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Sustainable Energy Action Plan for Tbilisi



May 2016

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SUSTAINABLE ENERGY ACTION PLAN FOR TBILISI

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DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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ACRONYMS

BAU	Business As Usual
C	Carbon
CDM	Clean Development Mechanism
CH ₄	Methane
Clima East	EU project on climate change Mitigation and Adaptation in Eastern Europe and Russia
CO ₂	Carbon dioxide
CoM	Covenant of Mayors
CNG	Compressed natural gas
EC -LEDS	Enhancing capacity for low emission development strategies
EU	European Union
GHG	Greenhouse Gas
GDP	Gross Domestic Product
GEL	Georgian Lari
Gg	Gigagram (10 ⁹ g=10 ³ t)
GWh	Gigawatt hour (10 ⁶ KWh)
GIZ	German Agency for International Cooperation
GEF	Global Environment Facility
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KWh	Kilowatt hour (10 ³ watt.hour)
LED	Light Emitting Diodes
LEPL	Legal Entity of Public Law
LEAP	Long-range Energy Alternatives Planning system

LLC	Limited Liability Company
MWh	Megawatt. hour (10^3 KWh)
N ₂ O	Nitrous Oxide
NGO	Non-governmental organization
SEAP	Sustainable Energy Action Plan
SWDS	Solid Waste Disposal Site
TTC	Tbilisi Transport Company
UNFCCC	United Nations Framework Convention on Climate Change
USAID	US Agency for International Development

FOREWORD

The environmental safety and creation of healthy ambience became one of the essential challenges to contemporary world. The rapid economic development conditions growing consumption of organic fuel, negatively affecting the state of the environment.

One of the important initiatives responding to existing challenges is the “Covenant of Mayors”. Tbilisi has joined this EU initiative in 2010 and voluntarily took the commitment to improve environmental state of the city by encouraging the use of renewable energy resources and rising energy efficiency.

To meet this obligation the Tbilisi City Hall has developed “Tbilisi Sustainable Energy Action Plan”, which includes measures in the sectors of Transportation, Buildings, Municipal infrastructure (street lighting, landfills) and the development of greenery areas. According to this Plan the emissions of carbon dioxide (CO₂) from the territory of Tbilisi will be decreased by at least 20% to 2020, turning Tbilisi into environmentally clean “green city” at the background of sustainable development.

We are thankful to participants of the project “Enhancing capacity for low emission development strategies/Clean energy program” and to the US Agency for International Development for technical assistance in developing the Sustainable Energy Action Plan.

EXECUTIVE SUMMARY

After joining in 2010 the “Covenant of Mayors”, the city of Tbilisi in 2011 has developed and submitted to the European Commission the city Sustainable Energy Action Plan (SEAP), aimed at the reduction of GHG emission from the territory of the city by at least 20% to 2020. According to the Action Plan, in two-year period from the presentation of the Plan the monitoring has been conducted on the implementation of planned measures and based upon the 2009 data- the GHG initial inventory in the city. Deriving from these facts, as well as considering future priorities and strategic visions, Tbilisi has worked out the updated version of the SEAP, which included outcomes of the second- 2014 inventory. In the revised document, along with both inventories the updated baseline scenario (BAU) and measures to be taken and already enacted in each sector activities have been incorporated.

For the construction of baseline scenario and assessment of upcoming emissions the computer model of Tbilisi energy system has been developed, while taking into account the inventory results the following sectors were selected to be examined: Transportation, Buildings, Street lighting and Waste. The Greening sector has been assessed as a removal of CO₂ from the atmosphere and an indicator of improving the healthy state of the environment. The obtained in this direction results for 2011-2014 along with the Monitoring Report will be submitted to the CoM Secretariat.

In the introductory part of the document, after the general overview of changes which took place during 2009-2014 in Tbilisi population and economics, the brief results of Tbilisi SEAP Monitoring Report for the same span are given. It is noted that in 2014, compared to the base year, the emissions from the public transport subsector have decreased by 28%, although in the Buildings sector only 8.5% reduction has been attained. In the Street lighting sector, through the introduction of a number of technical measures the saving of 983 MWh of electric energy has been achieved and the transfer from 2015 of the entire street lighting system to the energy efficient LED lanterns was prepared. During the discussed period for different reasons the area of city green cover has declined by 161 ha. Considering this fact the conduction of new large-scale greening activities are planned for the nearest future. In the Waste sector no envisaged in the SEAP GHG emission curtailing measure has been implemented.

The strategic vision of Tbilisi advancement in the selected sectors till 2020 is discussed, which should be based upon the principles of energy sustainable development. It is underlined that by this way the city plans to reach the 24% reduction of emissions relative to baseline scenario, being the equivalent of 1 198 GgCO₂eq.

The values of energy consumption and GHG emissions in Tbilisi for 2009 and 2014 in the sectors of Transportation, Buildings, Street lighting, Solid Waste and Wastewater are presented.

The issues of SEAP implementation, management and monitoring are discussed in detail, including barriers to energy sustainable development in Georgia and, particularly in Tbilisi. The management and monitoring measures worked out to overpass these barriers are listed out, including the setting up of Sustainable Development Agency, training of personnel and awareness raising, development of monitoring systemic processes and creation of database, conduction of research and introduction of new technologies.

In the SEAP Action Plan first of all are described planned and already implemented measures in Tbilisi Transportation sector. It is emphasized that in 2014 the emissions from this sector made 51% of total emissions from all examined sectors and compared to 2009 they increased by 33%. From the mentioned above measures the following activities should be featured: renovation of the bus fleet, arrangement of dedicated traffic lanes for the public transport, expansion of its popularization campaign, promotion of cable-car and other kinds of electric transport development, implementation of parking policy, consideration of cyclists and pedestrians priorities, extension of traffic lights Control Centre coverage area, encouragement of low-emission cars deployment, etc.

In the Buildings sector, sharing in 2014 the 31% of city's total emissions, from the main measures the following activities are discussed: municipal buildings' sustainable management program, co-financing of measures demanded by cooperatives, population awareness raising campaign, commercial and state buildings' energy efficiency program, etc.

From the street lighting measures the introduction of so called "ecosystems" and application of LED lanterns are examined.

Among the activities to be carried out in the Waste sector the methane collection and flaring system, planned to be installed from 2017 at the Norio operating landfill is described along with the collection and recycling of paper waste fraction at the Norio landfill and the modernization of Gardabani wastewater treatment facility, while among the activities planned in the Greening sector are defined the planting of greenery at the Tbilisi Sea Dendrological Park and the measures to provide sustainable management of city green cover and to toughen the relevant regulations.

Apart from the implemented and planned measures in the selected sectors the urban planning activities are separately discussed in the SEAP Report, from which the development and inaction of Tbilisi land-use General Plan, the demonstration and pilot measures, including the already arranged energy efficient manifestation building, operating on solar energy ornamental construction, the mackle-paper collection "green box" projects are to be mentioned.

In the final part of the Report Tbilisi Municipality strategy on the general public and target groups awareness raising and staff training is presented, the short-term objectives (2015-2018) of which includes preparation of technical potential for implementing the SEAP, raising awareness among general public and provision of Tbilisi Municipality and City Assembly representatives with proper information. The long-range objectives (2018-2020) comprise the strengthening of consultations with stakeholders, involvement of private sector in the SEAP implementation, identification of barriers and awareness raising among decision makers and general public on the role of prohibition measures and standards in providing the energy sustainability.

The Report is supplemented with the Tbilisi 2009 and 2014 GHG inventory data, where the values of energy consumption and GHG emissions in separate years are given for the Transport, Buildings and Waste sectors.

INTRODUCTION

1.1 Tbilisi Sustainable Energy Action Plan (SEAP)

On 30 March 2010 the city of Tbilisi¹ became a subscriber to the EU initiated “Covenant of Mayors”² (CoM), thus taking an obligation to reduce the GHG emissions from its territory by at least 20% to 2020³. Tbilisi created a precedent which in the following years was shared by other cities of Georgia. Since 2010 up to now in addition to Tbilisi Georgia’s 9 self-governing cities⁴ and 4 municipalities⁵ have joined the Covenant of Mayors.

In accordance with the CoM demands, for the efficient implementation of voluntary obligations taken in the frames of CoM, Tbilisi in 2011 has developed and submitted to the European Commission the city SEAP⁶. In the preparation of Action Plan the Tbilisi City Hall was assisted by the project “Modern Energy Efficient and Lighting Initiative” executed by the Winrock International under the financial support of USAID.

At the development stage of Tbilisi 2011 SEAP it was preconditioned that the country and correspondingly its capital are developing intensively, economic activity, GDP and population are growing. Consequently the rising economy automatically causes the increase in the consumption of resources, among them the energy resources, as the demand on comfort and accordingly its supply are expanding.⁷ The strategic vision of this document was focused both on the curtailing of GHG emission sources and on the expansion of natural sinks of emissions removal (green cover). At the implementation stage the document also considered retaining city cultural and historical heritage, the involvement of stakeholders in the planning and execution processes, raising of population’s awareness and modification of their behavioral norms.

According to the requirements of CoM and the JRC Guidelines⁸ after developing the SEAP in the span of 2 years the self-governing entity should prepared the Monitoring Report on the implementation of planned measures and submit this Report to JRC, while after 4 years the inventory of GHG emissions must be performed once again concurrently with the monitoring of undertaken measures. To realize this requirement Tbilisi has worked out the SEAP Monitoring Report describing the results of 2014

¹ http://www.covenantofmayors.eu/index_en.html

² http://www.covenantofmayors.eu/about/signatories_en.html?city_id=1537

³ http://en.wikipedia.org/wiki/greenhouse_gas

⁴ Batumi, Kutaisi, Telavi, Gori, Akhaltsikhe, Rustavi, Mtskheta, Zugdidi, Poti.

⁵ Tianeti, Kazbegi, Bolnisi and Telavi Municipalities

⁶ http://www.covenantofmayors.eu/about/signatories_en.html?city_id=1537&seap;http://remissia.ge/index.php/ka/2014-12-09-16-12-09/seaps

⁷ http://www.covenantofmayors.eu/IMG/pdf/seap_guidelines_en-2.pdf

⁸ The mentioned judgment consonants with the Environmental Kuznetz Curve hypothesis, according to which the environmental conditions worsen till to improve not after which the living conditions start to improve not at the price of harming the natural resources, but in contrary under the state of their enhancement, https://en.wikipedia.org/wiki/Kuznets_curve#Environmental_Kuznets_curve.

monitoring by sectors, the status of enacting of planned measures and outcomes of their implementation.

Based upon the monitoring results and the experience gained in 2010-2014 while implementing the SEAP, as well considering upcoming priorities and strategic visions, Tbilisi has developed the updated SEAP introduced in the present document, which along with the Monitoring Report will be submitted to the CoM Secretariat. In the revised SEAP the 2009 and 2014 inventories are offered along with the updated baseline BAU scenario as well as the planned and already undertaken in each sector measures.

1.2 Tbilisi since 2009

In the period of 2009-2014 Tbilisi has underwent important changes by different signs or parameters. It could be said that these four years represent one of the crucial and interesting moments in city's history.

On the one hand, the city as a spacial and temporal living organism has directly reflected processes going on in the country, region and in the world- Tbilisi turned into rapidly growing, business-like, noisy, economically attractive, multicultural, surcharged with new buildings, roads and transportation city.

The population of Tbilisi has grown as well as its economic activity and, correspondingly, its consumption of energy resources. According to official statistics⁹ the Tbilisi population as of 1 January 2014 equaled to 1 175.2 thousand¹⁰, making the 3.4% rise in comparison to 2009¹¹ data. The number of employed and non-monetary means of population has grown by 45% in comparison to 2011¹².

Along with the growth of population and incomes the demand on different services and energy carriers has increased, manifested in the significant rise in the Tbilisi GDP. In particular, according to National Statistics Office data, in the period of 2009-2013 the average 6.8% growth of Tbilisi annual GDP has been recorded¹³ being by 2.3% higher than is was assumed earlier in the Tbilisi SEAP (Table 1).

Table 1. The growth of GDP in Tbilisi in 2009-2013

Years	2009	2010	2011	2012	2013	Mean annual growth, %
GDP in current prices, GEL	7 274.3	8 472.6	9 914.3	11 194.2	11 300.9	
Annual growth, %		16	17	13	1	11.6
GDP in 2003 fixed prices, GEL	4 887.9	5 242.4	5 602.8	6 261.9	6 366.0	
Annual growth, %		7	7	12	2	6.8
Assumption made in Tbilisi SEAP, %		4	4	5	5	4.5

Source: Georgia's National Statistics Office

⁹ http://www.geostat.ge/?action=page&p_id=151&lang=geo

¹⁰ In November 2014 the population census has been carried out in Georgia, according to preliminary results of which the population of Tbilisi made 1 118 035 persons. However this data was not used in the present Monitoring Report, as its application would cause the necessary of recounting the number of population in the period between the last two censuses, that is not yet competed and the final results will be known after publishing the sequel data (April 2016).

¹¹ http://www.geostat.ge/?action=page&p_id=142&lang=geo

¹² http://www.geostat.ge/?action=page&p_id=1201&lang=geo

¹³ During the development of present Monitoring Report the data on Tbilisi GDP were known only till 2013 (including).

On the other hand, the city having its management body and significant part of critically minded population, became thoughtful on defining its development objectives and priorities to ensure the evolution of the city not according to the independent processes, but in the frames determined by its own vision.

Specific steps taken in different sectors to reduce the GHG emissions and to improve the citizen's standard of living will be discussed in the Part 1.3. Now we should briefly take a look on the progress going on in the city in the sphere of strategic planning and efficient management.

In 2015 the competition has been held by the City Hall Architect's Office on the renovation of Tbilisi land-use General Plan¹⁴ representing principle document on the management of spacial and territorial development of the capital city. This plan was worked out and approved by the Tbilisi City Assembly in 2009¹⁵, though later analysis has revealed that the mentioned document is not valuable, comprehensive and correspondingly relevant record for providing the spacial development of the capital in the long-run period.

The selection of the concept of revised Plan and, correspondingly, its implementer was carried out according to different criteria, among them the GHG emissions reduction, energy efficiency, encouragement of public transport, cycling and walking, specific regulation of construction processes, etc.

At the same time, under the initiative of the same Office the new program "Morgenstadt-City of the future Initiative"¹⁶ has started, in the frames of which the assessment of current state of Tbilisi will be performed using about 90 different criteria (in Transport, Buildings, Greening, Waste and other sectors), including their analysis and planning of upcoming measures aimed at facilitating the sustainable development of the city. The results and conclusions of this initiative will be shared with groups involved in the renovation process of the Land-use General Plan and vice versa, that will substantiate the coordinated execution of these two parallel initiatives.

Apart from these two important undertakings in 2011-2014 under the Tbilisi City Hall inventiveness the recreation zone status has been restored to the land area of 2 million m², the permit on the construction of transportation line in the recreation zone has been abolished, the rules on the licensing of construction activities were revised and reconsideration of existing criteria (so called coefficients) is under discussion, under the assistance of Asia Development Bank the transportation development strategy for Tbilisi has been developed, the pilot project on the arrangement of cycling tracks and encouragement of cycling in Tbilisi is prepared with backing of Dutch company "Move Mobility", the interactive map is being prepared providing any citizen with information to move freely in the city (e.g. location and number of parking sites, buildings under construction, stops of public transport, etc.), the concept of the transfer of city dividing railway is under development, the Urban Management Department has been created at the Tbilisi City Hall Architect's Office, the main objective of which is just to promote city urban planning and its sustainable development.

¹⁴ <http://tas.ge/?p=content&type=3&news=51350>

¹⁵ <https://matsne.gov.ge/ka/document/view/2364385>

¹⁶ <http://www.morgenstadt.de/en/city-of-the-future-.html>

All the above mentioned circumstances suggest that a new stage is beginning in the life of the city of Tbilisi, at which its population and ruling body have to decide in concord what kind of city they wish to live in for the long-time perspective and what specific steps are to be taken to reach this goal. Important measures have to be carried out by Tbilisi City Hall in this direction, certain part of which is put forward in the present document.

1.3 Outcomes of Tbilisi SEAP Monitoring Report

As it was mentioned above, according to the CoM and JRC guideline demand, after 4 years of developing the SEAP, in 2015 Tbilisi City Hall carried out the monitoring of implementing measures which were to be executed in 2011-2014 in the frames of Tbilisi SEAP document under the plans of mitigation activities¹⁷.

The results of the monitoring make it possible to draw some definite conclusions on priorities and development tendencies revealed in each sector and, above all, what emphases should be made by city management to provide the implementation of commitments taken in the frames of CoM.

