Sustainable Energy and Climate Action Plan of the Municipality of Self-Governing Community Telavi

MAY , 2016

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

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1 Introduction[1]

Geographic Location

Community Telavi Municipality represents an administrative-territorial unit at East Georgia, Kakheti region. Telavi Municipality borders Kvareli Municipality to the east, Daghestan Autonomous Republic of Russian Federation to the north-east, Akhmeta Municipality to the north-west, Gurjaani Municipality to the south-east, and Sagarejo Municipality to the south-west. Distance between the Administrative Center and Tbilisi makes 150km through Bakurtsikhe road, and 90km through Gombori road.

Central part of Community Telavi Municipality is spread on Alazani plain and is surrounded with the Gombori Mountain Range to the south-west and with the Caucasus Mountain Range to the north-east. In the Municipality the elevation of the plain reaches 350-600m. There runs the Gombori Range with the highest peak – Tsivi (1991m) in the south-west section of the Municipality and the Andarazani Range (the southern branch of the Caucasus Mountain Range of Kakheti) representing the watershed of the Didkhevi and Lopota Rivers. In the north of the Mountain Range peak Didi Andarazani (3039m) and in the south section - peak Patara Andarazani (2448m) are erected. Telavi Municipality occupies the south-west slope of Kakheti Caucasus Mountain Range: between Sajikhve-Girgala and Nakerala sub-ranges.

Total area of the Municipality is 589.5km^2. It is divided into 22 administrative units and consists of 29 villages. In terms of population the biggest villages are: Karajala – 8 800, Kurdgelauri – 4 435, and Tsinandali – 3 748 residents.

[1] The needed materials for introduction was provided by the local expert and taken from the document "Telavi Municipality Mid-run Program (2013-2017)"

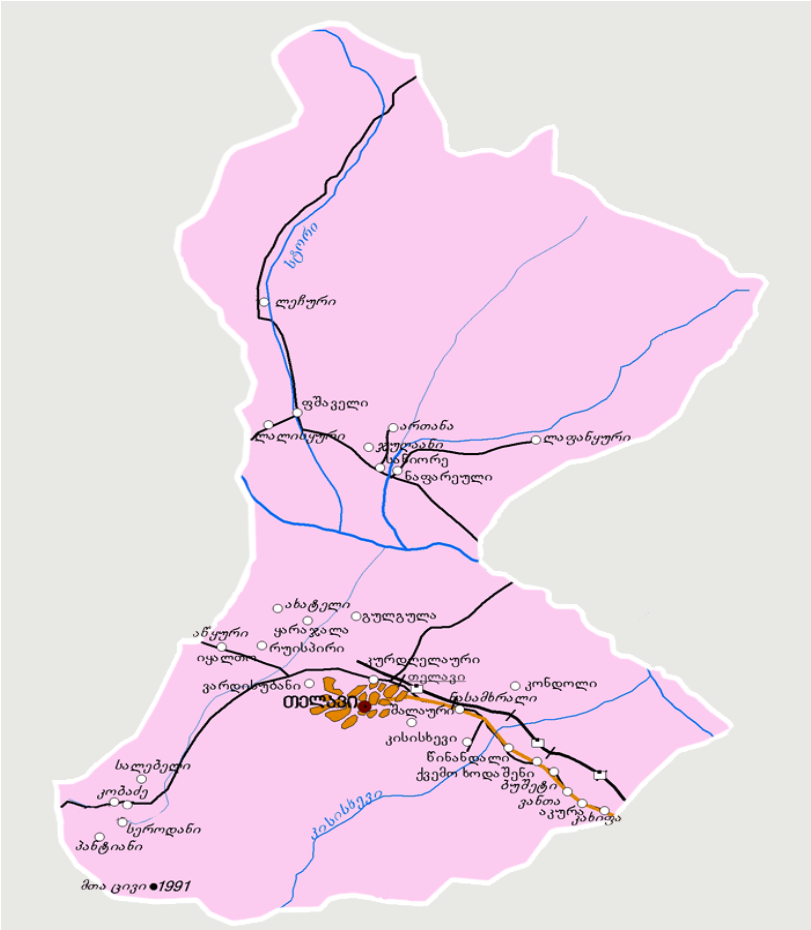

Fig. 1. Map of Community Telavi Municipality

Climate and Natural Conditions

The territory of Community Telavi Municipality belongs to the temperate humid subtropical climate zone. Alazani Plain is characterized with relatively humid climate with hot summers and moderately cold winters. The average annual air temperature is 12^{0}C, absolute maximum 39^{0}C, and annual precipitation is 700-800mm.

The climate on the Gombori Range up to 1200 meters above sea level is temperate humid. The mean annual temperature on the Peak Tsivi equals to 4^{0}C. On the Caucasus Mountain Range of Kakheti up to 1200m above sea level the climate is temperate humid, and annual precipitation is 1150mm. Annual precipitation in the subalpine zone rises up to 2000mm.

Main hydrological artery of the Community Telavi Municipality is the Alazani River. In its basin the following rivers are noteworthy: Stori, Kisiskhevi, Lopota, Turdo, Telaviskhevi, and others.

Strong winds and heavy rains have been quite frequent from natural disasters lately. Hail increase followed with floods and over-washing the river banks is observed. Danger from mentioned natural disaster has been increasing for the last 10 years. Drought is also increased.[2]

Community Telavi Municipality is rich in fertile soils, wood resources, marble, Sulphur springs, debit of ecologically clean drinking water, hydro-energetic resources, shale and marble deposits, pastures and forest

[2] http://nala.ge/uploads/telavi.pdf

massifs. Marble deposits give chance to produce valuable construction materials (however, the potential of the mentioned resource is not fully revealed and used). At the territory of the Municipality there are copper, lead, zinc, clay and clay-shale deposits.

Stages of Development and Cultural Heritage

Until 1917 the territory of the Municipality was included in Telavi District of Tbilisi Province, and since 1930 it has become a separate Region. In 2006 it obtained status of the Municipality. In 2014 the city of Telavi was separated from the Municipality as a self-governing city and in the same year Telavi Municipality was divided into 22 Administrative Units.

Picture 1. Ikalto Monastery with Renovated Façade

Ikalto Monastery Complex founded in the VI century by one of the Assyrian Fathers - Zenon Ikaltoeli is notable among architectural monuments of Telavi Municipality. The same can be said about Old Shuamta Monastery. The ensemble includes the V century basilica, a domed church and a church with minor dome. In the XVI century Old Shuamta Monastery was emptied. Near this church New Shuamta Monastery was founded by the spouse of King of Kakheti Levan II -Tinatin Gurieli.

In the village Kisiskhevi St. Virgin's Church (VI-VII century) is erected. In the vicinities of village Akura there is Mamadaviti Monastery. Some historical monuments are also preserved in the village of Ruispiri.

Population and Employment

According to the data of the National Statistics Service of Georgia[3], in 2012-2014, the number of Telavi Municipality population, including city of Telavi population, was reduced from 71 200 to 70 900 people. According to data of 2015, the number of Telavi Municipality population, again including the city Telavi population, accounted 58 300 people. And, in 2016, according to the Statistics Service information, Community of Telavi Municipality, this time excluding city of Telavi population (due to the reason that city

3 http://www.geostat.ge/?action=page&p_id=472&lang=geo

Telavi obtained the status of self-governing town and was separated from the Telavi Municipality Administration), accounted 51 700 people. The total population is divided among the Municipality villages.

81.6% of the Municipality population are Georgians, Azeris make up 17% of the population, and the rest is the population of different nationalities. The Municipality population of age under 18 makes 20,4%, of age 18-65 – 63,3%, and above 65 – 16,3%.

The Internally Displaced Persons (IDPs) from Abkhazia and South Ossetia also live in Community Telavi Municipality. According to the information of the Ministry of Internally Displaced Persons from the Occupied Territories, Accommodation and Refugees of Georgia[4] and Agency on Social Services[5], as of September 2014, the number of the IDPs registered in Community Telavi Municipality equaled to 461 persons and 157 households/families.

According to the 2011data, 8 451 persons were employed in different fields and spheres, which made 20,85% of the Municipality's able-bodied population. The most part of the employable population is either hired, or self-employed in agricultural sector. In 2009-2011, the number of the employed population was growing steadily by 6,7%. In 2009, 7 408 persons were employed, and in 2011 – 8 451 persons. It should be noted that compared with 2007 (3 894 employed persons), in 2011 the employment has been increased by 54,4%. The average monthly salary was also growing. In 2010 it made 3 551 GEL, and in 2011 – 3 748 GEL.

At present, 22 public schools and 20 kindergartens are functioning in the Community of Telavi Municipality.

Economy and Infrastructure

Main Fields of Economy

Industry, among them wineries, has significant specific share in the economy of the Community of Telavi Municipality. The forest fund existing at the territory of the Municipality gives a chance that, in case of rational utilization, it may make a positive contribution to the Municipality's economy and social sphere development process. The Municipality forests have certain potential in terms of development of hunting, Kakhetian pig breeding and Georgian bee farming, and pool-fish breeding. However, the existing potential needs to be studied and assessed in details.

Basic sectors of local economy include: trade (53%), agriculture, including viticulture and wine-making (28%), industry (5%), construction (5%), services (9%). By 2012, in Telavi Municipality about 1000 entrepreneurs were registered.

Among manufacturing industrial products, the production of construction materials, including wall and roofing tiles, construction blocks and bricks, as well as, food products - meat and meat products and dairy is to be mentioned. There are a number of bread and baking manufactures and non-alcoholic drink productions.

Infrastructure

The main transport routes in Telavi Municipality Community are: Telavi-Chalaubani- Tbilisi Central Highway with total length of 130km; Telavi-Gombori-Vaziani Motorway with length of 70km; Telavi-Tbilisi Railway line functioning with in-complete loading.

4 http://www.mra.gov.ge/
5 www.ssa.gov.ge/

Total length of local motorways is 503.7km including, as of 2012: asphalt coated road is 309.6km, graveled – 147.4km, and dirt roads – 46.7km.

Total number of bridges is 41 with total length of 720m.

As for drinking water supply and sewerage systems, Community Telavi Municipality is supplied with village water pipelines, with village water existing without the system, and individual wells. The 95% of town population and 80% of village population are supplied through central water supply systems.

The total length of sewerage system equals to 79km, which needs renovation and expansion. The Municipality at this stage does not have any water treatment facility.

Local Budget

The budget of Community Telavi Municipality under the plan for 2016, in terms of the program, equals to 12 013 100 GEL[6]. Financing according to sectors in 2014, 2015 and 2016 was distributed as follows[7]:

Table 1. Distribution of Community Telavi Municipality Budget for 2014, 2015 and 2016.

Sector	Actual Fact 2014	Actual Fact 2015	Program for 2016
Agriculture(where main funds are allocated for river bank reinforcement, arranging irrigation canals and irrigation systems)	1 12 000	225 900	171 200
Transport (including motor transport and roads)	1 787 700	842 400	2 194 300
Environment Protection (among them waste collection, treatment and disposal; wastewater management)	174 500	669 200	216 700
Housing and utility services (among them apartment construction)	958 300	2 539 000	2 061 200
Water Supply	628 500	2 080 400	1 593 200
Street Lighting	171 900	405 800	244 300

According to the Table, in 2016 the Municipality will direct significant financial resources towards transport sector and motorway development and improvement, environment protection, including, waste management, housing and utility services, and arranging water supply system. For example, in 2016, more than 406 600 GEL is allocated for the development of transport sector and over 1 102 900 GEL and 964 700 GEL is

[6] Data of Finance Service of Community Telavi Municipality
[7] https://matsne.gov.ge/ka/document/download/3130104/0/ge/pdf

allocated respectively for housing and utility services and water supply system arrangement compared to 2014.

Community Telavi Municipality Development Priorities

According to the Municipality vision, main goals of Telavi Municipality development have been identified based on the current situation in Community Telavi Municipality and the completed SWOT analysis, considering the "Main Data and Directions of the Country in 2013-2016":

- Economic growth through the development of agriculture to provide working places and better incomes;
- Investments in infrastructure, education, healthcare and public services in order to improve quality of life of the population;
- Development of tourist infrastructure, using the complete tourist potential, support to organizing festivals and other cultural-educational events.

Preconditions for reaching the above-mentioned goals are represented by existing natural and human resources, increasing involvement of population into local self-governing activities, full-scale operation of the potential of local self-governing bodies and support from the regional and central authorities.

Main priorities of the Municipality development have also been defined, including:

- Promoting viticulture and wine-making;
- Improving quality of infrastructure, installation of new water supply networks, control of potable water quality;
- Improving tourist infrastructure, among them, road signs, toilettes, local roads;
- Improving tourist services, among them popularization of the region, tourist information centers, maps. Providing availability of financial capital with favorable terms (subsidized loans, grants) for starting businesses, for example: guest houses, tour-operators, etc. Care and protection of cultural and historical monuments. Organizing and encouraging festivals.

Picture 2. Community Telavi Municipality City Assembly Building

On January 30, 2015, Community Telavi Municipality became the signatory to the CoM and thus has undertaken an obligation within its administrative borders to prepare and implement the Sustainable Energy Action Plan (SEAP) aimed at reduction of Greenhouse Gas (GHG) emissions to 2020 at least by 20%.

However, according to the Decree #8, as of February 29, 2016, issued by Telavi Municipality City Assembly, the Community Telavi Municipality has resolved to join the new Agreement of the CoM, concluded on the ground of Paris Agreement 2015 of Convention on Climate Change. Consequently, it was decided the Sustainable Energy and Climate Action Plan (SECAP) to be scheduled up to 2030 and to be added the climate change-related adaptation measures. According to the new Agreement, the emission from the community's territory should be reduced by 40% to 2030.

2 Sustainable Energy and Climate Action Plan

The SECAP for Community Telavi Municipality covers measures from Transportation, Buildings, street Lighting, Wastes and Greening Sectors, as well as, adaptation measures from Agriculture and Greening Sectors.

Presented version of the Plan was prepared in 2016, though 2014 was taken as the base year covering the period till 2030. However, the amount of emissions which may be reduced by 2020 is given separately.

Due to the length of the discussed period and the obligations undertaken at the first stage, the emissions reduction strategy consists of three periods: the period defined under the old obligation (2015-2020), mid-run period (2021-2026) and long-run period (2027-2030). It is noteworthy that the second and the third periods coincide with the periods of obligations undertaken by the country. In fulfilling the obligations undertaken at national level the processes going on in the Municipalities and self-governing cities within the frames of the CoM are considered by the country to be essential. As the Intended Nationally Determined Contribution (INDC) should be revised until 2020 the corresponding changes will be reflected in this plan as well. As a rule, the short-run period measures are more concrete and detailed, also the projected measures for the second period are more concrete to certain extent, but the measures to be implemented after 2027 are discussed in a more strategic sense and require additional survey, planning and technical and economic grounding.

Based upon the 2014 base year the GHG emissions inventory and CO_2 emissions projected growth parameters to 2020 and 2030, in the frame of Community Telavi Municipality SECAP the GHG emissions reduction sectoral strategy has been worked out for all sectors and main directions were defined.

Transportation Sector

Considering the results of 2014 inventory in Community Telavi Municipality, Transportation Sector emissions bear responsibility for 27% of total emissions, out of which 96.5% comes on private and commercial transport. Several strategic areas are considered in Transport Sector, which include:

- Municipal public transport renewal at the territory of Community Telavi Municipality
- Starting using municipal public transport working on cleaner/less carbon-containing fuel
- Putting in order the transport road cover
- Promoting pedestrians
- Regulating local private taxis
- Arranging cycling travel routes
- Arranging cableway system from Kvevris Sakhli (Pitcher House) up to Ikalto Academy

Within a short-run perspective, Community Telavi Municipality administration plans restoration of the municipal transport existed earlier at the territory of Community Telavi, abolished after the Soviet Union's breakup. The municipal transport will serve the Community Telavi Municipality population with well-planned

routes and comfortable buses. This means that on comparatively long distances the public transport will replace the currently established alternative of transportation by private cars.

In the mid-run perspective, Community Telavi Municipality's Transport Sector strategic concept consists of putting in order main roads, optimization of routes and developing modern energy-efficient comfortable municipal transport.

In the long-run perspective (after 2027), Community Telavi Municipality's transport sector strategic concept includes arranging rural roads completely, optimization of routes, regulating private taxis and the utmost promotion to functioning energy-efficient comfortable municipal public transport. It is also planned to promote cycling travel routes and develop cableway systems.

Buildings Sector

Considering the results of 2014 emissions inventory in Community Telavi Municipality, buildings sector emissions bear responsibility for 71% of total emissions. According to the existing data, 97% of emissions are emitted from the residential buildings[8]. Due to this reason, to reach 40% emissions reduction benchmark by 2030, development of programs for the residential buildings sector supporting introduction of energy-efficient and renewable energies in this sector is necessary. Postponing of this measure up to the end of the obligatory period (2027-2030) is at grave risk and piloting of the energy-efficient measures in the residential buildings should already be done at maximum level in the first, short-run period. At the same time, here should be considered the factor that in Community Telavi Municipality, like on the entire territory of Georgia, energy consumption is very low as the buildings are not heated completely and a great part of population lives in energetic poverty. Accordingly, such programs require urgent preparatory works, including, working with donors in seek of external funding, perfecting legislative base and regulations in order the municipality to be able to work directly with the population. Community Telavi Municipality City Hall considers the fact that, after developing this plan only 5 years are left till 2020, and due to this reason, by 2020 presumably emissions reduction will be implemented only by 12-15%.

In 2015-2020, Community Telavi Municipality strategy aims to provide maximum support to energy saving in municipal buildings and using renewable energies to demonstrate their advantages for population and other commercial buildings. In addition, promotion of energy saving measures in residential buildings being interested in this measure is planned. Currently, the Municipality has got co-financing programs with population (in case of private houses) and full financing programs (in some cases, especially in case of natural disaster victims), in frames of which basically roofs are repaired and windows are replaced, and the City Administration plans to consider thermal insulation of the ceilings and installation of energy-efficient doors and windows.

At the same time, to achieve the emissions reduction targets, it is highly valuable in private houses to conduct the energy efficiency and renewable energy introduction measures at larger scale. For this purpose, the City Hall will develop specific programs and will collaborate actively with state structures, as well as, different funds and private organizations. In the long-run perspective, the City Hall will care of providing the population and the construction organizations with building standards based upon the local climate conditions and explain them their importance in securing heat and budget savings.

[8] Here is a significant inaccuracy, as the data on complete electricity could not be found for the category of "other buildings".

According to the SECAP strategy, in buildings Sector of Community Telavi Municipality the following measures will be implemented under the short-run Action Plan:

In the Municipal Buildings:

1. Thermal insulation of attics in the Municipality administrative buildings;
2. Increasing the number of energy-efficient LED lamps in Municipality administrative buildings; thermal insulation of the attics in kindergartens;
3. Replacing windows in kindergartens;
4. Increasing the number of energy-efficient LED lamps in kindergartens;
5. Application of solar collectors in nurseries and kindergartens for hot-water supply;
6. Energy-efficient consumption of waste biomass in municipal buildings.

In a short run perspective in the Residential Sector the Municipality will continue working under social programs including energy-efficiency elements, like:

1. Thermal insulation of ceilings in typical private houses;
2. Installation of energy-efficient windows;
3. Implementing energy-efficient firewood stoves program;
4. Application of solar energy for hot-water supply;
5. Energy-efficient consumption of biomass.

Street Lighting Sector

One more sector which is not less important in the GHG emissions reduction process is Street Lighting. The mid-run Action Plan of the Municipality includes securing the complete Street Lighting, optimization of the existing Street Lighting system and increasing their energy-efficiency at maximum level at the territory of Community Telavi. About 300 households live dispersed on the Community territory who currently have no Street Lighting. In a long-run perspective arrangement of the Street Lighting systems applying the solar energy is planned for such families.

Out of existing 2 316 bulbs, a certain part (minimum 600 bulbs) will be replaced with the LED lamps By 2020, saving 604MWh electricity and 63t CO_2eq. By 2030 this measure will additionally save 152MWh electricity and 16t CO_2eq. In total by 2030 when all the lamps will be replaced with LED lamps in the network and the lighting will be regulated, 1759 MWh electricity and 183t CO_2eq. will be saved annually. However, the network emissions factor in Georgia is rather low and correspondingly emissions saving is less than 1%.

Other Sectors

Besides the above-listed directions, the plan contains measures of paper and plastic separation from the collected solid wastes and increasing green areas.

Sustainable Energy and Climate Action Plan Summary Concept

The methodology to work out Sustainable Energy and Climate Action Plan for Community Telavi Municipality does not mean the use of a fixed Base year which can create obstacles for the process of development and may hamper the Municipality to fulfill its commitments. The used methodology in the presented document provides envisaging the development perspective of the country and the Community Telavi Municipality and

the inevitable growth of emissions to 2020-2030 (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 BAU scenario methodology is presented in details in Appendix I.

In the following Tables (Table 2 and Table 3) the inventory summary results for 2014, 2020 and 2030 are presented, together with the emissions savings resulted from the implementation of the SECAP measures. As the Tables show, by 2020 there will be saved 38 030 tons of emissions in CO_2 equivalent, making up 21,5% of emissions projected for this year, and by 2030 there will be saved 109 493 tons of emissions in CO_2 equivalent, making up 50,35% of emissions projected for this year. However, we need to mention here that implementing most of these measures are rather difficult as it requires much more budget than it is available for Community Telavi Municipality for implementing this kind of projects.

Table 2. GHG Emissions in Community Telavi Municipality in 2014, 2020 and 2030 (t CO2 eq.)

Sector	2014	Share in Total Emissions (%)	2020 (BAU)	Share in Total Emissions (%)	2030 (BAU)	Share in Total Emissions (%)
Transport	**41 975**	**27**	**59 289**	**33.57**	**88 686**	**40.78**
Buildings	**110 000**	**71**	**113 174**	**64.09**	**120 999**	**55.64**
Street Lighting	**152**	**0**	**223**	**0.13**	**223**	**0.21**
Household Waste	**2 880**	**2**	**3 910**	**2.21**	**7 550**	**3.47**
Total	**155 007**	**100**	**176 596**	**100**	**217 458**	**100**

Table 3. GHG Emissions Savings in different Sectors according to the Community Telavi Municipality SECAP

Sector	Saving to 2020 (ton CO_2 eq)	%	Saving to 2020 (ton CO_2 eq)	%
Transport	**1 724**	**4.5**	**10 291**	**9.4**
Buildings	**36 145**	**95.0**	**96 998**	**88.6**
Street Lighting	**63**	**0.2**	**183**	**0.2**
Waste Collection	**65**	**0.2**	**1 035**	**0.9**
Greening	**33**	**0.1**	**986**	**0.9**
Total	**38 030**	**100.0**	**109 493**	**100.0**

Table 3 shows that emissions saving to 2030 in accordance with this Action Plan to the greatest extent (88,6%) is intended in buildings sector.

Fig. 2 shows distribution of sectoral emissions between 2014, as Base year, and 2020, and 2030 projected years, and other figures (Fig. 3; Fig. 4; Fig. 5; Fig. 6) show emissions increase in different sectors for the BAU and the SECAP implementation scenarios.

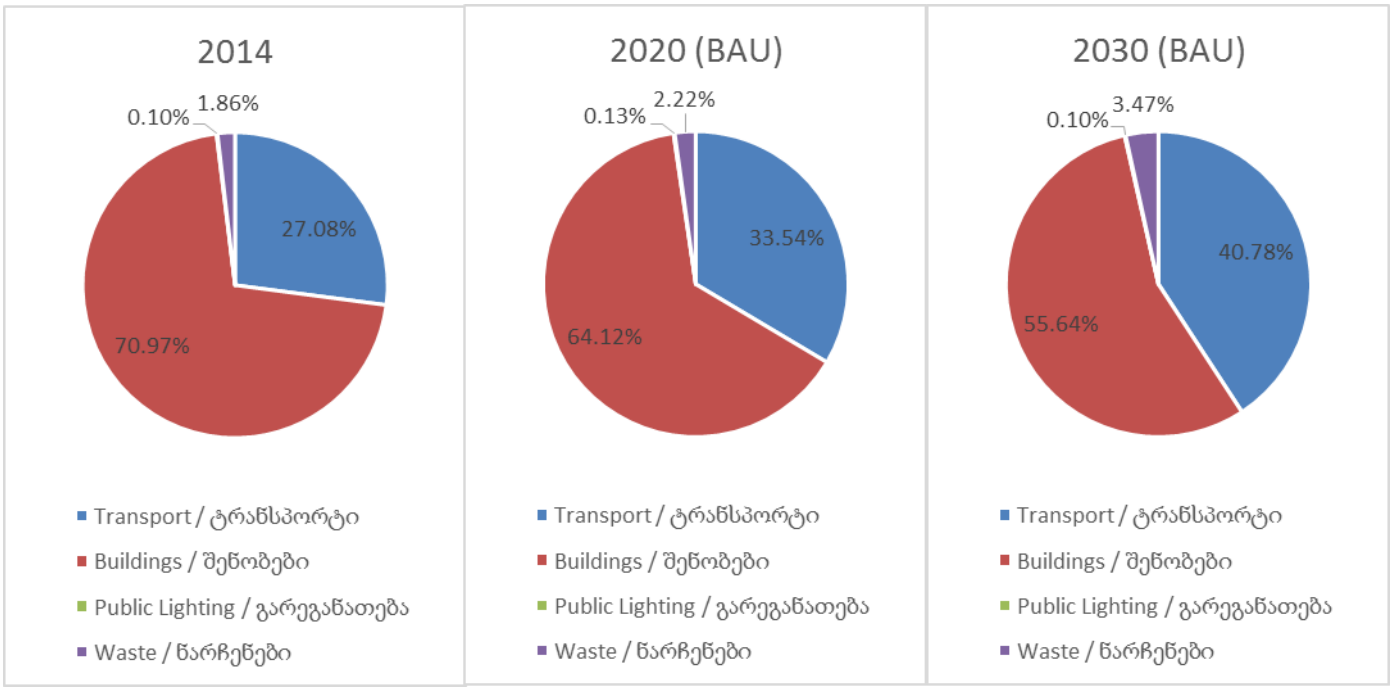

Fig. 2. Distribution of Sectoral Emissions in 2014, 2020 and 2030 (%)

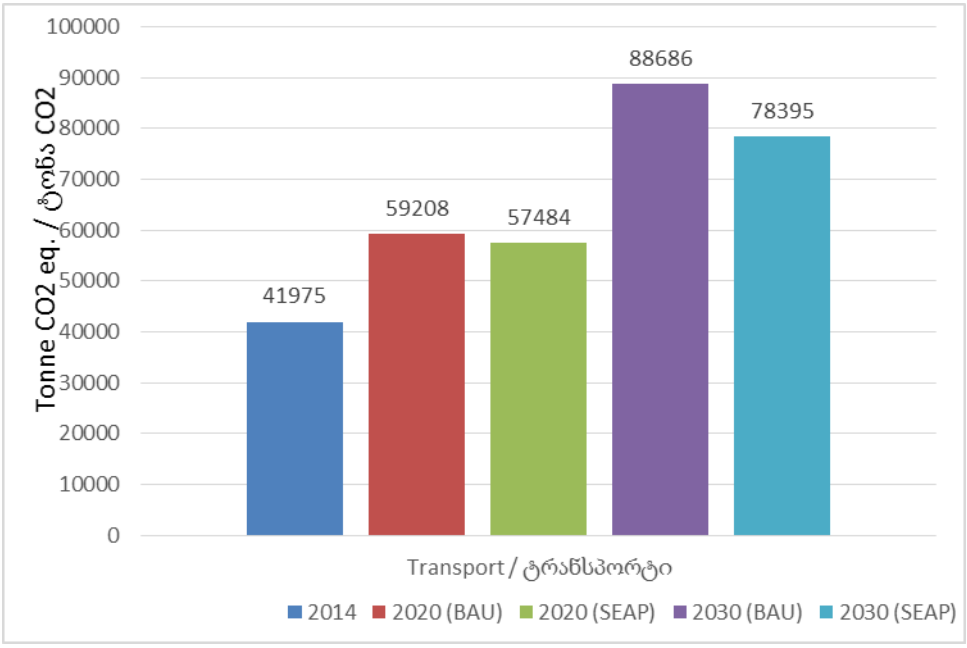

Fig. 3. Growth of Emissions according to BAU and SECAP Scenarios in Transport Sector (t CO_2 eq.)

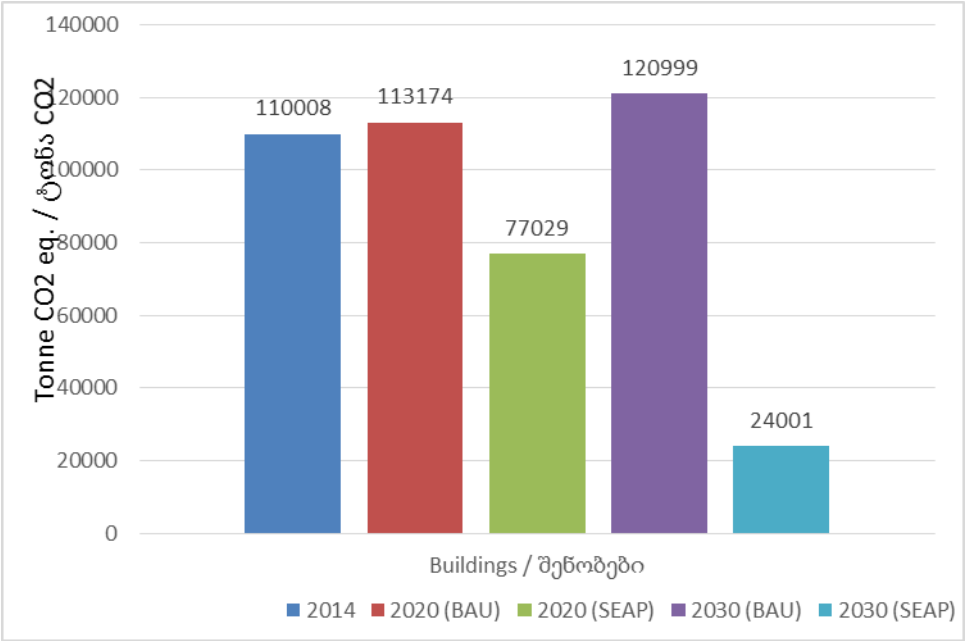

Fig. 4. Growth of Emissions according to BAU and SECAP Scenarios in Buildings Sector (t CO_2 eq.)

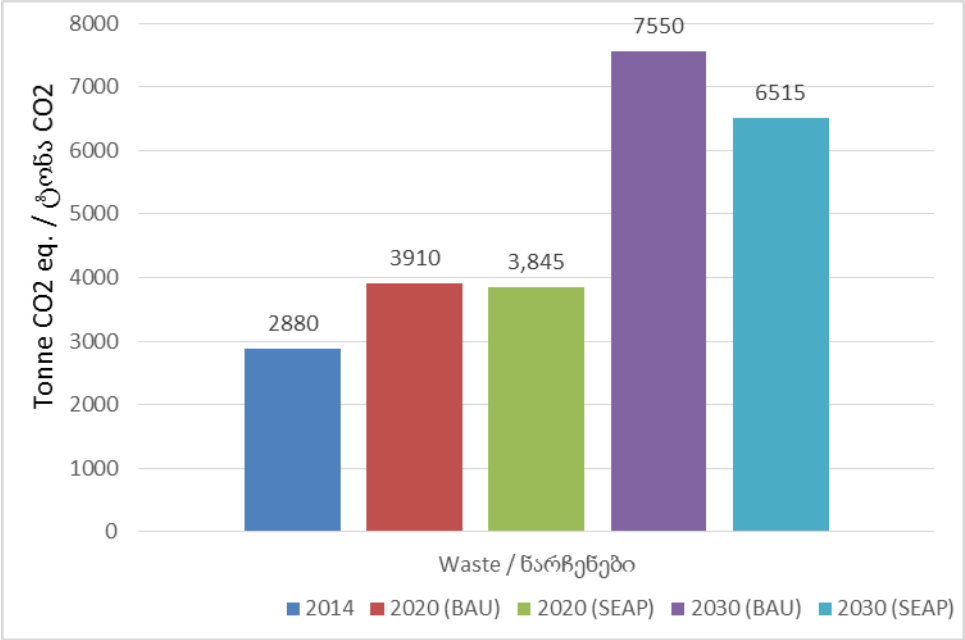

Fig. 5. Growth of Emissions according to BAU and SECAP Scenarios in Waste Sector (t CO_2 eq.)

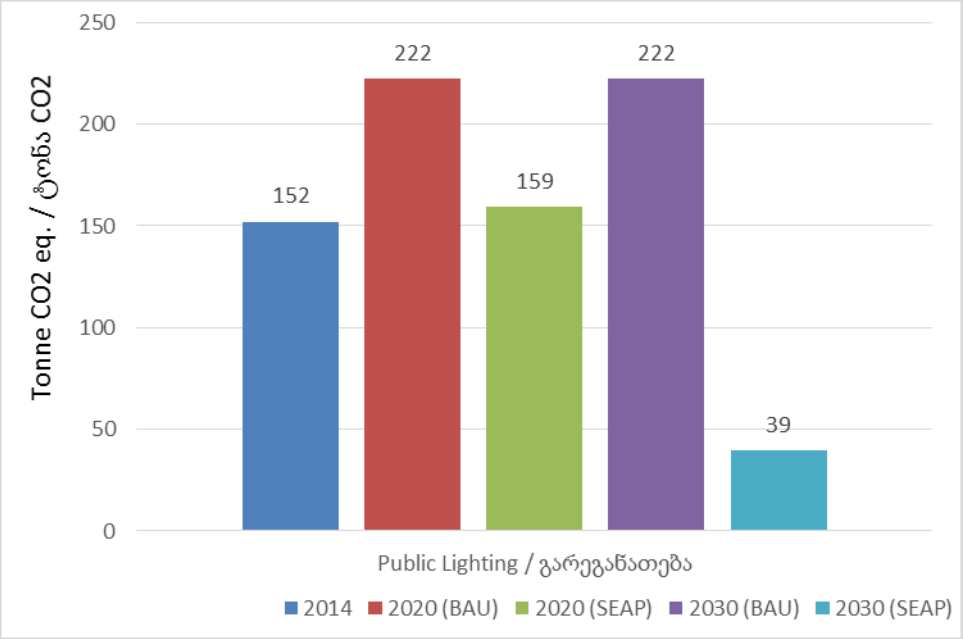

Fig. 6. Growth of Emissions According to BAU and SECAP Scenarios in Street Lighting Sector (tCO_2 eq.)

3 Transportation

3.1 Overview of the Sector

At the background of the ongoing world-wide globalization process and considering Georgia's geo-strategic location, the development of the country's economy is directly connected to the proper and effective functioning of Transport Sectors.

In this respect, Telavi Municipality has great importance as the Municipality is connected with motor roads with Telavi and Tbilisi through which taxis, shuttle minibuses, private cars arrive from the neighboring municipalities and ride at the territory of the Municipality:

- Akhmeta-Telavi, passes through the Municipality territory 12km
- Kvareli-Telavi, passes through the Municipality territory 7km
- Gurjaani-Telavi, passes through the Municipality territory 12km
- Akhmeta-Tbilisi, passes through the Municipality territory 20km

As well, the distribution vehicles arrive and ride on the Municipality territory to deliver to the shops different types of products from cities of Tbilisi and Telavi and from the bordering Municipalities. On distribution every day ride 400-500 vehicles during the whole day which pass at average 12-20km on the Community territory.

