“JOINT INTEGRATED POLICY FOR LOW-CARBON ECONOMY IN CROSS-BORDER REGION”
Ref. No.CB006.1.11.165

Carbon footprint For Municipalities Blagoevgrad, Simitli, Strumiani, Kresna Sandanski and fifteen private entities

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CONTENTS

Abbreviations:

CORINAIR	Methodologyforpreparation ofnationalinventories ofatmospheric emissions
EU	European Union
GHGs	Greenhouse Gasses
IPCC	IntergovernmentalPanel on Climate Change
NGO	Nongovernmental organizations
LPG	Liquid petroleum gas
UNFCCC	UnitedNations Framework Convention on Climate Change
USAID	TheUnitedStatesAgency forInternationalDevelopment
FAO	FoodandAgriculture Organization

CHEMICAL SYMBOLS of GHGs

CO	carbon monoxide
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
CH_4	Methane
N_2O	nitrous oxide
NO_X	nitrogen oxides
NMVOCs	non-methane volatile organic compounds

INTRODUCTION

ABOUT THE PROJECT

The main objective of project “Joint Integrated Policy for Low-Carbon Economy in Cross-Border Region” of which this contract will be a part is to contribute directly to the transition of the Cross-Border Region’s Economy from Carbon-intensive to Low-carbon basis as a part EU effort to transition the Europe’s economy. To achieve this objective, the projects partners will implement a direct cross-border joint protection and monitoring of natural resources in 9 border municipalities, as well as creating prerequisite for Low-carbon Economy and Sustainable Development in this area. Joint analysis of carbon emissions in the region will show the real state of the Carbon Footprint (CO2 emissions) and Greenhouse Gases (GHG), also giving ideas about necessity for their reduction.

All of these activities aim to craft a Joint Policy for Low-carbon Economy, which could contribute by acting as guidance for the regional authorities and other stakeholders, towards transition to Sustainable Cross-Border Development.

To achieve this, a joint research activities, inventories, information and know how exchange will be implemented. Joint network will be established with participation of all stakeholders from both sides of the border, representing Public, Private and Civil Sectors. Additionally a system for coordination, information and experience exchange between the project municipalities will be jointly developed and joint workshops will be held on in Cross-Border Area. This way the project will contribute to establishment of direct contacts between the local actors in both border regions.

1. CARBON FOOTPRINT

In accordance with the scientific research worldwide, is has been proven that the greenhouse gas emissions resulting from different human activities have impact on global climate. The activities that are performed at local level also have their contribution, and for this reason it is important to calculate the carbon footprint of the local government buildings in the municipality an also is important to calculate the carbon footprint of private entities.

A **carbon footprint** is historically defined as the total set of greenhouse gas emissions caused by an individual, event, organization, or product, expressed as carbon dioxide equivalent. The carbon footprint of all individuals that represent the population of the five municipalities is impossible to be calculated. It is also impossible to be calculated the carbon footprint of every single private entity that is situated on the territory of the municipalities that are subject of the project activities. That is why for the purposes of the project was selected different approach. As a representative extract for the public entities,were selected the local government buildings and transport means that are owned by the municipalities and for the private sector were selected 15 companies.

To define the carbon footprint of the selected entities first have to be calculated the total greenhouse emissions, which is connected to the greenhouse gas inventory. This inventory simply represents localization of the sources of greenhouse gas and quantification of the resulting emissions by means of precisely determined methodology for their calculation.

The local self-government can use the date about the carbon footprint in order to evaluate the effectiveness of the measures undertaken for greenhouse gas reduction. Accurate, complete, relevant and consistent measurements or calculations of the carbon footprint will enable the municipality and the private sector to develop appropriate strategies for struggle with climate changes that would most effectively target the sources of such emissions.

Benefits of carbon footprint:

Risk management: Determination of the carbon footprint helps the local authorities and private organizations to cope with risks from climate changes more successfully, by undertaking early activities for reduction of emissions of greenhouse gases.

Addressing inefficiencies: The calculation of the carbon footprint can help the municipalities to increase the efficiency in the reduction of emissions, by means of accurate targeting of sources, implementation of new innovative technologies or application of more ecological methods.

Education and informing of the affected parties: The carbon footprint can help in the process of providing information for the management committee in the municipality, to educate the private sector and the public about the activities that contribute to the global warming and to the anticipated negative effects of the climate changes.

1.1. PREPARATION PROCESS OF THE CARBON FOOTPRINT

The preparation of the Carbon footprintis generally performed in three stages:

- Stage 1: Identification of the of greenhouse gas emissions by the private companies and the local government buildings and activities (buildings and transport) and collection of data by Preparation of Questionnaires, accordingly IPCC and EMEP/EEA air pollutant emission inventory methodologies (latest versions);
- Stage2: Calculation of the emissions by applying appropriate emission factors and calculated the CO2e;
- Stage 3: Making a report of the calculated carbon footprint.

