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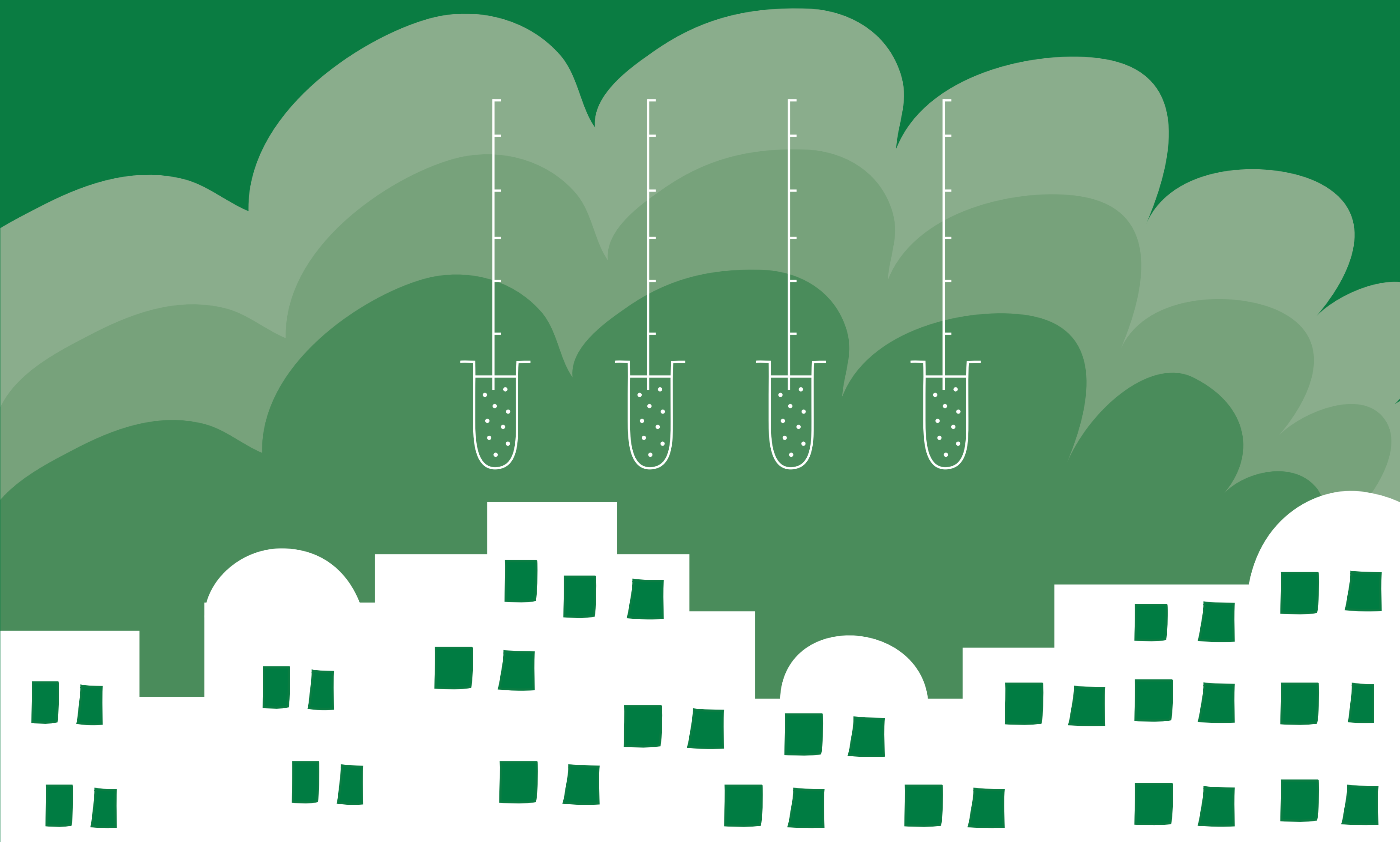

United Nations Development Programme

ENVIRONMENT AND ENERGY

SUSTAINABLE TRANSPORT AND GHG EMISSIONS IN BELGRADE

FINAL REPORT

SUSTAINABLE TRANSPORT AND GHG EMISSIONS IN BELGRADE

October, 2014

This report has been prepared under the GEF-UNDP project "Support to Sustainable Transport in the City of Belgrade", with the technical support of the United Nations Development Programme and financial support by Global Environment Facility.

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The overall objective of the project is to reduce the metropolitan emissions in the City of Belgrade by improving the public transport scheme, reinforce the participation of cyclists in the traffic and provide the policy framework for sustainable urban transport development of the city of Belgrade.

The project was implemented in partnership with the Ministry of Agriculture and Environmental Protection and the City of Belgrade, through its Land Development Agency and Secretariat for Transport.

The author of the report is Elena Gavrilova.

The views expressed in this publication are those of the author(s) and do not necessarily represent those of the United Nations, including UNDP, or UN Member States.

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LIST OF ABBREVIATIONS

UNFCCC	United Nations Framework Convention on Climate Change
IPCC	Intergovernmental Panel on Climate Change
SUTP	Sustainable Urban Transport Plan
FNC	First National Communication
SNC	Second National Communication
Beoland	Belgrade Development Agency
GPC	Global Protocol for Community – Scale GHG emissions
GSP Beograd	Public Transport Company of the city of Belgrade
EEA	European Environmental Agency
TEEMP	Transport Emissions Evaluation Models for Projects
SUPT	Sustainable Urban Transport Plan
VKT	Vehicle Kilometres Travelled
NMT	Non Motorized Transport

EXECUTIVE SUMMARY

The objective of the project "Support to Sustainable Transport in the city of Belgrade" is to contribute to the improvement of the city of Belgrade transport efficiency and safety, to reduce the environmental and climate change impact of the urban transport sector, and ultimately to enhance the national and local capacities concerning the sustainable urban transport planning and environmental management.

The project is consisted of four components, which were jointly implemented by the national stakeholders and the project team. The first component was consisted of provision of technical support for strengthening of the national capacities for sustainable transport, environmental and land use planning and management, with ultimate goal to sustenance the development of Sustainable Urban Transport Plan of the city of Belgrade. The second component was consisted of promotion of the cycling in the city of Belgrade and technical activities for improvement and extension of the bicycle infrastructure in the city. The third component was the pioneer initiative Safe ways to schools, complemented by the pilot project Pedibus followed by the continuous awareness raising campaigns for the youngest population. The forth component provided support for improvement of the public transport efficiency, safety and environmental impact through carrying out the practical hands on trainings on eco-driving modules on 25 drivers and 15 instructors from the public transport companies.

The assignment "Quantification of the GHG impact of the sustainable transport interventions in the City of Belgrade" has the main objectives to estimate the city of Belgrade GHG emissions for the period 2006 – 2012, to develop a dynamic baseline emissions scenario for the period 2013 - 2024, and to estimate the direct and indirect mitigation impact of the project components.

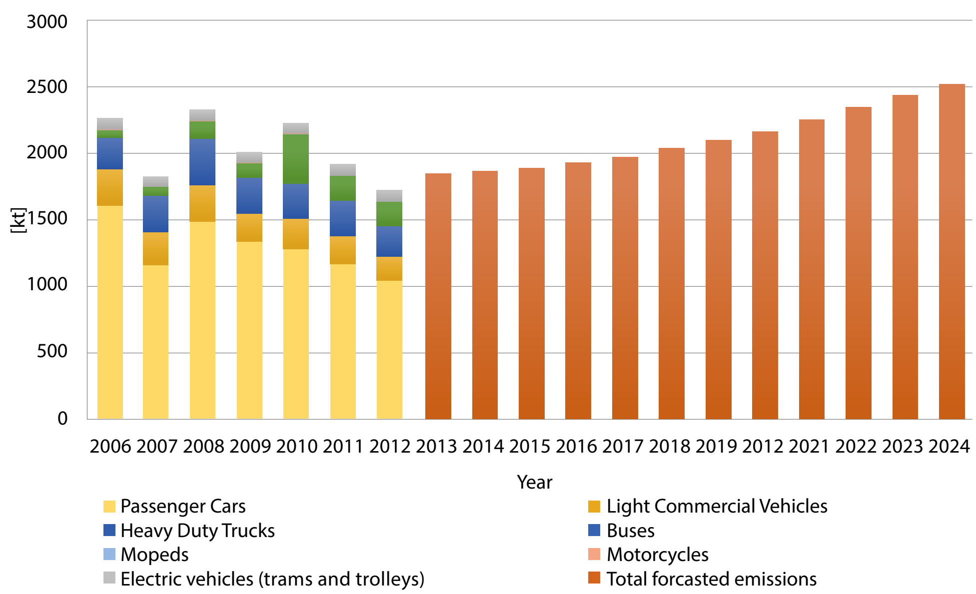

Figure 0.1. City of Belgrade road transport sector GHG emissions by vehicle class for the period 2006 - 2012 and estimated baseline emissions under BAU scenario for the period 2013 – 2024 [kt CO_2-eq]

From the assessment of the mitigation potential of the project components it can be concluded that the project mitigation potential is continuously increasing in the period 2012 – 2024, since the project components are gradually implemented. The initiative for promotion of the bicycle transport was implemented by the end of 2011 and beginning of 2012, so the first mitigation results are observed in 2012. The components Promotion on Eco-driving and Safe Ways to Schools have been completed in the last quarter of 2013, so the partial mitigation potential of these components is observed starting from the year 2013. The mitigation effects from the first project component, Provision of support for development of SUTP of the city of Belgrade are expected from the year 2016, when the plan is supposed to be adopted and implementation started.

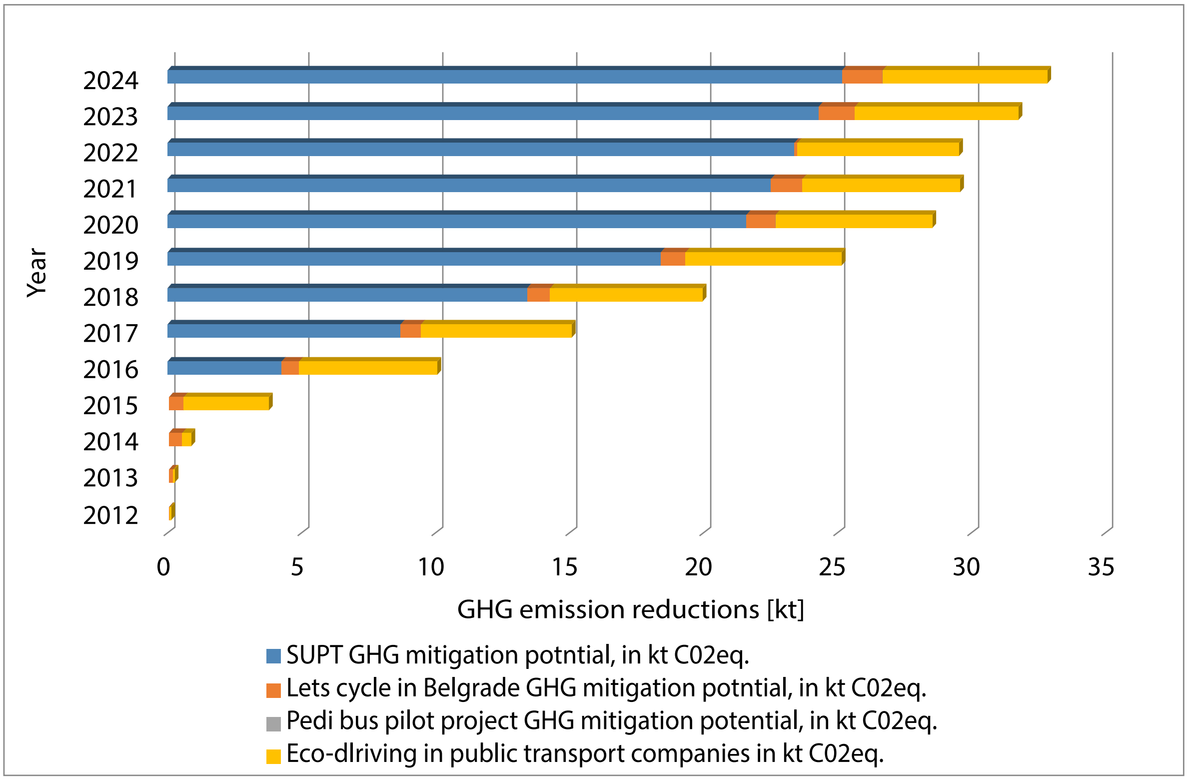

Figure 0.2.Estimated GHG mitigation potentialof the sustainable transport interventions done in the project framework for the period 2012 – 2024 [kt CO_2-eq]

Finally the overall direct GHG mitigation potential of the sustainable transport measures done in the project framework is estimated on cumulative reduction of227,5 kt of CO_2-eq for the period 2012 – 2024, or approximately 0,84% of the estimated baseline emissions under business-as-usual.

Concerning the potential indirect GHG mitigation potential of the project activities, the project replications in the cities Nis and Novi Sad, as cities similar in range and infrastructural management, reductions of approximately 3.6and 2.7 kt CO_2-eq. per year, respectively.The replication of the Pedibus programme in four additional primary schools in Belgrade can bring an annual reduction of 0.026 kt CO_2-eq. The expansion and wider application of eco efficient driving techniques, for example to the total number of commercial vehicles in the city of Belgrade, can bring an annual reduction of the city of Belgrade road transport sector GHG emissions of approximately 4 kt CO_2-eq. The establishment and implementation of integrated city transport management and control system, as part of the Sustainable Urban Transport Planning of the city of Belgrade, can bring an annual reduction of approximately 20kt of CO_2-eq.

Added value of the assignment and the project "Support for Sustainable Transport in the city of Belgrade" is the constitution of the city of Belgrade detailed vehicle fleet data for the period 2006 – 2012, and creation of input tables for run of the COPERT IV emission calculation model (*Table A.1. Detailed specification and categorization of the city of Belgrade vehicle fleet for the period 2006 – 2012*).These tables are very important since they sort the entire city of Belgrade vehicle fleet on 257 different vehicle subcategories, as requested by EEA and the COPERT IV model (according to the vehicle category, mass, usage, environmental standards and fuel). Having these tables, the city government or any other institution involved in the future design and modeling of transport mitigation actions, will have opportunities to precisely predict the impact of some policy changes or other mitigation intervention in the city of Belgrade.

There are number of co benefits of the project implementation beside the environmental and climate change impact of the project activities; the project is addressing the inclusive mobility and social aspects, supports the national and the local economy, promotes the healthy lifestyle, educates the population and ultimately supports the urban transport efficiency and safety.

Ultimately, the most important aspect of theconcept "Support to Sustainable Transport of the city of Belgrade" is that the project components and activities are focused on each person in the community, and are systematically working on constitution of sustainable policies and strategic plans, and constitution of healthy and environmentally aware generations.

1. INTRODUCTION

1.1. Cities and Climate Change

More than 50% of the World population lives in urban areas. It is foreseen that by 2030 this proportion will increase to 60% and by 2050 up to 70% of the total population will live in urban areas. The continuous demographic transition from rural to urban areas is associated with shifts from an agriculture-based economy to mass industry, technology, and service. Cities are significant and growing source of energy consumption and GHG emissions and consequently play a key role in tackling climate change.

The city ability to take effective action on climate change and monitor the environmental progress depends on having good quality data on GHG emissions. Planning for climate change action begins with development of GHG inventory, which enables the urban communities to estimate their GHG impact and understand the contribution of the different urban sectors and activities.

The urban GHG inventories allow identification of the appropriate mitigation efforts, creation of sustainable strategy for GHG reductions and track the progress toward the development of sustainable urban communities. From the other hand the urban GHG emissions are closely connected with the local pollution and the urban air quality, and in this context the urban GHG emissions inventories can emphasize the impact of the anthropogenic emissions on the human health and human wellbeing, the environment, urban infrastructure and the overall urban society.

In the recent few years, after the many natural disasters that stroke the world, the worldwide national and urban governments are faced with the increased pressure from the general public concerning the climate change and its consequences. The additional public aspect of the fact that the overpopulation and the development of the urban communities has undermined the main attributes of the urban living, as the accessibility of services, economic development, comfort, social and health benefits.

