responsible unit for the monitoring in AKhaltsikhe Municipality

In Akhaltsikhe Municipality the overall responsibility on the CoM and the development and implementation of the SEAP, its systematic updating according to new circumstances and development plans currently falls to specially appointed Coordinator and the City Hall Department on Property Management, Economic Development, Statistics, Infrastructure, Spacial Arrangement, Architecture and Construction (later on "Department of Economic Development"). Presumably this Department will be finally responsible for the conduction of monitoring, the analysis of its results and their consideration in the process of SEAP updating, for the verification of activity and monitoring results, as well as preparation of Monitoring Final Report, which will be approved by the Akhaltsikhe City Assebly before submitting to the EU. The Coordinator and relevant divisions of the Department of Economic Development also will be responsible for gathering the activity data, improvement of their quality and updating, identifying the new sources. The Coordinator and Economic Development Department can use in this process other Departments and LLC-es, subordinated to the Municipality, as well as certified external resources. Initially and later on the resources of nearest Regional Energy Efficiency Center[51] could be employed as well. In case of setting up of Regional Energy Efficiency Centres, this part of monitoring should be correspondingly modified and significant portion of activities, listed here will be implemented by them.

There are four main sectors considered within the Sustainable Energy Action Plan of Akhaltsikhe: Buildings sector, Transportation sector, Street lighting sector and increasing emission sinks by green area development (Greening sector). In order to evaluate each sector's baseline scenario, information on activity data is necessary. Each implemented project and measure must be monitored for its quantitative emissions reduction value and its total

[51] Setting up of such Regional Centers is planned in the frames of current EC-LEDS project.

emissions savings compared with the baseline scenario. The amount of final emission reductions can then be analyzed. At this stage, Akhaltsikhe City Hall is considering two options for monitoring and collecting sector-related data: a) Collect and provide statistical data according to each City Hall department; b) Archive data and carry out primary processing by the "Sustainable Development Agency" (later on "Agency"), planned to be set up in the nearest future.

Figure 13 demonstrates departments of City Hall and LLC-es, which will be responsible to collect data for monitoring before the setting up of Agency and its productive functioning.

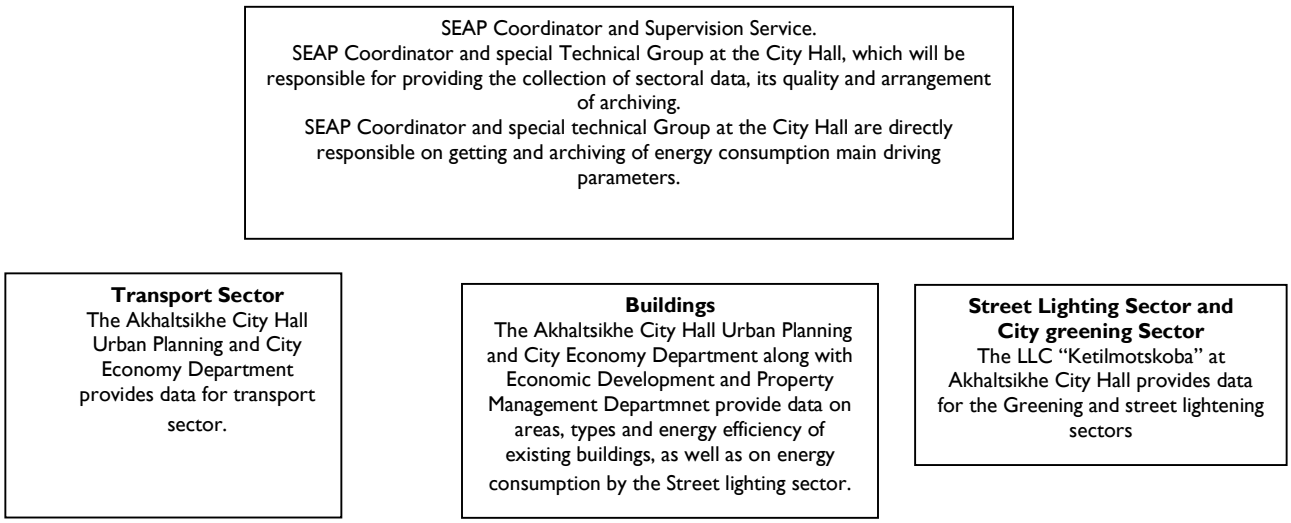


Figure 13. Monitoring Process Management

Four types of data will be collected and evaluated to prepare monitoring reports for each sector:

- Annual emissions in CO_2equivalent;
- Measures and project implementation status and emissions savings for a given period;
- Driving parameters of the baseline scenario (for example, in the transport sector: population, GDP, income growth and passenger-kilometers according to transport types);
- Economic and social effects of the measures taken.

In addition to these types of data other primary parameters can be considered for the monitoring process, taken from different sources and secondary data, and then automatically calculated with muni_EIPMP software. An approved special Technical Group and Energy Manager from the Akhaltsikhe Municipality will be responsible for annual reporting. These will

be compiled every two years and submitted to an independent third party for verification[52]. It is implied that the third party will be provided by EU Covenant of Mayors Office. The monitoring report structure is already worked out by the EU Research Centre, however it is expected that for the perfection of monitoring process new approaches and methodologies will be gradually introduced. In this case, where it will be relevant, the results obtained under the old methodology must be recounted with the new one to provide the conformity of results acquired in different years to the BAU data.

9.2 Monitoring of main driving parameters featuring GHG baseline inventory (BEI), BAU scenario and GHG baseline inventory monitoring (MEI)

The purpose of discussed below parameters is to conduct the MEI and update the BAU scenario in view of important social and economic changes going on in the city. Information presented in Tables below refers to 2014, taken as a base year for the GHG inventory in the Telavi SEAP. On the basis of these parameters and their 2014 values the Telavi energy consumption development scenario (BAU) has been developed for 2020. In comments it is explained how to update these parameters for the compilation of SEAP Monitoring Report.

Data/Parameter # 9.2.1	**Population through the monitoring year**
Data unit:	Number of population
Description:	Primary data[53]; Annual monitoring.
Source of data used:	Annual statistics (www.Geostat.ge) and local statistics
Value applied in SEAP:	**20 500 (2014)**
Any comments	On the basis of number of population in the monitoring year the increment should be calculated relevant to 2014 and the compliance with the reality of SEAP assumption on population growth must be assessed. This information will be used later in the comparative analysis of new and old BAU scenarios aimed at revealing the causes of deviation.