Data is collected by means of a questionnaire that represents a guide for the stakeholders and contains directions about the type of data that needs to be collected. Also, official demands have been delivered to the municipality and the private sector, as well as questionnaires and surveys with the residents of the municipality and the private sector and from national databases. A tool has been created (in MS Excel) for calculation of the carbon footprint, where the emission factors have been predefined for each type of activity in the municipality.

The completed questionnaire, together with the references for the collected data, is delivered to the project expert on climate change. These data are further inserted in the tool for calculation, in order to get specific figures about the carbon footprint of the local government activities in the municipality and the carbon footprint of the private entities.

The report is prepared at the end of the process, where the sources of emissions are indicated and the quantity of greenhouse gases are represented in CO2e and are shown for the public and the private sector separately.

1.2. METHODOLOGY FOR CALCULATION OF THE CARBON FOOTPRINT

The carbon footprint is directly connected with the quantities of the greenhouse gas emitted in the atmosphere directly or indirectly by the local governments or by the private entities. That is whyin general, two types of data are required and necessary for calculation of the greenhouse gas emissions: *activity rate and emission factor*. The activity rate is a value which will describe the quantity of an energy-generating product, product or in any quantitative manner it will describe the source of emissions of greenhouse gases and the same refers to the intensity of the process under research. The emission factor is the already calculated relation between the quantity of the activity rate and the emissions of greenhouse gases. The emission factors are scientifically determined by means of direct measurement, laboratorial analysis or calculations made on representative sample. Therefore, for the purpose of calculation of the greenhouse gas emissions, the following basic formula applies:

Emissions= Activity rate X Emission factor

It must be noted that this formula gets its more complex form depending on the sector in question, if there are additional coefficients that should be applied in order to calculate the activity rate or the emission factor. The more complex form of the equation above can be also obtained when applying higher methodology of calculation (tier). The inventories, in regard to use of higher methodology, (tier) with use of specific emission factors that reflect the specific national conditions, are based on use of information that is specific for the municipality or the country (knowledge of the type of processes and the specific conditions in which they take place, the quality of fuels being used etc.).

The methodology for calculation of the greenhouse gas emissions is in accordance with the IPCC Guidebooks for preparation of greenhouse gas inventories and the IPCC Guidebooks for good practices. For the first time in Macedonia, the emissions are calculated according to this methodology at local level, which is also used for national inventorying of greenhouse gases. The emission factors are in accordance with the document "National emission factors for CO_2andnon-CO_2gasses for the key Sectors of emissions in the air pursuant to the IPCCand the CORINAIRmethodologies".

IPCC methods use the following concepts: Good Practice: In order to promote the development of high quality national greenhouse gas inventories collection of methodological principals, actions and procedures were defined in the previous guidelines and collectively referred to as good practice. The 2006 Guidelines retain the concept of good practice including the definition introduced with GPG2000. This has achieved general acceptance amongst countries as the basis for inventory development and says that inventories consistent with good practice are those which contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as practicable.

Tiers: A tier represents a level of methodological complexity. Usually three tiers are provided. Tier 1 is the basic method, Tier 2 intermediate and Tier 3 most demanding in terms of complexity and data requirements.

Tiers 2 and 3 are sometimes referred to as higher tier methods and are generally considered to be more accurate.

Default data: Tier 1 methods for all categories are designed to use readily available national or international statistics in combination with the provided default emission factors and additional parameters that are provided, and therefore should be feasible for all countries.

Key Categories: The concept of key category8 is used to identify the categories that have a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions and removals, the trend in emissions and removals, or uncertainty in emissions and removals. Key Categories should be the priority for countries during inventory resource allocation for data collection, compilation, quality assurance/quality control and reporting.

In the process of inventorying, the emissions from the direct (CO_2,CH_4,N_2O)and the indirect greenhouse gases (CO,NOx,SO_2) are calculated.The inventorying applies the potentials of the global warming from the IPCC (SAR) Second Assessment Report and they are shown in Table 1.

Table1. Potentials of global warming from the IPCC Second Assessment Report (SAR).

Greenhouse gas	The potentials of global warming CO2e
CO2	1
CH4	21
N2O	310

CARBON FOOTPRINT

2. CARBONFOOTPRINT OF THE PUBLIC SECTOR

2.1. SECTOR ENERGY-EMITTED CO2 BY THE ENERGY USED IN THE LOCAL GEVERNMENT BUILDINGS

The emissions of greenhouse gases and the carbon footprint from the sector of energetics will be calculated as a result of the consumption of electricity and fuels in the municipalities own buildings. The data taken from the International Energy Agency and according to the data from the national greenhouse gas inventory of the Republic of Bulgaria for production of electricity, divided by the total production of electricity in the country from all types of sources, an indicative value of 0.819 t CO_2-eq for each produced MWh of electricity is obtained.