There are many global initiatives to estimate the GHG impact of the urban areas and to identify the appropriate roadmaps towards the green urban development and resilient and sustainable communities; Covenant of Mayors, Polis, Eurocities, Civitas etc. All initiatives have in common goal, to reduce the impact of the urban living on the environment and to promote the sustainable development of the cities.

In most of the developed and developing countries the transport sector is one of the biggest contributors to the overall national GHG emissions. Additionally, the GHG emissions from the transport sector are observed as the fastest growing emissions in most of the countries for the period 1990 – 2012.

The climate change and its environmental, health and economic impacts is strongly connected to the growing trends of the transport sector GHG emissions and the unsustainable mobility behavior of the world population. Furthermore, in the urban areas, the impact of the transport sector is even more emphasized and sometimes it considered as a major source of the local noise and air pollution. From the other side, the transport sector is one of the key economy supporters and drivers, and decoupling of these two segments is almost impossible to be achieved.

In the last few years the transportation policy is increasingly focused on reducing greenhouse gas emissions, air pollution, traffic congestion, injuries and deaths from vehicle crashes. Reducing the volume of total travel is one way to address these concerns, and many agglomerations have adopted policies aimed at accomplishing their economic and social functions while reducing VKT and consequently reducing the environmental footprint of the transportation system. These policies generally are targeted towards replacing the motorized passenger vehicle trips and increasing the walking, cycling, usage of public transport, as well as shifting goods movement to more energy efficient means of transport.

1.2. Overview of the climate change mainstreaming in R. Serbia

1.2.1. National circumstances

Republic of Serbia is a landlocked country in the central part of the Balkan Peninsula in Central Southeastern Europe. The country is largely mountainous. Its northeast section is part of the rich, fertile Danubian Plain drained by the Danube, Tisa, Sava, and Morava river systems. It borders Croatia on the northwest, Hungary on the north, Romania on the northeast, Bulgaria on the east, Macedonia on the south, and Albania, Montenegro, and Bosnia and Herzegovina on the west.

Economic forces and changes in major sectors such as industry, energy, transport and agriculture strongly influence environmental conditions and trends. They can either enhance or diminish the benefits of environmental policies and technical progress. Further integration of economic and sectorial policies is needed to move towards cost-effective environmental protection and sustainable development of R. Serbia.

During the spring of 2014 the country was faced with the heaviest rainfalls in the recent 120 years of recorded measurement. The heavy rainfalls caused significant floods and landslides, substantial number of human fatalities and hundreds of thousands of displaced people. The preliminary assessment of the damages was estimated on more than two billion dollars.

Presently the Serbian economy is faced with huge challenge to recover and stabilize the agricultural sector and the national economy. It is foreseen that significant time will be needed to stabilize the national economy and to renew the agricultural sector. Immediate actions are needed to mitigate the climate change impact and to undertake the necessary actions for adaptation and constitution of climate change resilient urban and suburban societies and citizens.

The Republic of Serbia ratified the Kyoto Protocol in 2008, and since 2001 is part of the UNFCCC as a developing country (non–Annex I country). Taking into account the status under the Convention in the first commitment period of the Kyoto protocol the country does not have quantitative greenhouse gases emission reduction commitments (2008 – 2012).

1.2.2. National aspirations

In December 2009 Serbia applied to join the EU. After 3 years, in 2012 the country gained full candidate status and at the beginning of 2014 the Council of the European Union approved opening negotiations on Serbia's accession. Subsequently the country has to transpose the EU legislation including the environmental legislation which is very demanding in terms of implementation of sustainable plans and environmental policies. So far, significant progress was made in transposition of EU environmental acquis in national legislation while, according to the National Programme for Adoption of the Acquis, this process is expected to be completed by 2018.

Additional aspect of the EU accessing procedure is shifting of the country towards the Annex I Party of the UNFCCC as the rest of the EU members and accessions countries. With this the R. Serbia will be faced with emission reduction pledges under the convention, as well as under the EU climate acquis and policies.

Another forthcoming issue is the need of reduction targets from all Parties under the Convention or the adaptation of Intended Nationally Determined Contributions (INDC), as future obligatory requirement under the UNFCCC membership. Intended Nationally Determined Contributions (INDCs) put forward by countries will form a key input to the negotiations leading towards the 2015 Paris climate agreement, after which all Parties will have emission reduction pledges to achieve.

1.2.3. National GHG emissions trends and transport sector emissions drivers

Serbia's Initial National Communication to the United Nations Framework Convention on Climate Change (2010) was a milestone for Serbia in intensifying its efforts to reduce the carbon intensity of its economy as part of its commitments under the Energy Community Treaty and the approximation process to the European Union. In the framework of the INC the national GHG inventory for the period 1990 – 1998 was prepared.

The Second National Communication of R. Serbia is currently under implementation and it is foreseen to be submitted by mid-2015. The GHG inventory prepared in the structure of the SNC is the timeframe 1990 – 2009. Since the GHG inventory prepared in the framework of the SNC is still not officially published, in this context we will observe the national GHG emissions estimated in the framework of the Initial National Communication, as well as GHG estimations published by international sources.

The country is also currently working on its First Biennial Update Report, which contains the national GHG emissions estimations up to 2012, as well as updated and comprehensive mitigation chapter. This report is also expected to be submitted by mid – 2015.

Table 1.1. National GHG emissions of R. Serbia for the years 1990 and 1998 [kt of CO_2-eq.]; Source: Initial National Communication of the Republic of Serbia

Republic of Serbia National GHG emissions [kt]	**1990**	**1998**
	Total in CO_2-eq.	**Total in CO_2-eq.**
Total national emissions and removals	80803,00	66346,00
I. Energy	62776,00	50549,00
A. Fuel combustion	59753,50	47768,00
1. Energy Industries	37713,90	34816,00
2. Manufactiring industries and construction	6333,50	3445,00
3. Transport	5715,80	3876,00
4. Other sectors	9990,30	5627,00
5. Other	0,00	0,00
B. Fugitive emissions from fuels	3022,30	2781,00
1. Solid fuels	1285,00	1179,00
2. Oil and gas	1737,30	1603,00

II. Industrial Processes	4270,80	3620,00
A. Mineral products	1831,00	1514,00
B. Chemical industry	827,80	701,00
C. Methal production	1612,00	1404,00
D. Other production	0,00	0,00
E. Production of halocarbons and sulphur hexafluoride		
F. Consumption of halocarbons and sulphur hexafluoride		
G. Other	not estimated	not estimated
III. Solvent and other product use		
IV. Agriculture	11827,00	9500,00
A. Enteric fermentation	3332,30	2843,00
B. Manure management	1510,40	1341,00
C. Rice cultivation		
D. Agricultural soils	6670,40	5121,00
E. Prescribed burning of savannahs	not occurring	not occurring
F. Field burning of agricultural residues	213,60	195,00
G. Other	0,00	0,00
5. Land–use change and forestry	-6665,00	-8661,00
A. Changes in forest and other woody biomass stocks	-6764,00	-8661,00
B. Forest and grassland conversion	99,00	not estimated
C. Abandonment of managed lands		
D. CO_2 **emissions and removals from soil**		
E. Other	not estimated	not estimated
6. Waste	1929,50	2678,00
A. Solid waste disposal on land	1684,60	2430,00
B. Waste–water handling	244,90	248,00
C. Waste incineration	not occurring	not occurring
D. Other (please specify)	not estimated	not estimated
*** Memo items**		
International bunkers	459,00	186,00
Aviation	459,00	186,00
Marine	not estimated	not estimated
CO_2 **emissions from biomass**	2404,00	1815,00

From the assessment of the Initial National Communication of the country it is concluded that in the observed period 1990 – 1998 the national GHG emissions had a downwards trend of 18%, which is a consequence of the national economic downfall. This period was very turbulent for the national economy and the territorial integrity of the country. The transitional issues of the former Federative Yugoslavia and the declined economic growth and political crises have been experienced in the all countries in the region in this period.

According to the Initial National Communication GHG inventory, in the year 1990 the transport related GHG emissions amounted to 7% of total GHG emissions in Serbia.As it can be seen on the Table 1.1. The transport sector GHG emissions also experience significant downwards trend in the period 1990 – 1998 and according to the OECD and ITF data the downward trend is noticed until 2000. After the year 2000,the transport related emissions are increasing, and in 2008 the transport sector emissions accounted to 13.4% of total GHG emissions in Serbia. This fact ranks the transport sector as the fastest growing source of GHG emissions in the country.[1]

National statistics indicate that 73 % of households in Serbia have a car, but 52 % drive cars that are older than 15 years. The average age of cars is 14 years, although the vehicle age is lower in the Belgrade region. In comparison, the average age of trucks is 15 years, public transport buses 4.5 years and taxis 13 years. This is in part because of a large number of used car imports from neighboring countries, whereas bus fleets have recently been upgraded by the city in recent years. Used car imports are regulated as of 2005 by an ordinance that requires Euro 3 certification, which covers all vehicles produced and sold in the European Union after January 2001.

In 2008 the Government adopted the Strategy of development of rail, road, water, air and intermodal transport in the Republic of Serbia for the timeframe 2008-2015. (Official Gazette of the Republic of Serbia No. 004/08, 13 January 2008). The directions for future transport sector development in the Strategy are based on principles of safety, intermodality, application of new technologies, complementary use of different transport modes and rational use of available capacities and resources in Serbia. Basic goal of Serbia's transport strategy is to reach the compatibility with the EU's transport system, while ensuring as low as possible adverse environmental impacts of such development.

1.3. City of Belgrade development strategy

The city of Belgrade is the capital and the largest city of Serbia. Belgrade is located in the center of South East Europe, at the intersection of the strategic transportation corridors No. 10 and No. 7 linking Western and Central Europe with the Middle East. Furthermore the city is located at the confluence of the Sava and Danube rivers, which gives huge possibilities for expansion of river transport and economic interconnections, but from the other side it makes the city especially vulnerable to the climate change.

The city population in 2011 is estimated at approximately 1.7million, living on a territory of 3222.68 km^2. The central city area is estimated on 359.96 km^2. The city is administratively divided on 17 municipalities.

The city of Belgrade is the main economic driver of R. Serbia and is responsible for approximately 40% of the national GDP.

In the recent years, investment conditions in Belgrade and Serbia have been significantly improved. The country is in the process of negotiating the Stabilization and Association Agreement with the European Union, and is the world's leading reformer as stated by the World Bank. Many notable Serbian companies are based in Belgrade and the city is also a leading educational center in Serbia comprising 62 university-level institutions. Belgrade is regionally perfected as well educated, fast learning, multilingual and IT literate labor force city whichoffers very good business and living conditions.

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1 Source: OECD annual reports for R. Serbia

Commercial and personal transportation activities, in particular, require large amounts of fuel and energy supply and are directly tied to economic conditions. In the conditions of anticipated economic growth, increase in employment rate, increased trade off with the surrounding areas and countries, attraction for daily commuters, tourists, as well as foreign business investments in the city, the existing transport system of Belgrade will not be capable to provide adequate level of service on long term. Such transport system will become a limiting factor of the economic and social development.

Strategy of development of Belgrade up to 2021 is defined by the Regional Spatial Plan of Administrative Area of Belgrade (RSP), city of Belgrade Development Strategy, the Master Plan of Belgrade up to 2021 and by the Smartplan – Transport Master Plan of the Belgrade. The development of Sustainable Urban Transport Planhas started with the initiation of the project "Support to the Sustainable Urban Transport Plan of the city of Beograd" in 2011.

2. ESTIMATION OF THE GHG IMPACT OF THE CITY OF BELGRADE ROAD TRANSPORT EMISSIONS

2.1. Overall evaluation of the city transport system and the vehicle fleet

For the purpose of the addressing of the impact of the city of Belgrade road transport sector GHG emissions, an evaluation of the national and city of Belgrade vehicle fleet was done. According to the national vehicle registration data gathered from the SSO database and MOI registration data, the national vehicle fleet is slightly increasing in the period 2006 – 2012 and the total number of registered vehicles in R. Serbia increased for approximately 1.7% inthe above mentioned period.

From the other side, the total number of vehicle registration in the city of Belgrade is rapidly growing and the same period(2006 – 2012) and the vehicle number trend assessment showed a cumulative growth of 20%. The rapid grow of the city of Belgrade vehicle fleet is owned to the combination of rising personal incomes of the citizens, the elevated economic activity of the city and a liberal trade policy in the assessed period.

Table 2.1. Registered vehicles in R. Serbia and registered vehicle on the territory of the city of Belgrade for the period 2006 – 2012; Source SSO of R. Serbia and MOI of R. Serbia

Year	2006	2007	2008	2009	2010	2011	2012
Total number of registed vehicles in R. Serbia	1943921	1793383	1740705	1903023	1809768	1932946	1977253
Registed vehicles on the teritory of the city of Belgrade	470396	501545	526842	548237	560922	553907	564467

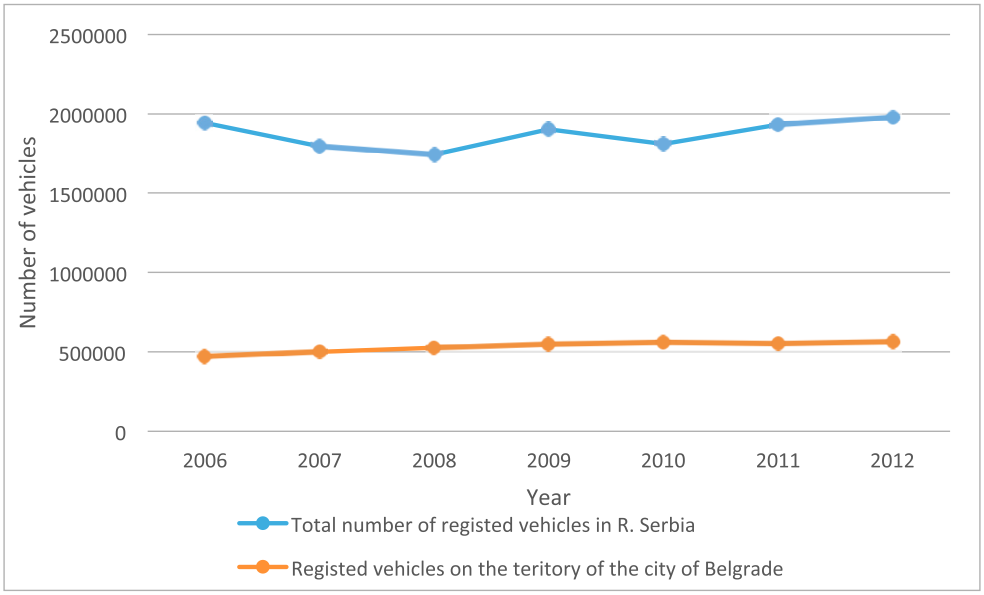

Figure 2.1. Trend of the registered vehicles in R. Serbia and registered vehicle on the territory of the city of Belgrade for the period 2006 – 2012; Source SSO of R. Serbia and MOI of R. Serbia

The proportion of the city of Belgrade vehicle registrations in 2006 is estimated on 24% while the city of Belgrade share in 2012 reached 28.5%. In line with the city of Belgrade vehicle fleet expansion, the urban GHG emissions are rapidly growing and as a result of these factors the urban air quality, problems of congestion andtransport safety are continuously getting worse. There are strong indications that current trends would not only cause greenhouse emissions to expand rapidly in coming years, but also produce other unsustainable outcomes for the local environment and economy, since the city is more and more dependent of imported fuel and the citizen's habits are transiting towards usage of personal motor vehicles instead of NMT and public transport.