Data/Parameter # 9.2.2	**Gross Domestic Product (GDP) in the monitoring year**
Data unit:	Million GEL
Description:	Calculated data; Annual monitoring
Source of data used:	Statistical annual (www.Geostat.ge) and local statistics. This SEAP source was Telavi Municipality.
Value applied:	This value has not been used in SEAP, because it did not exist, but must be evaluated for future monitoring.

[52] The frequency of monitoring is determined by the CoM Office. At this stage it is decided that the report on the monitoring of taken measures must be submitted at least with 2-year periodicity and complete monitoring report with calculations of reduction emissions – once in every 4 years.

[53]Data is considered primary if it is not calculated in the monitoring process and is taken from different sources. Primary sources may be calculated, but has to be drawn from a specific source and implementers should get the finished data.

Any comments	National Statistics Office publishes information only about annual GDP of the Region. In this case, using the Samtskhe-Javakheti Region's GDP and its total population, the per capita GDP in this Region could be evaluated, multiplied further by the number of population in Akhaltsikhe. Besides such assessment more precise methods could be used which also must be well described as well. The value of GDP in the monitoring year is used for recounting the BAU scenario, additional check-up of different quantities and their observation, data control and monitoring of emissions trends per unit of GDP, assessment of emissions intensity in the process of economy development.

Emission Factors

Data/Parameter # 9.2.3	**Grid emission factor**
Data unit:	tCO_2/MWh
Description:	Primary data. Calculated at the national level and provided to municipalities
Source of data used:	Calculated especially for SEAP, but there is also a value calculated for the Kyoto Protocol's Clean Development Mechanism projects (Ministry of Environment and Natural Resources Protection of Georgia)
Value applied:	0.104 t CO_2/MWh
Any comments	The emissions factor is calculated using average method by dividing annual emissions from the power sector by annual electricity generation. This emission factor is calculated centrally in order to monitor low emissions and is delivered to municipalities for their SEAPs. During SEAP preparation the used grid emissions factor has been calculated by averaging, since Akhaltsikhe does not produce electricity independently but receives it from the centralized energy system of Georgia.

Data/Parameter # 9.2.4	**Natural Gas (NG) emission factors**
Data unit:	t/TJ, or Kg/TJ
Description:	Primary data
Source of data used:	At this stage, the IPCC calculated typical value is being used (applied for Tier 1 calculations)
Value applied:	55.78 CO2 T/TJ; 5 CH4 Kg/TJ; 0.1 N2O Kg/Tj.
Any comments	It is recommended to use the national calculated value that depends on the natural gas calorific value (NCV). This should be updated constantly during the monitoring process using information about gas caloricity consumption.

Data/Parameter # 9.2.5	**Gasoline emission factors**
Data unit:	t/TJ, Kg/TJ
Description:	Primary data
Source of data used:	At this stage, the IPCC calculated typical value is being used (applied for Tier 1 calculations)
Value applied:	68.6 tCO2/Tj; 20 Kg CH4/Tj; 0.6 Kg N2O /Tj.

Any comments	It is recommended to use the national calculated value that depends on the carbon content of gasoline, and should be updated constantly during the monitoring process according to information on imported gasoline caloricity.

Data/Parameter # 9.2.6	**Diesel emission factors**
Data unit:	t/TJ, Kg/TJ
Description:	Primary data
Source of data used:	At this stage, the IPCC calculated typical value is being used (applied for Tier 1 calculations)
Value applied:	73.3 tCO2/Tj; 5 Kg CH4/Tj; 0.6 Kg N2O /Tj.
Any comments	It is recommended to use the national calculated value that depends on the carbon content of diesel, and should be updated constantly during the monitoring process according to information on imported diesel caloricity.

Data/Parameter # 9.2.7	**Net Calorific Value of Different Fuels (NCV) for, NG, Gasoline, Diesel**
Data unit:	TJ/Unit of fuel
Description:	Primary data. These data should be collected at the national level from fuel Importers.
Source of data used:	At this stage, typical values are used in the SEAP, provided by the IPCC
Value applied:	Gasoline 44.80 TJ/1000 t Natural gas 33.59 TJ/million m^3 Liquified Petrolium Gases (LPG) 47.34/1000 t Diesel 43.33 TJ/1000 t Firewood 7.50 TJ/million m^3 Coal 4.65 TJ/1000 t
Any comments	These data should be collected in the future for each type of fuel used in the country. The information sources are mainly fuel importers and distributors. Systematic update is recommended taking into account fuel parameters. It would be better to apply these typical data if local statistics is not available.

9.3 Activity Data Nessesary for Monitoring the Akhaltsikhe Transport Sector

Public Transport (minibuses)

Data/Parameter # 9.3.1.1	**Number of public transport-minibuses (according to fuel)**
Data unit:	Number of minibuses through the monitoring period (annual value)
Description:	Primary data.
Source of data used:	Data for the SEAP is provided by the Service Agency of the Ministry of Internal Affairs and EC-LEDS project questionings, as well as City Hall Departments.
Value applied:	Total 172 (Gasoline) 168 (Natural gas) (NG) 25 (Diesel) Among them 3 are operating in the city (diesel-powered)
Any comments	Public transportation in the city is performed by 3 private minibuses fueled by diesel. There are 2 shuttle routes in AKhaltsikhe. City Hall subsidizes trip expenses and establishes routes. Calculations were performed only for these 3 minibuses serving the Akhaltsikhe population.

Data/Parameter # 9.3.1.2	**Average distance traveled annually by one minibus according to fuel type (gasoline, diesel, NG)**
Data unit:	Km/yr
Description:	Primary data.
Source of data used:	Information provided for SEAP by independent expert on the basis of expert judgement after questioning private companies.
Value applied:	12 045 km (3 minibuses operating inside the city)
Any comments	It is recommended that this data be taken by the Monitoring Group directly from the minibus drivers or their companies. Responsible entity will be the Infrastructure Department of Akhaltsikhe Municipality as a city traffic regulating body. The Akhaltsikhe City Hall intends to set up public transport in the city and organize corresponding Transportation Service.