Table2. Electricity consumption in the Municipalities owned buildings in Republic of Bulgaria

	Electricity Consumption MWhe	EF t CO2/MWhe	Emissions t CO2/MWhe
Blagoevgrad	5 708, 182	0.819	4675
Simitli	1081	0.819	885.33
Kresna	160	0.819	131.04
Strumiani	372	0.819	304.66
Sandanski	2100	0.819	1719

The total the carbon footprint from electricity consumption in the Municipalities owned buildings in the five municipalities for the 2016 are 7715.03 CO2 t/MWhe

2.2. TRANSPORTATION- CO2 EMITTED BY THE FUELS USED BY LOGAL GOVERNMENTS OWN AUTOMOBILS

Road transport is defined as a key category, as a result of the considerable amount of CO2 emissions from the use of diesel, gasoline, LPG presented below.

The transportation sector includes the greenhouse gas emissions of many types of transportation vehicles, such as cars, trucks, tractors, motorcycles etc. These transportation vehicles run on different types of fuels: gasoline, diesel and LPG, the use of which causes emission of greenhouse gases CO_2(carbon dioxide), CH_4(methane) andN_2O(nitrous oxide)as well as other gases(CO,NMVOCs,PM,NOx)which cause air pollution in the municipality. The greenhouse gas emissions can be calculated according to the used fuel on the territory of the municipality (the fuel sold at the petrol stations) or according to the mileage traveled by the vehicles in the municipality. The determination of the emission factors for $CO_2$is made by selecting the standard CO_2emission factors for each fuel type. For CH_4andN_2O, the applied emission factors are appropriate to the type of fuel and the type of vehicle. These emission factors are in accordance with the national selection of emission factors proposed in the document "National emission factors" for $CO_2$and non-CO_2gases for the key Sectors of emissions in the air pursuant to the IPCCandCORINAIRmethodologies".

A unique feature of the Bulgarian vehicle fleet is its age structure. In 2015 more than 86% from the vehicles are above 10 years old, while new vehicles (1 to 5 years) are 4% from the total and 11% are5 to 10 years old. Road transport has the biggest share in total fuel consumption in Transport subsector in the investigated municipalities. In 2015 road transport consumed 94.4% from the total energy in the sector.The most significant contributor to GHG emissions are passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. Passenger cars account for 65.1%, light-duty vehicles are responsible for 13.7%, and heavy duty vehicles (incl. buses) account for 20.9% of total GHG CO2e emissions, with the share of passenger cars increasing over the time series. The remaining 0.3% were shared among and mopeds and motorcycles.Whereas CO2 emissions are closely linked to fuel consumption, CH4 and N2O emissions are considerably impacted by engine technology and do not follow the trend in the fuel consumption. As it can be observed in the following figure N2O emissions and implied emission factors tend to fluctuate for the period of the inventory following the introduction to the market of different engine technologies implementing EURO emission standards and different fuel quality standards (e.g. lead and sulphur content).The CO2 emissions are best calculated based on the amount and type of fuel combusted and its carbon content. The emissions of CH4 and N2O are more difficult to be estimated accurately because emission factors depend on vehicle technology, fuel and operating characteristics.*Emission factors*

According to the IPCC guidelines, an emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity. Whereas, an implied emission factor (IEF) is defined as emissions divided by the relevant measure of activity:

IEF = Emissions / Activity data

IEF are not equivalent to the emissions factors for emissions calculations. IEF are more as of results providing average values for complex categories such as road transport, where the emissions are dependent on many parameters related to the vehicle fleet distribution.The emission factors used for the calculations of GHG emissions form road transport subsector are based on the algorithms of COPERT 4, version 11. The emission factors are internal parameters that depend both on the input data (e.g. average trip distance, driving and climatic conditions, etc.) and COPERT algorithms. However, COPERT model uses different emission factors for each vehicle category and technology. Thus, it is only possible to provide the implied emission factors which take into account the calculated emissions of greenhouse gases per fuel by the model related to the reported fuel consumption.

The decrease in the CH4 implied emission factor (IEF) for gasoline and diesel fuel is a result of the gradual increase in the number of vehicles that meet the standards set out in the EU directive on emissions from motor vehicles (mostly EURO 2 and EURO 3 vehicles), which slowly replaced the older technologies. It has to be noted, that in Bulgaria are mostly sold second hand vehicles, imported from Western Europe, which leads to a delay of the introduction of each new vehicle technology by 4 to 7 years compared to other countries. It is also a bit more complex to model the vehicle distribution matrix, since it is influenced both by the sales of new vehicles and by the imports of second hand vehicles. At the same time there is still a very large number of very old vehicles –the average vehicle age is much higher than in the other European countries. For calculation of the carbon footprint in the project area are used EF from the national report for inventarization of the GHG in Bulgaria for year 2014. The data that were collected includes the use of fuel by the local governments and the private sector.

