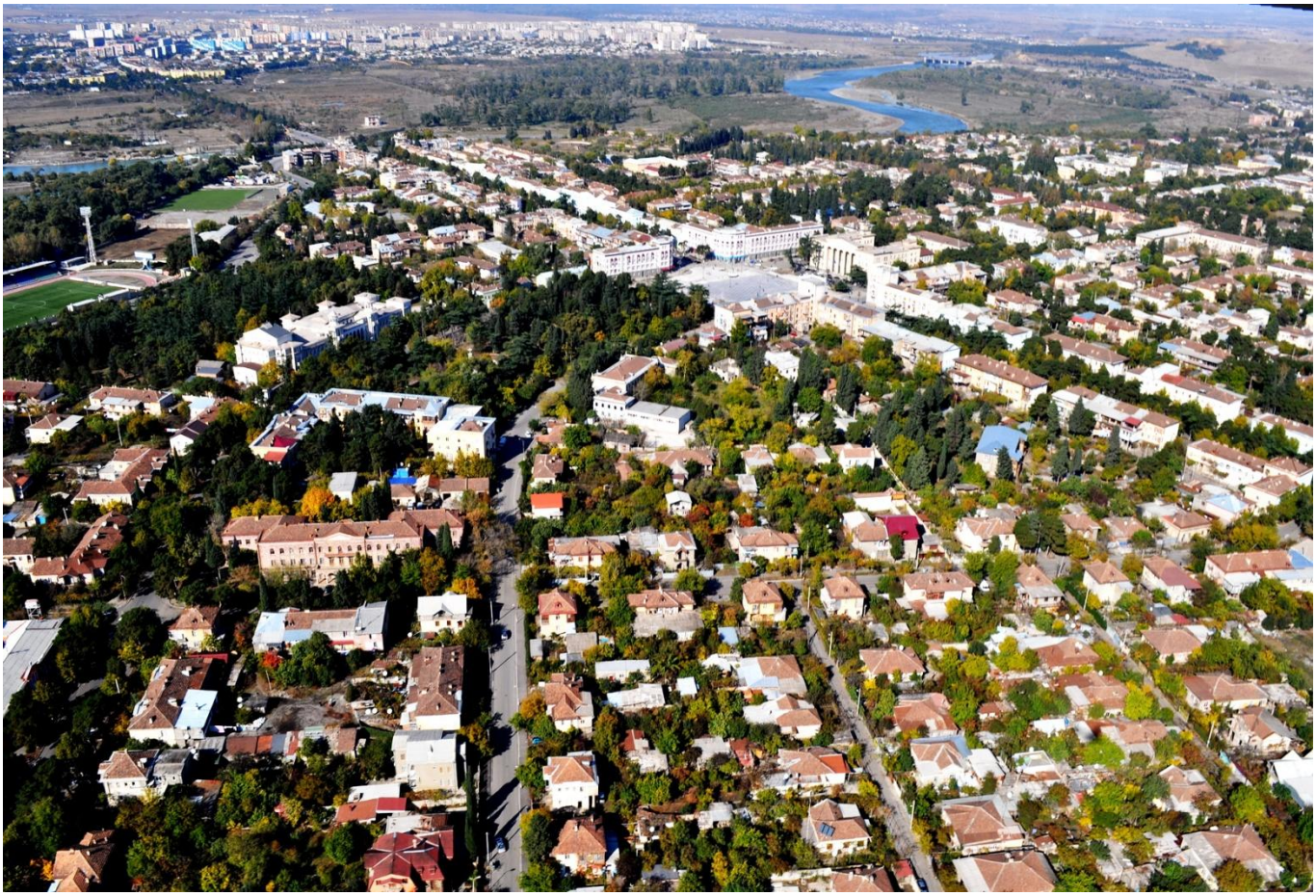
Sustainable Energy Action Plan

City of Rustavi



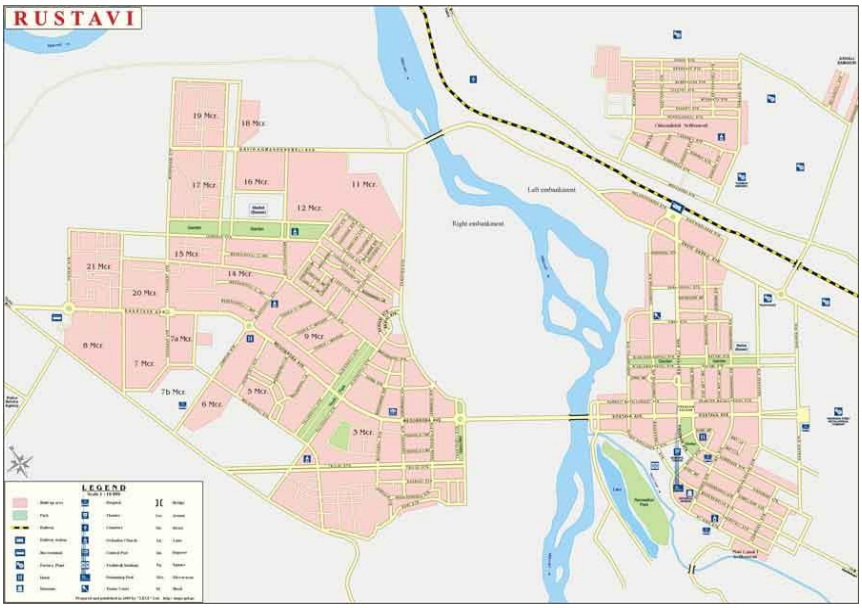
Approved by Order #751 of the Council of self-governing city of Rustavi,
October 31, 2012

Table of contents

Georgia – a country in Eurasia, located in South Caucasus, between the Black and the Caspian Seas, bordered by Russia from north, Turkey and Armenia from south and Azerbaijan from east.

Kvemo(lower) Kartli – administrative region in the east of Georgia. Kvemo Kartli is one of the most important economic provinces in Georgia. It occupies the second place in the field of manufacture. The administrative center of the province is the City of Rustavi.

Rustavi –self governing city of Rustavi, located in the Kvemo Kartli plain, on the both sides of the river Mtkvari, 370 metres above the sea. Rustavi belongs to semi-arid zone, resulting in lack of green cover.



The city is split in two parts by the river Mtkvari (Kura), the length of which (in Rustavi area) makes up 4 km. The city has no natural lakes or ponds. There is enough resource of service water (i.e. river Mtkvari) in Rustavi area, but no additional resource of drinking water. So, it is necessary to restore service water supply in Rustavi, as it will significantly reduce the use of drinking water.

History

Old city– Rustavi is one of the ancient cities in Georgia.

Archeologically Rustavi has not completely been studied, but in spite of the lack of archeological material, quite significant cultural layers are proved within the city territory.

