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METHODOLOGY FOR TOURISM SECTOR GHG EMISSIONS ACCOUNTING IN MONTENEGRO

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Acronyms

CH_4	Methane
CO_2	Carbon dioxide
CO_2e	CO_2-equivalents
DEFRA	Department for Environment, Food & Rural Affairs
EE-IOA	Environmentally Extended Input-Output Analysis
FOD	First order decay
GEF	Global Environment Facility
GHG	Greenhouse gas
GHG SSRs	Greenhouse gases sources, sinks and reservoirs
GWP	Global warming potential
ISO	International Organization for Standardization
IPCC	Intergovernmental Panel on Climate Change
LCA	Life-cycle analysis
MRV	Measuring, reporting and verification
MSW	Municipal solid waste
N_2O	Nitrous oxide
SNC	Second National Communication on Climate Change
SWD	Solid waste disposal
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
UNWTO	United Nations World Tourism Organization
WTTC	World Travel & Tourism Council

EXECUTIVE SUMMARY

In recent years, Montenegro's tourism sector has experienced a rapid development with an increase in the number of visitors and investments, becoming the main and most dynamic economic sector. As a major contributor to the country's GDP, is one of the strategic drivers of economic growth. As a result of this state of affairs, Montenegro's government has decided to curb the sector's emissions and seek its low carbon development.

In this context, Montenegro's Ministry of Sustainable Development and Tourism and the United Nations Development Programme (UNDP) launched the "Towards Carbon Neutral Tourism in Montenegro" project, with the immediate target of maintaining tourism sector related GHG emissions at the 2013 level. In order to assess the progress on the carbon intensity of the sector, a comprehensive methodology for tourism related GHG emissions accounting has been developed.

An analysis of the most relevant methodologies for GHG emissions calculation, i.e. top-down, bottom-up and hybrid approaches, offers the following results:

	Top-down	Bottom-up	Hybrid
Calculation method	EE-IOA	LCA	EE-IOA and LCA
Entity size	Large: global, national, regional.	Small: organization, process, activity.	Medium: sectorial, large organizations, industries
Pros	▪ Low quantity of data required: economic data (flow of products in monetary terms), GHG inventory or energy balances.	▪ Physical units. ▪ High-medium accuracy (depending on scope).	▪ Medium quantity of data required: Activity data, economic data, emission factors and GHG inventory or energy balances.
Cons	▪ Monetary units. ▪ Medium-low accuracy.	▪ High quantity of data required: activity data, emission factors.	▪ Monetary and physical units. ▪ Medium accuracy.

The selection of the methodological approach is highly dependent on the availability of data. The preferred approach in terms of accuracy of the results is a bottom-up approach. However, after the field visit and the study of the data obtained, a hybrid approach has been chosen.

The methodology presented in this document allows the yearly calculation and monitoring of the GHG emissions from the tourism sector in Montenegro. It is designed taking into account the data availability.

The scope of the calculation methodology is the emissions generated by the tourism sector of Montenegro. The accounted emissions are those generated by tourist, either foreign or domestic, within Montenegro and those originated by means of transport to reach the country, in a year of inventory. The detailed sources of GHG emissions considered are the following:

IN-COUNTRY EMISSIONS	OFF-COUNTRY EMISSIONS
Accommodation and other services: o Accommodation services. o Food and beverage services. o Travel agencies services. o Cultural services. o Sport and recreational services.	
Road transport	Road transport
Railway transport	Railway transport
Air transport: o Airports	Air transport: o Flights
Ship transport: o Inland navigation o Cruises at berth	Ship transport: o Maritime navigation
Waste o Solid waste o Wastewater	

In addition, the Consortium has identified the key stakeholders related to tourism GHG emissions accounting, in order to have a meticulous understanding of who is doing what, their needs and lacks in order to be able to improve their omissions in the sector through capacity building program.

Stakeholder	Location	Priority category
National Stakeholders		
Ministry for Sustainable Development and Tourism	Podgorica	Primary beneficiary
Environmental protection Agency (EPA)	Podgorica	Primary Beneficiary
Statistical Office of Montenegro (MONSTAT)	Podgorica	Primary Beneficiary
Ministry of Transport and Maritime Affairs	Podgorica	State Body
Ministry of Interior	Podgorica	State Body
Police Authority	Podgorica	State Body
National Tourism Organisation of Montenegro	Podgorica	Organisation directly involved in sustainable tourism and climate issues
Ministry of Economy	Podgorica	State Body involved in energy strategy
Port authority	Kotor	Project input
Railway Directorate	Podgorica	Project input
Local/Private Stakeholders		
Municipalities	-	Interested party
Hotel Association representatives	-	Private
Transport providers	-	Private

To guarantee that robust data collection will last only during the duration of the project but for future GHG sectorial assessment work in the sector of tourism as well, the

Consortium has proposed to set up an ‘Emissions Working Group’ (or ‘National Experts Network’) containing at least the primary beneficiary representatives listed above. This instrument stands for an effective way to ensure that stakeholders responsible for GHG data provision would have a forum to share data, to enhance their understanding of its use and to engender a sense of shared ownership. This would be a Group that could be taken forward beyond the life of this project and then could be chaired by Ministry for Sustainable Development and Tourism.

1. PRESENTATION

The main goal of this report is to analyse the existing methodologies and define the methodology to be used for the calculation and monitoring of the tourism's greenhouse effect gases (GHG) emissions in Montenegro.

An analysis of the most relevant methodologies for GHG emissions calculation is performed. Additionally, the previous experience of GHG emission baseline from Montenegro's tourist sector calculation is analysed. These analyses allow to define a methodological approach for the GHG emissions calculation.

This approach is presented in detail, including the data required and the equations to use for each sector, as wells as recommendations on how to improve the quality of the data and the results.

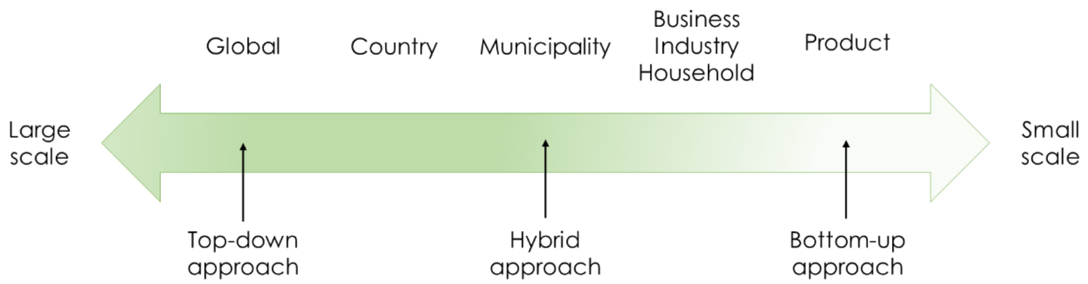
Finally, a proposal for a training programme on the use of the methodology is presented.

2. METHODOLOGICAL APPROACH

2.1. GHG emissions calculation: Top-down vs Bottom-up

The methodology for calculating the GHG emissions of any entity depends highly on its size (global, country, sector, municipality, company, etc.) and the data availability.

Figure 1: Methodological approaches to GHG emission calculation on different scales of application.
Source: Own elaboration based on Wu, 2011.



The three most common methodologies for the calculation of GHG emissions are the top-down approaches, the bottom-up approaches and the hybrid approaches.

The top-down approach is used for large entities as countries, regions or sectors. The main method is the one based on the work of Wassily Leontief, the Environmentally Extended Input-Output Analysis (EE-IOA). It uses input-output tables describing how industries are interrelated through producing and consuming intermediate industry outputs as represented by monetary transactions between industries (Joint Research Centre, 2006). It can be extended with environmentally related information, such as GHG emissions, making possible to obtain coefficients of GHG emissions per monetary unit of production in each sector (turnover). The emissions are obtained through national or regional energy balances. Essentially, this top-down approach distributes the known total emissions generated by an entity over different final expenditure categories.

The EE- IOA method presents two main disadvantages: 1) the relatively coarse schematization of the economy in input-output models (whereby economic activities with rather different natural resource use and emission intensities are part of one sector) and 2) the approximation of (often unknown) physical flows between sectors by the (known) inter-sector monetary flows (which ignores the fact that traded goods and services between sectors are not homogeneous) (Ercin & Hoekstra, 2012). These disadvantages lead to less accurate results in comparison to other approach such as bottom-up.

The bottom-up approach is indicated for smaller entities such as companies, households or products and is based on the Life-Cycle Analysis (LCA). It requires the gathering of activity data related to the processes encompassed in the scope, which must be predefined. These activity data have to be translated into GHG emissions through emissions factors (amount of GHG per unit of referred activity). Although the bottom-up approach produces results with a relatively high level of precision, it demands high quantity of data for medium or large entities. In addition, the arbitrary definition of system boundaries that bottom-up approaches require might cause that relevant emissions are ignored.

The hybrid approach combined the use of EE-IOA and LCA, allowing completing gaps in process and activity data using information provided by the analysis of input-output tables. Through applying different approach to different parts of the analysis, advantages of both approaches like completeness and specification can be achieved while deficiencies of both approaches like aggregated uncertainty and truncation error can be reduced. Although hybrid approaches can reduce the systematic truncation problem, the question of locating the boundary between the LCA and the EE-IOA system remains (Wu, 2011).

Table 1. Baseline calculation approaches summary.
Source: Own elaboration.

	Top-down	Bottom-up	Hybrid
Calculation method	EE-IOA	LCA	EE-IOA and LCA
Entity size	Large: global, national, regional.	Small: organization, process, activity.	Medium: sectorial, large organizations, industries
Pros	▪ Low quantity of data required: economic data (flow of products in monetary terms), GHG inventory or energy balances.	▪ Physical units. ▪ High-medium accuracy (depending on scope).	▪ Medium quantity of data required: Activity data, economic data, emission factors and GHG inventory or energy balances.
Cons	▪ Monetary units. ▪ Medium-low accuracy.	▪ High quantity of data required: activity data, emission factors.	▪ Monetary and physical units. ▪ Medium accuracy.