Table 3. Emission factors for the sector of Transportation in Bulgaria– Road traffic

	Unit	Emission Factor CO2 t/tj	Emission Factor CH4 kg/tj	Emission Factor N20 kg/tj
Motor gasoline	kg/TJ	72.30	16.57	2.62
Diesel	kg/TJ	75.12	3.15	1.72

LPG	kg/TJ	65.95	13.37	2.88

Table4. Carbon footprint in CO2e of the fuel consumption of the local governments of the Municipalities in Bulgaria

Municipality	EF CO2 t/tj	EF CH4 kg/tj	EF N20 kg/tj	Fuel Consumption tj	Fuel types	Emiss. CO2 t/tj	Emiss CH4 kg/tj	Emiss N20 kg/tj
Strumiani	72.30	16.57	2.62	0.23	Gazoline	15.9	3.81	0.61
	75.12	3.15	1.72	0.36	Diesel	26.02	1.13	0.61
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Municipality	**EF CO2 t/tj**	**EF CH4 kg/tj**	**EF N20 kg/tj**	**Fuel Consumption tj**	**Fuel types**	**Emiss. CO2 t/tj**	**Emiss CH4 kg/tj**	**Emiss N20 kg/tj**
Kresna	72.30	16.57	2.62	0.43	Gazoline	3.11	0.71	0.11
	75.12	3.15	1.72	1.09	Diesel	82.03	3.44	1.87
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Municipality	**EF CO2 t/tj**	**EF CH4 kg/tj**	**EF N20 kg/tj**	**Fuel Consumption tj**	**Fuel types**	**Emiss. CO2 t/tj**	**Emiss CH4 kg/tj**	**Emiss N20 kg/tj**
Simitli	72.30	16.57	2.62	0.15	Gazoline	10.84	2.48	0.39
	75.12	3.15	1.72	2.17	Diesel	163.18	6.83	3.73
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Municipality	**EF CO2 t/tj**	**EF CH4 kg/tj**	**EF N20 kg/tj**	**Fuel Consumption tj**	**Fuel types**	**Emiss. CO2 t/tj**	**Emiss CH4 kg/tj**	**Emiss N20 kg/tj**
Blagoevgrad	72.30	16.57	2.62	n/a	Gazoline	n/a	n/a	n/a
	75.12	3.15	1.72	n/a	Diesel	n/a	n/a	n/a

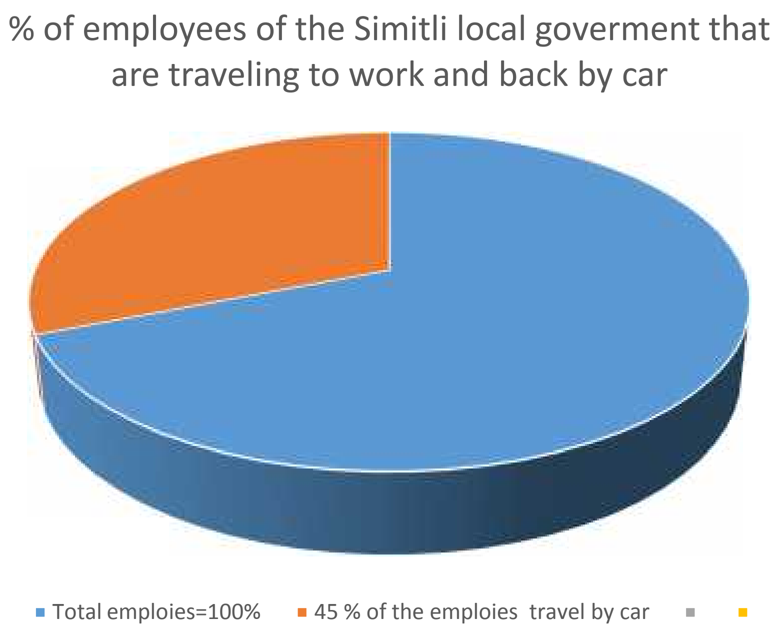
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Total all municipalities						301 CO2 t/tj	18 CH4 kg/tj	7.32 CH4 kg/tj
Total all municipalities in CO2e						301 CO2t/tj	0.4 CO2 t/tj	2.1 CO2 t/tj
Municipality	EF CO2 t/tj	EF CH4 kg/tj	EF N20 kg/tj	Fuel Consumption tj	Fuel types	Emiss. CO2 t/tj	Emiss CH4 kg/tj	Emiss N20 kg/tj
Sandanski	72.30	16.57	2.62	n/a	Gazoline	n/a	n/a	n/a
	75.12	3.15	1.72	n/a	Diesel	n/a	n/a	n/a
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Total all municipalities						301 CO2 t/tj	18 CH4 kg/tj	7.32 CH4 kg/tj
Total all municipalities in CO2e							0.4 CO2 t/tj	2.1 CO2 t/tj