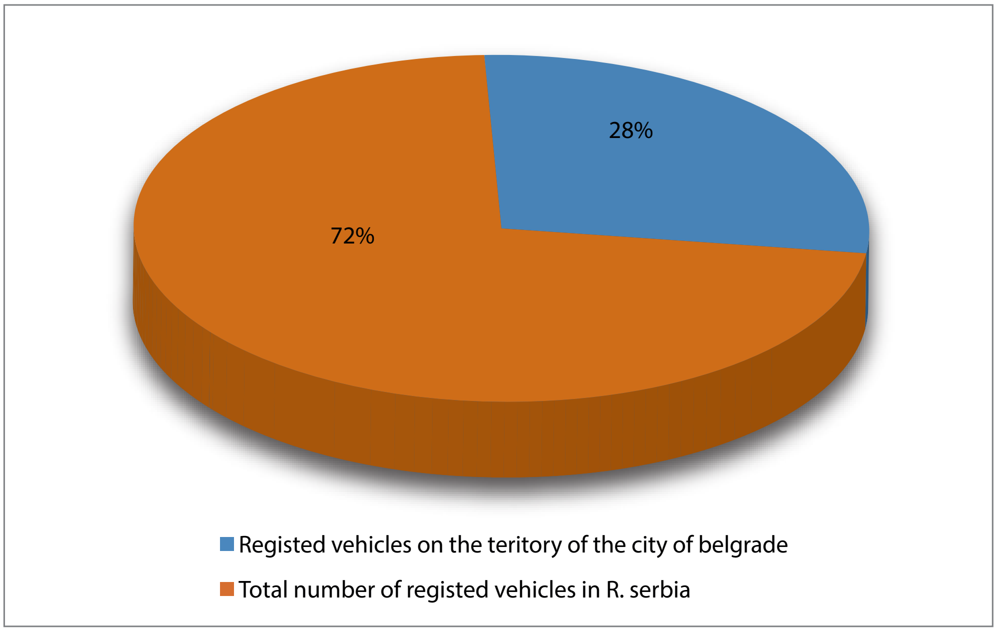

Figure 2.2. Average share of the registered vehicles, national and city of Belgrade, period 2006 - 2012

The main factors contributing to the increased GHG emissions of the road transport sector of the city of Belgrade are the large number of vehicles in Belgrade (564468 registered vehicles in 2012, or approximately 29% of all registered vehicles in the country); and a relatively high proportion of old cars, with an average car age of 13 years and average environmental standard Euro 3. Consequently the city has high levels of liquid fuels consumption and increased road congestion, which results in poor fuel economy and higher GHG emissions rates.

Concerning the public transport, the city of Belgrade has an extensive public transport system, which consists of buses, trams, trolley buses and trains operated by the city-owned GSP Belgrade and several private companies. The public transport in Belgrade has a long standing reputation of modern and reliable transport service and furthermore the public transportation in Belgrade is continuously improved in order to become the most efficient transport mode in the city.

2.2. GHG emissions estimation principles

2.2.1. Accounting and reporting principles

GHG emissions accounting and reporting principles are based on the reporting principles recommended by the IPCC and GPC, as well as by the TEEMP methodology principles. The incorporation of the following reporting methodologies is essential to represent a rational and accurate account of emissions:

- Relevance: The reported GHG emissions shall appropriately reflect emissions occurring as a result of activities and energy consumption within the city of Belgrade boundary. The relevance principle of accounting of the emissions of the fuel traded only on the city territory is clearly defined and positioned when selecting data sources and determining and prioritizing data collection procedures.
- Completeness: All road transport sector emissions within the city boundary are accounted. The only exclusion of this principle is the state security sectors fuel consumption (police and military).
- Consistency: Emissions calculations are consistent in approach, boundary and methodology. Using consistent methodology enables evocative documentation of emissions changes over time, trend analysis and comparisons between the city's urban transport emissions, as well as identification of the key GHG emissions sources within the city boundary.
- Transparency: Emissions sources, activity data, emission factors and accounting methodologies require adequate documentation and disclosure to enable verification and reproduction of the results. The calculations contained in this report are following the transparency principles and exclusions in terms of confidentiality issues related to some activity data which are clearly identified and justified.
- Accuracy: The calculation of the GHG emissions should not overestimate or underestimate the actual GHG emissions, and should be sufficient enough to provide the decision makers and the public reasonable assurance of the integrity of the reported information.

The ultimate scope of the estimation of the GHG impact of the city of Belgrade urban transport sector and the mitigation impact of the activities under the project is to assist the Government of the city of Belgrade to identify and allocate the proper strategy for constitution of sustainable urban transport system, and to provide workable decisions inbound climate change mitigation activities.

.2.2.2. Definition of the assessment boundary

The city of Belgrade lies on the territory of approximately 322286 ha or 3223 km2. The central city area is estimated at approximately 360km2. According to the census done in 2010, the city has a population of 1642097 citizens. The central city area is the most densely populated area, and is also an area in which most of the social and economic activities take place.

An assessment boundary identifies the following criteria that areincorporated and integrated in the GHG emission calculations: gasses, emissions sources, geographical area and time span coved by the GHG inventory.

For the estimation of the city of Belgrade transport sector emissions the relevant assessment boundary is taken as it follows:

- GHG gases considered: CO_2, CH_4 and N_2O. The rest of the six Kyoto protocol gasses (HFC, PFC and SF_6) and not occurring in the road transport activities.
- Emissions sources:all GHG emissions occurring as a consequence of the use of the supplied fuel and electrical energy within the city of Belgrade boundary, which is dependent of the transport activities and vehicle fleet.
- Geographical area: city of Belgrade asadministratively defined by its 17 municipalities.
- Time span:for the GHG emissions calculation 2006 – 2012 and for the scenario modeling activities the period 2013 – 2024.

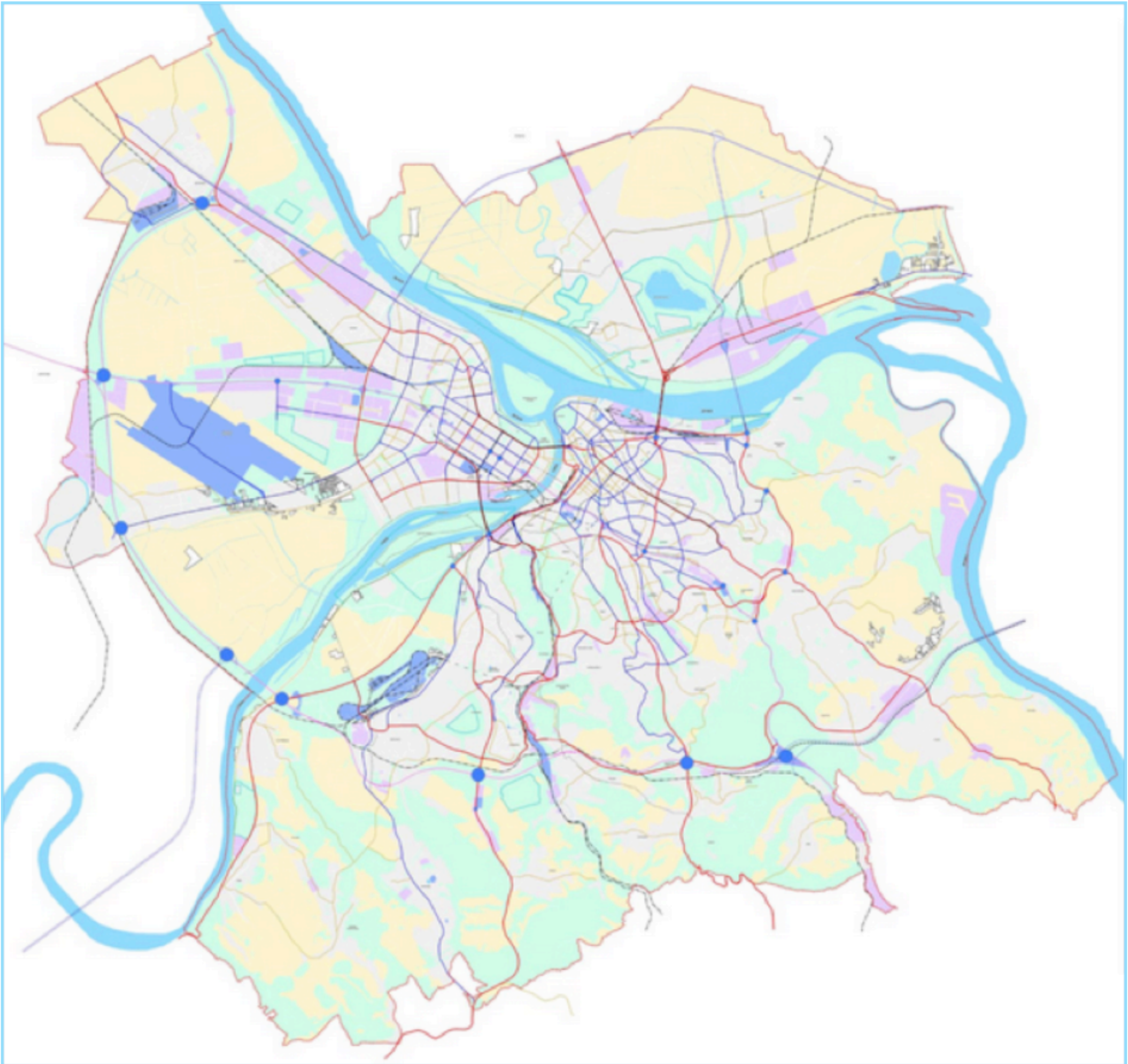

Figure 2.3 The administrative territory of the city of Belgrade with its infrastructural road transport network, source Master Plan of Belgrade to 2021

2.2.3. Overview of data sources used

The process of compilation of the activity data for the calculation of the GHG emissions from the road transport activities in the city of Belgrade was a comprehensive issue that required a long consultation and data gathering process.

The main data input needed for accurate calculation of the Belgrade road transport GHG emissions is the city fuel consumption and the transport activity records and statistics.

Since the overall city road transport fuel consumption statistics was not available, the activity data concerning the fuel consumption have been derived from different sources, models and methodologies:

- The overall national fuel consumption data was obtained by the Serbian Environmental Protection Agency.
- The city of Belgrade vehicle fleet was obtained by the Ministry of interior of R. Serbia, thought the Serbian Environmental Protection Agency.
- The public transport company GSP, as one of the main project partners provided the detailed datasets concerning the public transport vehicle fleet and fuel consumption for the period 2006 – 2012.
- The total relevant fuel consumption for the assessment period 2006 – 2012 was estimated via usage of the COPERT IV model with integration of the city of Belgrade detailed vehicle fleet, and furthermore validation of the model fuel consumption with the weighted share of the overall national road transport sector fuel consumption. Different weighting drivers specific for the assessed urban community have been used to adequately identify the corresponding city of Belgrade fuel consumption (the city vehicle fleet, the city GDP, population etc.).
- Oil Industry of Serbia – NIS provided data concerning the fuel delivery on the city territory for the above mentioned period, excluding the delivery to big fuel consumers and public institutions on the territory of the city of Belgrade.
- Belgrade Land Development Agency provided the infrastructural data and the short term plan for infrastructural development of the city.
- Additional relevant data was gathered from the National State Statistical Office reports and reports issued by the City of Belgrade Statistical Office.

Additional input data concerning the fuel saving recording have been taken from the technical report concerning implementation of eco driving techniques done in the project framework (by the RICO Training Centre, as a main technical partner for implementation of this component).

2.2.4. Calculation methodologies

The inventory methods that cities use to evaluate their GHG impact vary in terms of what emissions sources and GHGs are included in the inventory, how emissions sources are defined and categorized and how trans-boundary emissions are treated.

To achieve more credible reporting, meaningful benchmarking and grater consistency of the city of Belgrade transport sector GHG accounting and project reductions, the 2006 IPCC Guidelines for National GHG Inventories, the COPERT IV[2] emission estimation model and theGlobal Community Protocol for Community-Scale GHG emissions[3] have been used. Precisely, the 2006 IPCC Guidelines for National GHG Inventories have been used to estimate the national road transport GHG emissions, the GCP was used as a principle boundary of the estimation of the city of Belgrade road transport sector GHG emissions, and the calculation of the city of Belgrade emissions was done via usage of COPERT IV model and GCP calculation principles for emissions validation.

Since the project Support to Sustainable Transport in the city of Belgrade is funded by the Global Environmental Facility (GEF), the TEEMP model framework is used for evaluation of the mitigation impact of the transport interventions done in the project framework.

The conjunction between the TEEMP methodologies, GCP and the COPERT model is used to provide reliable and accurate definition of the GHG emissions and the mitigation potential, as well as to provide feasible and reasonable GHG emissions scenarios for evaluation of the project activities.

2.3. City of Belgrade road transport sector emissions for the period 2006 – 2012

The top down and bottom up approaches have been engaged to estimate the GHG emissions of the city of Belgrade road transport sector.

The advanced Tier 3 methodology COPERT IV model with detailed vehicle fleet data sets has been used and the resulting output concerning the GHG emission and fuel consumption have been compared with the calculated emissions on basis on GCP protocol, as a weighted average of the total national fuel consumption. The drivers used for the definition of the appropriate weighted average coefficients for aggregation of city of Belgrade fuel consumption and emissions are the share of the urban community to the national GDP, the share of the national vehicle fleet and the share of the population data of the assessed urban community to the national totals. This approach is proposed by IPCC and GCP since it reflects multiple aspects of the urban community activities. Different weighting coefficients have been given to the above mentioned factors, and the most influencing is the GDP share of the local community (40:40:30).

Added value of the overall baseline emissions estimation is the disaggregation of the city of Belgrade vehicle fleet according to the vehicle categories, subcategories, fuel used and emission standards. The dataset classify the city vehicle fleet on the following vehicle categories:

- Mopeds and Motorcycles (L category).
- Passenger Cars (M1).
- Buses (M2, M3).
- Light Commercial Vehicles (N1).
- Heavy Duty Trucks (N2, N3).

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2 The COPERT IV model is widely recognized in the scientific community and offers a developed Tier 3 methodology for road transport emission estimations. The model is recommended by the IPCC and its development is supported by the European Environmental Agency.

3 The GCP protocol is consisted of clear and robust framework for city –scale GHG emission and is fully consistent with the 2006 IPCC Guidelines for National GHG Inventories.

The further aggregation to vehicle types is done on a basis of: 2/4-stroke for mopeds and motorcycles, market segments for passenger cars (small, lower-medium, upper-medium, executive), urban/coaches for buses, and GVW (gross vehicle weight) types for heavy duty trucks (rigid from ≤7.5t to >32t, articulated from 14-20t to 50-60t). The fuels to be considered are: petrol (gasoline), diesel, LPG, CNG and Other.

Corresponding data in terms of detailed vehicle fleet of the city of Belgrade divided by vehicle category, subcategory, vehicle type, technology and age for the period 2006-2012 is given as Annex I to this document.

The detailed COPERT IV model output emissions for CO_2, CH_4 and N_2O, by vehicle categories are presented in the Table 2.2.

Table 2.2. COPERT IV model output GHG emissions by the road transport of the city of Belgrade, by vehicle type, 2006 – 2012, in kt CO_2-eq

CO_2 emissions [kt]							
Vehicle category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Passenger Cars	1591,70	1143,21	1472,54	1313,56	1260,03	1149,44	1025,26
Light Commercial Vehicles	269,47	241,58	269,24	215,65	221,13	207,70	176,96
Heavy Duty Trucks	236,96	277,08	347,74	262,63	264,91	256,02	223,51
Buses	63,28	63,44	133,77	110,65	379,48	191,17	188,78
Mopeds	0,05	0,02	0,02	0,02	0,02	0,02	0,16
Motorcycles	5,07	5,37	5,68	5,26	4,68	4,12	3,85
Total CO_2 emissions [kt]	2166,52	1730,70	2228,99	1907,76	2130,24	1808,47	1618,52
CH_4 emissions [kt]							
Vehicle category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Passenger Cars	0,19	0,20	0,20	0,20	0,20	0,20	0,20
Light Commercial Vehicles	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Heavy Duty Trucks	0,02	0,02	0,02	0,02	0,01	0,01	0,01
Buses	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Mopeds	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Motorcycles	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total CH_4 emissions [kt]	0,23	0,23	0,23	0,23	0,23	0,23	0,23
N_2O emissions [kt]							
Vehicle category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Passenger Cars	0,04	0,04	0,05	0,05	0,05	0,05	0,05

Light Commercial Vehicles	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Heavy Duty Trucks	0,01	0,01	0,01	0,01	0,01	0,01	0,01
Buses	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mopeds	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Motorcycles	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total N_2O emissions [kt]	0,06	0,06	0,06	0,06	0,06	0,07	0,07
Total GHG emissions in CO_2-eq. [kt]	**2188,62**	**1753,54**	**2252,94**	**1931,89**	**2154,69**	**1834,03**	**1644,88**

The annual COPERT IV model output emissions by vehicle categories are presented on the Figure 2.4. From the figure it can be noticed that the majority of emissions are originating from the passenger transport, followed by the emissions from the commercial vehicles and public transport.