2.2. Previous GHG baseline calculation: Towards a Carbon Neutral Tourism in Montenegro

A previous GHG emission baseline of the tourism sector in Montenegro was calculated for the year 2013 within the UNDP-GEF Project *Towards a Carbon Neutral Tourism in Montenegro*, resulting in 83.38 kt CO_2e. The baseline included the emissions from energy use in tourist accommodation, in-country road transport, by cruise ships staying at harbours and other tourism-related infrastructure (in particular from airports).

Table 2. Summary of Baseline GHG emissions from Montenegro's in-country tourism activities.
Source: *Towards a Carbon Neutral Tourism in Montenegro*.

Estimated in-country baseline emissions in 2013	kt CO_2e
Accommodation	45.24
In-country travel by car	20.30
Cruise ships at harbour	16.62
Others (airports)	1.21
Total	**83.38**

The calculation was perform using a bottom-up approach, in which data gaps were filled with estimations and assumptions of the authors. The use for each of the categories is shown in the next table:

Table 3. Summary of data used to calculate the GHG emissions baseline from Montenegro's in-country tourism activities.
Source: Own elaboration based on *Towards a Carbon Neutral Tourism in Montenegro*.

Subsector	Data used
Accommodation	• Number of overnight stays (real). • Average energy consumption per overnight stay: electricity, fuel oil, LPG, coal (estimations). • Emission factors (real).
In-country travel by car	• Annual number of visiting tourists (real). • Average in country travel (estimation). • Emissions per kilometre (estimation).
Cruise ships at harbour	• Average power demand (electricity) of cruise ships when staying at ports (estimation). • Average duration of stay (estimation). • Emission factor of electricity generation by using ships' own engines (estimation). • Number of visiting ships in 2012 (real).
Others (airports)	• Annual energy consumption (electricity, motor fuels) of Podgorica and Tivat airports (real). • Emission factors (real).

2.3. Conclusions on the methodological approach

After analysing the different approaches, it is clear that the selection of the methodological approach is highly dependent on the availability of data. Becken and Patterson (2006), in their study on GHG emissions of tourism in New Zealand, advocate applying both a bottom-up as well as a top-down approach to estimate a country's tourism CO_2 emissions. The preferred approach in terms of accuracy of the results is a bottom-up approach. However, after the field visit and the study of the data obtained, a hybrid approach has been chosen, as suggested by Becken and Patterson.

2.4. General considerations to develop methodology

Climate change affects tourism in various ways. Among the more noticeable adverse impacts affecting Montenegro are the decreasing of natural snow cover in winter sport destinations, sea level rise, coastal erosion and increase in floods with related damages to people and touristic villages (IPCC, 2007). However, tourism also contributes to climate change through the emission of GHGs in particular through transport, accommodation and other tourist activities. As a result, the tourism industry has a growing self-interest and it is under increasing pressure to act on climate change (Scott et al., 2008).

Moreover, Tourism is defined by the UN World Tourism Organization as ''the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited'' (Eurostat/OECD/WTO/UNSD, 2001, paragraph 1.1). It is important to note that business travel, which is not perceived as tourism in the public, is included in this official definition.

Indeed, Montenegro has registered an increasing percentage of visitors and investments in this sector as it is demonstrated by statistic data with more than 1.3 million tourists arrivals into the country in 2011 in comparison to 120.000 in 2002. These numbers show the great contribution that tourism is giving to GDP representing now 17.2% of the total. On the other hand, it is directly responsible of a share of GHG emissions, including its related subsectors which are transport, accommodation, waste and other linked activities.

However, and apparently in contradiction to what stated above, Tourism is not measured and considered in the national GHG inventory in its own right neither as a separate energy end-use sector nor the related subsectors in terms of GHG emissions deriving from tourism activities. Indeed, it cannot be defined as an output, but mainly as a demand-defined industry. Therefore, even if the national Accounts present results for transportation, entertainment services and accommodation individually they give no information on which shares are consumed by tourists. Consequently, the National Inventory does not include GHG intensities for tourism, quoted data cannot be used directly and therefore they must be disaggregated and in some cases, assumptions are needed due to the lack of sectorial information.

In other contexts, on the contrary, both the economic importance of tourism as well as its negative impacts on the environment have been studied and measured. For example, Economic impacts have been measured by means of surveys on spending and earnings among tourists and tourism service providers as well as economic methods including input–output analyses, multiplier analyses and general equilibrium models (Dwyer et al., 2004; Serio-Silva, 2006; Yuan, 2001). Environmental impacts of tourism and their measurement have also received widespread attention. Impacts have been described on local, regional, national and global level, in the developed as well as the developing world. Quantitative indicators used include the amount of GHG (Becken & Simmons, 2002; Forsyth et al., 2008) as well as the ''ecological footprint'' to measure the aggregate environmental impact of tourism (Gössling et al., 2002; Hunter, 2002; Hunter & Shaw, 2007).

2.4.1. Tourism sector

It is important to note that it is the tourism sector being investigated and not the tourists or tourism as an activity. The Value added is generated by the sector, which means that the emissions of the whole sector and related sub sectors in connection with its value added need to be taken into account. In this study, the term ''tourism sector'' encompasses the ''characteristic tourism industries'' accounting for the largest part of the gross value added and emissions and therefore, the ''connected'' tourism industries are not considered (e.g. retail trade, schools, hospitals, banks).

2.4.2. Transport sub-sector

To limit the increase in global mean temperature to between 2 and 2.4 8C worldwide GHG emissions must be reduced by 50–85% by 2050 compared to 2000 (IPCC, 2007b). For developed countries with more responsibility and capability, the reduction goal lies higher. Given the fact that in most of the developed countries 50–85% of tourism emissions are caused by air transport, the tourism sector can only achieve this reduction goal with a major cut of emissions in air transport.

Focussing on transport emissions, there are four options to reduce the GHG emissions of tourism (based on Peeters and Schouten, 2006):

a) Reducing GHG emissions per person kilometer travelled;
b) Shifting towards transport modes with less GHG emissions (i.e. from air and water to land transport);
c) Reducing travel distances by promoting domestic and short-haul markets;
d) Extending the length of stay.

In Montenegro, instead, the problem is not directly linked to air transport, but to traffic in general and in particular to road traffic. According to previous analysis developed in the framework of a GEF funded project[1] Tourism's GHG emissions are clearly dominated by the emissions from transport where local transport accounted for 20.30 kt CO_2e, 24% of total emissions. Meanwhile cruise ships at harbour for 16.62 kt CO_2e and airport for 1.21 kt CO_2e. If tourism were only considered from the land-based perspective, total emissions would thus be approx. 65.55 kt CO_2e, 31% of it corresponding to land transport (excluding international aviation emissions, BAFU, 2007). Indeed, as it emerges from the Consortium updated baseline review, the values related to transports are the followings:

Emissions summary (t)	CO_2	CH_4	N_2O	CO_2e
Road transport	***39,242***	***5.7***	***0.3***	**39,487**
Off-country road transport	21,480	3.1	0.2	21,614
In-country road transport	17,762	2.6	0.2	17,873
Railway transport	***660***	***0.1***	***0.3***	**741**
Off-country rail transport	39	0.0	0.3	116
In-country rail transport	621	0.1	0.0	625
Air transport	***325,587***	***23.5***	**2.8**	**327,000**
Flights	324,113	23.3	2.7	325,516
Airports	1,474	0.2	0.0	1,484
Ship transport	***62,247***	***10.4***	***0.6***	***62,673***
Maritime navigation	56,431	8.2	0.5	56,784
Cruises at berth	5,001	0.7	0.0	5,032
Inland navigation	815	1.4	0.0	857
Total	**427,736**	**39.7**	**3.9**	**429,901**

[1] Cfr. Towards Carbon Neutral Tourism (TCNT)

3. METHODOLOGY FOR TOURISM SECTOR GHG EMISSIONS ACCOUNTING

The following methodology allows the yearly calculation and monitoring of the GHG emissions from the tourism sector in Montenegro. It is designed taking into account the data availability. At the same time, it provides with recommendations to improve the data sets, as well as calculation options to calculate GHG in case these recommendations are followed and higher quality data is available. In this sense, in some cases two option are offered:

Applicable approach: the calculation approach applicable with the current data sets available. Offers lower accuracy and requires more use of assumptions.

Optimal approach: the calculation approach applicable in case certain data sets are improved. Requires a higher level of data quality than the *applicable approach*, but provides a higher level of accuracy and lower uncertainty.

3.1. Scope

The scope of the calculation methodology is the emissions generated by the tourism sector of Montenegro. The accounted emissions are those generated by tourist, either foreign or domestic, within Montenegro and those originated by means of transport to reach the country, in a year of inventory.

The definition of tourism considered for the calculations is the one provided by the United Nations World Tourism Organization: "Tourism is defined by the activities of persons identified as visitors. A visitor is someone who is making a visit to a main destination outside his/her usual environment for less than a year for any main purpose [including] holidays, leisure and recreation, business, health, education or other purposes" (UNWTO, 2010).

The detailed sources of GHG emissions considered are the following:

Table 4. Sources of GHG within scope.
Source: Own elaboration.

Geographical distribution	Sector	Source
IN-COUNTRY EMISSIONS	Accommodation and other services	Fuel consumption by tourists in: • Accommodation services. • Food and beverage services. • Travel agencies services. • Cultural services. • Sport and recreational services. • Other services.
	Road transport	Fuel consumption of vehicles used for tourists transportation within Montenegro.
	Railway transport	Fuel and electricity consumption due to tourists using the railway system within the Montenegro.
	Air transport	Fuel and electricity consumption in land activities and airport facilities due to tourists visiting Montenegro.
	Ship transport	Fuel and electricity consumption due to: • Inland navigation for tourists transportation. • Cruises at berth.
	Waste	Degradation of waste generated by tourists during their stay in Montenegro: • Solid waste • Wastewater
OFF-COUNTRY EMISSIONS	Road transport	Fuel consumption of vehicles used for foreign tourists transportation from origin country to Montenegro and back.
	Railway transport	Fuel and electricity consumption due to foreign tourists using the railway system from origin country to Montenegro and back.
	Air transport	Fuel consumption of planes due to foreign tourists transportation from city of origin to Montenegro and back.
	Ship transport	Fuel consumption of ships used for foreign tourists transportation from origin country to Montenegro and back.