Data/Parameter # 9.3.1.3	**Total average distance traveled by all minibuses annually according to fuel type (gasoline, diesel, NG)**
Data unit:	Km/yr
Description:	Secondary data, calculated by the MUNI-EIPMP.
Source of data used:	3.1.3=3.1.1.*3.1.2.
Value applied:	36 135 km/yr (diesel)

Data/Parameter # 9.3.1.4	**Average consumption of fuel by 1 minibus per 100 km (by fuel type)**
Data unit:	m^3/100 km (NG)

	l/100 km (gasoline, diesel)
Description:	Primary data.
Source of data used:	Information to the SEAP provided by independent expert of the basis of expert judgement after questioning the owners of private minibuses and filling stations.
Value applied:	16 l/ 100 km (gasoline) 16 l/ 100 km (diesel) 8 m^3/100 km (NG)
Any comments	As a matter of fact this data must be rechecked with the technical certificate of minibus and be explained in case of significant discrepancy. These minibuses are second-hand, several times altered, operating on a very poor roads and thus their fuel consumption is differing considerably from the initial data of technical certificate.

Data/Parameter # 9.3.1.5	**Annual consumption of fuel by all minibuses by fuel type (gasoline, diesel, NG)**
Data unit:	m^3/yr l/yr
Description:	Secondary data. Should be calculated by the Monitoring group.
Source of data used:	Computed by the MUNI-EIPMP software. Number of diesel-powered minibuses multiplied by the fuel consumption per 100 km, multiplied by the annual run of 1 minibus and divided by 100 3.1.5=3.1.1*3.1.2*3.1.4/100.
Value applied:	5 782 l (diesel)
Any comments	This data is calculated by the Monitoring Group.

Data/Parameter # 9.3.1.6	**City minibus passenger load factor**
Data unit:	Passenger. km/trans. km
Description:	This parameter should be evaluated by statistical methods and surveys. It could be calculated by parameter 3.1.7 or estimated by another method.
Source of data used:	In case of Akhaltsikhe SEAP was not assessed and used.
Value applied:	Not assessed.
Any comments	This parameter is used only to assess GHG emissions reductions after measures are taken in the sector. The GHG annual inventory from the transport sector is not dependent on it. These data can be assessed through surveys, bus tickets sold at public transport stops, etc. If Parameter 3.1.7 (minibus mobility) is known, it can be calculated.

Data/Parameter # 9.3.1.7	**Minibus annual passenger turnover (mobility)**
Data unit:	Passenger. km/yr

Description:	Secondary data which is usually calculated through the load factor
Source of data used:	Total distances traveled by buses per year is multiplied by one bus load factor.
Value applied:	In the Akhaltsikhe SEAP at this stage this parameter was not estimated.
Any comments	This parameter is calculated by City Hall Transport Department, transportation companies or Statistics National Office for entire country.

Private (passenger) cars

Data/Parameter # 9.3.2.1	**Number of private cars registered in AKhaltsikhe (by fuel type)**
Data unit:	Number of cars
Description:	Primary data
Source of data used:	Service Agency at the Ministry of Internal Affairs. EC-LEDS project questionings.
Value applied:	3 712 (total) 1 912 (gasoline); 1 327 (diesel); 473 (NG)

Data/Parameter # 9.3.2.2	**Average annual distance traveled/run by one vehicle (by fuel type is recommended)**
Data unit:	km/yr
Description:	Primary data.
Source of data used:	Provided to the SEAP by independent expert. Assessed via questioning of private cars and EC-LEDS interviews.
Value applied:	4 138 km/yr.
Any comments	In future the National Statistics Office and interviews with drivers could be used to learn average daily run, then to make yearly calculation. Surveys should meet reliability criteria. Interviews and surveys to determine daily run and the SEAP implementation will be conducted simultaneously.

Data/Parameter # 9.3.2.3	**Average distance traveled by all passenger cars per year (by fuel types)**
Data unit:	Trans. km/yr
Description:	Calculated data.
Source of data used:	Computed by MUNI-EIPMP. Data # 3.2.1. and 3.2.2.
Value applied:	15 359 382 km (total) 7 911 406 km (gasoline) 5 490 814 km (diesel) 1 957 163 km (NG)

Any comments	Annual run of 1 passenger car multiplied by total number of passenger cars.

Data/Parameter # 9.3.2.4	**Fuel consumption per 100 km (by fuel type)**
Data unit:	l/ 100 km m^3/ 100 km KWh/ 100 km
Description:	Primary data.
Source of data used:	In general, this parameter is taken from registration certificate of a motor vehicle. While developing this SEAP the data has been provided by Akhaltsikhe Municipality through the questioning of private cars.
Value applied:	Gasoline- 10 l/ 100 km Diesel- 8 l/ 100 km NG- 5 m^3/ 100 km
Any comments	As a matter of fact, this data must be rechecked via registration certificates of private cars (according to their types) and be explained in case of significant discrepancy. Large part of private cars in Akhaltsikhe are second-hand, operating on a very poor roads and thus their fuel consumption differs considerably from the initial data of technical certificate.

Data/Parameter # 9.3.2.5	**Fuel annual consumption by all passenger cars according to fuel types (gasoline, diesel, NG)**
Data unit:	l/yr m^3/yr
Description:	Secondary data. Should be calculated by Monitoring Group
Source of data used:	Calculated with MUNI-EIPMP. 3.2.5=3.2.1.*3.2.2.*3.2.4/100 Number of fuel powered passenger cars multiplied by fuel consumption per 100 km, multiplied by one car annual run and divided by 100.
Value applied:	791 141 l Gasoline 439 265 l Diesel 97 858 m^3 NG
Any comments	This data is calculated by the Monitoring Group and should be compared to the spent fuel in the city. Significant error is expected, however. At this stage is calculated by "Remissia".

Data/Parameter # 9.3.2.6	**Transport Load Factor**
Data unit:	Passenger. Km/ trans. km

Description:	This parameter should be evaluated by statistical methods and surveys. It could be calculated from Parameter 3.2.7. If it is assessed, or estimated by another method.
Source of data used:	While preparing the Akhaltsikhe SEAP this parameter was not assessed.
Value applied:	Not evaluated.
Any comments	This parameter is used only to assess GHG emissions reductions after measures taken in the sector. The GHG annual inventory from transport sector is not dependent on it. This data can be assessed as a result of a survey if Parameter 3.3.7 is known (mobility of private passenger cars) and calculated : #3.2.7/3.2.1/3.2.2

Data/Parameter # 9.3.2.7	**Total number of passengers transported by all passenger cars a year (annual mobility of private cars)**
Data unit:	Passenger. Km/ trans. km
Description:	Secondary data calculated usually through the load factor
Source of data used:	While preparing the Akhaltsikhe SEAP this parameter was not assessed
Value applied:	Not evaluated.
Any comments	Number of vehicles is multiplied by one car's annual run and multiplied by the average load factor of a car.

