



# 2014 GHG EMISSIONS FROM TOURISM IN MONTENEGRO

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# Acknowledgments

## 0.1. From Factor CO<sub>2</sub>:

- Asier Sopelana
- Juan Carlos Gómez

## 0.2. From EQO:

- Lluís Vilardell
- Predrag Novosel

## 0.3. From UNDP

- Aleksandra Kikovic
- Viktor Subotic

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## Acronyms

CH <sub>4</sub>	Methane
CO <sub>2</sub> e	CO <sub>2</sub> -equivalents
CO <sub>2</sub>	Carbon dioxide
DEFRA	UK Department for Environment, Food & Rural Affairs
HFC	Hydrofluorocarbon
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse effect gas
GWP	Global warming potential
IPCC	Intergovernmental Panel on Climate Change
MSW	Municipal solid waste
NIR	National Inventory Report
N <sub>2</sub> O	Nitrous oxide
TCNTM	Towards a Carbon Neutral Tourism in Montenegro
UNDP	United Nations Development Programme
UNWTO	United Nations World Tourism Organization

## 1. PRESENTATION

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 gross domestic product (GDP), is one of the strategic drivers of economic growth. However, in the business-as-usual scenario, tourism sector's greenhouse effect gases (GHGs) emissions will rise by 40% in 2020 above 1990 baseline. 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" (TCNTM) project, with the immediate target of maintaining tourism sector related GHG emissions at the 2013 level. In order to assess the effectiveness of the measures implemented under the project TCNTM's scope of action, the 2013 baseline emissions of GHGs from the tourism sector of Montenegro was calculated.

The main goal of this Report is to present the emissions of greenhouse effect gases (GHGs) from tourism in Montenegro during the year 2014.

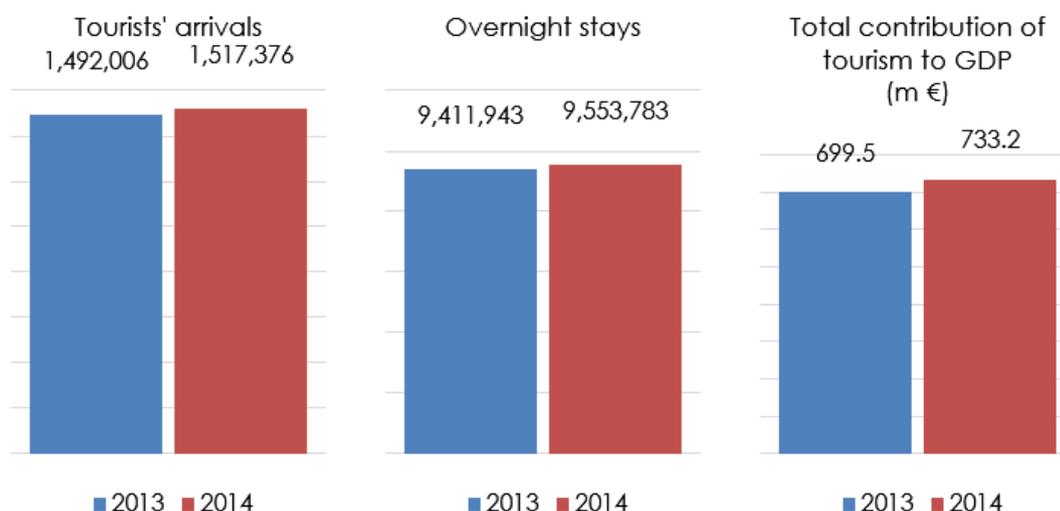
## 2. 2014 TOURISM IN MONTENEGRO

Montenegro registered 1,517,376 tourists' arrivals during 2014, representing an increase of 1.7 % in relation of previous year. The total overnight stays of tourists accounted for 9,553,783 nights, 1.5 % more than in 2013 (MONSTAT, 2015).

The total contribution of tourism to the national GDP was estimated in 733.2 million € (20 % of total GDP), a 4.8 % more than in 2013 (World Travel & Tourism Council, 2015).

**Figure 1: Main tourism figures for 2014.**

Source: Own elaboration.