Transportation sector. In 2011 under the initiative of Tbilisi City Hall the new comfortable minibuses have been introduced along with the improvement and optimization of bus and minibus routes, 241 “DAF” type buses were withdrawn from the fleet in 2010, decreasing the energy consumption and emissions. Furthermore, a number of measures have been introduced, which may be directly do not cause emissions saving, but they contributed to the increase of public transport attractiveness, significantly rising (by 34.4%) its overall passenger turnover. In particular:

- The Tbilisi Transport Company (TTC) website has been set up and put into operation (<http://ttc.com.ge/>), allowing to plan the trip, finding the schedules, observing the bus movement in real time;
- Obtaining information on shuttle minibus schedules became possible at the “Tbilisi Microbus” website: <http://tm.ge/routes/site.php>;
- The information and advertisements on public transport were regularly broadcast by TV and other mass media;
- Electronic displays have been installed at the bus stops all over the city, allowing the population to define exactly the arrival time of the necessary route bus and make a trip in time;
- The flexible and preferential pay system has been introduced providing the payment of travel in any public transport using the Metro-money plastic card;
- 63 subway wagons have been repaired, etc.

As a result of all these activities the emissions from the public transport subsector have been reduced in 2014 by 28% compared to the baseline year, suggesting the important share of public transport

¹⁷ The monitoring of Tbilisi 2011 SEAP has been conducted with the preparation of corresponding Report under the technical assistance of the project “Enhancing capacity for low emission development strategies/clean energy program”, implemented by Winrock International.

optimization and as far as possible improvement in saving energy consumption and relevant emissions in the transportation sector.

Besides a number of measures have been undertaken by the City Hall, directly or indirectly facilitating efficient management and regulation of transport sector in general, including the private vehicles. In particular, since 2012 the Traffic Lights Control Center functions in Tbilisi, providing the regulation of Traffic flows in optimal regime; In 2009-2014 the planning of new streets, different connecting roads and tunnels has been undertaken, aimed at the traffic unloading and shortening of travel distances, etc. However it should be mentioned that emissions reduction from the private vehicles compared to the base year is caused by activities having no direct impact from the City Hall, e.g. the transfer of gasoline-powered cars to natural gas supply, etc.

The above mentioned factors allow to conclude that significant steps have been taken by the City Hall for rising the efficiency of Transport sector regulation and management. Although the prioritization by City Hall of emissions mitigation measures in the Transport sector, their coordinated implementation, the combined examination of their results and, that is most important, the mechanisms of direct or indirect impact of City Hall on the private vehicles' subsector are for the time being weak and more radical and concrete steps should be taken in this direction.

In **Buildings sector** the mitigation measures implemented by Tbilisi City Hall were conducted mainly in the municipal buildings subsector, though the major part of emissions is relevant to residential and commercial buildings. The outcome is evident- according to Tbilisi 2011 SEAP the annual saving of emissions from the Buildings sector by 2020 was to be 188.2 GgCO₂eq, while actual saving in 2014 made 16 Gg, representing only 8.5% of planned value. Moreover, compared to baseline scenario this 16 Gg make only 1%, suggesting the need for intensified activities and new planning in the Buildings sector.

Ensuining from the existing mandate and legislative framework, the City Hall has no function and intention to be directly involved in private buildings possessors' and flat owners' decision making process. The function of the City Hall is to substantiate private owners as much as possible (by adopting relevant regulations, putting in order of legislative frames, introduction of stimulation mechanism and raising of awareness) in carrying out energy saving measures in residential or commercial buildings and alleviate for them the deployment of these measures. Specific measures in this direction are being planned in the City Hall, discussed in more detail in the section of upcoming measures. At the current stage, under the City Hall initiative various pilot projects are carried out, that is not sufficient, but creates important precondition for more substantial changes. E.g. the City Hall has implemented pilot project in the Temka Settlement, No.3 micro district, No.5 block, No.20 building. In particular, the heat supply of the building has been enacted from the common heat generator, placed at the rooftop of the building. Heat meters were installed in each flat for accounting the energy supply.

Along with the heat generator 23 blocks of vacuum-pipe solar collector with total area of 95 m² were mounted at the roof as well to provide hot water supply. Aimed at energy saving the double metal-plastic window-frames were installed with the total area of 272 m². The building has been divided into 2 parts (blocks A and B). In the block A the external walls, ceiling and the floor (from the basement side) were thermally insulated, while in the block B- were not. This was done to define the share of thermal insulation measures in saving the energy consumption.



Picture 1. The pilot residential building

During 2010-2014 the following measures have been implemented in the Tbilisi City Hall municipal buildings sector:

- Central heating systems have been mounted in 39 kindergartens;
- Energy efficient lamps were installed in 113 kindergartens;
- Wooden door and window frames were replaced by metal-plastic ones in 107 kindergartens;
- Solar energy saving system was adopted in 3 kindergartens;
- 27 113 sensors were installed in residential buildings by Tbilisi Municipality district authorities in collaboration with flat-owners' cooperatives using the co-financing mechanism;
- Pilot projects on renewable energy application and energy efficiency were implemented in different state and commercial buildings.

From the listed above measures it is evident that most of all and at the same time organized and coordinated mitigation measures were conducted in Tbilisi kindergartens. One of the preconditions for this situation is the fact that Tbilisi kindergartens are managed by City Hall non-commercial and non-profit legal entity "Tbilisi Kindergartens Management Agency¹⁸". This factor makes it possible to conclude that one of significant facilitating conditions for the purposeful planning and coordinated implementation of these measures is the presence of effective orchestrating body/unit. Currently in Tbilisi City Hall there is no joint body coordinating the Buildings sector, that represents a perceptible barrier to the planning and efficient realization of mitigation measures in this sector.

From this standpoint an important step has been taken in the **Street Lighting** sector as well. In particular, in 2010 the Tbilisi City Hall has established LLC "City of Light" providing the outdoor illumination of capital's streets. This company has installed and currently operates so called "Ecosystems", maintaining the stabilization of tension in the grid. In 2014 this device was mounted in 150 cupboards out of 784 existing ones, resulting in the saving of about 983 000 KWh during the 9 months of 2014. Currently the complete licensing of the system is underway and the installation of same

¹⁸ <http://kids.org.ge/>

“Ecosystems” in other cupboards is under examination. From 2015 the transfer of entire system of street illumination to the LED streetlights is planned in the city.

As to the Tbilisi **Green Cover** sector, in 2010 the Environment and Greening Department was set up at the Tbilisi City Hall, being responsible for carrying out the monitoring of greening and ecological state of city environment. During 2011-2014 both the increase and the reduction of greenery areas has been revealed. In particular, the total growth of planted areas made 21.5 ha, while their reduction was equal to 182.5, giving net downsizing of greenery by 161 ha. More specifically, under the initiative of the City Hall green areas in the city were extended and trees were planted at different sites (about 80 775 saplings). At the same time, in 2011 the 8 106 ha of forested area around Tbilisi has been transferred to the city authority.

According to 2015 data no GHG emissions reduction measure has been implemented in the **Waste sector**, that was being planned under the Tbilisi 2011 SEAP.

TBILISI IN 2020- A STRATEGIC VISION

Prior to the development of detailed plan it is important to initiate a strategic vision of city expansion. A version of what Tbilisi should like to be in 2020 in case of implementing the presented plan is offered below.

Strategic vision

In 2020 Tbilisi will be transformable according to European rules and developing city, having obtained important achievements. First of all, the city will have a strategic vision of long-term development including not only sustainable energy, but urban (land-use) and economic development plans and different sectorial strategies as well, being harmoniously interrelated and coordinated.

The city will have flexible, rapid, comfortable and diverse public transport, properly competing with the private transport, comfortable and pleasant walkable localities and routes, improved air quality.

The public will demand to plan new buildings according to sustainable development criteria. The population will possess knowledge and possibilities to rise the standard of living without increasing the expenses on energy resources. Commercial consumers will be more active in saving energy resources in buildings and their sustainable management. Municipal and other state buildings will set an example for them.

The street lighting in the city will be completely replenished by energy efficient lanterns, the greenery areas will be extended and rendered more healthy. Landfills and wastewater treatment will be managed in a sustainable way.

The awareness of general public on sustainable development and energy saving measures will be raised. The managerial team of the city, its population and the private sector will contribute to the

creation of sustainable development and European future of the city and the country.

For the achievement of these goals the implementation of Sustainable Energy Action Plan is of major importance, which apart from emissions reduction and execution of commitments under the Covenant of Mayors will condition other positive changes as well. These expected alternations are listed below.

Why is it necessary to have Energy Sustainable Development Plan

- **Improvement of standard of living-** The majority (72.5%) of Tbilisi population is living in fuel poverty¹⁹ conditions. At the same time the population is hard to pay energy expenses. The efficiency measures allow to increase the comfort level and overcome the fuel poverty without significant increase of family expenses on energy resources.
- **Environment protection-** The reduction of fuel consumption and the transfer to new up-to-date technologies on the one hand cuts the emissions of GHGs causing the climate change, and at the same time decreases local pollutants and improves the air quality, positively influencing the health of the population.
- **Saving of energy resources-** Georgia is importing natural gas and oil products from the neighboring countries, while for the covering of its growing demand on electric energy it needs additional local capacities requiring significant investments. The reduction in energy consumption makes it possible for the country to discount its dependence on the neighboring countries and use more efficiently electricity generated in the country.
- **Reduction of expenses-** In a number of cases (completely heated buildings, street lighting) the energy efficiency measures bring about essential cutback in expenses on energy carriers.
- **Encouragement of economic development-** The necessity in the sustainable development of energy will facilitate the creation and stimulation of new kinds of business, stimulating in its turn the development of new possibilities and new jobs.
- **Important step on the way to Europe-** Georgia is moving on the way to Europe. To become a full member of the European Community the relevant legal and living environment should be created in Georgia. One of the crucial preconditions for attaining this goal is the implementation of energy efficiency and renewable energy measures.

With the fulfilment by 2020 of the SEAP Tbilisi plans to reach the 24% reduction of emissions compared to the baseline scenario, making 1 221 Gg in CO₂eq.

For attaining this reduction a variety of measures have to be taken in the following directions:

1. Transportation
2. Buildings
3. Street lighting
4. Solid waste
5. Wastewater
6. Greening

¹⁹ This refers to the situation when the living space could not be sufficiently heated.

7. Urban planning
8. Demonstration and pilot projects.

The strategic objectives of each direction are discussed in corresponding sections of this Report. At the same time the Tbilisi City Hall will develop the public awareness raising plan, the strategic goals of which are described in Chapter 6.

GREENHOUSE GAS EMISSIONS IN TBILISI

The GHG emissions for 2009 and 2014 inventories in Transportation, Buildings and Street Lighting sectors are calculated by the IPCC Guidelines Tier I sectorial approach adapted to local conditions

formula, based upon the actual data on fuel consumption²⁰.

Electric energy emission factor

In the Tbilisi 2011 SEAP the electricity grid emission factor was taken to be 0.39995 tCO₂eq/MWh, calculated with the CDM methodology. In the present SEAP Georgia's actual average emission factor is used, calculated for each year as the ratio between the amount of GHG emissions from the entire electric energy generation sector and the total amount of generated electricity. In 2009 the emission factor was equal to 0.089 tCO₂eq/MWh and in 2014- 0.104 tCO₂eq/MWh.

The use of average emission factor well portraits GHG emissions from the territory of Tbilisi at the background of the whole country and allows to compare it with the emissions from other cities. However the application of this factor for the monitoring purposes creates additional difficulties, since it varies from year to year and consequently affects the annual emissions. Hence in the Monitoring Report the inventory was undertaken using both the CDM factor and the average factor, though in this Report the average emission factor is used.

In 2009 in Tbilisi 9 175 GWh of energy has been consumed in the mentioned above sectors, while in 2014- 13 461 GWh of energy. Although the consumption of energy has increased by 47%, from which in Transport sector it has increased by 43%, in Buildings sector- by 52% and in Street Lighting sector- only by 11%. It should be mentioned that in Transport and Buildings sectors the driving parameters are the same (GDP and population), though in buildings the energy consumption has increased faster. This is caused by the fact that in this sector relatively less measures have been carried out than in the Transport sector. Therefore, if in 2010-2014 virtually no measures were not taken in the Transport sector, the emissions were to be increased there at a faster rate as well.

As to the GHG emissions, that from the Transport sector has increased more slowly (only by 33%) than the energy consumption. This is caused by the substitution in transport of gasoline with the natural gas, reducing the emissions, but not the energy consumption. On the contrary, in the Buildings and Street Lighting sectors the emissions are growing faster than the energy consumption, that is conditioned both by the increase in electricity emission factor and by the rise in gas consumption relative to other energy carriers (electricity, firewood) in case of buildings.

²⁰ As to the methodologies applied in the Waste and Greening sectors, they are described in 2011 SEAP and are not cited here.

Table 2. Energy consumption and GHG emissions in Tbilisi for 2009 and 2014

Sector	Energy consumption (GWh)			Emissions by average factor (GgCO ₂ eq)		
	2009	2014	Change %	2009	2014	Change %
Transport	5 106.73	7 308.21	43	1 289.69	1 709.95	33
Buildings	4 021.59	6 101.30	52	635.77	1 045.68	64
Street Lighting	46.80	51.72	11	4.18	5.39	29
Solid waste				420.82	461.71	10
Wastewater				155.90	154.45	-1
Total	9 175.12	13 461.22	47	2 506.36	3 377.18	35

The methodology of Tbilisi SEAP elaboration does not imply the use of a settled baseline year which may hamper the city development process and impede the implementation of obligations taken by the city. The methodology applied in the present document foresees the prospects for the expansion of the city and indispensable growth of emissions (resulting from rising demand on energy carriers) by 2020. This growth is considered in the BAU scenario, in relation to which the emissions are reduced due to the implementation of various measures and project proposals.

Business-as-Usual (BAU) scenario describes the development of the system in a way that does not envisage any important changes in conduction of policy, human behavior or in technologies, i.e. the development proceeds without significant changes.

In other words this scenario is called a baseline scenario.

While developing the Tbilisi 2011 SEAP the computer model of Tbilisi energy system was created using the LEAP²¹ program, applied for the projection of baseline (BAU) scenario. It is based upon the 2009 inventory and projects energy consumption in future using the

²¹ Heaps, C.G., 2012. Long-range Energy Alternatives Planning (LEAP). Stockholm Environment Institute. Somerville, MA, USA. www.sei.se

Long-range Energy Alternatives Planning System LEAP

The LEAP is used by hundreds of institutions in more than 150 countries worldwide. It is used by state bodies, academic institutions, NGOs, consulting companies and energy institutes. It is applied at a variety of different levels in city, state, national, regional and global planning.

The LEAP is constructed around the analysis of long-range scenarios. The scenarios themselves include the description of energy systems' development pathways through the defined time period.

By using the LEAP political analysts can create and assess alternative scenarios considering their energy demand, social expenses and benefits, as well as environmental impact factors.

The LEAP scenario control system could be used in describing separate political measures, giving an opportunity to unite them further in different combinations of alternative scenarios. With such approach politicians are able to assess the efficiency of taking concrete political measures and the anticipated results of combined implementation of different policies.

forecast values of economic and demographic driving parameters. The scenario was founded at the forecasted values of Tbilisi economy and population growth. In the process of monitoring under the consideration of revealed in 2009-2014 actual changes in economy and population, as well as in trends of energy resources consumption, the baseline scenario has been recalculated. At the same time 2 subsectors were added to the baseline scenario “Other commercial buildings” and “Motorcycles”, earlier not accounted for. All changes occurred to the baseline scenario, are described in Annex B.

The recounted baseline scenario is presented at Figure I. According to this scenario by 2020 the emissions in Tbilisi will reach 5 088 GgCO₂eq.

Ensuing from the SEAP emissions reduction measures should provide the 24% saving of emissions, making 1 221 GgCO₂eq. In the following Chapters the Action Plan is presented, in which the amount of saved emissions is given, expected as a result of taking planned measures. The savings are distributed according to sectors as follows (Table 3).

Figure I. Baseline scenario of emissions growth

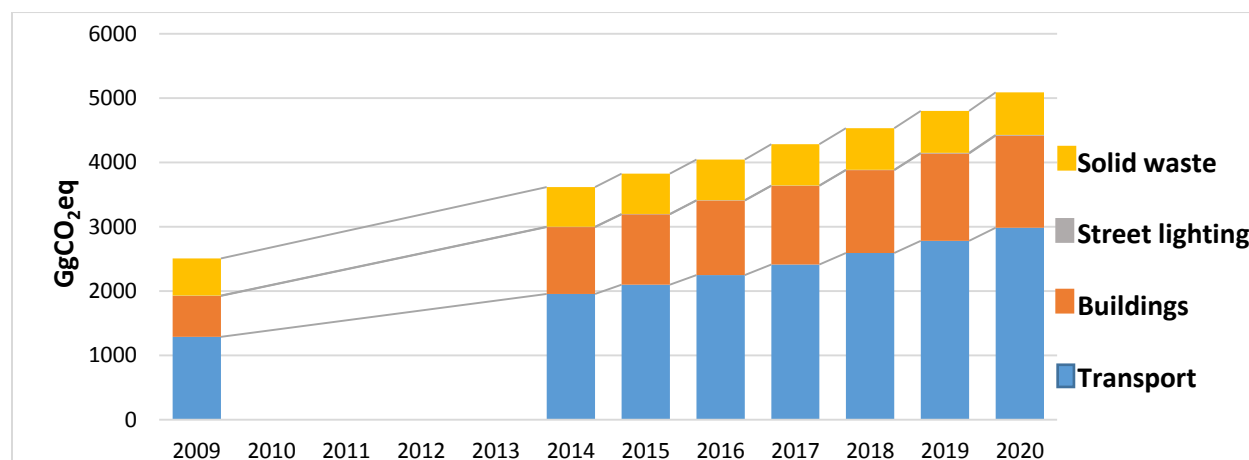


Table 3. Expected emissions reduction according to sectors due to implementing the SEAP measures

Sector	Emission reduction (GgCO ₂ eq)	Emission reduction (%)
Transport	561	46.0
Buildings	180	15.0
Street lighting	3	0.2
Solid waste	249	20.3
Wastewater	164	13.3
Greening	11	0.9
Urban planning	50	4.1
Pilot and demonstration projects	3	0.2
Total	1 221	100.0

The results of 2014 monitoring have proved that about 247 Gg of emission is already saved due to measures undertaken during the period of 2010-2014, making nearly 20% of anticipated savings. Attained emission savings according to sectors, resulting from the implemented by 2014 measures are shown in Table 4. As it could be seen from these data, the major part (93%) of savings are got from measures conducted in the Transportation sector.