Municipality Serving Vehicle Fleet

Data/Parameter # 9.3.3.1	**Akhaltsikhe Municipality service vehicles (by fuel type)**
Data unit:	Number of vehicles
Description:	Primary data.
Source of data used:	Provided to the SEAP by Akaltsikhe Municipality
Value applied:	Total: 44 Gasoline- 37, Diesel- 7.
Any comments	Akaltsikhe Municipality Economy/Transport Department is responsible for this data.

Data/Parameter # 9.3.3.2	**Average distance traveled by one vehicle a year (by fuel and vehicle types)**
Data unit:	km/yr
Description:	Primary data.

Source of data used:	Provided to the SEAP by Akaltsikhe City Hall Departments
Value applied:	17 317 km/yr
Any comments	Akaltsikhe City Hall Urban Development and City Economy Department

Data/Parameter # 9.3.3.3	**Average distance traveled by Municipality serving vehicles annually**
Data unit:	Trans. km/yr
Description:	Calculated data.
Source of data used:	Calculated by the MUNI-EIPMP. Data # 3.3.1 and 3.3.2
Value applied:	640 739 km (gasoline), 121 221 km (diesel).
Any comments	Verification should be performed by comparing the run with consumed fuel.

Data/Parameter # 9.3.3.4	**Fuel consumption per 100 km by fuel and vehicle types**
Data unit:	l/100 km
Description:	Primary data.
Source of data used:	Provided to the SEAP by Akhaltsikhe Municipality.
Value applied:	Gasoline- 11 Diesel- 12.5
Any comments	The Akhaltsikhe City Hall Urban Development and City Economy Department is responsible for these data. Could be verified by the vehicle certificate data.

Data/Parameter # 9.3.3.5	**Annual fuel consumption by the entire municipal vehicle fleet by fuel types**
Data unit:	l/ yr m^3/yr
Description:	Secondary data. Calculated by the Monitoring Group. At this stage calculated by "Remissia".
Source of data used:	Calculated with MUNI-EIPMP. 3.3.5=3.3.1.*3.3.2.*3.3.4/100
Value applied:	70 481 (gasoline) 15 153 (diesel)
Any comments	Verification should be performed accounting to consumed fuel costs.

Commercial Transport (Taxi)

Data/Parameter # 9.3.4.1	**Number of taxi cabs operating in Akhaltsikhe by fuel type**
Data unit:	Number of taxis by fuel type
Description:	Primary data.
Source of data used:	Provided to the SEAP by independent expert and considering questionings in the frames of EC-LEDS project
Value applied:	187: (total) 126 (gasoline); 31 (diesel); 30 (NG).
Any comments	Akhaltsikhe Municipality Infrastructure Development (Transport) Department will be responsible for getting thisinformation. Primary verification of these data is the responsibility of the City Hall Infrastructure Service, but they can control officially registered taxis only, thus the reliability of the data is very low. More likely this is to be reflected in total amount of fuel sold.

Data/Parameter # 9.3.4.2	**Average distance traveled by one taxi annually (by fuel type)**
Data unit:	Km/yr
Description:	Primary data.
Source of data used:	Provided for the SEAP by independent expert on the basis of questionings considering the EC-LEDS project examinations.
Value applied:	17 280 km/yr
Any comments	The Akhaltsikhe Municipality Economic Department/Infrastructure (Transport) Service will be responsible for collecting these data. These data for officially registered taxis can be obtained from the Revenue Service or Taxi unions. Estimations should be made by questioning drivers and observations. Present data is obtained by observations and questioning/survey.

Data/Parameter # 9.3.4.3	**Average distance covered by all taxis annually (by fuel type is recommended)**
Data unit:	Trans. km/yr
Description:	Calculated data.
Source of data used:	Calculated by the MUNI-EIPMP. Data # 3.4.1 and 3.4.2
Value applied:	2 177 280 km (gasoline) 535 680 km (diesel) 518 400 km (NG)

Any comments	At this stage calculated by "Remissia". Later on will be calculated by the Monitoring Group

Data/Parameter # 9.3.4.4	**Fuel consumption by vehicle type**
Data unit:	l/ 100 km m^3/ 100 km
Description:	Primary data.
Source of data used:	Provided for the SEAP by independent expert based upon expert judgement, EC-LEDS project questionings and other sources, private companies.
Value applied:	Gasoline 11.5 l/ 100 km Diesel 10.5 l/ 100 km NG 6.5 m^3/ 100 km
Any comments	Registration certificate could be used for verification, but majority of taxis are second- hand and their actual consumption differs from certificate data.

Data/Parameter # 9.3.4.5	**Annual fuel consumption by taxis according to fuel types**
Data unit:	l/yr m^3/yr
Description:	Secondary data.
Source of data used:	Computed by MUNI-EIPMP. 3.4.5=3.4.1.*3.4.2.*3.4.4./100
Value applied:	250 387 l (gasoline) 56 246 l (diesel) 33 696 m^3 (NG)
Any comments	Number of gasoline (or gas) fueled taxis multiplied by fuel consumption per 100 km, multiplied by one taxi annual run and divided by 100. At this stage calculated by "Remissia". Later on will be calculated by the Monitoring Group.

Data/Parameter # 9.3.4.6	**Passenger load factor for taxi cabs (load factor)**
Data unit:	Passenger. Km/trans.km
Description:	This parameter should be evaluated by statistical methods and surveys. It could be calculated from parameter 3.4.7 if it is assessed using other metod.
Source of data used:	Was not assessed for Akhaltsikhe SEAP
Value applied:	Not evaluated

Data/Parameter # 9.3.4.7	Total number of passengers carried by all taxi cabs a year (annual mobility of taxis)
Data unit:	Passenger. km/yr
Description:	Secondary parameter.
Source of data used:	Calculation must be conducted by the Monitoring Group.
Value applied:	Not assessed
Any comments	3.4.7=3.4.1.*3.4.2.*3.4.6.

Commercial vehicles: light-duty trucks (down to 2 tons capacity)

Data/Parameter # 9.3.5.1	**Light-duty trucks driving inside Akhaltsikhe by fuel types**
Data unit:	Number of light-duty trucks by fuel type
Description:	Primary parameter.
Source of data used:	Provided to the SEAP by independent expert. The source is Ministry of Internal Affairs Service Agency and private transportation companies.
Value applied:	242 (total) Gasoline- 130; Diesel- 112: NG- 0.
Any comments	Responsible for the initial verification of these data is the City Hall Monitoring Group.