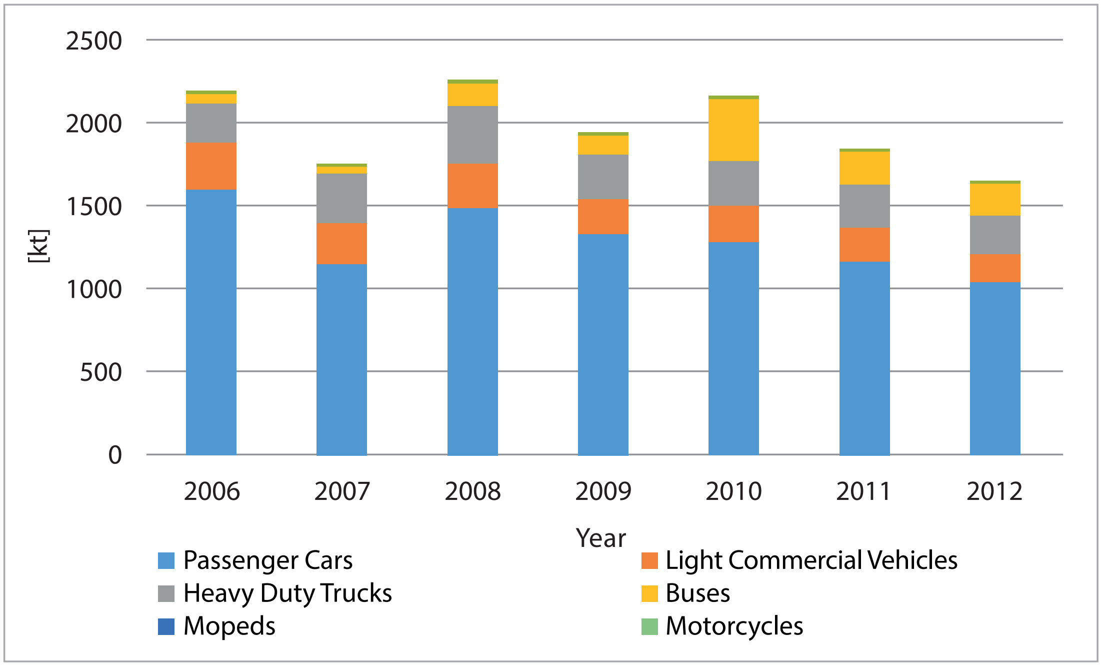

Figure 2.4. COPERT IV model annual emissions of city of Belgrade Road transport by vehicle categories (excluding emissions from electricity consumption), in kt CO_2-eq.

The summarized resulting emissions from the usage of the IPCC methodology for national GHG inventories, the GCP methodology for urban transport emissions estimation and the COPERT IV model output are presented in the Table 2.2 and Table 2.3.

The resulting fuel consumption and emission estimates from the both approaches and methodologies has shown an average difference of 4.2% for the period 2006 - 2012 , which proves the quality of the estimates and assures that the emission reporting is done on an accurate and a satisfactory manner.

When we analyze the resulting emissions by gas it can be noticed that slight difference occurs in the CH_4 and N_2O emissions since the GCP uses IPCC default emission factors for CH_4 and N_2O emissions (which are conservative and higher), while the COPERT IV model estimates the CH_4 and N_2O emission factors and emissions based on theexact vehicle data provided in the model.

Since the COPERT IV model estimates the road transport GHG emissions with Tier 3 accuracy level and is widely recognized and considered as the most advanced road transport emissions estimation tool, the COPERT output emission results will be used as BAU emission estimates.

According to the GCP methodology for calculation of the GHG impact of the urban emissions, the GHG emissions of one sector need to correspond with the overall activity of the sector. Consequently the electricity consumption of the vehicles in the city is one additional segment to adequately estimate the final impact of the urban road transport emissions of the city of Belgrade. Since the city of Belgrade doesn't have significant number of hybrid electric personal vehicles, only the electricity consumption of the public transport vehicles is taken as relevant. The city of Belgrade Public Transport Company - GSP uses electrically powered vehicles, as the trolleybuses, tramways and one short metro system. These activities emit indirect GHG emissions, which are consisted of the emissions from the electricity production, transmission and distribution.

The resulting emissions of the electricity consumption of the city of Belgrade Public Transport company are presented in the Table 2.4 bellow.

Table 2.3. National and City of Belgrade GHG emissions, IPCC 2006 and GCP methodology, Tier 1 calculations (excluding electricity consumption), in kt

Year	National road transport GHG emissions according to IPCC methodology [kt]				City of Belgrade characteristics				City of Belgrade GHG emissions from the liquid fuels used in the road transport sector based on weighted average of the national fuel consumption, Tier 1, IPCC methodology [kt]			
	CO_2	CH_4	N_2O	CO_2-eq.	Population Driver	Vehicle Fleet Driver	GDP Driver	% of total national fuel consumption	CO_2	CH_4	N_2O	Total emissions in CO_2-eq.
2006	7148,405	1,820	0,354	**7296,429**	0,227	0,242	0,390	**0,297**	2121,731	0,540	0,105	**2165,666**
2007	5552,476	1,054	0,281	**5730,889**	0,231	0,280	0,390	**0,309**	1717,446	0,326	0,087	**1751,201**
2008	6806,833	1,968	0,303	**7019,942**	0,236	0,303	0,390	**0,318**	2161,724	0,625	0,096	**2204,660**
2009	6042,870	2,332	0,257	**6249,212**	0,240	0,288	0,399	**0,318**	1921,545	0,741	0,082	**1962,420**
2010	5518,902	1,751	0,237	**5705,624**	0,243	0,310	0,399	**0,326**	1797,028	0,570	0,077	**1832,951**
2011	5315,347	1,600	0,231	**5499,096**	0,245	0,287	0,400	**0,319**	1697,566	0,511	0,074	**1731,181**
2012	4709,001	1,506	0,201	**4877,845**	0,246	0,285	0,396	**0,318**	1497,322	0,479	0,064	**1527,213**

Table 2.4. COPERT IV model output emissions of the road transport sector of the city of Belgrade, Tier 2 calculations and Emissions from electricity consumption of the road transport sector of Belgrade, 2006 – 2012 [kt]

Year	City of Belgrade GHG emissions from liquid fuels consumption based on the city of Belgrade vehicle fleet and COPERT IV model, Tier 3, IPCC [kt]				Emissions from electricity consumption of the road transport sector of Belgrade [kt]							
	COPERT IV CO_2 emissions	COPERT IV CH_4 emissions	COPERT IV N_2O emissions	Total output COPERT emissions in CO_2-eq.	Electricity consumption of the road transport sector of Belgrade (kWh)	CO_2 EF kg CO_2/ kWh	CH_4 EF kg CO_2/ kWh	N_2O EF kg CO_2/ kWh	CO_2 emissions from electricity consumption	CH_4 emissions from electricity consumption	N_2O emissions from electricity consumption	Total emissions from electricity consumption of the road transport sector of Belgrade in CO_2-eq.
2006	2166,522	0,227	0,056	**2188,644**	44751500	1,71	0,000017	0,000026	76,65	0,0008	0,0012	**77,0278**
2007	1730,701	0,228	0,058	**1753,566**	40251085	1,71	0,000017	0,000026	68,95	0,0007	0,0010	**69,2815**
2008	2228,992	0,230	0,062	**2252,972**	45264022	1,71	0,000017	0,000026	77,53	0,0008	0,0012	**77,9099**
2009	1907,758	0,231	0,062	**1931,927**	45198720	1,71	0,000017	0,000026	77,42	0,0008	0,0012	**77,7975**
2010	2130,245	0,233	0,063	**2154,727**	44385242	1,71	0,000017	0,000026	76,03	0,0008	0,0011	**76,3974**
2011	1808,470	0,234	0,067	**1834,060**	45603595	1,71	0,000017	0,000026	78,11	0,0008	0,0012	**78,4944**
2012	1618,519	0,233	0,069	**1644,914**	43480470	1,71	0,000017	0,000026	74,48	0,0008	0,0011	**74,8400**

* Source of the emission factor for electricity consumptions: Ecometrica, Technical Paper - Electricity-specific emission factors for grid electricity, August 2011

To quantify the total emissions of the city road transport sector it is necessary to decide which emissions estimate is considered as more reliable, the bottom up or the top down. As said before, the COPERT emission estimates are considered as more sophisticated and those estimates together with the indirect GHG emissions of the electricity consumption give the final GHG emissions of the road transport sector of the city of Belgrade. The total resulting emissions are presented in the Table 2.4. and the GHG emissions trend is shown on the Figure 2.5.

Table 2.5. National road transport sector emissions and Final GHG emissions of the city of Belgrade road transport sector for the period 2006 – 2012 in kt CO_2-eq.

Year	National road transport GHG emissions according to IPCC methodology [kt CO_2-eq.]	City of Belgrade emissions based on weighted average consumption, Tier 1 [kt CO_2-eq.]	City of Belgrade GHG emissions from liquid fuels consumption based on the city of Belgrade vehicle fleet and COPERT IV model, Tier 3, IPCC [kt CO_2-eq.]	Total emissions from electricity consumption of the road transport sector of the city of Belgrade [kt CO_2-eq.]	Total Road Transport emissions of the City of Belgrade, COPERT model output emission and electricity consumption [kt CO_2-eq.]
2006	7296,43	2165,67	2188,64	77,03	**2265,67**
2007	5730,89	1751,20	1753,57	69,28	**1822,85**
2008	7019,94	2204,66	2252,97	77,91	**2330,88**
2009	6249,21	1962,42	1931,93	77,80	**2009,72**
2010	5705,62	1832,95	2154,73	76,40	**2231,12**
2011	5499,10	1731,18	1834,06	78,49	**1912,55**
2012	4877,85	1527,21	1644,91	74,84	**1719,75**

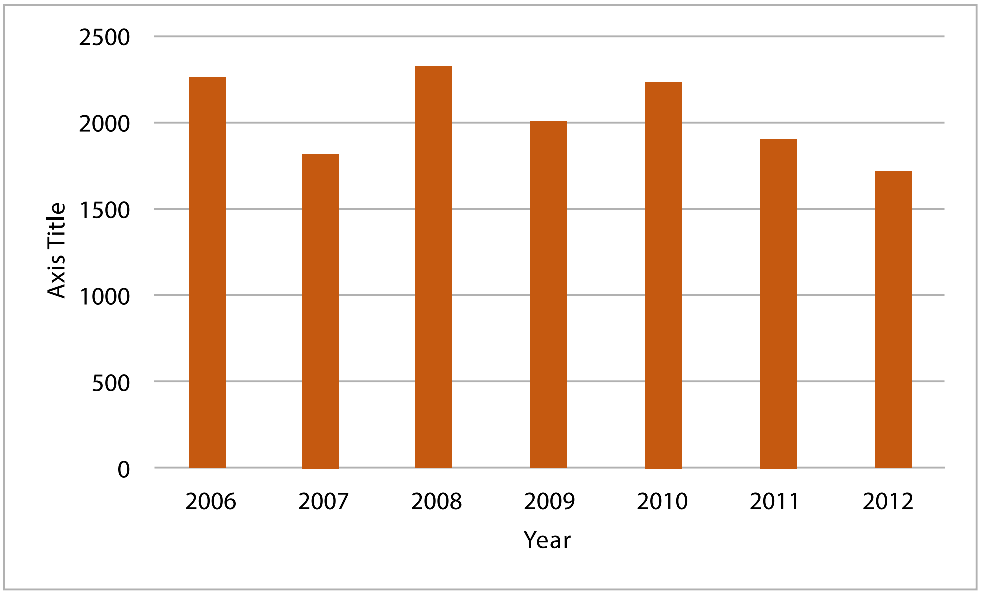

Figure 2.5. Estimated GHG emissions of the city of Belgrade road transport sector for the period 2006 – 2012, in kt CO_2-eq.

2.4. Baseline emissions under Business as Usual scenario for the period 2013 – 2024

The baseline emissions under Business as Usual scenario, are understood as a hypothetical and extreme situation, corresponding to the simulation of results if expected growth on the demand side occurs but transport supply is left at the level of baseline. The "business-as-usual" baseline case, assumes that future development trends follow those of the past and no changes in policies will take place. In other words this means that planned Smartplan infrastructures as from 2012 are not implemented nor the SUTP implementation is started.

The baseline emissions of the city of Belgrade road transport sector for the period 2006 – 2020 are defined via usage of calculated emission data for the period 2006 – 2012 and the forecasted economic, population and vehicle indicators for emission modeling in the period 2013 – 2024.

The Figure 2.5. represents the city of Belgrade primary transport network development plan. As it can be seen on the picture the city is constantly growing and the city government is constantly working on short and long term goals and targets.

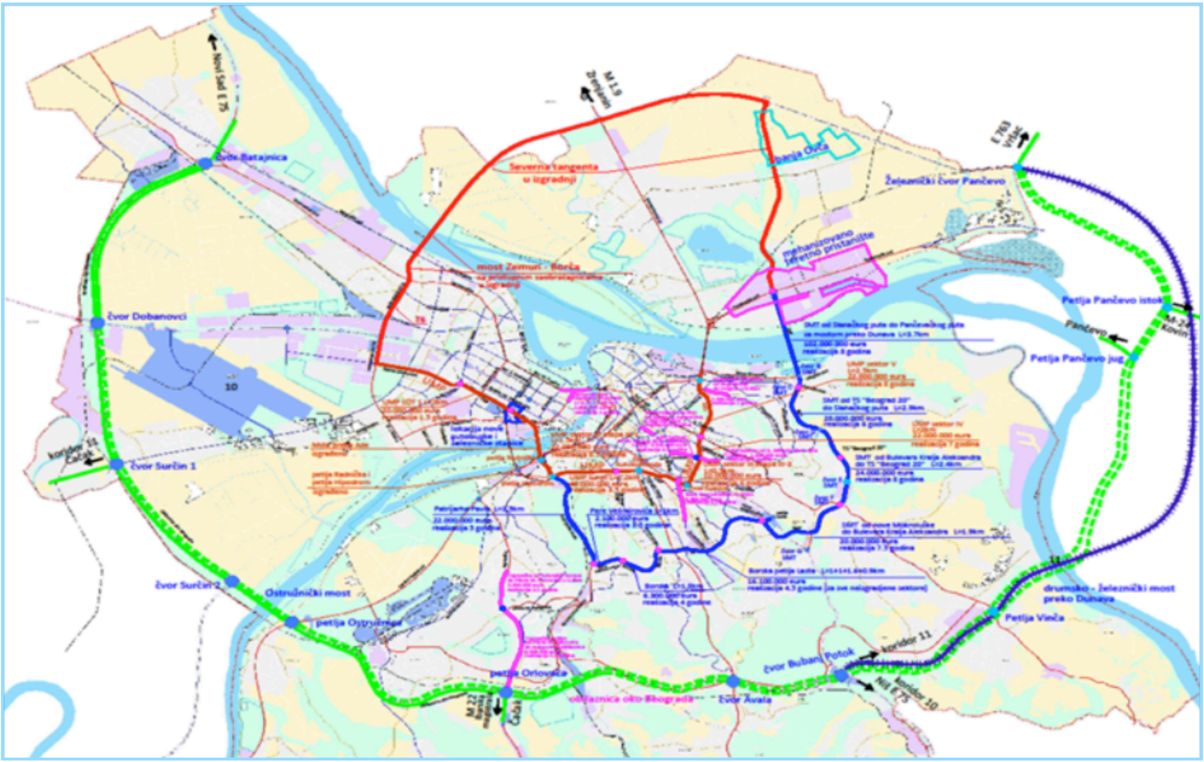

Figure 2.6. The City of Belgrade primary transport network development plan, source Beoland

The main drivers used for forecasting of the forthcoming emissions are:

- The forecasted national GDP and development indicators, taken form the World Bank and UN Statistical database.
- The forecasted population growth, taken from the State Statistical Office of R. Serbia and City of Belgrade Statistical Office.
- The GDP trend of the city of Belgrade and the consideration of the forthcoming city investment plans.
- The national and city of Belgrade vehicle data fleet and vehicle technology trends.
- The city of Belgrade Master Transport Plan.
- The Strategic Goals for development of primary transport network of the city of Belgrade, issued by Beoland.
- The national transport sector emission trends.