Table 4. Emissions reduction resulting from measures undertaken during 2010-2014

Sector	Emission reduction (GgCO ₂ eq)	Emission reduction (%)
Transport	230.0	93.0
Buildings	16.0	6.5
Greening	18.3	0.5
Total	264.3	100.0

IMPLEMENTATION, MANAGEMENT AND MONITORING

The process of SEAP preparation for Tbilisi and its monitoring has clearly revealed major barriers which could seriously disrupt the implementation of the Plan and, in general, the development of the city. Thus, it is necessary to appropriately assess all these disclosed barriers and determine ways to overcome them.

Resulting from these assessments it has been defined that the SEAP implementation process will have to deal with three types of barriers, namely:

- Barriers, existing in general in the country as a residual of past practices, caused by present economic and social problems or related with the lack of knowledge in technologies;
- Barriers typical for Tbilisi;
- Barriers related to the specific project proposals, measures and technologies.

List of first type (general) barriers is given at the following scheme.

Barriers to the process of sustainable energy development in Georgia

- 1. Wasteful approach to the energy resources**, existing in society since the Soviet period, as at that time the energy was almost free and unlimited. Presently the energy tariff in Georgia is low again and is being subsidized;
- 2. Insufficient awareness of local authorities and the population on the process of sustainable development.** This concept is mainly recognized by a very small portion of society directly involved in this problem;
- 3. Lack of common vision** on relatively long-range prospects of energy sector development (different target groups yet stand at sharply contrasting positions, not to be often confirmed by realistic calculations);

4. **There is no common, well-considered and formulated vision of the role of energy efficiency and renewable energy resources** in the short-term and long-run perspective of Georgia's energy sector development, while in recent years on the average a 10% annual increase in energy demand is on the record. Correspondingly the potential of mentioned resources (except the hydro) is not defined as well as the directions of their development, the relevant legislative basis is not elaborated and the objectives are not determined in contrast to country gasification or hydro energetics programs;
5. **Inferior and highly risky technology market.** The failure of each new technology or the demonstration project seriously affects further development prospects in this direction. The long-range planning of energy sector is not conducted considering the availability of technologies;
6. **Activities on energy efficiency and renewable energies (except hydro) mainly are carried out by separate NGOs in an uncoordinated and non-purposeful manner.** Although it should be mentioned that nevertheless the energy efficiency in the country is growing, to some extent facilitated by the market of modern technologies (predominantly domestic) and intrusion of international energy standards in Georgia.

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

Barriers to the Tbilisi sustainable energy development

1. **Lack of substantiated information and surveys limiting** the capacity of Municipality to plan the emissions reduction measures in proper way and at the same time to work more actively with the general public in informing correctly on contemporary processes taking place in different spheres (climate change, role of low energy efficiency and carbon fuel in energy consuming sectors, development of green and risk-resistant sustainable cities) and the positive function of these processes in the life of the city and the provision of safe and healthy environment for each citizen.
2. **In the energy efficiency and energy sustainable management sphere** Tbilisi faces the same major barriers as Georgia's all self-governing cities- it is their complete dependence on the centralized energy supply in energy sector and full reliance on the private sector concerning other energy carriers. This dependence on centralized processes partly deals with the gas supply sector, where municipalities mainly rely on the processes determined by plans worked out under the central government guidance. As to the gasoline, diesel and other kinds of fuel, this is the prerogative of private importers. Correspondingly, at this stage municipalities have no vision on their roles in the energy planning process, as well as on the risks related with centralized supply and do not plan measures to lessen these risks and hazards;

3. **The Tbilisi City Hall has no complete statistics on the energy consumption by the city that would serve as a basis for the planning of growing energy demand of the town.** There is no vision and strategy to foresee the energy supply of the city in case of failure of one of present rings of energy provision. Accordingly, the town has no sufficiently thought out energy efficiency substantiation, determining its role in the process of sustainable socio-economic development of the city. There is no vision of what problems the town could face in case of rapid growth of economy and number of population, as well as intensification of traffic.
4. The Tbilisi Municipality has no **relevant experience, knowledge and no sufficient expert potential to plan**, manage and implement the energy sustainable development process. In particular, in the short-run strategy for the energy sustainable development process in Tbilisi the priority sectors are the **Transport sector and the growth of energy efficiency of private buildings with elaboration of relevant programs.** However, for the preparation of long-range programs on energy efficient rehabilitation of buildings and implementation of energy efficient measures the presence at the site of skilled personnel is necessary, being unavailable at the present stage.
5. An important barrier is as well **the absence of additional funds** (most of the budget resources are directed towards the infrastructure development and social projects) for the expansion of sustainable development course (concerning the provision of energy sustainable consumption by the city);
6. **The energy resources consumption sphere is unmanaged and chaotic** at the Municipalities level and entirely in the country as well;
7. In the case of Tbilisi more or less all these barriers are acute, which are typical and general for the whole country.

Apart from the discussed above barriers related with the general development of local technologies, their import and dissemination, there are specific barriers concerning each concrete technology, which are to be envisaged in the process of SEAP implementation for the assessment of applied technologies.

Barriers related with measures and technologies

1. **Lack of knowledge on emissions reduction measures-** Often the technologies are regarded as an only way in reducing the energy consumption and emissions, while general public has no idea on emissions curtailing potentialities by policy and programs, as well as other “soft” measures which could make important contribution on the way to sustainable development.
2. **Lack of knowledge about modern energy efficient and renewable technologies available at the international market.** Only a few technologies are assessed and studied for their adaptation in Georgia, that significantly increases risks related with their introduction in the country. Private banks and the private sector are not willing to take upon these risks. Consequently, the import of technologies, their dissemination and adoption is almost totally in the hands of non-governmental sector or those big investors who are interested in developing markets for their own technologies. Accordingly, high technologies, which are imported at the limited scale, are accompanied with large part of worthless technologies. At the same time this is mostly determined by the cost of technology and unfortunately even for the short-time prospective;
3. **Lack of knowledge about the local environment**, in which certain technology should

operate. Studies of these aspects bring additional burden to technologies;

4. **Lack of knowledge and awareness on environmental and social counter-indications.** The study of technical risks associated with technologies requires profound understanding of technology by the accepting party to insure relevant assessment of risks and their minimization;
5. **Lack of sufficiently trained local personnel** which could be able to select correctly certain technology with respect to local conditions and provide its proper operation. This problem is especially acute at the municipalities and self-governing cities level.

For the planning of measures on the monitoring of Tbilisi SEAP implementation and GHG emissions reduction it is very important to define the internal structure of local self-government's executive body. The scarcity of financial and human resources should be taken into account, as well as the lack of relevant technical skills and knowledge.

At the present stage the SEAP implementation and management is conducted by Tbilisi City Hall Urban Department of Economic Policy, which along with other departments and organizations is gathering the information by communicating with them on the official level. At the same time for providing technical assessments and planning the City Hall is leaning on the external assistance, provided in this case by the EC-LEDS project. During the SEAP implementation and monitoring period it has been revealed that the personnel allotted for the conduction of SEAP is insufficient and under such conditions the collection of information becomes very time-consuming and complicates the coordination. In some cases the information is completely unavailable (e.g. about the municipal buildings). Therefore it is important to set up one common structure which will lead and coordinate the SEAP implementation and monitoring processes. That structure will be the Sustainable Development Agency. In the Tbilisi City Hall in the frames of "INOGATE" project in the nearest future the "Energy Efficient and Renewable Technologies Demonstration Center" will be created, which later may be transformed into the Sustainable Development Agency, combining at the same time the management, implementation and monitoring of the SEAP, though presently the Terms of Reference of the Demonstration Center is not yet worked out.

Considering all above discussed barriers and aimed at overpassing them, the implementation, management and monitoring measures have been developed described below.

Activity MMI - Setting up of Sustainable Development Agency. This Activity implies the creation of a separate structural element, which along with obligations to the city sustainable development will be responsible for coordinating the SEAP implementation, provision of appropriate funding, as well as the development and presentation of projects, conduction of awareness raising measures and monitoring. It will closely cooperate with the City Hall structural units and LLCs, responsible for the fulfillment of measures in different sectors such as Transport Department, "City of Light", the Environmental and Greening Department, "Tbiliservice Group", the Architect's Office, etc.

At the same time, the important task to be entrusted to this Agency will be the conduction of buildings' inventory and planning of measures in this sector. During the execution of monitoring it has been revealed that one of the major problems in the Buildings sector is the absence in the City Hall of a structural unit responsible for both municipal as residential, as well as other types of buildings, existing

in the city. Therefore it is essential to place this responsibility on some entity, e.g. on the Sustainable Development Agency.

In the frames of this function it will be in charge of accounting the buildings, collecting the information on their state, planning of measures and their implementation.

The Agency will be accountable for the collaboration with other Departments and City Hall units on ensuring the integration of energy sustainable development strategy in all sectorial strategies and formation of common vision for the city of Tbilisi.

It will be responsible as well for the coordination of energy efficient and renewable energy measures with the Ministries of Energy and Environment and Natural Resources Protection, for the coordination of regulations- with the Ministry of Economy and Sustainable Development and of financial measures- with the Ministry of Finance. At the same time it will coordinate its activities with other Municipalities.

Activity MM2- Training of personnel for management, planning and monitoring, as well as sectorial staff trainings in sustainable development different directions.

The personnel training strategy is described in Chapter 6.

Activity MM3- Development and implementation of Action Plan on awareness raising.

The awareness raising strategy is described in Chapter 6.

Activity MM4- Elaboration of strategy for securing financial support to the energy sustainable development plan.

The development of financial support strategy is the most important item for the successful implementation of the SEAP. This activity implies as well fund raising according to this plan for carrying out mitigation measures, preparation project proposals, etc.

Activity MM5- Development of systemic processes related with collection of statistical data for monitoring and creation of database.

This activity implies taking the following measures:

- Complete inventory of municipal buildings and regular accounting on their energy consumption;
- Setting up of communication system with the gas and electricity distributing companies to provide getting regular information from them;
- Setting up of communication system with Georgia's Ministries (of Internal Affairs, Energy, etc.) to provide getting regular information from them;
- Setting up of internal communication system (with City Hall Departments, services and LLCs) to provide getting regular information from them;
- Defining of parameters in the framework of cooperation memorandum with the National Statistics Office, that will be gathered by the Statistics Office and presented to the Agency.

At the same time organizing other types of monitoring measures is considered, such as questionings and social surveys on the effectiveness of GHG emissions reduction measures and the attitude of general public towards them.

Activity RB3. Research and introduction of new technologies.

One of the impending barriers to the adoption of new technologies is the lack of research to establish upcoming plans on them. Therefore one of the functions of the Agency should be the definition of surveys aimed at the expansion of energy efficiency and renewable energy application in practice, gaining financial support from the Rustaveli National Science Foundation or other research promoting organizations, the coordination of research and providing with data. This could be a research e.g. on the availability of renewable resources, or on the introduction of some new technology, etc.

THE ACTION PLAN

1.4 Measures to be introduced in Transportation sector

In 2014 GHG emissions from the Transport sector made 31% of overall emissions from all sectors examined in Tbilisi SEAP, making 33% rise compared to 2009 emissions. It ought to be mentioned that in the Transportation sector the increase in energy consumption is higher than the growth in emissions, being a result of the transfer of perceptible number of vehicles from gasoline to gas power supply.

Facts about the Transport sector

- According to 2014 GHG inventory results the highest emissions from the Transport sector are associated with private cars (36%), taxis (30%) and commercial vehicles (27%);
- In Tbilisi the share of public transport makes only 6%;
- The public transport consists of buses, minibuses, subway and cable-car. The funicular tram is functioning as well;
- In Tbilisi in 2014 total number of recorded passenger cars equaled to 245 213, making 209 cars per 1 000 persons;
- 90% of cars, owned by Tbilisi population is aged 10 years and more, and majority of them (57%) is produced in 1995-2005;
- In private cars the most widely used fuel is gasoline (71.1%). In 2014 the consumption of natural gas has significantly increased in comparison to 2009, making 26.3% of total energy consumption in the sector. The diesel is used only by 2.6% of cars owned by the population;
- The number of taxis has significantly increased in Tbilisi, though their exact number is to be determined by additional survey;
- In Tbilisi 22 405 commercial vehicles are registered. Their number is increasing in direct proportion to the growth of Tbilisi GDP.

In Tbilisi Transportation sector the implementation of GHG emissions reduction measures is facing a number of significant barriers.

Barriers and challenges

- The technological provision of public transport (new buses, subway stations and cable-cars) requires essential financial investments, being hard to provide for the developing city;
- In Tbilisi, like in Georgia as a whole, the private car is a visual demonstration of the social status and provides comfortable trip. That is why it is difficult to overpass the psychological affection of population towards the car;
- In view of social problems of the population it's hard to take the measures increasing its expenses (paid licensing of taxis, high parking prices, etc.)
- Such important measures as the technical inspection of cars, keeping of fuel standards, banning of the import of old and right-wheeled cars are regulated at the state level and are

outside the competence of local authorities. However the introduction of these measures is linked with a number of problems as well, as it will increase the fuel prices and expenses of the population;

- There is no reliable statistics on the transport, riding in the city.

The strategic goals of the SEAP in the Transportation sector are as follows:

Strategic goals

- To develop the public transport and make it faster, more comfortable and available, to provide its competition with private transport and attract more passengers;
- To convert the public transport into more diverse and safer kind of transportation;
- To turn walking in Tbilisi into comfortable and attractive way of movement, to introduce well-considered walkable routes.

To realize these strategic goals a number of measures are planned, described below.

Activity PBI: Renovation of bus fleet and its conversion to environmentally cleaner fuel

The existing bus fleet is obsolete and technically out of order. Therefore the most important and priority measure for Tbilisi public transport is the renovation and expansion of bus fleet, as all other measures become meaningless if the population is not offered by the sufficient number of alternative comfortable public transport. That is why it is of urgent necessity to timely purchase new buses.

The Tbilisi City Hall Transport Department and Tbilisi Transport Company (TTC) have examined in detail different city models of buses offered by various companies and conducted intensive consultations with them. As a result, the necessary technical parameters require the purchase of fitting European standards, low floor, operating on natural gas, equipped with air conditioner, adapted to disabled persons bus. The acquisition of 7.5, 10.5 and 12 m long buses is planned. The selection of natural gas as a fuel was conditioned by its relative environmental cleanness and efficiency compared to other types of fuel. Aimed at the provision of produce quality and fitting with contemporary requirements, the TTC in the first place has chosen the conformity of buses with European standards. In particular, the offered buses should comply with the European Parliament Directive No. 2007/46/EC, and the exhaust standard should comply with the Euro-6. Such demands are met by the MAN company Lion's City CNG bus, being one of the main pretenders to the contest.



Picture 2. MAN Lion's City CNG type bus

For the valuable provision of Tbilisi population with the bus services the city requires no less than 800 buses. They should be purchased step-by-step and the fleet will be filled up by 2020. The cost of one bus varies in the range of 200-250 thousand euro. Consequently, the total cost of this measure is about 180 million euro. At the time being the Tbilisi City Hall is searching for the financial support sources, after which the steps of bus purchasing will be planned.

To calculate the GHG emissions reduction it has been assumed that by 2020 all diesel-powered buses will be substituted by natural gas-powered vehicles and the new comfortable buses will attract about 10% more public transport using passengers compared to baseline scenario. Correspondingly, to 2020 the emissions saving will make nearly 15 thousand tCO₂eq, though the saving of energy actually will not take place.

Activity PB2: Arrangement of public transport special transit lines and planning of routes

This measure first of all includes the introduction of dedicated bus lanes that will allow the public transport (buses and minibuses) to operate/drive more freely, without contacting to other kinds of transport. Consequently these lanes provide the faster movement of passengers than by private transport, decreasing at the same time the number of road accidents.