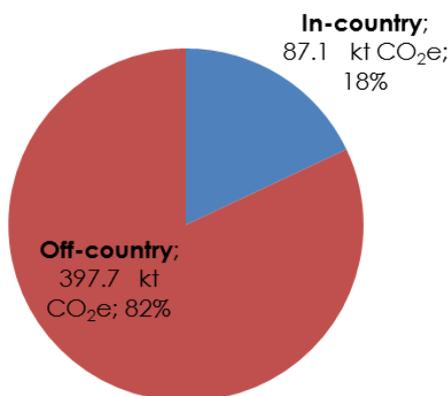


### 3. GHG EMISSIONS FROM TOURISM

#### 3.1. Global emissions

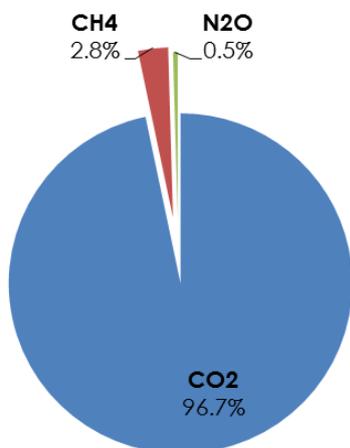
The total emissions from tourism in Montenegro in year 2014 were **484.75 kt CO<sub>2</sub>e**. The majority of these emissions (397.67 kt CO<sub>2</sub>e; 82 % of the total) took place out of the country, in the transportation of foreign tourists from their countries of origin to Montenegro. The rest (87.08 kt CO<sub>2</sub>e; 18 % of the total) was country-based and had its source in the touristic activities, transportation and waste management within Montenegro.

**Figure 2: Total emissions by geographical distribution.**  
Source: Own elaboration.



In terms of type of GHG, 2014 emissions were 464.87 kt CO<sub>2</sub>, 547.5 t CH<sub>4</sub> (13.69 kt CO<sub>2</sub>e) and 7.4 t N<sub>2</sub>O (2.19 kt CO<sub>2</sub>e). Considering each GHG global warming potential (GWP), CO<sub>2</sub> emissions were 96.7 % of the total emissions, while CH<sub>4</sub> and N<sub>2</sub>O had a 2.8 % and 0.5 % share of the total, respectively.

**Figure 3: Total emissions by type of GHG.**  
Source: Own elaboration.



The tourist emissions by sector were as follows:

**Table 1. 2014 emissions by sector.**

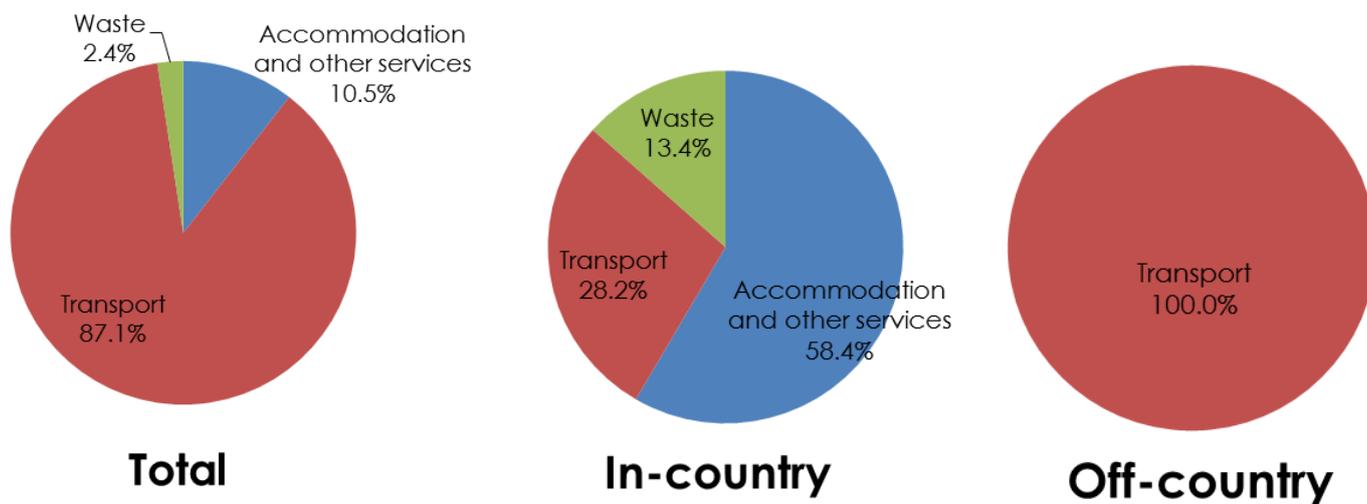
Source: Own elaboration.