The Table 2.6. represents the calculated baseline emissions of the national road transport sector emissions and the city of Belgrade road transport sector emissions. The main drivers used for forecasting of the emissions are presented in the table and provide justification for the forecasted values.

Table 2.6. Business as Usual emissions of the National and City of Belgrade Road Transport sector for the period 2006 – 2020, in kt CO_2-eq.

Year	National Characteristics		City of Belgrade characteristics			GHG emissions from the road transport sector of the city of Belgrade		
	National emissions from the road transport sector [kt CO_2 eq.]	National GDP in 000 000 USD	Population Driver	Vehicle Fleet Driver	GDP Driver	Total output COPERT emissions [kt CO_2 eq.]	Total emissions from electricity consumption of the road transport sector of Belgrade [kt CO_2 eq.]	Total emissions of City of Belgrade road transport sector [kt CO_2 eq.]
2007	5661.607	38992.200	0.231	0.280	0.390	1753.566	69.282	**1822.847**
2008	6942.032	47725.800	0.236	0.303	0.390	2252.972	77.910	**2330.882**
2009	6171.414	40313.600	0.240	0.288	0.399	1931.927	77.798	**2009.724**
2010	5629.226	36991.600	0.243	0.310	0.399	2154.727	76.397	**2231.124**
2011	5420.602	43751.000	0.245	0.287	0.400	1834.060	78.494	**1912.554**
2012	4803.005	38002.800	0.246	0.285	0.396	1644.914	74.840	**1719.754**
2013	5160.546	42520.512	0.252	0.270	0.400	1766.638	75.964	**1842.602**
2014	5212.151	42477.991	0.255	0.294	0.402	1784.304	75.964	**1860.268**
2015	5290.334	43115.161	0.259	0.296	0.404	1811.069	75.964	**1887.033**
2016	5422.592	44193.040	0.261	0.298	0.406	1856.346	75.964	**1932.310**
2017	5558.157	45297.866	0.265	0.301	0.407	1902.754	75.964	**1978.718**
2018	5724.902	46656.802	0.269	0.303	0.409	1959.837	75.964	**2035.801**
2019	5896.649	48056.506	0.272	0.306	0.410	2018.632	75.964	**2094.596**
2020	6103.031	49738.484	0.276	0.308	0.412	2089.284	75.964	**2165.248**
2021	6359.969	51832.474	0.280	0.310	0.413	2177.243	75.964	**2253.207**
2022	6621.364	53962.789	0.283	0.313	0.415	2266.728	75.964	**2342.692**
2023	6877.610	56051.149	0.287	0.315	0.416	2354.450	75.964	**2430.414**
2024	7132.082	58125.041	0.291	0.317	0.418	2441.565	75.964	**2517.529**

* The section shaded in blue represents the forecasted emission values under Business-as-usual GHG emissions.

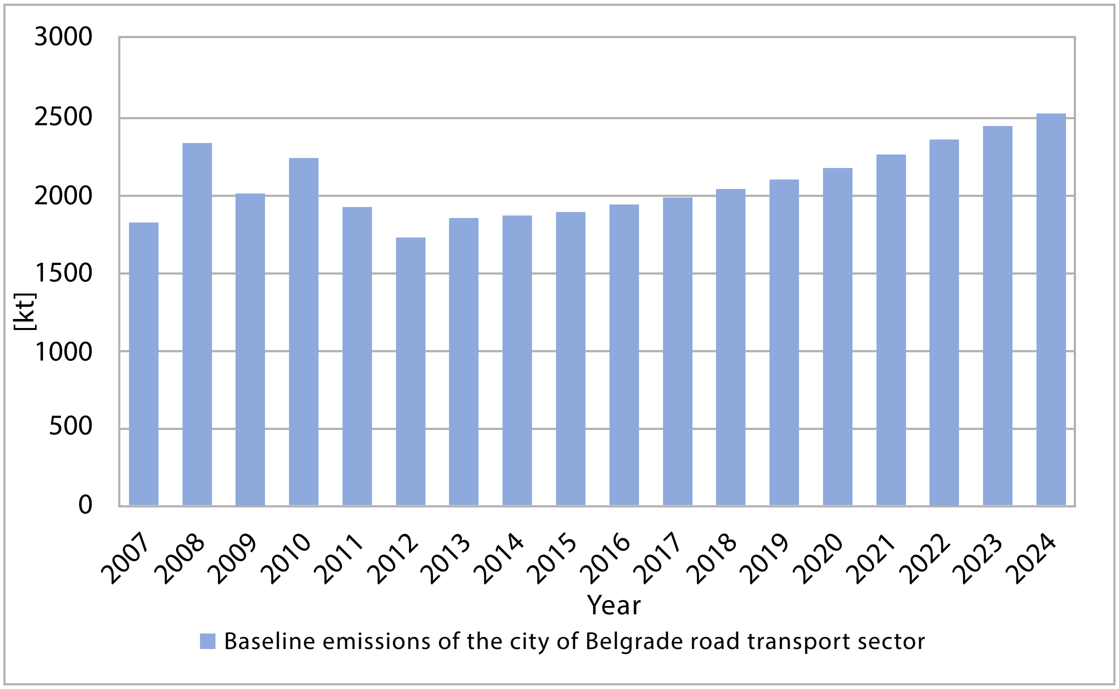

Figure 2.7. Baseline GHG emissions of the City of Belgrade road transport sector for the period 2006 – 2024, in kt of CO_2-eq.

As it can be seen from the Figure 2.6., the Baseline BAU Scenario GHG emissions of the city of Belgrade urban transport system will continuously grow in the period 2013 – 2024. The main reason for the forecasted grow of the city of Belgrade road transport sector GHG emissions is the forecasted economic growth of the city, the historical emission trends, the city development strategy and the continuous increase of the mobility needs of the citizens.

3. OUTLINE OF THE PROJECT SUPPORT TO SUSTAINABLE TRANSPORT IN THE CITY OF BELGRADE

3.1. Project components and activities

The overall objective of the project is to reduce the metropolitan emissions in the City of Belgrade by improving the public transport scheme, reinforcing the participation of the non-motorized means of transport, promotion of environmental friendly driving modes and providing the policy framework for sustainable urban transport development of Belgrade. Main project partners and beneficiaries are the City of Belgrade through the Land Development Agency and the Secretariat for Transport of the city of Belgrade.

The project design is conceived in such a way to stimulate and support the main partners in the targeting of the needs for improvement of the urban mobility schemes, as well as provision of technical and policy basis for constitution of sustainable urban transport in the City of Belgrade.The project also involved the civil sector, which allowed joint and critical approach to the solutions of the problems related to the sustainable management of the urban transport.

The project started at the beginning of 2011, and the year 2014 is the last year where the project activities and the project impact is monitored and evaluated.

The strategic vision of the project is to promote a sustainable, socially affordable and cost efficient urban transport in the city of Belgrade. The complete implementation of the project components will help resolve heavy traffic congestion and air and noise pollution caused by increased vehicles ownership, increased travel demand and the generally low environmental awareness of the urban citizens.

The project "Support to the Sustainable Transport of the City of Belgrade" is consisted of four components which are expected to deliver significant contribution to the reduction of the urban transport GHG emissions:

- Provision of basis for development of Sustainable Urban Plan of Belgrade
- Promotion of the cycling in the city
- Greener modes of transport to school
- Eco-driving modes in the public companies

The additional aspect of the project was to assist the R. Serbia to mainstream the environmental issues into its transport policies, strategies and the infrastructural management practices, as well as to support the national economy thought the reduction of the national dependency of imported fossil fuels.

3.1.1. Provision of basis for development of Sustainable Urban Plan of Belgrade

A Sustainable Urban Transport Plan is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life.The Sustainable Urban Transport Plans (SUTP) is the foundations upon new approaches to the constitution of the effective and efficient transport systemsare built. The whole process is supported by implementationof new policies and measures, and assisting in the process of integration of the transport, urban and economic planning.

The SUTP is an instrument that aims to establish a global intervention strategy in terms of accessibility and mobility management, defining a set of actions and measures that contributes to the implementation and promotion of a more sustainable mobility system:

- Compatible and aligned with the economic development;
- Promoting social cohesion;
- Objectives of the SUTP:
- Select and design measures that help to achieve the vision, objectives and targets;
- Ensure broad coverage of all policy approaches, strategies and action plan in the assessment boundary;
- Assure that all measures are clearly prioritized and the deliverable are realistically positioned;
- Secure efficient and effective allocation of resources
- Oriented towards the environmental protection and energy efficiency principles.

The provision of a basis for the development of Sustainable Urban Transport Plan of the City of Belgrade is important precursor and the fundamental element in the final constitution of sustainable urban transport policy document. The entire project activity required integrated approach to identify the mobility management practices, policies and needs, as well as to integrate the sustainable urban transport practices in the forthcoming design of the city of Belgrade.

The main effort and target in the implementation process of this componentwas focused on capacity building and provision of support to the Land Development Agency, as a main institution which is dealing with the urban planning in the city of Belgrade. The appropriate design and development of Sustainable Urban Plan of the city Belgrade will provide long term economic development of the city, as well as social cohesion of the citizens and integration of environmental friendly and energy efficiency principles in the urban community.

Main project activities have been focused on:

- Analysis and deliberation of policy options: strategies, instruments, tools;
- Technical support of the planning of measures;
- Preparation, realization and follow-up of stakeholder meetings

The SUTP process leads to agreement of a wide selection of measures for which diverse resources are required. To account for effectiveness and efficiency, as well as to ensure practical feasibility, a detailed synopsis of all measures is needed.

3.1.2. Promotion of the cycling in the city

The second component Promotion of the cycling in the city of Belgrade was focused on promotion of non-motorized means of transport, as cycling and walking, whichin the past were not adequately taken into account by the strategic urban development policies of the city. Significant attention was paid on promoting the cycling transport mode trough public campaigns, public open events, competitions, conferences etc. With all this, the awareness of the public authorities and the citizens was significantly raised, and consequently the non-motorized modes of transport have been prioritized in the urban strategic documents and technical and infrastructural planning and activities.

This component was consisted of the awareness raising campaigns and infrastructural activities for renovation of the existing bicycle pathways and building of new pathways, as well as provision of secondary infrastructure.

The accent of the public awareness campaigns was put to demonstrate the positive aspects of the usage of the cycling and to put this transport mode in the forefront, not only as a recreational activity, but as a proper transport mode in the city of Belgrade. Additionally the public campaigns were pointing towards the environmental, economic and health aspects of cycling and demonstrated the improved safety aspects of this means of transportation.

The overall achievement of implementation of this activity was significant increase of number of cycling trips in everyday traffic in Belgrade, thus contributing to lowering the urban transport GHG emissions and long term behavioural changes.

3.1.3. Greener modes of transport to school

Increasing numbers of children travelling to schools by sustainable modes can significantly contributes towards the reduction of the urban GHG emissions, solve the congestion issues around the schools, andsupport the constitution of health and environmental friendly generations.

The main benefits of the usage of greener modes to schools are:

– Health aspects - regular active travel, such as walking and cycling, can bring major health benefits for the young population, ranging from improved physical conditions, constitution of healthy habits, reduced obesity of the young population.

– Economy development - improving and promoting routes to schools facilities will help to develop local economies and support the long term usage of the non-motorized transport in the urban communities, which from the other side can bring significant economic benefits.

– Climate change - increased promotion and provision for walking and cycling will help to create a healthy environment and attitude that sustainable travel modes are realistic alternatives to the cars for many short journeys. Once sustainable transport is seen within this light it will provide an opportunity to reduce car use and the associated emissions which contribute towards climate change.

– Social benefits – the group walking to schools can be a significant social aspect for the young population, especially now a days when the children are not engaged in many collective activities due to the increased usage of the computers and virtual social networks.

– Social exclusion – walking to schools have vital role in reducing social exclusion amongst local residents and promotion of equity principles between the youngest populations.

These component main activities have been concentrated on the public campaigns for promotion of the walking among the youngest population, technical and practical activities for increasing of the safety of the daily home-school commuting of the children and awareness rising concerning the environmental aspects of the transport and the health and social benefits of the regular walking activities.

Additionally the pilot project "Safe Routes to Schools" has been completed in order to demonstrate the design and development process of the "safe routes to schools", as well as to emphasize the benefits of this component.

Since the pilot project has demonstrated great results, the sustainability of the integration of this component in the city of Belgrade was supported by the development of technical paper for design of five more safe routes to primary schools.

3.1.4. Eco-driving modes in the public companies

The urban transport is one of the mains sources of GHG emissions, noise and air pollution. The public and the commercial transport are usually the main consumers of the fossil fuels in the urban communities, and the appropriate training of the professional driving concerning the benefits of the eco-driving modes can bring significant reductions in the fuel consumption and urban GHG emissions.

Eco-driving is a term used to describe energy efficient use of vehicles. It is a great and easy way to reduce fuel consumption from road transport so that less fuel is used to travel the same distance. In the last decades, engine technology and performance of cars has improved rapidly, while most drivers have not adapted their driving style. Eco-driving represents a driving culture which suits to modern engines and makes best use of advanced vehicle technologies. Eco-driving offers numerous benefits, including GHG emissions reductions, fuel cost savings, as well as greater safety and comfort.

For that purpose the forth project component was focused on professional hands on training on eco-driving techniques for 25 instructors and 15 professional drivers from the city of Belgrade Public Companies. The synchronized trainings on instructors and divers provided the basis for immediate practical integration of the eco driving techniques in the public companies andfurther spreading of the eco-driving training within the companies/beneficiaries of the program.

3.2. Relation and integration with other initiatives and expansions plans

The project design is in line with the City of Belgrade commitment for sustainable development, the city of Belgrade Start Plan and the national commitments towards the EU aspirations and transposition of the EU climate and environmental acquies.

In the past few years the city of Belgrade has reached many tangible results in the field of sustainable mobility which are in line with the project activities:

- 30 new trams supplied during 2011/beginning of 2012, already commuting on the streets of Belgrade, reducing the electricity consumption by 30%;
- 100 new buses with the newest generation of diesel engines (Euro IV engines producing 1.5g /kWh CO instead of the previous generation of Euro III and 2.1 g/kWh CO);

- During 2012/13 additional 400 buses to be supplied equipped with Euro IV diesel engines;
- New buses on CNG;
- 83 new trolleybuses;
- Additional 8km constructed to the existing 65km of cycling routes;
- One bridge constructed and commissioned over the river Sava, including separated cycling lanes along the entire lane;
- 150.000 cyclists registered on the bicycle counter (the only one installed September 2011 at one of the main cycling routes);
- Rent-a-(e)bike scheme with 100 electric bikes was introduced in 2012 by the parking operator Belgrade Parking Service at outlying garages around Old Belgrade;
- Implementation of several traffic calming projects in parts of old Belgrade.

4. ASSESSMENT OF THE GHG IMPACT OF THE PROJECT ACTIVITIES

4.1. Overview of the GHG mitigation potential estimation methodology

The TEEMP methodology for estimation of the GHG mitigation impact of the transport project activities will be used to develop scenario outputs and to estimate the potential GHG emission reductions of the project activities. The methodology provides uniformity in the calculations and assumptions used to estimate the GHG impact over a very diverse array of potential projects. These include projects that:

- Improve the efficiency of transportation vehicles and fuels;
- Improve public and non-motorized transportation modes;
- Price and manage transport systems more efficiently;
- Train drivers in eco-driving;
- Package multiple strategies as comprehensive, integrated implementation packages.

The process of calculating GHG reductions from GEF projects has several steps. The complexity depends on the number and type of project components involved. The TEEMP methodology for estimation of the GHG mitigation potential of the transport projects implementation includes:

- Direct GHG emission reductions
- Indirect reductions.

4.2. Quantification of the mitigation impact of the project by project component

Since the project is consisted of 4 different project activities, it is necessary to separately estimate the mitigation potential of each project component. From the assessment of the project components mitigation potential it was observed that the GHG mitigation potential differs significantly for each activity type, but the long term impact of each component is the joint property and the most important outcome of the "Support to Sustainable Transport of the City of Belgrade" project.