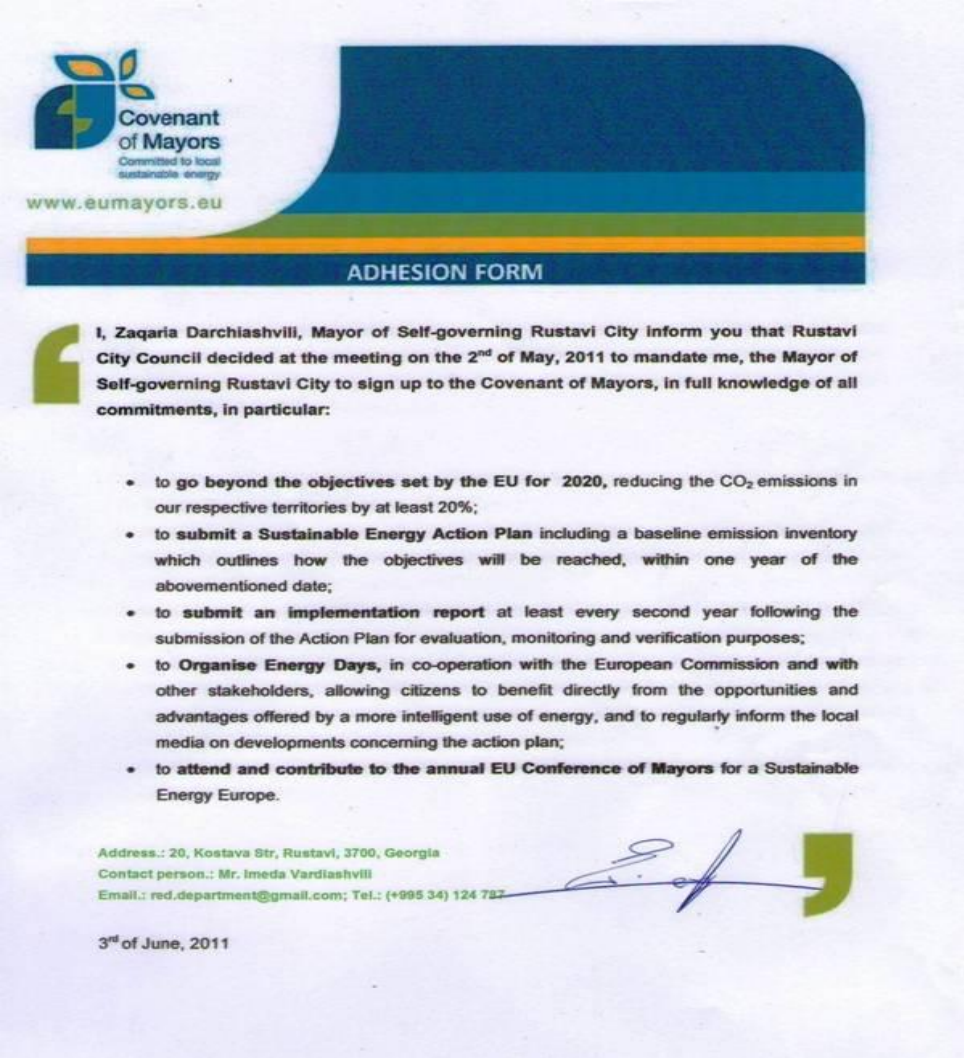
In XII-XIII centuries urban life reached the highest stage of development in Rustavi. Field of arts such as production of ceramics, glass, metal, leather, bone, wood, as well as weaving manufacture were thriving. Products made by Rustavian craftsmen were distinguished with high quality.

At the same time Rustavi was involved in the network of trade route of Near East.

In the XX century Rustavi was the second greatest industry center of Georgia after Tbilisi. The City began to rise in the Soviet period: about 90 large and medium enterprises operated there, including Metallurgical Plant, Nitrogen Plant, Chemical Fiber Factory, Cement Plant, Crane-Building Plants. After the fall of the Soviet Union and resulting dissolution of old economic links, many factories and plants went bankrupt. The Nineties turned to be especially hard for the city due to unemployment and swift increase of poverty. In 2004-2006 years the large-scale privatization of the state property took place, partially involving Rustavi plants as well. Hence the economics of the city is on its way to growth again.

Resume

Self-governing city of Rustavi signed the Covenant of Mayors on May 02, 2011 and committed itself to reduce greenhouse gas emission no less than by 20% below the baseline year. The present document of sustainable energy action plan (SEAP) of the city, along with the baseline inventory tables represents the part of commitments undertaken by the Covenant and reflects certain actions and arrangements for reduction of greenhouse gas emission, providing completion of obligations by 2020 year.



Covenant of Mayors
Committed to local sustainable energy
www.eumayors.eu

ADHESION FORM

I, Zaqaria Darchiashvili, Mayor of Self-governing Rustavi City inform you that Rustavi City Council decided at the meeting on the 2nd of May, 2011 to mandate me, the Mayor of Self-governing Rustavi City to sign up to the Covenant of Mayors, in full knowledge of all commitments, in particular:

- to **go beyond the objectives set by the EU for 2020,** reducing the CO_2 emissions in our respective territories by at least 20%;
- to **submit a Sustainable Energy Action Plan** including a baseline emission inventory which outlines how the objectives will be reached, within one year of the abovementioned date;
- to **submit an implementation report** at least every second year following the submission of the Action Plan for evaluation, monitoring and verification purposes;
- to **Organise Energy Days,** in co-operation with the European Commission and with other stakeholders, allowing citizens to benefit directly from the opportunities and advantages offered by a more intelligent use of energy, and to regularly inform the local media on developments concerning the action plan;
- to **attend and contribute to the annual EU Conference of Mayors** for a Sustainable Energy Europe.

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3rd of June, 2011

1. General Strategy

a) Objectives

City of Rustavi is one of the powerful industrial centers, in which significant part of metallurgical, energy and chemical industry of the country are concentrated. The course of rapid economic development undoubtedly requires consideration of the principles of sustainable development, formed by balance of economic, social and ecological development.

Considering these principles the *Development Strategy of the City of Rustavi* was developed in 2009, under which one of the priorities is improvement of ecological condition of the city.

Priorities of strategic plan of development of the city of Rustavi
1. Development of local entrepreneurship
2. Support of technical infrastructure development
3. Strengthening of self-governance
4. Improvement of social environment and public welfare
5. Recovery of ecological conditions/environment

The present document of Sustainable Energy Action Plan (SEAP) of the city was prepared in full compliance with the said strategy and reflects reduction of greenhouse gas emission - one of the most important aspects of improvement of ecological conditions within the obligations under the Covenant of Mayors. Reduction of greenhouse gas emission, namely of carbon dioxide by 20% by 2020 year compared with the level of 2011 year will significantly recover the climate of the city and improve the environment. Furthermore, implementation of the said Covenant will facilitate to raising public awareness in the environment protection, including entrepreneurs' providing, on its hand, further stability of sustainable development.

b) Current situation and vision of future

Currently Rustavi represents one of the industrial cities of Georgia, having its own self-governance. Its population amounts to 122 500, 4981 (1637 families), including internally displaced people, and features the tendency of slow increase, mainly at the expenses of natural increase and migration from neighboring villages and Tbilisi-city.

Table 1. Population trend of Rustavi

	2002	2005	2010	2011
Population (thousands)	116400	11550	119500	120800

Typical urban character of the city determines the high rate of energy consumption for continuous operation of lighting, heating, transport, industrial and non-industrial institutions.

Enterprises existing within Rustavi area, among which there are some giants – Metallurgical Plant, Heidelberg Cement Plant, Rustavi Nitrogen Plant, Geo Steel plant, did not operate with full capacity as a result of long suspension caused by the crisis of 90-ies and stagnation period. Their majority requires re-equipment and reconstruction for providing full capacity. Enterprises are privatized and are not subject to municipal management, still representing a significant field of employment and economic development, with related harmful effect on the ecological conditions of the city, being the worst among Georgian cities.

After 2004, in the course of rapid economic development of the country, the infrastructure of the city, as well as social service has been revived, industrial, number of cultural, educational, sports and public institutions has been increased and their quality improved. The field of construction has been boosting in the city, as well as in the whole country.