The GHGs within the scope of the methodology are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O). The three of them are converted into CO_2 equivalents (CO_2e) using the global warming potential (GWP) established by the IPCC for a time horizon of 100 years in the 4th Assessment Report:

Table 5. Global warming potential of GHG.
Source: Own elaboration based on IPCC.

	CO_2	CH_4	N_2O
GWP 100-yr	1	25	298

3.2. Methodological approach

The methodological approach to calculate the GHG emissions is a hybrid approach, combining both top-down and bottom-up approaches. The first one correlates economic data with emissions, through energy consumption of the economic sectors. The bottom-up utilizes activity data related to the sector in study and translates them into GHG emissions through emission factors. Which approach to use varies depending on the sector, as well as on the data availability.

Table 6. Methodological approach per sector.
Source: Own elaboration.

Sector	Subsector	Methodological approach: Applicable	Methodological approach: Optimal
Accommodation and other services	Accommodation services.	Hybrid	Bottom-up
	Food and beverage services	Top-down	Bottom-up
	Travel agencies services.		
	Cultural services.		
	Sport and recreational services.		
Road transport	In-country	Top-down	Bottom-up
	Off-country	Bottom-up	Bottom-up
Railway transport	In-country	Top-down	Bottom-up
	Off-country	Bottom-up	Bottom-up
Air transport	Flights	Bottom-up	Bottom-up
	Airports		
Ship transport	Inland navigation	Top-down	Bottom-up
	Maritime navigation	Bottom-up	Bottom-up
	Cruises at berth		
Waste	Solid waste	Bottom-up	Bottom-up
	Wastewater		

3.1. Emission factors

The emission factors used for the calculations are those derived from the National Inventory Report (NIR) of Montenegro. In case of lack of specific emission factors, default emission factors from other sources are used (e.g. 2006 IPCC Guidelines or the UK Department for Environment, Food & Rural Affairs, DEFRA). For the detailed list and values of emission factors, see Annex I.

3.2. General equation

The general equation of the GHG emissions generated by the tourism sector in Montenegro for an inventory year is:

Equation 1. General equation of GHG emissions from tourism sector.
Source: Own elaboration.

$$Total\ emissions_{CO_2e} = \sum [(Accom\&other_{GHG} + Road_{GHG} + Rail_{GHG} + Air_{GHG} + Ship_{GHG} + Waste_{GHG}) \cdot GWP_{GHG}]$$

Where:

Total emissions$_{CO2e}$ = total CO_2e emissions from Montenegro's tourism sector (t CO_2e)

Accom&other$_{GHG}$= total emission of given GHG from tourist accommodation and other services (t GHG).

Road$_{GHG}$= total emission of given GHG from tourists road transportation (t GHG).

Rail$_{GHG}$= total emission of given GHG from tourists railway transportation (t GHG).

Air$_{GHG}$ = total emission of given GHG from tourists air transportation (t GHG).

Ship$_{GHG}$ = total emission of given GHG from tourists ship transportation (t GHG).

Waste$_{GHG}$ = total emission of given GHG from tourists' waste treatment (t GHG).

GWP = global warming potential of given GHG.

3.3. In-country emissions

3.3.1. Accommodation and other services

➢ **Applicable option**

The calculation of the GHG emissions from accommodation and other services for tourists include the calculation of emissions from:

- Accommodation:
  - Collective accommodation establishments: hotels, boarding houses, motels, tourist resorts, etc.).
  - Private accommodation establishments: rooms, apartments, houses.
- Other services:
  - Beverage and food services.
  - Travel agencies services.
  - Cultural services.
  - Sport and recreational services.

The calculation is performed using a hybrid approach. For the accommodation in collective facilities and the other services a top-down approach is used, while for accommodation in private facilities (apartments, rooms, etc.) a bottom-up approach is used.

The general equations to calculate the GHG emissions from collective accommodation and other services are:

Equation 2. GHG emissions from fuel combustion in accommodation and other services.
Source: Own elaboration.

$$Emissions_{GHG,fuel} = \sum Fuel\ consumption_{fuel\ i} \cdot Emission\ factor_{GHG,fuel\ i}$$

Where:

Emissions$_{GHG,fuel}$ = emission of given GHG from fuel combustion in accommodation and other services (t GHG).

Fuel consumption$_{fuel\ i}$ = amount of fuel type i consumed in collective accommodation and other services (TJ).

Emission factor$_{GHG,fueli}$ = emission factor of a given GHG for fuel type i (t GHG/TJ).

Equation 3. GHG emissions from electricity consumption in accommodation and other services.
Source: Own elaboration.

$$Emissions_{GHG,electricity} = Electricity\ consumption \cdot Emission\ factor_{GHG,electricity}$$

Where:

Emissions$_{GHG,electricity}$ = emission of given GHG from electricity consumption in collective accommodation and other services (t GHG).

Electricity consumption = electricity consumed in accommodation and other services (GWh).

Emission factor$_{GHG,electricity}$ = emission factor of a given GHG for the electricity generation mix (t GHG/GWh).

Collective accommodation and other services

The energy consumption of services and other sectors is correlated with the gross output of all the services activities in Montenegro, obtaining the energy intensity of services. These data are used with a calculation of the mean expenditure of tourists in each service to obtain the final energy consumption of each of them.

Equation 4. Energy intensity of services (fuel).
Source: Own elaboration.

$$Energy\ intensity_{services;fuel\ i} = \frac{Consumption\ fuel\ i_{services}}{Gross\ output}$$

Where:

Energy intensity$_{services;\ fuel\ i}$ = energy intensity of services for fuel type i (TJ/mill €).

Consumption fuel i$_{services}$ = consumption of fuel type i for the category "Other sectors" in the energy balances (TJ).

Gross output$_{services}$ = total gross output of services activities (categories F, G and from I to R) for the year of inventory (mill €).

Equation 5. Energy intensity of services (electricity).
Source: Own elaboration.

$$Energy\ intensity_{services;electricity} = \frac{Consumption\ \ electricity_{services}}{Gross\ output_{services}}$$

Where:

Energy intensity$_{services;\ electricity}$= energy intensity of services for electricity (GWh/mill €).

Consumption electricity$_{services}$ = consumption of electricity for the category "Other sectors" in the energy balances (GWh).

Gross output$_{services}$ = total gross output of services activities (categories F, G and from I to R) for the year of inventory (mill €).

The calculation of the tourist's expenditure in each of the sector is performed using the "GDP: Total contribution" figure of tourism sector in Montenegro provided by the World Travel & Tourism Council (WTTC). In order to disaggregate the figure for each type of service, the share of the contribution of each services in the Pilot Tourist Satellite Accounts (TSA) of 2009 is used as an approximation. The categories, contribution and share to use are shown in the following table:

Table 7. Tourism services contribution to GDP.
Source: Own elaboration based on Pilot TSA 2009.

Category of service	Internal tourism consumption (€)	Share (fraction)
Accommodation services	248,978,383	0.44
Food and beverage services	110,488,266	0.19
Local passenger transport services	39,139,859	0.07
Air passenger transport services	32,508,049	0.06
Travel agencies services	12,224,189	0.02
Cultural services	16,687,406	0.03
Sport and recreational services	32,169,190	0.06
Other consumption products	76,792,995	0.13
TOTAL	**568,988,337**	**1**

The share is used to calculate the expenditure in **Food and beverage services; Travel agencies services, Cultural services and Sport and recreational services**[2], with the following equation:

Equation 6. Expenditure in other services.
Source: Own elaboration.

$$Expenditure_{service\ j} = Total\ contribution\ GDP \cdot Share_{service\ j\ 2009}$$

Where:

$Expenditure_{service\ j}$ = expenditure of tourists in service j in the inventory year (mill €).

Total contribution GDP = total contribution of the tourism sector to the GDP in the inventory year (mill €).

$Share_{service\ j\ 2009}$ = share of service j to the total contribution to GDP of tourism in 2009 (fraction).

For the calculation of the expenditure in **collective accommodation services**, the following equation is used:

Equation 7. Expenditure in collective accommodation services.
Source: Own elaboration.

$$Expenditure_{collective\ accomodation} = Total\ contribution\ GDP \cdot Share_{accomodation\ 2009} \cdot \frac{Overnight\ stays_{collective}}{Overnight\ stays_{total}}$$

[2] The shares of Local passenger transport services, Air passenger transport services and Other consumption products are not used for these calculations.

Where:

Expenditure$_{collective\ accommodation}$ = expenditure of tourists in collective accommodation services in the inventory year (mill €).

Total contribution GDP = total contribution of the tourism sector to the GDP in the inventory year (mill €).

Share$_{accommodation\ 2009}$ = 0.44; share of accommodation services to the total contribution to GDP of tourism in 2009 (fraction).

Overnight stays$_{collective}$ = overnight stays of tourists in collective accommodation facilities in the year of inventory.

Overnight stays$_{total}$ = total overnight stays of tourists in accommodation facilities (collective and private) in the year of inventory.

The fuel and electricity consumption of collective accommodation and other services is calculated according the following equation:

Equation 8. Fuel consumption in collective accommodation and other services.
Source: Own elaboration.

$$Fuel\ consumption_{service\ j, fuel\ i} = Energy\ intensity_{services; fuel\ i} \cdot Expenditure_{service\ j}$$

Where:

Fuel consumption$_{service\ j,\ fuel\ i}$ = amount of fuel type i consumed in service j (TJ).

Energy intensity$_{services;\ fuel\ i}$ = energy intensity of services for fuel type i (TJ/mill).

Expenditure$_{service\ j}$ = expenditure of tourists in service j in the inventory year (mill €).