4.2.1. Mitigation assessment of the Component 1 - Provision of basis for development of Sustainable Urban Plan of the city of Belgrade

This project activity is doing an important and groundbreaking job which is supposed to switch the city of Belgrade transport system development in a more sustainable direction. As a direct result of these project activitiesin 2013 the city started the preparation of the first SUTP, aiming to replace existing planning practice with a modern approach which is more capable to tackle transport-related problems and needs.

The main achievement for the sustainability of this activity is that the Land Development Agency, as one of the main partners and beneficiaries of the project, was able to secure finance for the preparation of the SUTP for Belgrade, which should start in 2013.

The SUTP of the city of Belgrade is supposed to be finalizes till the end of the 2015, and the implementation phase is foreseen in the period 2016 – 2024. Consequently the first resulting emission reductions of the implementation of the Sustainable Urban Transport Plan are expected in the year 2016.

The modeling methodology of the GHG impact of this component is based on the assumption that 5 years after the SUTP implementation started, in 2020, 1 % of the urban road transport emission reduction will be achieved, with a progressive penetration rate in the period 2016 – 2020. The reduction potential in the period 2021 – 2024 remains on the targeted 1% of the annual BAU emissions for the projected period, since all project activities and measures have been already implemented prior to the year 2021.

The estimated reduction rate is very conservative, since many European Studies, EPOMM (European Platform on Mobility Management) reports and evaluation guidelines reports[4] estimate higher emission reduction rates from the implementation of SUTPs (approximately 6% reductions for the similar project implemented in period of 10 years).

The cumulative mitigation potential of this component for the period 2016 – 2024 is estimated on 161.9 kt of CO_2-eq. The baseline emissions of the city of Belgrade road transport sector and the annual reductions from the constitution and implementation of the SUTP of the city of Belgrade are shown in the Table 4.1 bellow.

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4 Quantifying the Effects of Sustainable Urban Mobility Plans, JRC Technical Reports - Quantify the potential range of effects of policy measures on CO_2 emissions-for each NUTS3 zone- using transport demand and CO_2 estimation results(MODEL-T, JRC), EC;

The Future of Sustainable Urban Mobility in Europe – Visions and Scenarios. The report is in line with the Commission White Paper of Transport from 2011, and provides GHG mitigation figures for emission estimation from sustainable urban transport policies and measures, and other SUTP GHG mitigation results from cities with similar characteristics.;

Table 4.1.Estimated mitigation potential of the implementation of the Sustainable Urban Transport Plan of the City of Belgrade, period 2016 – 2020, in kt CO_2-eq.

Year	Total BAU GHG emissions of City of Belgrade road transport sector, [kt CO_2 eq.]	Resulting GHG emissions after the implementation of the SUPT of the city of Belgrade, [kt CO_2 eq.]	SUTP GHG mitigation potential, [kt CO_2 eq.]
2006	2265.672	NA	NA
2007	1822.847	NA	NA
2008	2330.882	NA	NA
2009	2009.724	NA	NA
2010	2231.124	NA	NA
2011	1912.554	NA	NA
2012	1719.754	NA	NA
2013	1842.602	NA	NA
2014	1860.268	NA	NA
2015	1887.033	NA	NA
2016	1932.310	1928.059	4.251
2017	1978.718	1970.012	8.706
2018	2035.801	2022.365	13.436
2019	2094.596	2076.164	18.432
2020	2165.248	2143.596	21.652
2021	2253.207	2230.675	22.532
2022	2342.692	2319.265	23.427
2023	2430.414	2406.110	24.304
2024	2517.529	2492.353	25.175

4.2.2. Mitigation assessment of the Component 2 -Promotion of the cycling mlitigation potential assessment

In the past the city of Belgrade developments plans were not considering the development of bicycle infrastructure and promotion of the non-motorized transport solutions. In the previous period the city identified the need and the prosperity of the cycling as a means of transport in the urban communities and many policy papers and urban strategies changed in direction to provide better circumstances for improved usage of the bicycles in the city of Belgrade.

The Support to Sustainable Transport in Belgrade project put a lot of effort and attention to the promotion of the cycling in the city of Belgrade, as well as undertook significant technical measures for renovation of the existing bicycle tracks, building of new infrastructure, improved horizontal and vertical signalization etc.

Another significant output of the project was the establishing of the City of Belgrade bicycle committee as a responsible body for coordination and information of the local activities and initiatives.

The assessments and surveys done in the project framework showed that only 1% of the population of the city of Belgrade uses the cycling as transport mode for every day commuting activities. The long term perspectives of the City of Belgrade urban community is enabling of the adequate cycling infrastructure in order to increase the bicycle travel to 5 -10%.

In the framework of the project Support to the Sustainable Transport in Belgrade of the city of Belgrade 37 km of bicycle tracks have been renovated and 4km of tracks have been built.

The estimation of the GHG emissions reduction potential was done with usage of the survey data for baseline bicycle usage and conservative penetration rate of the modal switch, which was projected according to the project interventions and activities done,the national and local vcvvcircumstances and the EPOMM Evaluation Tool based on real monitoring of the GHG emission reductions from transport interventions (European Platform on Mobility Management).

The overall assessment of the mitigation potential of this component imposed a brake thought rate of 10% increase of cycling among commuters by 2014 (very realistic targets), and consequentive increase of 1% for the period 2015 - 2024. The calculations are based on survey data (1% of the city of Belgrade population commutes with bicycles, 175 days per year, average trip distance 2 km)

The emission reductions from the implementation of this measure has been estimated on the fundamentals of the estimated emissions of the personal vehicle usage in the period 2006 – 2012, as well an on the baseline emissions under the Business as Usual emissions of the personal vehicles usage in the period 2013 – 2024.

The separate estimates concerning the GHG emissions of the usage of personal vehicles have been calculated via usage of the COPERT IV model and the city of Belgrade vehicle fleet and estimated fuel consumption.

The resulting GHG emissions of the baseline emissions under the BAU and the mitigation potential of the project component are presented in the Table 4.2.The cumulative mitigation potential of this component for the period 2013– 2024 is estimated on 10.132 kt of CO_2-eq.

Table 4.2. GHG mitigation potential of the component Promotion of cycling in the City of Belgrade for the period 2012 - 2024, in kt CO_2-eq.

Year	Total BAU GHG emissions of City of Belgrade passenge transport, [kt CO_2 eq.]	Total emission reductions of the BAU usage of the bycicle transport [kt CO_2 eq.]	Emission reductions from the component Let's Cycle in Belgrade [kt CO_2 eq.]	Resulting GHG emissions after the implementation of technical measures and awarness raising cycling champaigns of the city of Belgrade, [kt CO_2 eq.]	Let's Cycle in Belgrade GHG mitigation potntial, [kt CO_2 eq.]
2006	1609.077	7.724	NA	NA	NA
2007	1160.904	5.572	NA	NA	NA
2008	1490.786	7.156	NA	NA	NA
2009	1331.923	6.393	NA	NA	NA
2010	1278.680	6.138	NA	NA	NA
2011	1168.331	5.608	NA	NA	NA
2012	1044.225	5.012	5.062	1044.175	0.050
2013	1168.903	5.611	5.891	1168.622	0.281
2014	1180.110	5.665	6.231	1179.543	0.566
2015	1197.089	5.746	6.378	1196.457	0.632
2016	1225.811	5.884	6.590	1225.105	0.706
2017	1255.252	6.025	6.808	1254.468	0.783
2018	1291.464	6.199	7.067	1290.596	0.868
2019	1328.762	6.378	7.335	1327.805	0.957
2020	1373.582	6.593	7.648	1372.527	1.055
2021	1429.381	6.861	8.027	1428.214	1.166
2022	1486.148	7.134	7.262	1486.019	0.128
2023	1541.797	7.401	8.807	1540.391	1.406
2024	1597.060	7.666	9.199	1595.527	1.533

4.2.3. Mitigation assessment of the Component 3 - Greener modes of transport to school mitigation potential assessment

The main goal of this project component was to reduce the number of cars that make the short trips to the schools in the mornings and in the afternoons and consequently reduce the GHG impact of the transport activities.

Additionally there are other non-quantifiable advantages of the implementation of this measure, such as developing a sense of community and environmental awareness rising of the young population. The Pedibus also saves the parents' time and gives them the extra 20-40 minutes on either side.

Since this component is only implemented in one primary school in Belgrade, the GHG mitigation potential is very minor, but it has a huge potential if the Pedibus activity is implemented in all primary schools on the territory of the city of Belgrade.

The estimation of the emissions from the motorized driving to school of the children is done by usage of the survey data of the school concerning the rate of the usage of the motorized transport and the driving distances, and the average community vehicle age and environmental standard of the vehicles. From the survey done in the school it was observed that 20% of the pupils are driven to the school. The average age of the private vehicles in Belgrade is 13 years, or Euro 3 standard, which for an average vehicle emits 180g CO_2/km. The estimated extra distance that each parent drives to scholl is estimated on 1.5km in one direction. The estimated potential reduction is shown in the Table 4.3.

Table 4.3. Mitigation potential of the Pedi bus pilot component, period 2013 – 2024, in kt CO_2-eq,

Year	Total BAU GHG emissions of City of Belgrade passenger transport, in kt CO_2-eq.	Resulting GHG emissions after the implementation of technical measures and awarness raising cycling champaigns of the city of Belgrade, in kt CO_2-eq.	Pedibus pilot project GHG mitigation potntial, in kt CO_2-eq.
2006	1609.077	NA	NA
2007	1160.904	NA	NA
2008	1490.786	NA	NA
2009	1331.923	NA	NA
2010	1278.680	NA	NA
2011	1168.331	NA	NA
2012	1044.225	NA	NA
2013	1168.902732	1168.900	0.003
2014	1180.109862	1180.103	0.006
2015	1197.088663	1197.082	0.006
2016	1225.811134	1225.805	0.007
2017	1255.251667	1255.245	0.007
2018	1291.463523	1291.457	0.007
2019	1328.761735	1328.755	0.007
2020	1373.581753	1373.575	0.007
2021	1429.380754	1429.374	0.007
2022	1486.147702	1486.141	0.007
2023	1541.796673	1541.790	0.007
2024	1597.060127	1597.053	0.007

The cumulative mitigation potential of the pilot implementation of the component Pedibus in the Primary School "St. Sava" is estimated on 0,077 kt of CO_2 emissions for the period 2013– 2024.

In the project framework, four more technical papers for integration of Pedibus component in four more primary schools in the City of Belgrade were done. The potential reduction of the future implementation of this Pedibus projects will be calculated as post project GHG emission reductions and will be more evaluated in the Chapter 4.4.

4.2.4. Mitigation assessment of the Component4 –Assessment of the mitigation potential of the Eco-driving modes in the public transport companies

The public transport companies are observed as the most significant fuel consumers and GHG emitters in the urban communities. Consequently the public transport companies have significant potential for urban GHG emissions reductions, ranging from renewal of the vehicle fleet, usage of low carbon fuels, improved network management, improved driving performances etc.

The assessment of the mitigation potential of the integration of the eco-driving techniques in the public transport companies was done through detailed assessment of the fuel consumption and the vehicle fleet parameters on the main public transport companies of the city of Belgrade; GSP and Lasta.

Estimation of the mitigation impact of the Public Transport Company GSP Beograd

For the purpose of the evaluation of the mitigation impact of this project activity, the Public Transport Company of the city of Belgrade - GSP has provided the detailed fuel and electricity consumption and vehicle fleet database, as well as number of other technical and operational parameters, as number of lines, kilometers driven, number of passengers, average speed of the vehicles etc.

The most important parameters that are influencing the annual GHG emission, as the annual fuel and electricity consumption are presented on the Figures 4.1 and 4.2.

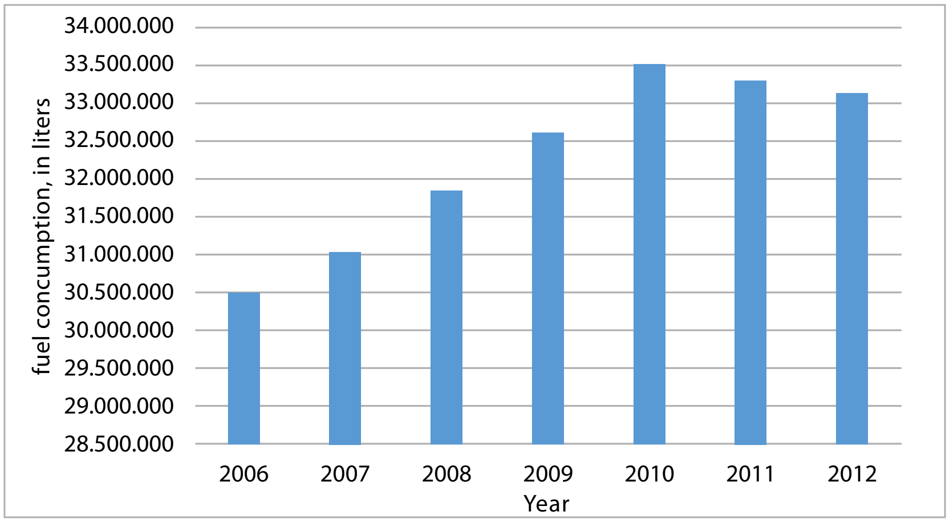

Figure 4.1. GSP Belgrade annual fuel consumption, in litters, 2006 – 2012

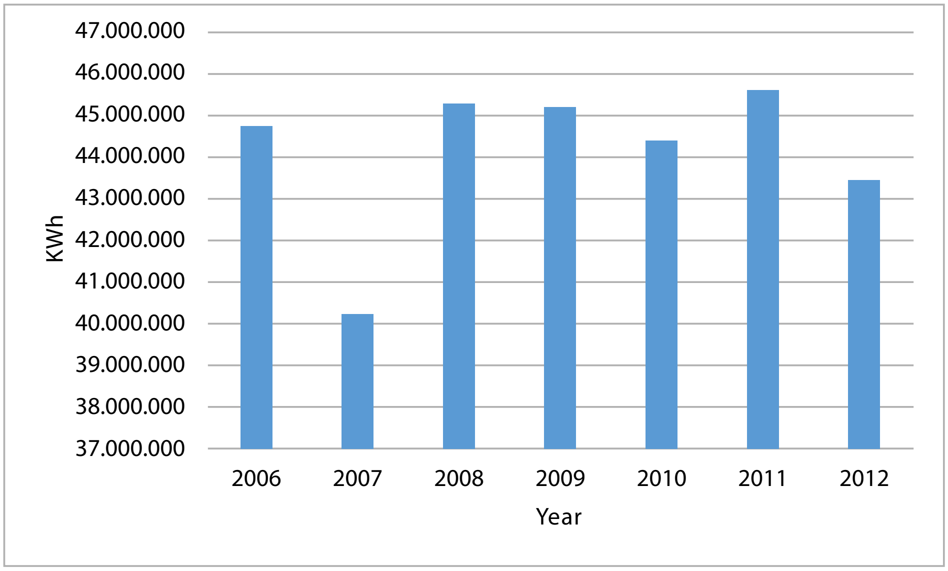

Figure 4.2. GSP Belgrade annual consumption of electrical energy for trams and trolleys, in kWh, 2006 – 2012

Additional operational parameters as the number of lines, the total length of the public transport lines and average driving speeds of the GSP Beograd by vehicle types for the period 2007 - 2012 are presented on the Figures 4.3, 4.4 and 4.5.