Sector	† CO <sub>2</sub>	† CH <sub>4</sub>	† N <sub>2</sub> O	kt CO <sub>2</sub> e
Accommodation and other services	48,868.6	62.5	1.5	50.9
Transport	420,003.3	39.1	4.0	422.2
Waste	-	445.9	1.8	11.7
<b>Total</b>	<b>468,872.0</b>	<b>547.5</b>	<b>7.4</b>	<b>484.8</b>

Of the total emissions, emissions from transport contributed to 87.1 % of the total, while accommodation and other services to 10.5 % and waste to 2.4 % respectively.

**Figure 4: Emissions by sector.**

Source: Own elaboration.



In the case of in-country emissions, accommodation and other services contributed to 58.4 %, in-country transport to 28.2 %, and waste to 13.4 % of the total. All off-country emissions were sourced from transport.

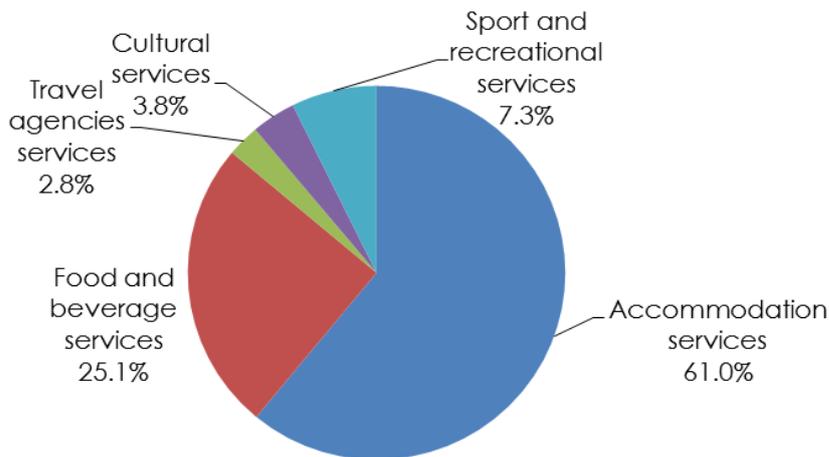
## 3.2. Accommodation and other services

The emissions from accommodation and other services for tourists in the year 2014 were as shown in following table:

**Table 2. Emissions from Accommodation and other services.**  
Source: Own elaboration.

Emissions summary (t)	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e
Accommodation services	29,256.6	57.0	1.2	<b>31,026</b>
Food and beverage services	12,629.9	3.5	0.2	<b>12,781</b>
Travel agencies services	1,397.3	0.4	0.0	<b>1,414</b>
Cultural services	1,907.5	0.5	0.0	<b>1,930</b>
Sport and recreational services	3,677.3	1.0	0.1	<b>3,721</b>
<b>Total</b>	<b>48,868.6</b>	<b>62.5</b>	<b>1.5</b>	<b>50,873</b>

**Figure 5: Source of emissions from accommodation and other services.**  
Source: Own elaboration.



All emissions from accommodation and other services took place in-country and were originated directly by the consumption of fuels or indirectly by the consumption of electricity.