Provided the current rate of economic growth of the country is maintained, industrial sector development will be supposedly enhanced in the nearest future, that, likely, will be reflected in increase of the share of employed population in this field and intensive activity. Thus, expansion of industrial cities, including Rustavi, as well as their intensive development is expected, which in case of ignoring the provision of sustainable development must by all means be reflected on the increase of greenhouse gas emission and general worsening of ecological conditions.

The vision of future of the city, proceeding from the city development strategy and feasible results of implementation of the present plan implies significantly recovered environment with energy saving way of life and rehabilitated enterprises, lots of parks and ecologically healthy infrastructure – improved roads, transport scheme and ,,green ways". What is the most important, the tendency of economic recovery shall continue after 2020 – on the basis of raised environmental awareness of public and entrepreneurs, as well as acknowledgement of vivid economic benefit of energy efficiency.

Having analyzed general tendencies of development of the city and the country in whole, as well as political and economic conditions and risks, the sectors, relevant to sustainable energy development plan, have been selected, where taking measures for reduction of greenhouse gas emission before 2020 seem feasible, taking into consideration that in case of proper political-economic conditions and stability this policy will continue

after 2020 year and involve other fields as well. One of the objectives of the present plan is also creation of such preconditions by 2020 year.

The sectors selected for greenhouse gas emission reduction according to sustainable energy action plan before 2020 include buildings, transport and infrastructure, involving lighting and green spaces. Selection of these sectors was conditioned by their high potential of energy saving, along with lower expenses required for measures to be taken, as well as time constraints (before 2020 year).

As for industrial sector, which is the largest emitter of greenhouse gas, it is not foreseen in the action plan due to privatization of this sector and consequent low accessibility to municipality. It is expected that this sector will be involved in the process of ecological recovery of the city later on, under stronger economic profitability and lower risks. Success of SEAP may play certain role in creation of such preconditions.

Residential and municipal buildings sector

Selection of this sector for making arrangements for greenhouse gas (GHG) emissions reduction was caused by several factors. Firstly, major part of residential and municipal buildings in the city was built in the Soviet period by the State budget, with the then low standards, aiming at rapid and cheap construction. The majority of such buildings do not even slightly meet energy saving requirements. Entrances are open, walls – thin, buildings – outdated. In such buildings energy saving potential is very big. Besides, the construction boom over the country,, spreads on Rustavi as well and implementation of energy-efficient technologies in new houses will significantly reduce energy loss.

Strategy, foreseen in this sector, implies rising of energy-efficiency on account of reduction of energy loss due to such measures as insulation of buildings and use of energy-efficient light bulbs. Both these measures are preceded by raising public awareness in efficiency and use of such measures. Both these measures are considered as medium-term strategy.

Use of renewable energy is an expensive, but prospective way for reduction of GHG emission and the present plan implies taking certain steps towards this direction, namely, installing solar collectors in kindergartens for hot water supply purposes. The said measure belongs to the long-term strategy and is aimed at popularization of renewable energies in the city, along with reduction of greenhouse gas emissions.

One more measure planned in this sector, is construction of a new energy-efficient social hostel, for 12 socially vulnerable /unprotected families, to replace non-energy-efficient housing for them. This innovative measure is considered as a short-term one and its implementation will significantly raise public awareness in energy efficiency and energy saving matters and increase motivation.

Municipal (outdoor) lighting sub-sector also includes energy saving potential and strategy in this sub-sector is aimed at the use of this potential on the account of raising energy efficiency of street lighting and traffic lights.

Transport Sector

Transport exhausts represent the significant source of national greenhouse gas emissions in Georgia and the city of Rustavi is not exception from this statistics either. Taking into consideration rate of urbanization and economic growth, further increase of these emissions are expected in the near future. Thu, transport sector is considered as a sector having significant potential for reduction of greenhouse gas emission, not only in the terms of fuel consumption. Transport fleet is outdated, infrastructure needs improving, and technical regulations –refinement. Transport schemes also contain significant potential for energy saving. As a result of analysis made, improvement of infrastructure, arranging of ,,greenways", renovation of transport fleet and optimization of transport schemes were selected as possible measures to be taken in the sector. All these measures belong to medium-term strategy and scheduled in optimal sequence with one another. Fuel-associated measures such as improving of fuel quality by means of moving to the bio-fuel consuming transport or Electrical cars is not considered in this plan before 2020, as long as its implementation seems unrealistic.

Sector of land use planning

Measures to be implemented in this sector belong to short or medium-term strategy and include those for planting trees and bushes in the city and adjacent territories. Besides absorbing of GHG emissions in the city and contributing to fulfillment of obligations under Covenant, this measure will facilitate to recovery of city climate being of vital importance for Rustavi, situated in semi-arid zone.

Landscape gardening (green spaces) policy is a long-term strategy and shall carry on after the period foreseen by Covenant.

c) Organizational and financial aspects

The municipality of the city is responsible for implementation of sustainable energy development plan in the city, conducting works in this direction by means of organizing group, coordinating performance of works foreseen by the plan and implementation of measures in sectors and fields defined in the plan. Organizational group consists of three members from the relevant services of the city hall. They carry out organization and control over the implementation of the measures under the plan in established terms and make relevant corrections in their implementation in order to provide proper performance of obligations under the Covenant within agreed terms. Experience and knowledge of the organizational group members in corresponding field conditions their competence in monitoring and control over relevant measures. Furthermore, group members are acquainted with the requirements and specifics of the Covenant of Mayors, while in case of arising possible problems have due knowledge of getting technical assistance from guideline documents, forum of the Covenant, and other ways of getting technical assistance, and skills to use them.

The Municipality fully acknowledges the importance of stakeholders involvement in all activities led by the city hall, and the population of Rustavi and stakeholders from various enterprises were actively involved in development of this plan. This involvement will be kept on along the implementation of the Plan, as

the municipality considers it necessary, not only for relevance of the measures foreseen by the plan, but also for provision of success of implementation and continuation of the plan.

Regardless the fact that energy saving, resulting from implementation of the measures, considered by the Plan, will be beneficial, in long-term, for population, as well as enterprises and institutions in the city, still additional fundraising will be needed to financially ensure development of the plan. The City Hall expects compensation of these funds in case of successful implementation of the plan. Costs for all actions will be detailed later on.

Sources of funding for the actions under the plan are self-governing city of Rustavi – City Hall - and donor organizations.

Municipality fully acknowledges the necessity of monitoring and control over the implementation of the plan in order to provide successful implementation of the plan. Monitoring of the plan implementation implies recurrent inspection of the actions determined by the plan according to their planned periods, but no later than once in two years, and, if necessary, making relevant corrections for providing due result. Monitoring is performed via organizational group, assisted by previously selected personnel having expertise in the relevant field. Results of monitoring will be reported to the municipality authorities and scope of possible relevant corrections agreed with them as well.

Active involvement of public and stakeholders in implementation and correction of the plan will be ensured by permanently informing of public on the action plan and the course of its implementation, via relevant section for the SEAP in the City Hall web-site.

2. Baseline emission inventory

Baseline inventory includes emissions of greenhouse gas of self-governing city of Rustavi within geographic borders of the city.

Methodology

Greenhouse gases: Carbon dioxide, methane and nitrous oxide – basis for this selection is that actions to be performed in one of the selected sectors (transport) reduce not only carbon dioxide, but also remaining two gases as well, that finally is reflected in the volume of emissions equivalent of carbon dioxide.