Total area of Telavi Municipality is 589.5 km^2. There are 32 central streets and 800 blind lanes in the villages of the Municipality including 5 streets of transit destination passing through the village territories and their total length makes 55km, and the total length of the internal roads makes 406km of which 60% is asphalt coted. There are 19 motor bridges in the territory of the Municipality. A great part of rural roads entering in Telavi Municipality requires total rehabilitation and another part – partial rehabilitation. Significant improvement is noticed in terms of road infrastructure development and asphalting the roads during the last years.

According to information requested from the Infrastructure Development, Spatial Arrangement, Architecture and Construction Service, 19.1km road was asphalted and arranged (in 2012 –5.0km, in 2013 – 7.1km, and in 2014 – 7.0km) in the Municipality. The disposition of the Municipality villages and the existing main infrastructure stipulates intensive flow of traffic on central roads. Sufficiently large part of Community Telavi Municipality population is engaged in the motor-car business (trading the second-hand vehicles), which seriously increases the number of the vehicles riding and registered in the Municipality.

Presently, the transportation means for Community Telavi Municipality population are represented by private taxis and minibuses, or personal cars. There is a lack of public transport and regular routes. Considering the tourist potential of the region and its disposition, the role of Community Telavi is huge in tourism development in the region requiring unloading the Municipality territory from excess vehicles and promoting clean healthy transportation (bicycles, walking) from the side of the Municipality Administration. Due to the lack of public transport in Telavi Municipality, private vehicles represent more the means of transportation rather than the luxury. During 2012-2014, in the Municipality, the total number of transport has been increased by 110%.

Table 4. Vehicle Number Increase Trend in Community Telavi Municipality

Year	Total	Passenger cars	Trucks	Different
2012	5 980	4 258	1 343	379
2013	8 627	6 592	1 587	448
2014	12 563	10 046	1 988	529
Increase (%)	110	136	48	40

As Table 4 shows, the pace of increase of motor vehicles in Telavi Municipality is rather noticeable. If in 2012 the transport means in total made 5 980 vehicles, in 2014 it made 12 563 vehicles, i.e. increased by 110%. According to the types of motor vehicles, the picture is as follows: The greatest increase 136% is noted in the passenger cars category, and in other category this increase is at average 40%.

The increase of emissions, environment pollution and annoying noise is the final result of the increased number of damaged motor roads and transport means. 7 gasoline service and 4 gas filling stations are operating at the Telavi Municipality territory.

According to 2014 data, about 15 000-16 000 vehicles of the Municipality are moving daily including transit vehicles that is about 40% of the total number, and basically it consists of vehicles of the following brands: BMW, MERCEDES, OPEL, TOYOTA,HONDA, VAZ and FORD-TRANZIT. The SECAP discusses only the vehicles registered at the territory of the Municipality and moving inside the Municipality territory. However, according to the information of the Municipality Administration, the transit share may presumably be much higher. Detailed information on the type of vehicles registered in 2012-2014 operating on different fuels is given in Tables below (data are taken from the statistics of the Ministry of Internal Affairs and the results of the population questioning, conducted in 2014 in frames of the EC-LEDS project, as well as, questioning of the Municipality village attorneys).

Information on the fuel consumption by the vehicles registered in 2014 at the territory of Community Telavi Municipality according to their types is given in Table 5. It is notable that obtaining statistics about transport is very difficult as old vehicle fleet which is not used anymore are not removed from registration list making it difficult to define exact number of the vehicles.

Data on consumed fuel was collected on the basis of questioning Municipality departments and LTDs, bus stations, population, state subordinate bodies, and gasoline filling stations.

Table 5. Vehicles in Permanent Ownership of Community Telavi Municipality in 2014

Vehicles	Passenger cars (except for taxi and municipal vehicles)	Vehicles serving municipality	Motorcycles	Buses	Minibuses (passenger)	Taxis	Small Trucks (2 tons carrying capacity)	Heavy duty Trucks
Number according to type of fuel								
Gasoline powered	4 325	16	134	0	21	71	152	71
Diesel powered	860	8	0	0	16	69	758	533
Natural gas powered	4 861	8	0	0	14	172	289	185
Total	10 046	32	134	0	51	312	1 199	789

Source: Community Telavi Municipality Administration

Fuel consumption in Community Telavi Municipality is distributed in the following way: natural gas – 44%, gasoline – 38%, and the rest 18% is diesel consumption.

Table 6. Increase in Fuel Consumption

Fuel Type	2012	2014	Increase (%)
Gasoline (l)	2 324 542	6 648 192	186
Diesel (L)	1 772 115	4 217 634	138
Natural gas (m^3)	1 124 672	7 838 964	597

Together with vehicle number increase fuel consumption is also significantly increased: consumption of gasoline is increased by 186%, diesel – by 138%, and gas – by 597%.

Public[9] Transport

[9] At this stage Community Telavi Municipality does not have any municipal public transport and plans to establish it in the frames of this Action Plan.

As it was mentioned in the Introduction, the biggest problem of the Municipality in Transport Sector is the fact that after the disintegration of the Soviet Union the public transport operating at this territory was abolished and it couldn't be reestablished till present that obviously increases travelling on rather long distances in private cars. There are 26 transport lines in the Municipality belonging to private companies: "New Bus Station of Telavi" and "Old Bus Station". On each route they operate two minibuses. The cost of carrying one passenger on internal routes varies from 0.40GEL up to 2.00GEL depending on the length of the route. Besides the internal routes, the private minibuses move from the City of Telavi to Akhmeta, Gurjaani, Kvareli, Sighnaghi, Lagodekhi, and Dedoplistskaro Municipalities, as well as, in the same way, from these municipalities the minibuses move to/from Tbilisi passing through the territory of Community Telavi Municipality.

The number of minibuses moving through the territory of Community Telavi Municipality in 2014 is given in Table 7.

Table 7. Public Transport (Minibuses) Moving in 2014

Minibuses	Number
Gasoline powered	21
Diesel powered	16
Natural gas powered	14

Source: Community Telavi Municipality Administration

The data on fuel consumption by different types of transport and the average run which was used to estimate the consumption of fuel is given in Table 8. To calculate fuel consumption only the vehicles moving on internal routes were used, as for the other transportations, they either move on the routes outside the Municipality, or are old and are not in use anymore (Table 8):

Table 8. Community Telavi Municipality Transport Characteristics

Vehicles	Passenger cars (except for taxi and municipal vehicles)	Vehicles serving municipality	Motorcycles	Minibuses (passenger)	Taxis	Small Trucks (2 tons carrying capacity)	Heavy duty trucks
Annual run (km/vehicle)	14 400	18 000	4 500	21 600	16 200	9 000	16 200
Average fuel consumption per 1 vehicle on Gasoline (l/100km)	9.5	10.0	4.0	12.0	10.0	12.0	30.0
Average fuel consumption per 1 vehicle on Diesel (l/100km)	10.0	10.0		10.0	8.0	10.0	25.0

Average fuel consumption per 1 vehicle on Natural gas (m^3/100km)	9.0	9.0		12.0	10.0	12.0	30.0

Source: Community Telavi Municipality Administration

3.2 Transport Sector Base Year (2014) Inventory and Baseline Scenario of the GHG Emissions (2015 – 2030)

Methodology of calculation in the base year and baseline scenario of the GHG emissions is given in Appendix I.

Structure and the baseline year inventory regarding Transport Sector of Community Telavi Municipality are based on 2014 data and discuss the following types of transportation:

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

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 territorial limits.

In 2014, fuel consumption by Transport Sector of Community Telavi Municipality made about **179 913** MWh.

Table 9. Final Energy Consumption in Community Telavi Municipality Transport Sector (MWh) - 2014

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	123	151	265	539
Public Transport (minibuses, taxis)	2 992	1 299	1 561	5 852
Private and Commercial Transport	71 350	42 737	59 435	173 521
Total	74 464	44 187	61 262	179 913

Therefore, in 2014, the GHG emissions from the Transport Sector made about 41 975 tons of CO_2 equivalent.

Table 10. GHG Emissions from Community Telavi Municipality Transport Sector in CO2eq (ton) -2014

Subsector	Natural Gas	Diesel	Gasoline	Total
Municipal Vehicle Fleet	24.83	39.9	66.16	130.89
Public Transport (minibuses, taxis)	603.28	343.52	389.28	1 336.08
Private and Commercial Transport	14 388.32	11 302.32	14 817.33	40 507.96
Total	14 991.6	11 645.84	15 206.61	41 974.93

The Table shows that the share of private and commercial transport in total energy consumption equals to 96% and in total emissions is equal to 96,5%. So, in the long-run perspective the main target group should be this sector. However, in short-run perspective it is urgent to arrange the public transport.

2020 - 2030 forecast of Transport Sector emissions was done based on MARKAL GEORGIA. By 2020 the forecasting mark of the GHG emissions for Transport Sector made about 59 289 tons of CO_2 equivalent, and by 2030 – 88 686 tons of CO_2 equivalent.

Increase of Transport Sector emissions according to the BAU scenario is given in Fig. 7.

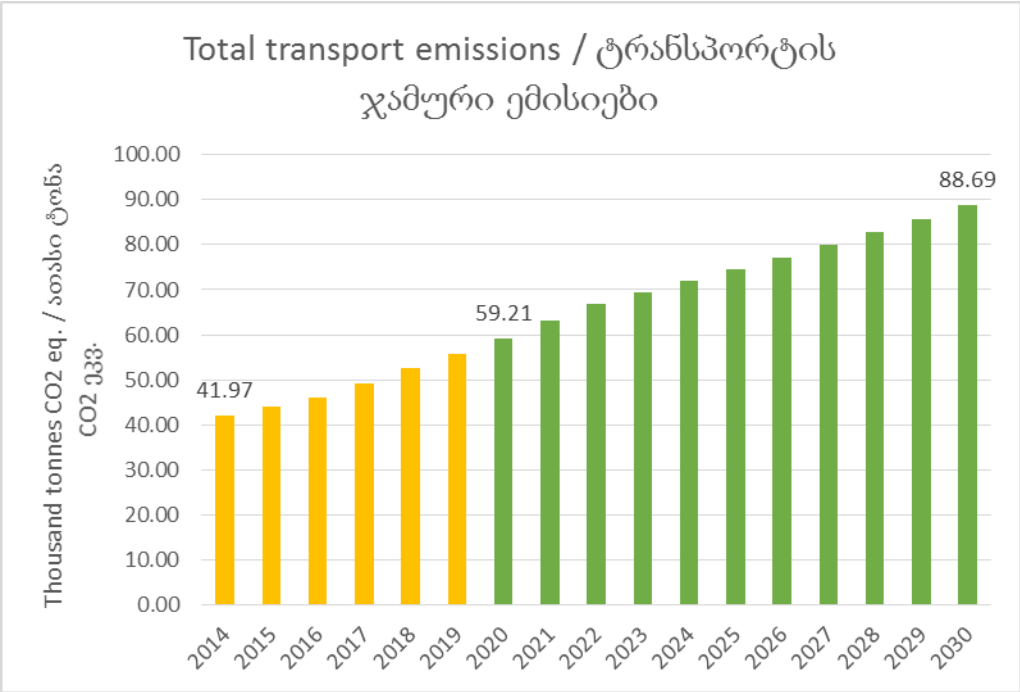

Fig. 7. Trend of GHG Emissions from Transport Sector according to the BAU scenario (tCO2 eq.)

3.3 Action Plan for Reducting Emissions from Community Telavi Municipality Transport Sector

Private vehicles ownership rate in Community Telavi Municipality is not high. There are 197 vehicles per 1000 inhabitants in Community Telavi Municipality which is a bit lower in compared to average rate Georgia.

As it was already mentioned, traveling by taxi is very popular and rather cheap at the territory of the Municipality. Therefore, strategic perspective for Transport sector is development of comfortable and cheap public transport on the entire territory of Community Telavi Municipality, and for the long-run perspective - regulation/limiting travel by private taxis and vehicles. Reaching this target is necessary to create and promote other, alternative transportation means (walking, ride by bicycle). Providing comfort in public transport development process is very urgent.

As a result of implemented measures considered in Community Telavi Municipality SECAP, compared to the baseline scenario by 2020 emissions of CO_2 from Transport Sector will be reduced by 1 773 tons CO_2

equivalent. All the measures will be implemented by the appropriate bodies of Community Telavi Municipality Administration.

Description of Measures

Measure PT1: Providing the territory of Community Telavi Municipality with Public Transport. In 2016-2017 the NNJP "Infrastructure and Municipal Amenities", under the Community Telavi Municipality Administration, plans to assign comfortable public transport on the territory of the community which will replace private minibuses and will be more affordable for the population. At present, on the Municipality territory 14 minibuses are moving in Shalauri-Akura zone passing 340 180km and carrying 155 490 passengers per year, and in Vardisubani-Ikalto zone are moving 6 minibuses passing 125 560km and carrying 70 810 passengers per year.

The Municipality plans to purchase two comfortable buses which will replace those 20 minibuses which now are moving in Shalauri-Akura and Vardisubani-Ikalto zones:

- One bus with 80 seats which will replace 14 minibuses moving in Shalauri-Akura zone, which will pass per year 87 600km, i.e. will run by 331 400km less, and will have the capacity to carry 175 200 passengers, i.e. will carry by 19 710 passengers more than the minibuses used to carry.
- One bus with 50 seats which will replace 6 minibuses moving in Vardisubani-Ikalto zone, which will pass per year 65 700km, i.e. will run by 59 860km less, and will have the capacity to carry 109 500 passengers, i.e. will carry by 38 690 passengers more than the minibuses used to carry.

Community Telavi Municipality currently is negotiating electric buses purchasing details. Energy consumption of each bus equals to 50KWh/100km.

To provide conservative assessment, it was assumed that at the first stage two diesel-powered buses will be purchased consuming 25litres of diesel per 100km, however, in the mid-run period until 2027 electric buses will be purchased, which will be more effective and cleaner for Georgian conditions. Consequently, by 2020 the saving will equal to 115 tCO_2 eq., and by 2030 - 205 tCO_2 eq.

Current minibus routes and runs are given in the Tables below (Table 11 and Table 12).

Table 11. Minibus Routes (Akura-Shalauri Zone)

Village	Length of the Route, km	Run per day	Passengers per Run	Total km per day	Total Passenger per day
Akura	30	6	7	180	42
Vanta	24	6	8	144	48
Busheti	22	6	8	132	48
Kv. Khodasheni	20	6	8	120	48
Tsinandali	18	8	10	144	80
Kisiskhevi	14	8	10	112	80
Shalauri	10	8	10	100	80

Total 14 minibuses	138	48	61	932	426

Table 12. Minibus Routes (Ikalto-Vardisubani Zone)

Village	Length of the Route, km	Run per day	Passengers per Run	Total km per day	Total Passengers per day
Ikalto	24	6	9	144	54
Ruispiri	20	6	10	120	60
Vardisubani	10	8	10	80	80
Total – 6 minibuses	54	20	10	344	194

The details of calculation of emissions are given in monitoring plan.

Measure PT2: Arranging Cableway from Kvevris Sakhli up to Ikalto Academy

Currently, on the territory of Community Telavi the construction of a rather large three-story Kvevris Sakhli (Pitcher House) is being carried out under the World Bank's funding, which will have both educational and tourist functions. As well, the draft government Decree exists regarding improving tourist infrastructure in Ikalto and after implementation of the above-mentioned projects, tourist flow will be increased threefold and presumably it will reach 1000 persons per day. Improving tourist infrastructure includes arranging pedestrian and bicycle paths and a cableway. By 2030 the road starting from the Kvevris Sakhli up to the Ikalto Academy will be closed for vehicles and travel will be allowed only on foot, bicycle or by cable car. On the spot there will be arranged bicycle renting stations.

At present, tourists are carried by cars, minibuses, and buses. The length of the road is 1 800m and the cableway length will be approximately 1300-1400m. At present, the tourist flow in Ikalto Academy is mostly during the tourist season, from April to November. For this period at least 2-3 buses with 40-men groups of foreigners and 5-10 minibuses and 20 passenger cars move on this road, to what at the weekends is added 10-15 minibuses arrived from other regions of Georgia. Considering this, presumably, at work days the cableway will usually have at least 200 passengers, and at weekends the number of passengers will double.

With implementing this measure 49 tCO_2eq. will be saved by 2030. See the details of emissions calculation in the monitoring plan.

Measure UP1: Rehabilitation of the Road Pavement

Total area of Telavi Municipality makes 589.5 km^2. There are 32 central streets and 800 blind lanes in the Municipality villages, including 5 streets having transit destination passing through the village territories and their total length equals to 55km, and the total length of internal roads equals to 406.2km, 60% of which is asphalted though the roads of villages entering in Community Telavi Municipality require complete rehabilitation. A significant improvement is noticed in terms of road infrastructure development and asphalting the roads recently. According to the information requested from the Municipality Architecture and Construction Service, including 2014, 19.1km (5%) of roads in the Municipality have been asphalted and arranged.

Out of the remaining 95% of roads it is needed to be asphalted 40% (162km) of dirt road, and to rehabilitate completely the damaged road cover on 55% (223km) of the already asphalt coated road, i.e. it is needed to carry out complete rehabilitation of all 95% of roads. Thus, according to the appropriate studies, in case of complete rehabilitation of the asphalt cover of roads, 95% of the emissions (84 387 $tCO_2eq.$) emitted from Transport Sector moving at the territory of Community Telavi Municipality may be reduced at least by 6% for 2030.

As a result of the measure there will be saved 5 063 t emissions (84 387*0.06).

Other details of the measure see in Monitoring Plan.

Measure UP2: Management of Transport flows at the Territory of Community Telavi Municipality.

This measure implies the following activities:

- Optimization of the transport routes to reduce travel distances. Namely, study of the overloaded roads and finding alternative routes, organizing new routes and roads. Existing routes and roads will be reviewed and changed in the way that travel will be improved;
- Building new roads or rehabilitation of the old ones which will reduce the distance of vehicle travel.

The details of the measure see in monitoring plan.

Measure PRT1: Setting up of Parking System at the Community Telavi Territory

At present, Community Telavi Municipality does not have any parking policy. However, in the long-run perspective the Municipality management discusses setting up the parking grounds and limiting parking of the transport means in certain areas, first of all, in tourist areas, and setting up special parking grounds. The main goal of this policy/measure is to unload certain areas (especially tourist areas and central districts) from vehicles.

12 000 vehicles of different types at the territory of Community Telavi Municipality at present, consuming in total 180 394MWh/y energy and emitting 42 102 tCO_2eq GHG emissions. By 2030 when this measure is planned to be implemented and it is expected to receive 88 819 tCO_2eq GHG emissions.

Based on the guiding literature on estimation of emissions reduction measures from Transport Sector, it becomes clear that in areas with parking systems each vehicle reduces the travel distance by 7-10%. Hence, the reduction for Community Telavi was assumed to be 7%. This is only for passenger cars which represent 80% of the entire vehicle fleet.

Based on this assumption, in case of implementation of the measure 80% of the emissions will be reduced by 7% by 2030.

Measure PRT2. Promotion of Pedestrians and Travelers by Bicycles

Travelling by bicycle and walking is one of the most effective and, what's more, very healthy alternatives of travel. However, it has some important barriers one of which is attachment of population to vehicles and apprehending it as the social status defining criterion. Therefore, it is crucial to overcome this stereotype within the population and make the walking people and travelers by bicycles more prominent. Some campaigns should be launched for population underlining modern, European and effective approaches both from the point of transportation and healthy environment maintenance. It is especially important to develop comfortable infrastructure in tourist areas.

To encourage pedestrians, Community Telavi Municipality will continue implementing measures of arranging pavements and crossings in order walking to become comfortable and safe. Improving the conditions for travel of disabled people will also be considered. For the moment, the Municipality does not have any concrete plan but it schedules to develop the plan in the nearest future.

For successful completion of these measures special programs have to be conducted, aimed at behavioral changes among population within the frames of which explanation should be provided about the advantages of walking and travelling by bicycles compared to travelling by vehicles. Despite the fact that reduction of emissions has not been calculated for this measure, the Municipality acknowledges that such measures are very important for the whole process and sustainable development of the Community.

Table 13. Action Plan for Transportation Sector

Sectors and Spheres of Activity	Principal Measures in Separate Sector	Responsible Department, Person or Company (in Case of Engaging the Third Party)	Dates of Beginning and Termination	Expected Energy Savings from an Activity (MWh)	Expected Reduction of CO_2 Emissions from an Activity (t) 2020	Expected Reduction of CO_2 Emissions from an Activity (t) 2030	Cost GEL
Public Transport	Measure PT1. Providing the territory of Community Telavi Municipality with Public Transport. (buses)	LLC "Infrastructure and Municipal Amenities" under the Community Telavi Municipality	2017-2018		205	205	300 000
Public Transport	Measure PT2. Arranging Cableway from Kvevris Sakhli up to Ikalto Academy.	LLC "Infrastructure and Municipal Amenities" under the Community Telavi Municpality	2025-2028			49	17 600 000
Improvement of Road Infrastructure	Measure UP1. Rehabilitation of the Road Pavement.	LLC "Infrastructure and Municipal Amenities" under the Community Telavi Municpality	2015-2030		1 519	5 063	55 000 000

Limiting Private Vehicles	Measure PRT1: Setting up of Parking System at the Community Telavi Territory	Community Telavi Municpality Administration and City Assembly	2025-2030		-	4 974	2 500 000
Promoting Clean Transport	Measure PRT2. Promotion of Pedestrians and Travelers by Bicycles	Community Telavi Municpality Administration and City Assembly	2017-2030		-	-	2 000 000
Total					**1 724**	**10 291**	**77 400 000**

4 BUILDINGS

4.1 Overview of the Sector

One of the key points of Telavi SECAP is Buildings Sector existing at the territory of Community Telavi, which alongside with the residential buildings includes municipal and other commercial buildings (offices, shops, hotels, etc.). In the process of reducing the GHG emissions from the territory of the Municipality, role of this sector is rather significant and therefore the measures of energy-efficiency of these buildings and increasing consumption of renewable energies should be planned with special attention.

According to the Telavi Municipality Administration, Telavi Community includes 22 villages. The absolute majority (99%) of individual residential buildings have been built in the 60-70ies of the last century. For construction materials basically stone and wooden bars were used in between the masonry, and for roofing – the corrugated asbestos-and-cement tiles (asbestos sheeting), tiles, and tin sheeting. The window frames are made of wood which require either replacement, or thermal insulation to reduce infiltration.

For construction of nursery-kindergartens and public schools, bricks and double-glazed metal-plastic windows are used.

Total Fund of Community Telavi Municipality Buildings

At the territory of Community Telavi Municipality, like other municipalities, different types of buildings are located: municipal, governmental, residential (individual and multi-apartment buildings) and commercial buildings. There are 11 multi-apartment residential buildings. 10 of them are two-storey buildings, and only one is a four-storey building. The four-storey building is located in village Tsinandali and it was built in 1965-1967 for the employees of the then Tsinandali Wine Plant. It has two open entrances, construction material is brick, and natural gas is supplied to the building, though residents use firewood for heating the rooms. It has flat roofing covered with slates and tin sheeting. Most windows and doors are made of wood materials and are damaged, and the number of metal-plastic windows is small.

10 two-storey buildings are located in village Napareuli and all ten buildings were built in 1960ies by agricultural farms for the farm workers. They are corridor-system buildings, roofing was done by tiles and partially tin sheeting, with wooden windows and doors, heated with firewood, in each multi-apartment building live 4-6 households; the buildings have open entrances, construction material is brick, no natural gas, one building is partially burnt due to the fire taken place in 2015.

The population in the Municipality lives in 15039 private houses with total area of 1 992 677 m^2, i.e. the average area of one house makes 133 m^2. About ¾ of the buildings are two-storey buildings, and the rest – one-storey buildings. The construction materials of 80% of buildings are stone and brick and 20% were built with construction blocks. The fund of residential buildings is mostly built in 1965-1980, about 15% - before the wartime and earlier periods, and about 10% - for the last 15 years. About 1/3 of the roofs are made of

tiles, 1/3 – of slates, 1/3 - of tin sheeting, and the rest of metal tiles (mostly, the new roofing was made under the disaster 2012 results elimination program), 10-15% of the windows is metal-plastic and the rest is wooden.

Information on residential buildings in Community Telavi Municipality is given in Table 14.

Table 14. Residential Buildings in Community Telavi Municipality

Building	Number of Stories	Quantity	Number of Entrances	Total Areas (m2)
Multi-apartment buildings	4	1	2	620
Total		**1**		**620**
Multi-apartment buildings	2	10	1	4 288
Total		**10**		**4 288**
Total Multi-apartment Buildings:		**11**		**4 888**
Private Residential Buildings	1 or 2	15 039		**1 992 677**
Total Private Residential Buildings:		**15 039**		**1 992 677**
Total		**15 050**		**1 997 565**

The given information about total areas of residential buildings was obtained from the Administration of Community Telavi Municipality which was compiled based on the data of the public register and the survey and registration of the buildings.

In total 15 481 buildings are disposed at the territory of Community Telavi Municipality the total area of which makes 2 188 452 m^2, i.e. the average area of one building equals to 141 m^2.

Besides the residential buildings given in Table 14, there are 22 kindergartens (total area 12 079m2); 24 public schools (total area 22 792 m^2), 20 municipal administrative buildings (total area 4 960m2) and 317 commercial buildings (total area 14 534m2) in Community Telavi Municipality.

The list of non-residential buildings located at the territory of Community Telavi Municipality is given in Table 15.

Table 15. Non-Residential Buildings in Community Telavi Municipality

N	Village	Kindergartens		Public Schools		Administrative		Commercial	
		Unit	Area m^2	Unit	Area m^2	Unit	Area m^2	Unit	Area m^2
1	Akura	1	820	1	680	1	450	20	1 800
2	Vanta	1	800	1	1 540	1	800	15	1 500
3	Kvemo Khodasheni	1	400	1	150	1	120	8	80
4	Busheti	1	250	1	300	1	300	5	200
5	Tsinandali	1	1 140	1	1 340	1	736	18	1 080
6	Kisiskhevi	1	100	1	250	1	110	18	700
7	Nasamkhrali	1	35	1	100	-	-	8	150
8	Kondoli	1	300	1	1 500	1	200	14	300
9	Shalauri	1	180	1	500	1	100	10	400
10	Kurdgelauri	1	227	1	1 500	1	113	20	1 500
11	Gulgula	1	650	1	1	1	80	6	150
12	Vardisubani	1	900	1	2 500	1	150	50	600
13	Ikalto	1	900	1	2 900	1	100	13	650
14	Ruispiri	1	200	2	1 100	1	100	11	300
15	Napareuli	1	785	1	800	1	540	35	1 210
16	Saniore-Jugaani	1	1 632	1	2 380	1	336	7	400
17	Artana	1	700	1	803	1	150	1	40
18	Pshaveli	1	165	2	1 100	1	195	9	554
19	Karajala	1	690	1	1 748	-	-	41	2 640
20	Lapankuri	1	60	1	600	1	30	4	80
21	Laliskuri	1	145	1	640	1	30	3	100
22	Tetritsklebi	1	1 000	1	1 000	1	320	1	100
	Total	22	12 079	24	22 792	20	4 960	317	14 534

According to the information given in Table 15, the average kindergarten is built on the 549 m^2 area. 8 kindergartens are one-storey, and 14 – two-storey. All kindergartens are built in 1975-1980, the construction materials are stone and brick, in 2016 roofing of three kindergartens was completed replacing the slates with

tin sheeting. For the last three years the wooden windows and doors in 2/3 of the kindergartens have been replaced with metal-plastic ones.

There are 20 municipal administrative buildings in villages, and the construction area equals to 4 960 m^2 (on the average 248 m^2) (in two villages: Karajala and Lapankuri the employees of District Governor's Office are placed in the buildings of kindergartens). Administrative buildings are mostly two-storey which were built in 1970-1980, construction material is stone and brick, roofing - slates and tin sheeting, and heating with firewood.

Administrative building of Community Telavi Municipality is shared with Self-government City Telavi Municipality. The building is located in #16, Erekle II Street, City of Telavi. The part of Community Telavi Municipality area makes 1 319 m^2; it occupies a part of the second floor of a three-storey building. The building was built in 60-80ies of the last century with brick, with reinforced-concrete roofing and metal-plastic windows.

There are 24 other municipal buildings with construction area of 10 764 m^2 at the territory of the Municipality built in 1965-1970, most part of which represents two-storey buildings (area of one building makes 448m2). These buildings are represented by houses of culture, libraries, village clinics and others. Construction materials are stone and brick, roofing slates, tiles and tin sheeting, windows – wooden; There are 2-3 rooms in the buildings with good windows and doors, and the rest of the rooms are useless due to damaged roof and doors and windows. Mainly firewood is used for heating, electricity is used for 2-3 bulbs only. It is almost impossible to rehabilitate these buildings due to their condition.

There are 24 village school buildings with construction area of 22 792 m^2 at the territory of the Municipality. Average area of one school is 950 m^2 and according to their stories they are grouped as follows: 4-storey – 1 school in village Pshaveli, 3-storey – 15 schools, 2-storey – 8 schools. The two-storey schools were built in the 70-ies, three-storey school – in the 1970-1975-ies of last century, and four-storey - in 1980 – 1983. All of them are roofed with tin sheeting, and have metal-plastic windows except the Tsinandali School.

There are 365 operating units of commercial facilities at the territory of the Municipality, including: shops, bakeries, 5 dairy-processing enterprises, 2 slaughter plants, 1 refrigerating facility, 22 wineries, restaurants, drugstores, and dental clinics. Excluding the area of wineries, the average area of the enterprises is within the frames of 250 m^2.

In total, 66 buildings with total area of 27803 m^2, including 22 kindergartens, belong to the Community Telavi Municipality. The list of buildings and their areas which are in the ownership of the Municipality are given in Table 16, and the list of kindergartens – in Table 17.

Table 16. The Buildings under the Ownership of Community Telavi Municipality (except Kindergartens)

Administrative Center	Number	Total Area (m2)

Akura	1	450
Vanta	1	800
Kvemo Khodasheni	1	120
Busheti	1	300
Tsinandali	1	736
Kisiskhevi	1	110
Nasamkhrali		
Kondoli	1	200
Shalauri	1	100
Kurdgelauri	1	113
Gulgula	1	80
Vardisubani	1	150
Ikalto	1	100
Ruispiri	1	100
Napareuli	1	540
Saniore-Jugaani	1	336
Artana	1	150
Pshaveli	1	195
Karajala		
Lapankuri	1	30
Laliskuri	1	30
Tetritsklebi	1	320
Total	20	**4 960**

Table 17. Kindergartens under the Ownership of Community Telavi Municipality

Nursery-Kindergartens	Number	Total Area (m2)
Akura	1	820
Vanta	1	800
Kvemo Khodasheni	1	400
Busheti	1	250
Tsinandali	1	1 140
Kisiskhevi	1	100
Nasamkhrali	1	35

Kondoli	1	300
Shalauri	1	180
Kurdgelauri	1	227
Gulgula	1	650
Vardisubani	1	900
Ikalto	1	900
Ruispiri	1	200
Napareuli	1	785
Saniore-Jugaani	1	1 632
Artana	1	700
Pshaveli	1	165
Karajala	1	690
Lapankuri	1	60
Laliskuri	1	145
Tetritsklebi	1	1 000
Total	**22**	**12 079**

Besides, there are state-owned buildings (for example: schools, medical institutions), and commercial buildings in Community Telavi Municipality. Their list is given in Table 19.

Table 18. The Incomplete List of State-owned and Commercial Buildings Functioning in Community Telavi Municipality

№	Name of Realty	Number	Area m2
1	Public Schools	24	22 792
2	Commercial Buildings	317	133 348
3	Other State-owned Buildings	8	3 362
4	Other Buildings	16	3 282
	Total	365	152 784

Energy Consumption by Buildings Sector in Community Telavi Municipality

Information on energy consumption by Buildings Sector in Community Telavi Municipality was obtained from different sources. Namely, information about energy consumption was taken from Kakheti Energy

Distribution Company distributing electric energy in Community Telavi Municipality. Information about consumption of natural gas was obtained from Gas Company "Wissol Gas Petroleum" supplying the Municipality with gas. Information on firewood consumption in the buildings was collected from the Administration of Community Telavi Municipality. As well, the information on energy consumption by different types of buildings was obtained from the following sources: surveys conducted in sites among the population, data of the Environment Protection Inspection, information provided by Municipality Administration Representatives in villages, the Municipality Finance Services, Education Resource Center, and Administration Control Service. Data on energy consumption by residential and non-residential buildings at the territory of Community Telavi Municipality in 2012 – 2014 according to the energy sources is given in Tables (Table 19, Table 20 and Table 21).

Table 19. Energy Consumption by Residential and Non-residential Buildings at the Territory of Community Telavi Municipality in 2012

N	Facility	Area m^2	Electric Energy KWh/yr	Natural Gas m^3/yr	Liquid Petroleum Gas kg/yr	Firewood m^3/yr
1	Residential Buildings	4 888	12500	400	-	80
2	Private Houses	1 992 677	20939970	1994337	600000	15480
3	**Total Residential Buildings**	**1 997 565**	**20 952 470**	**1 994 737,00**	**600 000**	**35 480**
4	Kindergartens	12079	132 000	-	-	180
5	Administrative Buildings	4960	60 000	-	-	160
6	Other Municipal Buildings	10764	86 000	-	-	20
7	**Total Municipal Buildings**	**27 803**	**278 000**	-	-	**360**
8	Schools	22792	175000	750	-	1800
9	Other State-owned Buildings	3662	30000	450	-	30
10	Commercial Buildings	133348	3050000	1200	-	250
11	Other Buildings	3282	38000	250	-	-
12	**Total Commercial and Other Buildings**	**163 084**	**3 293 000**	**2 650**	-	**2 080**
13	**Total**	**2 160 649**	**24 523 470**	**1 997 387**	**600 000**	**38 000**

Table 20. Energy Consumption by Residential and Non-residential Buildings at the Territory of Community Telavi Municipality in 2013

N	Facility	Area m^2	Electric Energy KWh/yr	Natural Gas m^3/yr	Liquid Petroleum Gas kg/yr	Firewood m^3/yr
1	Residential Buildings	4 888	10500	460	-	100
2	Private Houses	1 992 677	23373208	2208359	550000	60055
3	**Total Residential Buildings**	**1 997 565**	**23 383 708**	**2 208 819,00**	**550 000**	**60 155**
4	Kindergartens	12079	158 000	1 300	-	185
5	Administrative Buildings	4960	76 000	-	-	170
6	Other Municipal Buildings	10764	95 000	-	-	20
7	**Total Municipal Buildings**	**27 803**	**329 000**	**1 300,0**	**0**	**375**
8	Schools	22792	190000	1000	-	1720
9	Other State-owned Buildings	3662	32000	620	-	40
10	Commercial Buildings	133348	3420000	1400	-	310
11	Other Buildings	3282	57500	340	-	-
12	**Total Commercial and Other Buildings**	**163 084**	**3 699 500**	**3 360**	**0**	**2 070**
13	**Total**	**2 160 649**	**27 412 208**	**2 213 479**	**550 000**	**62 600**

Table 21. Energy Consumption by Residential and Non-residential Buildings at the Territory of Community Telavi Municipality in 2014

N	Facility	Area m^2	Electric Energy KWh/yr	Natural Gas m^3	Liquid Petroleum Gas kg/yr	Firewood m^3/yr
1	Residential Buildings	4 888	14 300	1 850	-	90
2	Private Houses	1 992 677	25498780	2968088	420000	80508
3	**Total Residential Buildings**	**1 997 565**	**25 513 080**	**2 969 938,00**	**420 000**	**80598**
4	Kindergartens	12079	190 000	2 300	-	192
5	Administrative Buildings	4960	85 000	-	-	155
6	Other Municipal Buildings	10764	120 000	-	-	25

7	**Total Municipal Buildings**	**27 803**	**395 000**	**2 300,0**	**0**	**372**
8	Schools	22792	210 000	1 200	-	1 680
9	Other State-owned Buildings	3662	34 500	860	-	40
10	Commercial Buildings	133348	3550000	1 500	-	400
11	Other Buildings	3282	62 000	660	-	-
12	**Total Commercial and Other Buildings**	**163 084**	**3 856 500**	**4 220**	**0**	**2 120**
13	**Total**	**2 160 649**	**29 764 580**	**2 976 458**	**420 000**	**93 090**

The summed up information about consumption of different types of fuel in the buildings is given in Table 22.