Equation 9. Electricity consumption in collective accommodation and other services.
Source: Own elaboration.

$$Electricity\ consumption_{service\ j} = Energy\ intensity_{services; electricity} \cdot Expenditure_{service\ j}$$

Where:

Electricity consumption$_{service\ j}$ = amount of electricity consumed in service j (GWh).

Energy intensity$_{services;\ electricity}$ = energy intensity of services for electricity (GWh/mill).

Expenditure$_{service\ j}$ = expenditure of tourists in service j in the inventory year (mill €).

Private accommodation services

In the case of the emissions from private accommodation (apartments, private rooms, etc.), a bottom-up approach is used. Through the fuel consumption of households, an activity factor of average fuel consumption per overnight stay is calculated and crossed with the total tourist overnight stays in private accommodation in the inventory year.

Equation 10. Fuel consumption in private accommodation.
Source: Own elaboration.

$$Fuel\ consumption_{private,fuel\ i} = Consumption\ fuel\ i_{households} \cdot \frac{Overnight\ stays_{foreign,private}}{Total\ population \cdot 365 + Overnight\ stays_{foreign,private}}$$

Where:

Fuel consumption$_{private,\ fuel\ i}$ = amount of fuel type i consumed in private accommodation (TJ).

Consumption fuel i$_{households}$ = consumption of fuel type i for the category "Households" in the energy balances (TJ).

Overnight stays$_{foreign,\ private}$ = overnight stays of foreign tourists in private accommodation facilities in the year of inventory.

Total population = total population of Montenegro in the year of inventory.

For the electricity consumption, a similar approximation is done, using the households' electricity consumption of the eight most visited cities of Montenegro, in terms of foreign tourists' overnight stays.

Equation 11. Electricity consumption in private accommodation.
Source: Own elaboration.

$$Electricity\ consumption_{private} = \left(\sum_{m=1}^{8} Consumption\ \ electricty_{hhls,city\ m}\right) \cdot \frac{Overnight\ stays_{foreign,private}}{\sum_{m=1}^{8} Population_{city\ m} \cdot 365 + Overnight\ stays_{foreign,private}}$$

Where:

Electricity consumption$_{private}$ = amount of electricity consumed in private accommodation (GWh).

Consumption electricity$_{hhls,\ city\ m}$ = consumption of electricity in the households of city m.

Overnight stays$_{foreign,\ private}$ = overnight stays of foreign tourists in private accommodation facilities in the year of inventory.

Population$_{city\ m}$ = total population of city m in the year of inventory.

Data required

Table 8. Data required for the calculation GHG emissions from Accommodation and other services.
Source: Own elaboration.

Data required	Source
Energy balances	MONSTAT
Gross output	
Pilot TSA 2009	
Tourist overnight stays	
Tourist overnight stays by cities	
Population estimations	
Households' electricity consumption by cities	
Tourism total contribution to GDP	WTTC
Emission factors	Annex I

- **Optimal option**

The optimal option would imply the use of electricity and fuel consumption reported by the facilities that provide services for tourist. This would require the generalization of reporting and the publication of data from the form **UG11E**. The consumptions would be used in the general equations for accommodation and other services.

An intermediate improvement would be the regular elaboration of TSA. This would allow to use directly the expenditure in each year directly, instead of estimating it through the contribution share of previous Pilot TSA.

3.3.2. In-country transport

The GHG emissions of tourist transport within Montenegro is calculated using a hybrid approach. The emissions of road transport, railway transport and inland navigation are calculated using a top-down approach. The in-country emissions from air transport (airports) and maritime navigation (cruises at berth) are calculated using a bottom-up approach.

3.3.2.1. *In-country road transport, railway transport and inland navigation*

- **Applicable option**

The GHG emissions from in-country road transport, in-country railway transport and inland navigation is calculated using a top-down approach similar to the one used for the emissions of collective accommodation and other services.

The general equations to calculate the GHG emissions is the following:

Equation 12. GHG emissions from fuel combustion in in-country road transport, railway transport and inland navigation.
Source: Own elaboration.

$$Emissions_{GHG,fuel,transport\ j} = \sum Fuel\ consumption_{fuel\ i,transport\ j} \cdot Emission\ factor_{GHG,fuel\ i}$$

Where:

$Emissions_{GHG,fue,\ transport\ j}$ = emission of given GHG from fuel combustion in transport j (road, railway, navigation) (t GHG).

$Fuel\ consumption_{fuel\ i,\ transport\ j}$ = amount of fuel type i consumed in transport j (TJ).

$Emission\ factor_{GHG,fueli}$ = emission factor of a given GHG for fuel type i (t GHG/TJ).

Equation 13. GHG emissions from electricity consumption in in-country railway transport and inland navigation.
Source: Own elaboration.

$$Emissions_{GHG,electricity,transport\ j} = Electricity\ consumption_{transport\ j} \cdot Emission\ factor_{GHG,electricity}$$

Where:

$Emissions_{GHG,electricity,transport}$ j = emission of given GHG from electricity consumption in transport j (t GHG).

$Electricity\ consumption_{transport\ j}$ = electricity consumed in transport j (GWh).

$Emission\ factor_{GHG,electricity}$ = emission factor of a given GHG for the electricity generation mix (t GHG/GWh).

The energy consumption of all the sectors is correlated with the total gross output of Montenegro in the year of inventory, obtaining the energy intensity of the economy. These data are crossed with the mean expenditure of tourists in transport services, which calculated using ***Equation 6. Expenditure in other services*** and the share of Local passenger transport services in ***Table 7. Tourism services contribution to GDP***.

Equation 14. Energy intensity of the economy.
Source: Own elaboration.

$$Energy\ intensity_{economy} = \frac{\sum Final\ energy\ consumption_{source\ i}}{Gross\ output}$$

Where:

Energy intensity$_{economy}$ = energy intensity of the economy (TJ/mill €).

Final energy consumption$_{source\ i}$ = final energy consumption of energy source i (TJ).

Gross output = total gross output of the economy for the year of inventory (mill €).

The expenditure in Local passenger transport services is used to estimate the energy consumption of tourist transportation within Montenegro with the following equation:

Equation 15. Total Energy consumption in in-country tourist transportation (road, railway, inland navigation).
Source: Own elaboration.

$$Energy\ consumption_{tourists,in-transport} = Energy\ intesity_{economy} \cdot Expenditure_{transport}$$

Where:

Energy consumption$_{tourists,\ in-transport}$ = total energy consumption of tourists in local transport services (TJ).

Energy intensity$_{economy}$ = energy intensity of the economy (TJ/mill €).

Expenditure$_{transport}$ = expenditure of tourists in Local passenger services in the inventory year (mill €).

The energy consumption per type of transport is estimated considering the contribution of each type of transport (road, railway and inland navigation) in the energy balances of the inventory year.

Equation 16. Energy consumption of tourists in-country transportation per type of transport.
Source: Own elaboration.

$$Energy\ consumption_{tourist,transport\ j} = Energy\ consumption_{tourists,in-transport} \cdot \frac{T.e.consumption_{transport\ j}}{(T.e.consumption_{road} + T.e.consumption_{railways} + T.e.consumption_{inland\ nav}}$$

Where:

Energy consumption$_{tourist,transport\ j}$ = total energy consumption of the use in-country of transport j (road, railway or inland navigation) by tourists (TJ).

Energy consumption$_{tourists,\ in\text{-}transport}$ = total energy consumption of tourists in local transport services (TJ).

T.e.consumption$_{transport\ j}$ = total energy consumption of transport j (road, railway or inland navigation) (TJ).

T.e.consumption$_{road}$ = total energy consumption of road transport in the energy balances of the inventory year (TJ).

T.e.consumption$_{railway}$ = total energy consumption of railway transport in the energy balances of the inventory year (TJ).

T.e.consumption$_{inland\ nav}$ = total energy consumption of inland navigation in the energy balances of the inventory year (TJ).

The disaggregation into types of fuel and electricity is done using the proportions of fuels consumption per type of transport in the energy balances of the inventory year.

Equation 17. Disaggregation into fuel types of energy consumption of tourists in-country transportation per type of transport.
Source: Own elaboration.

$$Fuel\ consumption_{fuel\ i,transport\ j} = Energy\ consumption_{tourist,transport\ j} \cdot \frac{Consumption_{fuel\ i,transport\ j}}{T.e.consumption_{transport j}}$$

Where:

Energy consumption$_{tourist,transport\ j}$ = total energy consumption of the use in-country of transport j (road, railway or inland navigation) by tourists (TJ).

Energy consumption$_{tourists,\ in\text{-}transport}$ = total energy consumption of tourists in local transport services (TJ).

Consumption$_{fuel\ i,\ transport\ j}$ = consumption of fuel type i in the transport j category of the energy balance in the inventory year (TJ).

T.e.consumption$_{transport\ j}$ = total energy consumption of transport j in the inventory year(TJ).

Table 9. Data required for the calculation GHG emissions from in-country road transport, in-country railway transport and inland navigatio.
Source: Own elaboration.

Data required	Source
Energy balances: Final energy consumption. Transport final energy consumption.	MONSTAT
Gross output	
Tourism total contribution to GDP	WTTC
Tourist expenditure in Local transport services	***Equation 6.***
Emission factors	Annex I

- **Optimal option**

The optimal option would require to carry out surveys similar to the NTO 2014 Guest Survey. In these surveys, tourists (foreign and domestic) would be asked about the use of means of transport to travel within Montenegro and distances travelled. The data gathered would be use to estimate passenger·km travelled.

Equation 18. GHG emissions from tourist in-country transportation (optimal option).
Source: Own elaboration.

$$Emissions_{GHG,in-transport\ j} = Distance\ travelled_{in-transport\ j} \cdot Emission\ factor_{GHG,transport\ j}$$

Where:

$Emissions_{GHG,in-transport\ j}$ = emission of given GHG from the in-country use of transport j by tourists (t GHG).

$Distance\ travelled_{in-transport\ j}$ = distance travelled within the country by tourist by transport j (passenger·km).

$Emission\ factor_{GHG,transport\ j}$ = emission factor of a given GHG for the use of transport j (t GHG/ passenger·km).