n/a - the respondents did not provide information about this date

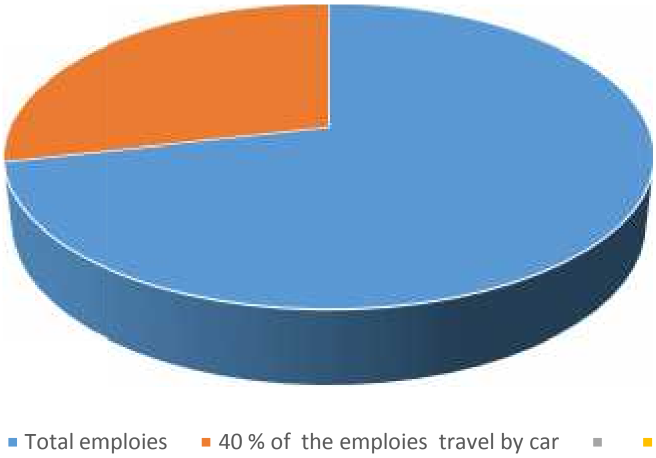
In total the carbon footprint of fuel consumption by the local governments for 2016 are 303 t CO2e

2.3. TRANSPORTATION- CARBON FOOTPRINT OF EMPLOIES THAT TRAVEL TO WORK AND BACK BY CAR

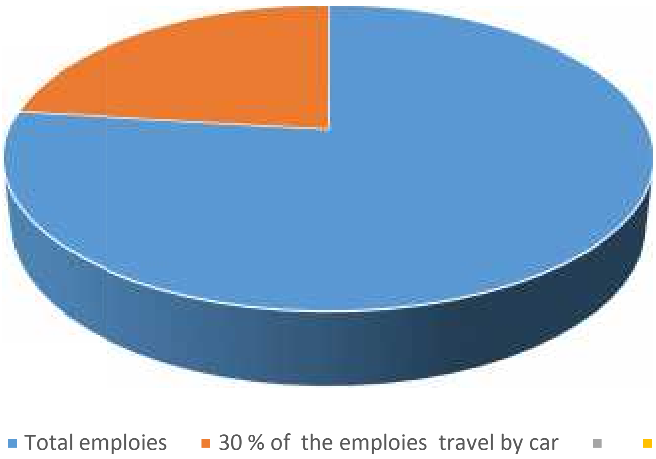
The number of employees in the local governments that travel by own car to work and back also is a source of Green gases emissions. The local governments did not have a date base with the total number of employees that travel with a car. That is why they are represented as a percent of the total employees. The distance that is covered to work and back also is given as an average value. There is no data about the fuel type neither the car type that are used by the employees to travel to work and back. Because of that is why to calculate the carbon footprint of this daily trips.were used an average values and a free carbon footprint calculator from **carbonfootprint.com**. For the purpose of the calculation was accepted that the average fuel consumption is 7l/100 km. and the fuel type is unknown. More over for the numbers of cars that are used for this daily trips was accepted the worst case scenario that every employees travel by own car. The total numbers of the employees that are traveling by car in the five municipalities is 467 . The average number of working days for one year is 260.

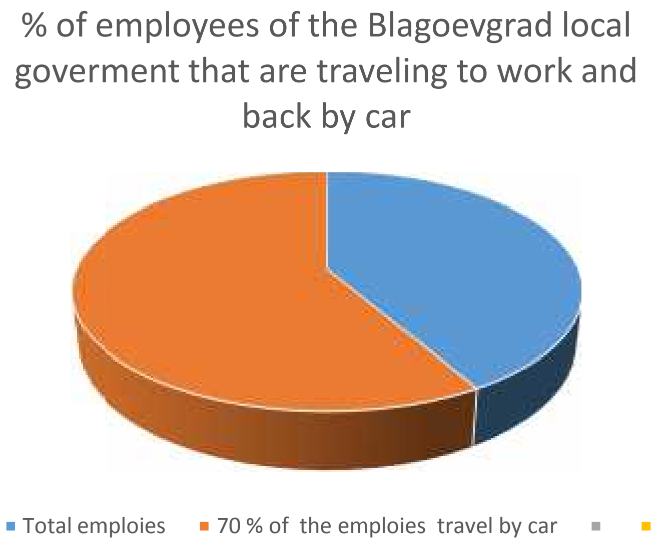

% of employees of the Simitli local goverment that are traveling to work and back by car
Total emploies=100%
45 % of the emploies travel by car

% of employees of the Strumiani local goverment that are traveling to work and back by car



% of employess of the Kresna local goverment that are traveling to work and back by car