### 3.3. Transport

Emissions from transport of tourists were as follows:

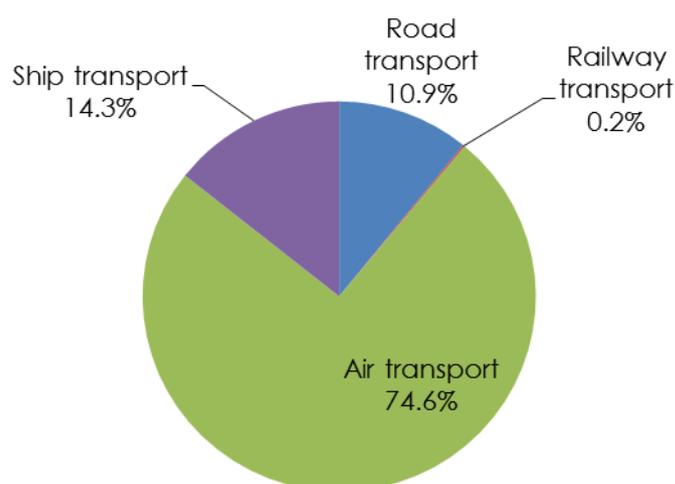
**Table 3. Emissions from Transport.**

Source: Own elaboration.

Emissions summary (t)	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e
<b>In-country road transport</b>	17,081.2	2.5	0.1	17,188.2
<b>In-country railway transport</b>	500.4	0.1	0.0	503.7
<b>Air transport (airports)</b>	1,959.9	0.2	0.0	1,973.6
<b>Ship transport</b>	4,808.3	1.1	0.0	4,848.7
Cruises at berth	4,345.7	0.6	0.0	4,372.9
Inland navigation	462.5	0.4	0.0	475.8
<b>Total</b>	<b>24,349.8</b>	<b>3.9</b>	<b>0.1</b>	<b>24,514.2</b>
<b>Memo items</b>				
Off-country road transport	28,498.2	4.2	0.2	28,676.2
Off-country rail transport	67.2	0.1	0.4	199.3
Air transport (international flights)	311,717.1	23.0	2.6	313,080.1
Maritime navigation	55,371.0	8.1	0.5	55,717.0
<b>Total (including memo items)</b>	<b>420,003.3</b>	<b>39.3</b>	<b>3.8</b>	<b>422,186.8</b>

**Figure 6: Source of emissions from transport.**

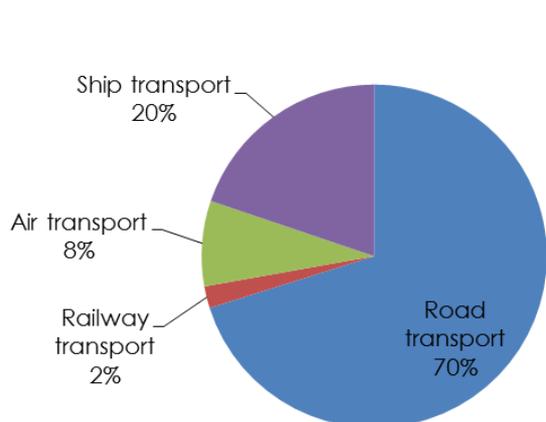
Source: Own elaboration.



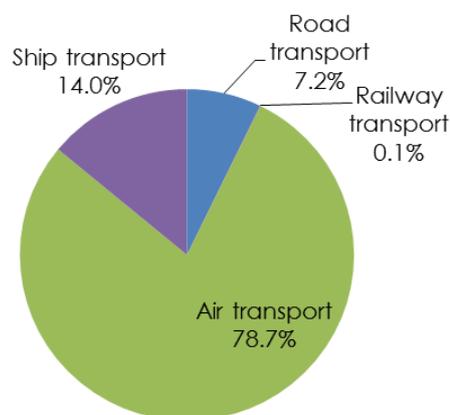
The majority of transport emissions were originated by air transport, followed by ship, road and railway transport. If in- and off-country emissions are analysed separately, the contribution of each type of transport was as follows:

**Figure 7: Source of emissions from transport by geographical distribution.**

Source: Own elaboration.



**In-country transport emissions**

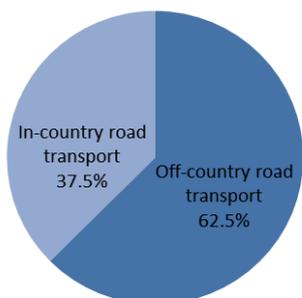


**Off-country transport emissions (memo items)**

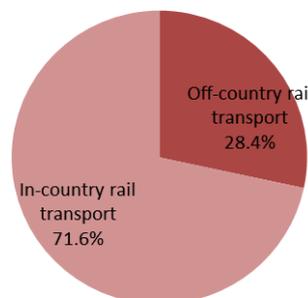
The emissions analysed by type of transport were:

**Figure 8: Emissions by transport type.**

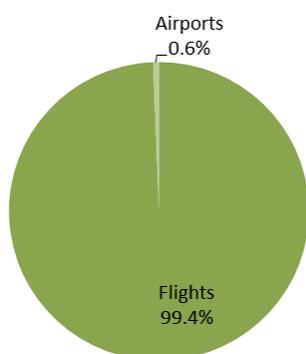
Source: Own elaboration.