Baseline is a level towards which reduction of greenhouse gases shall be performed under the Covenant of Mayors by 2020 year. For the baseline 2011 year is selected as the closest year from signing the Covenant, with relevant data available. This selection is in compliance with the methodology defined for East European countries, issuing from specifics of development of these countries since 1990 year up today, distinguishing

them from developed countries.

Unit of estimates and mandatory reduction value: Mandatory reduction shall be measured in quantity, in tons of carbon dioxide equivalent (tCO2eq) and not by calculating per capita. This choice is caused by selecting all three greenhouse gases for estimation and slow growth tendencies of Rustavi population, and is conservative approach.

Emission factor: standard coefficients stated in IPCC guidelines have been selected, as easier to apply for calculation of emissions for base year and following years.

Selected sectors for reduction of emissions: Building and transport sectors, as well as land use planning, as an additional sector. This choice is in compliance with methodological requirements of SEAP on the recommended sectors and caused by emission reduction potential and feasibility of planned actions.

Building sector

Building sector, as it is known, greatly contributes to energy consumption in cities. Rustavi is not an exception from this rule. Along with high consumption, there is also a high potential of energy saving in this sector, related with rising of energy efficiency and energy saving, entailing reduction of GHG emission on its hand.

For calculation of baseline emissions, guidelines and instructions for development of sustainable energy action plan were used in building sector. From the recommended list municipal buildings, residential buildings and municipal (outdoor) lighting sub-sectors had been selected, as those most available for city municipality for performing emission reduction measures.

For calculation of baseline emissions from municipal and residential buildings sub-sectors of the building sector, electricity and gas consumption data of 2011 have been used. Municipal buildings comprise buildings under the municipal management, including buildings of local budgetary institutions, kindergartens among them. Residential buildings comprise residential houses and blocks-of-flats of local inhabitants and internally displaced persons.

Electricity and natural gas are used as energy sources for these buildings. Electricity in the buildings are used for lighting, as well as household purposes (in residential buildings), such as heating, cooking, refrigeration, water heating, washing, bathing and ironing. Natural gas in the buildings is mainly used for heating, cooking and water heating.

In the Baseline emission inventory entire consumption and associated GHG emissions for electricity, as well as for natural gas were calculated.

Data on electricity and gas consumption for the various types of buildings, provided by electricity and gas distribution companies to the municipality, had been used to identify activity data for final consumption of energy in municipal and residential buildings.

Emission coefficient for natural gas was taken as IPCC default value, (2006 IPCC guidelines), recommended also by the SEAP guidelines (56.1tCO2/TeraJoule=0.202tCO2/kWh), while a country-specific coefficient for Georgian energy system was calculated for electricity, based on the shares of hydro and natural gas in the nationwide consumption in 2011, as natural gas is the only one fossil fuel used for electricity generation. Calculated emission factor for electricity equals to 0.146 tCO2eq/kWh, well complying with relevant coefficients of the countries where, like Georgia, the source of renewable energy is extremely high. It must be noted that this coefficient differs from the country-specific value (0.39) calculated for projects under *Clean Development Mechanism*, according to its methodologies, because of from different purposes of SEAP.

As for municipal outdoor lighting, including decorative lighting of streets and traffic lights, their energy consumption and emissions were calculated aggregated in the baseline emissions inventory, using data on general municipal consumption and same country-specific emission factor for electricity greed.

Table 2. Final energy consumption and emissions from buildings sector

Subsectors of buildings sector	**Consumed electricity (MWh)**	**GHG Emissions from electricity consumption (tCO_2-eq)**	**Consumed natural gas (MWh)**	**Emissions from consumption of natural gas (tCO_2-eq)**
Local budgetary buildings	6 741.8183	986.37280	2693.786152	544.1448028
Residential buildings (indigenous population)	62 335.80304	9 120.14202	254945.0953	51 498.90925
Refugees (Internally displaced persons)	**1 144.61457**	**167.46471**		
Totally (residential buildings)	63 480.41761	9 287.60673		

Totally buildings	70 222.23591	10 273.97953	257 638.8815	52 043.05406
Outdoor lighting	5256.356	767.427976	——	——
Totally in the sector	75 478.59191	11 043.01933	257 638.8815	52 043.05406

Totally: consumed energy = 333117 473.3 kWh; GHG emissions = 63 086.07405tCO_2 eq.

Of course, consumed gas does not include the gas spent for electricity generation.

Totally 333 117 473.3 kWh energy is consumed in the buildings (2011 year), while 63 086.07405 tCO_2-eq GHG are emitted.

Transport Sector

Baseline emissions are calculated only from road transport, including municipal, public and private transport, for which emission reduction measures are foreseen.

CO_2 emissions from subsectors presented in the inventory are calculated based on standard emission coefficients of consumed fuel (petrol, diesel and compressed natural gas) (accordingly 0.249, 0.267 and 0.202tCO2/kWh).

Activity data for municipal and public transport rely on the data provided by the municipality, while quantity and composition of private fleet is evaluated proceeding from the following assumptions:

Number of private light vehicles: 10% of city population;
Among them operating on petrol: 80%;
Operating on diesel: 10%;
Operating on gas: 10%.

Table 3.Activity Data of road transport fleet of Rustavi

Type	Quantity	Age			Fuel			Expected mileage (annual)	Expected fuel consumed
		0-6	6-12	Older than 12	Petrol	Diesel	Gas	km	(litres/per 100km)
a) Public transport									
Buses	8	-	-	8	-	8	-	63600	40
Route mini-buses	25	18	6		-	24	1	1380000	19
Operating on diesel	24							1380000	19
operating on gas	1			1				42224	
2)Municipal transport	27	16	5	6	22	5			14
Fire engines	5			5	4	1			39 diesel 47petrol
3) commercial									
4) Private (light) vehicles	2080				1664	208	208		14

For estimation of fuel consumption by private cars, fuel consumption statistics (of petrol and diesel) by municipal service (light) vehicles, also by route mini-buses (operating on gas) was used, generalized on the entire fleet of light vehicles, considering percentage ratio.

Using the obtained values emissions were calculated for all three major greenhouse gases: Carbon Dioxide, Methane and Nitrous oxide. Decision on inclusion of all three gases in the inventory was made because emissions of Methane and Nitrous Oxide make significant part of transport emissions, as transport fleet existing in Georgia mainly are lacking due filters, that increases emissions of these two gases compared with EU countries, where relevant regulations associated with exhausts are in place. Accordingly, measures foreseen by SEAP will be reflected on the reduction of all three GH gases.

Table 4. Estimates of fuel consumption in transport sector and baseline GHG emissions (2011) from the vehicles under municipal management

Type of transport		Consumption (MWh)	CO_2emission (t)	CH4 emission(t)	N2O emission(t)	Total emission (t CO_2eq.)
Public	Buses	2022,698336	540,0604558	28,39641293	28,39641293	9939,273135
	Route mini-buses (operating on gas)	47,85769498	9,667254385	15,84920064	0,51682176	502,7152134
	Route mini-buses (operating on diesel)	62541,45092	16698,56739	878,0117299	878,0117299	307320,45
Municipal	Light cars(operating on petrol)	198,0896515	49,32432322	23,53116811	2,281810241	1250,840028
	Light cars(operating on diesel)	44,07955808	11,76924201	0,618827489	0,618827489	216,601141
Fire engines	Operating on diesel	23,25626035	6,209421514	0,326491776	0,326491776	114,2781994
	operating on petrol	103,4192395	25,75139065	12,28522284	1,191294336	653,0423145
Totally		64975,86648	17340,34248	959,0190537	911,3433884	319996,193

For estimation of fuel consumption by private vehicles, the data on fuel consumption (petrol and diesel) by the municipal (light) cars, also gas consumption by route mini-buses (operating on gas) were used, which was generalized on the whole fleet of light vehicles, considering percentage ratio.