To carry out this measure first of all Tbilisi streets and passenger flows will be studied to identify the areas where the arrangement of such lanes is possible and they should provide the maximum efficiency. The arrangement of lanes is examined at one- way streets against the transportation flow. It should be mentioned that such streets already exist in Tbilisi having dedicated lanes for public transport, e.g. the Agmashenebeli Avenue and the Gorgasali Street. The monitoring has indicated that this measure significantly affects the speed of public transport movement.

For the conduction of this measure the cooperation with the Patrol Police will be essential with the introduction of fines for private cars crossing the public transport special lines and strict administration of violations of such type. Other preliminary activities include the training of drivers to move on dedicated lanes, awareness raising of general public, etc.

The measure will be implemented by Tbilisi City Hall Transport Department using its own resources. The information on the necessity of additional expenses is unknown at the present stage.

Corresponding to the growth in the number of buses the network of shuttle minibuses will be reorganized- new schemes will be added and new routes will be set up, some routes will be extended. The basis for planning the routes will be their optimization (in particular the financial, considering the reduction of expenses on fuel consumption) accounting for the passenger flows and creation of maximum comfort for the passengers. The integration of public transport special transit lines with the shuttle minibus schemes will be envisaged along with the optimization of their routes. The measure will be permanently conducted by the Tbilisi City Hall Transport Department.

Under the routes optimization measures significant saving of GHG emissions has been already attained in 2014 (77.2 thousand tCO₂eq). On the other hand, the addition of special transit lines will cause the gaining over of taxi and private car users to public transport. For calculating the emissions reduction it has been assumed that with the introduction of special lines about 2% of population will be transferred from private transport to public one, additionally saving 47.3 thousand tons of GHG emissions. Altogether by 2020 this measure will provide saving of emissions by 124.5 thousand tCO₂eq.

Activity PB3: Information campaign on public transport popularization and other ways of improving services

Apart from the listed above activities, other activities are also underway, aimed on the one hand to popularize public transport, and on the other hand- to increase its comfort. In the preceding version of the SEAP they were presented separately as the components of preferential direction, though at this stage other measures have gained advantage and the popularization measures were combined in one activity. Most part of activities included in this measure has been already implemented during 2010-2014 (see the Monitoring Report) and therefore their support is necessary in future. These measures are as follows:

- Increasing the comfort and attractiveness of bus stops/stations (covering, raising compatibility with the city landscape, etc.);
- Installing electronic displays at the stops/stations;
- Introducing flexible pay systems;
- Providing comfortable and safe transportation by shuttle minibuses;

- Supporting the information portals;
- Other.

The objective of introducing the above listed measures is to increase the priority of public transport in the process of city transportation planning and to undertake the measure that will increase the comfort, rapidity and safety of public transport. At the same time, under the information campaign, as many as possible citizens should be informed on the innovations adopted in the public transport and advantages of this kind of transportation. As a sequel of this, more citizens preferring to use taxi or private car, will utilize public transport. Resulting from measures taken in 2010-2014, the increase in passenger turnover by 34% has been observed (excluding the second trip in 90-minute transfer) instead of 25% rise, planned earlier. To calculate the emissions saving the assumption was made, according to which this tendency will continue and by 2020 the passenger turnover in public transport will grow by 15% compared to baseline scenario assumption. As a result of this total emissions from the Transport sector in relation to the baseline scenario will decrease roughly by 47.3 thousand tons.

In 2014 nearly 2.5 million GEL was spent from the Tbilisi Municipality budget in this direction. The allocation of funds for this purpose will continue further, although the amount of funding is not known in advance.

Activity PB4: Opening of the subway station “University”

The metro station “University” was planned as a terminal for Saburtalo line with the combined train deadlock infrastructure. The construction of this station had been started decades ago, shortly after halted and transferred into conservation regime. In 2011 SEAP the completion of this station’s construction was considered. However, the activities started on 20 June 2015. According to project design, putting the station into operation is planned in 24 months after the commencing of the work. The project is implemented by the Municipal Development Fund under the financial support of the Asia Development Bank. The competition for extension of Tbilisi Metro second line and the construction of metro station “University” has been won by the Spanish companies “Cobra Instalaciones Y Servicios, S.A.” and “Assignia Infraestructuras, S.A.”. The cost of this undertaking equals to 83 000 670 GEL.

As it was indicated in the survey, conducted by the SYSTRA in 2011, resulting from the construction of this metro station about 4.4 million more passengers will use the subway annually. Correspondingly the GHG emissions will be reduced by nearly 20.8 thousand tons.

Activity PB5: Energy efficient lighting in the subway

During the rehabilitation of subway carriages in 2013-2014 the ЛБ-20 type luminescent lamps have been replaced by LED lanterns. Lamps were substituted in 20 wagons and 860 bulbs were replaced in total with 11 520 LED cells. By this measure the annual saving of electric energy makes $(17.2-12.2)*10*365=18\ 250$ KWh and 7.3 tCO₂eq of GHG emissions.

Altogether 63 wagons have been repaired in 2010-2014, costing in total 39 816 037 GEL, out of which the cost of lanterns is estimated about 172 000 GEL; i.e. 15 GEL per one LED cell.

At the same time, nearly 30 900 illuminators are placed in metro stations, tunnels and buildings, annually consuming 5 189 414 KWh of electricity, that costs 622 730 GEL.

In the upcoming period the substitution of existing lighting system by contemporary LED lamps is planned, presumably costing about 500 000 GEL. This measure could save annually 2 594 712 KWh of electricity and reduce the lighting expenses by 311 365 GEL according to present electricity tariff. With this measure 272 tCO₂eq of emissions will be saved in total by 2020.

Activity PB6: Encouragement of cable-car and other electric transport development

The tram. In the 2011 SEAP the introduction of tram in Tbilisi was planned in the period of 2018-2020 with 3 proposed lines: the 16 Km tram line from metro Delisi to Samgori; the 15 Km line from Chavchavadze Avenue to Rustaveli Avenue and the 23 Km long line from Didi Dighomi to Samgori metro. The economic and technical examinations have revealed that investment cost of the projects is extremely high, as in the meantime no infrastructure exists to be used by the tram and everything is to be made anew; including the park for the fleet. Therefore the tram is not considered in the context of Tbilisi public transport till 2020 and the emphasis is made on buses and cable-cars.

Cable-car. Tbilisi has a mountainous relief and thus the development of cable-cars and their integration into the public transport network deserves special attention. In 2012 the Narikala cable-car was added to city public transport system (see the Monitoring Report). Two additional cable-cars are considered in the updated SEAP- these are the Turtle Lake cable-car and the Samgori-Vazisubani connecting cable-car. By 2015 the Turtle Lake cable-car design was already prepared and the construction has to start in September 2015. The cable-car upper and lower old, obsolete buildings will be repaired, new gondolas will be mounted and a new control center will be installed. The pulling cable will be replaced completely. The Turtle Lake is a significant recreational area in Tbilisi both for Tbilisians and for city guests as well. Using the rehabilitation Turtle Lake cable-car the passengers would be able to reach the lake from the Chavchavadze Avenue in 5-6 minutes. The rehabilitation design cost makes 1 174 950 GEL and according to project plan the cable-car should be put into operation in 105 days from the beginning of the work. The measure supposedly will be financed by Tbilisi City Hall itself. The passenger turnover of the cable-car is expected to make 150-200 passengers in hour, while the anticipated annual consumption of electricity will reach 350 MWh. This cable-car will substitute the 2.5 Km long motor-vehicle trip, correspondingly saving 925 MWh of energy and 230 tCO₂eq of emissions.

Besides, the construction of cable-car from the Vazisubani district to the Samgori metro station is considered to be integrated into the public transport system and intended to serve the population. The length of the cable-car will be about 2000 m with one intermediate stop/station. The design of "Samgori-Vazisubani" cable-car is not yet prepared. Ensuing from the expected passenger turnover the cable-car instead of pendulum type will be of circular one. The anticipated cost of the cable-car varies in the range of 6.5-9.0 million EUR. At the present stage the construction dates, funding source, expected electricity consumption and passenger turnover is unknown, though this issue is actively examined by the Tbilisi City Hall LEPL "Technological Development Fund".

Apart from this, since 2012 the funicular tram is being put into operation, which carried passengers in 2014 and, according to the Monitoring Report, saved 740 tCO₂eq of emissions.

Activity PRT1: Organizing the taxi movement

The 2014 inventory demonstrates that 30% of emissions from the Transport sector is associated with taxis, making it obvious that for the 20% reduction of emissions, pledged under the CoM, it is necessary to take a definite measure in this sector. The 2011 SEAP did not contain any measures concerning the taxis and as a result the increased emissions were got, significantly reducing the efficiency of measures undertaken for other categories. Such perceptible share of taxi emissions could be explained by their large number and great distances covered by them. As to the growth of the number of taxis, today each owner of a private car, without state restrictions, can use it as a taxi in case of having the “B” category of driving license. No special licensing or registration is required to proceed with the “taxi business”. The taxi yellow stencil is sold publicly for 40 GEL and is available to any person.

The most important aspect of this process is related with the fact that such municipality of taxis drops the trip payment creating problems not only to professional taxi drivers, but bringing about the competition with the public transport. It should be mentioned as well that taxis are not accounted for and their exact number is unknown. Consequently it is highly important to introduce their registration and elimination of “casual” taxi movement. At the next stage the conduction of technical and economic survey should become necessary to determine the licensing fee and technical norms required for taxis. Such licensing will serve as a precondition for securing the safe and comfortable taxi service and to set up a competing environment for taxi drivers. Correspondingly here 2 types of actions should be considered:

- Licensing of taxis (initially free of charge, aimed at registration, and further- requiring payment);
- Setting up of taxis’ technical inspection.

It is important to manage the taxi sector in cooperation with other state agencies to guarantee the optimal solution of vehicles’ registration and taxation problems.

It is expected that licensing (even free, but related with some administrative proceedings) will eliminate the riding of “incidental” taxis and create healthier competing conditions for drivers regularly engaged in the taxi business, as the number of low quality and cheap competitors will be decreased. As to the emissions reduction estimates, it was assumed conservatively that with this measure the number of taxis in Tbilisi will be cut by about 10%, saving 245 GWh of energy and 52 thousand tCO₂eq of emissions. Though it should be anticipated that in case of paid licensing this saving will be higher.

The activity will be implemented by the Tbilisi City Hall Transport Department without involving additional expenses. However the technical and economic survey for the determination of taxis’ licensing and their required technical parameters will demand additional funding, that is not known at the present stage.

Activity PRT2: The parking policy

The parking management is a mighty instrument in the hands of local authorities for the regulation of vehicles use. The taxation, time limitation and control of parking sites are important means at the disposal of city self-governing bodies.

At the territory of Tbilisi Since 2007 the parking problems are regulated by the LLC “CT Park”, being today a sole company responsible on the arrangement and perfection of parking system in the capital. From 2015 the Tbilisi City Hall has started negotiations with the “CT Park” on the banning of parking at the pavements and on the revision of other articles of the Agreement with the company.

In 2015 at the request of City Hall Transport Department 210 parking sites were abolished at the pavements. The criterion for the abolishment was the requirement for the permissible clearance between the edge of the car and pavement border to be no less than 3 m. Before the endorsement of this criterion the parking sites infringed upon the walking areas and the moving at the pavement car endangered the pedestrians. The long-range vision in this direction by 2020 consists of total abolition of such parking sites in view of 2 reasons: 1) jeopardizes the pedestrians and 2) damages the coating of the pavement, not intended for the car movement.

The Tbilisi long-range parking policy vision by 2020 also includes the division of Tbilisi territory by zones and introduction of differentiated tariffs. Such approach will unload the downtown districts of Tbilisi from the cars and will make these areas attractive for the population and the tourists. The priority will be given as well to the special underground and surface parking grounds compared to parkings along the roads and streets. According to new rules each newly constructed building should have the underground parking site considering the number of storeys and flats to restrict the parking at the street. Releasing of streets from the parked cars will increase the attractiveness of walkable and cycling areas, and allow the City Hall/the population to use the disengaged territories for public transport or cycling tracks. The high price of special parking sites on its turn will increase the expenses on car maintenance and walking or cycling. Correspondingly will be saved the energy and reduced the emissions.

For assessing the emissions curtailing it was assumed that this measure will decrease to 2020 the traffic of private cars in the streets by 3%, resulting in the saving of energy by 251.7 GWh and saving of emissions by 62.8 GgCO₂eq.

Activity PRT3: The encouragement of cycling and walking

One of the main directions of the SEAP is the prioritization of walking in comparison to other participants of road traffic. It should be mentioned that perfection of legislation in this direction is going on at the national level. At the same time, it is important for the city population and tourists to provide maximum comfort and safety for walkable zones (pavements, crossroads, etc.). With that end in view the Tbilisi City Hall Amenities Department continues to equip with modern conveniences the walkable zones in the city. In 2015 all 35 pedestrian subways will be equipped with video cameras and anti-vandalism monitors. In places where there are no traffic lights and underground crossings, the walkable crossings (so called “zebras”) are added. As it has been mentioned above, the parking at the pavements is banned.

The bicycle is one of the most widespread and priority means of transportation in European cities. In Tbilisi the definite decision on the provision and popularization of cycling is not taken yet, one of the reasons of which is the mountainous terrain of the city. By 2015 there is no cycling network in Tbilisi, though one track has been arranged at the Khudadov street and a cycling area allotted at the Lisi Lake, mostly having a recreational purpose. A surveys on the possibilities of arranging regular cycling in Tbilisi

have been conducted by foreign experts, concerning the creation of cycling lanes on the Vazha-Pshavela and Chavchavadze avenues, the Agmashenebeli Alley. It ought to be mentioned that final decision on this issue is not taken, although the Tbilisi City Hall examines the arrangement of such tracks in case of the readiness of general public.

To assess the emissions reduction potential, it has been assumed that in case of successful implementation of the measure the population will give the preference to walking and cycling on the short distances, reducing the private car traffic to 2020 by 3%, that will provide relevant saving of energy by 251.7 GWh and of emissions by 62.8 GgCO₂eq.

Activity PRT4: Programs on behavioral changes

One of the significant preconditions for the successful implementation of above listed measures is the study of behavioral norms of the population, working out of programs on behavioral changes and their implementation.

As it has been mentioned above, in Tbilisi, like in Georgia as a whole, the private car serves as a visual demonstration of social status and provides a comfortable transportation. On the other hand maintenance of the car and its use increases the cost of living, causes delays and creates permanent stress to drivers. The behavioral change programs assist the population to familiarize with the barriers to and preferences of the selection of transportation means and assess realistically the expectations of the car ownership. They inform the population on the alternative means of transportation and their advantages for the health, financial savings and lesser impact on the environment.

The programs of behavioral change first of all should be aimed at the popularization of the healthy way of life, demonstration of the use of public transport and dissemination of relevant information among general public. This should be enacted at the places of mass gathering, at working places, in schools and other educational facilities, by the phone and press releases, radio and TV.

This measure is also discussed in the Awareness Raising section, yet it is included in the Transportation sector as well, in view of the necessity of the demonstration of its particular importance.

The Tbilisi City Hall has no allocated funding for this measure, although the work is going on for the elaboration of the project and awaking interest among potential donors.

Activity PRT5: Study of commercial vehicles movement and imposition of regulations

The 2014 inventory has demonstrated that the commercial vehicles sector is one of the major GHG emitters and thus for the achievement of 20% emissions reduction it is urgently necessary to take some measures in this sector. First of all it is important to study the movement characteristics of commercial vehicles for the assessment of possibilities in improving their movement and establishment of feasible regulation. The regulations supposedly will concern rush restrictions as the movement in daytime and such hours. These restriction will increase the efficiency of commercial vehicles and relieve the streets in the mentioned periods of the day.

As there is no exact data on the proposed measure, it has been assumed that resulting from the measure the effectiveness of commercial vehicles will increase only by 3%. Consequently by 2020 about 74.2 GWh of energy and 19.7 GgCO₂eq of emissions will be saved.

Activity PRT6: Traffic lights control center

Since 2012 the Traffic Lights Control Center is functioning in Tbilisi, to which 121 from existing 217 traffic lights are connected (the description of performed activities see in the Monitoring Report).

From 2015 the extension of traffic lights control system is planned to provide the linking by 2020 of all traffic lights in the capital to the Control Center. This concerns not only the remaining 96 traffic lights, but new units as well, which will be added to the system in the process of its development. Resulting from this measure by 2014 the saved energy and emission were assessed as 78.2 GWh and 53.3 Gg respectively. In case of connecting all traffic lights to the Control Center (assuming proportional expansion), the saving will make up 140.2 GWh of energy and 95.6 GgCO₂eq of emissions.