Table 22. Trends of Energy Resources (MWh) Consumed by Residential and Non-residential Buildings in Community Telavi Municipality in 2012-2014

Type of Building	Total Area (m^2)	2012	2013	2014
Residential Buildings	**1 997 565**	**149 211.9**	**223 160.4**	**289 113.77**
Municipal Buildings	27 803	**1 304.72**	**1 410.85**	**1 477.79**
Other Buildings	163 084	**9 250.33**	**9 635.06**	**9 942.83**
Total Energy consumption (MWh)		**159 766.95**	**234 206.3**	**300 534.38**

Presented Table is targeted only to analyze general trends of energy consumption. It does not include firewood consumption the percentage of which in total consumption is rather high but the data provided by the Municipality on firewood consumption is of low reliability. Namely, firewood consumption in this period increased by 83%, however, according to the Municipality information, this increase is resulted from the actually improved (stricter) registration. As for the other fuel, total increase of electric energy is 21%, natural gas – 49%, but there is 30% reduction in total liquid gas consumption. According to Table 22, in 2012-2014, energy consumption (except firewood) in residential sector increased by 94%, and in non-residential[10] sector – by 8%.

Table 23 shows energy consumption in Base year 2014 according to the fuel type and building categories in natural units the total sum of which is 300 535MWh with 79% of firewood.

Table 23. Energy Resources by Types Consumed in Residential and Non-residential Buildings in Community Telavi Municipality during Base Year 2014

[10] Here should be considered that energy consumption by non-residential buildings (wineries, etc.) is not registered completely.

Subsectors of the Buildings	Electric Energy (kWh)	Natural Gas (m^3)	Liquid Gas (kg)	Firewood (m^3)
Residential	25 513 080	2 969 938	420 000	80 598
Municipal	395 000	2 300	0	372
Other Buildings (schools, governmental sub-departmental buildings, hotels, etc.)	3 856 500	4 220	0	2 120
Total	29 764 580 (29 765 MWh)	2 976 458 (28 274 MWh)	420 000 (5 523 MWh)	83 090 (2363 MWh)

4.2 Methodology

The Methodology given in Appendix was used for conducting CO_2 baseline (2014) emissions inventory from the Building Sector and defining future trends (by 2020 and 2030). This methodology also includes carbon dioxide emissions factors and transfer coefficients, as well as, methane and nitrous oxide emissions factors resulted from incomplete combustion of fuel. They were taken from the IPCC 1996 and are shown in Table 24.

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

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

As for the emissions reduction potential resulted from energy saving measures, it has been assessed by selecting typical buildings for Community Telavi Municipality, carrying out energy audits and evaluating energy efficiency measures, then transposing these results to other buildings. Energy audit methodology is given in Appendix III.

In short, it could be said that assessment of the energy consumption from Buildings Sector and on its basis calculation of carbon dioxide emissions, may be conducted according to three different scenarios (E_1=E_2=E_3): first scenario (E_1) – based on the annual energy consumption from Buildings Sector (electricity, gas, firewood suppliers) obtained from different sources; second scenario (E_2) - based on the energy consumption calculated for area unit after auditing different types of buildings which is planned to be generalized on the entire existing area; and third scenario (E_3) - also based on the buildings auditing or surveys, calculated with multiplying

energy consumption per capita by the number of population. Comparing the results of these three scenarios it is possible to identify the accuracy of calculation according to each scenario (E_1=E_2=E_3).

Detailed energy audit of selected 8 facilities was conducted in 2016 to develop Community Telavi Municipality SECAP. The facilities have different energy resource consumption specifics and include the following buildings:

Kindergarten in village Vardisubani

Public Scool in village Naphareuli

Private House in village Naphareuli

Administration building of village Naphareuli

Commercial Building in village Naphareuli

Private House in village Naphareuli

Private residenmtial house in village Nasamkhrali

Private residential house in village Kisiskhevi

Private resuidential house in village Tsinandali Private residential house in village Kvemo Khodasheni

Private residential house in village Busheti

Picture 3. Community Telavi Municipality Buildings

After specifying specific energy costs, annual energy consumption (E_2, kWh/y) for heating, hot water, cooking and electric appliances was identified for different types of buildings.

The third scenario of methodology (E_3) is based on statistical data about the number of residents in the populated facility. Identifying the energy cost calculated per capita (kWh/y per capita) makes it possible to calculate the annual energy consumption for the entire population (E_3,kWh/y).

4.3 Base Year (2014) Inventory and GHG Emissions Baseline Scenario (2014-2020-2030) for Buildings Sector

As it was already mentioned, three sub-sectors are considered in the structure of Municipality Buildings Sector according to guidelines for the SEAP development. They are: municipal buildings, residential buildings and others (commercial buildings).

Community Telavi Municipality is almost completely electrified and power supply is provided to all populated areas except 50 households which live in high mountainous village Tetritsklebi.

Energy consumption in Buildings Sector in 2014 is shown in Table 25.

Table 25. Final Energy Consumption in Community Telavi Municipality Buildings Sector (MWh) - 2014

#	Subsectors	Electric Energy	Natural Gas	Liquid Gas	Firewood	Total
1	Municipal Buildings	395	22	0	1 061	1 478
2	Other (Commercial) Buildings	3 857	40	0	6 046	9 943
3	Residential Buildings	25 513	28 212	5 523	229 865	289 113
	Total	29 765	28 274	5 523	236 972	300 534

Consequently, in 2014 GHG emissions from buildings made 110 thousand tons CO_2eq. The 2014 power grid average emissions factor is considered as the power emissions factor – 0.104 tons CO_2eq./MWh.

Table 26. GHG Emissions from Community Telavi Municipality Buildings Sector in 2014

Ton CO_2eq.

#	Subsectors	Electric Energy	Natural Gas	Liquid Gas	Firewood	Total
1	Municipal Buildings	41.08	4.4	0.0	447.53	493.01

2	Other (Commercial) Buildings	401.08	8.08	0.0	2 550.45	2 959.6
3	Residential Buildings	2 653.36	5 683.91	1 255.55	96 962.78	106 555.6
	Total	3 095.52	5 696.39	1 255.55	99 960.76	110 008.21

According to the baseline scenario of emissions calculated by the MARKAL Georgia, there will be 36,5% increase of coefficients by 2020 and 125% increase by 2030.

As of 2013, 77% of Community Telavi Municipality population consumes natural gas. Natural gas is not supplied only to 6 villages (Laliskuri, Pshaveli, Lechuri, Lapankuri, Tetritsklebi and Karajala), representing the rest 23%.

According to the forecast of 2020 and 2030, firewood consumption will be less likely increased, on the contrary, there will be transition on gas and the MARKAL coefficients will imply only electricity and natural gas increase. That's why 36,5% and 125% increase are considered only electricity and natural gas emissions, which in 2014 in total was equal to 8 792 tons CO_2eq. Consequently, by 2020, emissions from consumption of these two energy resources will equal to 8 792+3165=11957tons CO_2eq., and by 2030 it will equal to 8792+10990=19782tons CO_2eq. As for total emissions, considering firewood consumption by 2020 it will equal to 11957+1256+99961=113 174 tons CO_2eq., and by 2030 it will equal to 19782+1256+99961=120 999 tons CO_2eq.

The Figures (Fig. 8; Fig. 9) show emissions t CO_2eq., according to types of buildings and fuel in 2014-2020-2030.

Fig. 8. BAU Scenario up to 2020 and 2030 according to Types of Buildings

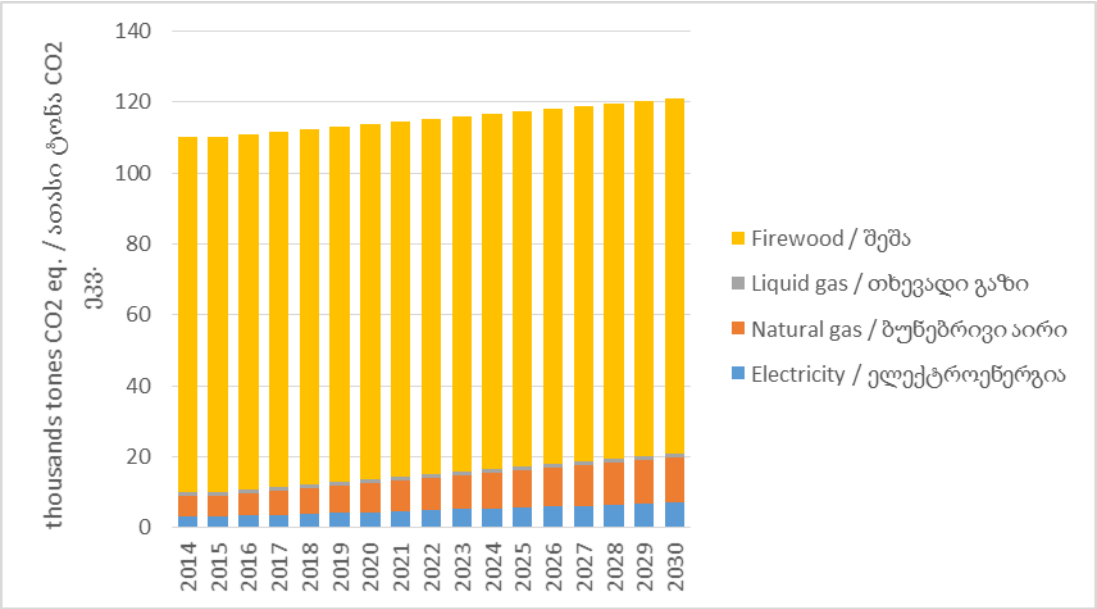

Fig. 9. BAU Scenario up to 2020 and 2030 according to Types of Fuel for Buildings Sector

4.4 GHG Emissions Reduction Action Plan for Community Telavi Municipality Buildings Sector

As it is seen from Tables (Table 23 and Table 25), 97% of the GHG emissions from Community Telavi Municipality are released from residential buildings. Therefore, to achieve the 20% reduction of emissions by 2020 and 40% reduction by 2030, it is important to develop sector programs in the residential buildings facilitating introduction of energy efficiency and renewable energy adoption measures. At the same time, it should be considered that the energy consumption in Community Telavi Municipality is low, the buildings are not completely heated and large part of population lives in energy poverty. Such programs require serious preparatory activities, collaboration with donors in terms of external financing, improvement of legislative basis and regulations enabling the Municipality to work directly with the population and carry out corresponding projects. Community Telavi Municipality Administration takes into consideration the fact that only 4 years left for preparation of the plan that may not be enough to reach 20% reduction by 2020. Therefore, more realistic will be reaching 40% reduction of emissions by 2030 as it is considered in the new Covenant of Mayors to which Community Telavi Municipality has already joined. In the nearest 4 years the strategy of Community Telavi Municipality 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 buildings. At the same time, energy saving measures will be popularized and promoted for the residential buildings the co-financing programs to which the Administration has already planned. The Municipality actively cooperates with gas company "Wissol" to ensure natural gas supply for kindergartens,

schools and population consuming firewood irregularly (illegally cut firewood). At the same time, the Municipality plans to establish Sustainable Development Agency the main function of which will be to develop energy efficiency and renewable energies programs for the population.

Based on the discussed above considerations implementation of following measures is planned.

In accordance with the short-run and long-run SECAP strategy, the implementation of following measures may be completed in Buildings Sector.

In municipal buildings (before 2020):

1. Thermal insulation of attics (in the Municipality administrative building and kindergartens);
2. Installation of new lighting systems (in the Municipality building and kindergartens);
3. Application of solar collectors in kindergartens.

In the short-run (2020) perspective the Municipality will work on adoption of following measures for residential sector:

1. Thermal insulation of attics in residential buildings;
2. Thermal insulation of entrances in residential buildings;
3. Reduction of infiltration from the windows in residential buildings;
4. Application of solar collectors in residential buildings.

In the long-run (2030) perspective the Municipality plans to work out programs and projects for private house owners on introduction of following measures:

1. Thermal insulation of roofs in private houses;
2. Application of solar collectors in private houses;
3. Application of high-efficiency wood stoves and generators operating on bio-waste.

The Action Plan 2020 and 2030 for reduction of the GHG emissions from buildings existing at the territory of Community Telavi Municipality is presented in Table 27 and below is given the description of the planned measures.

Measure MB 1: Thermal Insulation of Attics in Municipal Buildings

Measure MB 1.: Thermal Insulation of Attic in Municipal Building. The measure is considered to be implemented in Community Telavi Municipal building located in village Napareuli.

As a result of implementation, the expected energy savings were calculated by the ENSI computer program and makes 6 080 kWh/yr. For one sq. m area of the attic, these savings make 6 080/207=29.4 kWh/m^2yr where 207m^2 is the attic area.

As the Municipal building is heated with firewood, the energy savings in firewood equivalent will be 6 080/(2 852 x 0.35)= 6.09m^3/yr. Considering the cost of firewood (70GEL/m^3) the annual savings will equal to 6.09 x 70 = 426GEL.

Accordingly, the CO_2 emissions reduction will equal to 6.09*2852*x 0.42/1000 = 7.29 t/yr.

Amount of investment required for thermal insulation of the attic equals to 207 x 10 = 2070GEL, where 207m² is the ceiling area, and 10 – the cost of one m2 attic insulation material (glass wool) GEL/m².

Profitability parameters of measure MB1.1 are given in Table B1.

Table B1. Profitability Parameters of Measure MB 1.1

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR, %	Net Present Value Quotient NPVQ	CO2 Reduction ton/y
Thermal Insulation of Attic	2 070	8.3	12.7	0.35	7.29

*PB – Payback Period; *IRR – Internal rate of Return; *NPVQ - Net Present Value Quotient

Measure MB 1.2. Thermal Insulation of Attics in Kindergartens in Community Telavi Municipality

To calculate potential GHG emissions reduction for case of thermal insulation of attics in kindergartens operating at the territory of Community Telavi Municipality the audit has been carried out at the kindergarten building in village Vardisubani. The audit revealed that expected energy savings resulting from thermal insulation of the attic calculated by the ENSI computer program, will equal to 19955KWh/yr. On one m² area of attic this savings makes 19 955/457=43.7KWh/m²yr, where 457m² is the attic area of village Vardisubani kindergarten.

As the kindergarten is heated with firewood therefore the energy savings in equivalent of firewood will be 19 955/(2 852 x 0.35) =19.99m³/yr. Considering the cost of firewood (70GEL/m³), the annual savings will equal to 20x70=1 400GEL.

Reduction of CO_2 emissions from the attic will equal to 19.99*2852*0.42/1000 =23.94 t CO_2eq./yr, of which 0.42kg CO_2/KWh is the quantity of CO_2 coming on one KWh energy in kg.

The needed investment for completing thermal insulation of attic of Vardisubani kindergarten equals to 457 x 20 = 9 140GEL, in which 457m² is the attic area, and 20 is the price of one m2 insulation material for attic (glass wool) - GEL/m².

This measure will be implemented for insulation of attics of 22 kindergartens with total area of 6 100m². As the energy savings per one square meter area make 43.7KWh/m²yr, savings will equal to 6 100 x 43.7 = 266 570 KWh/m²yr for all kindergartens. The needed investment for thermal insulation of attics in 22 kindergartens is 6 100 x 20 =122 000GEL.

This measure may imply 15 kindergartens which at present consume approximately similar amount of firewood and presumably their demand on firewood (or on other fuel) will be increased in case of providing

children with full comfort. In case of 19 kindergartens, the annual economic profit will be 20*19*70=26 600GEL, the saved firewood will be 20*19=380m^3 and the emissions will equal to 23.94*19=455 t CO_2eq./y.

Profitability parameters of measure MB1.2 are given in Table B2.

Table B2. Profitability Parameters of Measure MB 1.2

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR, %	Net Present Value Quotient NPVQ	CO2 Reduction ton/yr.
Thermal Insulation of one Kindergarten's Attic	9 140	11.2	9.6	0.13	23.94
This Measure is Considered for Kindergarten (22)	122 000	13.1	9.0	0.1	445.00

Measure MB 2: Increase of Lighting Systems' Energy Efficiency

Measure MB 2.1: Installation of New Lighting System in Municipal Building

Energy savings resulted from substitution of the existing bulbs with the LED bulbs has been calculated by the ENSI computer program for the municipal building located in village Napareuli and makes 311KWh/yr[11], considering the electricity rate (0.15GEL/KWh) annual savings make 311 x 0.15 = 47GEL in monetary terms.

Accordingly, reduction of CO_2 emissions from the buildings will equal to 311 x 0.104 /1000 = 0.032 t/yr.

It is necessary in the building to substitute 10 100Wt incandescent bulbs with 10 40Wt LED bulbs[12]. For completing this measure, the needed investment equals to 10 x 15=150GEL, in which 15GEL is the price of the bulb.

The profitability parameters of measure MB 2.1 are given in Table B3.

Table B3. Profitability Parameters of Measure MB2.1

Measure	Investment Cost GEL	Payback PB	Internal Rate of	Net Present Value Quotient NPVQ	CO2 Reduction ton/yr.

[11] With minimum 1,5hour work per day during 365 days.

[12] The calculations were done assuming that 1 bulb is switched on for 2hours a day and this bulb is loaded for 2hours a day during 365 days per year

			Return IRR, %		
New System of Lighting	150	3.0	31.1	1.22	0.032

Measure MB 2.2. - Installation of Energy-efficient Lighting System in Kindergarten of Village Vardisubani

Previous years' experience showed that due to instability of power supply voltage very often luminescent bulbs fall into disuse very often, that is why they still continue using incandescent bulbs. Considering this fact, it is urgent to give recommendations to use LED bulbs.

In the building there should be substituted 25 100W incandescent bulbs with 40W LED ones. The needed investment for this measure is 25 x 15 = 375GEL, where 15GEL is the bulb's price.

Energy audit revealed that 335 100W incandescent bulbs of 22 kindergartens should be replaced with 40W LED ones. Needed investment for this measure is 335 x 15 = 5 025GEL.

The profitability parameters of measure MB 2.2 are given in Table B4.

Table B4. Profitability Parameters of Measure MB 2.2

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR, %	Net Present Value Quotient NPVQ	CO2 Reduction ton/yr.
New System of Lighting	375	5.4	13.3	0.24	0.114
New System of Lighting Kindergartens (22)	5 025	5.9	13.1	0.22	1.5

Measure MB 3: Application of Renewable Energy Resource in Municipal Buildings

Measure MB 3.1: Application of Solar Collectors in Community Telavi Kindergartens

Solar energy collectors convert solar radiation into heat transferred then to water, which could be supplied to the building. The above-discussed measure aims to use solar collectors for hot water supply to such municipal buildings as kindergartens. Approximately 2 000 liters of hot water are used daily by Community Telavi kindergartens for heating purposes requiring12 400 KWh of energy.

The solar collector generates 1 050KWh/m^2 per year. In case of using vacuum solar collectors mounted at the roofs, a total area of 12m^2 may get annually 12600 KWh heating energy.

The surface area of a standard solar collector is 2m^2 and costs 1 300GEL. For 2 000 liters of hot water 6 such collectors will be needed with investment cost of 7 800GEL.

17 kindergartens of Community Telavi Municipality are provided with natural gas used for cooking and hot water in summer period as in winter firewood is usually consumed for heating. Considering this, getting mentioned energy (12 600kWh/yr) from consumption of natural gas require 12 600/(9.72 x 0.9) = 1 440 m^3 of gas, being 1 440 x 0.98 = 1 411GEL in monetary terms.

If natural gas is changed to solar energy, the reduction of CO_2 emissions will be 1440*9.72* 0.202/1000 = 2.82 t per year. As there are 17 kindergartens using natural gas for hot water supply, this measure will be implemented only for them others will be substituted by electric energy.

Profitability parameters of MB 3.1 measure are given in Table B5.

Table B5. Profitability Parameters of Measure MB 3.1

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR, %	Net Present Value Quotient NPVQ	CO2 Reduction ton/yr.
Application of Solar Collectors in one Kindergarten	7 800	6.0	25.9	0.62	2.82
This Measure is Foreseen for Kindergartens (22)	171 600	6.0	25.9	0.62	47.94

Measure RB 1: Thermal Insulation of Attics in Residential Buildings

Measure RB 1.1: – Thermal Insulation of Attics in Residential buildings of Village Napareuli

Expected energy savings resulted from thermal insulation of the attic of one two-storey residential building in village Napareuli was calculated by the ENSI computer program and makes 15 709KWh/y. In total the compact settlement consists of 10 residential buildings. The constructions of all 10 buildings are identical and so the total energy-savings resulted from thermal insulation of their attics will equal to 157 090KWh/y (Table B6).

Table B6. Energy Savings by Thermal Insulation of Attics in Residential Buildings

	Number of Stories	Number of Residential Buildings	Energy Savings in One	Energy Savings in All	Attic Area in One	Attic Area in All

			Residential Building kWh/yr	Residential Buildings kWh/yr	Residential Building m^2	Residential Buildings m^2
1	Two-storey Buildings	10	15 709	157 090	240	2 400

Amount of saved firewood after implementation of the measure will equal to 157090/(2 852 x 0.35) = 157.37m^3/yr. Considering the rate of firewood (70GEL/m^3), annual monetary savings will be 157.37 x 70= 11 016GEL. Accordingly, the reduction of CO_2 emissions from residential buildings will equal to 157.37*2852* 0.42/1000 = 188.5t/yr.

Required investment for thermal insulation of attics of residential buildings makes 2 400 x 15 = 36 000GEL, where 2 400m^2 is the attic area, and 15 is the cost of one square meter insulation material (glass wool), GEL/m^2.

Profitability parameters of Measure RB 1.1 are given in Table B7.

Table B7. 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
Thermal Insulation of Attics of Residential Buildings	36 000	4.9	20.0	0.98	188.5

Measure RB 1.2. - Thermal Insulation of Attics in Typical Private Houses

Expected energy savings which will be resulted from implementation was calculated by the ENSI computer program and makes 5 734KWh, that is equivalent to 5 734/(2 852x0.35) = 5.75m^3/yr firewood. Considering the rate of firewood (70GEL/m^3) the annual monetary savings will be 5.75 x 70= 402GEL.

Accordingly, the reduction of CO_2 emissions from the buildings will equal to 75*2852*0.42/1000 =6.88t/yr.

The needed investment for thermal insulation of attics of private houses makes 95x15 = 1 425GEL, where 95m^2 is the attic area, and 15 is the cost of one square meter insulation material (glass, wool), GEL/m^2.

Thermal insulation of attics is considered for 100 private houses.

Profitability parameters of Measure RB 1.2 are given in Table B8.

Table B8. Profitability Parameters of Measure RB 1.2

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 Reduction t/yr
Insulation of Attics in Typical Private Houses	1 425	6.0	18.1	0.82	6.88
Insulation of Attics in Typical Private Houses (100)	142 500	6.0	18.1	0.82	6 880

Measure RB 2: Reduction of Infiltration from Windows of Residential Buildings

Measure RB 2.1: - Reduction of Infiltration from Windows of Multi-apartment Residential Buildings

Due to draught air flow, rooms are cooled very soon and a big amount of energy is needed to heat them. A cold flow of air comes in from outside and warm air flow goes out through gaps in doors and windows. Therefore, it is necessary to ensure tightness of doors and windows that makes it possible to reduce energy needed for heating the room by 25-30%. To cover fissures, cracks and gaps and reduce air leaking using of very simple and cheap methods are possible: Filling the gaps between window glass and frame with silicone, scotch or putty. It is also possible to stick from both sides of glass scotch and special transparent plastic material and attach on the window frame surface foam rubber, penopoliurethane, silicone and rubber sealing.

Expected energy savings after implementation of the measure was calculated by the ENSI computer program and makes 80 140KWh, that is equivalent to 80 140/(2 852x0.35) =80.28m^3/yr firewood. Considering the rate of firewood (70GEL/m^3) the annual monetary savings will be 80.28 x 70= 5 620GEL.

Accordingly, the reduction of CO_2 emissions from the buildings will equal to 80.28*2852*0.42/1000 = 96.16 t/yr.

Heat savings resulted from reducing infiltration in buildings have been taken based on the conducted auditing and are given in Table B8.

Table B8. Energy Savings with Infiltration Reduction in Residential Buildings

#	Number of Stories	Number of Residential Buildings	Energy Savings in One Residential Building kWh/y	Energy Savings in All Residential Buildings kWh/y
1	Two-storey residential Buildings	10	8 014	80 140

Under this measure about 550m^2 of windows should be sealed up. Investment for windows will be 2GEL/m^2 x 550m^2 = 1 100GEL.

Profitability parameters of Measure RB 2.1 are given in Table B9.

Table B9. 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
Reduction of Infiltration	1 100	0.33	342	21.8	96.16

Measure RB 2.2. - Reduction of Infiltration from Windows of Typical Private Houses

Expected energy savings was calculated by the ENSI computer program and makes 1 463KWh, that is equivalent to 1 463/(2 852x0.35) = 1.47m^3/yr firewood. Considering the rate of firewood (70GEL/m^3) the annual monetary savings will be 1.47 x 70= 103 GEL.

Accordingly, the reduction of CO_2 emissions from the buildings will equal to 1.47*2852*0.42/1000 = 1.76t/yr.

Under this measure about 31m^2 of windows should be sealed up in one house. Investment for windows will be 2GEL/m^2 x 31m^2 = 62GEL.

Reduction of infiltration from windows is considered for 1000 private houses.

Profitability parameters of Measure RB 2.2 are given in Table B10.

Table B10. 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/y
Reduction of Infiltration	62	1.04	112.3	6.4	1.76
Reduction of Infiltration in typical Private Houses (1000)	62 000	1.04	112.3	6.4	1 760

Measure RB 3. Application of Renewable Energy in Residential Buildings

Measure RB 3.1. - Application of Solar Energy for Hot-water Supply in Residential Buildings

In village Napareuli there are ten residential buildings and all of them are two-storey. Base energy calculated by the ENSI computer program and required for one residential building hot water supply, makes 1 874KWh/y, i.e. in total saving for 10 buildings will be 1 874 x 10 = 18 740KWh/y.

Assuming that 50% of this energy is needed during the heating season, this amount may be received from a firewood stove which still is used for heating and does not use any additional heating. Thus, the needed energy is calculated only for 50% during non-heating period making 9 370KWh that is equivalent to 9370/(2852*0.35)= 9.4m^3 firewood.

In case of transferring from firewood to solar energy, reduction of CO_2 emissions will equal to 9.4* 2852* 0.42/1000 =11.26t/y, where 0.35 is the coefficient of efficiency of the tin stove.

Considering the rate of firewood (70GEL/m^3) its annual cost will be 9.4x 70 = 658GEL.

Profitability parameters of Measure RB 3.1 are given in Table B11.

Table B11. 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
Application of Solar Collectors in one Residential Building	700	10.0	9.3	0.1	1.13
This Measure is foreseen for 10 Residential Buildings	7 000	10.0	9.3	0.1	11.26

Measure RB 3.2. - Application of Solar Energy for Hot-water Supply in Typical Private Houses

The base energy calculated by the ENSI computer program required for hot water supply of the audited typical individual residential house in village Kisiskhevi makes 867KWh/y. In total, there are 669 such individual residential houses in this village.

Based on the conducted audit, the base energy calculated by the ENSI computer program needed for hot water supply of a typical individual residential house in village Napareuli makes 693KWh/yr. In total, there are 940 typical individual residential houses in this village.

The base energy calculated by the ENSI computer program required for hot water supply of a typical individual residential house in village Nasamkhrali makes 519KWh/yr. In total, there are 160 typical individual residential houses in this village.

In village Tsinandali 363KWh/yr base energy is needed to provide one typical individual residential house with hot water. In total, there are 995 typical individual residential houses in this village.

In village Kveda Khodasheni 1 007KWh/yr base energy is needed to provide one typical individual residential house with hot water. In total, there are 685 typical individual residential houses in this village.

In village Busheti 558KWh/y base energy is needed to provide one typical individual residential house with hot water. In total, there are 350 typical individual residential houses in this village.

Accordingly, in total, for 3 799 houses of all six villages there will be saved 867 * 669 + 693* 940 + 519 * 160 + 363 * 995 + 1 007 * 685 + 558 * 350 = 2 560 763KWh/y. To get such amount of energy with firewood stove of 0.35 coefficient of efficiency it will be needed 2 560 763/(2 852*0.35) = 2 565m^3 firewood.

In case of transferring from firewood to solar energy reduction of CO_2 emissions will equal to 2565*2852*0.42/1000= 3 073t/yr.

Considering the rate of firewood (70GEL/m^3) its annual cost will be 2565 x 70= 179 550GEL.

Profitability parameters of Measure RB 3.2 are given in Table B12.

Table B12. Profitability Parameters of Measure RB 3.2

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 one House	500	10.0	9.3	0.1	0.81
This Measure is Foreseen for the houses of 6 villages (3 799)	1 899 500	10.0	9.3	0.1	3 073.00

Measure RB 3.2. - Application of High Efficiency Firewood Stoves in Private Houses

The average annual demand on heating of a typical private house makes 32 500KWh/yr. The measure implies substitution of the 0.35 coefficient of efficiency stoves with the high efficiency firewood stoves having 0.7 coefficient of efficiency in case the whole house is heated. In total, the measure is planned for 1000 houses.

To implement this measure, application of high efficiency firewood stove will be needed which costs 600GEL.

In case of application of traditional tin stoves, consumption of firewood makes 32 500/(2 852x 0.35)=33m^3/y, where 0.6 is coefficient of efficiency of the tin stove. Considering the firewood rate (70GEL/m^3), the annual cost makes 33.0 x 70= 2 310GEL.

With application of modern high efficiency stoves the consumption of firewood will be 32500/(2 852 x 0.7) =16.3m^3/yr, where 0.7 is the efficiency of the tin stove.

As a result of implementation of the measure, 33.0-16.3= 16.7 m^3 firewood will be saved per house that equals to the reduction of 16.7*2852*0.42/1000=20 tCO_2 emissions.

Considering the firewood cost (70GEL/m^3), the annual savings on firewood will equal to 16.7 x 70= 1169GEL. In one-year period the high efficiency stove expenses will be fully covered.

This measure is planned to be implemented as a pilot one in 1 000 two-storey residential buildings.This measure will significantly reduce the quantity of unsustainably consumed firewood.

Profitability parameters of Measure RB 3.3 are given in Table B13.

Table B13. Profitability Parameters of Measure RB 3.3

Measure	Investment Cost GEL	Payback PB	Internal Rate of Return IRR,%	Net Present Value Quotient NPVQ	CO_2 Reduction t/yr
For one House	600	1.8	61.0	3.1	20.00
For 1000 Houses	600 000	1.8	61.0	3.1	20 000.00

Measure RB 4.1: Substitution of Fuel

Measure RB 4.1: – Substitution of Unsustainably Produced Biomass (Firewood) with Natural Gas. Firewood consumption in residential sector of Community Telavi Municipality equals to about 79% of total energy consumed in this sector. All this happens at the expense of illegal wood cutting and becomes a very heavy burden for greenery existing at the Municipality territory. Therefore, substitution of firewood with gas was scheduled as one of the most important measures which will be promoted significantly by the Municipality, especially from the point of consumption energy-efficient technologies.

So, it was assumed that in 2018-2030, 50% of the households which at present use firewood will use gas. Currently, the residential sector consumes 80 598m^3 firewood equaling to 229 865 496 KWh energy. As this firewood was produced by unsustainable (illegal) cuttings it is considered to be source of emissions, and annual emissions from firewood consumption equal to 229865MWh*0.42= 96 543 t CO_2 eq. To get the same amount of energy from natural gas 229 865 496 KWh/9.72=23 648 714m^3 of gas will be needed. In case of receiving the same amount of energy 229 865 MWh*0.202= 46 433 t CO_2eq. will be generated through natural gas. In case of transferring 50% of the population to efficient consumption of natural gas by 2030 the savings will make (96543 t-46 433t)/2= 25 055 t CO_2eq.

Table 27. Action Plan for Reducing GHG Emissions from the Buildings Sector in Community Telavi Municipality

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] 2020	Expected CO2 Reduction [t/yr] from each Measure 2020	Expected Energy Saving from each Measure [MWh/yr] 2030	Expected CO2 Reduction [t/yr] from each Measure 2030	Cost of each Measure [GEL]
Municipal Buildings (MB)								
Measure MB1	Improvement of Thermal Insulation of Attics in Municipal Buildings							
MB 1.1	Thermal Insulation of Attic in Municipality Buildings	Community Telavi Municipality Construction and Architecture Service	2016-2020	17.35	7.29	17.36	7.29	2 070
MB 1.2	Thermal Insulation of Attics in Kindergartens (22)	Community Telavi Municipality Construction and Architecture Service	2016-2020	1083.33	455.00	1083.33	455.00	122 000
Measure MB 2	Energy Efficiency Lighting Systems							

MB 2.1	Installation of New Lighting System in Municipal Building	Community Telavi Municipality Construction and Architecture Service	2016-2020	0.31	0.032	0.31	0.032	150
MB2.2	Installation of New Energy-efficient Lighting Systems in Kindergartens (22)	Community Telavi Municipality Construction and Architecture Service	2016-2020	14.42	1.50	14.42	1.5	5 025
Measure MB 3	Application of Renewable Energy Resource for supplying hot water							
MB 3.1	Application of Solar Collectors in Kindergartens (22)	Community Telavi Municipality Construction and Architecture Service	2016-2020	237.33	47.94	237.33	47.94	171 600
Residential Buildings (RB)								
RB1	Thermal Insulation of Attics in Residential buildings							
RB 1.1	Thermal Insulation of Attics in Multi-apartment Residential buildings	Community Telavi Municipality Construction and	2018-2020	448.80	188.5	448.80	188.50	36 000

		Architecture Service						
RB 1.1	Thermal Insulation of Attics in Typical Private Houses (100 houses before 2020) and additional 1000 houses by 2030	Community Telavi Municipality Construction and Architecture Service	2019-2030	1638.10	688.00	16380.10	6 880.00	142 500
Measure RB 2	Reduction of Infiltration from Windows of Residential Buildings							
RB 2.1	Reduction of Infiltration from Windows of Multi-apartment Residential Buildings	Community Telavi Municipality Construction and Architecture Service	2016-2020	228.95	96.10	228.95	96.10	1 100
RB 2.2	Reduction of Infiltration from Windows of Typical Private Houses (1000 buildings before 2020) and additionally 1000 buildings by 2030	Community Telavi Municipality Construction and Architecture Service	2016-2020	4 190.48	1 760.00	8380.95	3 520.00	62 000

Measure RB 3	Application of Renewable Energy in Residential Buildings							
RB 3.1	Application of Solar Energy for Hot-water Supply in Multi-apartment Residential Buildings	Community Telavi Municipality Construction and Architecture Service	2018-2020	18.74	11.26	18.74	11.26	
RB 3.2	Application of Solar Energy for Hot-water Supply in Typical Private Houses	Community Telavi Municipality Construction and Architecture Service	2020-2030			2 560	3073	
RB 3.3	Distribution of High Efficiency Firewood Stoves in Private Houses (1000 each before 2020 and	Community Telavi Municipality Construction and Architecture Service	2019-2030	47 619.05	20 000.00	142 857.14	60 000.00	600 000

	additionally 2000 each by 2030)							
Measure RB 4								
RB 4.1	Substitution of Firewood Consumption with Natural Gas in villages/in Residential Sector (among 50% of population)	Community Telavi Municipality Construction and Architecture Service	2018-2030	0	12 901.00	0	25 802.00	-
Total				55 478.12	36 145.36	169 648.69	96 998.36	

5 Street Lighting

5.1 Sector Overview

Length of central roads (streets) at the territory of Community Telavi Municipality makes about 107km 56km of which were not illuminated in 2014 .