3.3.2.2. *In-country air transport (airports)*

➢ **Applicable option**

The in-country air transport GHG emissions are those sourced in the energy consumption due to land activities in airports and the consumption of airport facilities themselves. The calculation uses a bottom-up approach, in which the contribution of tourists to energy consumption is differentiated from the total energy consumption.

Equation 19. GHG emissions from tourist in-country air transport (airports).
Source: Own elaboration.

$$Emissions_{GHG,airport} = (Electricity\ consumption_{airport} \cdot EF_{GHG,electricity} + \sum Fuel\ consumption_{airport,fuel\ i} \cdot EF_{GHG,fuel\ i}) \cdot \frac{Torusit\ arrivals}{Total\ arrivals}$$

Where:

Emissions$_{GHG,airport}$ = emission of given GHG from airport facilities (ground activities, t GHG).

Electricity consumption$_{airport}$ = total electricity consumed by Podgorica and Tivat airports (GWh).

EF$_{GHG,electricity}$ = emission factor of a given GHG for the electricity generation mix (t GHG/GWh).

Fuel consumption$_{airport,fuel\ i}$ = total amount of fuel type i consumed by Podgorica and Tivat airports (ground activities; TJ).

EF$_{GHG,fuel\ i}$ = emission factor of a given GHG for fuel type I (t GHG/TJ).

Tourist arrivals = total number of foreign passenger arrivals (passengers).

Total arrivals = total number of arrivals to airport (Tivat and Podgorica) in the year of inventory (passengers).

Table 10. Data required for the calculation GHG emissions from in-country air transport.
Source: Own elaboration.

Data required	Source
Airports energy consumption	Podgorica and Tivat airports
Foreign passenger arrivals	Police authority
Total passenger arrivals	Police authority
Emission factors	Annex I

➢ **Optimal option**

There is no better option than the applicable option.

3.3.2.3. *In-country maritime transport (cruises at berth)*

➢ **Applicable option**

The emissions caused by cruises staying at port are calculated through a bottom-up approach. The number of cruises arriving at port, along with specific information provided by Kotor's Port Authority is used in the following equitation:

Equation 20. GHG emissions from tourist in-country maritime transport (cruises at berth).
Source: Own elaboration.

$$Cruise_{sGHG} = \left(\sum Cruise_i tonnage\right) \cdot Avg\ time\ at\ berth \cdot \frac{Fuel\ consumption_{h,t}}{1{,}000{,}000} \cdot Emission\ factor_{GHG,fuel\ oil}$$

Where:

$Cruise_{GHG}$ = total emission of given GHG from cruises at berth (t GHG).

$Cruise_i$ *tonnage* = cruise i gross tonnage (t).

Avg time at berth = average time of ships at berth (hr).

$Fuel\ consumption_{h,t}$ = 9.2 kg of fuel oil/hr/1,000 tonnage; hourly fuel consumption of cruise at berth[3].

$Emission\ factor_{GHG,fuel}$ oil = emission factor of a given GHG for fuel oil (t GHG/t fuel oil).

Table 11. Data required for the calculation GHG emissions from Cruises at berth.
Source: Own elaboration.

Data required	Source
Number of cruises arrivals	MONSTAT
Number of cruises per gross tonnage	Kotor's Port Authority
Average time of stay	Kotor's Port Authority
Emission factors	Annex I

[3] Figure provided by Ecofys in its document *Potential for Shore Side Electricity in Europe* (http://www.ecofys.com/files/files/ecofys-2014-potential-for-shore-side-electricity-in-europe.pdf).

➢ **Optimal option**

The optimal option would be to have available the cruises tonnage and average time of stay at berth not only from Kotor's port, but also from all ports in Montenegro.

3.3.3. Waste

The calculation of GHG emissions from the waste generated by tourists (either solid waste or wastewater) is done based in the methodology of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Waste.

3.3.3.1. *Solid waste*

➢ **Applicable option**

The calculation of emissions from solid waste generated by tourists is performed through a bottom-up approach method based on the First Order Decay (FOD) method contained in IPCC's 2006 Guidelines. The equation is:

Equation 21. CH_4 emissions from tourists' SWD.
Source: Own elaboration based on IPCC.

$$CH_4\ Emissions_{SWDS,tourists} = \left[\sum CH_4 generated\right] \cdot (1-R) \cdot (1-OX_T)$$

Where:

$CH_4Emissions_{SWDS,tourists}$ = CH_4 emissions from tourist's solid waste managed in landfills in the year of inventory (t CH_4).

$CH_4generated$ = CH_4 generated from the solid waste of tourists managed in landfills (t).

R = recovered CH_4 (fraction).

OX= 0, oxidation factor (IPCC default) (fraction).

The recovered CH_4 is calculated in base of the figure of CH_4 burned in landfills provided by EPA and the total CH_4 generated from SWD provided by the National Inventory Report.

Equation 22.Recovered CH_4 from tourists' SWD.
Source: Own elaboration based on IPCC.

$$R = \frac{CH_4\ burned}{CH_4 generated_{Montenegro}}$$

Where:

R = recovered CH_4 (fraction).

CH_4 burned = CH_4 burned in landfills' torches (t).

CH_4 generated$_{Montenegro}$ = total CH_4 generated in landfills of Montenegro according to the NIR (t).

The CH_4 generated by tourists' solid waste is calculated considering a period of 30 years from the moment of disposal. The equation to use is the following:

Equation 23. CH_4 generated from tourists' SWD.
Source: Own elaboration based on IPCC.

$$CH_4generated_t = L_0 \cdot W_{tourist} \cdot k \cdot \left(\frac{1-e^{-k}}{k}\right) \cdot \sum_{i=0}^{30} e^{-k \cdot i}$$

Where:

CH_4generated = CH_4 generated from the solid waste of tourists managed in landfills (t).

L_0 = CH_4 generation potential (fraction).

$W_{tourists}$ = solid waste generated by tourists and managed in landfills in the inventory year (t).

k = 0.05 reaction constant (IPCC default).

Equation 24. CH_4 generation potential from tourists' SWD (*L_0*).
Source: Own elaboration based on IPCC.

$$L_0 = DDOCm \cdot F \cdot 16/12$$

Where:

L_0 = CH_4 generation potential (fraction).

$DDOC_m$ = decomposable fraction of degradable organic carbon deposited (fraction).

F = 0.5; fraction of CH_4 in generated landfill gas (IPCC default) (fraction).

16/12 = molecular weight ratio CH_4/C (ratio).

Equation 25. Decomposable fraction of degradable organic carbon deposited (*DDOCm*).
Source: Own elaboration based on IPCC.

$$DDOCm = DOC \cdot DOC_f \cdot MCF$$

Where:

$DDOC_m$ = decomposable fraction of degradable organic carbon deposited (fraction).

DOC = 0.131; degradable organic carbon in tourists' waste deposited in the year of inventory (fraction).

DOC_f = 0.5; fraction of DOC that can decompose (IPCC default) (fraction).

MCF = 1; CH_4 correction factor for aerobic decomposition in the year of deposition (IPCC default) (fraction).

The degradable organic carbon in tourists' waste is calculated in base of the 2006 IPCC guidelines, using the municipal solid waste characterization of the *National Waste Management Plan*. For more detail of its calculation, see Annex II.

The amount of solid waste generated by tourists in a year is calculated in base of the global amount of municipal solid waste (MSW) generated in Montenegro. The equation to use is the following:

Equation 26. Solid waste generated by tourists ($W_{tourist}$).
Source: Own elaboration based on IPCC.

$$W_{tourist} = MSW_{total} \cdot \frac{Overnight\ stays_{foreign}}{Overnight\ stays_{foreign} + Total\ population \cdot 365}$$

Where:

$W_{tourists}$ = solid waste generated by tourists and managed in landfills in the inventory year (t).

MSW_{total} = total municipal solid waste collected in Montenegro in the year of inventory (t).

Overnight $stays_{foreign}$ = total overnight stays of foreign tourists in the year of inventory.

Total population = total population of Montenegro in the year of inventory.

Table 12. Data required for the calculation GHG emissions from Solid Waste.
Source: Own elaboration.

Data required	Source
CH_4 generated in landfills	NIR
CH_4 burned in landfills	EPA
Municipal solid waste collected in Montenegro	MONSTAT
Foreign tourists' overnight stays	
Total population	
Default values	IPCC

- **Optimal option**

The optimal option would use the same general equations from 2006 IPCC Guidelines, but would require periodical studies to determine the waste generation ratio of tourists and the characterization of this waste.

3.3.3.2. *Waste water*

- **Applicable option**

In a similar way to emissions from solid waste, GHG emission from tourists' wastewater are calculated using a bottom-up approach based on the 2006 IPCC Guidelines. The equations to use are:

Equation 27. CH_4 emissions from tourists' wastewater treatment.
Source: Own elaboration based on IPCC.

$$CH_4\ Emissions_{WW,tourists} = \frac{T \cdot B_0 \cdot MCF \cdot TOW_{tourists} \cdot (1-S) \cdot (1-R)}{1{,}000}$$

Where:

CH_4 Emissions$_{WW,tourists}$ = *CH_4* emissions from tourists' wastewater treatment (t CH_4).

T= degree of utilisation of septic tanks by tourists (fraction).

B_0 = maximum CH_4 producing capacity (kg CH4/kg BOD).

MCF = 0.5; methane correction factor of septic tanks (IPCC default) (fraction).

$TOW_{torusits}$ = total organics from tourists in wastewater (kg BOD).

S = 0; organic component fraction removed as sludge (IPCC default) (fraction).

R = 0; fraction of CH_4 recovered (IPCC default) (fraction).

Equation 28. Organics from tourists in waste water.
Source: Own elaboration based on IPCC.

$$TOW_{tourists} = Overnight\ stays \cdot BOD \cdot 0.001 \cdot I$$

Where:

$TOW_{torusits}$ = total organics from tourists in wastewater (kg BOD).

Overnight stays = total overnight stays of tourists (day·tourist).

BOD = per capita BOD (g/person/day).

0.001 = conversion from grams BOD to kg BOD.