Data/Parameter # 9.3.5.2	**Average distance traveled by one light-duty truck a year (by fuel type is recommended)**
Data unit:	km/yr
Description:	Primary parameter.
Source of data used:	Provided for the SEAP by independent expert. Information obtained under questioning of private companies and expert judgement.
Value applied:	28 235 km/yr.
Any comments	Responsible for the initial verification of these data will be the City Hall Economic Development Department's Transportation Service or the Monitoring Group

Data/Parameter # 9.3.5.3	**Average distance traveled by light-duty truck a year (by fuel type is recommended)**
Data unit:	Trans. km/yr
Description:	Secondary data.

Source of data used:	Computed with MUNI-EIPMP by "Remissia". Data # 3.5.1 and 3.5.2
Value applied:	3 670 512 km (gasoline) 3 162 288 km (diesel)

Data/Parameter # 9.3.5.4	**Fuel consumption by light-duty trucks according to vehicle types**
Data unit:	l/ 100 km m^3/ 100 km
Description:	Primary parameter.
Source of data used:	Provided for the SEAP by independent expert on the basis of questionings, expert judgement and survey among private companies.
Value applied:	Gasoline- 15 l Diesel- 10 l
Any comments	This data should be verified with vehicle registration certificate and in case of significant discrepancy must be explained.

Data/Parameter # 9.3.5.5	**Annual fuel consumption by vehicle and fuel types**
Data unit:	l/ yr m^3/yr
Description:	Secondary data.
Source of data used:	Computed with MUNI-EIPMP by "Remissia" 3.5.5=3.5.1.*3.5.2.*3.5.4/100
Value applied:	550 577 l gasoline 316 229 l diesel
Any comments	Number of light-duty trucks powered by different types of fuel multiplied by fuel consumption per 100 km, multiplied by annual run of the track and divided by 100.

Data/Parameter # 9.3.5.6	**Light-duty trucks load factor**
Data unit:	Ton. Km/trans.km
Description:	This parameter should be evaluated by statistical methods and surveys. It could be calculated from parameter 3.5.7 if it is assessed or estimated by another method.
Source of data used:	While developing the Akhatsikhe SEAP this parameter was not assessed.
Value applied:	Not estimated.
Any comments	Essential in calculations of measures taken

Data/Parameter # 9.3.5.7	**Transported freight by all light-duty trucks in a year (annual freight turnover)**
Data unit:	Ton. km/yr
Description:	Secondary data.
Source of data used:	Computed with MUNI-EIPMP by "Remissia". Data # 3.5.1.*3.5.2.*3.5.6.
Value applied:	Not assessed.
Any comments	Number of light-duty trucks (<2 ton capacity) multiplied by their annual run, multiplied by transported freight per one vehicle (ton).This parameter can by verified through freight actually transported and the relevant run by vehicles.

Commercial transport (Heavy-Duty Trucks up to 2 ton capacity)

Data/Parameter # 9.3.6.1	**Number of heavy duty trucks operating in Akhaltsikhe**
Data unit:	Number of heavy-duty trucks by fuel type
Description:	Primary data.
Source of data used:	Provided for the SEAP by independent expert. Sources- Ministry of Internal Affairs Service Agency and private transportation companies.
Value applied:	118 (total) 29 (gasoline) 73 (diesel) 16 (NG)
Any comments	Primary verification of these data will be the responsibility of the Infrastructure Department of the City Hall and the Monitoring Group.

Data/Parameter # 9.3.6.2	**Average distance covered by one heavy-duty truck a year (by fuel type is recommended)**
Data unit:	Km/yr
Description:	Primary data.
Source of data used:	Provided to the SEAP by independent local expert on the basis of questioning among private companies and expert judgement.
Value applied:	3 613
Any comments	Primary verification of these data will be the City Hall Transport Department.

Data/Parameter # 9.3.6.3	**Average distance covered by all heavy-duty truck a year (by fuel type is recommended)**
Data unit:	Trans. km/yr
Description:	Calculated data.

Source of data used:	Computed with MUNI-EIPMP by "Remissia". Data # 3.6.1 and 3.6.2
Value applied:	104 778 km (gasoline) 263 751 km (diesel) 57 809 km (NG)

Data/Parameter # 9.3.6.4	**Fuel consumption by vehicle type**
Data unit:	l/ 100 km m^3/ 100 km
Description:	Primary data.
Source of data used:	Registration certificate of the vehicle. Provided to the SEAP by independent local expert basing upon expert judgement and questioning of private companies.
Value applied:	Gasoline- 25 l Diesel- 18 l NG- 10 m^3

Data/Parameter # 9.3.6.5	**Annual fuel consumption according to vehicle and fuel types**
Data unit:	l/yr
Description:	Secondary data.
Source of data used:	Computed with MUNI-EIPMP by "Remissia".
Value applied:	26 194 l gasoline 47 475 l diesel 5 781 m^3 NG

Data/Parameter # 9.3.6.6	**Heavy-duty trucks load factor**
Data unit:	Ton. Km/car. km
Description:	Primary data.
Source of data used:	While developing the Akhaltsikhe SEAP this parameter was not assessed
Value applied:	Not estimated
Any comments	Required to assess emissions saving from measures implemented during the monitoring period.

Data/Parameter # 9.3.6.7	**Transported freight by all heavy-duty trucks in a year (annual freight turnover)**
Data unit:	Ton. km/yr
Description:	Secondary data.
Source of data used:	Computed with MUNI-EIPMP by "Remissia" Data # 3.6.1.*3.6.2.*3.6.6
Value applied:	Not assessed
Any comments	These parameters could be verified via actual annually transported freight and relevant total run of trucks.

Data/Parameter # 9.3.6.8	**Total amount of fuel consumed in Akhaltsikhe Transport sector by fuel types**
Data unit:	l/yr m^3/yr
Description:	Secondary data calculated during the monitoring and SEAP development process
Source of data used:	Calculated by the SEAP tean ("Remissia") using emissions growth index derived by the EU Research Center.
Value applied:	Consumed through 2014 under the SEAP: 26 106 MWh equivalent fuel, corresponding to 6 593 tCO_2eq emission. In 2020 the emission of 8 967 tCO_2eq is projected.
Any comments	This is one of the most important data for balance verification during the monitoring process.

9.4 Buildings sector

Baseline Emissions Monitoring

Data/Parameter # 9.4.1	**Areas of municipal buildings according to their purpose (kindergartens, administrative, etc.)**
Data unit:	m^2
Description:	Primary parameter
Source of data used:	SEAP Development Coordinator appointed by the Akhaltsikhe City Hall and City Hall Architecture, Construction and Statistics Departments.
Value applied:	Total- 21 946 Kindergartens- 5 816 Municipal administrative buildings- 6 618

	Other municipal buildings- 9 512
Any comments	Information possessed by the City Hall.