Photo

Picture 4. Illuminated Sights of Community Telavi Municipality

Table 28 shows energy consumption and expenses on Street Lighting Sector in Community Telavi Municipality in 2014.

Table 28. Energy Consumption and Expenses of the Community Telavi Municipality Street Lighting Sector in 2014

Infrastructure Units	Electricity Energy Consumption (KWh)	Financial Expenses (GEL)
Community Telavi Municipality Street Lighting	1 462 237	233 625
Total	1 462 237	233 625

Based on the Table, consumption of electric energy by the Community Telavi Municipality in 2014 was a bit less than 1.5mln KWh costing more than 233 thousand GEL. In total, 1716 street lighting fixtures were installed in the Municipality in 2014, types and capacities of which are shown in Table 29.

Table 29. The Number and Features of Community Telavi Municipality Street Lighting Fixtures in 2014

#	Existing Lighting Fixture	Features	Number
		Capacity, W	
Street Lighting			
1	Sodium (Д н а т)-70	84	82
2	Sodium (Д н а т)-150	170	116
3	Sodium (Д н а т)-250	290	141
4	Д Р Л – 250	290	1 054
5	Economic - 85	85	323

	Total		1 716

5.2 Methodology

As it was already mentioned, the number of street lighting lanterns operating in Community Telavi in 2014 was 1 716. They covered 51.5 km that is 48% of the total length (107km) of main streets. By 2015, the Municipality replaced 400 lamps with the LED (70W) ones, 300 old bulbs were installed in those places where lighting poles were damaged and where there was no illumination. The rest 100 old bulbs were unfit for use. There are 2 016 lamps in the grid at present. For 2017 substitution of 100 lamps with LED (70W) bulbs and moving the old ones in the suburbs is planned; As a result of the action, the number of lanterns in the grid will equal to 2 116, or additionally 15km of grid will be illuminated during 2015 – 2017; for filling the 107km grid will be needed and is planned to fill the rest 40.5km grid completely by 2020, for what it is urgent to rehabilitate 1 350 lighting poles and install lanterns. By 2025 the Municipality plans to have only energy-efficient LED bulbs at its territory with 30 and 70W capacity. Actually, by 2020-2025 at least 3 466 lanterns will be in the grid. Before 2030 a forecast was made with assumption that the number of bulbs will not be increased but if Community Telavi becomes the European type settlement it will be needed all the streets (including non-central ones) to be illuminated that will increase the number of lamps.

5.3 Base Year (2014) Inventory and GHG Emissions Baseline Scenario in the Street Lighting Sector (2015 – 2030)

In 2014 the consumption of electric energy by Street Lighting Sector made up 1.462GWh.

In 2014 the emissions from street lighting equaled to 152.07 t CO_2eq.

The value of emissions factor for electricity equals to 0.104 tCO_2/MWh, which is the grid average emissions factor for 2014.

According to the baseline scenario, the energy consumption by street lighting will grow in future and by 2020-2030 will make up 3.381 GWh, and CO_2 annual emissions by 2020-2030 will reach 351.61 t CO_2eq. It means that in 2020, whole territory of the Community Telavi will be illuminated and nothing changes until 2030.

5.4 Emissions Reduction Action Plan for Community Telavi Municipality Street Lighting Sector

As it could be seen from Table 30, rather a big number (86%) of bulbs existing in the street lighting of Community Telavi Municipality is inefficient. The Action Plan consists of 4 measures:

- S1 – was implemented in 2015 when 400 new LED lanterns were installed;
- S2 – it is planned additionally to install 100 new LED lanterns by 2017;
- S3 - it is planned additionally to install 1 350 new LED lanterns by 2020;
- S4 – it is planned by 2025 to substitute all the inefficient bulbs (1 616 units) existing in 2020 with new LED lanterns;
- S5 - it is planned by 2030 to install the street lighting managing systems in central districts and streets.

Basically, 30 and 70W LED lamps will be installed. It is planned as well in 2025-2030 to arrange the remote control and efficient consumption systems at the territory of the Municipality (S5).

In **Error! Reference source not found.** the number of existing inefficient streetlights and their effective substitutes are presented by their types, number and capacity.

Table 30. Street Lanterns Existing in 2020 in Case of Complete Rehabilitation of the Grid and Not Implementing the Energy Efficient Measures and the Types, Capacity and Luminosity of their Planned Energy Efficient Substitutes

	Existing Streetlights in 2020				Substitute LED Streetlights				
	Streetlight Type	Number	Capacity W	Total Capacity KW	Streetlight Type	Number	Capacity W	Total Capacity KW	Luminosity Lm
Street Lighting									
1	Днат-70	82	84	6.89	LED 30	82	30	2.46	2 700
2	Днат-150	116	170	19.72	LED 70	116	70	8.12	5 700
3	Днат-250	141	290	40.89	LED 70	141	70	9.87	5 700
4	ДРЛ–250	2 804	290	813.16	LED 70	2 804	70	196.28	5 700
5	Eco-85	323	85	27.46	LED 30	323	30	9.69	2 700
	Total	**3 466**		**908.12**		**3 466**		**226.42**	

Measure S1: This measure was implemented in 2015, when all 400 bulbs of the street lights (ДРЛ 250W) existing on the poles on the central road from village Vardisubani up to village Ikalto have been replaced with 400 LED (70W) ones. 300 of the replaced 400 ДРЛ bulbs have been installed on the 11 km road having no lighting and the rest were unfit for use. This measure would annually save 356MWh electric energy and 37.11 t CO_2eq. The measure costs 14 000GEL. According to the information obtained from the Municipality, installation of each bulb costs 350GEL.

Measure S2: It is planned in 2017 to install additional 100units of the new LED (70W) lighting fixtures. Since 2017, these lighting fixtures will save annually 82.42MWh electric energy and 8.57 t CO_2eq. The measure costs 35 000GEL.

Measure S3: It is planned in 2018-2020 to install 1350units of new LED (70W) lighting fixture. These lighting fixtures will save annually 370.88MWh electric energy and 38.57 t CO_2eq. The measure costs 472 500GEL.

Measure S4: It is planned to substitute all the 3 466 lanterns existing in the grid in 2020-2025 with new LED lamps (30 and 70W). In this case, by 2025 and then by 2030 the annual saving will equal to 200.53MWh electric energy and 20.85 t CO_2eq. The measure costs 565 600GEL.

In total, in case of implementation of **S1** – **S4** measures in 2025 – 2030 will be saved 2 554MWh electric energy and 265.57 t of emissions CO_2eq annually.

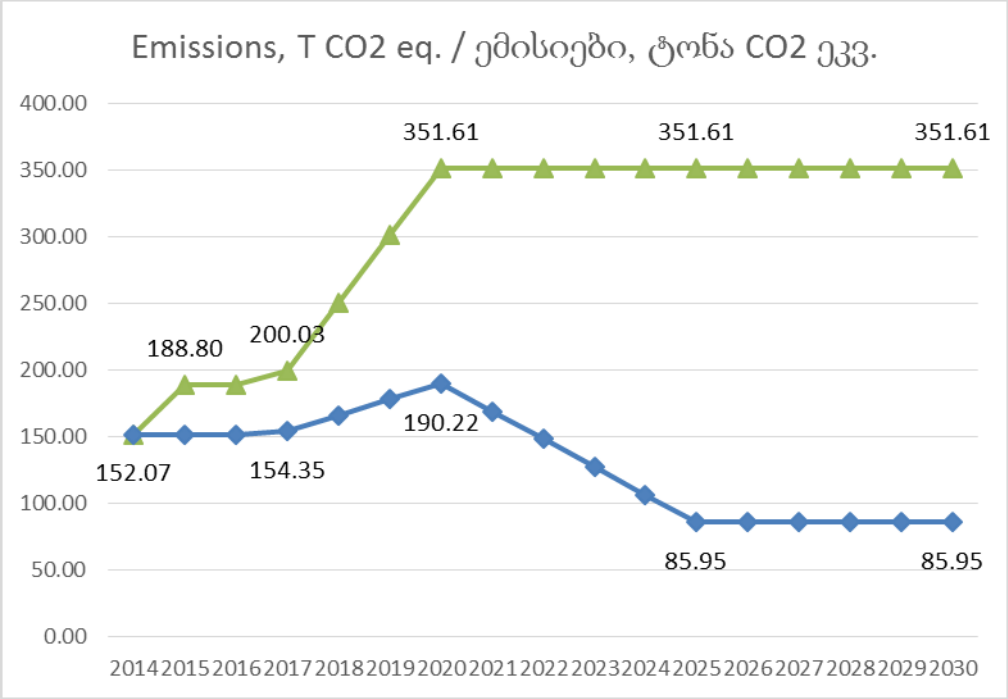

Fig. 10. Emissions from Street Lighting Sector in Case of BAU Scenario and in Case of Implementing the Measures Considered in the SECAP Scenario for the Municipality (for Measures S1–S4)

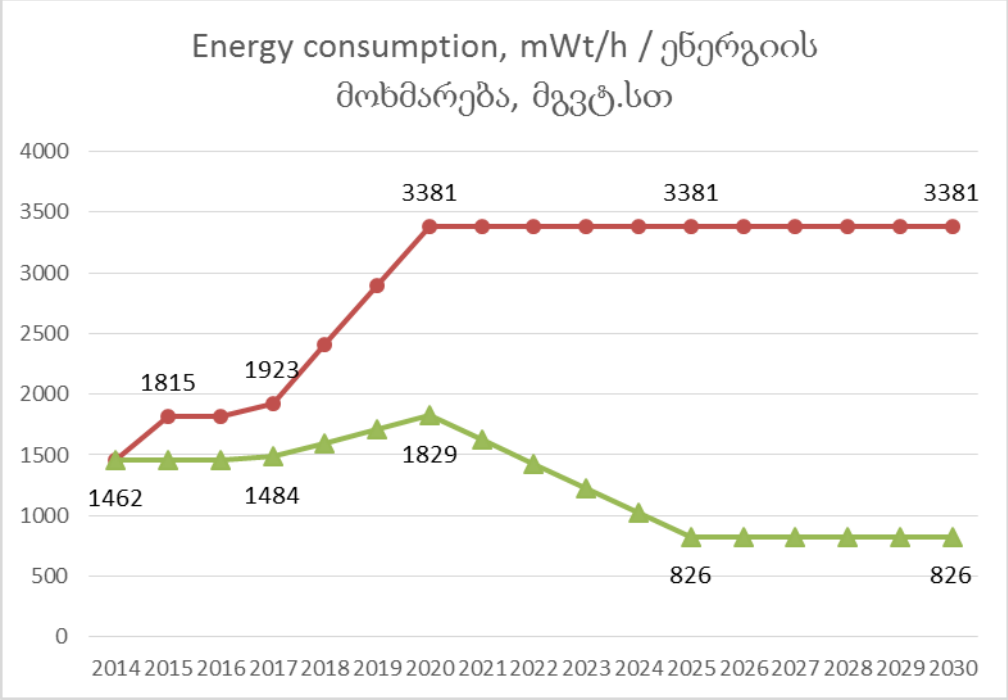

Fig. 11. Energy Consumption in Street Lighting Sector of the Municipality in Case of BAU Scenario and in Case of Implementing the Measures Considered in the SECAP Scenario (for Measures S1 – S4)

Measure S5: At the territory of Community Telavi Municipalityt the remote control and efficient consumption of street lighting systems will be installed. This means that the measure will start after implementation of the measures **S1 – S4** and continue in 2025 – 2030. During implementation of this measure, the energy saving will be completed via remote control regulating the street lighting system. A control room

will be arranged to manage the street lighting system: during night hours, the lighting will be reduced and switched off based on the next but principle, etc. At a first stage, before 2030, the above-mentioned system presumably will include main streets of Community Telavi Municipality villages only.

Similar measure implemented in other countries saves about 40%-60% of energy.

Fig. 10 shows the graph of the GHG emissions of the base year scenario and total emissions reduction by 2030, which includes the first four measures (installation of energy efficient lanterns) and arranging the remote control and efficient consumption of street lighting systems (**S5**). Fig. 13 clearly indicates advantages of introducing this measure to the Community Telavi Municipality in terms of energy consumption.

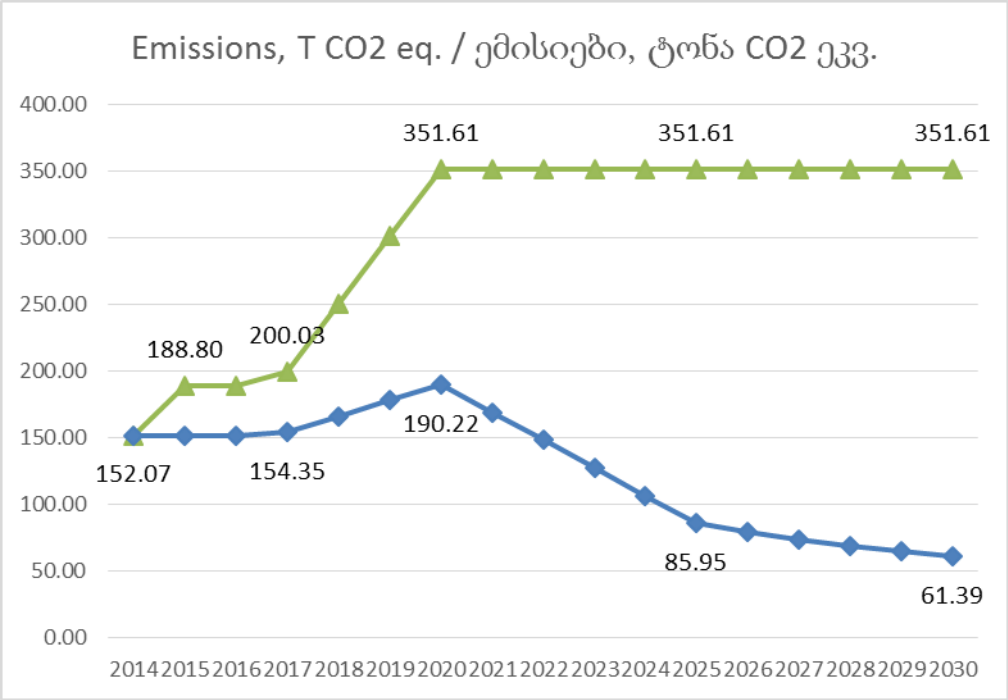

Fig. 12. Emissions from Street Lighting Sector in Case of BAU Scenario and in Case of Implementing the Measures Considered in the SECAP Scenario for the Municipality (for Measures S1 – S5)

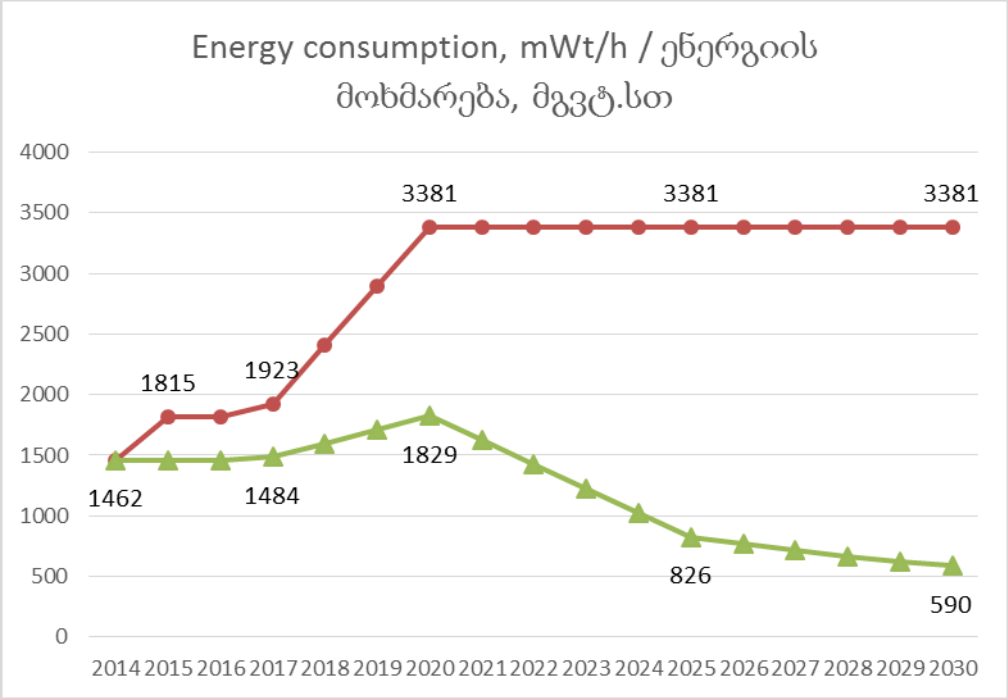

Fig. 13. Energy Consumption in Street Lighting Sector of the Municipality in Case of BAU Scenario and in Case of Implementing the Measures Considered in the SECAP Scenario (for Measures S1 – S5)

In total, by 2030, the implemented measures will save 2 790.6MWh energy and 290.22 t emissions CO_2eq.

Table 31. Action Plan for Community Telavi Municipality Street Lighting Sector

Sectors and Activity Sphere	Main Measures in the Sphere of Activity	Department/Person or Company in Charge (if the third party is involved)	Implementation Period [start and End Date]	Expected Energy Savings from Each Measure (MWh/yr) 2020	Expected CO_2Reduction from Each Measure [t/yr] 2020	Expected Energy Savings from Each Measure (MWh/yr) 2030	Expected CO_2Reduction from Each Measure [t/yr] 2030	Cost of Each Measure [in GEL]
Street Lighting S				1 551.85	161.39	2 790.6	290.22	3 213 100
Energy-efficient Bulbs S1	Increasing the share of energy efficient bulbs in street lighting grid	LLC. "Service of Infrastructure and Municipal Amenities"	2015-2016	356.8	37.11	356.8	37.11	140 000
Energy-efficient Bulbs S2	Increasing the share of energy efficient bulbs in street lighting grid	LLC. "Service of Infrastructure and Municipal Amenities"	2017	82.42	8.57	82.42	8.57	35 000
Energy-efficient Bulbs S3	Increasing the share of energy efficient bulbs in street lighting grid	LLC. "Service of Infrastructure and Municipal Amenities"	2018-2020	1 112.63	115.71	1 112.63	115.71	472 500
Energy-efficient Bulbs S4	Increasing the share of energy efficient bulbs in street lighting grid	LLC. "Service of Infrastructure and Municipal Amenities"	2020-2025			1 002.63	104.27	565 600
Energy-efficient Bulbs S5	Remote control and efficient consumption systems	LLC. "Service of Infrastructure and Municipal Amenities"	2025-2030			236.12	24.56	2 000 000

6 Greening

6.1 Sector Overview

Telavi Municipality, located at the farthest east of Georgia, represents an administrative-territorial unit of Kakheti. It is the largest region (1 200 000ha) of the country, and its area makes 107 765ha. The north-east the Municipality is surrounded with the slopes of the Caucasus High Mountain Range and Russian Federation, namely, Dagestan Autonomous Republic, and the south-west – the slopes of the Gombori Low Mountain Range. Central section of Telavi Municipality is occupied with the plain of the River Alazani, located at 350-600m above sea level, which is divided into two parts by the River Alazani. The center of the Municipality is City of Telavi.

Telavi Region is located in dry subtropical climate zone and is characterized with altitude zoning of climate, particularly, starting from the lowest location - the Alazani Plain (350m above sea level) where winter is temperate cold and summer is moderately hot, and average annual temperature is in frames of 11-12^0, and finishing with temperate damp climate of high mountains with cold winter and short summer.

Within the boundaries of Telavi Municipality the natural vegetation is represented with different formations. First of all, it should be noted that a great part of the Alazani Plain and the foothills are occupied with agricultural lands and because of it the natural vegetation is presented only in the form of plants of the uncultivated lands - steppe, forest-and-steppe and secondary-forest. The remnants of forest grove with lianas are preserved on the plain, on the Alazani River banks, where grows poplar, oak, alder, willow, wing nuts, and others. The low-mountain and partially mid-mountain lines of the Gombori and the Caucasus Mountain Ranges are represented by oak, oak-and-hornbeam and, in some places, beech woods, and the high mountain line is mostly covered with beech forests mixed with hornbeam, oak, and maple. It is followed with subalpine forests and shrubs (birch, pit, maple, and rhododendron) and meadows with alpine herbage.

The area covered with forests makes 62 612ha which is completely administered by the National Forestry Agency through four forest managements: Pshaveli – 17 576ha, Napareuli – 15 998, Tsinandali – 16 383ha and Telavi Forestry Service – 12 655ha. In total, forest occupies 58% of the Municipality's total area.

Green cover in recreation zones of the Municipality (parks, squares, etc.) and in the homestead plots of the population is mostly represented with artificially planted perennials with total area of 250ha.

Development of recreation zones and their landscaping works started mainly in the 60- ies of the last century. At present the areas covered by perennials occupy different green zones within the Municipality, particularly, such areas as the recreation zones (parks, squares, etc.), as well as, the homestead plots, areas near the state buildings, along the roads, cemeteries, agricultural lands (plantations of fruit trees, vineyards) covered by perennial plants.

Table 32. Areas Covered with Plants in Green Zones of Telavi Municipality

#	Green Zones	Fragmented Cover area, ha	%
1	Recreation Zones (parks, squares)	15.5	0.2
2	Greening of different areas in the Municipality (in the homestead plots, areas near buildings, along the roads, etc.)	250	3.5

3	Agricultural lands covered with perennial plants (among them vineyards)	7 351	96
4	Cemeteries	28.5	0.3
Total Green Cover		7 645	100

As it is seen from the Table, in total **7 645**ha of area is covered with perennial plants in different kinds of greenery zones under disposition of Telavi Municipality.

The greatest part of the Municipality area covered with plants comes on the plantations of fruit trees and vineyards on the agricultural lands, particularly, as it is shown in Table 32, their share in total area reaches 96%.

In green zones of the Municipality the least coverage by greenery, only 0.2%, comes on recreation zones (parks, squares, etc.). It should be noted that the most part of the landscaped area on the populated territories is concentrated in the yards of private residential houses and near different kinds of buildings. Yards of private residential houses are mostly planted with fruit trees.

As it was already mentioned, the forest grove within the boundaries of Telavi Municipality is under disposition of several forestry services. As for the Telavi Municipality, there are no areas covered by forests or any joined canopy planting in its disposition, thus, no green cover of such type will be considered in calculations.

In total, the landscaped areas covered by perennial plants in Telavi Municipality, except forest areas (58%) located far from the residential areas, occupy only 7% of the Municipality.

Table 33. Recreation Zones Existing within the boundaries of Telavi Municipality

#	Recreation Zones (Parks, Squares)	Area Covered with Plants m^2	Average Age of the Plants, year	Mostly Spread Species
1	Tsinandali Garden	102 000	80-120	Cypress, cedar, lime, etc.
2	Tsinandali Square	18 878	50-80	Pine, cypress, plane-tree
3	Village Shalauri Square	13 389	50-60	Lime, Cyprus, boxwood and oak
4	Village Napareuli Square	7 821	40-50	Plane-tree, poplar, maple
5	Village Kvemo Khodasheni Square	6 877	40-50	Pine, maple
6	Village Ikalto Square	546	40-50	Plane-tree, cedar
7	Square in Village Jugaani	2 829	40-50	Pine, lime
8	Square in Village Napareuli	206	40-50	Pine, cypress
9	Square in Village Vardisubani	414	40-50	Poplar, pine, cypress
10	Square in Village Tetritsklebi	237	40-50	Plane-tree, poplar
11	Square in Village Kondoli	172	40-50	Pine, poplar, cypress
12	Total area of other small recreation zones (square, garden)	1 558	40-50	Cypress, pine, plane-tree

	Total	**154 927 (15.5 ha)**		

Here we should mention Tsinandali Garden (see Picture 4) as one of the leading places in Georgia among the park landscaping historical monuments. Currently Tsinandali Garden is stretched at 12ha area but it used to occupy much more area during the period of Alexander Chavchavadze (in 1830). According to the historical sources, Alexander invited European decorators and used all his efforts and funds to decorate the garden.

Specificity of Tsinandali Garden is formed not only by the pre-calculated setup and layout of the environment created by human hands, like it is in case of the Versailles Garden, but by organic synthesis of the wilder naturalness and the landscapes created by the decorator. Therefore unlike European parks, Tsinandali Garden was created under freer planning principle. Some experts compare this garden to English parks like Richmond Park, Kew, etc.

Currently, plenty of exotic species of trees of western, eastern and American origin are presented in the garden, including: Araucaria, Californian Sequoia, evergreen Sequoiadendron, Cork Oak, Magnolia, Sweet Hovenia, Dracaena, Bamboo, Camphor Tree, Fir tree, and many others.

Picture 5. The Tsinandali Garden

Table 34. The Dominant Species in the Areas of Green Cover in Telavi Municipality

Areas Covered by Perennial Plants	Dominant Species	Average Age	%
Recreation Zones (parks, squares)	Pine	40-50	15

	Cypress	60-70	15
	Cedars	30-45	10
	Plane-tree	40	10
	Asp	40	10
	Other	-	40
Greening in different areas in the Municipality (in homestead plots, near building, along roads, etc.)	Plane-tree	35-45	25
	Pine	50-60	15
	Cedars	40	20
	Apple	35	15
	Peach	30-45	10
	Other	-	15
Agricultural lands covered with perennial plants (among them vineyards)	Vineyard	5-15	37
	Walnut	10-15	13
	Peach	20-50	12
	Apple	10-15	10
	Cherry	5-10	9
	Mulberry	10-20	9
	Other	-	10
Cemeteries	Cypress	30-40	40
	Tuya	20-30	40
	Pine	50-70	10
	Other	-	10

"Service of Infrastructure and Municipal Amenities" LLC founded by 100% share under the Municipality carries out works of maintenance and care of plants in the Municipality's green cover areas: cutting off dry and defective trees, trimming and pruning the trees, digging ground around the trees, and other works. This organization has undertaken to perform mentioned works under the terms of Agreement that is financed by local budget. The volume of the wood resource received from cutting off, trimming and pruning the trees depends on the amount of the plants needing these actions, or which are damaged either by natural disaster taken place in the Municipality, or by some other reasons. At average 40-60m^3 wood resource is logged per year (the figure is considered in calculations) which is distributed free of charge among the municipal organizations or the vulnerable population on the territory of cutting off the trees to be used for heating as firewood.

As for greening works, there is developing a square on 3ha area formed as a result of the ravine reinforcement works in the Municipality, namely, at the entrance of City Telavi, on the territory of village Vardisubani. In addition, 100 lime saplings have been planted at the projected territory. Mentioned plantings have been considered in green zones of the Municipality while assessing the Carbon accumulation potential.

6.2 Methodology

Calculations of Carbon accumulated in Telavi Municipality green cover and its annual accretion in base year (2014) was performed using the Intergovernmental Panel on Climate Change (IPCC) – 2003 methodological guidelines (see Appendix III). The calculations were conducted for so called "live biomass" (including underground biomass). Accumulated Carbon stock within the perennial plants and volume of Carbon accretion in Telavi Municipality have been calculated under the mentioned methodology.

As for the indexes of some coefficients used in calculations, considering the fact that perennial arboreal plants in green zones of the Municipality are represented in fragmented forms, only corresponding indexes for this type of seedlings were used in calculations that are different from those of the closed canopy seedlings. To identify the corresponding indexes of the perennial plants presented in the green zones (which are mainly represented in fragmented forms) specific data of these plants have been used like their wood stocks data (average age 60 years) and the different relevant scientific sources, for example, Tables of Growth Rates and Stocks13, etc. As a result, an average index has been obtained allowing approximate assessment of wood stock (50m3) at 1ha area of fragmented greening.

As it was already mentioned, the perennial arboreal plants are represented only in fragmented forms at 7 645ha of green cover of the city. Therefore, emissions factor typical for the respective type of green cover were applied for calculations. It should be noted that in accretion coefficient used in calculations the factor of planting trees in green zones of town in 2014-2015 has been taken into account, resulting the adjustment of accretion factor towards the growth rate.

More specifically, in calculations based on the taxation materials, data on average annual accretion and wood stocks of plants (see Appendix III) have been considered. Moreover, to obtain the average wood volume weight (D) index the data on absolute dry wood volume weight for dominant arboreal plants were employed which was taken from different scientific sources. Values of other parameters (BEF1, BEF2, R, CF) were taken from Tables attached to the IPCC Guidelines, particularly from the list of standard indexes typical for the region's climate conditions.

As for the Carbon accumulation potential resulting from the planned measures, the CO2FIX model has been used for its assessment. According to the scenario considered in the project (planting of greenery), two computing modules applied for calculations, namely: biomass and soil modules.

6.3 Base Year (2014) Inventory and Carbon Dioxide Removal Baseline Scenario (2014-2030) Calculation Outcomes

Calculation outcomes of the accumulated Carbon in Base Year 2014 are given in Table 35, and the values of annual accretion – in Table 36.

Table 35. Carbon Stocks Accumulated at Telavi Municipality Planted Areas in the Base Year 2014

Plants in Green Zones	Area, ha	Stock, m^3/ha	D t/m^3	BEF_2	(1+R)	CF	Total Carbon Stock, tC
2014							

[13] Forestry Taxation Directory, V. Mirzashvili, G. Kuparadze

Fragmented Covered Plants	7 645	50.0	0.55	1.30	1.24	0.50	169 451.4

Table 36. Annual Accretion of Carbon at Telavi Municipality Planted Areas in the Base Year 2014

Plants in Green Zones	Area, ha	Stock, m^3/ha	D t/m^3	BEF_2	(1+R)	CF	Total Carbon Stock, tC
2014							
Fragmented Covered Plants	7 645	1.8	0.55	1.15	1.24	0.50	5 396.4

In the baseline scenario (2014-2020) of Carbon stocks accumulation at Telavi Municipality planted areas, the index of annual accretion of Carbon in the biomass has been taken into account, resulting in the assessment of Carbon stocks' expected potential (see Table 37) which could be changed in future due to different causes of biomass decrease (biotic or abiotic).

Table 37. Baseline Scenario (BAU, 2014-2030) for Carbon Sequestration Removal and Relevant Carbon Dioxide

	Annual Accumulation							
	2014	2015	2016	2017	2018	2019	2020	2021
Carbon Annual Accumulation tC	169 451.4	189 238.2	209 025.0	228 811.8	248 598.6	268 385.4	288 172.2	207 226.2
Carbon Dioxide Annual Removal, Thousand tCO_2	621 321.8	693 873.4	766 425.0	838 976.6	911 528.2	984 079.8	1 056 631.4	759 829.4

Continued

Annual Accumulation									
	2022	2023	2024	2025	2026	2027	2028	2029	2030
tC	212 622.6	218019.0	223 415.4	228 811.8	234 208.2	239 604.6	245 001.0	250 397.4	255 793.8
tCO_2	779 616.2	799 403.0	819 189.8	838 976.6	858 763.3	878 550.2	898 337.0	918 123.7	937 910.6

6.4 Action plan for the Increase of Carbon Dioxide Removal from Telavi Municipality Greening Sector

According to the Action Plan, in 2015 – 2016, at the entrance of City Telavi, on the territory of village Vardisubani activities of laying out a square at the 3ha area formed as a result of the ravine reinforcement works have been carried out. The project was financed by the World Bank with the sum of 1,5 million GEL. It is foreseen to arrange the infrastructure appropriate for rest at the project territory. At present, installation of street lighting and irrigation system, and planting 100 samplings of lime was performed. According to the project, 2ha area of 3ha is occupied with lawns and trees, and on the rest area there will be arranged car parking ground and paths for pedestrians. In the following years it is planned to continue greening works in different villages of the Municipality (concrete locations are not defined yet) and by 2030, in total the planted area should reach 15ha.

As it was already mentioned above, within the frames of the Action Plan measures, namely, after setting out the plantings at the landscaped areas the Carbon accumulation potential has been assessed using the model CO2FIX.

Planned Measure G1. As it was mentioned, in 2015 in total 100 of saplings have been planted at 2ha area (see Table 38) in village Vardisubani.

Table 38. The Trees Planted at 2ha Area in Village Vardisubani in 2015

Planted Arboreal Plants	Number of Planted Saplings, pieces	Age of Saplings
Lime	100	5-6

At present, almost 100% of the planted saplings have taken roots. Following the measure, the expected Carbon accumulation potential has been assessed using the model CO2FIX, and calculation outcomes are given in Table 39.

Table 39. Annual Accumulation Indexes in the 2ha Plantings

	2015	2016	2017	2018	2019	2020	2021
Carbon Accumulated tC	0.7	1.3	2.0	2.9	3.5	4.7	3.9
Annual Carbon Dioxide removal, tCO_2	2.6	4.8	7.3	10.6	12.8	17.2	14.3

Continued

2022	2023	2024	2025	2026	2027	2028	2029	2030
4.3	5.0	5.6	6.1	6.7	7.2	7.7	8.4	8.9
15.8	18.3	20.5	22.4	24.6	26.4	28.2	30.8	32.6

Planned Measure G2. In 2016-2030 it is planned to arrange recreation zones of different sizes, and perform rehabilitation and greening of several locations at the territory of City Telavi Municipality (at this stage the locations are not identified yet). In total, particularly planting works are considered to be performed at 15ha area. During developing greening project of some area the largest section is given to the area covered with plants suited to forest landscape where 1ha will be covered with at least 3000 pieces of saplings (Table 40).

Table 40. List of Perennial Saplings for Planting in Telavi Municipality in 2017

List of Saplings Planned for Planting	Number of Saplings, pieces	Age of Saplings
Trees Planned for Planting at 1ha area Around the City		
Lime	1000	3-5year
Maple	1000	
Oak	250	
Plane-Tree	250	
Paulownia	250	
Pine	250	
Total:	3000	

As a result, a perfectly featured Carbon accumulation pool may be obtained in which soils will be engaged in Carbon accumulation process and the city will acquire green zone comparable to valuable forest ecosystem. Selection of seedling material assortments plays an important role. While designing the territory to be greened the most important moment is correct selection of the species of trees and shrubs. Selecting arboreal species requires foreseeing environmental conditions of the location where they will be planted, for example, what kind of soil, climate conditions and slope exposition are there, and the potential of Carbon Dioxide removal by the arboreal plants.

Considering the above-mentioned criteria, several arboreal plants have been selected for planting. From leafy plants there have been selected lime, maple, Georgian oak, plane-tree, and Paulownia. Georgian oak is not distinguished with its great ability of absorption but in local conditions it stands out with its well taking roots and growing process. As for coniferous trees, for this location pine was selected.

It should be noted that to implement activities within the project territory, development of a landscaping project is required, necessary components of which are: schematic maps of arranging planting and infrastructure utilities, list of the greenery selected for planting and budget of all scheduled activities. Below (see Table 41) are given the presumable expenditures necessary for implementing the planned measures.