Table 5. Consumed fuel by private light vehicles (cars) in 2011 and total emissions

Type of light vehicles (cars)	Consumption (MWh)	CO2 emission (t)	CH4 Emission (t)	N2O emission (t)	Emission (tCO_2-eq)
Operating on gas	9954,400555	2010,788912	0,915804851	0,029863	2039,27841
Operating on petrol	14982,78091	3730,712448	0,49443177	0,047945	3755,95843
Operating on diesel	1833,709616	489,6004675	0,007151468	0,007151	491,967603
Total	26770,89109	6231,101827	1,417388089	0,08496	6287,20444

Totally baseline GHG emissions from the whole sector equals to 326284,4 tCO_2eq.

Private vehicles sub-sector was added as long as some measures foreseen in the road transport sector are reflected not only on the transport means under municipal management.

Table 6. Baseline GHG emissions (2011)

Sectors	Basaline emissions (t CO2-eq.)
Buildings sector without outdoor lighting	70222,23591
Outdoor lighting sector	767,427976
Buildings together with outdoor lighting	**63086,07339**
Transport sector without private (light)vehicles	319997,2
Private (light) vehicles	6287,204443
Transport totally	**326284,4045**
Grand total	**389370,4779**

Data on consumption of electricity and natural gas and associated Carbon Dioxide emissions from buildings and transport sectors, also emissions of Methane and Nitrous Oxide from transport sector are put into tables A and B of the baseline emissions inventory.

Additional information/notes

Any additional (non-compulsory) sector isn't foreseen for implementation of measures under the Rustavi SEAP, so baseline emissions weren't calculated for them

Furthermore, Rustavi municipality is not going to purchase ,,certified green energy ". The city does not produce either electricity or heat within its territory, therefore relevant emissions are not counted in the baseline emission inventory.

3. Planned actions and measures

In order to implement measures for GHG reduction in Rustavi before 2020, buildings and transport sectors, as well as sector for land use planning ("green spaces") have been selected.

Measures to implement in this sector have been selected according to their energy saving potential, low cost and feasibility criteria. The measures include also working with stakeholders and public awareness-raising activities as well as measures aimed at enhancement of civil monitoring, that will create necessary conditions for implementation of the SEAP and also for continuation of long-term policy of greenhouse gas reduction.

Measures to be implemented in buildings sector and estimation of greenhouse gas reduction potential

There is a huge energy saving potential in buildings sector, dispersed in heating, lighting and low insulation of buildings causing energy losses. When selecting the measures to be implemented within the SEAP, general strategy in this sector was focused on reduction of energy loss, thus raising energy efficiency. Based on optimal efficiency and feasibility, the following actions have been selected:

In municipal buildings sub-sector:

Insulation of buildings and refurbishment/renovation;
Installation of efficient light bulbs;
Installation of sun collectors in kindergartens.

In residential houses sub-sector:

Insulation of buildings and renovation/refurbishment;
Installation of energy efficient light bulbs;
Construction of exemplary low-emission (efficient) social hostel.

In outdoor lighting/municipal public lighting sub-sector:

Replacing of light bulbs of street decorative lighting with more efficient ones;
Replacing of traffic lights bulbs with energy efficient bulbs;
Installation of ,,intelligent" traffic lights.

Transport sector

Improvement of infrastructure;
Improvement of public transport scheme;
Renovation of public transport fleet;
Renovation of municipal transport fleet;
Promotion of public transport use.

Land use planning sector (arrangement of green spaces)

Arrangement of green spaces inside and around the city

These actions will be conducted by means of implementation of certain measures, presented and described in the tables:

Table 7. Table of actions foreseen by the action plan

Actions	Description of measure		Quantity, size
1.Municipal buildings			
Measure 1.1.	Improvement of insulation (replacement of doors and windows with metal-plastic ones, reparation of roofs)		20 buildings before 2020 year
Measure 1.2.	Installation of solar batteries in kindergartens		5 or 10 batteries, 1 pilot kindergarten
2.Residential buildings			
Measure 2.1.	Improvement of insulation (closure of entrance, reparation of roofs and entrance doors.		14 buildings a year, starting from 2013
Measure 2.2.	Installation of energy efficient light bulbs		One light bulb for each family
Measure 2.3.	Construction of low-emission pilot/exemplary building (social hostel)		
3. Outdoor lighting			
Measure 3.1.	Increase of energy efficiency in outdoor lighting		In all newly built squares, parks, roads
Measure 3.2.	Increase of energy efficiency of traffic lights		On all rehabilitated roads
4. Transport			
Measure 4.1.	Improvement of infrastructure (construction and rehabilitation of roads) 2 Improvement of traffic management	Establishing of traffic light management center, installing sensors on traffic lights, revoking traffic lights on the roads with intensive traffic, creating ,,green ways”	
Measure 4.2.	Improvement of public transport scheme	Reduction of fleet, optimization of routs (road, frequency)	
Measure 4.3.	Renovation of public transport fleet		Replacement of 6 municipal buses of Bogdan type with new ones
Measure 4.4.	Promotion of public transport use	Media coverage, enhancement of conveniences at bus stops by arranging electrical boards at bus stops, benches; creation of web-page with routes and schedules	
Measure 4.5.	Renewing of municipal transport fleet	Replacement of old vehicles	6 vehicles (6-12- years old)
5. Planning of land use			
Measure 5.	Arrangement of green spaces (plantation of parks, gardens, green spots)		

Description of measures

a) Buildings

Action 1.1. Renovation of municipal buildings (improvement of insulation)

Insulation of buildings saves considerable thermal energy, especially when majority of buildings are built with old, Soviet standards or below them.

In the frame of the buildings renovation plan, municipality may, for SEAP purposes, implement such measures as insulation of kindergartens and other municipal buildings, such as replacement /reparation of outer frames of residential buildings, mend of roofs, insulation and/or replacing of doors and windows. According to conditions of certain buildings, doors and windows of buildings will be replaced or only insulated by special isolation tapes. These measures will provide better saving of accumulated heat and it will save approximately 40% of heat.

Emission reduction potential of the measures was estimated using the number of municipal buildings, volume of energy consumption in one building and percent of saved energy.

Expected number of municipal buildings towards which renovation and repairs will be made within SEAP, involving insulation measures, amount to 20, mainly kindergartens, based on municipal plan.

Energy consumption in one building was counted using general energy consumed in municipal buildings per building and the assumption that 80% of consumed energy goes for heat.

According to these calculations this volume of warmth saved by these measures in one building makes up 0.4*Q, where

$$Q = 0.8*Q^{total}/N = 0.8* (Q_{el}+Q_{ng})/N,$$

Where Q Q^{total} ,$Q_{el}+Q_{ng}$ and N are respectively mean quantity of saved heat, total consumed energy in municipal buildings, energy consumed from electricity, that from natural gas and number of municipal buildings.. This figure, i.e. energy quantity saved per building comprises 37742, 41781 kWh per year. For 2 refurbished buildings per year during 9 years (2012-2020) this quantity shall amount to 3396817,603 kWh.
Accordingly quantity of reduced emission was calculated by multiplying the saved energy by the emission coefficients of electricity and natural gas, considering their proportion in energy consumption in municipal buildings sector. This amounts to 550. 9863357 tCO_2-eq.