Data/Parameter # 9.4.2	**Annual consumption of electric energy by municipal buildings**
Data unit:	MWh/yr
Description:	Primary parameter.
Source of data used:	The Akhaltsikhe City Hall Finance Department. Final accuracy of data is under the responsibility of Akhaltsikhe SEAP Coordinator.
Value applied:	Total- 328. 4 Kindergartens- 23.9 Municipal administrative buildings- 268 Other municipal buildings- 36.3
Any comments	These data should be revised at the Energo-Pro distribution company and by energy audit assessments.

Data/Parameter # 9.4.3	**Areas of Akhaltsikhe residential buildings by types (one and two-storey private houses, multi-storey buildings, etc.**
Data unit:	m^2
Description:	Primary parameter.
Source of data used:	Provided to the SEAP Group by the Akhaltsikhe City Hall Archtecture/Urban Development Department. Information on the multi-storey buildings is possessed by the City Hall's Economic Development Department, which implements various types of social projects for these buildings. Data on the number of private houses (mainly one- and two-storey) are owned by the City Hall Architecture/ Urban Development Department. The total area of these buildings was assessed by the local expert.
Value applied:	Total- 1 065 832 Residential buildings- 436 282 Private dwelling houses- 629 550
Any comments	

Data/Parameter # 9.4.4	**Annual energy consumption by residential buildings according to their types**
Data unit:	MWh/yr
Description:	Primary parameter.

Source of data used:	"Energo-Pro Georgia". Representative of Akhaltsikhe City Hall/Coordinator is responsible for the eventual quality of data.
Value applied:	Total- 9 681 Residential buildings- 3 997 Private dwelling houses- 5 683
Any comments	Acquiring data on energy consumption according to types of the buildings proved to be impossible. At this stage the city of Akhaltsikhe has a common electricity feeder with some neighboring villages, hence the separation of city energy consumption was performed on the basis of expert judgement. This data could be verified by questioning of typical buildings and relying on energy audit estimations. The presented data reflects the 2014 consumption.

Data/Parameter # 9.4.5	**Total area of commercial buildings in Akhaltsikhe**
Data unit:	m^2
Description:	Primary parameter.
Source of data used:	The SEAP team was provided by Akhaltsikhe City Hall Coordinator. Large part of commercial areas was counted using the cleaning tax value, mostly determined by the area of commercial buildings, and the remnant areas by estimation at the site. Earlier the schools belonged to the City Hall and accordingly areas of schools were assessed by this old data, as they were not significantly altered in recent years.
Value applied:	Total- 1 714 508 Schools- 44 346 Other state buildings- 1 334 929 Other commercial buildings- 335 233
Any comments	

Data/Parameter # 9.4.6	**Annual electricity consumption by commercial buildings**
Data unit:	MWh/yr
Description:	Primary parameter.
Source of data used:	"Energo-Pro Georgia". The Akhaltsikhe City Hall is responsible for the ultimate quality of data.
Value applied:	3 555
Any comments	This data could be verified by the questioning of commercial buildings and using the energy audit assessments.

Data/Parameter # 9.4.7	**Annual consumption of natural and liquid (LPG) gas by municipal buildings**
Data unit:	m^3/yr; kg/yr (MWh/yr)
Description:	Primary parameter.
Source of data used:	Akhaltsikhe City Hall Finance Department. Final quality of data is under the responsibility of AKhaltsikhe City Hall.
Value applied:	128 239 m^3
Any comments	Could be verified at the gas supply company.

Data/Parameter # 9.4.8	**Annual consumption of natural and liquid (LPG) gas by residential buildings**
Data unit:	m^3/yr; kg/yr (MWh/yr)
Description:	Primary parameter.
Source of data used:	Natural gas distribution company serving Akhaltsikhe. Eventual quality of data is under the responsibility of Akhaltsikhe City Hall.
Value applied:	128 239 m^3

Data/Parameter # 9.4.9	**Annual consumption of natural gas by commercial buildings**
Data unit:	m^3/yr; (MWh/yr)
Description:	Primary parameter (annual).
Source of data used:	Gas-distributing company serving Akhaltsikhe. Akhaltsikhe City Hall is responsible for the final quality of data.
Value applied:	Natural gas- 2 011 435 m^3
Any comments	This data could be verified by the questioning of commercial buildings and energy audit assessments.

Data/Parameter # 9.4.10	**Annual consumption of liquid gas (LPG) and diesel by municipal buildings**
Data unit:	kg/yr; (MWh/yr)
Description:	Primary parameter.
Source of data used:	Information obtained from the Akhaltsikhe City Hall.
Value applied:	Not applied.

Data/Parameter # 9.4.11	**Annual consumption of firewood in residential buildings**
Data unit:	m^3/yr
Description:	Primary parameter.
Source of data used:	Vouchers issued to population. Akhaltsikhe City Hall carries responsibility on the concluding accuracy of data.

Value applied:	Total firewood- 24 448 m^3/yr Private dwelling houses- 16 120 m^3 Residential buildings- 8 328 m^3
Any comments	Firewood is predominantly used in two-storey private houses. Data should be verified by systematic questionings accounting for the fact that actually firewood is consumed in more quantities than considered according to vouchers.

Data/Parameter # 9.4.12	**Annual consumption of liquid gas and diesel by commercial buildings**
Data unit:	Kg/yr, l/yr, (MWh/yr)
Description:	Primary parameter (annual).
Source of data used:	Questioning of commercial buildings. Akhaltsikhe City Hall Energy Manager is responsible for the final quality of data.
Value applied:	At present stage diesel and firewood are not used in commercial buildings, although monitoring is necessary.
Any comments	This data could be verified by the questioning in commercial buildings.

Data/Parameter # 9.4.13	**Annual monitoring of CO_2 emission from all three sub sectors (municipal, residential and commercial)**
Data unit:	tCO_2/yr
Description:	Secondary parameter (annual).
Source of data used:	Calculated by the Monitoring Group.
Value applied:	2014 baseline year- 14 544 2020 year- 19 779 (projected).
Any comments	This data could be verified by the questioning in commercial buildings.