Activity PRT7: Encouragement of low emission cars

The encouragement of low emission and less harmful exhaust cars has been planned in the 2011 SEAP. It should be noted that in 2010-2014 the massive transfer of cars from gasoline to natural gas was conducted by population, mainly caused by rising prices on energy carriers. While developing the foregoing measures it was expected that technical control of motor vehicles would become mandatory from 2015, thus facilitating the adoption of various stimulant measures, e.g. the substitution of highly polluting gasoline and diesel powered cars by environmentally clean vehicles. This was to be supplemented by the introduction of other environmentally friendly measures such as the establishment of low or zero fees on parking of environmentally clean vehicles, low tariffs on their technical control, dismounting tariffs for taxi drivers operation low-emission cars, etc.

The mandatory technical control of vehicles has been postponed till 2018 that has caused the putting back of the possibility to take appropriate measures in this direction as well, though they are again considered as one of the measures incoming into the updated SEAP.

Activity MFI: Renovation of Tbilisi City Hall serving cars fleet

In 2011 the Tbilisi City Hall has purchased from the company "KIA Motors Georgia" Ltd 210 units of new cars and handed over old cars owned by the City Hall. Total cost of cars made 4 139 490 GEL from which part of the cost was covered by the City Hall at the expense of commissioned old cars. Compared to the baseline scenario the energy has been cut by 4 832 MWh, and the emissions by 1 276 tCO₂eq. The measure is taken, although by 2020 the emissions reduction would have to be recalculated.

1.5 Measures in the Buildings sector

GHG emissions from the Buildings (residential and commercial constructions) sector have constituted 31% of total emissions from all sectors, considered in 2014 in the Tbilisi SEAP. 65% of residential

structures consist of multi-storey residential buildings constructed since 1960-es, mainly featured by low energy efficiency, thus containing significant potential for the reduction of emissions in this sector.

Facts about the Buildings sector

- The largest share of emissions from the Buildings sector is related with the residential subsector (73.3%), though the electricity consumption in the commercial subsector yet remains to be specified;
- The emissions from the municipal buildings subsector comprise only 0.5% of total emissions from the Buildings sector;
- 83% of Tbilisi population are living in the multi-storey buildings' flats;
- 72.5% of Tbilisi residents are living in the energy poverty conditions (71.3% of flats and 78.6% of private houses), but as it is expected, along with the growth of city economy and incomes of population, the heated areas will expand with the corresponding rise in energy consumption;
- 11% of Tbilisi population has no hot water supply.

The introduction of energy efficiency and renewable energy measures in the Tbilisi Buildings sector is faced by a number of significant barriers.

Barriers and challenges

- No norms defined by national legislation exist on the construction of new buildings (the application of several different construction standards is permitted);
- The measures to be taken in the Buildings sector have a high investment cost and long period of return;
- Resulting from the lack of completely heated areas and due to relatively low upsetting/distress temperatures the energy efficiency measures are mainly directed towards the increase of the comfort and often do not bring the reduction in energy expenses;
- The Property Department of the City Hall has no complete register of buildings belonging to the City Hall;
- There is no City Hall department or agency holding complete information on buildings at the territory of Tbilisi and having a possibility to plan appropriate measures;
- Getting information on the number of commercial buildings, their areas and energy consumption is possible only by contacting the private companies (energy distributors or commercial companies themselves), having no obligation to the City Hall for providing the required information;
- Loans from the commercial banks usually are featured by high rate, even more increasing the capital expenses. In some banks the programs on relatively low preferential loans for energy efficiency measures exist, but they are characterized by insufficient flexibility (being linked to specific technologies or construction materials) and information on them is not known for the general public.

The strategic goals of the SEAP in the Buildings sector are as follows:

The strategic goals

- To increase the level of comfort in Tbilisi buildings without significant rise in energy consumption;
- To identify the funding sources for financing the energy efficiency measures in the Buildings sector;
- To disseminate among general public the information on the possibilities of using energy efficiency and renewable energies in the Buildings sector as a way to increase the comfort and preserve/reduce the energy expenses;
- To rise the interest of large energy consumers in Tbilisi towards the efficient use of energy.

For attaining the above listed goals the programs should be developed and implemented in different directions: for the municipal buildings, for residential buildings and other commercial edifices. At the same time regulations and standards should be approved for the rehabilitation of municipal buildings and the management of energy consumption in the structures. The letter will facilitate the adoption of energy efficiency elements even in those municipal buildings which do not participate in the renovation program.

Activity MBI: The municipal buildings' complete renovation program

In the frames of this activity a long-term renovation program should be planned and executed for the municipal buildings, in which the energy efficiency measures and renewable energy application possibilities will be considered.

The program should consist of two phases:

- Initial phase: readiness and planning, which will be targeted on the grounding and elimination of existing barriers;
- Second phase: implementation of the program.

While realizing the initial phase (2016-2017):

- A complete register of municipal buildings should be compiled, containing names of owners and users (the first version of this register was composed during the preparation of 2011 SEAP and it has been updated by the EC-LEDS project while developing the Monitoring Report). The list will be transferred to the Sustainable Development Agency, further being responsible for its perfection and improvement;
- The information should be gathered on the areas of these buildings and on the consumption of energy by them, at the same time creating relevant database (see Activity MM2);

- The buildings should be classified according to energy consumption both in absolute units and per m², as well as considering other parameters, such as functional loading of the building, number of employees, number of students, number of users, etc.;
- Those buildings should be selected, which consume maximum amount of energy per unit of area, unit of the number of staff or students, the priority measures should be planned for them and a plan should be drawn targeted on the reduction of energy consumption in municipal buildings.

During the implementation of the second phase (2018-2025):

- The funding sources should be identified and activities planned in the initial phase should be performed;
- The monitoring on the fulfillment of enacted measures should be conducted.

For the assessment of emissions reduction it has been assumed that the program embraces no less than 50% of the buildings and in each building at least 50% saving will be achieved (in case of complete rehabilitation). Under such conditions nearly 10 GWh of energy and 1.6 GgCO₂eq of emissions will be saved by 2020.

Activity MB2: Regulations for the municipal buildings repairs and energy consumption management

This Activity considers the introduction of Municipality Internal Regulation for carrying out major repairs of municipal buildings, aimed at the provision of appropriate energy efficiency measures. It will include as well the rules for conducting smaller repairs (not considered as a major repairs), e.g. the installation of only one type of lanterns, necessity of renewable energy application, etc.

Apart from this, the regulations should be elaborated on the management of energy consumption by the buildings, e.g. on the rules of operating the heating system, the cooling system, etc. The work should be conducted with the users of the buildings to explain to them the behavioral norms of buildings' energy consumption management to provide the minimal consumption of energy.

To assess the emissions reduction potential by this measure it has been assumed that at least 10% saving will be attained in the remaining 50% of buildings (which are included in the renovation program), resulting in the reduction of about 1 GWh of consumed energy and 0.15 GgCO₂eq of emissions.

Activity RB1: The residential buildings sustainable management program

This activity includes the following measures:

- Identification and introduction among the population of financial stimulation measures for the implementation of energy efficiency and renewable energy application actions.
- Encouragement among the population of energy efficiency and renewable energy application initiatives with related fund rising, in which the municipal funds could be partly included. At the same time the Sustainable Development Agency will be responsible for working out the criteria to define the recipients of the grants. In the ideal case the grant should cover only the energy

efficiency component. E.g. if the resident purchases a heating system, the grant is covering the extra cost needed to buy the energy efficient system instead of an ordinary one. The same principle is valid in case of repairing the building or constructing a new one. Say, if the resident repairs the roofing, the grant should compensate the expenses only in case of arranging the energy efficient roof. The Agency may work out other types of criteria as well.

- Despite the fact that grants or other forms of financial incentives are reducing the necessary funding, the investor (resident, private company) nevertheless has to spend significant expenditure. Hence, the Sustainable Development Agency should collaborate with the banks and financial institutions to make low-interest loans more available to the residents in case of undertaking such type of measures.
 - Encouragement of population in the process of planning the energy efficiency and renewable application measures.
- The energy audits represent a precondition for the introduction of energy efficient measures in the buildings, as they permit to define the best energy saving measures for each individual building. The Agency may have its own group of energy auditors, or simply may assist the external auditors by informing the population on the necessity of audits, by training the auditors, supporting them financially, etc.

In order to assess the emissions reduction potential as a result of taking such kind of measures, it has been assumed that the campaign conducted in this direction would be able to realize in 20% of private houses the installation of roof thermal insulations and solar hot water supply devices, as well as to substitute in 20% of dwellings (buildings and flats) old window frames with new ones, that will result, according to energy audits, in the saving of nearly 327 GWh of energy and 66 GgCO₂eq of emissions. The total investment cost of these measures will make about 203 million GEL, the major part of which should be covered by the population.

Activity RB2: Co-financing of measures demanded by the cooperatives

The objective of this measure is to add the energy efficiency procedures to the activities, which have to be implemented in collaboration with the cooperatives. These are:

- Energy efficient roofing;
- Heating of entrances;
- Energy efficient lift/elevator;
- Sensory lighting (partly enacted).

To assess the emissions reduction potential through these measures it has been assumed that as a result of this campaign it would be possible to undertake in 20% of residential buildings the roofing and entrances heating measures, while in 50% of buildings- to install the sensory lanterns. According to conducted energy audits, these measures will provide the annual saving of 116 GWh in energy and 21.2 GgCO₂eq in emissions. The total investment cost of the measures will be equal to about 30 million GEL, including the co-financing from the cooperatives.

Activity RB3: The public awareness raising and behavioral changes campaigns

In the frames of these campaigns the public awareness on energy efficiency raising effort should be implemented aimed at informing the population on measures having relatively short period of return. They mainly include the energy efficient devices and lighting systems. In the frames of the campaign the population should be provided with the following information:

- On the system of marking the appliances;
- On the indicators of energy saving by the energy efficient devices that will be transformed into expenses to demonstrate in the long-term period the profitability of appliances;
- On different types of lamps and their advantages;
- Other.

The implementation of the measures should be accompanied by the visual information (booklets, information broadcasts, etc.), that will be discussed in more detail in the awareness raising strategy. For the assessment of emissions saving by these measures it has been assumed that each family will install at least one energy efficient lamp and at least 20% of families will purchase some electric device of the A+++ category. Corresponding saving will constitute 96 thousand GWh of energy and 10.5 tons of emissions in CO₂eq.

The funding allotted by the City Hall for this measure is the same as funding for the awareness raising campaign and is not approved at this stage.

Activity OBI: The energy efficiency program for other (commercial and state) buildings

In the frames of this measure it is important to carry out work with the owners of other commercial and public buildings on the increase of energy efficiency and application of renewable energies. For the achievement of this goal it is significant to elaborate and implement the energy efficiency program especially for commercial and public buildings, at the first stage related with largest energy consumers and big non-residential buildings.

In the frames of the program the following initiative should be performed:

- The list of Tbilisi non-residential buildings must be compiled (under the assistance of Public Register) and singled out large and relatively small energy consuming commercial buildings;

At the initial stage the measures should be implemented concerning the large energy consumers (2016-2020):

- To establish the communication with organizations using these buildings for the exchange of information and initiation of cooperation;
- To collect the information on energy consumption in these buildings and other parameters;
- To carry out meetings, workshops and trainings with organizations using/owing these buildings to provide efficient management of energy efficiency and application of renewable energies, as well as on the possible sources of financing these measures and on the preferential loans (in case of their availability);
- To encourage these organizations in carrying out energy efficiency measures in their buildings.

At the next stage the same measures should be implemented for other buildings (2021-2025):

The final objective of the program must be the achievement to 2020 of emissions reduction by 20% in commercial and non-municipal state buildings, resulting in total saving of about 530 GWh in energy and 80 GgCO₂eq in emissions.

1.6 The measures in street lighting

The Street Lighting sector occupies only a tiny portion of Tbilisi GHG emissions, making 0.16% of total discharges. However, taking emissions reduction measures in this sector is highly important as these actions well reflect the aspiration of the capital to turn into the energy efficiency model to other towns or organizations.

Facts about the Street Lighting sector

- The outdoor illumination of the capital is provided by the municipal enterprise “City of Light”.
- The number of outdoor lanterns (street lighting, ornamental illumination sites) in Tbilisi has made 133 377 units to 2014, from which 99 121 units were used for street lighting;
- 92% of lanterns employed for street lighting in 2014 are the sodium inefficient lamps, and 2%-the incandescent lamps.

Challenges and barriers

The only barrier facing the implementation of the SEAP in this sector is the sufficiently high primary investment, the elimination of which became possible by confirming the relevant type of contract with the provider.

The strategic goals

- Only the energy efficient LED lanterns should be applied for street lighting;
- The City Hall expenses on outdoor illumination should be reduced to the minimum, concerning both the electricity expenditure and the maintenance costs.

The measures to be undertaken for the implementation of these strategic goals are as follows:

Activity S1: Ecosystems

In 2014 the so called “Ecosystems” were installed in the street lighting network, providing the stabilization of tension in the grid. The mounting of the device is aimed at the efficient use of electric

energy and the increase of its quality index. During 2014 this appliance has been installed in 150 cupboards out of 784 existing ones. By this way in 9 months of 2014 about 983 000 KWh of electric energy has been saved, reducing 103 tons of GHG emissions in CO₂eq, calculated using the grid average emission factor. Presently the complete licensing of the system is under way and the positioning of such ecosystems in other cupboards is being examined. In the meantime the number of installations is unknown, as well as the efficiency of this system in case of implementing the Activity S2. Therefore the energy reduction potential through this measure is not assessed at this stage and the main emphasis is made on the Activity S2.

Activity S2: Application of LED lanterns in the street lighting

The execution of pilot projects in this deirection was started in 2015 at some streets, namely M. Javakhishvili, Kachinski, Baratashvili Bridge, Melikishvili, the Airport entrance and Leonidze st, where LED lanterns produced by different companies were installed and observations are going on. In 2015 a competition was announced on taking interest on the program, in frames of which the substitution of all streetlights (about 100 000 lamps) by LED lanterns is planned in 2016. According to the competition terms the investment is enacted by the investor, while the cost will be compensated by the “City of Light” from the saving of energy income. Resulting from preliminary tests the replacement of streetlights brings more than 60% saving of energy. For the estimation of this saving conservatively it has been assumed that its value would make 50%. In 2014 the total consumption of energy for street lighting made nearly 74.4 thousand MWh. In case of half as much consumption the saving will constitute 23.7 thousand MWh, being the equivalent of 2.42 thousand tons of CO₂eq.

1.7 Measures in the Waste sector

The Waste sector is responsible for 18% of emissions from all sectors examined in Tbilisi GHG inventory.

This sector consists of solid waste and wastewater subsectors, the annual division of emissions between them in the sector being respectively 75 and 25%.

Facts about the Waste sector

- Currently Tbilisi is served by one landfill- the Norio SWDS, total area of which makes 840 000 m²;
- Till 2010 Tbilisi was maintained by 3 official landfills (Gldani, Lilo and Jagluja SWDSs), owned by Tbilisi Municipality and presently closed;
- Since 2007 the cleaning of the city, collection of solid waste, its transportation and disposal at the operating landfill, as well as the maintenance of functioning/closed landfills is performed by the LLC “Tbiliservice Group”, set up under the 100% sharing of the Tbilisi Government;
- The Gardabani wastewater treatment facility is owned by private company “Georgian Water and Power- GWP”.

Until recently there was no united legislative system in Georgia for the management of waste, partly existing regulations were not completely describing the present realities and did not comply to the international demands. For the improvement of existing situation, according to the commitments under the EU Association Agreement Georgia has to provide the implementation of relevant measures. Under this obligation the “Waste Management Code” was put into force on 15 January 2015, which complies with the commitments subordinated to Georgia’s Association Agreement with the EU.

The goal of the Code is to create a legislative basis in the waste management for implementing measures that will promote the prevention of waste expansion and their recovery, environmentally safe processing of waste (that implies recycling and picking out of secondary raw material, recovery of energy from the waste, safe disposal of waste), the main objective of the Code being the protection of environment and the human health.

Despite the fact that the legislative basis has been put into order, other challenges and barriers are remaining.

Barriers and Challenges

- The tendency of the growth of waste;
- Low level of population awareness on the civilized habits of waste management;
- The scarcity of waste infrastructure at the “new” adjoined territories of the city;
- Lack of the waste integrated sustainable management plan;
- The problem concerning the availability of information on the amount and parameters of wastewater, as well as measures undertaken, because the Gardabani wastewater treatment facility is owned by the private company.

In 2015 the Tbilisi City Hall has developed and published the 2015-2020 Environment Protection Strategy²².

The strategy describes current state and challenges in the fields of air, water, urban environment and biodiversity, as well as on the waste management and concerning the climate change. It is suggested in the document that the management of solid waste according to international standards is one of the important commitments taken by Georgia under the Agreement with the EU. At the same time it is elucidated that this obligation means that the old type, inadmissible from the sanitary viewpoint landfills will no more exist in Georgia.

It is indicated in the Strategy that along with the putting in order of landfills new standards consider the sorting of domestic waste as well, to provide the lessening of harmful impact on the environment and the society, existing in this environment. In parallel with the arrangement of landfills according to modern standards, these commitments require the construction of contemporary waste processing

²² <http://www.liberali.ge/ge/liberali/news/127255/>

facilities, as well as taking the detailed inventory of generated waste, including the definition of the amount and composition of the waste.