Action 2.1. Improvement of insulation in residential buildings

This measure is analogous to that for municipal buildings (measure 1.1.) and requires analogous approach and calculation, with the difference that insulation works include closure of entrances and reparation of roofs, and number of buildings to be restored is determined on the basis of municipal plan for residential buildings and makes up 3% of buildings per year, while for quantity of saved heat is considered as 30%.

Calculating the saved heat under such assumptions the analogous formula was used where value of consumed energy for residential buildings was put, corrected for residential blocks-of-flats, assuming that 90% of the city population live in blocks-of-flats. Calculated value for 1 residential building makes up 69056.13533 kWh saved heat per year. Considering that 14 buildings will be refurbished yearly from 2012 to and including 2020 year, total saved heat amounts to 43505365.26 kWh.

Accordingly, quantity of saved GHG emissions was calculated by multiplying the saved energy by the emission coefficients for electricity and natural gas, considering proportion of their consumption in residential buildings. This amounted to 9227.832 tCO_2-eq.

Action 2.3. Construction of low-emission pilot (exemplary) building (social hostel)

The methodology for calculation of saved energy and GHG emission reduction from this measure relies upon logics that emissions reduction is resulting from moving certain number of inhabitants from ordinary residential blocks-of-flats to a low-emission hostel, and should be calculated from the difference between consumed energies in former and new residences, on the assumption that energy consumption in low-emission hostels shall be the same as it would be in ordinary building, if energy saving measures, foreseen for low-emission buildings, were implemented there. Just that very difference comprises the saved energy.

Selection of high energy saving potential (percent) was base on the assumption that a building to be constructed would satisfy socially most unprotected population, living in the worst conditions. Hence this house belongs to residential buildings sub-sector, with, however, more saving potential, than it was assumed for that sub-sector (0.3 i.e. 30% of saving potential), as it was considered that the best energy saving measures are to be implemented in such house (insulated roof and walls, hermetic metalo-plastic doors and windows), making sharp contrast with the worst residential conditions, where these residents used to live. Consequently, 45% energy saving potential was assumed for this building.

Other assumptions: 80% of consumed energy comes to heating and 90% of city population (120800 inhabitants) lives in blocks-of-flats.

Based on these assumptions energy consumed, then heat consumed and its saved share per 1 resident of ordinary residential building were calculated, that was multiplied by the planned number of future residents of low-emission residential building .

$Q_{saved\ in\ LERB/a} = Q_{saved/a} \times m/n$

$Q_{saved/a} = Q_{cons/a} \times 0.45$

$Q_{cons/a} = E_{cons/a} \times 0.8$

Where $Q_{saved\ in\ LERB/a}$ is saved heat in low-emission building per year, $Q_{saved/a}$ – the same in ordinary residential building, $Q_{cons/a}$ – consumed heat in ordinary residential building, m – expected number of residents in low-emission building, while n is number of residents of ordinary buildings.

The values resulting from the calculation comprise:

In ordinary residential building quantity of consumed energy (without insulation) per capita per year =2635,972789 kWh. It is considered that the same amount of energy would be consumed in low-emission residential buildings if it were insulated.

Quantity of consumed energy per year multiplied by the number of future residents in low emission residential buildings = 158158,3673 KWh.

Energy share spent for heat=80%, saving potential =45%.

Total saved energy resulting from moving of 60 people from ordinary residential building to the low-emission building (per year) =56937,01224, and total saved energy up to 2020 year equals to 56937,01224 multiplied by 7 years, from the consideration that the social hostel is to be handed over by the spring of 2013, and equals to 398559,0857 kWh, corresponding to 76.08378491 tCO_2-eq emissions, according to the proportion between electricity and natural gas consumption and using emission coefficients for electricity and natural gas (0.146306642 and 0.202 t CO_2eq/kWh respectively).

Action 1.2. Installation of solar batteries in kindergarten(s)

Kindergartens fall into the focus of the City Hall special care and along with general actions planned for municipal buildings (building renovation Action 1.1) under the SEAP there is an additional measure to implement in kindergarten(s): – installation of solar batteries for hot water supply in pilot kindergarten, to save energy consumption and corresponding emissions.

It is obvious that there is high demand on hot water consumption in kindergartens because of high need in washing of children. As long as kindergartens operate only in daytime, electricity consumption for lighting takes less share than that for other needs. Large share of consumed energy in such institutions falls on water heating following to heating of building and cooking.

Installation of solar batteries in kindergartens for water heating purposes, as a GHG emission reduction measure within the SEAP was chosen in order to support non-traditional renewable energy use and issuing from suitability of this type of energy use for water-heating purposes in kindergartens. Due to expensiveness and low power-generation capacity, introduction of solar batteries is often unaffordable for population and greenhouse gas reduction goal create additional motivation for facilitation of introduction and promotion of this kind of energy.

Saved energy amount was calculated from the substitution of the natural gas required for water heating, for mainly natural gas is used for water heating.

Solar energy in Georgia and namely within Rustavi area is estimated as amounting to about 1500 kWh per year. In case of optimal design and considering 70% efficiency of solar energy collector for 1 m^2 in a year it may equal to 1500*0.7=1050 kW/h per 1m^2 a year. For 10 m^2 this energy equals to 10500 kWh, being quite enough to meet hot water demand in an average kindergarten. The same quantity of natural gas will be saved, that corresponds to 2.121 tCO_2eq per year from each kindergarten. Taking into consideration

that the solar collector will be installed no later than by 2015 year, during its operation (5 years up to 2020) it will reduce 5 times 2.121=10.605 t CO_2 eq. GHG emissions.

Action 2.2. Installation of energy efficient bulbs

This measure in residential buildings sub-sector includes replacement of non-efficient incandescent electric bulbs with modern energy efficient bulbs in order to reduce electricity consumed for lighting and corresponding GHG emissions.

Ineffective incandescent lamps, commonly used in the country, consume much electricity and their lifespan is short too. It is extremely unprofitable for population, but still energy efficient bulbs are not yet popular because of their relatively expensive price. Simple calculations are showing that in long-term these bulbs are profitable, but due to their inaffordability for the population and partially also common practice additional motivation is required for wide introduction of modern light bulbs.

The action is aimed at distributing one energy efficient light bulb per family in some pilot residential buildings (besides social hostels), provided that in each family it will be installed in the sitting rooms with the most frequent and longest lighting, where the family usually gather in the evening and spend most of their time.
Implementation of the measure should be accompanied by explanatory works with residents of pilot buildings on the specifics and economic and ecological benefits of the energy efficient light bulbs. For calculation of saving potential of the measure coefficients of efficiency of incandescent and energy efficient lamps were used as well as assumptions on the share of lighting in total consumed electricity per family. Issuing from the assumption that 80% of consumed energy falls on heating, it is considered that about 10% out of the rest 20% fall on lighting, which makes up 0.1x63,480,417.61=6.348,041.76 kWh per year in residential buildings of the city in total.

For pilot building were chosen 50 out of 286 highest (9-storied) residential buildings (blocks-of-flats), with 50*9*23.5 =10 575 inhabitants in approximately 2700 flats (families), 3.9 people average in each family (this number and average number of residents living on one floor in the building (23.5) were calculated from the numbers of population and residential buildings in Rustavi). Number of light bulbs foreseen by the measure, equals to 2700 (one light bulb per family).