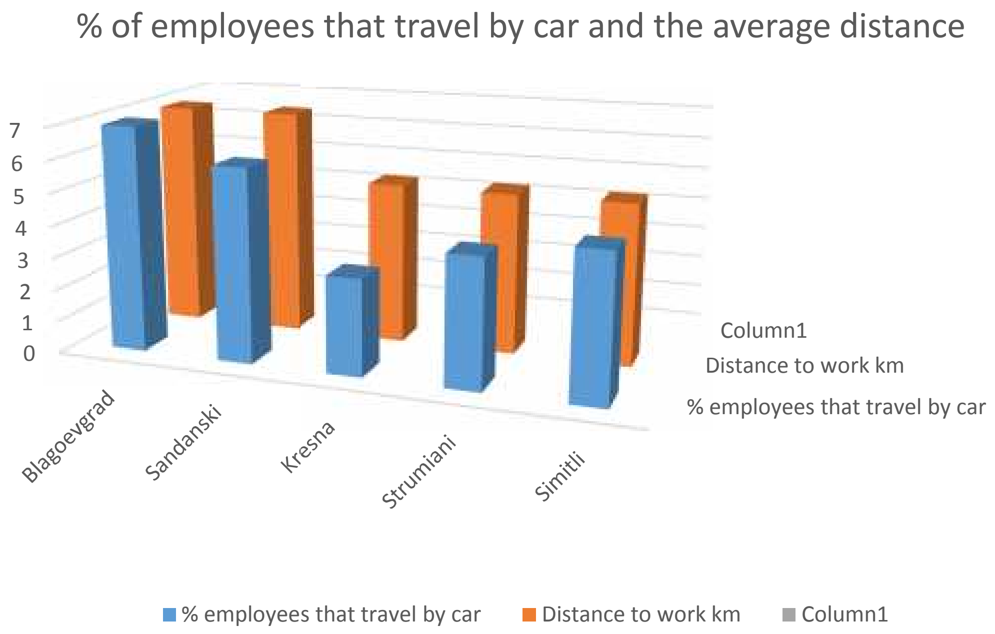


Table5. Emissions of CO2 emitted by daily trips of the local governments employees to work and back

	Number of employees That travel with car	Average distance Per day	Emissions t CO2 e/year
Blagoevgrad	300	7	84.02
Simitli	56	5	11.2
Kresna	20	5	4
Strumiani	35	5	7
Sandanski	150	6	36.01

The total the carbon footprint of the daily trips of the employees in the local governments are 142,23 t CO2e

In total the carbon footprint of the local governments activities for 2016 is 8160.26 t CO2e

3. CARBONFOOTPRINT OF THE PRIVATE SECTOR

3.1 SECTOR ENERGY-EMITTED CO2 BY THE ENERGY USED DUE TO OPERATIONAL ACTIVITIES IN THE PRIVATE COMPANIES.

The emissions of greenhouse gases and the carbon footprint from the sector of energetics are calculated as a result of the consumption of electricity and fuels due to operational activities of the selected companies. The data taken from the International Energy Agency and according to the data from the national greenhouse gas inventory of the Republic of Bulgaria for production of electricity, divided by the total production of electricity in the country from all types of sources, an indicative value of 0.819 t CO_2-eq for each produced MWh of electricity is obtained.

Table6. CO2 emissions from the electricity consumption of the private companies

All private companies	Electricity Consumption MWhe	EF t CO2/MWhe	Emissions t CO2/MWhe
Total	144.8	0.819	79

In Total the Carbon footprint of the electricity consumption due to operational activities for 2016 of the asked companies are 79 T CO2e

3.2. TRANSPORTATION- CO2 EMITTED BY THE FUELS USED BY PRIVATE COMPANIES OWNED AUTOMOBILS

Road transport is defined as a key category, as a result of the considerable amount of CO2 emissions from the use of diesel, gasoline, LPG presented below.
The transportation sector includes the greenhouse gas emissions of many types of transportation vehicles, such as cars, trucks, tractors, motorcycles etc. These transportation vehicles run on different types of fuels: gasoline, diesel and LPG, the use of which causes emission of greenhouse gases CO2 (carbon dioxide), CH4 (methane) and N2O (nitrous oxide) as well as other gases (CO, NMVOCs, PM, NOx) which cause air pollution in the municipality. The carbon footprintcan be calculated according to the used fuel on the territory of the municipality (the fuel sold at the petrol stations) or according to the mileage traveled by the vehicles in the municipality. The determination of the emission factors for CO2 is made by selecting the standard CO2 emission factors for each fuel type. For CH4 and N2O,the applied emission factors are appropriate to the type of fuel and the type of vehicle. These emission factors are in accordance with the national selection of emission factors proposed in the document "National emission factors" for CO2 and non-CO2 gases for the key Sectors of emissions in the air pursuant to the IPCC and CORINAIR methodologies".