I = 1; correction factor for additional industrial BOD discharged into sewers (IPCC default value) (fraction).

To calculate the nitrous oxide emissions from wastewater, the following equations are used:

Equation 29. N_2O emissions from tourists' wastewater treatment.
Source: Own elaboration based on IPCC.

$$N_2O\ Emissions_{WW,tourists} = \frac{N_{effluent} \cdot EF_{effluent} \cdot 44/28}{1{,}000}$$

Where:

N_2O Emissions$_{WW,tourists}$= N_2O emissions from the wastewater generated by tourists (t N_2O).

$N_{effluent}$ = total amount of nitrogen from tourists in the wastewater effluent (kg N).

$EF_{effluent}$= 0.005 emission factor for N_2O from nitrogen discharged to wastewater (IPCC default) (kg N_2O-N/kg N).

44/28 = conversion factor from kg N_2O-N to N_2O.

Equation 30. Nitrogen from tourists in the wastewater effluent ($N_{effluent}$).
Source: Own elaboration based on IPCC.

$$N_{effluent} = (Overnight\ stays \cdot Protein \cdot F_{NPR} \cdot F_{NON-CON} \cdot F_{IND-COM}) - N_{sludge}$$

Where:

$N_{effluent}$ = total amount of nitrogen from tourists in the wastewater effluent (kg N).

Overnight stays = total number of tourists' overnight stays (person-day).

Protein = daily per capita protein consumption (kg/person-day).

F_{NPR} = 0.16; fraction of nitrogen in protein (kg N/kg protein).

$F_{NON-CON}$ = 1.10, factor for non-consumed protein added to the wastewater (IPCC default).

$F_{IND-COM}$ = 1.25; factor for industrial and commercial co-discharged protein into the sewer system (IPCC default).

N_{SLUDGE} = 0; nitrogen removed with sludge (IPCC default) (kg N).

Table 13. Data required for the calculation GHG emissions from Wastewater.
Source: Own elaboration.

Data required	Source
CH_4 producing capacity	EPA
Utilisation of septic tanks	
BOD	
Per capita protein consumption	FAOSTAT
Default values	IPCC
Tourists' overnight stays	MONSTAT

- **Optimal option**

The optimal option would use the same equations, requiring only the use of country-specific data, instead of IPCC default values.

3.4. Off-country emissions: off-country transport

All the off-country GHG emissions accounted are those generated by off-country transport. Off-county transport emissions are those generated by roundtrips made by foreign tourists between their countries of origin and Montenegro. All the off-country transport calculations use a bottom-up approach.

3.4.1. Estimation of foreign tourists' transport mode

- **Applicable option**

The first step of the calculation requires the estimation of the transport modes used by foreign tourist to travel for and back from Montenegro. The starting point is the figure of **foreign arrivals** provided by MONSTAT every year. The general equation of transport modes is:

Equation 31. General equation of transport modes.
Source: Own elaboration.

$$F.arrrivals_{total} = F.arrrivals_{road} + F.arrrivals_{train} + F.arrrivals_{plane} + F.arrrivals_{ship}$$

Where:

$F.arrivals_{total}$ = total arrivals of foreign tourists in the year of inventory (passengers). Figure provided by MONSTAT.

$F.arrivals_{road}$ = arrivals of foreign tourist by road (passengers). To estimate.

$F.arrivals_{train}$ = arrivals of foreign tourist by train (passengers). To estimate.

$F.arrivals_{plane}$ = arrivals of foreign tourist by plane (passengers). Figure provided by Police authority in the Passenger activity of the year of inventory.

$F.arrivals_{ship}$ = arrivals of foreign tourist by ship (passengers). Result of adding foreign arrivals of tourists by vessel and arrivals by cruise. Both figures are provided by MONSTAT.

The estimation of the arrivals by road and by train is done using the data of Passenger activity in the year of inventory provided by Police authority.

Equation 32. Foreign arrivals by road.
Source: Own elaboration.

$$F.arrrivals_{road} = \frac{(F.arrrivals_{total} - F.arrrivals_{plane} - F.arrrivals_{ship}) \cdot Cross_{road}}{Cross_{road} + Cross_{train}}$$

Where:

$F.arrivals_{road}$ = arrivals of foreign tourist by road (passengers).

$F.arrivals_{total}$ = total arrivals of foreign tourists in the year of inventory (passengers). Figure provided by MONSTAT.

$F.arrivals_{plane}$ = arrivals of foreign tourist by plane (passengers). Figure provided by Police authority in the Passenger activity of the year of inventory.

$F.arrivals_{ship}$ = arrivals of foreign tourist by ship (passengers). Result of adding foreign arrivals of tourists by vessel and arrivals by cruise. Both figures are provided by MONSTAT.

$Cross_{road}$ = Border crosses of foreigners (in or out, choose minimum value) by road in the year of inventory(passengers). Figure provided by Police authority.

$Cross_{train}$ = Border crosses of foreigners (in or out, choose minimum value) by train in the year of inventory (passengers). Figure provided by Police authority.

Equation 33. Foreign arrivals by train.
Source: Own elaboration.

$$F.arrrivals_{train} = \frac{\left(F.arrrivals_{total} - F.arrrivals_{plane} - F.arrrivals_{ship}\right) \cdot Cross_{train}}{Cross_{road} + Cross_{train}}$$

Where:

F.arrivals$_{train}$ = arrivals of foreign tourist by train (passengers).

F.arrivals$_{total}$ = total arrivals of foreign tourists in the year of inventory (passengers). Figure provided by MONSTAT.

F.arrivals$_{plane}$ = arrivals of foreign tourist by plane (passengers). Figure provided by Police authority in the Passenger activity of the year of inventory.

F.arrivals$_{ship}$ = arrivals of foreign tourist by ship (passengers). Result of adding foreign arrivals of tourists by vessel and arrivals by cruise. Both figures are provided by MONSTAT.

Cross$_{train}$ = Border crosses of foreigners (in or out, choose minimum value) by train in the year of inventory (passengers). Figure provided by Police authority.

Cross$_{road}$ = Border crosses of foreigners (in or out, choose minimum value) by road in the year of inventory(passengers). Figure provided by Police authority.

Data required

Table 14. Data required for the estimation of foreign tourists' transport modes.
Source: Own elaboration.

Data required	Source
Foreign tourist arrivals	MONSTAT
Foreign arrivals by vessels	
Foreign arrivals by cruises	
Foreign arrivals by plane	Policy authority
Foreign border crossing by road	
Foreign border crossing by train	

➢ **Optimal option**

The optimal option would Policy authority would distinguish between tourists and just passenger in transfer passing by Montenegro to reach other destination. This would provide the arrivals per mode of transport directly and would make unnecessary the estimation of road and train arrivals.

Other option is for MONSTAT to gather not only number of foreign arrivals, but also mode of transport to reach the country.

3.4.2. Off-country road transport

➢ **Applicable option**

The general equation of off-country road transport is the following:

Equation 34. GHG emissions from off-country tourist road transportation.
Source: Own elaboration.

$$Emissions_{GHG,off-road} = \frac{Distance\ travelled_{road} \cdot Emission\ factor_{GHG,road}}{1{,}000}$$

Where:

Emissions$_{GHG, off-road}$ = emission of given GHG from the use of cars off-country (t GHG).

Distance travelled$_{road}$ = car distance travelled off-country by tourist (km·car).

Emission factor$_{GHG,road}$ = emission factor of a given GHG per kilometre travelled with cars (kg GHG/km·car).

The distance travelled is calculated in based of the distance from the tourist's home country to Montenegro. To do so, the procedure is to create a table containing all the countries of origin of foreign tourist in the inventory year (provided by MONSTAT). The distance from these countries is calculated considering roundtrips from the capital cities of the home-country to Podgorica and **subtracting 100 km** (in order to prevent the double accounting of emission within the country). In the case of routes that require the uses of ferries, the distance travelled by ship must be subtracted as well. Countries from which is not feasible to reach Montenegro by road, are not included. Common tools such as Google Maps can be used to determine the trip distances.

Equation 35. Distance travelled by road.
Source: Own elaboration.

$$Distance\ travelled_{road} = \frac{F.arrivals_{road}}{Car\ occupancy} \cdot \sum (Roundtrip_{country\ m} \cdot Share_{road,country\ m})$$

Where:

Distance travelled$_{road}$ = car distance travelled off-country by tourist (km·car).

F.arrivals$_{road}$ = arrivals of foreign tourist by road (passengers).

Car occupancy = 2,23 passengers/car([4]).

Roundtrip$_{country\ m}$ = road roundtrip from country of origin m to Montenegro's border (km).

Share$_{road,\ country\ m}$ = share of foreign tourists that come from country m traveling by car (fraction).

The share of tourists per country is calculated using an exponential distribution in which the closer countries to Montenegro are the countries from which more tourists travel by car. To calculate the share, consider the following proportions:

Table 15. Distribution by roundtrip distance of foreign tourists traveling by road.
Source: Own elaboration.

Roundtrip distance	Proportion of foreign tourists
< 500 km	67%
> 500 km and < 1,000 km	24%
> 1,000 km	9%

These proportions are distributed between the roundtrip distances for each country in inverse proportionality: the closer the country is, the bigger the proportion of total foreign tourists that come from that country.

Data required

Table 16. Data required for the calculation GHG emissions from Off-country road transport.
Source: Own elaboration.

Data required	Source
Foreign tourist arrivals by road	***Equation 32.***
Roundtrip distances	Google Maps or similar tools
Emission factors	Annex I

- **Optimal option**

[4] Calculated on base of surveys of travel company and travel modes in MTO Guest Survey 2014.

The optimal option would be that Police authority could provide the number of foreign tourists travelling by road, thus avoiding the need to undertake estimations.

3.4.3. Off-country railway transport

- **Available option**

The GHG emissions of off-country railway transport of tourists are calculated in a very similar way than off-country road transport. The general equation of off-country railway transport is the following:

Equation 36. GHG emissions from off-country tourist railway transportation.
Source: Own elaboration.

$$Emissions_{GHG,off-train} = \frac{Distance\ travelled_{train} \cdot Emission\ factor_{GHG,train}}{1{,}000}$$

Where:

$Emissions_{GHG,off\text{-}train}$ = emission of given GHG from the use of railway systems off-country (t GHG).