Electricity saved by each light bulb can be calculated from the difference between the consumed energy by 60 watt standard incandescent and energy efficient (low emission) compact fluorescent (CEL) light bulbs.

It makes up 68.5% of consumed energy (*How to develop a sustainable energy action plan (SEAP) – guidebook, part III, p11).*

Consumed energy by 1 incandescent lamp per hour = 60wt=0.06kW. Considering that this light bulb is lit for about 6 hours a day (in most used room), the consumed energy equals to 0.06x0.36kWh a day (24 hours) and 0.36 x 365 =131.4 kWh per year. Thus saved 68.5% of energy equals to 90.009 kWh, which for 2700 families makes up 243024.3 kWh per year and corresponding 35.55602537 t CO_2eq of emission reduction.

b) Outdoor lighting

Action 3.1. Raising energy efficiency in street lighting

Currently in Rustavi street lighting is partially equipped with energy efficient light bulbs, but energy consumption still keeps increasing year after year, likely because of continuous process of widening geographic coverage of street lighting. In 2011 this energy consumption was 5 256 356 kWh, comprising 769.04 t CO_2 eq emissions. To stop the growth of energy consumption it is necessary to improve energy efficiency in this sector and the city does have the potential for.

The most effective from possible measures is replacement of old light bulbs with energy efficient ones. Within this SEAP it is foreseen to replace ordinary high pressure mercury light bulbs with sodium light bulbs, that will 2-2.5 times increase the efficiency.

Replacing 10% of light bulbs with energy efficient ones will result in decrease of energy consumption by 350 424.734 kWh less, reducing 51.27 t CO_2 eq of emissions.

For alternative or additional measures we can consider a) replacement of incandescent halogen lamps with LED light bulbs, reducing consumption more than by 50%. b) Sensor management of street lighting, including regulation of streets illumination in accordance with street traffic intensity. This measure has a high potential of energy saving – up to 50% (this measure is described below, in sub-chapter for Transport sector activities).

c) Transport

Actions to be implemented in transport sector and estimation of greenhouse gas reduction potential

Transport sector is represented by road transport, divided into private, municipal (service) and public transport subsectors. Due to various reasons road transport sector is a key source of greenhouse gases all over the country, particularly in large cities. Rustavi is not an exception either. Steady growth of transport fleet, large share of second-hand vehicles in this fleet, bad conditions of roads and low restrictions on fuel quality are major reasons causing large GHG emissions from this sector.
The part of transport fleet in Rustavi, foreseen in the SEAP is presented by the vehicles under municipal management and private vehicles. Notwithstanding that the measures are mainly aimed at the fleet under municipal management, the emissions from private vehicles were still estimated in the baseline inventory because some of the planned measures will be reflected on all the fleet of the city.
Note: Fleet of commercial vehicles is not considered due to unavailability of relevant data.

Sustainable energy strategy in transport sector implies the following:

- Development and improvement of infrastructure;
- Limitation of private transport use by means of encouraging public transport use, improvement of its service and popularization;
- Renovation of municipal and public transport fleet (medium-term strategy) .

Based on this strategy the measures to be implemented within the SEAP were selected according to the criteria of maximum efficiency and feasibility. These measures involve all the three subsectors, but

focus mainly on municipal and public transport subsectors, where the city hall has much more levers to implement the measures. For private transport subsector only informational measures are foreseen, though some measures such as improvement of motor roads, will be reflected on all types of transport, including private transport as well.

Measures foreseen by the SEAP in road transport are as follows:

Action 4.1.	Improvement of infrastructure
4.1.1	Improvement of motor roads
4.1.2.	Improvement of traffic management
Action 4.2	Optimization of public transport service
Action 4.3.	Renovation/recovery of public transport fleet
Action 4.4.	Popularization and promotion of public transport
Action 4.5.	Renovation of municipal transport fleet

Action 4.1. Improvement of infrastructure

Improvement of infrastructure falls within the priorities of the city development strategy. Measures for improvement of infrastructure are the most demanded to precede other measures and to lighten heavy traffic in the city and improve movement for all types of transport. Such measures which foresee construction and rehabilitation of roads together with and other means of optimization of traffic in the city (management, creation of „green" ways, management of traffic lights) are to be finalized by 2015 that will set a base for implementation of other measures.

4.1.1. Sub-action: rehabilitation of roads

Bad roads represent a significant factor for extra fuel consumption, reflected in economic, as well as ecological losses. Rehabilitation and construction of roads, intensively ongoing since 2004 in the whole country, will significantly improve their conditions, but still much is to be done in this field. Therefore, improvement of the roads has significant GHG emission reduction potential.

Construction and rehabilitation of the following streets in Rustavi is planned by the Municipality for 2012 year:

№	Streets	Area (m^2)	Length (m)
1	Aslanikashvili street	4863	383
2	Pushkin street	6427	580
3	Inner blocks of 17-th micro/district	4772	560
4	Meskhishvili street	4805	259
5	Pirosmani street	2840	215

6	St. Nino's street	1960	330
7	Communals' s street	2699	372
8	Akhmeteli street	2801	312
9	Way to the prosectorium	660	145
Subtotal:		**31827**	3156

Along with construction of roads, reconstruction of inner yards and ways to buildings is ongoing and planned, also having significant potential for emission reduction. Both these measures improve traffic and save fuel consumption.

The works are planned by the end of 2012 and further works of road construction and rehabilitation will continue till 2015. Implementation of all these measures will "shorten" ways for motor transport, on the one hand, and save fuel due to lightened traffic, on the other hand, because of improved conditions of roads and decreased number of stops.

To calculate emission reduction resulting from implementation of both measures, it was considered that the action will be reflected on traffic and energy consumption of all transport in the city; consequently, the assumption has been made that average annual mileage for all types of vehicles of entire fleet of the city will be evenly (by 10%) reduced, that will reduce the fuel consumption and accordingly emissions by the same quantity. Emission reductions achieved from roads construction make up 10% of baseline emissions from transport (32628,44 tCO_2eq). It must be noted that commercial vehicle fleet data wasn't used, due to unavailability, for calculation of baseline emissions or for emissions reduced by the measure.

Sub-action 4.1.2. Improvement of traffic management

Sub-measure includes creation of traffic lights management center, intensive movement and ,,greenways" sections. It will reduce exhaust and fuel consumption at expenses of facilitation of traffic, raised rapidity and minimization of stops.

Creation of traffic lights management center implies installation sensors in traffic lights and their management for providing ,,greenways". Avoiding extra stops, on the one hand, and equipping of traffic lights with sensors and removing traffic lights on selected places, on the other, will enable to save fuel and electricity. If we consider intensiveness of transport, its growth, as well as that these measures will be made in optimally selected places of most intensive movement, energy saving potential is rather high due to raised energy efficiency. This measure is associated with certain costs, and requires intensive work as well, but it is profitable in the long-term, as its results are foreseen farther and will continue even after 2020 year.

According to expert judgment the traffic management improvement measures will enable to reduce entire road transport emissions by 5%, by conservative approach, comprising 1631,422 t CO_2 eq.

Action 4.2. Optimization of public transport service

Rustavi city public transport consists of buses and route mini-buses, as well as light taxis being in private ownership. Subway, tram and trolleybus do not operate in the city.