Data/Parameter # 9.4.14	**Saving in the Buildings sector under the adopted measures**
Data unit:	MWh/ per single measure
Description:	Secondary parameter. Calculated annually or in the monitoring period for each measure separately.
Source of data used:	Project executors (population, municipality, head of commercial building)
Value applied:	This parameter is calculated when carrying out each specific measure in accordance with the monitoring plan accompanying each measure.
Any comments	The assessment/measurement of energy consumption with the corresponding CO_2 baseline scenario and actual measurements are required for all buildings and fuel types. Energy consumption can be reduced due to various reasons (technical disconnections, cutting off because of unpaid bills, etc.). Therefore,

	proving that reduction has actually resulted from fulfilling a measure without the interference from other sources is important. Emissions savings estimation methods should be described separately for each measure. Preliminary theoretical estimates of saved emissions are presented in the SEAP.

9.5 Street Lighting Sector

Data/Parameter # 9.5.1	**Annual amount of electricity consumed for street lighting**
Data unit:	KWh/yr
Description:	Primary data
Source of data used:	Akhaltsikhe City Hall Infrastructure Department, which is responsible for the delivery of monthly/annual data on the amount of electric energy, consumed for street lighting.
Value applied:	657 557 KWh (in 2014) 1 065 900 KWh (projection for 2020)
Any comments	This data should be verified by the paid expenses. The projection for 2020 is calculated by the SEAP developing group.

Data/Parameter # 9.5.2	**Carbon dioxide emission from street lighting sector**
Data unit:	tCO_2/yr
Description:	Secondary data
Source of data used:	Calculated by the Monitoring Group
Value applied:	87 tCO_2eq (2014) 145 tCO_2eq (projection for 2020)

Monitoring of planned activites in the Akhaltsikhe Street lighting sector

Activity S1	**Remote control and energy thrifty consumption system**
Planned implementation (dates)	**2015-2020**
Description of activity:	The City Hall in 2015 has accomplished activities costing 450 thousand GEL on the replacement of street lighting network at the central streets of the city (Didimamishvili, Natenadze, Kostava, Nebieridze, Ketskoveli, Sulkhan-Saba, King Parnavaz streets). In the frames of this project the saving of energy will be calculated on these streets, the results will be recalculated for the entire system and the substitution of old system by the new one will continue. The project also includes the arrangement of lighting in places, which were not illuminated earlier. During the implementation of this measure the saving of

	energy will be performed by regulating the street lighting system using the remote control technology. For running the street lighting system the Control Centre will be set up at the City Hall: the illumination will be lessened in night-time hours, the switch-offs will be enacted by turns, etc. It is implied that the measure will proceed till 2020 and the system will embrace both already illuminated streets (49.35% of total number of streets) and yet dark streets, as to illumine up to 80% of all streets by 2020. Total cost of the measure makes 2 million GEL.
Indicators to be monitored	• Number of control points; • Amount of annually saved electric energy by each control point, which will be assessed for the systems, installed in the initial phase.
Amount of reduced emission, achieved during the monitoring period	The development and integration of lighting Control System will increase the electricity saving by 40-60%. Resulting from the implemented measure 640 MWh of energy and 67 tons of emission in CO_2eq will be saved in total.
Any comments	
Implementing body	LLC "Ketilmotskoba" at the Akhaltsikhe Municipality.

9.6 The Akhaltsikhe Greening

Baseline Emissions Monitoring

Data/Parameter # 9.6.1	**Total planted area in Akhaltsikhe (2014)**
Data unit:	ha Number of plantings by species
Description:	Primary parameter
Source of data used:	Akhaltsikhe City Hall Infrastructure Department
Value applied:	458 ha are covered by plants within the limits of the city. 133 ha are joint canopy plants occuping city suburbs. 325 ha are covered by fragmentary plantings.
Any comments	Among them: cemeteries- 35 ha, recreation zones- 2.2 ha, other territories including population orchards- 173 ha and outskirts slopes of the city- 248 ha.

Data/Parameter # 9.6.2	**Annual removal of carbon dioxide from the Akhaltsikhe territory under the baseline conditions of 2014 greening**
Data unit:	tCO_2/yr
Description:	Secondary parameter
Source of data used:	Calculated through the SEAP development process
Value applied:	Annual removal- 616 tCO_2/yr.

	Amount of sequestered carbon in 2014 at the whole territory of 458 ha equals to 7 992 tC.
Any comments	Among them: cemeteries- 35 ha, recreation zones- 2.2 ha, other territories including population orchards- 173 ha and outskirts slopes of the city- 248 ha.

Data/Parameter # 9.6.3	**Annual cutting/ trimming of trees by species**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Akhaltsikhe City Hall Infrastructure Department
Value applied:	Trees were trimmed in 2015. 56 m^3 were cut down
Any comments	Trimmings should be considered in the monitoring process.

Data/Parameter # 9.6.4	**Annual fires or other causes of damage to trees**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	Akhaltsikhe City Hall Infrastructure Department
Value applied:	Fires should be considered in the monitoring process.

Data/Parameter # 9.6.5	**Annual monitoring of CO_2 removal changes**
Data unit:	tCO_2/yr
Description:	Secondary parameter. Calculated by the Monitoring Group
Source of data used:	At this stage calculated by the SEAP developing group
Value applied:	Resulting from different measures taken by 2020 at the territory of Akhaltsikhe 8 700 tC will be sequestered.

Monitoring of carbon sequestration increase resulting from the adoption of measures

Activity G1	**Greening of 5 ha area in the outskirts of Akhaltsikhe**
Planned implementation (dates)	2016-2019 (by 1 ha annually)
Description of activity:	The greening of total 5 ha area is planned in the outskirts of Akhaltsikhe. While designing the greening activities it is advisable to plant at the major part of project territory species similar to forest landscape with the density of no less than 3 500 saplings per 1 ha (includings the shrubby species). As a result a perfect pool of carbon sequestration could be obtained, where soils will be

	involved in carbon deposition process and the city should get a valuable green zone consisting of forest ecosystem.
Indicators, according to which the monitoring should be performed	• Number of planted species according to areas; • Area covered by new plantings; • Planted tree species according to age; • Coverage of territory with canopy/crown; • Application of fertalizers; • Cuttings and wildfires.
Amount of reduced emissions, got through the monitoring period	Area covered with new plantings will remove annually 108 t of carbon dioxide by 2020 and sequesters 29.4 t of carbon.
Comments	The cost of project implementation makes 10 080 USD
Implementing body/unit	LLC "Ketilmotskoba" at the Akhaltsikhe City Hall