$Distance\ travelled_{train}$ = railway distance travelled off-country by tourist (passenger·km).

$Emission\ factor_{GHG,train}$ = emission factor of a given GHG per kilometre travelled per passenger by train(kg GHG/ passenger·km).

The distance travelled is calculated in a similar way as for off-country road transport: roundtrip distance from tourists' countries of origin (capital city) to the border of Montenegro (in order to prevent the double accounting of emission within the country). Countries from which is not feasible to reach Montenegro by train, are not included. As there is no common tool to calculate railway distances the use of Google Maps is recommendable, make the assumption that railway distances are similar to road distances, once routes that include the use of ferries are eliminated.

Equation 37. Distance travelled by train.
Source: Own elaboration.

$$Distance\ travelled_{train} = F.arrivals_{train} \cdot \sum (Roundtrip_{country\ m} \cdot Share_{train,country\ m})$$

Where:

Distance travelled$_{road}$ = railway distance travelled off-country by tourists (passenger·km).

F.arrivals$_{train}$ = arrivals of foreign tourist by train (passengers).

Roundtrip$_{country\ m}$ = road roundtrip from country of origin m to Montenegro's border (km).

Share$_{road,\ country\ m}$ = share of foreign tourists that come from country m traveling by train (fraction).

As in off-country road distance, the share of tourists per country is calculated using an exponential distribution in which the closer countries to Montenegro are the countries from which more tourists travel by train. To calculate the share, consider the following proportions:

Table 17. Distribution by roundtrip distance of foreign tourists traveling by train.
Source: Own elaboration.

Roundtrip distance	Proportion of foreign tourists
< 500 km	67%
> 500 km and < 1,000 km	24%
> 1,000 km	9%

These proportions are distributed between the roundtrip distances for each country in inverse proportionality: the closer the country is, the bigger the proportion of total foreign tourists that come from that country.

Data required

Table 18. Data required for the calculation GHG emissions from Off-country railway transport.
Source: Own elaboration.

Data required	Source
Foreign tourist arrivals by railway	Previous calculations
Roundtrip distances	Google Maps or similar tools
Emission factors	Annex I

- **Optimal option**

The optimal option would be that Police authority could provide the number of foreign tourists travelling by railway, thus avoiding the need to undertake estimations.

3.4.4. Off-country air transport

- **Available option**

The off-country air transport emissions are calculated using a bottom-up approach. The activity data to use are the passenger-kilometers to reach Podgorica and Tivat airports. As no other data is available, it is preferred to considered the whole flight emissions as off-country, taking into account that DEFRA emission factors (used in this case) already include emissions from taking-off and landing.

Equation 38. GHG emissions from off-country tourist air transportation.
Source: Own elaboration.

$$Emissions_{GHG,flight} = Distance\ travelled_{flight,tourist} \cdot Emission\ factor_{GHG,flight}$$

Where:

Emissions$_{GHG,flight}$ = emission of given GHG from tourist air transportation(t GHG).

Distance travelled$_{flight,tourist}$ = distance travelled by foreign tourists by plane (passenger·km).

Emission factor$_{GHG,flight}$ = emission factor of a given GHG for tourist air transportation (t GHG/passenger-km).

The distance travelled is calculated on the base of the city of origin/destiny that reach Tivat and Podgorica airports. These data are provided by the airport's authorities. The flight distances can be found in common web tools to calculate flight mileages (e.g. https://www.webflyer.com/travel/mileage_calculator/ or http://www.flightmanager.com/content/timedistanceform.aspx).

Equation 39. Distance travelled by plane.
Source: Own elaboration.

$$Distance\ travelled_{flight,tourist} = F.arrivals_{plane} \cdot \left(\sum Flight\ distance_{city\ n} \cdot \frac{Arrivals_{city\ n}}{Total\ arrivals}\right)$$

Where:

Distance travelled$_{flight,tourist}$ = distance travelled by foreign tourists by plane (passenger·km).

F.arrivals$_{plane}$ = arrivals of foreign tourist by plane (passengers).

Flight distance$_{city\ n}$ = roundtrip flight distance from city n to airport (Tivat or Podgorica) (km).

Arrivals$_{city\ n}$ = passenger arrivals from city n to airport (Tivat or Podgorica) in the year of inventory (passengers).

Total arrivals = total number of arrivals to airport (Tivat or Podgorica) in the year of inventory (passengers).

Table 19. Data required for the calculation GHG emissions from Off-country air transport.
Source: Own elaboration.

Data required	Source
Passenger arrivals per city of origin/destination.	Podgorica and Tivat airports
Foreign arrivals by plane	Police authority
Flight distances	https://www.webflyer.com/travel/mileage_calculator/ or http://www.flightmanager.com/content/timedistanceform.aspx
Emission factors	Annex I

- **Optimal option**

There is better option than the available option.

3.4.5. Maritime navigation

- **Available option**

The emissions from maritime navigation are calculated using a bottom-up approach, in which the distance travelled by tourist is an estimation based on distance of neighbouring ports. The equation is the following:

Equation 40. GHG emissions from tourist maritime navigation.
Source: Own elaboration.

$$Maritime_{GHG} = Distance\ travelled_{maritime,tourist} \cdot Passengers_{maritime,tourist} \cdot Emission\ factor_{GHG,maritime}$$

Where:

Maritime$_{GHG}$ = total emission of given GHG from tourist maritime navigation (t GHG).

Distance travelled$_{maritime,tourist}$ = 1,481.6 km, assumption of distance travelled by tourists by maritime passenger ships (800 nautical miles).

F.arrivals$_{ship}$ = arrivals of foreign tourist by ship (passengers). Result of adding foreign arrivals of tourists by vessel and arrivals by cruise. Both figures are provided by MONSTAT.

Emission factor$_{GHG,maritime}$ = emission factor of a given GHG for tourist maritime navigation (t GHG/passenger·km).

Table 20. Data required for the calculation GHG emissions from Maritime navigation.
Source: Own elaboration.

Data required	Source
Foreign arrivals by vessels	MONSTAT
Foreign arrivals by cruises	
Emission factors	Annex I

- **Optimal option**

Having the last port of vessels before docking in Montenegro would allow to have a more reliable estimations of distance travelled by sea than the current assumption of 800 nautical miles.

4. DATA COLLECTION METHODOLOGY

4.1. Comparison with other economic sectors of Montenegro

In general terms, Montenegro's tourism sector ranks among the most intense sectors with a GHG intensity estimated around 3-5% of total national GHG emissions (around 70-100 kt CO_2e /year). Indeed, only few other economic segments display even less favourable GHG intensities: *Total greenhouse gas (GHG) emissions decreased by 17 per cent between 2007 and 2011, while CO_2 emissions increased by 8.1 per cent during the same period.* The energy sector, comprising energy supply and consumption in the transport, residential and service sectors, has the highest share of GHG emissions, accounting for nearly 68 per cent of total emissions in 2011. This share was followed by those of industry (20 per cent), agriculture (10 per cent) and waste (2 per cent).[5]

4.2. Critical gaps

Below there is a table containing the data available for the monitoring of GHG emissions, the sector in which is used and recommendations to improve the data sets.

Table 21. Available data, sector of use and improvement recommendations.
Source: Own elaboration.

Data available	Used in sectors	Preferable data	Recommended improvements
National energy balances. Source: MONSTAT.	Accommodation (collective) and other services	Fuel and electricity consumption of accommodation facilities and other facilities that provide services for tourists.	Generalize the requirement for tourism facilities to complete the UG11E form to gather fuel and electricity consumption from tourism sector facilities.
	Accommodation (private)		Disaggregate the "Other sectors" category in the energy balances (Services, Public Administration, Others).
	In-country road transport	In-country road transport tourist-kilometres by type of vehicle	Elaborate similar surveys to the MTO Guest Survey 2014, including not only mode of transport to reach Montenegro, but

[5] UNECE, Environmental Performance Review (Third Review), ECE /CEP/173, February 2015

	In-country railway transport	In-country rail transport tourist-kilometres	also modes of transport used within the country.
	Inland navigation	Fuel and electricity consumption of inland passenger ships	
Gross output. Source: MONSTAT.	Accommodation and other services; In-country road and railway transport; Inland navigation.	None	None
Pilot TSA 2009 Source: MONSTAT.	Accommodation and other services; In-country road and railway transport; Inland navigation.	TSA 2013	Elaborate Tourist Satellite Accounts yearly or at least every five years, following the model of the Pilot TSA 2009.
Tourist overnight stays. Source: MONSTAT.	Accommodation and other services; In-country road and railway transport; Inland navigation; Wastewater.	None	None
Tourist's countries of origin. Source: MONSTAT	Off-country road and railway transport.	None	None
Tourists' off-country modes of transport. Source: MTO Guest Survey 2014.	Off-country road and railway transport.	Guest Survey 2013	Keep elaborating this survey, at least once every five years.
Airport land activity and facilities' energy consumption. Source: Tivat and Podgorica airports.	In-country air transport	None	None
Passengers per flight's city of origin. Source: Tivat and Podgorica airports.	Off-country air transport	None	None
Passenger traffic. Source: Police authority.	Off-country air transport	None	Police authority should differentiate between foreign passenger in transfer through the country (no overnight stays) and those that stays at least one night. This would allow to use this data for off-country road and railway transport as well.
Number of arrivals by vessel and by cruise. Source: MONSTAT.	Maritime navigation	None	Record the port of origin of vessels before docking in Montenegro.