This action involves a set of measures for optimization of bus and mini-bus operation, and implies optimization of fleet number, lengths of routes and movement schemes, providing transport network to become simultaneously comfortable, energy saving and environment-friendly. Such complex implies minimal transport movement as long as it ensures necessary needs and convenience. According to experts' judgment, at least 3% reduction (978,853 t CO_2eq.) from entire road transport baseline emissions may be achieved.

Action 4.3. Renovation/rehabilitation of public transport fleet renovation and provision of technical safety

This measure includes replacement of the part of bus and mini-bus fleet that haven't been replaced yet. This process is under way for several years, but it has not finished yet. Introduction of new mini-buses in the country significantly recovered transport fleet of the city and increased its efficacy but this process is not finished yet, and there is still some reserves in this regard. 6 mini-buses are older than 6 years, while all buses need replacement. Their replacement is planned for 2013-2014 years that will reduce fuel consumption and corresponding emissions.

Technical level of fleet has a strong impact on amount of emissions too. Regular inspection of public transport and their reparation when needed is part of these measures and along with replacement of the fleet, represents one of the ways of emission reduction.

Description of methodology of this measure and emission reduction-related assessments are provided in the text for Action 4.5 below.

Action 4.4. Popularization and promotion of public transport

This measure includes several activities:

- Making bus stops comfortable and installation of informational boards;
- Leading informational campaign in mass media;
- Creation of internet site on the schedule and route of city transport.
- Introduction of the scheme of payment by cards, under the conditions profitable for passengers.

These measures can not immediately reduce emissions, but contribute to this process, as it promotes use of public transport at the expenses of reduced use of private cars, and changes inhabitants behavior stereotypes that finally facilitates reduction of fuel consumption and corresponding GHG emissions. Long-term effect of the results of this measure makes it even more important.

Action 4.5. Renovation of municipal transport fleet

This measure is analogous to that of renovation of public transport fleet and implies renovation of fleet under municipal management, namely step by step replacement of 6 obsolete (6-12 years old) vehicles operating on diesel. Implementation of the measure is planned by 2013-2014 years (all 6 vehicles).

Hence emissions saved by 2020 shall equal:

$E_{reduced}$ = (7*6)* emissions reduced per vehicle per year

Last value is calculated based on difference between actually consumed fuel for 1 km (see table 3) and standard (default) values of the same coefficient (corresponding to new vehicles) for municipal (light) vehicles (operating on petrol and diesel).

Table 8. Emission reduction potential per vehicle per year in municipal and public fleet

Type of transport	Fuel consumption (kg/km)		Difference in consumption	Emissions				Per 1 vehicle
	Real	default		tCO2	tCH4(g/Mj)	tN2O(g/Mj)	tCO2eq	
Buses	0,4	0,24	2030315,52	542094,2438	7918230,528	7918230,528	544715,1781	68089,39727
Route mini-buses (operating on gas)	0,1	0,0575	55735,68	11258,60736	5127682,56	167207,04	11418,12288	11418,12288
Route mini-buses (operating on diesel)	0,19	0,08	111198412,8	29689976,22	433673809,9	433673809,9	29833522,25	1243063,427
Municipal Light cars (operating on petrol)	0,093	0,07	-7358,61984	-1832,29634	-242834,4547	-23547,58349	-1844,695615	-83,84980066
Municipal Light cars (operating on diesel)	0,084	0,06	22449,7152	5994,073958	87553,88928	87553,88928	6023,054296	1204,610859
Private cars operating on diesel	0,39	0,24	21795,84	5819,48928	85003,776	85003,776	5847,62553	5847,62553
Private cars operating on petrol	0,47	0,23	127743,48	31808,12652	4215534,84	408779,136	32023,37428	8005,843571
Total							30431704,91	

Hence reduction for 1 vehicle in case of private vehicles (operating on diesel) makes up 1204,610859 t CO_2 eq.

Total emissions will be 1204,610859 *6*7=1544,532751 t CO_2 eq.

As for public transport, it is planned to replace all buses with new ones under the following scheme: In 2015 – 4 buses, in 2016 – 1, causing reduction of emission per bus by 68089,39727 *23*6=63745,14597 tCO_2 eq.

Land use planning

Action 5. – arrangement of green spaces

Due to level of industrialization of the city and its semi-arid soil, Rustavi needs intensification of "greening" measures. As it is generally known, plants not only contribute to climate but also can absorb greenhouse gases. This fact conditioned inclusion of such measures in the SEAP of the city.

Totally plantation of 1200 plants in parks, yards and other places of the city is foreseen by the action plan. Special attention shall be paid to the districts with intensive transport movement and industrial districts. This measure will be implemented gradually, in duly selected periods of the year and by involvement of wide public in it, thus contributing into public awareness-raising.

By implementing "greening" measures, supposedly about 1500 t CO_2eq emissions will be absorbed (reduced), default coefficients from 2006 IPCC Guidelines were used.

Table 9. Actions to be implemented and corresponding emissions reductions

Action	Description	Emission reduction (tCO_2eq)	% of Baseline emissions
1. Municipal Buildings			
1.1.Improvement of insulation in municipal buildings	Replacement of doors and windows with plastic ones, reparation of roofs	550,9863357	0,141506962
1.2. Installation of solar batteries in kindergartens	Installation of solar batteries in a pilot kindergarten	10,605	0,002723627
2. Residential buildings			
2.1. Improvement of insulation in residential buildings	Closure of entrance, change/ reparation of roofs in residential buildings	9227,832547	2,369936364
2.2. Installation of energy-efficient light bulbs	Installation of energy-efficient light bulbs (1 bulb per family in pilot buildings)	35,55602537	0,00913167

2.3. Construction of low-emission pilot building (social hostel)	Construction of low-emission pilot building (social hostel) for socially vulnerable inhabitants	76,08378491	0,019540204
3.Outdoor (Street and traffic) lighting			
3.1. Increase of energy efficiency in street lighting	Replacement of street lamps with more energy-efficient ones	51,27	0,013167408
3.2. Increase of energy efficiency in traffic lights	Replacement of traffic lights with more energy-efficient ones	50	0,012841241
4.1. Improvement of infrastructure			
4.1.1.Improvement of roads	Construction and reconstruction of roads)	32628,44	8,379792987
4.1.2.Improvement of traffic management	Creation of traffic lights management center, intensive movement and „greenways”	1631,422	0,418989649
4.2.Optimization of city transport operation	optimization of fleet number, lengths of routes and movement schemes	48,94266	0,012569689
4.3 Renovation of public transport fleet	Rehabilitation and replacement of public vehicles	63745,14597	16,37133517
4.4 Popularization of city transport	Promotion of public transport in media, equipment of bus stops with electronic boards and other conveniences, creation of web-page with routes and timetable of public transport.	0	0
4.5. Renovation of municipal transport fleet	Replacement of obsolete municipal (service) vehicles	257,4221252	0,066112389
5.Land-use planning	Arrangement of green spaces, parks, gardens, plantation of trees and bushes	-1500	-0,385237219
Total (without sinks)		108 313,706	27,81764736

Implementation and monitoring of SEAP

Municipality of the city of Rustavi is responsible for implementation of Sustainable Energy Action Plan, while its monitoring shall be performed by the coordinating board - organizing group from the City Hall, dedicated particularly for these purposes, to coordinate due implementation of the actions under the SEAP and biennially prepare and submit monitoring inventory, reflecting state of implemented measures and their results for the past two years.

References:

1. 2006 IPCC Guidelines for GHG inventory
2. MEP/EEA emission inventory guidebook 2009
3. How to develop sustainable energy action plan.