A unique feature of the Bulgarian vehicle fleet is its age structure. In 2015 more than 86% from the vehicles are above 10 years old, while new vehicles (1 to 5 years) are 4% from the total and 11% are5 to 10 years old. Road transport has the biggest share in total fuel consumption in Transport subsector in the investigated municipalities. In 2015 road transport consumed 94.4% from the total energy in the sector.The most significant contributor to GHG emissions are passenger cars, followed by heavy-duty vehicles, light-duty vehicles and motorcycles and mopeds. Passenger cars account for 65.1%, light-duty vehicles are responsible for 13.7%, and heavy duty vehicles (incl. buses) account for 20.9% of total GHG CO2e emissions, with the share of passenger cars increasing over the time series. The remaining 0.3% were shared among and mopeds and motorcycles.Whereas CO2 emissions are closely linked to fuel consumption, CH4 and N2O emissions are considerably impacted by engine technology and do not follow the trend in the fuel consumption. As it can be observed in the following figure N2O emissions and implied emission factors tend to fluctuate for the period of the inventory following the introduction to the market of different engine technologies implementing EURO emission standards and different fuel quality standards (e.g. lead and sulphur content).The CO2 emissions are best calculated based on the amount and type of fuel combusted and its carbon content. The emissions of CH4 and N2O are more difficult to be estimated accurately because emission factors depend on vehicle technology, fuel and operating characteristics.*Emission factors*
According to the IPCC guidelines, an emission factor is defined as the average emission rate of a given GHG for a given source, relative to units of activity. Whereas, an implied emission factor (IEF) is defined as emissions divided by the relevant measure of activity:
IEF = Emissions / Activity data

Table7. Fuel consumption by the private companies

All private companies	Diesel Consumption Liters	Petrol Consumption Liters
Total In Tones	15.702	4.824

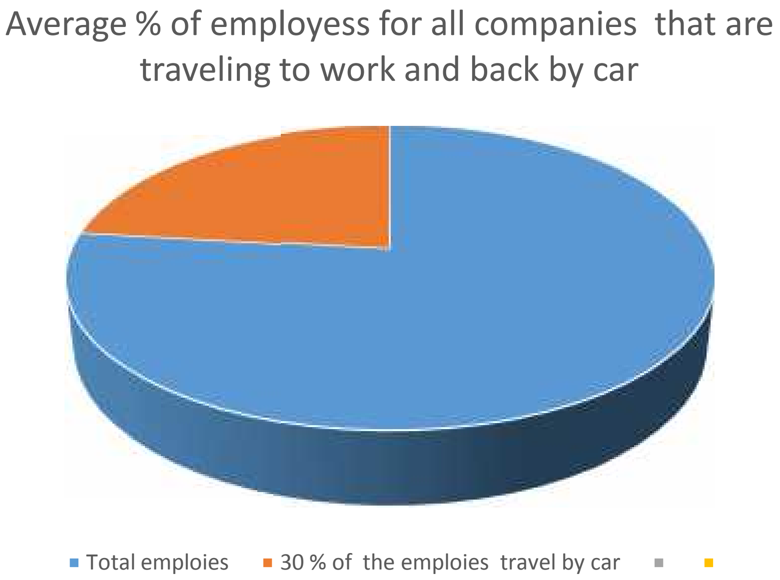
Table8. Carbon footprint of the fuel consumption by the private companies

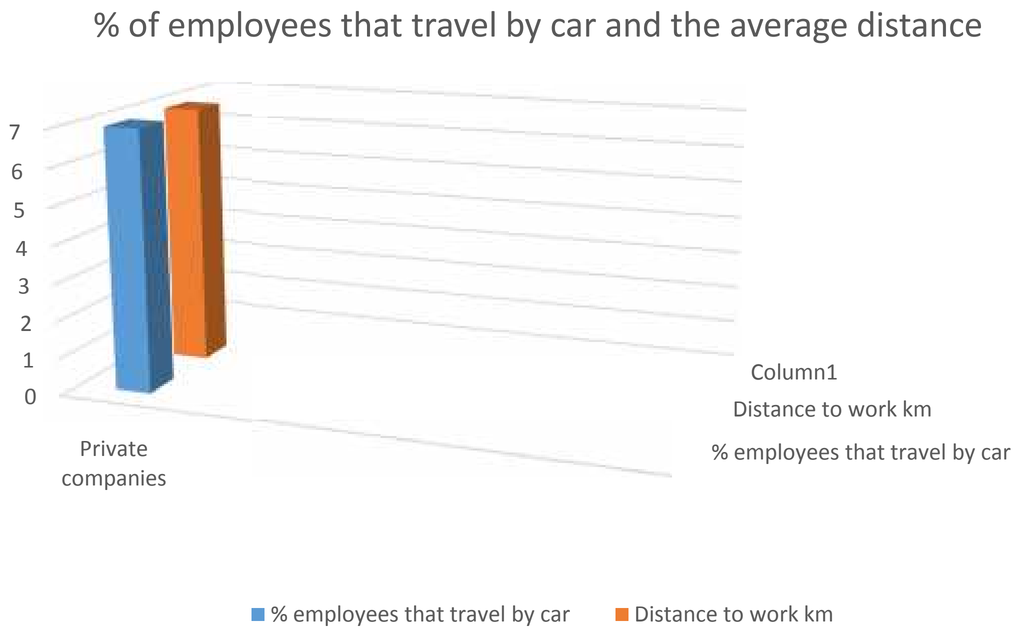
	EF CO2 t/tj	EF CH4 kg/tj	EF N20 kg/tj	Fuel Consumption tj	Fuel types	Emiss. CO2 t/tj	Emiss CH4 kg/tj	Emiss N20 kg/tj
All companies	72.30	16.57	2.62	0.20	Gazoline	14.4	3.3	0.52
	75.12	3.15	1.72	0.65	Diesel	48.8	2.04	1.11
	65.95	13.37	2.88	n/a	LPG	n/a	n/a	n/a
Total in t CO2e						63.2	0.11	0.5