The goal of the mentioned above Strategy is to create in Tbilisi a clean environment and a modern system of healthy and safe waste management, the main components of which are given below.

The strategic goals

Creation of present-day waste management system, implying as follows:

- Providing the proper conservation/renovation of old landfills for the elimination and minimizing the environmental hazard, related with the landfills;
- Conducting regular monitoring on the state of soil, air and underground water for the assessment of contamination, caused by landfills and planning the mitigation measures;
- Encouraging the implementation of waste sustainable management principles, primarily aimed at the prevention of waste expansion and minimization of waste generation;
- Carrying out of the waste inventory for Tbilisi according to following categories: domestic waste, industrial waste, medical waste and biological waste;
- Introducing modern technologies of waste collection and processing;
- Setting up and the development of waste processing infrastructure;
- Step-by-step adoption and provision of careful functioning of municipal waste separated collection system;
- Providing the introduction of waste separation, processing and secondary utilization mechanism;
- Elaborating the waste management local plan, indicating in detail the issues of disposal and management of construction and perilous waste (including mercury, asbestos, etc.);
- Developing and executing projects and programs on awareness raising of population in the waste management;
- Planning of waste management infrastructure in Tbilisi suburbs (villages of New Tbilisi) to eliminate the unauthorized disposition of household waste in ravines and along the roads.

The Tbilisi City Hall plans to create a legislative fundamentals for the waste management, based upon the “Waste Management Code”, enacted in Georgia in 2015 and to introduce the measures promoting the prevention of generating waste and products of its decay. At the initial stage the emphasis is made on 2 measures:

1. The construction of solid domestic waste processing facility;
2. The collection and flaring of biogas, generated by the landfill gas collectors, mounted at the Norio landfill cells.

The Tbilisi City Hall publicized an information on the construction of solid residential waste processing plant in February 2015, that was connected with the authorization of the “Waste Management Code” in Georgia. The objective of the Code is to create legislative basis for the introduction of measures in the Waste management sphere, which will facilitate the reduction at the site of waste generation and the

extension of secondary produce utilization, processing of waste by the safe for the environment way, getting the energy from the waste, as well as the safe disposal of the waste²³.

The waste processing plant, ordered by Tbilisi City Hall, will be constructed by the Czech company “Vialta”. At this stage the company is designing the facility, considering 3 different versions among which the most suitable for Tbilisi conditions will be selected²⁴. In the meantime the type of the plant to be built in Tbilisi is not known.

The most realistic measure to prevent the technogenic loading on the environment from the Waste sector is the arrangement of methane flaring system at the Norio landfill. This landfill has a prepared potential for the methane emissions reduction from the Tbilisi Waste sector through the flaring of the biogas, if its utilization in other way should prove impossible. The fulfillment of this measure is expected already from 2017.

Apart from measures revised in the process of developing the Tbilisi SEAP updated version (Activities WI and W4), there were other measures in the previous version, and invariably transferred into the renovated version of the SEAP, as it is impossible to get the 24% reduction of emissions without these measures. However there is a possibility they could not be implemented. In this case it would be necessary to replace these measures by other activities equivalent in the context of emissions reduction.

Activity WI: Methane collection and flaring from 2017 using existing biogas collectors at the Norio operating landfill

According to Tbilisi City Hall projection for today there is no planned measure concerning Tbilisi closed landfills, though from 2017 the methane collection and flaring is planned at Tbilisi operating Norio landfill, as a result of which recent methane (CH₄) emission will be substituted by the carbon dioxide (CO₂) discharge, having much less global warming potential and the methane emissions from the operating landfill will begin to decline. Table 5 demonstrates the projection of methane emissions from the functioning Norio landfill. The amount of reduced emissions is calculated for the described above case, in the frames of which it has been assumed that the number of population linked with the landfill annually grows by 0.5%, and the amount of waste disposed at the landfill- by 2.5%. The assumption was made as well that the methane *in situ* flaring system would be installed in 2017 and all 100% of garbage generated in Tbilisi would be placed at the landfill (without separation of waste and its processing/secondary utilization).

²³ <http://new.tbilisi.gov.ge/news/2450>

²⁴ <http://www.ipress.ge/new/4235-chekhuri-kompania-tbilisshi-narchenebis-qarkhnis-proeqtit-dainteresda>

Table 5. Amount of saved CO₂ at the Norio landfill in case of implementing the project

Year	Gg/yr			
	CH ₄	CO ₂ eq	Amount of CO ₂ released by flaring 80% of methane	Saved CO ₂
2012	1.66	34.95	0.00	0.00
2013	2.87	60.23	0.00	0.00
2014	3.89	81.69	0.00	0.00
2015	4.76	99.98	0.00	0.00
2016	5.55	116.56	0.00	0.00
2017	6.27	131.72	13.80	91.58
2018	6.94	145.73	15.27	101.32
2019	7.56	158.80	16.64	110.41
2020	8.15	171.13	17.93	118.98
Total 2017-2020	28.92	607.38	63.63	422.27

As it could be seen from the Table, under these assumptions the emission of CO₂ in 2020 will be decreased by 118.98 Gg (69.5%). In performed calculations 2 assumptions have been taken: first- that technically it is feasible to collect 80% of methane generated and the second- as a result of flaring of 1 ton of methane 2.75 tons of CO₂ are discharged into the atmosphere. In case of project implementation totally in the 4-year period 422.27 GgCO₂eq emission will be saved from releasing into the atmosphere, making 69.5% of overall expected emissions.

Activity W2: Collecting of paper and its processing

In Tbilisi, in the Orkhevi Settlement at present functions the paper processing facility, producing the toilet paper through the secondary treatment of the paper. Consequently, this residual fraction is decreased in the dumped at the landfill waste, causing from its turn the reduction of methane emission from the landfill. As no information is available concerning the portion of processed paper in the total generated amount, it has been assumed that 5% of paper will be processed in 2015, while to 2020 this value would increase reaching 15% of total paper waste (annual increase by 2%). The emissions reduction was calculated for the above described case: number of population linked to the landfill increases by 0.5%, while the amount of dumped trash- by 2.5% annually.

Table 6. Amount of methane saved by decreasing the paper residual fraction at the Norio landfill

Year	CH ₄ , Gg		Amount of methane saved through the paper processing, ton	
	Without paper treatment	Resulting from paper treatment	CH ₄	CH ₄ in CO ₂ eq
2015	4.76	4.76	0.00	0.00
2016	5.55	5.55	0.19	4.09
2017	6.27	6.27	1.62	33.94
2018	6.94	6.93	4.42	92.90
2019	7.56	7.55	8.76	183.86
2020	8.15	8.13	14.73	309.37
Total 2015-2020	39.23	39.20	29.72	624.16

As it is evident from the Table, in case of taking this measure the emission of methane to 2020 would be reduced by 309.37 tons in CO₂eq (0.18%). In case of project realization totally in the 6-year span the saving of emission into the atmosphere would reach 624.16 tCO₂eq, making 0.076% of the initial value.

Activity W3: in situ flaring of methane recovered from the closed landfill (Gldani 1, Gldani 2 and Yagluja)

Activity W3.1: Methane collection and in situ flaring at the Gldani closed landfills (Gldani 1 and Gldani 2)

This measure was planned in the frames of initial Tbilisi 2011 SEAP, when these landfills were newly closed and getting some emission reduction was still expected. However, at present the methane generation is significantly decreased and correspondingly this measure is no more examined in the updated SEAP to administer all available funding on the combustion at the site of methane and its utilization as an energy resource at the operating (Norio) landfill.

Activity W3.2: Methane collection and in situ flaring at the Yagluja closed landfill

This measure is similar to the Activity W3.1.

Activity W4: The modernization of wastewater treatment facility

The Gardabani wastewater treatment plant would possess significant potential in GHG emissions reduction in case of utilizing or flaring the methane and the recovery of nitrous oxide (N₂O). The latter is a more distant perspective, but methane recovery and at the site its burning is easily attainable.

The Gardabani wastewater treatment facility, constructed in the Soviet period, has secondary processing devices and methane reservoirs designed in that period for the generation of methane and its further storing. The proposed measure may include the check up/testing of the device and its following rehabilitation (or renovation). In the frames of this measure the extra profit could be got by composting the silt remaining after the methane recovery. The degased dry sediment could be utilized in agriculture as a nitrogen containing fertilizer.

This measure considers the following activities: The updating of wastewater treatment plant according to modern standards including the transformation of plant's structure and the introduction of new present-day technologies incorporating the methane recovery technology. The recovered methane will be stored in gas-holders and will be flared or utilized, either sold. The silt remained after the wastewater treatment could be used in agriculture or disposed at the landfill. According to preliminary estimations this measure will cost about 10 million USD and will save annually nearly 163 870 t of emissions in CO₂eq.

1.8 The Greening Measures

The Greening sector represents a carbon dioxide removal from the atmosphere in Tbilisi, therefore emissions from this sector are not discussed in the inventory.

Facts about Greening sector

- Areas of green zones in Tbilisi have been identified using the orthoimagery of the Public Register National Agency's digital cadaster map and the approximate relative index of greenery coverage on them was defined. As a result it was established that as of 2014 the area of greenery in Tbilisi makes 10 436 ha (20% of Tbilisi total territory), from which 78% (8 106 ha) comes to forest areas around the city of different destination (e.g. parks, squares, cemeteries, boulevards, etc.) in the city;
- The composition of perennials, artificially planted in green zones of Tbilisi is widely different. The most widespread species are pine (25%) and platanus (20%), followed by maple (8%), ash (7%) and others;
- In the suburbs of the city at the forest areas of natural origin the dominant kinds are hornbeam (31%), shrub hornbeam (25), oak (11%) and others;
- In Tbilisi (as of 2014) the greenery area per one citizen, (including the population of adjoined to the city villages) accounting for total population of 1 118.3 thousand²⁵, makes 93.3 m², from which about 90% (84.5 m²) comes to recently joined settlements (1 348.3 ha) and covered by greenery common areas (8 106 ha);
- As to the common area covered by greenery in the green zones of Tbilisi districts, it is rather small (981.7 ha, including 413.8 ha of greenery in recreation zones, 157.9 ha of greenery at the cemeteries, 410.0 ha of plants on the boulevards, slopes and other places) and makes 8.78

²⁵ Georgia Statistics National Office, <http://www.geostat.ge>

m² per one citizen;

- According to norms adopted as far back as in the Soviet period, in the city having the population more than 0.5 million, the greenery area per one person had to be no less than 15 m². In case of Tbilisi this value never exceeded 13 m² (1983)²⁶.

Barriers and challenges

- The assessment of current state of Tbilisi greenery is complicated by the lack of inventory of areas covered with plants;
- At the territory of the city, especially in its old districts, the decline in green zones is mainly conditioned by the disorderly and chaotic construction boom, predominantly progressing at the expense of green zones in the downtown areas;
- During recent years the pine-tree groves, planted inside the limits of the city (the pine occupies about 25% of artificially planted area in Tbilisi) began to dry up massively, sharply worsening the environmental state of the city. Especially alarming situation has created in the environs of Mtatsminda Park, where the dried pine groves occupy nearly 100 ha. The pine-trees are intensively drying in the vicinities of Turtle Lake as well, where about 80 ha of groves have dried up completely.

For the elimination of problems facing the city, the City Hall Environmental Department annually plans the greening activities (see Table 7) which have noticeably expanded for the last two years.

Table 7. Trees planted at the territory of Tbilisi in 2010-2014

Species	Year					Total planted in 2010-2014
	2010	2011	2012	2013	2014	
Cypress	3 215	417	1 430	950	4 540	11 052
Linden	400	363	550	800	5 090	8 003
Ash	1 415	200	300	500	3 390	6 405
Maple	1 673	500	450	530	3 490	7 243
Oak	-	-	-	220	2 340	2 660
Pine	3 665	800	2 850	8 300	9 000	25 015
Cedar	1 762	800	1 125	300	6 500	10 487

²⁶ GEO-cities Tbilisi: <http://geocities-tbilisi.ge/failebi/2388-Introduction.pdf> , 2011

Paulownia	200	-	-	-	-	200
Poplar	1 810	-	-	10 000	-	11 810
Abies	-	-	50	-	-	50
Spruce	-	-	50	-	-	50
Catalpa	-	-	-	210	50	260
Platanus	-	-	-	150	165	315
Celtis	-	-	-	-	155	155
Total	14 140	3 080	6 855	21 960	34 720	80 755

Besides the already implemented activities (the plantings indicated in the Table, as a factor of carbon sequestration growth, are already included in 2014 inventory), some additional caring and planting rehabilitation measures are planned by the Tbilisi City Hall Environment and Greening Department, that are included in the Action Plan of this Department for 2015-2020, though this document is not yet finalized and is under development.

List of strategic goals is given below, the implementation of which at this stage is already decided (2015-2020):

The strategic goals

- **Caring of green zones:**
 - Phytosanitary examination of greenery, carrying out of agrotechnical measures to protect the vegetation from pests and diseases;
 - Formation/trimming of greenery, cutting/treating of dried and sick trees and taking them away;
 - Looking after clipping of trees in the adjoined forests;
 - Cutting down and carrying out of dried pine-trees.
- **Planting of greenery**
 - Planting of trees for the greening of different territories in Tbilisi, including planting at the place of logged pine-trees and caring of newly planted greenery;
 - Rehabilitation of Tbilisi Dendrological Park (greening of 80 ha);
- **Conduction of recreation and green zones' inventory.**

The carbon sequestration potential after carrying out of planned greenery measures at the appropriate territories was assessed using the CO₂ fix model.

According to the Action Plan in the Greenery sector a number of large-scale rehabilitation measures are planned at this stage, in particular felling and taking away dried pine-trees from the Tbilisi Sea (Dendrological) Park and Tbilisi green zones and planting of new trees at their place.

Activity G1: The greening of Tbilisi Sea Dendrological Park

As it has been mentioned above, the planting of various kinds of saplings at the territory of 80 ha (presently almost completely devoid of vegetation) is planned in the environs of Dendrological Park at the Tbilisi Sea shore. The total area of the Park makes 183.7 ha, from which 35% (65ha) is occupied by plants and from the remaining 118.7 ha greenery will be planted at the area of 80 ha, while the rest of the territory is planned to be used for infrastructure facilities and rehabilitation.

The planting of mixed kinds, both deciduous and coniferous perennials, will be carried out at the design territory. Among the species planted the preference will be given to deciduous kinds as they are absorbing the carbon dioxide more actively and are more resistant to exhaust gases. At the same time the green zones consisting of mixed species are believed to be more sustainable to the negative impact of future climate change.

While the landscape planning of the Dendrological Park, especially near the squares and along the walkable paths, the age of planted trees should be no less than 7-10 years (according to selected kinds), therefore the functional forest-park could be created earlier in the recreation zone of design territory.

In designing the forest-park it is expedient to devote maximum area to plants close to forest landscape, having no less than 2 500 saplings (including the shrub plants) per 1 ha. As a result the best index of carbon deposition reservoir could be achieved, involving the soils in the sequestration of carbon and providing the city with the green zone embracing the valuable forest ecosystem.

While selecting sorts of planting material for the design territory the experience of past years should be taken into account: same to 2014-2015 the saplings should include maple, ash, cypress and others.

It out to be mentioned that for carrying out activities at the selected territory the planting design must be drawn up, the necessary component of which are: the planting and infrastructure schemes, list of selected for planting greenery and the budget of all activities. The anticipated expenses for carrying out the planned measures at the design territory are given in Table 8.

Table 8. Budget of activities at 80 ha (the Tbilisi Sea)

No	Description of expenses	Unit	Unit cost (USD)	Total amount	Total cost (USD)
1. Capital expenses					
I.	Field activities				
I.1	Cleaning of area (from shrubs, offshoots, etc.)	ha	100.0	80.0	8 000
I.2	Marking of area and digging holes	Sapling/piece	0.07	200 000	14 000
I.3	Purchase of saplings	Sapling/piece	3.5	200 000	700 000
I.5	Planting of saplings	Sapling/piece	0.08	200 000	16 000
I.6	Watering of saplings	Sapling/piece	0.05	200 000	10 000
Total sum (USD)					748 000

The features of carbon sequestration after the planting are given below in Table 9.

Table 9. Features of annual carbon uptaking and CO₂ removal at the 80 ha of planted area

Parameter	2016	2017	2018	2019	2020
Carbon deposited at 80 ha, tC	417.6	600.8	787.2	974.4	1 163.2
Annual removal of carbon dioxide, tCO ₂	1 531.2	2 202.9	2 886.4	3 572.8	4 265.1

Activity G2: Provision of sustainable management of city green cover and toughening of regulations

The urgent necessity for the city green zones is the logging and taking away of dried pine-trees and planting of new trees at the same areas. Same to planned planting measures it is essential to plant slopes using mixed (coniferous and deciduous) kinds of trees. At the same time the draught resistant species (celtis, soap-tree, etc.) should be added to already selected kinds, being planted predominantly at the pitches of southern exposition/inclination.