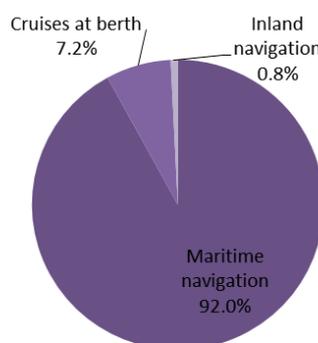
**Emissions from Road transport**



**Emissions from Railway transport**



**Emissions from Air transport**



**Emissions from Ship transport**

These emissions were originated by the consumption of fuels by vehicles, planes and ships, as well as electricity in the case of trains. Additionally, emissions originated by other activities related to transport are taken into account: fuel and electricity consumed by land activities and airports facilities and fuel consumed by cruises at berth in ports.

### 3.4. Waste

The emissions from the management of waste generated by tourists in the year 2014 were as shown in following table:

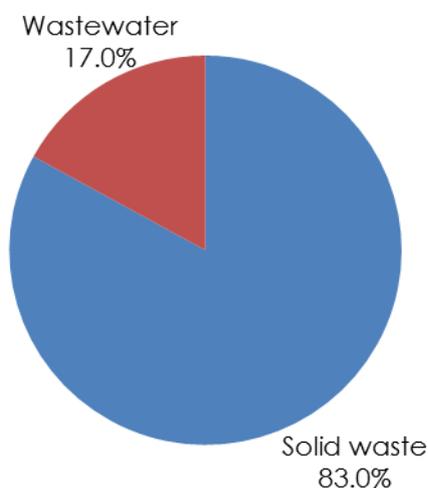
**Table 4. Emissions from Waste.**

Source: Own elaboration.

Emissions summary (t)	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e
Solid waste	-	388.2	-	9,704.0
Wastewater	-	57.8	1.8	1,988.4
<b>Total</b>	-	<b>445.9</b>	<b>1.8</b>	<b>11,692.5</b>

**Figure 9: Source of emissions from waste.**

Source: Own elaboration.



All emissions from waste took place in-country and were originated by the decomposition of the waste (solid or liquid) generated by tourists.

### 3.5. Main indicators

In the following table, the most relevant indicators of 2014 emissions from tourism in Montenegro are shown:

**Table 5. Main indicators of tourism GHG emissions.**

Source: Own elaboration.

Indicator	Unit	Value
Total average emission per tourist arrival (including memo items)	kg CO <sub>2</sub> e/tourist arrival	319.5
Total average emission per tourist arrival (excluding memo items)	kg CO <sub>2</sub> e/tourist arrival	57.4
Total average emission per overnight stay (including memo items)	kg CO <sub>2</sub> e/overnight stay	50.7
Total average emission per overnight stay (excluding memo items)	kg CO <sub>2</sub> e/overnight stay	9.1
Average emission per overnight stay (excluding in- and off-country transport)	kg CO <sub>2</sub> e/overnight stay	6.5
Accommodation and other services emissions per overnight stay	kg CO <sub>2</sub> e/overnight stay	5.3
Accommodation emissions per overnight stay (excluding other services)	kg CO <sub>2</sub> e/overnight stay	3.2
Accommodation and other services emissions per tourist arrival	kg CO <sub>2</sub> e/tourist arrival	33.5
Off-country transport emissions per foreign tourist arrival	kg CO <sub>2</sub> e/foreign tourist arrival	294.5
In-country transport emissions per tourist	kg CO <sub>2</sub> e/tourist arrival	16.2
Waste emissions per tourist arrival	kg CO <sub>2</sub> e/tourist arrival	7.7

## 4. EVOLUTION OF EMISSIONS

The following table shows the comparison of 2014 GHG emissions from tourism with the baseline emissions, corresponding to the year 2013<sup>1</sup>.