Table 41. Budget of the Greening Activities per 1ha Area in Telavi Municipality (2016)

#	Description of Expenditures	Unit	Cost of Unit (US $)	Total Amount	Total Cost (US $)
I. Core Expenses					
1.	**Field Activities**				
1.1	Cleaning up the Area (from shrubs, sprouts, etc.)	Ha	150.0	1	150.0
1.3	Marking the Area and Digging out Pits	Sapling/ piece	0.08	3 000	240.0
1.4	Purchasing Saplings	Sapling/ piece	5.0	3 000	15 000.0

1.6	Planting Saplings	Sapling/ piece	0.11	3 000	330.0
1.7	Watering Saplings	Sapling/ piece	0.10	3 000	300.0
	Total Sum (USD)				**16 020.0**

Indexes of Carbon accumulation after planting the trees per 1ha are given in Appendix III, Table 3, and accumulation at 15ha – in Table 42.

Table 42. Indexes of Annual Carbon Sequestration after Planting Trees at 15ha Area

Year		2016	2017	2018	2019	2020	2021	2022	2023
		1	2	3	4	5	6	7	8
Carbon Accumulated tC	2016	2.25	4.45	6.68	8.92	11.16	13.41	15.67	17.93
	2017		2.25	4.45	6.68	8.92	11.16	13.41	15.67
	2018			2.25	4.45	6.68	8.92	11.16	13.41
	2019				2.25	4.45	6.68	8.92	11.16
	2020					2.25	4.45	6.68	8.92
	2021						2.25	4.45	6.68
	2022							2.25	4.45
	2023								2.25
Total Annual Accumulation tC		**2.25**	**6.70**	**13.38**	**22.30**	**33.46**	**46.87**	**62.54**	**80.47**
Carbon Dioxide Annual removal, tCO_2		**8.25**	**24.56**	**49.06**	**81.77**	**122.69**	**171.86**	**229.31**	**295.06**

Continued

Year		2024	2025	2026	2027	2028	2029	2030
		9	10	11	12	13	14	15
Carbon Accumulated tC	2016	20.19	22.45	24.70	26.94	29.17	31.39	33.61
	2017	17.93	20.19	22.45	24.70	26.94	29.17	31.39
	2018	15.67	17.93	20.19	22.45	24.70	26.94	29.17
	2019	13.41	15.67	17.93	20.19	22.45	24.70	26.94
	2020	11.16	13.41	15.67	17.93	20.19	22.45	24.70
	2021	8.92	11.16	13.41	15.67	17.93	20.19	22.45
	2022	6.68	8.92	11.16	13.41	15.67	17.93	20.19
	2023	4.45	6.68	8.92	11.16	13.41	15.67	17.93
	2024	2.25	4.45	6.68	8.92	11.16	13.41	15.67
	2025		2.25	4.45	6.68	8.92	11.16	13.41
	2026			2.25	4.45	6.68	8.92	11.16
	2027				2.25	4.45	6.68	8.92
	2028					2.25	4.45	6.68
	2029						2.25	4.45
	2030							2.25
Total Annual Accumulation tC		**100.66**	**123.11**	**147.81**	**174.75**	**203.92**	**235.31**	**268.92**
Carbon Dioxide Annual removal, tCO_2		**369.09**	**451.40**	**541.97**	**640.75**	**747.71**	**862.80**	**986.04**

In Table 43 there is given Carbon accumulated in green cover of Telavi Municipality and annually sequestered Carbon Dioxide both without implementation of measures and in case of their implementation.

Table 43. Carbon Deposition Potential Resulting from the Planned Greening Activities in 2014 (Base Year) and within the Frames of Action Plan

		Annual Accumulation of Carbon, tC						
		2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
1	Carbon accumulated in green cover of the city (without implementation of measures)	169 451.40	174 847.80	180 244.20	185 640.60	191 037.00	196 433.40	201 829.80
2	Greening in Village Vardisubani at 0.25ha Area	-	0.40	1.00	1.60	2.10	2.70	3.20
3	Greening in Telavi Municipality at 15ha Area	-	-	2.25	6.70	13.38	22.30	33.46
4	Total	**169 451.4**	**174 848.2**	**180 247.4**	**185 648.9**	**191 052.5**	**196 458.4**	**201 866.5**
5	Correspondingly Absorbed (Sequestrated) Thousand tCO_2	**621 321.8**	**641 110.1**	**660 907.3**	**680 712.6**	**700 525.7**	**720 347.5**	**740 177.0**

Continued

	Annual Accumulation of Carbon, tC									
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
1	207 226.2	212 622.6	218 019.0	223 415.4	228 811.8	234 208.2	239 604.6	245 001.0	250 397.4	255 793.8
2	3.90	4.30	5.00	5.60	6.10	6.70	7.20	7.70	8.40	8.90
3	46.87	62.54	80.47	100.66	123.11	147.81	174.75	203.92	235.31	268.92
4	**207 277.0**	**212689.4**	**218 104.5**	**223 521.7**	**228 941.0**	**234 362.7**	**239 786.5**	**245 212.6**	**250 641.1**	**256 071.6**
5	**760 015.5**	**779 861.3**	**799 716.4**	**819 579.4**	**839 450.3**	**859 329.9**	**879 217.3**	**899 112.9**	**919 017.3**	**938 929.2**

The Action Plan for the Sector is given in Table 44.

Table 44. Action Plan for the Municipality Greening Sector

Activity	Planned Measures	Responsible Body	Implementation period (Start and End Dates)	Cost of Each Measure (GEL)	Expected CO_2 Reduction from Each Measure(t) by 2030	Preliminary Quantitative Index of CO_2 Reduction (t) by 2030
1	2	3	4	5	6	7
G	**Green Zones**					1 019.0
G1	Arranging (with Infrastructure) Recreation Zone in Village Vardisubani at 3ha Area, Particularly, the Planted Area – 0.25ha	Telavi Municipality	2015	1.5 Million	33.0	
G2	Greening of 15ha Area in Telavi Municipality	Telavi Municipality	2016-2030	511 839	986.0	

7 Waste

7.1 Sector Overview

For today, the unresolved problems of solid household waste management still existing in the regions of Georgia represents serious danger in terms of human health and ecology. To resolve these problems, on January 15, 2015, "The Waste Management Code"[14] was enacted, on the basis of which on April 1, 2016 the Resolution #160 of Georgian Government "On the Adoption of National Waste Management Strategy 2016-2030 and National Waste Management Action Plan 2016-2020"[15] was issued. General objective of establishing Waste Management System of Georgia is the adoption of best waste management practices at national level in compliance with the EU-Georgia Association Agreement and the legal requirements of International Conventions ratified by Georgia, representing the important part of the Action Plan and Strategy.

Until 2014, Telavi Municipality covered both the City of Telavi and Community Telavi. In August 2014, on the basis of the Resolution #1 issued by the City Assembly of the Self-Governing Community Telavi Municipality the Self-Governing Community Unit of Telavi Municipality was established covering the villages of Telavi Municipality. At present, the waste management at the territory of Community Telavi is being conducted by the "Georgian Solid Waste Management Company" the goal of which is to provide support to the development of "Integrated Solid Waste Management System" planned by the government as one of the priorities. For the moment, a concept of solid waste management in Community Telavi Municipality is being developed by the Company considering alternative versions of waste management: collection, separation, processing/recycling and disposing at landfills.

In 2015, the Self-governing Community Telavi, co-financed by CENN started adoption of "Integrated Solid Waste Management System" in five pilot villages: Akura, Vanta, Busheti, Kv. Khodasheni, and Tsinandali, where already is being conducted separated collection of waste – paper / cardboard, plastics / polyethylene, and glass in 75units of 1.1m^3 capacity waste containers designated for separation. At the territory of village Tsinandali the Administration hired the premises at which the waste purchasing company installed the waste ramming equipment where the first recycling process of waste is being conducted[16].

One landfill operates in Community Telavi Municipality disposed at 6-7km in the north-west of the city, between villages Vardisubani and Gulgula, in 100m distance from the bank of the River Turdo, on the right bank of the river ravine and in the opposite side of village Karajala. The territory represents a part of Alazani lowland plain. The landfill territory was allotted in 1981 and it has been operating since 1982. The total area of the landfill makes 5.5ha[17]. The cemetery road runs along the east edge of the landfill which is in a distance of 100-150m from the landfill. The distance up to the closest village Karajala makes 0.5km. Besides City of Telavi, the landfill is serving the Community Telavi, and Akhmeta and Gurjaani Municipalities. Until 2013 the waste disposal was conducted chaotically without any registration and systematization. There was no control of the leaking wastewater and landfill gases. The landfill was not fenced until 2013 and it did not have any watch-box[18]. The depth of the waste was 7-8meters by that time.

[14] https://matsne.gov.ge/ka/document/view/2676416
[15] https://matsne.gov.ge/ka/document/view/3242506
[16] Self-Governing Community Telavi Municipality
[17] Self-Governing Community Telavi Municipality
[18] http://nala.ge/uploads/telavi.pdf and Self-Governing Community Telavi Municipality

Since 2013, after passing it to the disposition of Solid Waste Management Company, the rehabilitation works[19] have started on the landfill. By the end of 2013, Telavi Municipal landfill was completely organized. The landfill satisfies minimal standards of environment protection and citizens are protected from the dangers caused by the household waste. There is a clay ground stock to cover the delivered waste. Waste and insulation layers are permanently impacted with vibro-rammer. To orginize the landfill and secure disposal of waste, the territory of landfill was fenced and the watch-box was arranged, the fire-brigade stand and landfill indicating and restriction signs were installed. The landfill was equipped with 60-ton truck-scales, the territory was electrified, and a store-house for mechanisms was constructed. Bank reinforcement works have been performed at the River Turdo which, in case of the river swelling, excludes the danger of occurring waste into the river. At present Telavi landfill is being used by Telavi and Akhmeta Municipalities[20]. The thickness of waste at the landfill makes 8-10m[21]. Since 2015 the mentioned landfill enters into Community Telavi Municipality territorial jurisdiction.

7.2 Methodology and Incoming Parameters

To calculate emissions from Waste Sector, guidelines of Intergovernmental Panel on Climate Change (IPCC) were used that is developed by the United Nations Framework Convention on Climate Change (UNFCCC), under the principle of which this sector covers emissions based on the following source-categories:

- Solid Waste Disposal (6A)
- Wastewater Treatment (6B1 , 6B2)
- Waste Incineration (6C)
- Other Waste – Industrial, Medical and Radioactive (6D)

A Waste Sector inventory for Community Telavi Municipality was conducted for one source-category only: "Disposal of Solid Waste" (6A). Sub-categories "Household and Commercial Waste Water Treatment (6B1) and "Industrial Wastewater"(6B2) are not considered as there is no sewerage system and no waste water treatment facility in Telavi Municipality and there are no large industrial enterprises, and consequently, the methane emissions from subsector will be insignificant. The IPCC source-categories "Waste Incineration" and "Other Waste" are not considered as no waste is burnt and Other Waste (Industrial, Medical, and Radioactive) is not recorded and disposed at the site in Community Telavi Municipality.

There are two ways to calculate methane emissions from landfills, suggested by the IPCC guidelines: (1) "Typical Default Method", - methodological approach Tier 1, and "First Order Decay Method" (FOD) – methodological approach Tier 2. Main difference between these two methods is that the FOD method gives a time-dependent profile of emissions production that better reflects waste degradation processes, while the typical default method is based on the assumption that complete methane production potential, as well as emissions of the generated methane, occur in the year of disposal. The "Typical Default Method" result is satisfactory if there is a permanent amount and composition of waste disposed at a landfill, or if the variations are insignificant over several decades. However, if there are important changes in the amount and composition of waste in the country/region then the use of the "Typical Default Method" is not recommended.

To calculate methane emission from waste generated throughout Telavi landfill "First Order Decay Method" (FOD, Tier 2) has been applied, and the relevant formula and parameters are given in the box below[22].

[19] http://static.mrdi.gov.ge/53d106840cf23064fe48caad.pdf
[20] http://ick.ge/rubrics/ecology/17550-i.html
[21] Self-Governing Community Telavi Municipality
[22] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf

Tier 2: "First Order Decay Method" (**FOD**)

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

Where:

Σ $CH_{4generated x,T}$ – is amount of methane generated, equal to CH_4 $generated_T$ = DDOCm $decomp_T$ • F •16 /12, where (DDOCm $decomp_T$ – is decomposed mass (DDOCm) 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)

$CH_{4\ Emissions}$ - emitted into the atmosphere CH4 Gg, in the year *T*;

T – year of inventory;

x – fraction of waste/composition;

RT - collected from the landfill and rendered harmless CH4 Gg, in the year *T*;

OXT - Oxidation factor in the year *T*.

Activity Data

Population which generates the waste that is delivered or was carried to the landfills[23]

As of 2013 data, the complete service of carrying Solid Household Waste from the Georgian population is performed only in cities of Tbilisi and Batumi. In other regions of Georgia the population whose waste is delivered or was carried to the landfills makes about 814 799 residents that in total equals to only 48% of Georgia's population.

The territory of Community Telavi Municipality makes 589.58km^2 with population of 51 000 (in 2014) that is about 14 571 households (Table 45).

Table 45. Population of City of Telavi, Telavi Municipality and Community Telavi Municipality, Thousand Persons[24]

Year		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Thousand persons	City of Telavi	20.2	20.2	20. 5	20. 4	20. 3	20. 2	20. 4	20. 6	20. 0	20. 7	20. 5

[23] http://lemill.net/content/webpages/10e5-10e410dd10d710d810e1-10d310d410db10dd10d210e010d010e410d810d0/view
[24] http://geostat.ge

	Telavi Municipality	69.7	69.5	70.6	70.4	70.0	69.8	70.5	71.0	71.2	70.9	70.9
	Community Telavi Municipality	49.5	49.3	50.1	50.0	49.7	49.6	50.1	50.4	50.2	50.2	50.4

The population number forecast by 2030 has been done with the same assumption as was used in the MARKAL GEORGIA, or 0.5% growth per year.

According to the survey conducted by the CENN during 2015, 34 000t solid domestic waste was collected and disposed at official landfill per year in Kakheti Region from the population, consequently, 34000/405000=0.084t/person/year which is rather small amount compared with other regions of Georgia. To this, the practice of collection of waste and providing service to the population is less developed in Kakheti region, and there is no exact data what part of population generates the waste which is delivered to the official landfills. The populated areas in the region exist where no waste collection and removal service is provided.

Cleaning service in Community Telavi Municipality is provided by the corresponding division of Ltd. "Service of Infrastructure and Municipal Amenities" founded by 100% share under the Municipality. During 2015, 1 912 tons of waste was collected and disposed at the landfill from the population of Community Telavi Municipality; besides, after cleaning the unorganized dumps at the territory of the community, 4 216 tons of old waste was removed and disposed at the landfill but there is no information during what time it was collected and how many other unorganized dumps are left to be liquidated. Each month 160t[25] of waste is collected and disposed at the landfill from Community Telavi territory that is very small index if we divide this mass by the whole population of the community: 1912t/51000persons = 0.037 t/y, or 37kg/y. While, according to the inventory conducted in 2014, the amount of solid household waste per person in Tbilisi makes 310.6kg/person/year, and according to the inventory conducted by the CENN in Ajara it makes 163.9kg/person/year. Considering this, it is obvious that the amount of waste 36kg/person/year for Community Telavi population is extremely small and this fact may be stipulated with the incomplete cleaning service of Community Telavi territory and existence of illegal landfills. As it was already mentioned, the cleaning service in the region serves only 30% of the population (to this, it should be noted that solid household waste is mixed with construction waste at the average by 7%[26]).

Assuming that waste at the Community Telavi territory is collected from only 30% of population, or 1 912t equals to the waste generated by 15300 persons, in total the generated waste presumably makes 6 373t and the waste generated per capita equals to 125kg/yr.

An assumption was made for calculations that 70% of waste is not subject to registration at the territory of Community Telavi Municipality and its disposal by the population is conducted at the territories of the unorganized dumps selected by the citizens[27].

To calculate the emissions trend from solid household waste by 2030, an assumption was made that waste amount per year will be increased by 2.5% per capita[28].

[25] Self-Governing Community Telavi Municipality
[26] Self-Governing Community Telavi Municipality
[27] http://www.sao.ge/files/auditi/efeqtianobis-angarishi/mkari-narchenebi.pdf
[28] Tbilisi SEAP

Waste Composition

Morphological study of solid domestic waste was conducted by the CENN in 2015 in the whole Kakheti Region[29] and the exact data obtained from the outcomes of the research is presented in Table 46 that was used for the ongoing inventory.

Table 46. Composition of Solid Household Waste Generated in Kakheti (%)

Waste Fraction	Organic Waste	Paper/Cardboard	Wood	Textile/Leather	Hygiene Waste	Plastic/Inert Material	Total
By Mass %	41.4	14.9	-	6.2	4.2	33.3	100

It should be considered that in the composition of the waste removed from the unorganized dumps from the territory of the community and disposed at the main landfill in 2015 mostly the fractions of less decaying household waste like plastic bottles and polyethylene bags and scrap metal (inert fractions[30])[31] were included.

Emissions Factors

Different emission factors are used in the process of methane emission 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 in the Oxygen-containing conditions. The IPCC 2006[32] gives default values of the MCF which are presented in Table 47.

Table 47. Methane Correction Factor (MCF) Default Values for Different Types of Landfills

Type of Landfill/Landfill	MCF
Managed [33]	1.0
Managed-thin (waste thickness<5m)[34]	0.5
Unmanaged – deep (waste thickness>5m)	0.8
Unmanaged (thin-waste thickness<5m)	0.4
Uncategorized Landfill	0.6
Official Landfill (1982-1992)	0.4
Official Landfill (1993-2013)	0.8

[29] Waste Management Technologies in Regions "Report on Survey to Define Morphological Composition of Solid Domestic Waste Generated in Kakheti Region", CENN, 2015
[30] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf
[31] Cleaning the illegal landfill areas in Akhmeta Municipality in the vicinities of Duisi, Dumasturi and Khalatsni, CENN, 2015
[32] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf (pg. 3.14)
[33] A managed landfill implies the disposal area kept under control (waste is placed at specially prepared places where the waste is "blown" and is controlled against self-flaring). At the same time the waste is covered, rammed and layered. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000, pg. 5.9
[34] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, http://www.ipcc-nggip.iges.or.jp/public/2006gl (pg.3.16)

Official Landfill (2014-2030)	1
Unorganized dumps	0.4

At present, waste thickness at the Community Telavi landfill is about 8-10m. Exploitation of this landfill which is close to standards, has been carried out since 2014, hence, considering values given in Table 48, for the calculation of methane emissions correction factor equals to: in 1982-1992 - 0.4 (Unmanaged-thin), from 1993 till the end of 2013 – 0.8 (Unmanaged-deep), 2014 -2030 – 1 (Managed), and for unorganized dumps – 0.4[35].

Degradable Organic Carbon - DOC

Degradable Organic Carbon (DOC) is the organic waste component which is decomposed biochemically and measured in GgC/Gg of waste.

The value of the DOC depends on waste composition and country/region climate conditions. To calculate value of the DOC for waste components the IPCC 2006 methodology[36] was used. Values of the DOC according to waste composition are given in Table 48.

Table 48. Values of DOC According to Waste Fractions

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

Fraction of Degradable Organic Carbon Dissimilated-DOC_F

DOC_F is actually a dissimilated component of organic Carbon. A certain part of organic Carbon is not decomposed at all or decomposes very slowly. The IPCC GPG 2000 recommends for DOC_F the value 0.5-0.6 (in this case it is assumed that the landfill is in anaerobic conditions and lignin[37] carbon is included in the DOC value). The DOC_F value depends on a number of factors such as air temperature and moisture, pH, waste composition, etc.

IPCC GPG recommends for DOC_F to use national values though they should be based on well-documented surveys.

Methane Content of Landfill Gas (F)

Methane concentration in landfill gas is up to 50% according to the IPCC 2006. Only oil and fat containing materials generate bio gas with more than 50% of methane.

Oxidation Factor (OX)

Oxidation factors reflect the amount of methane generated in waste cover materials (soil, etc.). In case of managed landfill (where waste is covered by oxidizing materials – soil, compost) OX value is equal to 0.1, amounting to 0[38] for unmanaged dumps. This volume (OX=0) has thus been taken for the Community Telavi landfill.

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[35] Unorganized dumps are those small size areas where is gathered the scattered waste and where anaerobic processes don't take place.
[36] http://www.ipcc-nggip.iges.or.jp/public/2006gl (pg. 2.16)
[37]Plant cell consists of three important components: cellulose, lignin and hemicellulose. Lignin strengthens cell walls, binding the latter as well. Dissimilation of lignin is anaerobic process. Lignin becomes durable under anaerobic conditions
[38]. http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html (pg.5.10)

7.3 Waste Sector Base Year Inventory and GHG Emissions Baseline Scenario (BAU, 2014-2030)

In compliance with the "National Waste Management Action Plan 2016-2020", in all the regions of Georgia achieving the waste collection minimal national index is planned by 2020 – 90%[39], and by 2030 – 100%, which means increasing the number of population served by the cleaning service, and accordingly, closing/liquidation of the unorganized dumps, that on its side, will increase the methane emissions in the atmospheric air. One of the methods of the emissions reduction resulted from the mentioned activity is minimization of waste disposed at the landfill with the help of separation.

Table 49 shows methane emissions forecast from Community Telavi Waste Sector without separation and after waste management improvement (growth of number of population served by the cleaning service from 30% in 2014 – up to 90% in 2020, and 100% - in 2030)

Table 49. Baseline Scenario (BAU, 2014-2030) of CO_2 Emission from Community Telavi Municipality Waste Sector

Year	Amount of Waste Disposed Officially and in Unorganized Way, t	CH_4. Gg			CO_2eq. (Gg)
		Official Landfill	Unorganized Dump	Total	
2014	5 706.29	0.0700	0.0674	0.1373	2.88
2015	5 926.84	0.0728	0.0692	0.1420	2.98
2016	6 105.39	0.0758	0.0709	0.1466	3.08
2017	6 289.31	0.0787	0.0724	0.1510	3.17
2018	6 478.78	0.0876	0.0716	0.1592	3.34
2019	6 673.95	0.1020	0.0689	0.1709	3.59
2020	6 875.00	0.1216	0.0645	0.1861	3.91
2021	7 082.11	0.1461	0.0586	0.2047	4.30
2022	7 295.46	0.1696	0.0533	0.2228	4.68
2023	7 515.24	0.1922	0.0484	0.2406	5.05
2024	7 741.63	0.2143	0.0438	0.2582	5.42
2025	7 974.85	0.2361	0.0396	0.2757	5.79
2026	8 215.09	0.2576	0.0357	0.2933	6.16
2027	8 462.57	0.2781	0.0322	0.3104	6.52

[39] National Waste Management Action Plan 2016-2020 https://matsne.gov.ge/ka/document/view/3242506, Goal 3, Task 3.3

2028	8 717.51	0.2978	0.0292	0.3270	6.87
2029	8 980.12	0.3168	0.0265	0.3433	7.21
2030	9 250.65	0.3353	0.0242	0.3595	7.55

Wastewater

Villages located at the territory of Community Telavi Municipality do not have any sewerage system. Households use individually arranged pits for the sewerage network and waste water collection. The sewerage collector of Telavi city also represents a serious problem because it is damaged at the territory of village Kurdgelauri and open flow of waste water runs into the irrigation channel of Zemo Alazani passing through the village and part of the water flows into the drainage channel running along the agricultural lands. Due to the awful pollution an unbearable smell is felt in the air in this section of village Kurdgelauri.

Resolving the above-mentioned problem requires high expenses. Due to this reason, it is impossible to perform the needed works with local budget and the process of fundraising is going on.

Before 1990, at the territory of Community Telavi Municipality both sewerage collector and waste water treating facility existed in the vicinity of the River Alazani which is not operating at present[40].

The ongoing Action Plan does not consider methane generated from wastewater as the wastewater treatment facility is out of order and it is not known yet when this problem will be resolved[41].

7.4 Emissions Reduction Action Plan from Community Telavi Municipality Solid Waste Subsector

Waste Management Effectiveness of Community Telavi Municipality at this stage considers sorting fractions (paper, plastic, and glass) of the solid household waste for further processing before its disposal to the Community Telavi landfill. As a result of mentioned activities the amount of paper, plastic and glass fractions in the waste will be reduced and, consequently the emission of the product generated from their decay (among them methane) into the atmosphere will also be reduced.

For today, first steps in this direction have been made (in cooperation with CENN). Unfortunately, there is no information about the results of the mentioned activities (sorting), so, an assumption was made to reduce methane emission from Community Telavi Municipality Waste Sector, that[42]:

- During 2016 5% separation of paper will be conducted and by 2020 it will reach 30% and by 2030 – 80%;
- During 2016 5% separation of plastic will be conducted and by 2020 it will reach 30% and by 2030 – 80%;
- During 2016 5% separation of glass will be conducted and by 2020 it will reach 30% and by 2030 – 80%;

In accordance with the Action Plan, amount of waste disposed at the landfill will reduce by 9.25% for 2020, and by 31% - for 2030 after implementation of the measure.

[40] Self-governing Community Telavi Municipality
[41] According to Self-governing Community Telavi Municipality, it is impossible to perform the needed works with local budget and the process of fundraising is going on.
[42] National Waste Management Action Plan 2016-2020 https://matsne.gov.ge/ka/document/view/3242506 , Goal 5, Task 5.2

Table 50. In Case of Project Implementation the Methane Emission Forecast from Community Telavi Municipality Waste Sector

Year	Amount of Waste Disposed Officially and in Unorganized Way, t	CH_4. Gg			CO_2eq. (Gg)
		Official Landfill	Unorganized Dump	Total	
2014	5 706.29	0.0700	0.0674	0.1373	2.88
2015	5 926.84	0.0728	0.0692	0.1420	2.98
2016	6 069.81	0.0758	0.0709	0.1466	3.08
2017	6 182.58	0.0785	0.0724	0.1509	3.17
2018	6 261.08	0.0870	0.0716	0.1586	3.33
2019	6 302.07	0.1005	0.0689	0.1694	3.56
2020	6 302.13	0.1185	0.0645	0.1830	3.84
2021	6 336.73	0.1407	0.0586	0.1993	4.19
2022	6 361.33	0.1613	0.0533	0.2146	4.51
2023	6 375.10	0.1806	0.0484	0.2290	4.81
2024	6 377.17	0.1989	0.0438	0.2427	5.10
2025	6 366.62	0.2163	0.0396	0.2559	5.37
2026	6 379.20	0.2329	0.0357	0.2686	5.64
2027	6 386.76	0.2480	0.0322	0.2802	5.88
2028	6 388.98	0.2618	0.0292	0.2910	6.11
2029	6 385.54	0.2744	0.0265	0.3009	6.32
2030	6 376.10	0.2860	0.0242	0.3102	6.51

Table 51. Reduced Methane Emission Resulting from the Implementation of Measures

Year	CO_2eq. (Gg)		
	Without Implementation of the Measure (Gg)	With Implementation of the Measure (Gg)	Reduction, %
2014	2.88	2.88	0
2015	2.98	2.98	0

2016	3.08	3.08	0
2017	3.17	3.17	0.08
2018	3.34	3.33	0.35
2019	3.59	3.56	0.86
2020	3.91	3.84	1.63
2021	4.30	4.19	2.56
2022	4.68	4.51	3.63
2023	5.05	4.81	4.75
2024	5.42	5.10	5.90
2025	5.79	5.37	7.25
2026	6.16	5.64	8.44
2027	6.52	5.88	9.82
2028	6.87	6.11	11.06
2029	7.21	6.32	12.34
2030	7.55	6.51	13.77

According to the outcomes (Table 50 and Table 51), in case of project implementation, methane emission from Waste Sector will be reduced by up to 1.63% for 2020, and by 13.77% for 2030.

Table 52. Action Plan for Waste Sector

Activity	Planned Measures	Responsible Body	Implementation period (Start and End Dates)	Expected CO_2 Reduction from Each Measure (t) by 2020	Expected CO_2 Reduction from Each Measure (t) by 2030	Cost of Each Measure (GEL)
1	2	3	4	5	6	7
W	Solid Household Waste and Wastewaters			65	1 035	
W1	Separation of Paper, Glass and Plastics Fractions from Solid Household Waste for further Utilization	LLC "Service of Infrastructure and Municipal Amenities", under the Community Telavi Municipality	2016	65	1 035	

8 Agriculture

8.1 Sector Overview

The impact of climate change on the territory of Community Telavi basically has been assessed in Georgia's Third National Communication on Climate Change[43]. Two sectors have been considered: Agriculture, as the leading field in the Municipality, and Healthcare as one of the most sensitive fields throughout the whole Kakheti Region.

Impact of Climate Change on Agriculture

Temperature. According to the analysis of changes in climate elements between the periods of 1961-1985 and 1986-2010, an average annual temperature in Telavi Municipality increased by +0.4^{0}C and compared with the period of 1932-1960 – by 0.7^{0}C. warming is going on in each season and the highest warming occurs in summer (+0.8^{0}C). Revealed warming is stable and is confirmed with trends in summer and autumn, as well as, according to the average annual value. An absolute maximum of temperature increased in each season except winter. Increments in summer and autumn seasons reach +2.2^{0}C. An absolute minimum in winter and summer is rather warm (+3, +4^{0}C). The average daily amplitude of temperature is increased in all the seasons in the frames of 0.3 – 0.5^{0}C which increases the risk of plants' stress.

Precipitations. Total precipitation in Telavi between the above-mentioned two periods decreased by 3% (91mm). As for the maximums of daily precipitation, decrease of their absolute values was recorded for each season except autumn with 2% increase.

Annual and seasonal values of ***relative air humidity*** during these two periods have not been changed actually and varied within the frames of 70%.

Thus, between the discussed two periods the highest warming at the territory of Telavi Municipality took place in summer (+0.8^{0}C). Precipitation has significantly reduced in summer (-17%), and, has considerably increased in autumn (+12%).

Duration of vegetation period for limiting temperature 10^{0}C between the discussed two periods increased by 3 days, accordingly the sum of active temperatures increased by 123^{0}C. The sums of precipitation in vegetation period decreased on the average by 5%. For limiting temperature 12^{0}C duration of vegetation period increased by 2 days and the sum of active temperatures accordingly increased by 115^{0}C while the sum of precipitation here has also been decreased (9%). Duration of period without frost between these periods was decreased on the average by 9 days that significantly reduces danger of night frosts.

From extreme events there should be noted that the number of very hot days (SU30) in the second period increased by 10 days (mostly in summer season). The amount of the maximum successive rainfall during 5 days increased by 25% in summer and by 24% - in autumn. Such increase in the amount of successive rainfalls for 5 days causes degradation of soils and washing away agricultural lands located on the river banks. An

[43] http://moe.gov.ge/files/Klimatis%20Cvlileba/ErovnuliShetkobinebebi/2015_bolo/geo.compressed.pdf

increase of extremely hot days and droughts at the background of the decreased precipitation by 9% during vegetation period increases the risk of yield reduction of comparatively damp-loving crops.

The leading agricultural field in Kakheti is viticulture and total area of vineyards makes up 28 500hectares. Among the 8 municipalities of Kakheti Region, Community Telavi takes the third place with the size of vineyard areas. Here are gathered 17% of Kakheti vineyards with total area of 4 000ha. 50-60% of the vineyards existing today in Kakheti were laid out in the Soviet period, and the rest has been laid out since 1994-95. In old vine-plantings there is a great spacing between the rows and due to this reason the yield[44] per hectare and grape quality[45] is very low. For 2014 vineyard areas of Telavi Municipality compared with the previous years increased by 150ha and the laying out of the vineyards is still going on actively. The biggest part of the newly planted vineyards comes on Rkatsiteli and Saperavi kinds, and a small amount comes on Kakhuri Mtsvane and other grape varieties.

There are many small, medium and large-scale vine-growing farms in the Municipality and main lands are family-owned ones. Significant share comes on the vineyards belonging to large-scale commercial wineries the areas of which grow[46] every year. Owners of large areas are about 605 farmers to whom more than 1ha vineyards belong. Average grape yield in the Municipality is 6-7 tons per hectare.

Generally, vine culture is rather vulnerable to climate parameters and soil. Moisture is necessary condition for vine growing and development to get good harvest. Lack of humidity especially affects fruiting plants and decreases yields per ha, it also changes other parameters of grapes, while high temperatures increase sugar content at certain stage of vine development that is not always desirable.

In the past, there was the Research Institute for Viticulture and Winemaking in Telavi where systematic observations of soil, climate, biologic and other changes of plants were conducted and scientific recommendations were issued. As well, soil-science and plant protection laboratories operated there. Today these labs are closed. Level of vine-growing farmers' knowledge is insufficient; they don't possess any knowledge of modern technologies in the sphere of vine care and grape production.

Climate change lately has caused activation of pests and diseases in Telavi Municipality creating danger for viticulture, as well as, for grain production, rose-flower production, etc. For example, 30-50 years ago, some occurrences of vine ticks and mealy bugs were noticed in viticulture; increase of temperature in recent years caused their activation to critical level becoming necessary to start active combat against them as they represent danger not only for the harvest and its quality but for the plant life as well.

Devastating thunderstorm took place on July 19, 2012 (such disaster had not happened during centuries before 2012) causing serious damage to agriculture of Community Telavi Municipality. It was mostly harmful for viticulture as not only the ongoing harvest was lost but perennial plants ruined almost completely. It takes at least three years period to reestablish the value of damaged vine harvest. As a result, many perennial gardens were completely damaged and cut down. Generally, for the last 4 years the hail, which rested for a time, has strengthened and increased. Hail in Kakheti is one of the most serious dangers caused by climate, especially for those Municipalities in which viticulture is the leading field (like it is in case of Community Telavi Municipality), as heavy hail causes damage not only to the one year harvest but to the vine itself which becomes unproductive during next 2-3 years.

[44] In old vineyards it is hardly harvested 2tons of grapes per 1ha.
[45] Kakheti region Development Strategy 2014-2021
[46] There are 21 large wineries at the territory of Community Telavi Municipality

Using the method of multi-criteria analysis, the vulnerability of Agriculture Sector to climate change has been assessed for all eight Municipalities of Kakheti Region. It was revealed that the territory of "Community Telavi" in the whole region is the most vulnerability to the risks of climate change.

Recommendations

Problems conditioned by current and expected climate changed at the territory of Telavi Municipality are similar to the problems existing in Gurjaani and Kvareli Municipalities of which hail, as well as, soil erosion caused by heavy rainfall should be outlined. Besides, urgency of irrigation systems during the current rate of growing maize fields should also be stressed. The following measures should be implemented in the Municipality to avoid mentioned risks:

- Introducing modern anti-hail methods and adoption of other safety measures; State involvement is especially crucial here;
- Renovation of the irrigation and drainage systems of Telavi Municipality through modern technologies (water saving, high-efficient atmosphere cooling systems like fertigation, mulching, drip and spray watering, etc.) and providing their appropriate exploitation;
- In relations to the growth of maize crop areas testing ecologically appropriate soil-tillage aggregates with different effects (chisels, combined aggregates, aggregates for sowing without plowing) in some concrete natural climate conditions and adoption of the best ones (throughout the Municipality).
- Private sector should be promoted (offering them modern technologies) to reestablish rose and other essential oil plantations (and the production) in corresponding micro-climate zones that in return will reduce erosion of soils and increase the carbon dioxide removal from the atmosphere;
- To equip nurseries with modern technologies for fruit producing field development purposes which will allow the peasants and farmers to grow saplings without viruses;
- To find effective mechanisms/means in order to allow the private sector involved in viticulture to share the knowledge of modern technologies with smaller-scale farmers;
- To increase the potential of the personnel employed in information-consultation centers founded in the Municipalities by providing them with information about modern achievements;
- To promote the process of cooperatives formation.