Total number of cruises arrivals. Source: MONSTAT.	Cruises at berth	None	None
Number of cruises per gross tonnage. Source: Kotor's Port Authority.	Cruises at berth	None	Provide these data from all the ports, not only Kotor.
Average time of stay. Source: Kotor's Port Authority.	Cruises at berth	None	
Tourist waste generation rate and waste characterization. Source: National Waste Management Plan	Solid waste	None	Although the National Waste Management Plan is a one-time document, waste characterization and generation rates studies should be performed at least once every decade.
CH_4 burned in Livade landfill. Source: EPA	Solid waste	Global rate of CH_4 recovered in landfills.	Include the figure CH_4 recovery in Mozura landfill.
CH_4 producing capacity, wastewater management systems' degrees of utilisation and BOD. Source: EPA	Wastewater	None	Review the BOD generation figure provided (21900 g/cap/day) as it seems to be far bigger than the default values provided by IPCC's 2006 Guidelines.
Per capita protein consumption. Source: FAO	Wastewater	None	Verify the value provided by FAO (110.52 g/person/day), as it is for the year 2011 (last one available).

5. TRAINING SESSION ON GHG EMISSIONS FROM TOURISM SECTOR MONITORING

5.1. General principles

Training is a core part of this project as it allows building the capacity of Statistical Office of Montenegro (MONSTAT) and Environment Protection Agency (EPA) staff.

The training sessions will have a limited number of trainees from both stakeholders and especially the targeted subjects should be carefully considered and evaluated considering their present role in the organization chart lined to the project.

Practical training sessions on how calculate the GHG emissions from tourism in a year, which data should and not should not be used, how to elaborate an Excel tool containing the main topics for GHG projection for MONSTAT-EPA staff will help to ensure compliance with EU standards.

There is the possibility to upload training materials on an online site for ease of access.

5.2. Methodology to be used

The training sessions will be developed using a "LEARNING-BY DOING APPROACH" in order to ensure that all stakeholders have a consistent level of knowledge and are capable of facing similar issues in the future.

According to the consortium's experience, this it is the most productive technique to work with individuals that are responsible for 'on-the-job' implementation.

Moreover, this kind of supportive approach will facilitate the integration of the different activities to achieve the project results. It will also help to harmonise the outcomes of each result, transfer the necessary expertise to all involved stakeholders and support the application during the whole project life cycle - of control instruments in order to enable effective monitoring of activity progress.

5.2.1. Training Facilitators

The Consortium will use the technical and international experience of one of its international experts. In addition, it also will count with its local expert, Predrag Novosel, native Montenegrin, who can therefore easily explain the most updated procedures and methodologies avoiding any communication issues and avoid language barriers.

The Consortium members, Factor CO_2 and EQO, have been assessed and certified to meet the ISO 9001 standard requirements for providing higher and ongoing educational services.

5.2.2. Attendees

Seminar trainings will be organised for staff of the main national authorities that are involved in GHG emissions accounting, monitoring, and reporting; MONSTAT and EPA. This will lead to a deepened knowledge of the on-the-ground mechanisms on which relevant national authorities will have to operate and of the aims, the roles and the responsibilities related with the management and climate change strategy in terms of GHG emissions.

5.2.3. Structure

Training seminars will be organised in two-day training sessions covering the methodological approach on the calculation and monitoring of GHG emissions from tourism sector in Montenegro.

Training seminars will be organised as follows: The first day will be used to train staff from MONSTAT and EPA and will focus on the methodological approach for GHG emissions calculation and data collection methods. The second day will focus on the case study of the 2013 baseline calculation, the discussion of results, conclusions and recommendations.

The proposed training seminars, combine a more technical part through the presentation of methodological tools, equations and Excel spreadsheets on sectorial emissions with a more dynamic part, in which the local attendees may intervene explaining the problems they face, their approach to these themes and their working experience. Given the consulting team's experience, it is interesting to combine in a same workshop both aspects, in order to ensure a better understanding of the given information.

Two weeks before the training session, the following data will be necessary to receive:

- Confirmation of attendance from each participant.
- Resource availability confirmation: besides having a proper room and audio-visual equipment, computers will be needed as well as internet access.

5.2.4. Topics

We propose that at least the following topics will be covered during this training seminars:

- Link between climate change and neutral carbon tourism from GEF and UNDP perspective.
- Purpose and importance of developing carbon footprint from tourism sector in Montenegro.
- GHG emissions inventory accounting methodology for emissions calculation.
- Baseline review and calculation methodology.
- Data collection methods.
- Discussion of results.
- Conclusions and recommendations.

5.3. Objectives

- To enhance the technical capacity of the relevant national authorities on GHG emissions accounting and monitoring.
- To share tools and relevant sources of direct use with the national authorities to facilitate their work on the process to elaborate GHG emission inventories.
- To share experiences, best practices and lessons learned that relevant national authorities can build on in the process to develop GHG emission inventories.

5.4. Programme

The Consortium suggests the following tentative 2-day training programme on baseline recalculation and GHG inventory subject to changes based on attendee's level of knowledge.

DAY 1 Time	December 2015 Topic/Activity
8:45	Registration
9:00	Session opening: Session objectives and schedule.
9:15	Neutral carbon tourism: developing carbon footprint for tourism in Montenegro. Purpose and importance.
9:35	GHG emissions inventory accounting methodology (Part I) - GHG emissions calculation: methodological approaches - Previous GHG baseline calculation: Towards a Carbon Neutral Tourism in Montenegro
10:15	*Coffee break*
10:45	GHG emissions inventory accounting methodology (Part II) - Methodological approach for GHG emissions calculation
11:30	Questions & Answers
12:00	*Lunch break*
13:30	GHG emissions inventory accounting methodology (Part III) - Data Collection Methods (Roles, critical gaps and data quality validation system
15:00	Coffee break
15:15	Final questions and debate, share working experiences and best practise
16:00	Session closure

DAY 2 Time	December 2015 Topic/Activity
8:45	Registration
9:00	Session opening: Session objectives and schedule.
9:15	GHG emissions inventory accounting methodology (Part IV) - Case study: 2013 Baseline calculation
10:15	*Coffee break*
10:45	GHG emissions inventory accounting methodology (Part V) - Practical session: calculation of examples of GHG emissions on 2014.
12:00	*Lunch break*
13:30	GHG emissions inventory accounting methodology (Part VI) - Discussion of results - GHG emissions inventory results analysis and interpretation
15:00	Coffee break
15:10	Final questions and debate, share working experiences and best practise
16:00	Session closure

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ANNEX I: EMISSION FACTORS

Fuels emission factors (stationary)

	LPG	Motor gasoline	Kerosene aviation fuel	Transport diesel and residual fuel oil	Waste oil (Mazut)	Other oil products	Lignite	Fuelwood and long-meter roundwood	Wood residue	Wood chips	Wood briquettes	Wood pellets	Charcoal
CO_2 Emission factor (t CO_2/TJ). Source: NIR	63.1	68.6	70.8	68.6	76.6	73.3	99.2	-	-	-	-	-	-
CH_4 Emission factor (t CH_4/TJ). Source: IPCC	0.010	0.010	0.010	0.010	0.300	0.010	0.010	0.300	0.300	0.300	0.300	0.300	0.200
N_2O Emission factor (t N_2O /TJ). Source: IPCC	0.001	0.001	0.001	0.001	0.004	0.001	0.002	0.004	0.004	0.004	0.004	0.004	0.001

Electricity emission factor

	Electricity
CO_2 Emission factor (t CO_2/GWh)	395.2
CH_4 Emission factor (t CH_4/GWh)	0.040
N_2O Emission factor (t N_2O /GWh)	0.006

Road transport (IPCC adjusted)

Emission factors Source: DEFRA 2013	kg CO_2/unit	kg CH_4/unit	kg N_2O/unit
Car (car-km)	0.19	0.00003	0.000
Coach (pass-km)	0.03	0.00000	0.000
Motorcycle (mc-km)	0.12	0.00002	0.000
RV (RV-km)	0.27	0.00004	0.000

Railway transport (IPCC adjusted)

Emission factors Source: DEFRA 2013	kg CO_2/pass-km	kg CH_4/pass-km	kg N_2O/pass-km
Rail	0.01	0.00001	0.00008

Air transport (IPCC adjusted)

Emission factor Source: DEFRA 2013	kg CO_2/pass-km	kg CH_4/pass-km	kg N_2O/pass-km
Domestic (average passenger)	0.324811	0.000046	0.000003
Short-haul (average passenger)	0.191452	0.000011	0.000002
Long-haul (average passenger)	0.225351	0.000011	0.000002

Ship transport (IPCC adjusted)

Emission factors Source: DEFRA 2013	kg CO_2/pass-km	kg CH_4/pass-km	kg N_2O/pass-km
Boat	0.12	0.00002	0.000001

ANNEX II: DEGRADABLE ORGANIC CARBON IN TOURISTS' SOLID WASTE

The calculation of the degradable organic carbon (DOC) content in the solid waste from tourists is performed in accordance with values of DOC content per type of wet waste of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Waste. The characterization of municipal solid waste (MSW) is taken from the National Waste Management Plan.

MSW component	1-Composition of waste (%)	2-DOC content of wet waste (%)	3-DOC 3= 1 x 2	
Organic	32.1%	15%		4.8%
Paper and paperboard	13.0%	40%		5.2%
Glass	8.5%	0%		0.0%
Heavy metals	1.1%	0%		0.0%
Non-ferrous metals (Al, etc.).	1.6%	0%		0.0%
Wood	2.6%	43%		1.1%
Composite packaging	3.7%	4%		0.1%
PET	5.6%	0%		0.0%
Plastic	11.9%	0%		0.0%
Textile	2.8%	24%		0.7%
Inert waste (rubble, etc.)	2.3%	4%		0.1%
Hazardous waste	0.6%	0%		0.0%
Green waste	5.1%	20%		1.0%
Other	9.0%	0%		0.0%
Source:	National Waste Management Plan	IPPC default	**4-DOC (t/RSU t) 4=∑3/100**	**0.131**

An optimal estimation of the DOC content would require regular actualizations on the MSW characterization every five years or, at least, once per decade. It would be even better, although more resource demanding, to conduct characterization studies on actual solid waste generated by tourists, as this waste would present significant variations in comparison to the waste generated by local population.

However, in case that not more recent data is available, it is recommended to use the value of **0.131** tons of DOC per ton of solid waste, as this value would be more accurate than tier 1 values provided by IPCC guidelines.