Activity G2	**Greening and rehabilitation of two squares in the city**
Planned implementation (dates)	2016
Description of activity:	The rehabilitation and planting of 2 squares is planned in the city, including one square adjoining the 8-storey buildings (650 m^2) and another at the Mikutishvili street (9 350 m^2), altogather planted with 440 saplings. It should be mentioned that before the field activities the reconstruction design of the park must be drown, consisting of schematic maps of arranging saplings planting and different infrastructure units (walkable tracks, lawns, etc.), list of plants selected for introduction and the budget of all planned activities. At the initial stage the preliminary budget should include only the principal activities.
Indicators, according to which the monitoring should be performed	• Total area of squares; • New areas originated by the greening in the squares; • Species of plants according to areas; • Degree of canopy/crown merging of the trees.
Amount of reduced emissions, got through the monitoring period	Area covered with new plantings will remove annually 27 t of carbon dioxide by 2020 and sequester 7.4 t of carbon.
Comments	The cost of project implementation equals to 24 645 USD
Implementing body/unit	LLC "Ketilmotskoba" at the Akhaltsikhe City Hall

9.7 Waste

Baseline Emissions Monitoring

Data/Parameter # 9.7.1	**Parameters of Akhaltsikhe landfill**
Data unit:	Area, ha;

	Depth, m.
Description:	Primary data.
Source of data used:	During the SEAP development process data has been provided by the Akhaltsikhe City Hall municipal cleaning service LLC "Ketilmotskoba", which should remain the main source of information through the monitoring process, as well.
Value applied:	Total area- 2 ha and the depth- less than 5 m.
Any comments	The Akhaltsikhe landfill was opened in 1960- es.

Data/Parameter # 9.7.2	**Daily amount of waste delivered to the Akhaltsikhe landfill**
Data unit:	m^3 or ton
Description:	Primary data.
Source of data used:	During the SEAP development process data has been provided by the Akhaltsikhe City Hall municipal cleaning service LLC "Ketilmotskoba", which should remain the main source of information through the monitoring process, as well.
Value applied:	30-40 t/day (2 municipalities: Akhaltsikhe and Adigeni). 22 t of waste is delivered daily from the city of Akhaltsikhe itself.

Data/Parameter # 9.7.3	**Calculation of generated methane**
Data unit:	m^3 or ton
Description:	Secondary data. The amount of methane generated should be computed applying the First Order Decay (FOD) model. The computation is under the responsibility of Monitoring Group.
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl (p. 3.36). This is ready software prepared for the input of necessary parameters.
Value applied:	Parameters necessary for computation: • Waste composition Composition of waste (% by mass): Food products- 46.62%, Textile/leather- 1.62%, Paper/cardboards- 16.18%, wood- 4.85%, hygienic waste- 1.62%, Plastic/Inert material- 29.11%. • Methane Correction Factor (MCF)- 1 • Degradable Organic Carbon Waste composition DOC Food waste 0.15

	Garden 0.20 Paper 0.40 Wood and Straw 0.43 Textiles 0.24 Disposable Diapers 0.24 • Actually Dissimilated Component of Organic Carbon (DOC_F) • Methane Content of Landfill Gas (F) • Oxidation Factor (OX) (Managed landfill) 2014- 4.34 $GgCO_2eq$ 2020- 4.50 $GgCO_2eq$ (projected)
Any comments	As to the emissions from the landfill, their projection to 2020 is based on the assumption that number of population grows annually by 0.5%, and the amount of waste disposed at the landfill- by 2.5% per annum.

Monitoring of emissions reduction, resulting from measures implemented

Activity W1	**Reduction of paper, plastics and glass content in the waste due to preliminary separation**
Planned implementation (dates)	2017-2020
Description of activity:	In Tbilisi, in the Orkhevi Settlment currently functions the paper processing mill, producing toilet paper. Setting up of paper processing facility in Tbilisi and the regions has facilitated the process of collecting and handing over of secondary paper. The leading position in this process belongs to state agencies (ministries, City Halls, schools, etc.). Cosequently the mentioned fraction in overall waste composition is being decreased, causing corresponding reduction in the generation of methane from the landfill. The Akhaltsikhe authorities plan to separate along with paper the plastics and glass as well. According to experts assessment about 5% of secondary paper and 5% of plastic materials will be separated to 2017, while by 2020 the amount of separated paper, plastics and glass could reach 10% of generated waste. The calculation of emission from the Akhaltsikhe landfill has been performed taking into consideration the fact that currently the share of paper in the waste makes 16.18% and of plastics- 29.11%.
Indicators, according to which the monitoring should be performed	Here only the general indicators are given, the monitoring of which would be necessary to conduct a project of that type. • Annual amount of collected and utilized, or flared at the site methane; • Share of paper in the waste before implementing the project- 16.18%; • Share of plastics in the waste mass before implementing the project- 29.11%;

	• Share of paper in the waste mass after implementing the project; • Share of plastics in the waste mass after implementing the project; • Share of glass in the waste mass after implementing the project; • Amount of waste generated per capita or total amount of waste produced in the city; • Amount of separated and recycled paper, kg; • Amount of separated and recycled plastics, kg; • Amount of separated and recycled glass, kg.
Amount of reduced emissions, got through the monitoring period	According to preliminary assessments the methane emission to 2020 would be reduced by 24 tons in CO_2eq (0.52%). In case of project implementation during 3 years 44 tCO_2eq of methane emission will be saved from the discharge into the atmosphere.
Comments	
Implementing body/unit	This is a planned activity and presumably it will be implemented by the LLC "Ketilmotskoba".

10 Sustainable Development Criteria

Monitoring reports should also include the results of observations on sustainable development criteria/indicators, as listed in general:

1. Local capacity building of Akhaltsikhe Municipality (staff, plans);
2. Increase in population's quality of life and energy expenditure savings (per capita hot water consumption, expansion of heated areas/space, approximations of per area energy consumption to European standards, etc.);
3. Promotion of residential condominiums creation;
4. Improved comfort and energy savings in municipal/commercial buildings (heat, electricity, hot water consumption per area unit);
5. Introduction of modern waste recycling technologies;
6. Expansion of per capita green areas;
7. Reduction of local pollutants (mainly due to measures taken in the transport sector);
8. Increased number of jobs;
9. Better gender equity;
10. Demonstration and piloting new technologies;
11. Promoting private sector development;
12. Municipalities are able to report on additional criteria that were influenced by measures carried out within the SEAP framework, as well as on main barriers hampering the plan implementation, plans in place to avoid and overcome main obstacles, and steps towards achieving success.