The planting of new trees should be performed at the territory of felled pine-trees, accompanied in case of necessity with the uprooting of stumps and carrying them out of the territory.

The reconstruction works cover approximately 180 ha of areas occupied by dried up pine-trees, their cleaning and planting anew. As at this stage the number of dried trees is not accounted for, the approximate data concerning the same age (60 years) low-productivity pine groves were taken, equaling to 675 trees per 1 ha of area.

The pine-tree project activities are designed for 4 years, including annual plantings at 45 ha of territory. As the pine-trees were planted mainly at the poor stony soil, while selecting the kinds for planting it is necessary to take into account the demand of selected vegetation in soils. E.g. the linden should not be planted at the rocky slopes, where the Georgian oak, celtis, cypress and soap-tree are recommended for planting.

The tentative expenses for implementing activities at the project design territory are given in Table 10. As the number of pines to be stubbed is not known in advance, it has been assumed that 20% of all trees should be grubbed up and the relevant expenses were considered in the budget.

Table 10. Budget of activities planned at the 180 ha area

No	Description of expenses	Unit	Unit cost (USD)	Total amount	Total cost (USD)
I. Capital expenses					
I.	Field activities				
I.1	Felling of dried up pines, processing, transporting away	piece	3.0	121 500	364 500
I.2	Grubbing of stumps and their transportation away	piece	40.0	24 300	972 000

1.3	Marking of area and digging holes	Sapling/ piece	0.07	121 500	8 505
1.4	Purchase of saplings	Sapling/ piece	2.0	121 500	243 000
1.5	Planting of saplings	Sapling/ piece	0.08	121 500	9 720
1.6	Watering of saplings	Sapling/ piece	0.05	121 500	6 075
	Total sum (USD)				1 603 800

During the initial year of planned planting 143.0 tCO will be sequestered at the 45 ha area, while till 2020 at the total targeted area of 180 ha this value would reach 1 721.6 tC. The annual course of expected carbon stocktaking in the discussed 5-year greening period is shown in Table 11.

Table 11. Features of annual carbon sequestration at the gradually planted (by 45 ha each year) 180 ha of target area

	2016	2017	2018	2019	2020
Deposited carbon, tC	143.0	241.2	342.4	445.0	550.0
		143.0	241.2	342.4	445.0
			143.0	241.2	342.4
				143.0	241.2
					143.0
Total annual sequestration, tC	143.0	384.2	726.6	1 171.6	1 721.6
Annual removal of carbon dioxide, tCO ₂	524.3	1401.4	2 664.2	4 295.8	6 312.5

1.9 The Urban Planning Measures

In December 2009 the Tbilisi Architect's Office, being City Hall structural unit, has acquired a LEPL status, aiming the improved development of the branch, simplification of services, raising of quality and the introduction of innovations. The Department of Urban Planning of the mentioned above Office was supplemented with the Urban Development and Management Group, main functions of which is the city urban management and sustainable development, being in closest connection with the promotion of SEAP successful implementation.²⁷

In 2014 the Tbilisi City Assembly has approved the Land-use General Plan of the capital (Resolution No. 20-105)²⁸, which defines the main parameters of utilization (land-use) and building of territories, terms of creating good amenities, protection of the environment and cultural heritage realty, special aspects of

²⁷ <http://tas.ge/>

²⁸ <https://matsne.gov.ge/ka/document/view/2669598>

transport, engineering and social infrastructure as well as that of economic development and territorial issues of settling.

In the end of 2014 the Tbilisi Architect's Office, under the assistance of invited experts, has analyzed another major document on the management of capital's special and territorial development- "General Plan for the Prospective Development of the City of Tbilisi", approved by the Tbilisi City Assembly in 2009. The analysis has revealed that this document does not represent a valuable, comprehensive and consequently relevant report for the provision of city special development in the long-run period. In the Tbilisi Prospective Development General Plan there is no vision of ways to implement the priorities, it does not demonstrate the clean model of city development, does not contain a strategic eyesight of Tbilisi in future; the intercoordinated schemes for the development of most important city subsystems-transport and infrastructure are not properly integrated . As the mentioned document does not reflect the city development priorities, the Tbilisi City Government considered as an urgent necessity to work out the Land-use general Plan, based upon new challenges and priorities of territorial and spacial development and ordered the Tbilisi Architect's Office to announce a competition on the renovation of General Plan.²⁹

Activity UPI: The development and implementation of Tbilisi Land-use General Plan

The competition on the development of Land-use General Plan, announced by the Tbilisi City Hall, has been won by joint project from "Tbilisi Group", "City Institute Georgia", "Albert Speer & Partner GmbH".

There are a number of issues, which should be decided in the context of urban planning and will affect the GHG emissions reduction in the city. These are:

- The transfer of railway- in the meantime Tbilisi is divided by the railway in two parts, impeding the transportation inside the city and increasing emissions from the transport;
- Arrangement of transfer stations- Currently the work is going on to determine the necessity of transfer stations for public transport, entering the city from different directions: the eastern flow to Ortachala, and the western flow- to Didube. The economic substantiation of this approach is to be studied at the initial stage, aimed at the relieving of traffic in the city;
- The road and street infrastructure development for the reduction of emissions/decrease of distance between two points, construction of new streets and bridges to shorten the travel distances.

As the effect of these measures is not completely studied at this stage, it has been roughly assessed that the emissions reduction by them will make at least 50 GgCO₂eq annually. This values will be defined more precisely after completing the elaboration of Strategy.

²⁹ <http://new.tbilisi.gov.ge/news/2472>

1.10 The Demonstration and Pilot Measures

Aimed at the raising of awareness among the population and the private sector, as well to encourage the introduction of new technologies and visions, the City Hall plans to undertake a number of demonstration/exhibition and pilot measures. For 2015 the implementation of listed below manifestation measures is planned.

Part of these measures is being conducted by the Technology Development Fund, the objective of which is to present Tbilisi to the international community as a center of innovations and modern technologies in the field of municipal services and commodities within the Caucasus Region. The mission of the Fund is the adoption of innovations and contemporary technologies in the municipal services and commodities, offered to the city population by its self-governing authority.

Activity DPI: The display buildings

The display building permits to serve as an example for constructing the energy efficient structure. Such building could be available to be examined by general public and the builders. The list of buildings, for which the projects are already implemented or the construction has been started, is given below. In future the execution of such demonstration projects will continue further.

1. In Tbilisi, at the Temka micro-district 3, block 5, building 20 the City Hall has conducted a complex of measures. In particular, the heat supply of the building has been provided with common heat generator, placed at the rooftop of the building. For the counting of heat supply the heat meters were installed in each apartment- 34 meters in all, costing $400 \times 34 = 13\,600$ GEL. Along with heat generator 23 blocks of vacuum-pipe solar collector with total area of 95 m^2 were mounted at the roof as well to provide hot water supply. Aimed at energy saving the dual metal-plastic window frames were inserted with the total area of 272 m^2 , among them 157 m^2 in the block A and 115 m^2 in the block B. Besides, in the block A the external walls, ceiling and the floor (from the basement side) were thermally insulated. According to the monitoring results, the saving of energy on heating in the winter season of 2014 made 87 MWh/yr , while on hot water supply the saving equaled 75 MWh/yr . Hence, as a result of measures taken 162 MWh/yr of energy and $33\text{ tCO}_2\text{eq/yr}$ of emission have been saved. Total expenses spent by the Municipality on this measure equaled to $620\,000$ GEL.
2. In 2015 the complete rehabilitation of one kindergarten considering the energy efficiency measures is planned by the Technology Development Fund. $100\,000$ EUR is allocated for this purpose and, as it is expected, the annual saving will reach 420 MWh in energy and $45\text{ tCO}_2\text{eq}$ in emissions.
3. The Energy Efficiency Center is conducting energy efficiency and renewable energy application measures in Tbilisi Elderly-asylum. Total cost of the project makes $849\,814$ USD and is supported by different organizations (including the Tbilisi City Hall). The anticipated annual saving equals to 404 MWh of energy and approximately $44\text{ tCO}_2\text{eq}$ of emissions.

Activity DP2: Solar energy fit ornamental construction (the solar tree)

For the popularization of energy saving measures the Tbilisi City Hall considers to mount a 300 W capacity ornamental construction, fit with solar energy, at the public gathering place (park, square). This device will permit the all-day-round cableless power supply of Internet and laptops, as well as charging of mobile phones (approximately 20 pieces). The function of this ornamental construction in the form of a tree is as follows: the energy generated by the solar battery, placed at the construction, may be used for charging different electric appliances (mobiles, laptops). The chargers of various types, with which the construction will be equipped, could allow the citizens to charge free their devices and use the apparatus. Under the assumption that the mentioned above 300 W capacity will be utilized during 8 hours through the day, the annual saving could make 876 MWh of energy and about 95 tCO₂eq of emissions.

Activity DP3: The Green box

From 2015 the Tbilisi City Hall started to implement the project “The Green box” implying the collection of mackle-paper. In the frames of this project special places will be singled out in the administrative buildings of Tbilisi City Hall and district authorities with putting of appropriate containers. The paper waste will be collected in them. The Tbilisi City Hall LEPL “Property Management Agency” will define the cost of mackle-paper and terms of its auction sale.

According to the City Hall plans, the income got after the auction sale of the mackle will be used to provide the greening activities at the territory of Tbilisi-planting of trees and their caring of.

At the same time the project implementation will promote the rational management of waste and the regulation of environmental issues at the territory of the capital.



Picture 3. The Green box

Activity DP4: Other demonstration/pilot measures

Apart from the discussed above measures other pilot activities will be implemented (e.g. the concept of carrying out the “Green Street” project is developed in the Technology Development Fund, that is not yet finalized) which, according to assumptions, will provide the saving of at least 2.5 GgCO₂eq of emissions.

THE GENERAL PUBLIC AND TARGET GROUPS AWARENESS RAISING AND STAFF TRAINING STRATEGY ON THE PROSPECTS OF ENERGY SUSTAINABLE DEVELOPMENT IN TBILISI AND ECONOMIC AND SOCIAL OUTCOMES OF THIS PROCESS

The involvement of state and public structures in the process of energy sustainable development has an equal importance. The public awareness raising in the sphere of renewable energy, energy efficiency and energy saving requires complex and comprehensive approach and the preparation of relevant communication strategy by the City Hall represents one of the most important components of the SEAP.

Among most significant features differing Tbilisi from other cities of Georgia is high activity of public sector that necessarily should be taken into account while examining the problems of city development. Consequently, the incorrect communication with the public sector or its absence at all may create a major barrier to the city development process. As the high social activity in general is a positive phenomenon on the way to progress, often the elevated activity in case of low awareness or the lack of correct information negatively affects right and sustainable development of the city instead of promoting these processes.

While assessing the barriers the **absence of sufficiently grounded information and surveys** should be taken into account, that limits the chances of Municipality to cooperate more actively with the public and deliver right “message” about contemporary processes taking place in different spheres (climate change, the role of energy efficiency and low-carbon containing fuel in the energy consuming sectors, development of “green” and risk-resistant cities) and the positive role of these processes in the life of the city and in providing each citizen with safe and healthy environment.

The target groups discussed in the present Strategy are as follows: different Departments of Tbilisi Municipality (Transport, Environment and Greening, Architecture, Infrastructure, etc.), LLC- es which should directly develop and implement the projects, members of City Assembly, the flat owners cooperatives and the population of Tbilisi.

As the priority of Tbilisi Municipality is the sustainable development of the city and, specifically at this stage, putting in order the Transport and municipal Buildings sectors, for implementing the Action Plan it is necessary to regularly inform the city population and raise its awareness on the energy efficient measures and technologies in the transport and buildings energy consumption sector. Generally, the

population should be aware of the SEAP development and implementation objectives and in case of its successful realization- of its positive social and economic outcomes. At the concrete stage, when the introduction of behavioral changes should become necessary, to gain the required support from the population its maximum involvement in the elaboration of the Plan will be provided. As the practice demonstrates, the more active is the participation of public sector and the population at the early stage of the process, the more efficient is the implementation stage and the higher is the public support.

At the initial stage of the SEAP development the meetings and consultations with Tbilisi population (where the necessity of behavioral changes is expected to be most urgent) will be essential to explain the need for the conduction of the project and benefits to be gained by the population in future. In this process the City Hall should have a well- considered understanding of population needs and envisage them during the development/revision of the Plan. Through the consultations new project ideas could emerge, bringing the necessity of amending the planned projects.

During the process of Tbilisi SEAP implementation monitoring and updating the meetings with stakeholders, experts, decision-makers were held, but such gatherings are not enough to provide final success, for which the preparation of public relations program is necessary.

Aimed at the solution of these and other technical and technological problems in the Tbilisi City Hall, in the frames of EU Energy program “INOGATE” the energy efficiency and renewable technologies demonstration/presentation center (further “Presentation Centre”) is being organized, in which the potential should be created to permit this Centre to carry out the functions of “Energy Manager”.

The awareness raising and local staff training Strategy in the process of Tbilisi SEAP implementation consists of the following stages:

The short-term strategy (2015-2018)

1. Permanently informing local authorities on the trends of energy consumption by the city, the advantages and prospects of providing sustainable energy consumption and city development and on social and economic benefits of this initiative.
2. Training of Municipality employees and outside experts for providing the successful implementation and monitoring of the SEAP.
3. Strengthening of coordination between different urban services of the City Hall, being at present one of the most serious barriers, revealed both during the development of the SEAP and in the process of its monitoring and updating.
4. Provision of Tbilisi with technical personnel, which will support the preparation of energy efficient projects in the Transport and municipal Buildings sectors and identify the necessary investments.
5. Conduction of information and educational campaigns for raising awareness among the city population, especially on the subject of increasing energy in the Transport and Buildings sectors. Preparations of information/educational/illustrative materials on the recommended modern technologies for the development of green cities. Demonstration to the population of the advantages of introducing energy efficient measures and technologies in various sectors.
6. Arrangement on the competitive principle measures for stimulating energy efficiency in different sectors.

7. Provision of private sector involvement in the SEAP implementation by supplying them information on energy saving and profitable technologies, as well as offering programs on the cooperation between public and private sectors.

The long-range strategy (2018-2020)

The introduction of certain types of prohibitions in the Transport sector and adoption of standards in the Buildings sector would become necessary in the long-run strategy, demanding changes in the awareness and significantly- in the behavioral patterns of the population. The main directions of the long-range strategy are as follows:

1. Starting consultations with stakeholders (city population, the private sector, non-governmental sector) on banning measures and standards, which should be carried out by the Municipality in different sector (Buildings and construction, Transport, Waste generation). Identification by consulting with stakeholders of barriers, which could arise in the process of endorsement of prohibition measures and different types of standards;
2. Creation and implementation of awareness raising and encouraging programs for various target groups to provide the unimpeded introduction of standards (e.g. concerning the energy efficiency).

TBILISI MUNICIPALITY STRATEGY ON THE AWARENESS RAISING OF CITY POPULATION AND STAFF TRAINING

Major strategic objectives	Main target groups	Measures to be implemented	Potential leading organization (s)	Outcome	Potential donors
<p>Short-term strategic objectives (2015-2018).</p> <p>The major objective of the short-term strategy is to facilitate the awareness of city authorities on the prospects of city Transport and Buildings sectors sustainable development and its social and economic advantages; highest possible informing and awareness raising of target audience; assisting city population and other stakeholders in getting benefit from this initiative and training appropriate staff for implementing the Action Plan and provision of its monitoring.</p>	<ul style="list-style-type: none"> • Tbilisi Municipality and City Assembly. • Stakeholders related with Transport sector (city Transport Department, private transportation companies, car-owing population, environmental NGOs and • Tbilisi population. 		<ul style="list-style-type: none"> • Tbilisi City Hall • Coordinators of CoM in Georgia (Ministry of Energy and Ministry of Environment and Natural Resources Protection) • Different local and international programs going on in the frames of CoM and EC-LEDS 	<ul style="list-style-type: none"> • Implementation of Tbilisi SEAP is advancing successfully • Tbilisi City Hall continues the same activity after 2018 • Tbilisi population is informed on initiatives undertaken by the City Hall in the frames of this process 	<ul style="list-style-type: none"> • Tbilisi City Hall • Coordinators of CoM in Georgia (Ministry of Energy and Ministry of Environment and Natural Resources Protection) • Different local and international programs going on in the frames of CoM and EC-LEDS • International donors contributing to Climate Change mitigation and renewable energy, energy efficiency and sustainable development processes.