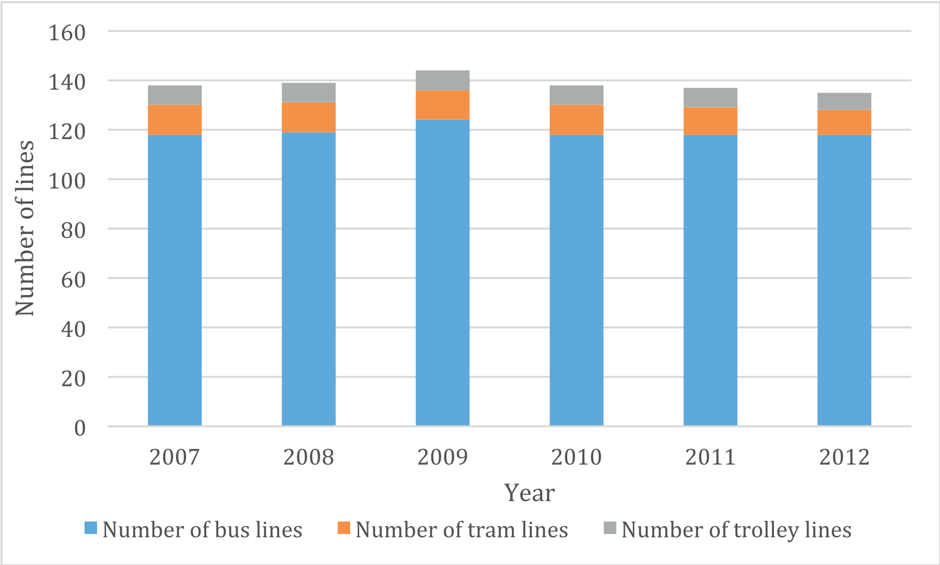

Figure 4.3. GSP Belgrade number of lines, 2007 – 2012

Figure 4.4. GSP Belgrade total length of the lines in km, 2007 – 2012

Additionally GSP Beograd provided appropriate operational and economic parameters which are indicating the company work intensity and the rate of usage of the public transport in the city, as the annual number of transported passengers presented on the Figure 4.6. As it can be senn from the figure, the number of transported passengers in the period 2007 – 2012 is slightly decreasing, despite the fact that the country felt the influence of the world economy crisis in 2009 and 2010.

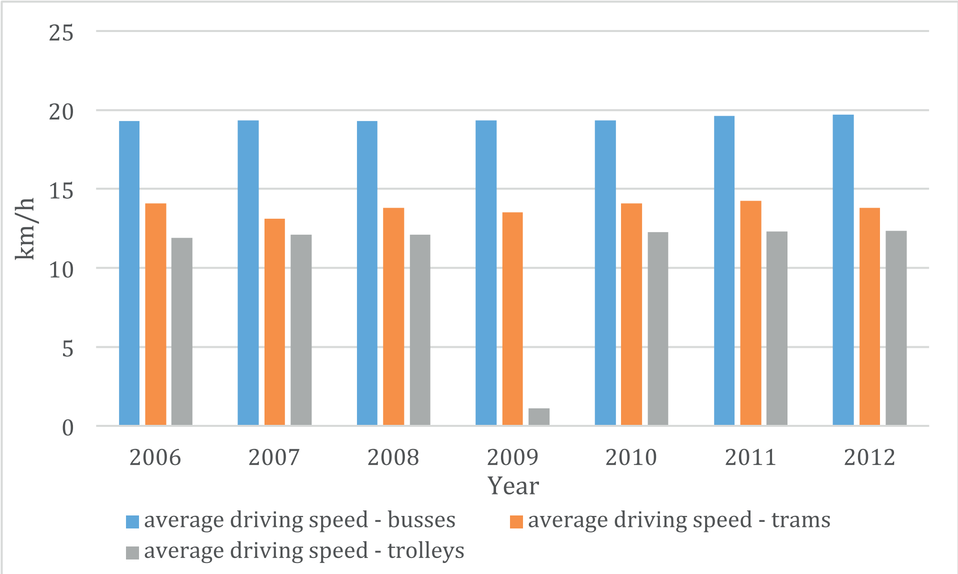

Figure 4.5. GSP Belgrade average driving speed of the vehicle fleet, 2006 – 2012

Figure 4.6. GSP Belgrade, number of transported passengers, in millions, 2006 – 2012

The GHG emissions from the transport activities of the GSP Beograd are consisted of the GHG emissions from the diesel oil consumption and GHG emissions from the usage of the electricity as a powering source of the trams and trolleys.

The resulting annual GHG emissions of the GSP transport activities supported by different energy sources are presented in the Table 4.4.

Table 4.4. Annual energy consumption and GHG emissions from the public transport activities, GSP Beograd, 2006 - 2012

Year	Diesel oil consumption [kt]	CO_2 emissions from fuel consumption [kt CO_2 eq.]	CH_4 emissions from fuel consumption [kt CO_2 eq.]	N_2O emissions from fuel consumption [kt CO_2 eq.]	Total emissions from the fuel consumption of the GSP Belgrade [kt CO_2 eq.]	Electricity consumption of the road transport sector of Belgrade [kWh]	CO_2 emissions from electricity consumption [kt CO_2 eq.]	CH_4 emissions from electricity consumption [kt CO_2 eq.]	N_2O emissions from electricity consumption [kt CO_2 eq.]	Total emissions from electricity consumption of the road transport sector of Belgrade [kt CO_2 eq.]	Total emission of the public transport activity of the GSP Beograd, [kt CO_2 eq.]
2006	25,923	82,598	0,004	0,004	84,038	44751500	76,650	0,001	0,001	77,028	161,066
2007	26,381	84,058	0,004	0,004	85,521	40251085	68,950	0,001	0,001	69,282	154,802
2008	27,071	86,256	0,005	0,005	87,759	45264022	77,530	0,001	0,001	77,910	165,669
2009	27,716	88,311	0,005	0,005	89,851	45198720	77,420	0,001	0,001	77,798	167,648
2010	28,479	90,743	0,005	0,005	92,325	44385242	76,030	0,001	0,001	76,397	168,722
2011	28,301	90,175	0,005	0,005	91,748	45603595	78,110	0,001	0,001	78,494	170,242
2012	28,162	89,733	0,005	0,005	91,295	43480470	74,480	0,001	0,001	74,840	166,135

The baseline fuel consumption and GHG emissions for the period 2006 – 2012 have been estimated via usage of provided activity data. For the estimation of the baseline emissions under Business as Usual for the period 2013 – 2024 advanced mathematical modeling with consideration of the company strategies and goals have been applied.

The emissions reduction potential from the implementation of the eco driving procedures in the systematic working plan of the GSP Beograd are estimated via usage of the TEEMP model Eco-driving tool for estimating the direct impact on transportation efficiency, the company eco driving training programme and the recorded fuel reductions by GSP Beograd.

The initial hands on practical training by accredited company was held in the period July – September 2013, the first results GHG emission reduction results are observed starting from the last quartile of 2013. The TEEMP model also recommends and foresees progressive penetration rates of the measure, since the Eco driving training is not immediately available for all professional drivers in the company. The progressive penetration rate of the measure is estimated by usage of the official eco driving planning document issued by the GSP Beograd.

During the initial training 11 drivers and 14 GSP instructors have been trained for eco driving. Since September 2014 the company intensified the eco driving training in the company, and the official eco training planning documents indicateshands on trainings on 200 new drivers per month. Since the company employees 3500 bus drivers, the overall GSP divers'fleet will be trained by the beginning of 2016, when the full mitigation potential of the measure is estimated.

The resulting practical fuel reduction rates have been obtained by the GSP report based on the technical measurements of the fuel consumption reductions from implementation of the eco driving modes and the TEEMP model correction factors. The TEEMP model output fuel reduction results are presented in the Table 4.5.

The estimation of the emission reduction potential and the percentage of the drivers trained for eco driving indicated in the TEEMP modelreflect the dynamics of the company eco driving plan.

Table 4.5. TEEMP model output results for the fuel consumption reductionsof GSP Beograd, in %,

Year 1 (Implementation Year) Inputs

Year 1	**2013**
Scoring Factors	
Nature of Ecodriving Training (Choose one)	Structured Training Program
Program Type in Detail under corresponding Training	Hands-on Training Program
	Passenger
Percent of population reached by Ecodriving training programs	0,24%

Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Net Adoption Rate (calculated)	0,18%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	75%
Net Adoption Rate (calculated)	0,1%
Year 1 Outputs	
Fuel Use Reduction, training	0,011%
Fuel Use Reduction, on-board display tools	0,003%
Total Fuel Use Reduction (multiplicative)	0,013%
Year 2 Inputs	
Year 2	**2014**
	Passenger
Percent of population reached by Ecodriving training programs in Year 2	4%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 2	85%
Net Continuing Adoption Rate (calculated)	2%
On-board display tools:	

Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to respond to on-board display tools in Year 2	100%
Net Adoption Rate (calculated)	0,8%
Year 2 Outputs	**Passenger**
Fuel Use Reduction, training	0,14%
Fuel Use Reduction, on-board display tools	0,04%
Total Fuel Use Reduction (multiplicative)	**0,18%**
Year 3 Inputs	
Year 3	**2015**
	Passenger
Percent of population reached by Ecodriving training programs in Year 3	55%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 3	85%
Net Continuing Adoption Rate (calculated)	35%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	100%
Percent of that population that continues to respond to on-board display tools in Year 3	75%
Net Adoption Rate (calculated)	16,5%
Year 3 Outputs	**Passenger**
Fuel Use Reduction, training	2,10%

Fuel Use Reduction, on-board display tools	0,83%
Total Fuel Use Reduction (multiplicative)	**2,91%**

Year 4 Inputs

Year 4	**2016**
	Passenger
Percent of population reached by Ecodriving training programs in Year 4	99%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 2	85%
Net Continuing Adoption Rate (calculated)	63%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to respond to on-board display tools in Year 2	100%
Net Adoption Rate (calculated)	22,3%
Year 2 Outputs	**Passenger**
Fuel Use Reduction, training	3,79%
Fuel Use Reduction, on-board display tools	1,12%
Total Fuel Use Reduction (multiplicative)	**4,87%**
Year 5 Inputs	
Year 5	**2017**
	Passenger

Percent of population reached by Ecodriving training programs in Year 5	100%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 3	85%
Net Continuing Adoption Rate (calculated)	64%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	100%
Percent of that population that continues to respond to on-board display tools in Year 3	75%
Net Adoption Rate (calculated)	30,0%
Year 3 Outputs	**Passenger**
Fuel Use Reduction, training	3,83%
Fuel Use Reduction, on-board display tools	1,50%
Total Fuel Use Reduction (multiplicative)	**5,27%**

The estimated fuel consumptions and emissions reductions and presented in the Table 4.6.

The total mitigation potential of the implementation of the eco-driving in the GSP Beograd operational activities is estimated on a cumulative reduction of 52 kt CO_2-eq. for the period 2013 – 2024.

Table 4.6. GSP Beograd fuel [kt] and GHG emissions reductions [kt of CO_2-eq.]caused from the integration of the eco driving training and procedures in the period 2013 -2024

Year	Diesel oil consumption [kt]	BAU emissions from the fuel consumption of the GSP Belgrade [kt CO_2-eq.]	Eco driving reductions[%]	Mitigation emissions from the fuel consumption of the GSP Belgrade [kt CO_2 eq.]	GHG emissions reductions [kt CO_2 eq.]
2006	25,923	84,038	NA	NA	NA
2007	26,381	85,521	NA	NA	NA
2008	27,071	87,759	NA	NA	NA
2009	27,716	89,851	NA	NA	NA
2010	28,479	92,325	NA	NA	NA
2011	28,301	91,748	NA	NA	NA
2012	28,162	91,295	NA	NA	NA
2013	29.143	94.422	0.0001	94.410	0.012
2014	29.570	95.806	0.0018	95.634	0.172
2015	29.997	97.191	0.0291	94.363	2.828
2016	30.425	98.575	0.0487	93.775	4.801
2017	30.852	99.960	0.0527	94.692	5.268
2018	31.279	101.345	0.0527	96.004	5.341
2019	31.707	102.729	0.0527	97.315	5.414
2020	32.134	104.114	0.0527	98.627	5.487
2021	32.561	105.498	0.0527	99.938	5.560
2022	32.988	106.883	0.0527	101.250	5.633
2023	33.416	108.267	0.0527	102.561	5.706
2024	33.843	109.652	0.0527	103.873	5.779

Estimation of the mitigation impact of the Public Transport Company Lasta Beograd

Since the official data concerning the detailed fuel consumption and vehicle fleet of the public transport company Lasta Beograd for the period 2006 – 2012 havenot been obtained directly from the company, the calculation of Lasta annual fuel consumption and GHG emissions have been done via usage of the company reported annual fuel consumption for the year 2012.

This reported fuel consumption in this report is in line with the publically available company data concerning the vehicle fleet and annual financial results for the company.

Since the historical fuel consumption data for the period pre-2012 are not available, the baseline emissions under Business as Usual are estimated starting with the year 2012, and forecast a slight annual increase in the fuel consumption for 1% for the period 2013 – 2024.

The emissions reduction potential from the implementation of the eco driving procedures in the regular operational working of the Lasta Beograd are estimated via usage of the TEEMP model Eco-driving tool for estimating the direct impact on transportation efficiency, together with incorporated emission reductions rates as observed fuel reductions by GSP Belgrade (as company with similar vehicle fleet) after the implementation start[5].

The emissions reduction potential from the implementation of the eco driving procedures in the systematic working plan of the GSP Beograd are estimated via usage of the TEEMP model Eco-driving tool for estimating the direct impact on transportation efficiency, the measure penetration rate and the recorded fuel reductions.

The initial hands on practical training by accredited company was held in the period July – September 2013, the first results GHG emission reduction results are observed starting from the last quartile of 2013. The TEEMP model also recommends and foresees progressive penetration rates of the measure, since the Eco driving training is not immediately available for all professional drivers in the company. The progressive penetration rate of the measure is estimated by usage of the official eco driving planning document issued by the GSP Beograd.

During the initial training 1 driver and instructor have been trained for eco driving (1% of the employed drivers). In the year 2014 the company intensify the eco driving trainings, and in average 50% of the drivers have been trained by the end of the year 2014. The overall diver fleet is expected to be trained by the beginning of 2015, when the full mitigation potential of the measure is estimated.

The resulting practical fuel reduction rates have been obtained by the report based on the technical measurements of the fuel consumption reductions from implementation of the eco driving modes (from GSP, as company with similar vehicle fleet) and the TEEMP model correction factors. The TEEMP model output fuel reduction results are presented in the Table 4.7.

Table 4.7. TEEMP model output fuel consumption reductions for Lasta Belgrade, in %

Year 1 (Implementation Year) Inputs	
Year 1	**2013**
Scoring Factors	
Nature of Ecodriving Training (Choose one)	Structured Training Program
Program Type in Detail under corresponding Training	Hands-on Training Program
	Passenger

[5] Source: "Final Report UNDP & Belgrade Secretariat for Transport – ECO effect Project"

Percent of population reached by Ecodriving training programs	1,00%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Net Adoption Rate (calculated)	0,75%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	75%
Net Adoption Rate (calculated)	0,2%
Year 1 Outputs	
Fuel Use Reduction, training	0,045%
Fuel Use Reduction, on-board display tools	0,011%
Total Fuel Use Reduction (multiplicative)	0,056%
Year 2 Inputs	
Year 2	**2014**
	Passenger
Percent of population reached by Ecodriving training programs in Year 2	50%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 2	85%
Net Continuing Adoption Rate (calculated)	32%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to respond to on-board display tools in Year 2	100%
Net Adoption Rate (calculated)	11,3%
Year 2 Outputs	**Passenger**

Fuel Use Reduction, training	1,91%
Fuel Use Reduction, on-board display tools	0,56%
Total Fuel Use Reduction (multiplicative)	**2,46%**
Year 3 Inputs	
Year 3	**2015**
	Passenger
Percent of population reached by Ecodriving training programs in Year 3	100%
Percent of Trainees with on-board display tools	30%
Constants	
Ecodriving Training:	
Individual Fuel Use Reduction from training	6%
Percent of population reached that implements lessons learned	75%
Percent of that population that continues to implement ecodriving in Year 3	85%
Net Continuing Adoption Rate (calculated)	64%
On-board display tools:	
Individual Fuel Use Reduction from on-board display tools	5%
Percent of population reached that implements lessons learned	100%
Percent of that population that continues to respond to on-board display tools in Year 3	75%
Net Adoption Rate (calculated)	30,0%
Year 3 Outputs	**Passenger**
Fuel Use Reduction, training	3,83%
Fuel Use Reduction, on-board display tools	1,50%
Total Fuel Use Reduction (multiplicative)	**5,27%**

The total mitigation potential of the implementation of the eco-driving in the public transport company Lasta Beograd operational activities is estimated on a cumulative reduction of 3.347 kt CO_2-eq. for the period 2013 – 2024. The estimated fuel consumptions and emissions reductions are presented in the Table 4.8 on the following page.