8.2 Vulnerability of the Healthcare Sector

Using the method of multi-criteria analysis the vulnerability of Healthcare Sector to climate change has been assessed for all eight Municipalities of Kakheti Region. In total, 25 different indicators have been assessed. The assessment of sensitivity was conducted in three directions: climate change effect on Healthcare Sector, Healthcare Sector's sensitivity to the changes and the potential of adaptation of the Municipality population to current and future changes. The climate change parameters were taken for two 25-year periods: 1961-1985 and 1986-2010. The results of observations of 8 weather stations have been used and based on them the Tourism Climate Index (TCI) was calculated. The used weather stations reflect the corresponding climate zone to some extent.

The assessment revealed that during the current period in Kakheti Region Healthcare Sectors of Kvareli and Telavi Municipalities are the most vulnarable to climate change. As well, using the method of multi-criteria analysis the future vulnerability of Kakheti Region Healthcare Sector to climate change has been assessed and

it was revealed that in the future Telavi Municipality will become more vulnarable mostly caused due to the risks of climate change.

Recommendations

In order to reduce the vulnerability to climate change of the Healthcare Sector in Community Telavi Municipality, the following measures should be implemented:

- To conduct detailed study of the climate change impact on spreading climate-depending diseases in the region and for this purpose should be implemented:
  - Studying the concentration of suspended solid particles in the air and its relation with cardiovascular and respiratory diseases;
  - Assessment of climate change effect on spreading infectious diseases in the region.
- To prepare and implement pilot projects basically for prevention of cardiovascular diseases (training the medical personnel, mobilization of the representatives of first aid units, for example, emergency medical service, in heat waves period);
- To define needs of stationary unit, as the weakest element, related to management of climate-depended diseases (providing trainings and appropriate equipment for treatment);
- To promote development of Tourism Sector with creating comfortable and healthy environment for tourists: equipping the rest complexes (for example, Lopota and Kvareli Lakes) with medical personnel (with already trained medical personnel, among them, with the representatives of emergency medical service) which will take care of the tourists' health during the heat waves period.
- To promote the awareness of the representatives of Kakheti Region Healthcare and Tourism Sector, as well as, of the population about climate change and climate-depended diseases.

8.3 GHG Emissions Reduction Measures in Agriculture

As it was already mentioned above, Agriculture is the primary field in Community Telavi Municipality with winemaking as its leader. The total grape harvest in 2014 is increased by 49% compared to 2012.

At this stage, one of the growing sectors among sub-sectors of Agriculture after viticulture is livestock breeding and the dairy products produced from it; however, due to the lack of animal food, this product is seasonal and basically it is available in those periods when natural food is available at pastures. Namely, compared to 2012, in 2014 the cattle number increased by 865 heads (by 7%), the milker cattle is also increased by the same number, and accordingly production of milk and dairy products increased as well. Most heads of the cattle comes on small-scale farming and small family-owned farms who produce the main part of local products and who possess 1-10 heads of cattle.

There are the following livestock products mostly produced in the Municipality: meat, cheese, milk, and sour-milk. Products produced by farmers are sold at local market. There are one dairy collecting plant and 3 milk processing enterprises in Community Telavi which produce cheese with the delivered milk. These enterprises are: in village Ikalto "Individual Proprietor David Botkoveli", whose enterprise consumes 15678KWh electric energy per year; "Individual Proprietor Gocha Ghaghashvili" in village Kurdgelauri, consuming 60132KWh electric energy per year and Milk Processing Enterprise in village Tsinandali having approximately the same capacity as it is in village Kurdgelauri, or consumes 60132KWh electric energy per year. In total, these three dairy enterprises consume 135 942KWh electric energy corresponding to 14 138kg CO_2eq (14t).

This field starts developing now in Community Telavi Municipality and as earlier the energy efficient and renewable technologies are offered, the more profitable will be this process economically for the private sector involved in this sphere. As the sector producing dairy products uses much hot water for what basically is consumed electric energy, so it is planned to consume solar energy for hot water supply in this field that according to the preliminary calculations may substitute 60-70% electric energy. However, in purpose of conservativeness an assumption was made that substitution of electric energy will be conducted only by 50% and below are given consequently the saved GHG emissions.

In case of successfully implemented measure, electric energy saving per year for three enterprises totally will equal to 67 971KWh that in monetary terms will be 11555GEL, and total emissions saving per year will be 7t CO_2eq. The expected reductions in Agriculture Sector at this stage were not considered in the Action Plan for Community Telavi as it is planned to be implemented after 2020 on the basis of the first monitoring.

9 Awareness Raising and Staff Training Strategy

"Community Telavi" Municipality was the first among the self-governing cities and Municipalities of Georgia that join the new initiative of the CoM signed in Paris in 2015 and implies the "Sustainable Energy and Climate Action Plan". Involvement of both the government and society plays equally important role in the process of implementation of this Action Plan. Raising public awareness for introducing renewable energies, increasing energy efficiency and maintaining sustainability of local economic fields and ecosystems to climate changes require complex and multilateral approach and the relevant communications strategy represents one of the most important components of the "Sustainable Energy and Climate Action Plan" (SECAP).

Despite the fact that self-governing reforms started in Georgia in early 90-ies and important steps are periodically made for strengthening self-governing units (among them in terms of legislation), potential of self-governing units in terms of effective management, planning, and obtaining financial independence due to complexity of the process, as well as, certain political (unstable condition, governmental changes, etc.) or socio-cultural difficulties (mentality, tradition of central control, etc.), still remains weak. In this respect, Community Telavi Municipality does not represent an exception, especially when it obtained independence in 2014 when City Telavi was announced as a self-governing city and Community Telavi became an independent governing unit. Consequently, the real decentralization processes for Community Telavi are at the very earliest stage. As a rule, the main problem of municipalities including Community Telavi Municipality is lack of independent management experience, and, accordingly, lack of experienced personnel, while, developing and implementation of the SECAP requires independent planning and searching additional funds and effective implementation of the planned measures. The SECAP preparation process within the frames of the CoM clearly revealed those basic barriers which may create significant threats on the way of implementation of the strategy. Therefore, it is urgent to conduct proper evaluation of all identified barriers and set the ways of their overcoming. This assessment revealed that in the process of strategy implementation mainly three types of barriers will be dealt with: country level barriers existing in energy and, namely, energy efficiency sector linked to bad past practices (especially in the sphere of public awareness), the existing economic and social problems and the lack of knowledge related with technologies; barriers specific to Community Telavi Municipality and concrete project proposals and technology related barriers. As for the Climate Action Plan here we deal with serious deficit of knowledge and studies.

Barriers to Sustainable Energy Development Process in Georgia

1. **Wasteful Approach to Energy Sector**, still practiced since soviet period when energy was almost free of charge and consumption was unlimited;
2. Generally, **insufficient awareness of sustainable development process by local authorities and population**. Mainly small part of society directly engaged in these activities is aware of the concept of sustainable development;
3. **Absence of common vision** of the relatively long-term prospects of the Energy Sector development (different target groups still have sharply contrasting positions which often are not based on real calculations);
4. **There is no single, well-considered and formulated vision of the role of energy efficiency and renewable energy resources** in short-run and long-run perspectives of Georgia's Energy Sector development, while in recent years at average 10% growth rate is recorded in energy demand annually. Correspondingly, potential of these recourses (except hydro) and the directions for development of this potential are not defined; there is no relevant legislation base and the set objectives similar to gasification of the country or hydro-energetics. At present, in coordination with the Ministry of Energy, the National Energy Efficiency Action Plan is being prepared which will significantly improve this direction;
5. **Technologies market is inferior and contains high risks.** Each failure of a new technology and the demonstration project is seriously damaging the follow-up prospects of the development in this direction. The long-run planning of Energy Sector is not conducted considering 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**. However, it should be stressed that improvement of 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. Besides, as it was already mentioned above, the country has already started working on developing the National Energy Efficiency Action Plan that in return will contribute the growth of energy efficiency coordination at the municipality level.

While identifying barriers of Community Telavi Municipality it has been considered that the managerial team of the Community has a vision of sustainable energy development prospects, demonstrates great interest to the adoption of modern, clean, energy efficient and renewable technologies and has relevant knowledge to certain extent but it lacks sufficient experience in managing present-day technologies and sustainable development planning, as well as, working with investors. Very often, the support by the Municipalities is not fully reasoned out and lacks eyesight of what could be done at local level and how this or that measure could be realized effectively.

Barriers to Community Telavi Municipality Sustainable Energy Development:

Community Telavi Municipality faces the same main barriers in energy resource consumption planning process as all other regions and Municipalities in Georgia. **This is their complete dependence on centralized energy supply and full reliance on the private sector concerning other energy carriers.** 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

for 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. Community Telavi **Municipality has no complete statistics on the energy consumption** that would serve as basis for planning growing energy demand. There is no vision and strategy to foresee energy supply of the Municipality in case of failure of one of the present rings in the energy supply system. Accordingly, the Municipality managerial team has no sufficiently thought-out energy efficiency urgency and its role in the process of sustainable socio-economic development. There is no vision of what problems the Municipality could face in case of rapid growth of economy and number of population, as well as, intensification of traffic network. The situation is aggravated by high consumption of firewood, as the cheap energy resource.

The Municipality **has no relevant experience, knowledge and sufficient expert potential** to plan energy sustainable development process, manage and implement the SECAP for Community Telavi Municipality; In particular, in the short-run strategy for energy sustainable development process in Community Telavi Municipality the priority sectors are **Transportation, Buildings and Waste Management. However, to secure the painless solving of the problems of mentioned sectors a serious public awareness raising campaign should be undertaken to demonstrate advantages that energy-saving and local renewable energy consumption in heat supply will bring to population in long-run perspective, and to inform them what problems may bring to the country the unsustainable consumption of forest as firewood.**

Very important barrier is **absence of free additional funds** as well (most of the budget resources are used for infrastructure development, that is very important at this stage, and for social projects) to develop this direction (provision of energy sustainable consumption);

The local energy resource consumption sphere (except hydro) is unmanaged and chaotic at the level of Municipalities like it is at the level of the whole country;

In the case of Community Telavi Municipality all those barriers are acute, which are typical and general for the whole country.

Among those sectors experiencing urgent need of public awareness raising programs in terms of energy efficiency are Transportation and Waste Sectors. As it is described in the corresponding chapters, according to data of 2014, daily, about 15-16 thousand units of transportation means including transit vehicles drive at the Municipality territory. According to data of 2012-2014, total number of transport in the Municipality has increased by 110%. As for the Waste Management, there is one official landfill of Community Telavi Municipality located at 5.5ha area in the vicinity of village Gulgula and operating since 1990. Unfortunately, in parallel with this landfill there are other illegal dumps created by the population without permission which have not been rooted up despite repeated attempts of the Municipality.

Apart from above barriers there are some specific ones that have to be considered in the process of the SECAP implementation and assessment of the selected and applied technologies.

Barriers related to Technologies

Lack of knowledge about the 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 the risks related with their introducing in the country. Private banks and private sector are not willing to take the risks. Consequently, import of technologies, their dissemination and adaptation is almost totally in the hands of non-governmental sector or those big investors who are interested in developing market for their own technologies. Accordingly, high technologies which are imported at the limited scale are accompanied with large part of worthless technologies. This is mostly promoted by the cost of the technology and unfortunately even for short-run prospective;

Lack of knowledge about the local environment in which certain technology should operate (for example, energy-efficient bulbs become absolutely ineffective and economically unprofitable within old and improper functioning electricity network). Studies of these aspects bring additional cost to technologies and raises their prime cost;

Lack of knowledge of environmental and social counter-indications of the technologies. 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 minimization; in the case of Georgia, experience of assessment of these types of risks actually does not exist;

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 level of the Municipalities and self-governing cities;

Most renewable technologies are not sufficiently flexible and easily adaptable to different environments. Majority of them lack market shape and their adaptation to local conditions requires additional funding and knowledge.

Especially should be highlighted adaptive technologies sharing of which without special adaptation from other countries, even from successful ones bear great risks. **The climate change impact** on different sectors of Georgia's economy and ecosystems **is not studied well that accordingly affects the process of selecting technologies to be adapted.**

Important hazards and risks caused by climate change were revealed in the process of developing this Action Plan for the territory of Community Telavi Municipality described in the section of Climate Action Plan.

The analysis of stakeholders in the frame of Community Telavi Municipality SECAP has identified target groups for awareness raising and retraining with which active collaboration is necessary to overcome the majority of the listed above barriers. However, it should be stressed that there are barriers common with the country the over-passing of which will be extremely difficult without the serious intervention from the side of the government.

The target groups to be engaged in the awareness raising process to which this strategy is addressed are as follows: Community Telavi Municipality staff and City Assembly members; small businesses engaged in the spheres of Transportation, Waste Management and Agriculture; Community Telavi Municipality population.

As at the present stage in the direction of sustainable energy the first priorities for Community Telavi Municipality are Transportation, Buildings and Waste Management Sectors, and in the direction of adaptation

- Agriculture Sector, therefore, for implementation of Action Plan it is necessary to plan and execute such measures which require intense informing and awareness raising among Community Telavi Municipality population and the above-mentioned target groups on the measures to be implemented in the mentioned sectors and prospect for the sustainable development of these sectors.

The survey conducted in Community Telavi Municipality showed that in terms of transport it has a significant loading. The Municipality is connected with motorways with the capital of Georgia through which the trade cargo service is carried out in the Municipality. Public transport and transportation routes, as well as, the disposition of villages within the Municipality, poor conditions of roads and long distances among the villages reduce the number of pedestrians and cause growth of transportation means. Public transport in Community Telavi Municipality is represented by private minibuses and the lines of commercial minibuses.

As for the Waste Management, since 2015 the Ltd. "Georgian Solid Waste Management Company" owns and operates the landfill disposed at the territory of Community Telavi Municipality aiming to provide support to the development of "Solid Waste Integrated Management System". In this respect, the pre-condition of the plan implementation is conducting the appropriate technical-economic survey which has already started in July 2015 and is being carried out by German Consulting Company INFRASTRUKTUR & UMVELT Professor Bohm und Partner (IU), with the Regional Development Center in Caucasus (RDC) in cooperation with the Policy and Management Consulting Group (PMCG) and Selhof Gmbh. On the basis of the survey the final territory for landfill will be selected. In parallel with selection of the location, the concept of Solid Waste Management will be worked out considering alternative options of waste management: collection, separation, processing/recycling and disposal at landfill for what is developed the Action Plan and schedule.

The average daily amplitude of temperature at the territory of Community Telavi Municipality is increased in all seasons in the frames of 0.3 – 0.5^{0}C which rather increases the risk of plants' stress. According to the last two 25-year period data, the highest warming took place in summer (+0.8^{0}C) and the precipitations were significantly reduced in summer (-17%); The number of very hot days is also increased significantly that caused activation of different pests and diseases creating danger for viticulture, as well as, for grain production, rose-petal production, etc. For example, in viticulture 30-50 years ago some occurrences of vine ticks and mealy bugs were noticed; for the last period the increase of temperature caused their activation to such a level that it is necessary to start active fighting against them as they represent danger not only for the harvest and its quality but for the life of the plant itself.

It is essential the population to be aware of the SECAP and to make for them understandable its objectives and the positive social and economic sequels which could be obtained in case of its successful implementation. To achieve maximum support from the side of population it is necessary to carry out some behavioral changes among the population, as well as, to provide its involvement in the process of the plan development. Global practice has demonstrated that the higher is population's involvement at the early stage of the process the more effective is implementation process and the higher is the public support.

At the initial stage of the SECAP, development the meetings and consultations with the population of Community Telavi Municipality (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 Community Telavi Municipality SECAP the meetings with the Municipality Administration were arranged systematically. It should be underlined that it is just the stakeholders, acting in

specific sectors, who own the major part of information necessary to develop and carry out the SECAP and they represent the basis determining the success of the entire project.

In the process of the Community Telavi Municipality SECAP implementation, for purpose of the awareness raising and local staff training a long-run strategy has been developed set out until 2030, as Community Telavi Municipality joined the new Covenant of Mayors, which considers reduction of the GHG emissions by 40% and adaptation to climate change by 2030.

Long-Run Strategy 2015-2030

The strategy considers the following directions:

- Constantly informing local authorities on the trends of energy consumption (in particular this refers to firewood), advantages and prospects of efficient consumption of energy resource and providing sustainable development, as well as, social and economic benefits of this initiative. Constantly informing local personnel on climate change risks and the urgency of developing future plans and mobilizing additional financial sources;
- Training/retraining the Municipality personnel and external human resources to ensure successful implementation and monitoring of the SECAP;
- Provision of Community Telavi Municipality with technical staff which will guarantee the development of energy efficient/low emissions and adaptation projects in Transportation, Buildings, Waste Management, Agriculture, Healthcare and other sectors;
- Preparation of information/education/illustration materials about successful experiences and modern technologies that are recommended for the green development of the Municipalities; Demonstration to the population the advantages of introduction in different sectors (Transportation, Waste Management, Agriculture) energy efficient and adaptation measures and technologies;
- Providing the involvement of private sector in the implementation of the SECAP providing them with information on energy efficient and economically beneficial technologies, as well as, on adaptation measures offering programs on cooperation between public and private sectors.

Awareness Raising and Staff Training Long-Run (2015-2020) Strategy[47] in Community Telavi Municipality

Main Strategic Objectives (2015-2020)	Main Target Groups	Measures to be Implemented	Potential Leading Organization(s)	Outcome	Potential Donors and Partners
Facilitation of the systematic awareness of the Municipality Administration / Managerial Team on the prospects of sustainable development related to sustainable energy and climate change, and its social and economic benefits; Highest possible notification and awareness raising of main target audience (community population, private sector engaged in Transportation, Waste Management and Agriculture Sectors) on modern energy efficient and adaptation technologies; Assisting the population and other stakeholders in getting advantages from this initiative and training appropriate personnel for implementing the Action	• Community Telavi Municipality Administration and the Municipality Assembly • Community Telavi Municipality population • Companies engaged in Transportation, Buildings, Waste Management and Agriculture Sectors		• Community Telavi Municipality Administration • 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 Community Telavi Municipality SECAP is advancing successfully • Community Telavi Municipality continues the same activity after 2030 and enhances it • Community Telavi Municipality population is informed about the initiatives undertaken by the authorities in the frames of this process	• Community Telavi Municipality Administration • 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

[47] For Community Telavi at this stage was developed only short-run up to 2020 Awareness Raising and Communications Strategy as since 2014 Community Telavi became an independent Municipality from City Telavi, and later this strategy will be renewed for longer-run prospect.

Plan and provision of its monitoring.					renewable energy, energy efficiency and sustainable development process.
• **Staff Training (Short-run Target until 2020)**					
Training of technical personnel for Community Telavi Municipality to provide sustainable development (GHG emissions reduction and adaptation to climate change), which will be able to plan and implement the sustainable development processes in Transportation, Buildings, Waste Management and Agriculture Sectors, work with population to raise their awareness and behavior change, as well as, to assist the private companies and non-governmental organizations engaged in the mentioned sectors in preparing and implementation of energy efficient/low emissions and adaptation project proposals	• Technical Experts Group/Sustainable Development Agency under the Administration of Community Telavi Municipality, which will provide service both to the City Hall and the population and private sector in preparing and implementation of specific project proposals on sustainable development in different sectors considered in Action Plan	• Under the support of Community Telavi Municipality Administration the "Sustainable Development Agency/Group" should be set up serving both the Administration and collaborate with the population and private sector in preparing energy efficient projects and offering modern energy efficient technologies, as well as, measures for adaptation to climate change • Elaboration of training program for Technical Group/Agency. The program should include at least the analysis of modern technologies (of both GHG emissions reduction and adaptation to climate change) and barriers to their introduction, as well as the study of advantages of different measures. • Development of manuals for the Technical Group/Agency employees.	• Community Telavi Municipality Administration • Non-governmental Sector • International Donors • Representatives of different countries' private sector, engaged in this sphere.	• The program and manual are developed for training personnel of the City Hall's Technical Group/Agency, which will provide the Municipality with sustainable development projects • The staff is trained and selected in accordance with competition rules. • Technical Group is actively involved in exchange programs and international networks to obtain newest information on present-day technologies and approaches in energy sector as well as, on adaptation technologies. • Technical Group/Agency is actively	• Community Telavi Municipality Administration • EC-LEDS Project • USAID • GIZ • EU • Different projects and programs which work in the direction of enhancing local potential

		• Involvement of Technical Group/Agency employees in exchange programs and various information networks for getting international experience.		collaborating with population, private sector and Municipality in the process of implementation of measures related to GHG emissions reduction and adaptation to climate change	
• **Public Awareness Raising and Dissemination of Information**					
Awareness of the population on the planned and ongoing measures in Transportation, Waste Management, Buildings and Agriculture Sectors Widest possible dissemination of information and awareness raising among the general public on the social and economic advantages which will be achieved in the process of SECAP implementation; Providing the population with consultations about the energy efficient and adaptation measures to be carried out in priority sectors and delivery newest information on technologies available at the market and especially on their introduction, with special	• Community Telavi population • The companies engaged in Transportation, Buildings, Waste management and Agriculture Sectors • Non-governmental sector • And other public associations	• Development of information materials on measures and technologies, which will improve and provide healthy environment for the Municipality population • Preparation of information materials for the population about Community Telavi Municipality (e.g. on its potential in terms of green development and how can the population contribute to these processes). • Preparation of information material for the population on the energy efficient/low emissions development measures undertaken by other cities and municipalities to the CoM and their outcomes, as well as, on adaptation measures	• Community Telavi Municipality Administration • Non-governmental sector	• The TV trailers and programs are prepared for local TV channel • Updating of information for the population of Community Telavi Municipality is performed at the Municipality web-site ((http://telavi-temi.ge/) and on Facebook page • Inforamtion booklets are developed on the preferences of energy efficiency measures and their application. • Inforamtion booklets are developed	• Community Telavi Municipality Administration • USAID • GIZ • EU

accent on the world over best practice in this field.		• Systematic meetings with population • Involving the population in the process of pilot projects development and implementation		on the risk reduction in case of implementation of adaptation measures. • Several pilot projects are implemented, providing maximal involvement of population.	
• **Systematically Informing Community Telavi Municipality and the Assembly Representatives**					
Provision of informing local authorities on the advantages and prospects of low emissions/green development by the Municipality, on the social and economic benefits of this initiative, on reduction of risks caused due to climate change.	• Community Telavi Municipality Administration • Community Telavi Municipality Assembly	• Holding awareness raising workshops for Administration and City Assembly representatives on the advantages and prospects of the measures planned to be implemented by the Municipality in the spheres of Transportation, Buildings, Waste Management and Agriculture. • Encouranging participation of Administration 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 (in case such center is established) • Ministry of Energy of Georgia • Ministry of Environment and Natural Resources Protection of Georgia	• 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. • Representatives of City Hall and City Assembly are fully involved in processes	• EC-LEDS • USAID • EU-COM • GIZ • Partnership for mitigation • GHG emissions reduction projects • Georgia's National Communications on Climate Change

				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/Facebook page.	
1. Involvement of Private Sector in Achieving the SECAP Goals					
Strengthening of private sector involvement in the SECAP implementation by providing information on energy-saving and beneficial technologies, as well as, adaptation technologies, offering programs on cooperation between public and private sectors.	• Private Sector (at this stage engaged in Transportation, Buildings, Waste Management, and Agriculture Sectors) • Initiative groups of private sector	• Taking an interest of private sector using different stimulating mechanisms in the application of innovative 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.	• Community Telavi Municipality Administration • 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	Community Telavi Municipality Administration Private Sector EU COM GEF UNFCCC Programs

				created for the private sector; • Initiative groups are organized in different sectors, being the main connecting ring between the state and private sectors; • Representatives of private sector are incorporated in international processes, associations and professional networks.	
5. Identification of Barriers by Consulting with Stakeholders					
Identification of barriers via consultations with stakeholders, which may arise in the process of introducing restrictive measures and different types of standards which presumably will be the main direction of the long-term strategy	• Community Telavi Municipality Administration • Community Telavi Municipality Assembly • Community Telavi Municipality population • Private Sector operating in Community Telavi Municipality (Transportation, Buildings, Waste	• Identification of barriers in the process of consultations with the population on the developed standards and restrictive measures for the long-term SECAP sectors; • Working out of measures to overcome the determined barriers by consulting with different target groups	• Community Telavi Municipality Administration • Community Telavi Municipality Assembly	• Groups are identified (private sector initiative group, non-governmental sector, mass-media) to carry out consultations; • For each sector, discussed in the SECAP, barriers are identified; • In cooperation with target groups the measures to overcome the barriers are revealed.	• Communit y Telavi Municipality Administration

	Management, and Agriculture Sectors) • Non-governmental sector				

The Implementation Structure

- This strategy, as a constituent part of the Development Action Plan, is approved and its implementation is monitored by the Community Telavi Municipality Assembly;
- The responsible body on revising and implementation of the Strategy is the Community Telavi Municipality Administration;
- The responsible body for training local staff, necessary to execute the Strategy and monitor its implementation will be the "Technical Group/Sustainable Development Agency" under the Administration. Community Telavi Municipality Administration does not exclude setting up such an agency. However, at this stage, no concrete steps are made in this respect.
- The development of awareness raising and information dissemination materials at the initial stage mainly should be conducted using the outside resources (non-governmental sector).

10 Plan for the Monitoring, Verification and Reporting on the Implementation of SECAP and GHG Emissions Reduction in Self-Governing Community Telavi Municipality

The plan to carry out monitoring measures on the implementation of Self-Governing Community Telavi Municipality SECAP and the reduction of GHG emissions, the way local government reforms are carried out are of significant importance. These reforms must ensure high quality of municipalities' independence. Important factor for that is strengthening local potential in all directions including monitoring of the processes. Interior structures of municipalities have lack of adequate hunam capacity (especially senior managers who own information about the trends of their development of the sector) at this stage. During preparation of this monitoring plan the municipality had a coordinator of CoM process (one person) who (together with other tasks and responsibilities) has created temporary working group that took part in preparation of the SECAP document. Strengthening existing capacity and bringing additional resources will be needed for implementing SECAP and ensuring stability of monitoring. In this process it is very important how effective will be a mobilization, an increase and distribution of local financial and human resources. Lack (often even missing) of needed resources and adequate technical skills and knowledge is one of the biggest barrier for municipalities during preparation and implementation of SECAPs.

That is why, in this transitional phase, the monitoring plan can include several options, however a distribution of functions and clear separation of duties and responsibilities between internal structural units of the municipality and external resources will be the most effective. This option means combined use of internal and external resources for monitoring.

Creating the action plan showed that one of the most important problems of the Self-Governing Community Telavi Municipality 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. It must be said that this information was not needed in the past because municipalities were not self-governing units. Sometimes the database needs

additional processing, which can only be done by the owners of the source of the data because there is always additional commercial information that could be confidential. The Self-Governing Community Telavi Municipality became independent only in 2014. Before that the Telavi Municipality consisted of the Self-Governing Community Telavi Municipality and the city of Telavi before, so disaggregated statistics are available only after 2014.

2014 has been chosen as a base year for the action plan and reduction of GHG emissions of the Self-Governing Community Telavi Municipality camparable with the same components of other municipalities and self-governing cities. 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 both, SECAP implementation and monitoring. To reduce the risks from a lack of data, the "Monitoring" section of the Self-Governing Community Telavi Municipality SECAP offers a performance methodology that seeks to compensate for these gaps. One measure is to create a data register for monitoring baseline scenarios that is updated regularly with systematic information from the Self-Governing Community Telavi Municipality SECAP monitoring group. 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 of the Municipality 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.

Simple software Muni EIPMP for municipalities has been prepared by Sustainable Development Centre – Remissia under the project "Enhancing Capacity for Low Emission Development Strategies/Clean Energy Program". This software allows municipalities to calculate BAU scenario of energy consumption and reduction potential or reduced GHG emissions, in case of appropriate statistical data. Signatory municipalities of the CoM and self-governing cities including representatives of the Self-Governing Community Telavi Municipality Municipality are systematically trained for using the Muni EIPMP.

During preparation of the monitoring periodic reports for implementation of the action plan, that is obligatory due to terms of the CoM, it is possible to include invited expert(s) in monitoring process, at least during preparation of the first obligatory report.

Main activities included in the Monitoring and Reporting process of Self-Governing Community Telavi Municipality 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 Self-Governing Community Telavi Municipality is responsible for obtaining statistical information about main parameters (GDP, population, per capita income, share of economic activities/economic sectors in GDP, etc.) of municipality development processes. To calculate the baseline scenario, external technical assistance could be approved by the municipality to 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 Municipality under the LEDS. Emissions factors will also be aligned with the responsible authority of the UN Framework Convention on Climate Change in Georgia.

2. Implementing Unit 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 Municipality is responsible for a final report that must be approved by the Municipality Council, after which it will be submitted to the EU.

The Report includes elements of monitoring process, general parameters that have to be monitored during the SECAP implementation, 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.

10.1 Responsible unit for the monitoring in Self-Governing Community Telavi Municipality

In Self-Governing Community Telavi Municipality the overall responsibility on the CoM and the development and implementation of the SECAP, its systematic update according to new circumstances and development plans currently falls to specially appointed Coordinator and the Municipality Department of Architecture and Construction. They will also be responsible for monitoring, analysis of its results and foreseeing of these results in renewed process of action plan, verification of monitoring data and preparation of the final report of monitoring that will be approved by the Self-Governing Community Telavi Municipality Council before presenting it in EU.

The Coordinator and relevant divisions of the Department of Architecture and Construction will also 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 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 six main sectors considered within the Sustainable Energy Action Plan of Self-Governing Community Telavi Municipality municipality: Buildings sector, Transport sector, Street lighting sector, Waste, Agriculture and increasing emission sinks by green area development. In order to evaluate each sector's baseline scenario, information on activity data is necessary. This data is given below. Each implemented project and measure must be monitored for its quantitative emissions reduction value and its total emissions savings compared to the baseline scenario. The amount of final emission reductions can then be analyzed.

So, at this stage, Self-Governing Community Telavi Municipality considers two options for monitoring and collecting data: collect and provide statistical data by different department os the municipality or create a new structure that will be responsible for providing statistical data.

Figure below demonstrates departments of the municipality and LTD[48]s that were taking part in creation of SECAP and presumably will be responsible for gathering data for monitoring as well:

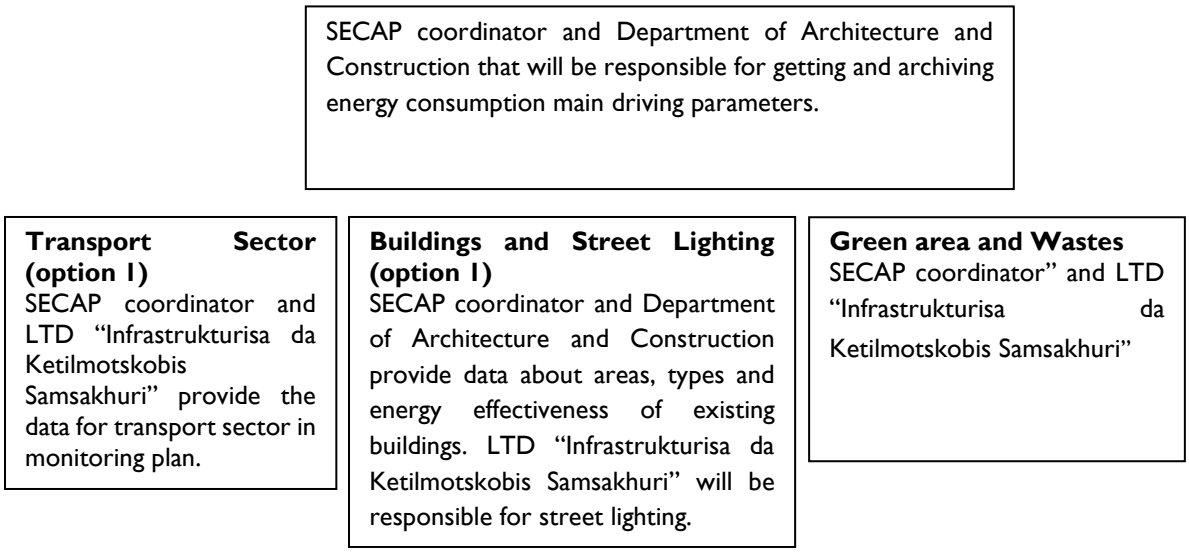

Fig. 14. Monitoring Process Management

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 emission savings for a given period;
- Main parameters of the baseline scenario (for example, in the transport sector: population, GDP, income growth and passenger-kilometers per transport types);
- Economic and social effects of the measures taken.

In addition to these types of data other parameters can be considered for the monitoring process, taken from primary and secondary data. Primary data is gathered from different sources by responsible group. Secondary data is based on primary data and then automatically calculated with muni_EIPMP software.

An approved special technical group and energy manager will be responsible for annual reporting. These will be compiled every two years and submitted to an independent third party for verification. 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.

[48] Unit of Public Services and Amenities and Infrastructure

10.2 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 Self-Governing Community Telavi Municipality SECAP. On the basis of these parameters and their 2014 values in the Self-Governing Community Telavi Municipality energy consumption development scenario (BAU) has been developed for 2020. In comments it is explained how to update these parameters for the compilation of SECAP Monitoring Report.

Data/Parameter # 10.2.1	**Population through the monitoring year**
Data unit:	Number of population
Description:	Primary data; Annual monitoring.
Source of data used:	Annual statistics (www.Geostat.ge) and local statistics
Value applied in SECAP:	**51 700 (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 SECAP 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 # # 10.2.2	**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.
Value applied in SECAP:	This value has not been used in SECAP but must be observed for monitoring. GDP is not calculated concretely for Self-Governing Community Telavi Municipality, but average growth of GDP in the Kakheti region is 14% in 2011-2014.
Any comments	National Statistics Office publishes information only about annual GDP of the Region. In this case, using the 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 Self-Governing community Telavi municipality. 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 # 10.2.3	**Grid emission factor CO_2** t/MWh
Data unit:	t**CO_2**/MWh
Description:	Primary data. Calculated at the national level and provided to municipalities
Source of data used:	Calculated especially for SECAP, 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 (this is grid emission factor in 2014)
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 SECAPs. During SECAP preparation the used grid emissions factor has been calculated by averaging, since Self-Governing Community Telavi Municipality municipality does not produce electricity independently but receives it from the centralized energy system of Georgia.

Data/Parameter # 10.2.4	**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 # 10.2.5	**Gasoline**
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 # 10.2.6	**Diesel**
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 # 10.2.7	**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 SECAP, provided by the IPCC
Value applied:	Gasoline 44.80 TJ/1000 t Natural gas 33.59 TJ/million m^3 Liquefied Petroleum Gases (LPG) 47.34/1000 t Diesel 43.33 TJ/1000 t Firewood 7.50 TJ/thousand m^3 Coal 14.65 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.

10.3 Transport Sector

Public Transport (buses, planned until 2020)

Data/Parameter # 10.3.1.1	**Number of municipal buses**
Data unit:	Number of minibuses through the monitoring period (annual value)
Description:	Primary data.
Source of data used:	Self-Governing Community Telavi Municipality Transport Company
Value used in SECAP	O buses in 2014 2 municipal buses are planned until 2020
Any comments	Responsible for this information are Department of Construction and Architecture of the Self-Governing Community Telavi Municipality and LTD " Infrastrukturisa da Ketilmotskobis Samsakhuri". Municipality must verify these data in comparison with used fuel costs that must be requested from financial department.