1. Capacity building for implementing the SEAP

<p>Training of technical staff for Tbilisi, which will be able to assist different target groups in preparing energy proposals and their implementation</p>	<ul style="list-style-type: none"> • Tbilisi City Hall Technical Group • Special Department at the City Hall or the “Demonstration Center”, which will serve both the City Hall and the population as well as the private sector in preparing project proposals in different sectors and implementing these measures. 	<ul style="list-style-type: none"> • Under the support of Tbilisi City Hall the Technical Group/”Demonstration Center” should be set up, serving both the City Hall and relevant target groups in preparing energy efficient projects and offering modern technologies • For the capacity building of Technical Group/”Demonstration Center” the program should be worked out. The program should include at least the analysis of contemporary technologies, the examination of barriers to their introduction and the study of advantages of various energy efficiency measures • Development of manuals for Technical Groups (in different sectors). • Involvement of Technical Groups/”Demonstration Center’s” personnel in exchange programs and various information networks for getting international experience. 	<ul style="list-style-type: none"> • Tbilisi City Hall • Different international organizations, operating in staff training and strengthening of local potential 	<ul style="list-style-type: none"> • The “Demonstration Center” is set up at the City Hall, one of the functions of which is to train technical personnel for the City Hall. • The program and manual are developed for training staff of the City Hall Technical Group. • The staff is trained and selected according to competition rules. • Technical Group is actively participating in exchange programs and international networks to obtain newest information on present-day technologies and approaches in energy sector. • Technical Group is actively cooperating with 	<ul style="list-style-type: none"> • Tbilisi City Hall • EC-LEDS project • USAID • GIZ • EU • INOGATE
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				<p>target groups in the process of implementing the energy efficiency measures.</p> <ul style="list-style-type: none"> • Technical Group is prepared to train necessary staff for the private sector. 	
<p>Preparation for Tbilisi of such personnel which will be able to perform strategic planning of the city based upon sustainable development recommendations for technically successful implementation of CoM process.</p>	<ul style="list-style-type: none"> • SEAP Group at the Tbilisi City Hall • “Demonstration Center”/”Energy managers” 	<ul style="list-style-type: none"> • Setting up at the Tbilisi City Hall or outside of the special group/Agency, serving the City Hall in developing program for the implementation of SEAP and conduction of monitoring. The program, at the lower level, should include measures on sustainable energy and climate change mitigation, EU Directives, CoM commitments and analysis of recent technologies with the study of barriers to their introduction. • Preparation of guidelines for the mentioned group. • Inclusion of the group in exchange programs and various information networks for gaining international experience. • Suitable expected applicants for this group as far as possible should be involved from the beginning in the SEAP development process. 	<ul style="list-style-type: none"> • Tbilisi City Hall • Ministry of Energy and Ministry of Environment and Natural Resources Protection • Representative of CoM process in Georgia (at present stage- the Energy Efficiency Center) 	<ul style="list-style-type: none"> • The program and manual are developed for the City Hall SEAP Group to train the staff. • Their rights and obligations are clearly formulated as well as the working program, which considers both the assistance by the City Hall and cooperation with citizens and the private sector. • SEAP Group is actively involved in exchange programs and international networks for getting newest information on recent approaches (especially in Transport and Buildings sectors). • 	<ul style="list-style-type: none"> • Tbilisi City Hall • EC-LEDS project • USAID • GIZ • EU • INOATE

2. Public awareness raising and dissemination of information

<p>Public awareness raising and maximal dissemination of information</p> <p>In this process the public should be well-informed on social and economic well-being, which could be achieved as a result of energy sustainable development.</p> <p>The main direction of Municipality will be to inform the target groups on the sustainable development measures in the Transport and Buildings sectors, providing consultations and delivering newest information on technologies available at the market and especially on their introduction, on the best practice world over in this field.</p>	<ul style="list-style-type: none"> • Organizations and agencies, acting in the Transportation sector • Flat-owners cooperatives • Non-governmental sector and other public associations • The Tbilisi population 	<ul style="list-style-type: none"> • Preparation/development of information materials for stakeholders acting in Tbilisi Transport sector on measures and technologies, which could improve the functioning of Transport sector and increase its safety and comfort. • Preparation of information materials for stakeholders acting in Tbilisi Buildings sector on measures and technologies which will turn buildings energy efficient and more comfortable. • Elaboration of information material for target groups about city of Tbilisi (e.g. on the city potential concerning the development of energy efficiency and green cover and how could the population to promote these processes). • Development of information material for the city population on energy efficiency measures conducted by the cities, subscribers to the CoM and their outcomes. • Setting up measures based upon 	<ul style="list-style-type: none"> • Tbilisi City Hall • Coordinators of CoM in Georgia • Non-governmental sector 	<ul style="list-style-type: none"> • Tbilisi population is aware of measures to be undertaken by Tbilisi Municipality in the Transport and Buildings sectors. • Updating of information for Tbilisi population is performed at the Municipality website (Tbilisi.gov.ge) • Information booklets are developed on the preferences of energy efficient measures and their application. • A number of pilot projects are implemented providing maximal involvement of population • Different competitions are held to encouragement the energy efficiency. 	<ul style="list-style-type: none"> • Tbilisi City Hall • USAID • GIZ • EU
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		the competition principle to stimulate energy efficiency in different sectors.			
3. Providing maximal awareness of Tbilisi Municipality and City Assembly representatives					
Provision of continuously informing local authorities on the energy consumption by the city and prospectiveness of energy efficiency measures, social and economic advantages of this initiative.	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly 	<ul style="list-style-type: none"> Holding awareness raising workshops for City Hall and City Assembly representatives on the advantages of providing sustainable development of Transport sector and benefits of energy saving in Buildings sector. Encouragement participation of City Hall and City Assembly staff at international meetings and conferences on the CoM process. Inclusion of mass-media representatives in the high level meetings on the CoM issues and maximal public awareness raising by this way on the current processes. Providing the decision making process in the frames of CoM through the consultations with stakeholders. 	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly Regional Energy Efficiency Centre Ministry of Energy of Georgia Ministry of Environment and Natural Resources Protection of Georgia. 	<ul style="list-style-type: none"> Illustrative materials are prepared for holding information meetings. 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 publized by mass-media. Representatives of City Hall and City Assembly are fully involved in processes in processes going on both in the country and at the international level as well. Constantly updated information on current processes 	<ul style="list-style-type: none"> EC-LEDS USAID EU-COM GIZ Partnership for mitigation GHG emissions reduction projects Georgia's National Communications on Climate Change

				and projects is available at the City Hall website.	
<p>Long-range objectives (2018-2020)</p> <p>The major objective of the long-range strategy is to involve the private sector in achieving the SEAP goals, maximal awareness raising of prohibition measures and standards, awareness raising on the role of banning measures and standards in providing the sustainable consumption of energy</p>	<ul style="list-style-type: none"> • Tbilisi City Hall • Tbilisi City Assembly • Tbilisi population • Private sector • Non-governmental sector 		<ul style="list-style-type: none"> • Tbilisi City Hall • Tbilisi City Assembly • Energy Efficiency Centre • Initiative groups of private sector • Programs and projects of the CoM 		
1. Involvement of private sector in achieving the SEAP goals					
<p>Strengthening of private sector involvement in the SEAP implementation by providing information on energy saving and beneficial technologies, offering programs on cooperation between public and private sectors.</p>	<ul style="list-style-type: none"> • Private sector • Initiative groups of private sector 	<ul style="list-style-type: none"> • Taking an interest of private sector using different stimulating mechanisms in the application of innovative technologies (e.g. establishing certain privileges in the frames of local taxis for companies, introducing energy efficient and innovation technologies); • Providing consulting services to private sector aimed at decreasing the risks; • Setting up of different funds aiming the deployment of new technologies for the reduction of risks, related with adapting 	<ul style="list-style-type: none"> • Tbilisi City Hall • Energy Efficiency Centre • Private sector • Non-governmental sector 	<ul style="list-style-type: none"> • Various encouraging measures are being held annually for the private sector; • Motivating mechanisms for private sector are elaborated to provide its involvement in processes of new technologies development and introduction; • The Energy Efficiency and Renewable Technologies Centre 	<p>Tbilisi City Hall</p> <p>Private sector</p> <p>EU COM</p> <p>GEF</p> <p>UNFCCC programs</p> <p>EU</p> <p>INO GATE</p>

		<ul style="list-style-type: none"> of new technologies; Promoting the creation of private sector initiative groups, facilitation maximal involvement of this sector in the CoM process. 		<p>is set up, providing consultations on the deployment of new technologies;</p> <ul style="list-style-type: none"> Risk-insurance financial schemes related with technologies are created for the private sector; Initiative groups are organized in different sectors, being the main connecting ring between the state and private sector; Representatives of private sector are incorporated in international processes, associations and professional networks. 	
2. Strengthening of consultations with stakeholders in the process of introducing prohibitive measures and standards					
<p>Intensifying consultations with stakeholders (city population, private sector, non-governmental sector) on the introduction of prohibitive/banning measures in Transportation sector and standards in the Buildings sector</p>	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly Tbilisi population Private sector, acting in Tbilisi Non-governmental sector 	<ul style="list-style-type: none"> Giving maximal explanations on the developed standards (Buildings sector) and prohibitive measures (Transport sector) in the frames of SEAP sectors to the population, private sector and other target groups; Preparing the appropriate informing materials explaining the social and environmental benefits of undertaking the mentioned 	<ul style="list-style-type: none"> Tbilisi City Hall Energy Efficiency and Innovation Technologies Regional Centre 	<ul style="list-style-type: none"> Staff members, who will systematically cooperate with target groups, are trained; Explanations and consultations on restrictive measures and standards, the implementation of which is necessary to realize the SEAP, are 	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly

		<p>above measures;</p> <ul style="list-style-type: none"> It is necessary to prepare/train the activists who will daily cooperate with the target groups. 		<p>systematically conducted. The non-governmental sector actively cooperates with the population and various target groups.</p> <ul style="list-style-type: none"> Mass-media is actively involved in explaining social and environmental benefits of discussed measures (clips, talks, etc.) 	
3. Identification of barriers by consulting with stakeholders					
<p>Identification of barriers through the consultations with stakeholders, which may arise in the process of introducing prohibitive measures and different types of standards.</p>	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly Tbilisi population Private sector, acting in Tbilisi Non-governmental sector 	<ul style="list-style-type: none"> Identification of barriers in the process of consultations with the population on the developed standards (Buildings sector) and banning measures (Transport sector) for the SEAP sectors. Working out of measures to surmount the determined barriers by consulting different target groups (e.g. transportation in certain district or the street should be prohibited gradually, in defined days of the week. Yet some measures, e.g. technical inspection of cars, should be taken simultaneously, under the 	<ul style="list-style-type: none"> Tbilisi City Hall Tbilisi City Assembly 	<ul style="list-style-type: none"> Groups are trained (private sector's initiative group, non-governmental sector, mass-media) to carry out consultations; For each sector, discussed in the SEAP, barriers re identified; In cooperation with target groups the measures to overcome the barriers are revealed. 	<ul style="list-style-type: none"> Tbilisi City Hall

		government decision, etc.)			
4. Awareness raising of decision makers, representatives of public and private sectors on the role of prohibitive measures and standards in providing sustainable energy consumption					
<p>Development and implementation of awareness raising and stimulating programs for different target groups to provide the unimpeded introduction of standards (e.g. in energy efficiency). This section will be more effective in awareness raising among decision makers and implementers and their preparedness for the mentioned processes.</p>	<ul style="list-style-type: none"> • Tbilisi City Hall • Tbilisi City Assembly • Tbilisi population • Private sector, acting in Tbilisi 	<ul style="list-style-type: none"> • Informing decision makers and implementers on successful and ineffective international practices; • Participation of decision makers and implementers in international processes related with CoM and low emission development; • While developing information materials for decision makers and implementers on restrictive measures and new standards the emphasis should be made on the need of energy sustainable consumption to provide Georgia's independence in energy supply; • While dealing through the mass-media with questions on decision concerning restrictive to the population measures and the new standards, special attention should be paid to social and environmental issues, as well to the encouragement of tourism; • While dealing through the mass-media questions on decisions concerning restrictive to private sector measures and the new 	<ul style="list-style-type: none"> • Tbilisi City Hall • CoM programs and projects 	<ul style="list-style-type: none"> • Decision makers and implementers are involved and well-informed on the current international processes, Georgia's commitments on climate change and energy efficiency; • Information portfolios are developed in which the CoM process is well-analysed in the context of EU Directives implementation; • Good practice manuals are compiled; • The inclusion of foreign consultants should be necessary in this process. 	<p>Government of Georgia</p> <p>EC-LEDS</p> <p>EU- CoM</p> <p>GIZ</p> <p>Clima East</p> <p>And other offered in the future programs.</p>

		standards, special attention should be paid to economic benefits in the long-range perspective.			
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The Implementation Structure

- This strategy, as a constituent part of the City Development Action Plan, is approved and its implementation is monitored by the Tbilisi City Assembly;
- The responsible body on updating the Strategy and its performing is Tbilisi City Hall;
- The responsible body for training local staff, necessary to execute the Strategy and monitor its implementation will be the special Agency at the City Hall, planned to be set up by the City Hall. Currently the structure of this Agency is being discussed and for this purpose the local and international programs, going on in the frames of CoM, will be applied;
- The development of awareness raising and information dissemination materials for the City Hall mainly will be conducted using the outside resources (non-governmental sector).

ANNEX 1. THE 2009 AND 2014 GHG INVENTORY

Table 12. Energy consumption in Tbilisi in 2009

Category	FINAL ENERGY CONSUMPTION (MWh)					
	Electricity	Natural gas	Diesel	Gasoline	Firewood	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:						
Municipal buildings, equipment/facilities	11 105	11 208	280	0	5 550	28 142
Tertiary (non-municipal) buildings, equipment/facilities	737 203	524 432	0	0	0	1 261 635
Residential buildings	798 033	1 933 779	0	0	0	2 731 812
Municipal public lighting	46 800					46 800
Subtotal buildings, equipment's/facilities and industries	1 593 141	2 469 418	280	0	5 550	4 068 389
TRANSPORT:						
Municipal fleet	0	0	4 589	7 109		11 698
Public transport	62 949	0	474 805	352		538 105
Private and commercial transport	0	19 751	1 409 613	3 127 563		4 556 927
Subtotal transport	62 949	19 751	1 889 007	3 135 023	0	5 106 730
Total	1 656 090	2 489 169	1 889 287	3 135 023	5 550	9 175 119

Table 13. GHG emissions in Tbilisi in 2009

Category	All emissions (t CO ₂ eq)					
	Electricity	Natural gas	Diesel	Gasoline	Firewood	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:						
Municipal buildings, equipment/facilities	991	2 258	74	0	151	3 474
Tertiary (non-municipal) buildings, equipment/facilities	65 806	105 657	0	0	0	171 463
Residential buildings	71 236	389 598	0	0	0	460 834
Municipal public lighting	4 180					4 180
Subtotal buildings, equipment's/facilities and industries	142 213	497 514	74	0	151	639 952
TRANSPORT:						
Municipal fleet	0	0	1 214	1 770		2 984
Public transport	5 619	0	125 657	88		131 363
Private and commercial transport	0	4 046	373 053	778 565		1 155 664
Subtotal transport	0	4 046	499 924	780 422	0	1 290 011
OTHER:						
Waste management						420 800
Waste water management						155 900
Total	142 213	501 560	499 999	780 422	151	2 506 664

Table 14. Energy consumption in Tbilisi in 2014

Category	FINAL ENERGY CONSUMPTION (MWh)				
	Electricity	Natural gas	Diesel	Gasoline	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:					
Municipal buildings, equipment/facilities	11 188	20 037	30	0	31 255
Tertiary (non-municipal) buildings, equipment/facilities	986 836	847 344	0	0	1 834 180
Residential buildings	887 738	3 348 122	0	0	4 235 860
Municipal public lighting	51 720				51 720
Subtotal buildings, equipment's/facilities and industries	1 937 482	4 215 503	30	0	6 153 015
TRANSPORT:					
Municipal fleet	0	0	426	7 281	7 707
Public transport	65 149	2 119 565	462 514	182 014	2 829 242
Private and commercial transport	0	988 986	1 905 529	1 576 742	4 471 258
Subtotal transport	65 149	3 108 551	2 368 470	1 766 037	7 308 207
Total	2 002 631	7 324 054	2 368 500	1 766 037	13 461 222

Table 15. GHG emissions in Tbilisi in 2014

Category	All emissions (t CO ₂ eq)				
	Electricity	Natural gas	Diesel	Gasoline	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:					
Municipal buildings, equipment/facilities	1 165	4 037	8	0	5 210
Tertiary (non-municipal) buildings, equipment/facilities	102 766	170 714	0	0	273 480
Residential buildings	92 446	674 546	0	0	766 992
Municipal public lighting	4 932				4 932
Subtotal buildings, equipment's/facilities and industries	201 309	849 297	8	0	1 050 614
TRANSPORT:					
Municipal fleet	0	0	113	1 813	1 925
Public transport	26 056	434 176	122 404	45 316	627 952
Private and commercial transport	0	202 586	504 297	392 559	1 099 442
Subtotal transport	0	636 761	626 814	439 687	1 729 319
OTHER:					
Waste management					461 710
Waste water management					154 450
Total	201 309	1 486 059	626 822	439 687	3 396 093