In total the carbon footprint of the fuel consumption are 63.81 t CO2e

3.3. TRANSPORTATION- PERCENTS OF EMPLOIES THAT TRAVEL TO WORK AND BACK BY CAR

The number of employees in the presented companies that travel by own car to work and back also is a source of Green gases emissions. The private entities did not have a date base with the total number of employees that travel with a car. That is why they are represented as a percent of the total employees. The distance that is covered to work and back also is given as an average value. There is no data about the fuel type neither the car type that are used by the employees to travel to work and back. Because of that is difficult to calculate the carbon footprint of this daily trips.





In total the carbon footprint of the private companies operational activities for 2016 is 142.8 t CO2e.

CONCLUSION

Over the past century, atmospheric concentrations of carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and hydrogenated hydrocarbons, i.e. greenhouse gases, have increased as a consequence of human activity. Greenhouse gases prevent the radiation of heat back to space and cause warming of the climate. According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (AR4) (IPCC 2007)1, the atmospheric concentrations of CO2 have increased by 35%, CH4 concentrations have more than doubled and N2O concentration has risen by 18%, compared with the pre-industrial era. Changing climate has effects on both human and natural systems (e.g. human settlements, human health, water and food resources, ecosystem and biodiversity). Some of the effects on environmental and socio-economic systems will be beneficial, some damaging. The larger changes and the rate of changes in climate, the more adverse effects will predominate. In the examine area IN Bulgaria the adverse impacts are related, for example, the winter tourism, increased floodings and droughts and the prevalence of pests and diseases. Positive impacts could be possible growth of productivity in agriculture and forestry and decreased need for heating energy. According to the "Fifth National Communication of Bulgaria on Climate Change"2 from the year 2010 the average temperature in the country could rise. Extreme weather events, such as storms, droughts and heavy rains, are likely to increase. According to the HadCM33 model significant summer warming in the Western Balkan countries were projected for 2080. Air temperatures during this time of the year are expected to increase between 5°C and 8°C over most of the countries in the peninsula. Summer precipitation is projected to decrease in the region.

Acknowledging the importance of the climate change issue is the reason for building of GHG inventories for local governments. The results from the Questionnaires and analyses of the data collected have shown the low level of information that the local governments and the private companies possess about their carbon footprint.

According the results of this research the combined carbon footprint of the public and the private sector in CO2e is 8303.26 tCO2e. The public sector contributes with 8160 t CO2e and the private sector contribute with 142.8 t CO2e The biggest source of CO2 in the bough sectors is the electricity consumption with total emissions of 7794 tCO2e. Here the emissions of the public sectors are much bigger (7794 t CO2e) than the emissions of the private sectors (79 t CO2e). This is due to the higher number of employees that are employed in the municipalities and the bigger size of the public buildings. As a second biggest source of CO2 according the questionnaires are the emissions from fuel consumption that is associated with, public or private own transport means which are 366.81 tCO2e. In this category, again the carbon footprint of the public sector (303) is bigger than in the private sector (63.81). This is due to greater number of public own vehicles, the social services like public transportation and may be because of the more accurate date that were collected form the municipalities. In the public sector, also substantial quantities of CO2eare emitted by the daily trips of employees to work and back. The carbon footprint of this trips is equivalent to 142.23 tCO2e. It is difficult to be calculated the carbon footprint of this category in the private sector, or at least the numbers will be calculated with great uncertainty, that is why they are not presented in this enquiry.

Usually worldwide the electricity consumption's and fuel consumption are the biggest contributors to the carbon footprints of public or private entities, which turn out to be also correct in this research. The public and the private sector should take curtain measures to reduce the use of electricity and consumption of petrol fuels as well. They can use electricity efficient bulbs or invest in roof types solar electricity installations. This can reduce the electricity consumption and increase the share of the renewable energy in the energy mix. To reduce the carbon footprint of the fuel consumption both the private and the public sector can substituted the Diezel and Petrol with LPG for example or switch to hybrids or electricity driven cars which are more suitable for short distance trips or town traffic. More over the private or the public sector should encourage with bonuses their employees to use the public sector for going to work or which is even better to use bicycles or going on foot.

LITERATURE AND REFERENCES

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