Data/Parameter # 10.3.1.2	**Average distance traveled annually by one bus according to fuel type (gasoline, diesel, NG)**

Data unit:	Km/yr
Description:	Primary data.
Source of data used:	LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri" of the Self-Governing Community Telavi Municipality. Provided to SECAP by Self-Governing Community Telavi Municipality
Value applied in SECAP:	2014 – 0 km/yr 2020 – 87 600 km and 65 700 are planned
Any comments	This data is preferred to be gathered according to daily covered distance. Planned distances in the Self-Governing Community Telavi Municipality are Akura-Shalauri (240 km) and Ikalto-Vardisubani (344 km) zones. Information provider must be LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri". Final information must be checked by monitoring group of Self-Governing Community Telavi Municipality for SECAP. Municipality must verify these data comparing it with used fuel costs that must be requested from financial department. Alternative way would be getting annual value from LTD[49] "Infrastruktura" but its verification will be more difficult than verifying monthly data by random choosing.

Data/Parameter # 10.3.1.3	**Total average distance traveled by all buses annually according to fuel type (gasoline, diesel, NG)**
Data unit:	Km/yr
Description:	Secondary data, calculated by 10.3.1.3=10.3.1.2*10.3.1.1
Source of data used:	Calculated by monitoring and SECAP groups
Value applied:	**2014 – 0 km/yr** **2020 – 153 300 km/yr (planned)**
Any comments	Municipality must verify these data during monitoring process, comparing it with used fuel costs that must be requested from financial department.

Data/Parameter # 10.3.1.4	**Average consumption of fuel (diesel) by 1 bus per 100**
Data unit:	L/100 Km
Description:	Primary data.
Source of data used:	Self-Governing Community Telavi Municipality Transport Department
Value applied:	**2014 - 0**

[49] Infrastruktura means Infrastructure

	2020 - 30 l/100 km (planned)
Any comments	This data must be checked with bus technical passport and must be explained in case of big difference.

Data/Parameter # 10.3.1.5	**Annual amount of used fuel by all city buses**
Data unit:	L/yr
Description:	Secondary data[50], calculated
Source of data used:	Must be calculated by SECAP group
Value applied:	**2014 – 0** **2020 - 45 990 l/yr = 481.82 MWh = 127.42 t CO_{2eq}**
Any comments	This data is calculated so: 10.3.1.5.= 10.3.1.3*10.3.1.4 / 100 It can be calculated by parameter 10.2.1.3 and fuel cost on 100 Km if fuel types and buses are similar. This data must be checked by Economic Development and Property Departments and monitoring group by using financial costs used on fuel.

Data/Parameter # 10.3.1.6	**Passenger turnover per year (quantity of passengers carried by all buses per year)**
Data unit:	Passenger/yr
Description:	Secondary data. Calculated by the Department of Architecture and Construction of Self-Governing Community Telavi Municipality according to daily passenger turnover.
Source of data used:	Provided to SECAP by the Department of Architecture and Construction of Self-Governing Community Telavi Municipality.
Value applied:	**2014 – 0**
Any comments	City bus company calculates by sold tickets that can be checked with data of financial department by economic development group.

Public transport (private microbuses that do not have contact with the municipality)

Data/Parameter # 10.3.2.1	**Number of private microbuses (by fuel type)**

[50] Secondary data is data that is calculated by monitoring holder

Data unit:	Number of cars through period of monitoring (annual number)
Description:	Primary dada
Source of data used:	Provided to SECAP by Self-Governing Community Telavi Municipality. Information had been delivered to the city hall by LTD[51] "Telavis Akhali Avtosadguri" and LTD [52]"Dzveli Avtosadguri".
Value applied:	**2014:** **Total 51** **Gasoline – 21** **Diesel – 16** **Natural Gas - 14**
Any comments	51 local and 44 transit microbuses were on the territory of the municipality in 2014. Total daily run is 384 km. Local microbuses are property of LTD "Telavis Akhali Avtosadguri" and LTD "Dzveli Avtosadguri".

Data/Parameter # 10.3.2.2	**Average annual distance traveled/run by one microbus (by fuel type is recommended)**
Data unit:	km/yr
Description:	Primary data.
Source of data used:	Provided to SECAP by LTD "Telavis Akhali Avtosadguri" and LTD "Dzveli Avtosadguri".
Value applied:	As of 2014, average annual run of 1 microbus on the territory of the municipality is 21 600 km (62 km daily).
Any comments	LTDs "Telavis Akhali Avtosadguri" and "Dzveli Avtosadguri" are private enterpreneurs and do not have any contract with the municipality about passengers.

Data/Parameter # 10.3.2.3	**Average distance traveled by all microbuses per year (by fuel types)**
Data unit:	km/yr
Description:	Description:
Source of data used:	Source of data used:
Value applied:	**2014:** **Total distance covered – 1 101 600** **Gasoline – 453 000** **Diesel - 345 600** **Natural Gas – 302 400**

[51] "Telavis Akhali Avtosadguri" means New Auto Station of Telavi

[52] "Dzveli Avtosadguri" means Old Auto Station

Any comments	All these microbuses belong to LTDs "Telavis Akhali Avtosadguri" and "Dzveli Avtosadguri". 30 cars go outside the territory of the municipality but 10 of them run twice per day. That is why we have got 40 runs.

Data/Parameter # 10.3.2.4	**Data/Parameter # 10.3.2.4**
Data unit:	Data unit:
Description:	Description:
Source of data used:	Provided to SECAP by LTD "Telavis Akhali Avtosadguri" and LTD "Dzveli Avtosadguri".
Value applied:	**12 l/100 km (Gasoline)** **10 l/100 km (Dieseli)** **12 m^3/100 km (Natural Gas)**
Any comments	Logically, this data must be verified with microbus technical passport and must be explained in case of big difference. These microbuses are secondary, customized many times, move on a bad roads and that difference may be logical.

Data/Parameter # 10.3.2.5	**Fuel annual consumption by all microbuses 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. Number of Diesel powered microbuses multiplied by fuel consumption per 100 km, multiplied by one microbus annual run and divided by 100. 10.3.2.5.= 10.3.2.1. * 10.3.2.2. * 10.3.2.4/100
Value applied:	**2014:** **Gasoline -54 432 l = 501.58 MWh = 125.05 t $CO_{2\ eq.}$** **Diesel - 34 560 l = 362.07 MWh = 95.75 t $CO_{2\ eq.}$** **Natural Gas - 36 288 m^3 = 344.71 MWh = 69.51 t $CO_{2\ eq.}$**
Any comments	This data is calculated by the Monitoring Group

Data/Parameter # 10.3.2.6	**Microbus annual passenger turnover (mobility)**
Data unit:	Passenger/yr
Description:	Secondary data. In case of Self-Governing Community Telavi Municipality is calculated by LTD "Telavis Akhali Avtosadguri" and LTD "Dzveli Avtosadguri".

	In 2014 suburban microbuses (20 microbuses) ferried 620 passengers per day and 226 300 annually. 11 microbuses outside the territory of the unicipality ferried 70 passengers per day and 25 550 annually.
Source of data used:	Primary data are provided to SECAP by LTD "Telavis Akhali Avtosadguri" and LTD "Dzveli Avtosadguri".
Value applied:	**2014 -226 300+25500=98 550**
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. Its verification is possible by local government because this LTD is accountable with financial parameters.

Private cars (light-duty)

Data/Parameter # 10.3.3.1	**Amount of cars registered in the municipality**
Data unit:	Number of vehicles
Description:	Primary data.
Source of data used:	Service Agency of MIA of Georgia. Data has been verified by SECAP group of the municipality
	2014: **Total – 10 046** **Gasoline – 4 325;** **Diesel – 860;** **Natural Gas - 4 861.**

Data/Parameter # 10.3.3.2	**Average distance traveled by one vehicle a year (by fuel types)**
Data unit:	km/yr
Description:	Primary data.
Source of data used:	Rated by survey of private cars that has been held by SECAP group of the municipality
Value applied:	**14 400 km/yr**
Any comments	In the future, in the monitoring process, interviews with car owners/drivers may be used. It may allow calculate average daily run and then annual run. Results of survey must satisfy criteria of statistical reliability. Interviews and surveys for calculating daily run (even annual is possible) must be held periodically together with implementation of SECAP.

Data/Parameter # 10.3.3.3	**Average distance travelled by all private cars annually (by fuel types)**
Data unit:	km/yr
Description:	Calculated data.
Source of data used:	Calculated by the MUNI-EIPMP. Data # 10.3.3.1 and 10.3.3.2
Value applied:	**Total - 144 662 400** **62 280 000 km (Gasoline)** **12 384 000 km (Diesel)** **69 998 400 km (Natural Gas)**
Any comments	Annual distance covered by 1 vehicle multiplied by amount of vehicles.

Data/Parameter # 10.3.3.4	**Fuel consumption per 100 km by fuel types**
Data unit:	l/100 km m^3/100 km Kwh/100 km
Description:	Primary data.
Source of data used:	Basically this parameter is taken from technical passport. It was provided for this SECAP by local government of Self-Governing Community Telavi Municipality. SECAP group has held drivers' survey.
Value applied:	**Gasoline -9.5 l/100 km** **Diesel -10 l/100 km** **Natutal Gas -9 m^3/100 km**
Any comments	Logically, this data must be verified with technical passport of private cars (by vehicle types) and must me explained in case of big difference. Big part of private cars use bad roads and that may be a reason for primary consumption specified by technical passport.

Data/Parameter # 10.3.3.5	**Annual fuel consumption of private cars by fuel types**
Data unit:	l/ yr
Description:	Secondary data. Must be calculated by the Monitoring Group
Source of data used:	Calculated with MUNI-EIPMP. 10.3.3.5 = 10.3.3.1. * 10.3.3.2. * 10.3.3.4/100 Amount of cars on Gasoline multiplied by fuel cost on 100 km and multiplied by annual covered distance by 1 car and divided by 100.
Value applied:	**2014:**

	Gasoline - 5 916 600 l=54 520.25 MWh = 13 592.09 t CO_2 **Diesel - 1 238 400 l =12 974.27 MWh = 3 431.22 t CO_2** **Natural Gas - 6 299 856 l =59 843.92 MWh = 12 068.09 t CO_2**
Any comments	This data is calculated by the Monitoring Group and must be verified with sold fuel but quite important difference is possible. On this stage, it is calculated by Remissia that helped municipality in technical aspects of SECAP.

Data/Parameter # 10.3.3.6	**Amount of passengers carried by all light-duty cars annually**
Data unit:	passenger/ yr
Description:	Secondary data. Must be calculated by load factor
Source of data used:	This parameter was not rated during preparing Self-Governing Communityy Telavi Municipality SECAP
Value applied:	Not rated
Any comments	Amount of cars multiplied by annual covered distance and multiplied average load factor of 1 car

Data/Parameter # 10.3.3.7	**Load factor of transport type**
Data unit:	Passenger.km/ trans.km
Description:	This parameter must be rated different statistical methods and surveys. SISTRA surveys for Tbilisi was used in this SECAP
Source of data used:	This parameter was not rated during preparing Self-Governing Community Telavi Municipality Municipality SECAP
Value applied:	1.85
Any comments	This parameter is used only for rating GHG emissions reduced by taken measures in sector. GHG emissions from transport sector are not dependent on it.

Car pool owned by the Municipality

Data/Parameter # 10.3.4.1	**Number of vehicles by fuel type**
Data unit:	Number of vehicles
Description:	Primary data.
Source of data used:	Provided to the SECAP by Self-Governing Community Telavi Municipality municipality local government
Value applied:	**Total - 32** **Gasoline - 16;** **Diesel - 8;**

	Natural Gas -8.
Any comments	Responsible for this data are Department of Construction and Architecture of the municipality and LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri"

Data/Parameter # 10.3.4.2	**Average distance traveled by one vehicle annually (by fuel and vehicle type)**
Data unit:	Km/yr
Description:	Primary data.
Source of data used:	Responsible for this data are Department of Construction and Architecture of the municipality and LTD " Infrastrukturisa da Ketilmotskobis Samsakhuri "
Value applied:	**18 000 km/yr**
Any comments	

Data/Parameter # 10.3.4.3	**Average distance covered by vehicles annually**
Data unit:	Trans. km/yr
Description:	Calculated data.
Source of data used:	Calculated by the MUNI-EIPMP. Data # 10.3.4.1 and 10.3.4.2
Value applied:	**2014:** **Total -576 000** **Gasoline -288 000 km** **Diesel - 144 000 km** **Natural Gas - 144 000 km**
Any comments	Must be verified with comparing used fuel to covered distance

Data/Parameter # 10.3.4.4	**Fuel consumption on 100 km by fuel and vehicle types**
Data unit:	l/ 100 km
Description:	Primary data.
Source of data used:	Provided to the SECAP by Economic Development and Property Ruling departments of the Self-Governing Community Telavi Municipality municipality
Value applied:	Gasoline - 10 l

	Diesel - 10 l Natural Gas - 9m^3
Any comments	Responsible for this data are Department of Construction and Architecture of the municipality and LTD " Infrastrukturisa da Ketilmotskobis Samsakhuri ". May be verified with passport data of transport type.

Data/Parameter # 10.3.4.5	**Annual fuel consumption of all auto park by fuel types**
Data unit:	l/yr m^3/yr
Description:	Secondary data. Calculated by the Monitoring Group. On this stage, calculated by Remissia.
Source of data used:	Computed by MUNI-EIPMP. 10.3.4.5=10.3.4.1.*10.3.4.2.*10.3.4.4./100
Value applied:	**2014:** **Gasoline- 28 800 l = 265.39 MWh = 66.16 t CO_2** **Diesel- 14 400 l = 150.86 MWh = 39.90 t CO2** **Natural Gas 12 960 l = 123.11 MWh = 24.83 t CO2**
Any comments	Must be verified by cost of used fuel

Commercial transport (taxi)

Data/Parameter # 10.3.5.1	**Amount of taxis in Self-Governing Community Telavi Municipality Municipality by fuel types**
Data unit:	Amount of taxis by fuel types
Description:	Primary data
Source of data used:	Responsible for this data are Department of Construction and Architecture of the municipality and LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri".
Value applied:	**Total - 312** **Gasoline - 71;** **Diesel -69;** **Natural Gas -172;**
Any comments	Responsible for this data are Department of Construction and Architecture of the municipality and LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri". This number must be verified during the monitoring process.

Data/Parameter # 10.3.5.2	**Average distance covered by single taxi annually by fuel types**
Data unit:	Km/yr
Description:	Primary data
Source of data used:	Responsible for this data are Department of Construction and Architecture of the municipality and LTD "Infrastrukturisa da Ketilmotskobis Samsakhuri".
Value applied:	16 200 km
Any comments	Getting this data from Revenue Service and Taxi Union is possible for officially registered taxis, but there are no any officially registered taxi companies in the municipality. On this stage, taxi drivers' survey would be the most effective.

Data/Parameter # 10.3.5.3	**Average distance covered by all taxis annually by fuel types**
Data unit:	Trans.Km/yr
Description:	Calculated data
Source of data used:	Calculated by the MUNI-EIPMP. Data # 10.3.5.1 and 10.3.5.2
Value applied:	**Total - 5 054 400** **Gasolime - 1 150 200** **Diesel - 1 117 800** **Natural Gas - 2 786 400**
Any comments	**On this stage, it is calculated by Remissia. Will be calculated by the monitoring group in the future.**

Data/Parameter # 10.3.5.4	**Fuel consumption by transport types**
Data unit:	l/100 km m^3/100 km
Description:	Primary data
Source of data used:	Provided to SECAP by SECAP group of local government
Value applied	Gasoline 10 l/100 km Diesel 8 l/100 km Natural Gas 10 m^3/100km
Any comments	Technical passport could be used for verifying but most of the taxis are secondary and their real consumption is different from technical passport data

Data/Parameter # 10.3.5.5	**Fuel consumption by taxis annually by fuel types**
Data unit:	l/ km m^3/ yr
Description:	Secondary data
Source of data used:	Calculated by the MUNI-EIPMP. Data # 10.3.5.5 = 10.3.5.1. *10.3.5.2. * 10.3.5.4/100
Value applied:	2014: Gasoline -115 020 l = 1 059.89 MWh = 264.23 CO_{2eq} Diesel - 89 424 l = 936.86 MWh = 247.77 CO_{2eq} Natural Gas - 278 640 l = 2 646.87 MWh = 533.77 CO_{2eq}
Any comments	On this stage, it is calculated by Remissia. Will be calculated by the monitoring group in the future

Data/Parameter # 10.3.5.6	**Amount of passengers ferried by all taxis annually**
Data unit:	passenger/ yr
Description:	Secondary parameter
Source of data used:	Monitoring group is responsible for calculation
Value applied:	Has not been rated
Any comments	

Data/Parameter # 10.3.5.7	**Load factor of taxis with passengers**
Data unit:	Passenger.km/trans.km
Description:	This parameter must be rated with different surveys and statistical methods
Source of data used:	Has not been rated for the municipality SECAP but the same factor has been used as for motor cars.
Value applied:	1.85
Any comments	This parameter is used only for rating GHG emissions reduced by taken measures in sector. GHG emissions from transport sector are not dependent on it.

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

Data/Parameter # 10.3.6.1	**Light-duty trucks driving inside Self-Governing Community Telavi Municipality Municipality by fuel types**
Data unit:	Number of light-duty trucks by fuel type
Description:	Primary data

Source of data used:	Provided to SECAP by SECAP group of the municipality Local Government. Service Agency of MIA of Georgia and private carrier companies are also used as a source.
Value applied:	Total - 1 199 Gasoline - 152; Diesel - 758; Natural Gas-289.
Any comments	Responsible for the initial verification of these data is the local government Monitoring Group.

Data/Parameter # 10.3.6.2	**Average distance traveled by one light-duty truck a year (by fuel type is recommended)**
Data unit:	km/yr
Description:	Primary data
Source of data used:	Provided for the SECAP by SECAP group of Municipality Local Government. Information is received from the surveys of private companies and drivers.
Value applied:	9 000 km
Any comments	Responsible for the initial verification of these data is the local government Monitoring Group.

Data/Parameter # 10.3.6.3	**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 # 10.3.6.1 and 10.3.6.2
Value applied:	T otal - 10 791 000 km Gasoline - 1 368 000 km Diesel - 6 822 000 km Natural Gas - 2 601 000 km
Any comments	

Data/Parameter # 10.3.6.4	**Fuel consumption by light-duty trucks according to vehicle types**
Data unit:	l/ 100 km

	m^3/ 100 km
Description:	Primary data
Source of data used:	Provided for the SECAP by SECAP group of Municipality Local Government. Information is received from the survey of private companies.
Value applied:	**Gasoline -12 l/100km** **Diesel- 10 l/100km** **Natural Gas -12 m^3/100km**
Any comments	This data should be verified with vehicle technical passport and in case of significant discrepancy must be explained.

Data/Parameter # 10.3.6.5	**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" 10.3.6.5=10.3.6.1*10.3.6.2*10.3.6.4/100
Value applied:	2014: Gasoline - 164 160 l = 1 512.7 MWh = 377.12 tCO2 Diesel - 682 200 l = 7 147.16 MWh = 1 890.16 t CO2 Natural Gas - 312 120 l = 2 964.91 MWh = 597.9 t CO2
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 # 10.3.6.6	**Light-duty trucks load factor**
Data unit:	Ton. Km/trans.km
Description:	This parameter should be evaluated by statistical methods and surveys.
Source of data used:	While developing the municipality SECAP this parameter was not assessed.
Value applied:	Not estimated.
Any comments	Essential in calculations of measures taken

Data/Parameter # 10.3.6.7	**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".

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 # 10.3.7.1	**Number of heavy duty trucks operating in the municipality**
Data unit:	Number of heavy-duty trucks by fuel type
Description:	Primary data.
Source of data used:	Provided to SECAP by SECAP group of municipality Local Government; Service Agency of MIA of Georgia
Value applied:	**2014:** **Total - 799** **Gasoline - 71;** **Diesel - 533;** **Natural Gas - 185.**
Any comments	Responsible for initial verification of this data will be the Monitoring Group of the local government.

Data/Parameter # 10.3.7.2	**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 SECAP by SECAP group of municipality Local Government; Survey
Value applied:	16 200 km/yr
Any comments	Responsible for initial verification of this data will be the Monitoring Group of the local government.

Data/Parameter # 10.3.7.3	**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 # 10.3.7.1 and 10.3.7.2
Value applied:	Total in 2014 -12 943 800 km/yr

	Gasoline - 1 150 200 km/yr Diesel - 8 634 600 km/yr Natural Gas - 2 997 000 km/yr
Any comments	

Data/Parameter # 10.3.7.4	**Fuel consumption by vehicle type**
Data unit:	l/ 100 km m^3/ 100 km
Description:	Primary data.
Source of data used:	Technical passport of the vehicle. Provided to the SECAP to SECAP group of municipality Local Government. Source – survey of private companies
Value applied:	Gasoline - 30 l/100 km Diesel - 25 l/100 km Natural Gas - 30 m^3/100 km
Any comments	

Data/Parameter # 10.3.7.5	**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:	**2014:** **Gasoline - 345 060 l = 3 179.66 MWh = 792.7 t CO2** **Diesel - 2 158 650 l = 22 615.4 MWh = 5 980.94 t CO2** **Natural Gas - 899 100 l = 8 540.78 MWh = 1 722.33 t CO2**
Any comments	

Data/Parameter # 10.3.7.6	**Heavy-duty trucks load factor**
Data unit:	Ton. Km/car. km
Description:	Primary data.
Source of data used:	While developing the SECAP 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 # 10.3.7.7	**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"
Value applied:	Not assessed
Any comments	These parameters could be verified via actual annually transported freight and relevant total run of trucks.

Data/Parameter # 10.3.7.8	**Total amount of fuel consumed in Self-Governing Community Telavi Municipality Transport sector by fuel types**
Data unit:	l/yr (Mwh) m^3/yr (Mwh)
Description:	Secondary data calculated during the monitoring and SECAP development process
Source of data used:	Forecast of emissions for 2020 and 2030 is calculated by SECAP group (Remissia) and is based on forecasts of MARKAL Georgia.
Value applied:	2014: Fuel in total -180 394 MWh = 42 102.35 t CO_{2eq} Forecast for 2020: Total emissions - 59 337.35 t CO_{2eq} Forecast for 2030: Total emissions - 88 818.65 t CO_{2eq}
Any comments	This is one of the most important data for balance verification during the monitoring process.

Monitoring on planned measures in Self-Governing Community Telavi Municipality Transport sector

Measure #PT1	**Improvement of Self-Governing Community Telavi Municipality public transport (buses)**
Implementation date	**2016-2017**
Description	Department of Construction and Architecture of the Self-Governing Community Telavi Municipality plans to set comfortable transport on the

	territory of the municipality for 2016-2017 together with LTD "Ketilmotskoba and infrastruktura" that will replace private microbuses and will be more available for the population. On this stage, 14 microbuses work in Shalauri – Akuri zone that cover 340 180 km annually and carry 155 490 passengers. There are also 6 microbuses in Vardisubani – Ikalto zone that cover 125 560 km annually and carry 70 810 passengers. Municipality plans to buy two comfortable buses on Diesel that consume 25 l diesel per 100 km and that will replace those abovementioned 20 microbuses • One bus with 80 seats that will replace Shalauri-Akuri microbuses. This bus will cover 87 600 km annually that is 331 400 km less and will be able to carry 175 200 passengers (difference will be 19 710). • One bus with 50 seats will replace Vardisubani-Ikalto microbuses. It will cover 65 700 km annually (59 860 less than existing) and will carry 109 500 passengers (38 690 more). In a long-term perspective (until 2030) municipality plans to replace these new buses with electric buses. One electric bus consumes 100-150 KWh electricity per 100 km.
Indicators that must be monitored	• Number of passengers carried per day • Average distance covered by passengers per day • Fuel consumption by buses per 100 km
Amount of reduced emissions reached in the period of monitoring	This activity will lead to emissions reduction: Emission from microbuses un Akura-Shalauri zone is: 94.68 t CO2 eq in total; 32.82 t CO2 eq on Gasoline; 47.13 t CO2 eq on Diesel; 11.73 t CO2 eq on Natural Gas. Emission from microbuses un Ikalto-Vardisuvbani zone is: 32.6 t CO2 eq in total; 22.5 t CO2 eq on Gasoline; 10.10 t CO2 eq on Natural Gas. Beside this, this activity will reduce emission from taxis that work in addition to microbuses but new buses will be able to carry their passengers, too. Carrying 58 400 more passengers will be able with new buses in total annually. Load factor on 1 taxi is 1.8, so approximately 32 444 cars (cars mean 1 road here)will be free as a result of this. Existing emission from these taxis 97 t CO_2 eq (calculated on Gasoline). In total we have

	221.28 t CO_2 eq emissions on this stage and it will reduce to 106.19 t CO_2 eq thanks to new buses. Emission savings will reach 115.09 t CO_2 eq for 2020. In case of replacing new buses with electric buses for 2030, as it is planned, emission savings will reach 205.28 t CO_2 eq compared with existing level.
Any comments	115 t CO_2 eq from transport sector is 0.2% of total prejected emission for 2020 and 205 t CO_2 eq is 0.2% of total prejected emission for 2030.
Responsible structure	Department of Construction and Architecture with LTD "Ketilmotskoba and infrastruktura" of the Self-Governing Community Telavi Municipality.

Measure #PT2	**Arrangement of ropeway for Ikalto Academy touristic centre**
Implementation date	**2026-2030**
Description	This measure implies development of touristic infrastructure from "Qvevris Sakhli" to "Ikalto Academy" that will lead to increase touristic flow by 3 times, at least and will reach 1 000 persons per day. Development of touristic infrastructure implies arrangement of pedestrian and bicycle roads, as well as ropeway. Road from "Qvevris Sakhli" to "Ikalto Academy" will be closed for cars for 2030 and motion will be only possible by walking, cycling or ropeway. Bycicle renting places will be set on the place. On this stage, tourists move on this road by cars, microbuses and buses. Length of the road is 1 800 meters and the length of ropeway will be approximately 1 300-1 400 meters. Mostly, tourists visit Ikalto Academy during touristic season from April to November. During this period, this road of 1 800 meters is loaded with at least 2-3 buses with 40 seats, 5-10 microbuses and 20 light-duty cars. In addition to this, 10-15 buses from regions use this road on the weekends. According to this, ropeway will have about 200 passengers per day in week days and twice more on weekends.
Indicators that must be monitored	• Total number of passengers carried by ropeway daily • Amount of electricity (KWh) consumed by ropeway daily (annually) • Average distance that must be covered my single passenger in case of not using ropeway • Main transport (in case of absence of ropeway) and its fuel consumption per 100 km (by fuel types)
Amount of reduced emissions reached in the period of monitoring	Reduction of emissions for 2013 will be 49 t CO_2 eq, correspondingly.

	On the example of Tbilisi ropeway, we know that ropeway consumes 52 KWh electricity per hour when working. If the length of Self-Governing Community Telavi Municipality ropeway is 1 500 meters and its speed reaches 5 m/s on an average, duration of one way will be 1 500/5/60=5 minutes. It means that making 12 trips and 6 in one direction (full) is possible per hour. In case of two gondolas, 12 full trips are possible. Each gondola can carry 10 passengers. According to an approach that passengers will be 3 times more in 2030, we will receive that they must work 8-8.5 per day on an average that is 450 KWh daily = 450*365=159 MWh and 3 042 hours annually that is equal to 16.45 t CO_2 emissions. Now about buses, microbuses and cars: There are 3 buses, 10 microbuses and 20 cars daily that carry about 250 passengers. Each of them runs 2 km to-and-fro. Annual energy consumption is 64 MWh=16.42 t CO_2 emissions. According to this, we can say that energy consumption and emissions will reach 256 MWh and 65.68 t CO_2 emissions, respectively, when calculating for 1 000 persons. So, ropeway can save 49.23 t CO_2 emissions..
Any comments	
Responsible structure	Department of Construction and Architecture of Self-Governing Community Telavi Municipality plans implementation and looking after this project together with LTD "Ketilmotskoba and Infrastruktura". Owner will be chosen according to his/her investments and interests. In case of fund, owner will be a municipal LTD. Identification of costs is impossible in a short-term period because of absence of engineering collections and there is only information about Batumi ropeway with 22 gondolas in the internet that is not suitable for us. Cost of 1 km in Batumi is 8 800 000 GEL.

Measure #UP1	**Road reconstruction**
Implementation date	**2015 – 2025**
Description	Total area of Self-Governing Community Telavi Municipality is 589.5 m^2, in its villages there are 32 central roads and 800 dead ends. 5 streets are transit roads that run through villages and their total length is 55 km. total length of interior roads is 406.1 km, 60% of which are asphalte, but roads of Self-Governing Community Telavi Municipality need total reconstruction. Through the last years there has been an important progress in infrastructural development and asphalting roads. According to the

	Department of Architecture and Construction, 19.1 km of roads were asphalted until 2014 (5 km in 2012, 7.1 km in 2013 and 7 km in 2014) Total amount of emission from all types of Self-Governing Community Telavi Municipality Municipality transport sector is presumably 88 819 t CO_2 for 2030. According to the existing information, 19.1 km road was done with high quality until 2014, that is about 5% of existing interior roads. 40% (162 km) from the rest 95% needs to be asphalted and other 55% (223 km) is already asphalted and needs only full change of absorbed coverture. 95% of road must be fully rehabilitated. So, these emissions can be reduced by at least 6% in case of full rehabilitation of roads for 2030. This approach is quite conservative because it is about replacing asphalted road with concrete road. In Self-Governing Community Telavi Municipality it is exclusively difficult and 40% graveled road must be replaced with asphalted road and 55% absorbed asphalted road needs to be replaced with the high quality road.
Indicators that must be monitored	• Total length of asphalted roads • Reduction of GHG emission from all types of transport • Consumed fuel by single car (by types) per 100 km
Amount of reduced emissions reached in the period of monitoring	As a result of this measure 5 063 t emission will be saved (84 387*0.06)
Any comments	According to different sources this measure is not exact because emission flows even during road construction and reconstruction process. But it must be said that in a long-term perspective emission reduction effect will be higher on loaded roads than emission during road construction and reconstruction.
Responsible structure	LTD "Ketilmotskoba and infrastruktura" of the Self-Governing Community Telavi Municipality.

Measure #UP2	**Transport stream management in Self-Governing Community Telavi Municipality Municipality**
Implementation date	**2025 – 2030**
Description	This measure consists of following measures:

	• Optimization of transport routes for shortening distances. For example, studying loaded roads and finding alternative routes, organizing new roads. Existing roads must be reviewed and changed so that it could lead to reducing traffics • Creating new roads or reconstruction of old ones that will shorten the distance
Indicators that must be monitored	• Tendency of street traffic changes (increase – decrease?) • Fuel used by single car for covering the same distance on traffic and non-traffic time
Amount of reduced emissions reached in the period of monitoring	At this stage, for this measure emission reduction has not been counted because final plan is not known yet and in more long-term perspective after 2025 it will be realized. Revision of this measure and calculation of emission will take place in renewed action plan until 2030.
Any comments	Realization of GHG emissions reduction potential that is connected with road motion management (as well as an improvement of road infrastructure) is hard process with barriers. Reducing traffic will cause reducing of GHG emissions from private cars by their more effective motion. But it does not always reduce emissions because it makes moving by cars more attractive when streets are not overloaded that increases emissions. As a result, this measures and emission reduction connected with them can be discussed as a part of a large-scale transport strategy with documents mentioned with this measure.
Responsible structure	Department of Construction and Architecture of Self-Governing Community Telavi Municipality

Measure #PRT1	**Parking in Self-Governing Community Telavi Municipality City**
Implementation date	**2025 -2030**
Description	On this stage, parking politic of Self-Governing Community Telavi Municipality municipality is planning. The main purpose (especially of the central districts) is to unload it from cars. Most of the parking lots will be located in the central streets, where are more cars. Especially in touristic zones. There are 12 000 cars of different types that consume 180 394 MWh/yr energy and produces 42 102 t CO_2 eq GHG emissions. This measure is

	planned for 2030 and 88 819 t CO_2 eq GHG emission is expected at that time. Based on the literature about measures for reducing emissions in Transport Sector, we can say that every single car reduces distance by 7-10% where there are parking systems. An approach has been made for Self-Governing Community Telavi Municipality that reduction will be 7% and only in case of private cars in the city, that are 80% of total autopark, this correlation will be kept. According to this approach, 80% of emission will be reduced by 7% for 2030.
Indicators that must be monitored	• Amount of parking lots the distance covered by private cars annually (survey). • Distance covered annually by private cars (with surveys) • Share of restricted parking area in city area • Fuel consumption by single car per 100 km
Amount of reduced emissions reached in the period of monitoring	With an approach that emissions from private cars will not be less than 80% in 2030 and with an estimation that this measure will mostly affect on them, emission reduction will be 4 974 t CO_2 eq in 2030.
Any comments	
Responsible structure	Local government of the Self-Governing Community Telavi Municipality

Measure #PRT2	**Helping pedestrians and cyclists in Self-Governing Community Telavi Municipality Municipality**
Implementation date	**2018 – 2025**
Description	For helping pedestrians and cyclists Self-Governing Community Telavi Municipality Municipality Local Government will continue arrangement of pavements, crossings and bicycle roads especially in village centers and touristic zones for more comfortable and safer movement of pedestrians (also for valetdinarians). No specific roads and places are planned or chosen yet.
Indicators that must be monitored	• Length of pedestrian roads in 2025 and 2030; • Increase of pedestrians (surveys before and after the measure)

	• Average distance covered by a single pedestrian before and after measure (survey and researches) • Length of bicycle roads in 2025 and 2030 • Increase of cyclists (surveys before and after the measure) • Average distance covered by a single cyclist before and after measure (survey and researches)
Amount of reduced emissions reached in the period of monitoring	Emission has not been calculated but the City Hall recognizes that this kind of measures is important for the whole process and sustainable development of the city.
Any comments	Programs for changing public behavior are also needed for successful measure. The difference and advantage between cycling/walking and driving must be explained.
Responsible structure	Department of Infrastructural development, Spatial arrangement, Architecture and Construction of Self-Governing Community Telavi Municipality.

10.4 Buildings sector

Baseline Emissions Monitoring

Data/Parameter # 10.4.1	**Areas of municipal buildings according to their purpose (kindergartens, administrative, etc.)**
Data unit:	m^2
Description:	Primary parameter
Source of data used:	SECAP Development Coordinator of Self-Governing Community Telavi Municipality Municipality local government and City Hall Property Ruling Departments.
Value applied:	Total - 27 803 Kindergartens - 12 079 Municipal administrative buildings - 4 960 Other municipal buildings - 10 764
Any comments	Information possessed by the local government

Data/Parameter # 10.4.2	**Annual consumption of electric energy by municipal buildings**
Data unit:	MWh/yr
Description:	Primary parameter.

Source of data used:	The Municipality City Hall Finance Department. Final accuracy of data is under the responsibility of municipality SECAP Coordinator.
Value applied:	Total - **395** Kindergartens **- 190** Other municipal buildings - **205**
Any comments	These data should be revised at the Kakheti Energo-Pro distribution company and by energy audit assessments.