Table 4.8. Lasta Beograd fuel [kt] and GHG emissions reductions [kt of CO_2-eq.] caused from the integration of the eco driving training and procedures in the period 2013 -2024

Year	Diesel oil consumption [kt]	Total emissions from the fuel consumption of the Lasta Belgrade [kt CO_2-eq.]	Reductions [%]	Mitigation emissions [kt CO_2 eq.]	GHG emissions reductions [kt CO_2 eq.]
2006	NE	NA	NA	NA	NA
2007	NE	NA	NA	NA	NA
2008	NE	NA	NA	NA	NA
2009	NE	NA	NA	NA	NA
2010	NE	NA	NA	NA	NA
2011	NE	NA	NA	NA	NA
2012	1.741	5.641	NA	NA	NA
2013	1.759	5.698	0.0006	5.695	0.003
2014	1.776	5.755	0.0246	5.613	0.142
2015	1.794	5.812	0.0527	5.506	0.306
2016	1.812	5.870	0.0527	5.561	0.309
2017	1.830	5.929	0.0527	5.617	0.312
2018	1.848	5.988	0.0527	5.673	0.316
2019	1.867	6.048	0.0527	5.729	0.319
2020	1.885	6.109	0.0527	5.787	0.322
2021	1.903	6.164	0.0527	5.840	0.325
2022	1.921	6.223	0.0527	5.895	0.328
2023	1.939	6.281	0.0527	5.950	0.331
2024	1.957	6.340	0.0527	6.006	0.334

Total mitigation impact of the integration of eco driving in the major public transport companies in the city of Belgrade

The cumulative mitigation potential of this component for the period 2013– 2024, which is a sum of the estimated mitigation potentials from the integration of eco-driving in the two major public transport companies (GSP and Lasta Beograd), is estimated on 55.347kt of CO_2-eq.

The potential reductions by company, as well as the sum of the potential reductions from the implementation of this measure are presented in the Table 4.9.

Table 4.9. Mitigation potential of the implementation of eco driving techniques in the city of Belgrade major public transport companies, for the period 2013 –2024, in kt of CO_2-eq.

Year	GSP Beograd potential GHG emissions reductions [kt CO_2-eq.]	Lasta Beograd potential GHG emissions reductions [in kt CO_2-eq.]	Total potential GHG emission reductions [kt CO_2-eq.]
2006	NA	NA	NA
2007	NA	NA	NA
2008	NA	NA	NA
2009	NA	NA	NA
2010	NA	NA	NA
2011	NA	NA	NA
2012	NA	NA	NA
2013	0.012	0.003	0.015
2014	0.172	0.142	0.314
2015	2.828	0.306	3.135
2016	4.801	0.309	5.110
2017	5.268	0.312	5.580
2018	5.341	0.316	5.656
2019	5.414	0.319	5.733
2020	5.487	0.322	5.809
2021	5.560	0.325	5.885
2022	5.633	0.328	5.961
2023	5.706	0.331	6.037
2024	5.779	0.334	6.113

4.3. Quantification of the overall GHG mitigation potential of the project activities

To estimate the mitigation potential of the project "Support to Sustainable Transport of the City of Belgrade", it is necessary to integrate the baseline emission scenario under BAU and the mitigation impacts of each project component.

The road transport sector BAU emissions under the baseline scenario and the emission reductions by project component for the period 2006 – 2024 are shown in the Table 4.10. Consequently the integrated mitigation scenario for estimated reduction from all four project component is presented, as well as cumulative GHG emission reductions for the period 2013 – 2024.

From the scenario development and the estimated mitigation potential of the project components in can be concluded that in the assessment period 2012– 2024, the project has a cumulative direct GHG mitigation potential of 227.473 kt of CO_2-eq, or a reduction potential of 0.84% of the forecasted cumulative baseline emissions under BAU for the road transport sector of the city of Belgrade.

Table 4.10. BAU emissions, mitigation potential by project components, mitigation scenario emissions and total mitigation potential of the project Support to the Sustainable Transport of the City of Belgrade, 2006 – 2024, in kt CO_2-eq.

Year	BAU GHG emissions of City of Belgrade road transport sector, in [kt CO2 eq.	SUPT GHG mitigation potntial, [kt CO_2 eq.]	Lets cycle in Belgrade GHG mitigation potntial, [kt CO_2 eq.]	Pedi bus pilot project GHG mitigation potential, [kt CO_2 eq.]	Eco-driving in public transport companies [kt CO_2 eq.]	Total mitigation potential of the project Support to the Sustainable Transport of the city of Belgrade, [kt CO2 eq.]	Mitigation Scenario GHG emissions of City of Belgrade road transport sector, [kt CO_2 eq.]
2006	**2265.672**	NA	NA	NA	NA	**NA**	2265.672
2007	**1822.847**	NA	NA	NA	NA	**NA**	1822.847
2008	**2330.882**	NA	NA	NA	NA	**NA**	2330.882
2009	**2009.724**	NA	NA	NA	NA	**NA**	2009.724
2010	**2231.124**	NA	NA	NA	NA	**NA**	2231.124
2011	**1912.554**	NA	NA	NA	NA	**NA**	1912.554
2012	**1719.754**	NA	0.050	NA	NA	**0.050**	1719.704
2013	**1842.602**	NA	0.281	0.003	0.015	**0.299**	1842.303
2014	**1860.268**	NA	0.566	0.006	0.314	**0.887**	1859.381
2015	**1887.033**	NA	0.632	0.006	3.135	**3.773**	1883.260
2016	**1932.310**	4.251	0.706	0.007	5.110	**10.074**	1922.236
2017	**1978.718**	8.706	0.783	0.007	5.580	**15.077**	1963.642
2018	**2035.801**	13.436	0.868	0.007	5.656	**19.967**	2015.834
2019	**2094.596**	18.432	0.957	0.007	5.733	**25.128**	2069.468
2020	**2165.248**	21.652	1.055	0.007	5.809	**28.523**	2136.725
2021	**2253.207**	22.532	1.166	0.007	5.885	**29.590**	2223.617
2022	**2342.692**	23.427	0.128	0.007	5.961	**29.523**	2313.169
2023	**2430.414**	24.304	1.406	0.007	6.037	**31.754**	2398.660
2024	**2517.529**	25.175	1.533	0.007	6.113	**32.828**	2484.700
						Total cumulative reduction 2012 – 2024	**227.473 kt CO_2-eq.**

The Figure 4.7. represents the comparison between the baseline emissions under BAU scenario and the mitigation scenario GHG emissions.

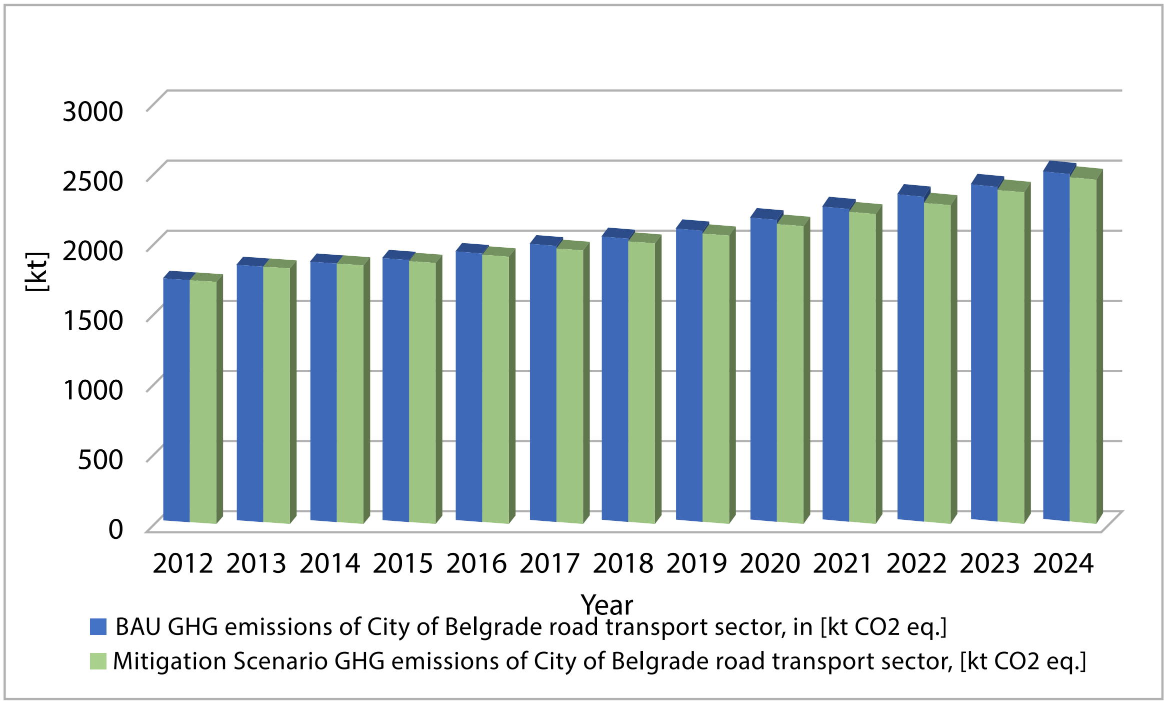

Figure 4.7. BAU and Mitigation Scenario emissions of the road transport sector of the city of Belgrade, 2013 – 2024, in kt-CO_2 eq.

From the assessment of the mitigation potential of the project components it can be concluded that the project mitigation potential is continuously increasing in the period 2012 – 2012, since the project components are gradually implemented. The initiative for promotion of the bicycle transport was implemented by the end of 2011 and beginning of 2012, so the first mitigation results are observed in 2012. The components Promotion on Eco-driving and Safe Ways to Schools have been completed in the last quarter of 2013, so the partial mitigation potential of these components is observed starting from the year 2013. The mitigation effects from the first project component, Provision of support for development of SUTP of the city of Belgrade are expected from the year 2016, when the plan is supposed to be adopted and implementation started.

4.4. Estimation of the potential indirect GHG mitigation potential of the project

All successful projects tend to catalyze replication by emphasizing capacity building,promotion of project activities and development of innovative approaches.

According to the GEF Methodology for calculating the GHG benefits of transportation projects, the GHG emission reductions that result from replication are referred to as “indirect” GHG impacts.They are counted separately from direct impacts because they occur outside the project logframe..

The potential replication of a project depends not only on its market potential, but also on project attributes that increase the potential of its replication. These can include the quality of the project design, the amount of co-benefits that project achieves, and activities designed specifically to encourage replication.

In the project framework, four additional technical papers for integration of Pedibus component in four additional primary schools in the City of Belgrade were done. The indirect GHG mitigation potential of the integration of the Pedibus programme in this schools with similar characteristics as St. Sava Primary School can bring an annual reduction of 0.026 kt of CO_2-eq.

Another indirect GHG emission reduction can be achieved trough the expansion and wider application of eco efficient driving techniques, for example on the total number of commercial vehicles in the city of Belgrade, including the heavy duty vehicles. This can bring an annual reduction of the city of Belgrade road transport sector GHG emissions of approximately 4kt CO_2-eq.

The possible establishment and implementation of integrated city transport management and control system, as part of the Sustainable Urban Transport Planning of the city of Belgrade, can bring an annual reduction of approximately 20kt of CO_2-eq per year.

The possible project replications in the cities Nis and Novi Sad, as cities similar in range and infrastructural management, can be evaluated as indirect GHG emission reductions of the project "Support to Sustainable Transport of the city of Belgrade". Based on the population data assessment, the possible project replication in the city of Nis would bring urban transport sector GHG emission reductions of approximately 2.7 kt CO_2-eq per year. The same estimation approach was used for the city of Novi Sad, and the potential GHG emission reductions are estimated on approximately 3.6 kt CO_2-eq. per year.

5. RECOMMENDATIONS FOR FURTHER DEVELOPMENT OF THE SUSTAINABLE TRANSPORT SYSTEM OF THE CITY OF BELGRADE

To support the citizen's needs and the economic prosperity of the urban community, each city government should implement the "sustainable management principles" in its urban planning activities and strategic plans. The integrated transport and the land use planning is the first step towards the constitution of environmental friendly and economically sustainable communities, with adequate capacity to meet the citizen's criteria and to support the urban mobility practices and needs.

The city of Belgrade has already done anenormous step towards its sustainable development pattern, but the constitution of the sustainable urban mobility shouldn't stop here, especially when the City Government has proven its capacity and competence to introduce new concepts and to raise initiatives for long term sustainable development.

Continuous monitoring and reporting of the project impact is needed in the forthcoming period in order to make sure that all stakeholders are continuously working together to achieve the full mitigation potential of the project components, as well as to support the development of new initiatives for sustainable mobility management.

Taking into account the cost benefit assessment of the measures, the component for implementation of the Eco-driving procedures in the public companies have been evaluated as component with biggest GHG mitigation potential and major economic benefits for the companies and users. To assure the implementation of the Eco-driving procedures in the public transport companies, the company management should continuously provide additional trainings for improvement and refreshment of the drivers' knowledge concerning the Eco-driving, as well as continuously monitor the fuel consumption by driver. Additionally, motivational encouragements as financial incentives, best driver achievements and working hour's benefits should be presented in order to achieve better results and to keep the drivers interested in integration of the Eco-driving procedures in their everyday work.

The Eco-driving principles and the monitoring system should be further more integrated in all public companies under the city of Belgrade, and moreover the local government should also support broader implementation of the Eco-driving procedures in the private sector trough financial subsidies and eco-transport labeling and certification.

The constitution of SUTP of the city of Belgrade should be continuously monitored and updated, and possible prioritization of the public transport in direction of dedicated bus lines and constitution of vehicle free zones should be underlined as most effective instruments for support of the environmental friendly transport modes. The main focus of the city of Belgrade development concept should be the prioritization of the active or NMT modes and maintenance and development of the bicycle infrastructure.

Finally, the long term development patterns which need to be considered by the local government is the implementation and promotion of so called "soft mobility measures", which are cost effective, and in the same time can bring significant benefits to the overall community and the governmental and national budget.

RECOMMENDATIONS

The following set of measures can be considered as a basic outline for development of sustainable transport systems in the urban communities:

- Coordinating land use and transport planning
- Promoting and improving collective transport
- Encouraging cycling and walking
- Urban freight management
- Parking management
- Traffic calming and reallocation of road space to most environmentally friendly vehicles and modes of transport
- Restricting access for the most polluting road vehicles (low emission zones)
- Fostering the use of cleaner, quieter and lower CO_2 road vehicles
- Soft and smart measures (car-sharing, business and school travel plans, mobility management centers, awareness raising campaigns etc.)

6. CONCLUSION

The soul of the city is not in the streets or buildings, but the interactions among people that take place on these streets. Lately, the social interaction and the comfort of the citizens which are living in the big cities are "taken away" by the increased urbanization, pollution, noise and congestion.

Long term existing cities as the city of Belgrade have tradition and resources to attract many people and to present a social and interaction center of the entire national population.

Many activities can be implemented to support the development of sustainable urban communities, but the most important aspect of the overall "sustainable development concept" relies on the integrated land use and urban transport planning and behavioral changes of the urban population.

The project "Support to Sustainable Transport of the City of Belgrade" is recognized as one of the first initiatives in the region which supported the local government in the identification and enlargement of sustainable urban transport policies and is also a pioneer concept which implements activities for constitution of long-term sustainable communities through emphasizing the environmental and climate change impact of the transport sector.

The GHG mitigation assessment of the project activities showed that in the assessment period 2012 – 2024 the project has a cumulative direct GHG mitigation potential of 227.473 kt of CO_2-eq, or a reduction potential of 0,84% of the cumulative forecasted baseline emissions under BAU for the city of Belgrade road transport sector.

The possible indirect GHG emission reduction of the project activities are estimated on approximately 30.3 kt CO_2-eq. per year, and are consisted of replication of the project activities in two more cities in R. Serbia, integration on the eco-driving procedures on all commercial vehicles in the city of Belgrade, replication of the Pedibus programme in four additional schools and constitution of integrated city transport management and control system.

There are many co benefits of the project implementation beside the environmental and climate change impact of the project activities; the project is addressing the inclusive mobility and social aspects, supports the national and the local economy, promotes the healthy lifestyle, educates the population and ultimately supports the urban transport efficiency and safety.

Finally, the"Support to Sustainable Transport of the city of Belgrade" project is a fundamental support to the long term development concept of the city of Belgrade, since the project components and activities are focused on each person in the community, and are systematically working on constitution of sustainable policies, strategic plans and healthy generations.

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