Data/Parameter # 10.4.3	**Areas of the Self-Governing Community Telavi Municipality 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 SECAP Group by the Department of Construction and Architecture of the Self-Governing Community Telavi Municipality Local Government. Data on the number of private houses (mainly one- and two-storey) are owned by local governments and Departments of architecure and construction. The total area of these buildings was assessed by the local expert.
Value applied:	Total **-** 1 997 565 Residential buildings - 4 888 Private dwelling houses - 1 992 677
Any comments	

Data/Parameter # 10.4.4	**Annual energy consumption by residential buildings according to their types**
Data unit:	MWh/yr
Description:	Primary parameter.
Source of data used:	"Energo-Pro Kakheti". Representative of the Municipality City Hall/Coordinator is responsible for the eventual quality of data.
Value applied:	Total - 25 513 Multi-storey -14.3 Private houses -25 499
Any comments	This data could be verified by questioning of typical buildings and relying on energy audit estimations.

Data/Parameter # 10.4.5	**Total area of commercial buildings in Self-Governing Community Telavi Municipality Municipality**
Data unit:	m^2

Description:	Primary parameter.
Source of data used:	The SECAP team was provided by Self-Governing Community Telavi Municipality Municipality 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.
Value applied:	Total - 163 084 Schools - 22 792 Other state buildings - 3 662 Other commercial buildings - 133 348 Other buildings - 3 282
Any comments	

Data/Parameter # 10.4.6	**Annual electricity consumption by commercial buildings**
Data unit:	MWh/yr
Description:	Primary parameter.
Source of data used:	"Energo-Pro Kakheti". The Self-Governing Community Telavi Municipality Municipality City Hall is responsible for the ultimate quality of data.
Value applied:	Total -3 293 000 Schools -175 000 Other state buildings - 30 000 Other commercial buildings - 3 050 000 Other buildings -38 000
Any comments	This data could be verified by the questioning of commercial buildings and using the energy audit assessments.

Data/Parameter # 10.4.7	**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:	Self-Governing Community Telavi Municipality Municipality City Hall Finance Department. Final quality of data is under the responsibility of Self-Governing Community Telavi Municipality Municipality City Hall.
Value applied:	Kindergartens - 2 300 m^3
Any comments	Could be verified at the gas supply company.

Data/Parameter # 10.4.8	**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:	Gas distribution company Socar that serves Self-Governing Community Telavi Municipality Municipality. Eventual quality of data is under the responsibility of Self-Governing Community Telavi Municipality Municipality City Hall.
Value applied:	Natural Gas - 2 969 938 m^3/yr LPG - 420 000 kg/yr
Any comments	

Data/Parameter # 10.4.9	**Annual consumption of natural gas by commercial buildings**
Data unit:	m^3/yr; (MWh/yr)
Description:	Primary parameter (annual).
Source of data used:	Gas distribution company Socar that serves Self-Governing Community Telavi Municipality Municipality. Eventual quality of data is under the responsibility of Self-Governing Community Telavi Municipality Municipality City Hall.
Value applied:	Natural gas - 4 220 m^3
Any comments	This data could be verified by the questioning of commercial buildings and energy audit assessments. This data is not exact and needs to be recalculated.

Data/Parameter # 10.4.10	**Annual consumption of liquid gas (LPG) and diesel by municipal buildings**
Data unit:	M^3; l (MWh/yr)
Description:	Primary parameter.
Source of data used:	Information obtained from the Self-Governing Community Telavi Municipality Municipality Local Government
Value applied:	Not applied.
Any comments	

Data/Parameter # 10.4.11	**Annual consumption of firewood in municipal buildings**
Data unit:	m^3
Description:	Primary parameter.
Source of data used:	Financial Department of the Self-Governing Community Telavi Municipality Municipality Local Government
Value applied:	Total firewood in 2014 - 372 m^3/yr Kindergartens -192 m^3/yr Administrative buildings - 155 m^3/yr Other buildings - 25

Any comments	

Data/Parameter # 10.4.12	**Annual consumption of firewood in residential buildings**
Data unit:	m^3
Description:	Primary parameter.
Source of data used:	Given vouchers to the population. Eventual quality of data is under the responsibility of Self-Governing Community Telavi Municipality Municipality City Hall
Value applied:	Total firewood in 2014 - 80 598 m^3/yr
Any comments	Level of firewood consumption in Self-Governing Community Telavi Municipality Municipality is very high. This consumption is calculated by SECAP group only in the schools where there is no Natural Gas and only firewood is being used. Calculated by the amount of firewood consumer families and consumed firewood by single family (7 m^3).

Data/Parameter # 10.4.13	**Annual consumption of firewood in other buildings**
Data unit:	m^3
Description:	Primary parameter.
Source of data used:	Self-Governing Community Telavi Municipality Municipality Local Government.
Value applied:	Total firewood in 2014 - 2 120 m^3/yr
Any comments	In this category the most part of this consumption comes from Schools.

Data/Parameter # 10.4.14	**Annual consumption of liquid gas and diesel by commercial buildings**
Data unit:	M^3 (MWh/yr)
Description:	Primary parameter (annual).
Source of data used:	Questioning of commercial buildings. Self-Governing Community Telavi Municipality Municipality Local Government and Energo-Pro are 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 # 10.4.15	**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 Base year - 110 008 2020 - 113 174
Any comments	

Monitoring of planned activities in the Self-Governing Community Telavi Municipality Municipality building sector

Activity #MB2.1; MB 2.2;	**Replacing old lamps with new energy effective lamps**
Planned implementation (dates)	**2016-2020**
Description of activity:	The aim of an activity was installation of energy effective lighting system in the Municipality buildings (10 lamps), in 12 kindergartens (335 in total)
Indicators to be monitored	• Amount of replaced lamps, capacities of old and new lamps • Electricity consumption of building/system before and after replacing of lamps • Annual working duration (in hours) before and after replacing • Ensuring of lighting standard - satisfactory
Amount of reduced emission, achieved during the monitoring period	1.53 t CO_2 will be saved annually in total
Any comments	
Implementing body	Self-Governing Community Telavi Municipality kindergarden agency

Activity #MB3.1	**Using sun collectors in kindergartens**
Planned implementation (dates)	**2017-2020**
Description of activity:	Aim of this measure is to use sun collectors for delivering hot water in municipal buildings like kindergartens and schools. Nowadays, 2 000 l of hot water is being spent in these buildings every day that is equal to 12 400 KWh electricity. Sun collector in the Self-Governing Community Telavi Municipality Municipality produces 1 050 KWh/m^2 per year. In case of using vacuum sun collectors that are installed on the roof, 16 600 KWh energy could be produced on 12 m^2 per year. Area of standard sun collector is 2 m^2 and costs 1 300 GEL. In case of Self-Governing Community Telavi Municipality 6 collectors will be needed that will cost 7 800 GEL.
Indicators to be monitored	• Areas of installed sun collectors (m^2) • Consumed thermal energy (measured) • Amount of consumed hot water (l) and its temperature (measured)

Amount of reduced emission, achieved during the monitoring period	For gaining this energy (12 600 KWh/yr) 12 600/(9.4x0.9)=1 440 m^3 natural gas is needed that is equal to 1 440x0.98=1 411 GEL. In case of replacing natural gas with solar energy, reduction of CO_2 emissions will be 1440*9.72* 0.202/1000 = 2.82 t CO_2 per year
Any comments	
Implementing body	Self-Governing Community Telavi Municipality kindergarten agency

Activity #RB4.1	**Replacing unsustainably produced biomass (firewood) with natural gas in residential buildings**
Planned implementation (dates)	**2018-2020**
Description of activity:	Firewood consumption in residential sector of Self-Governing Community Telavi Municipality Municipality is about 70% of whole energy consumption. This happens because of illegal wood cutting and has serious results effect on green area. That is why one of the most important measures is replacement of firewood with natural gas. Municipality is interested in this measure to begin using more energy effective technologies. So an approach has been made for 2018-2030 that 50% of those families who use firewood nowadays will use natural gas. Nowadays residential sector consumes 80 598 m^3 firewood annually that equals to 229 865 496 KWh of electricity. As this firewood is received from non-sustainable (but illegal) cuttings it is treated as an emission source and emission from firewood is 229 865 MWh*0.42=96 543 t CO^2. 142 529 275 KWh/9.4=15 162 689 m^3 firewood and MWh 229 865 *0.202=46 433 m^3 natural gas would be needed for the same energy. If 50% of population will use Natural Gas effectively for 2030, 25 055 t CO^2 will be saved
Indicators to be monitored	• Amount of families that replaced firewood with natural gas • Average heated area in a single family and energy consumption during firewood consumption (base scenario, rated with the amount of consumed firewood in m^3) • Average heated area in a single family and energy consumption during natural gas consumption (measured) • Total natural gas consumption by residential sector
Amount of reduced emission, achieved during the monitoring period	As a result of this activity 25 055 t CO_2 will be saved annually for 2030
Any comments	It is also important in Sef-Governing Community Telavi Municipality to implement energy effective furnaces and boilers but it will cause firewood consumption probably. Though there is a big amount of biomass.
Implementing body	Self-Governing Community Telavi Municipality population and local government

Activity # MB4.1; RB 2.1; RB 2.3	Activities mainly implicate window covering, reduction of infiltration from windows and entrance covering
Planned implementation (dates)	**2016-2020**

Description of activity:	One activity is planned on 10-storey house and implicates filling holes among window glass and frame with silicone or putty. The second activity is estimated on one two-storey private house and must spread on 1 000 houses until 2020.
Indicators to be monitored	• Total area of covered windows; • Total area of new windows; • Energy consumption reduction on covered area (window) unit and area of new window unit; • Must me rated or chosen these sizes rated in other countries; • Natural gas (other fuel) consumption before activities; • Natural gas (other fuel) consumption after activities; • Daily temperature of room/heated area before and after activities; • Heated area before and after activities
Amount of reduced emission, achieved during the monitoring period	As a result of these activities reduction of energy and emissions will be 1 543 MWh and 1 156 t CO_2, respectively.
Any comments	Cost of these activities is 346 586 GEL in total.
Implementing body	Other (NGOs, communities, municipality, local governments)

Activity # MB 1.1; MB 1.2; RB 1.1; RB 1.2	**Heating of roof**
Planned implementation (dates)	**2016-2020**
Description of activity:	Activity implicates thermal isolation of roof of the municipality building that is 207 m^2. The same activity must be implemented in 22 kindergartens with the total area of 6 100 m^2, 10 residential multi-storey buildings with the total area of 2 400 m^2 and 1 000 typical private houses (95 m^2 on an average).
Indicators to be monitored	• Area of heated garrent; • Natural gas (other fuel) consumption for heating before activity; • Natural gas (other fuel) consumption for heating after activity; • Daily temperature of room/heated area before and after activity; • Total number of children and staff in kindergartens before and after activity; • Heated area before and after activity.

Amount of reduced emission, achieved during the monitoring period	Annual saving of CO_2 will be 7 521 t on an average for 2020.
Any comments	Total cost of activities is 302 570 GEL.
Implementing body	Other (NGOs, communities, municipality, local governments).

10.5 Street Lighting Sector

Data/Parameter # 10.5.1	**Annual amount of electricity consumed for street lighting**
Data unit:	KWh/yr
Description:	Primary data
Source of data used:	LTD "Gare Ganateba" of the Self-Governing Community Telavi Municipality. This office is responsible for the delivery of monthly/annual data on the amount of electric energy consumed for street lighting.
Value applied in SECAP:	**2014: - 1 462 000 KWh** **Forecast for 2020 - 2 139 000 KWh** **Forecast for 2030 - 2 139 000 KWh**
Any comments	This data should be verified by the paid expenses. The projection for 2030 is calculated by the SECAP developing group.

Data/Parameter # 10.5.2	**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 in SECAP:	**2014 – 152.07 t $CO_{2eq.}$** **2020 projection - 222.49 t $CO_{2eq.}$** **2030 projection - 222.49 t $CO_{2eq.}$**
Any comments	

Data/Parameter # 10.5.3	**Amount of street lamps in Self-Governing Community Telavi Municipality Municipality**
Data unit:	Quantity
Description:	Primary data

Source of data used:	LTD "Gare Ganateba" of the Self-Governing Community Telavi Municipality. This office is responsible for the delivery of monthly/annual data on the quantity of street lamps.
Value applied in SECAP:	**2014 - 1 716** **2020 - 2 316**
Any comments	On this stage there are Sodium-vapor lamps mainly in Self-Governing Community Telavi Municipality Municipality.

Data/Parameter # 10.5.4	**Duration of lamp/street lighting or evaluable system**
Data unit:	H/day or h/yr
Description:	Primary data
Source of data used:	LTD "Gare Ganateba" of the Self-Governing Community Telavi Municipality
Value applied in SECAP:	10 h /d 3 650 h/ yr
Any comments	Street lighting in Self-Governing Community Telavi Municipality Municipality mainly consists of street lamps.

Data/Parameter # 10.5.5	**Grid effectiveness in the Self-Governing Community Telavi Municipality Municipality**
Data unit:	KWh/yr consumed averagely by one lamp
Description:	Secondary data
Source of data used:	Calculated by Remissia
Value applied in SECAP:	2014– 852 KWh/yr (one lamp consumes 322 W (0.233) KW per hour on an average 2020 - 663 KWh/yr (one lamp will consume 182 W per hour on an average after activity 2030 - 164 KWh/yr (in case of implementation all five activities one lamp will consume 63 W (0.063) KW per hour on an average)
Any comments	

Monitoring on planned measures in Self-Governing Community Telavi Municipality Municipality street lighting sector

Activity #S1 – S4	**Replacing blaze lamps with energy effective LEDS lamps**

Planned implementation (dates)	**2016 - 2025**
Description of activity:	**Activity S1:** This activity was held in 2015 when 400 existing lamps (ДРЛ 250 W) were replaced with 400 LED lamps (ДРЛ 70 W) on the posts of the Vardisubani - Ikalto central road. 300 lamps from replaced 400 were set on unilluminated 11 km-s and the rest was useless. As a result of this activity, 356 MWh electricity and 37.11 t $CO_{2eq.}$ is being saved annually. This activity cost 140 000 GEL/ **Activity S2:** Installation of 100 more LED lamps is planned. These lamps will save 82.42 MWh and 8.57 t CO_{2eq} annually from 2017. It costs 35 000 GEL. **Activity S3:** 2 installation of 200 more LED lamps is planned in 2018-2020. These lamps will save additional 54.94 MWh and 5.71 t CO_{2eq} annually from 2017. It costs 70 000 GEL. **Acticity S4:** According to the plans, all existing 2 316 lamps of the grid must be LED in 2025-2030. In this case annual saving of electricity and emissions will be 200.53 MWh and 20.85 t CO_{2eq}, respectively. It will cost 565 500 GEL.
Indicators to be monitored	• Amount of lighting points by types • Annual time of lighting (h/yr) • Average usage of a single lamp
Amount of reduced emission, achieved during the monitoring period	In case of implementation of activities **S1-S3** annual saving of electricity and emissions will be 604.05 MWh and 62.82 CO_{2eq} for 2025. In case of implementation of activities **S1-S4** annual saving of electricity and emissions will be 1 607 MWh and 167 CO_{2eq} for 2025.
Any comments	
Implementing body	LTD "Infrastrukturisa da ketilmotskobis samsakhuri" of the Self-Governing Community Telavi Municipality.

10.6 Greening Sector

Baseline Emissions Monitoring

Data/Parameter # 10.6.1	**Total planted area in the Self-Governing Community Telavi Municipality Municipality(2014)**
Data unit:	ha Number of plantings by species

Description:	Primary parameter
Source of data used:	LTD "Infrastrukturisa da ketilmotskobis samsakhuri" of the Self-Governing Community Telavi Municipality.
Value applied:	7 645 ha are covered by plants within the limits of the municipality
Any comments	Does not contain agricultural plants

Data/Parameter # 10.6.2	**Annual removal of carbon dioxide from the Self-Governing Community Telavi Municipality Municipality territory under the baseline conditions of 2014 greening**
Data unit:	tCO_2/yr
Description:	Secondary parameter
Source of data used:	Calculated through the SECAP development process
Value applied:	2014: annual abasorption 19 786.8t CO_2 Amount of sequestered carbon in 2014 at the whole territory of 7 645 ha equals to 621321.8 t C.
Any comments	

Data/Parameter # 10.6.3	**Annual cutting/ trimming of trees by species**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	LTD "Infrastrukturisa da ketilmotskobis samsakhuri"
Value applied:	Trees are being trimmed every year Approximate reduction of biomass as aresult of trimming 40 – 60 m^3
Any comments	Trimmings should be considered in the monitoring process.

Data/Parameter # 10.6.4	**Annual fires or other causes of damage to trees**
Data unit:	m^3
Description:	Primary parameter
Source of data used:	LTD "Infrastrukturisa da ketilmotskobis samsakhuri"
Value applied:	Fires should be considered in the monitoring process.
Any comments	

Data/Parameter # 10.6.5	**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 SECAP developing group
Value applied:	Resulting from different measures taken by 2020 at the territory of Self-Governing Community Telavi Municipality Municipality 201 866.5 t C will be sequestered.
Any comments	

Monitoring of carbon sequestration increase resulting from the adoption of measures

Activity #G1	**Planting 1000 trees on 0.25 ha**
Planned implementation (dates)	**2015**
Description of activity:	Establishment of square on 3 ha origined from coast-protecting activities on the territory of village Vardisubani. On this stage, 100 lime-trees have been cultivated on 0.25 ha. In the period of preparing this document, 100% of cultivated plants are flourished.
Indicators, according to which the monitoring should be performed	• Number of planted species according to areas; • Coverage of territory with crown; • Application of fertilizers; • Cuttings and wildfires.
Amount of reduced emissions, got through the monitoring period	Area covered with new plantation will absorb 11.7 t CO_2 for 2020 and will sequester 3.2 t C. Absorbtion and sequester of carbon will reach 32.6 t and 8.9 t, respectively. It costs 1.5 GEL (704 821 USD)
Comments	It costs 1.5 mln GEL (704 821 USD).
Implementing body/unit	LTD "Infrastrukturisa da ketilmotskobis samsakhuri" of the Self-Governing Community Telavi Municipality.

Activity #G2	**Greening of 15 ha area in total in Self-Governing Community Telavi Municipality suburbs**
Planned implementation (dates)	**2016-2030**
Description of activity:	Greening of 15ha is planned on the territory. During projecting of greening it is recommended to plant such kind of plants which are suitable for forest landscape. At least 3 000 plants (including bushes) will be planted on 1 ha. As a result we will get the reservoir with the best accumulation of carbon where soil will be a part of this accumulation that will lead to valuable forest ecosystem. Several types of arboretum plants have been selected for planting. From leafy plants: lime-tree, maple, Georgian oak, plene and paulownia. Georgian oak is not famous for a big potential of absorption but in local conditions it grows fast and effectively. From pines pine-tree and cedar were selected.

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 fertilizers; • Cuttings and wildfires.
Amount of reduced emissions, got through the monitoring period	Area covered with new plantation will absorb 122.7 t CO_2 for 2020 and will sequester 33.5 t C. Absorbtion and sequester of carbon will reach 986 t and 268.9 t, respectively.
Comments	It costs 511 839 GEL (240 300 USD)
Implementing body/unit	LTD "Infrastrukturisa da ketilmotskobis samsakhuri" of the Self-Governing Community Telavi Municipality.

10.7 Waste Sector

Baseline Emissions Monitoring

Data/Parameter # 10.7.1	**Parameters of Self-Governing Community Telavi Municipality Municipality landfill**
Data unit:	Area, ha; Depth, m.
Description:	Primary data.
Source of data used:	During the SECAP development process data has been provided by the LTD Communal Farming of Self-Governing Community Telavi Municipality Municipality which should remain the main source of information through the monitoring process, as well.
Value applied:	Total area- 5.5 ha and the depth- 8-10 m.
Any comments	The Self-Governing Community Telavi Municipality Municipality landfill was opened in 1982.

Data/Parameter # 10.7.2	**Daily amount of waste delivered to the Self-Governing Community Telavi Municipality Municipality landfill**
Data unit:	m^3 or ton
Description:	Primary data.
Source of data used:	During the SECAP development process data has been provided by the LTD Communal Farming of Self-Governing Community Telavi Municipality Municipality which should remain the main source of information through the monitoring process, as well.
Value applied:	1 912 t of waste is delivered annually from the Self-Governing Community Telavi Municipality Municipality itself in 2015. 7% of it are construction wastes.
Any comments	

Data/Parameter # 10.7.3	**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- 41.4%, Textile/leather- 6.2%, Paper/cardboards- 14.9%, hygienic waste- 4.2%, Plastic/Inert material- 33.3%. • 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) – 0.6 • Methane Content of Landfill Gas (F) – 50% • Oxidation Factor (OX) (Managed landfill) - 0 2014- 2.88 $GgCO_2eq$ 2020- 3.91 $GgCO_2eq$ (projected) 2030- 7.55 $GgCO_2eq$ (projected)
Any comments	As to the emissions from the landfill, their projections to 2020 and 2030 are 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)	**2016 -2030**
Description of activity:	In Tbilisi, in the Orkhevi Settlement 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.). Consequently the mentioned fraction in overall waste composition is being decreased, causing corresponding reduction in the generation of methane from the landfill. The Self-Governing Community Telavi Municipality authorities began separation of paper, plastic and glass in 2016 with CENN. According to experts assessment about 5% of secondary paper 5% of glass and 5% of plastic materials will be separated to 2016, while by 2020 the amount of separated paper could reach 30%, glass – 20% and plastic – 20% generated waste. And for 2030 separation of each of them will reach 80%. The calculation of emission from the Self-Governing Community Telavi Municipality Municipality landfill has been performed taking into consideration the fact that currently the share of paper in the waste makes 14.9 %, glass – 6.1% and of plastics- 17.8 % [CENN].
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- 14.9%; • Share of glass in the waste before implementing the project- 6.1%; • Share of plastics in the waste mass before implementing the project- 17.8%; • 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 municipality; • 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 3.1 tons in CO_2eq (1.63%) that equals to 65.1 t. And for 2030 – 1 035 t CO_2eq.
Comments	
Implementing body/unit	This is a planned activity and presumably it will be implemented by the LTD "Infrastrukturisa da ketilmotskobis samsakhuri" of the Self-Governing Community Telavi Municipality.

11 Sustainable Development Criteria

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

- Local capacity building of Self-Governing Community Telavi Municipality (staff, plans);
- 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.);
- Promotion of residential condominiums creation;
- Improved comfort and energy savings in municipal/commercial buildings (heat, electricity, hot water consumption per area unit);
- Introduction of modern waste recycling technologies;
- Expansion of per capita green areas;
- Reduction of local pollutants (mainly due to measures taken in the transport sector);
- Increased number of jobs;
- Better gender equity;
- Demonstration and piloting new technologies;
- Promoting private sector development;

Municipalities are able to report on additional criteria that were influenced by measures carried out within the SECAP 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.

12 Annex I

Methodology and coefficients for calculation of baseline emissions and BAU scenario

GHG emissions are calculated using a formula adapted for the Intergovernmental Panel on Climate Change (IPCC) methodology Tier 1 sectoral approach for the local level, which is based on actual fuel consumption data:

Carbon Dioxide emissions$_j$ (GgCO2) =

☐☐$_i$ {Actual fuel consumption ji (unit) x caloric value of fuel i(MW.h53/per unit)

x carbon emissions factor (TC/MW.h)/1 000 x oxidized carbon portion i} x 44/12,

Where lower index j 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) =

☐☐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 53. Transfer Coefficients and Carbon Emissions Factors for Different Types of Fuel

Type of Fuel	Unit	Transfer Coefficient (MW/h unit)	Carbon Emission Factor (Ton C/ MWh)
Gasoline	1 000 liters	0.00950	0.247
Diesel	1 000 tons	0.01070	0.267
Liquid Gas	1 000 tons	0.0132	0.227
Natural Gas	1 million m^3	0.00935	0.202
Firewood	1 000 m^3	0.00210	--

The average emissions factor from the electricity grid was applied in 2014, which was 0.104 kg CO_2/kWh.

[53] 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

A small portion of carbon in fuel is not oxidized during combustion but most is oxidized later in the atmosphere. It is calculated 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 54.

Table 54. Portion of Oxidized Carbon for Different Fuels

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

Different gas emissions factors for the transport sector are given below in Table 55.

Table 55. 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 56.

Table 56. 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[54] 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.

[54]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

The Self-Governing Community Telavi Municipality SECAP uses emissions reduction calculations for the BAU scenario. There are two options of scenario construction described by the guidance document:

1. The country can develop its own methodology, which will be evaluated by the JRC later;
2. The country may use national ratios indicated in the guidance document, developed for the Global Atmosphere Research (EDGAR) project CIRCE[55] employing an emissions database. The POLES (Prospective Outlook for the Long-term Energy Systems)[56] method has been used, and considers growth 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 population, economy, technologies and human behavior will continue, and that no national measures will be taken towards a reduction of emissions[57].

For the Self-Governing Community Telavi Municipality 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 creation of SECAP of the Municipality of Community Telavi. 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 Telavi SECAP the BAU national scenario has not been generated yet, the JRC coefficients were applied.

13 Annex II

Methodology for energy audits

An energy audit of typical buildings in Community Telavi Municipality was conducted using "Key Numbers" of the ENSI software. A Norwegian Consulting Company—ENSI--founded in 1992, developed simple software called "Key Number" for a quick calculation of energy characteristics that can be applied both for projecting rates for new buildings and reconstruction activities and for assessing energy-saving measures for existing buildings. Key figures reflect model values of specific types of energy consumption, taking into account all factors. Comparing measured and calculated values of energy consumption with key numbers permits a rapid assessment of energy efficiency and energy saving potential.

Today the actual exploitation conditions of buildings in Georgia differ substantially from designed/normative conditions. Thus, measured energy consumption may be higher than the one calculated e.g. due to water

[55] 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

[56] 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

[57] 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

leakage or improper operation of a heating system; or 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 energy savings the calculated values of energy consumption should be used as a "baseline scenario", which describes the building's energy consumption under the comfort conditions.

In order to assess the energy consumption and relevant emissions three different scenarios (E_1=E_2=E_3) could be used: E_1- to get statistical data on energy (power, NG, wood,etc) consumption by building sector from energy providers; E_2- to calculate specific consumption of energy per sq. meter of building based on the results of energy audits and applied the data to other buildings. E_3- to calculate per capita energy consumption based on the results of building audit or surveys and multiply it by city population. Finally, cross comparison of these three scenarios makes it possible to determine the accuracy of calculation for each scenario (E1 = E2 = E3).

According to the **first scenario (E_1)**, it is possible to estimate an annual energy consumption on the basis of annual statistical data of consumed natural gas, electricity and firewood obtained from providers. Usually data on consumption are provided in standard units (kWh/yr, m^3, l, etc) and should be converted to kWh in order to compare, sum up or do any other mathematical operations (E1, 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 energy expenditures (energy consumption per m^2, kWh/m^2yr) on heating, cooking and electricity use by various appliances. An energy audit carried out using ENSI software would allow us along to the assessment of energy consumption to determine the actual potential of energy-savings, involves a situational analysis and other tools to reduce energy consumption and CO_2 emissions.

14 Annex III

Methodology for calculation of carbon stock and annual carbon accumulation

The calculation of carbon accumulated in Telavi Community 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 falling 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 love 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.

Equations system to calculate annual increment in carbon stocks of biomass based upon the biomass accretion – decrease method (see Fig. 15).

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

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

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

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

Fig. 15. System of equations to calculate carbon accretion in biomass

$C_{F_{LB}}$ is annual increase in carbon stocks due to 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, tone of dry mass/ha/year;

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

G_W- aboveground biomass increment, t day 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 Self-Governing Community Telavi Municipality 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 Telavi Municipality Forestry taxation materials were used, 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[58], etc. As a result average value of index has been obtained, permitting the approximate assessment of wood stock at 1 ha of fragmentary greening (40 m3).

As it has been mentioned above, the perennial arboreal plants in the city 1 590 ha of green cover are represented both in joined canopy and in fragmentary forms, from which joint canopy groves are dominating mainly at 50 ha of state forest territories, and the remaining 1 540 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 2014-2015 has been taken into account. Ensuing from this, the Accretion Factor was adjusted towards the growth rate.

In particular, the data on average annual accretion and woody stocks were used from the taxation materials (see Table 57), while for the specific weight of the wood (D) the data on absolutely dry wood volume weight of the dominant species were taken from different reference sources. The values of other coefficients (BEF1, BEF2, Rand CF) were brought from the standard Tables of IPCC methodology, relevant to climate conditions of examined region.

Table 57. Indexes used in calculations and their sources

Main indexes applied in calculations	Used value of indexes	
	Fragmentary plants	Joint canopy plants
V- Tree stock m3/ha[59]	75	105
I_V- Woody plants (trees) mean annual increment, m^3	1.6	1.8

[58] Mirashvili V., Kuparadze G. Forest Taxation Reference Book (in Georgian)

[59] "Land Use Planning „of Samegrelo Zemo-Svaneti Regional Department, 2008;

D - volume weight of totally dry wood, ton totally dry mass[60]	0.55	0.65
BEF_1- Coefficient for conversion of wood mean increment into total aboveground (including crown) mean increment [61]		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.[62]		1.3
R - Ratio of root mass to trunk[63]		0.24
CF-carbon share in dry wood. [64]		0.5

The model has been developed under the project CASFOR II, which was financed by the European Commission programme INCO2. The project was additionally financed by the Ministry of Agriculture, Nature Management and Fishing of the Netherlands and the National Council on Science and Technology of Mexico (CONACYT).

The model CO2FIX V3.1 determines the amount of carbon accumulation in the nature using the called "Accounting Method" of carbon stock-taking. In particular, the model calculated changes in carbon stockpiles, taking place for the specific span in all carbon "reservoirs" existing in the forest. (The carbon "reservoir" is considered to be that part of the ecosystem where the accumulation of carbon is taking place – the living biomass, litter, organic soils and produced timber resources).

In the model CO2FIX V3.1 the calculations are performed for one year and one ha scale in existing 6 main modules:

1. Biomass module;
2. Soil module;
3. Produce of timber resources module;
4. Bioenergy modules;
5. Financial module;
6. Carbon credits accounting module (for CDM).

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

CTt = Cbt +Cst + Cpt (Mg C/ha),

where

"Global Wood Database" http:/datadryad.org; მახვილაძე ე. მერქანმცოდნეობა, თბილისი 1962; Боровников А.М., Уголев Б. Н., Справочник по древесине. «ЛеснаяПромышленность», Москва, 1989;

[61]Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10,http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf;
[62]Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.10;
[63]Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003),Table 3A1.8http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf;
[64]Good Practice Guidance for Land Use, Land Use Change and Forestry, (IPCC 2003).

Cb_t - Total amount of carbon in underground and above-ground biomass of a plant (Mg C/ha);

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

Cp_t –Carbon stocks of woody products obtained from forestry works (Mg C/ha).

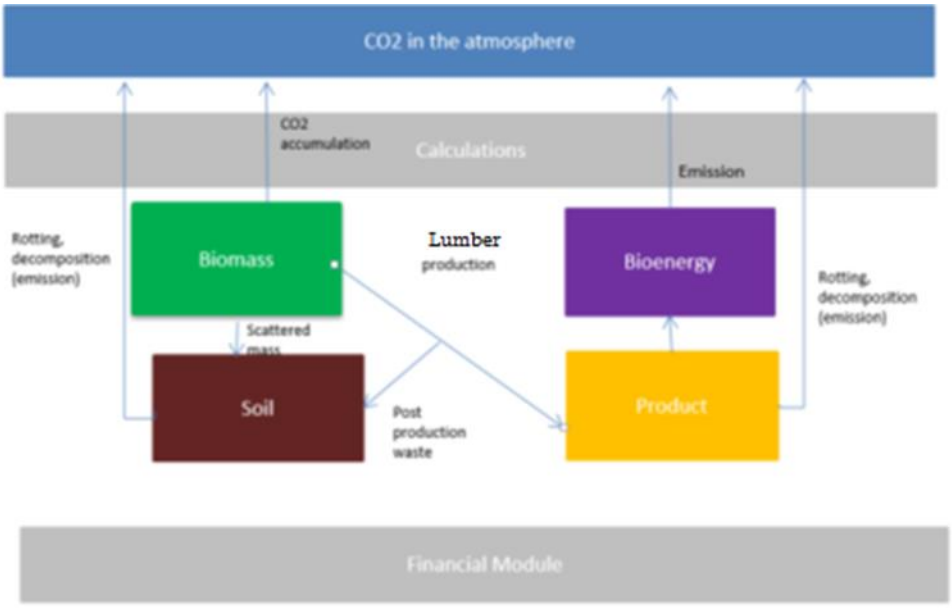

Fig. 16. Model Structure

Two counting modules – biomass and soil modules have been applied to calculate accumulation potential as a result of greening activities.

Biomass module: The biomass module uses a "Cohort System" for calculations. Cohorts comprise one or various groups of woody plants. Growth, drying and other features separately characterize each cohort species.

As an example the values of the main coefficients used in 2014 calculations are given in Table 58.

Table 58. Values of indexes used in the biomass module for the project scenario in Municipality of Telavi Community

Indexes used in the Biomass Module	Value of the index
Carbon content	0.5 t.C /t dry mass
Wood density t dry mass/m^3	
Maple	0.655
Pine	0.430
Georgian Oak	0.660
Green ash	0.650
Cotinus	0.560
Sapindus	0.700
Paulownia	0.540
Inicial carbon	0 t C/ha

Growth correction factor	1
Turnover rate of phytomass	
წიწვოვანები:	
Needles	0.3
Branches	0.04
Roots	0.03
Deciduous:	
Leaves	1
Branches	0.05
Roots	0.08

Soil module: The Yasso model is applied to determine carbon dynamics in soil. (http://www.efi.fi/projects/yasso/). The model (included into CO2FIX system) describes carbon decomposition and its dynamics in dry soil.

It is calibrated for detection of total carbon stock in any soil layers. This model is suitable for coniferous, as well as for deciduous forests, and was tested in different countries with dissimilar climate zones to describe the influence of specific climate conditions on the decomposition process of the fallen leaves and branches.

Table 59. Indexes of carbon accumulation after cultivation (1ha)

	Sequestered Carbon Planting of ...	Sequestered Carbon Planting of ...		Sequestered Carbon Planting of ...	Sequestered Carbon Planting of ...		Sequestered Carbon Planting of ...	Sequestered Carbon Planting of ...
year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...	year [yr]	carbon [MgC/ha]	CO2 equiv. [MgCO2eq...
0	0.08	0.30	19	42.40	155.47	39	79.88	292.89
1	2.26	8.29	20	44.51	163.20	40	81.48	298.75
2	4.47	16.39	21	46.60	170.85	41	83.05	304.52
3	6.71	24.60	22	48.66	178.43	42	84.60	310.20
4	8.96	32.84	23	50.71	185.94	43	86.13	315.81
5	11.21	41.10	24	52.74	193.37	44	87.63	321.33
6	13.47	49.39	25	54.75	200.74	45	89.12	326.77
7	15.74	57.70	26	56.72	207.99	46	90.58	332.14
8	18.01	66.03	27	58.67	215.13	47	92.03	337.45
9	20.28	74.36	28	60.59	222.16	48	93.46	342.69
10	22.55	82.69	29	62.48	229.08	49	94.87	347.87
11	24.81	90.98	30	64.34	235.90	50	96.27	352.98
12	27.06	99.23	31	66.17	242.62	51	97.65	358.04
13	29.30	107.44	32	67.97	249.24	52	99.01	363.04
14	31.53	115.62	33	69.75	255.76	53	100.36	367.98
15	33.75	123.75	34	71.51	262.19	54	101.69	372.86
16	35.95	131.80	35	73.23	268.52	55	103.01	377.70
17	38.12	139.77	36	74.93	274.76	56	104.31	382.47
18	40.27	147.66	37	76.61	280.89	57	105.60	387.20
19	42.40	155.47	38	78.26	286.94	58	106.88	391.88