**Table 6. Comparison of emissions with baseline year.**

Source: Own elaboration.

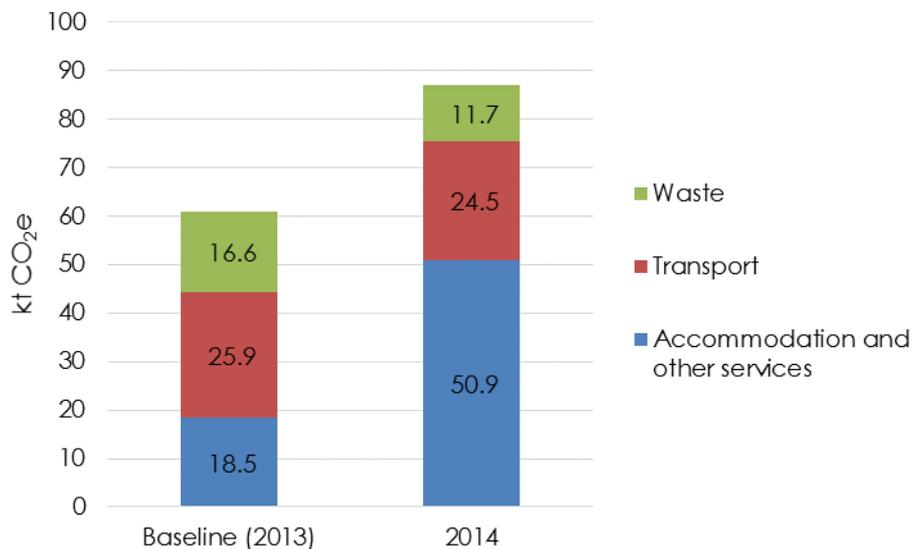
Emissions (t CO <sub>2</sub> e)	Baseline (2013)	2014	Variation (%)
<b>Accommodation and other services</b>	<b>18,461.2</b>	<b>50,872.9</b>	<b>176%</b>
<b>Transport</b>	<b>25,871.7</b>	<b>24,514.2</b>	<b>-5%</b>
<b>Road transport</b>	<b>17,873.2</b>	<b>17,188.2</b>	<b>-4%</b>
In-country road transport	17,873.2	17,188.2	-4%
<b>Railway transport</b>	<b>624.6</b>	<b>503.7</b>	<b>-19%</b>
In-country rail transport	624.6	503.7	-19%
<b>Air transport</b>	<b>1,484.4</b>	<b>1,973.6</b>	<b>33%</b>
Airports	1,484.4	1,973.6	33%
<b>Ship transport</b>	<b>5,889.5</b>	<b>4,848.7</b>	<b>-18%</b>
Cruises at berth	5,032.1	4,372.9	-13%
Inland navigation	857.4	475.8	-45%
<b>Waste</b>	<b>16,571.5</b>	<b>11,692.5</b>	<b>-29%</b>
Solid waste	14,612.6	9,704.0	-34%
Wastewater	1,958.9	1,988.4	2%
<b>Total</b>	<b>60,904.4</b>	<b>87,079.6</b>	<b>43%</b>
<b>Memo items</b>			
Off-country road transport	21,613.7	28,676.2	33%
Off-country rail transport	116.0	199.3	72%
Flights	325,515.5	313,080.1	-4%
Maritime navigation	56,783.7	55,717.0	-2%
<b>Total (including memo items)</b>	<b>464,933.3</b>	<b>484,752.2</b>	<b>4%</b>

<sup>1</sup> Comparisons with the baseline have to take into account that the emissions of Accommodation and other services in year 2013 are abnormally low due to the fact that the values of final energy consumption for the category *Other sectors* included in the energy balance of Montenegro for that year are remarkably low. It is expected that the energy balances are going to be redone, allowing to achieve a more coherent value for Accommodation and other services emissions in 2013.

The following figure shows the evolution of in-country emissions.

**Figure 10: Evolution of in-country emissions.**

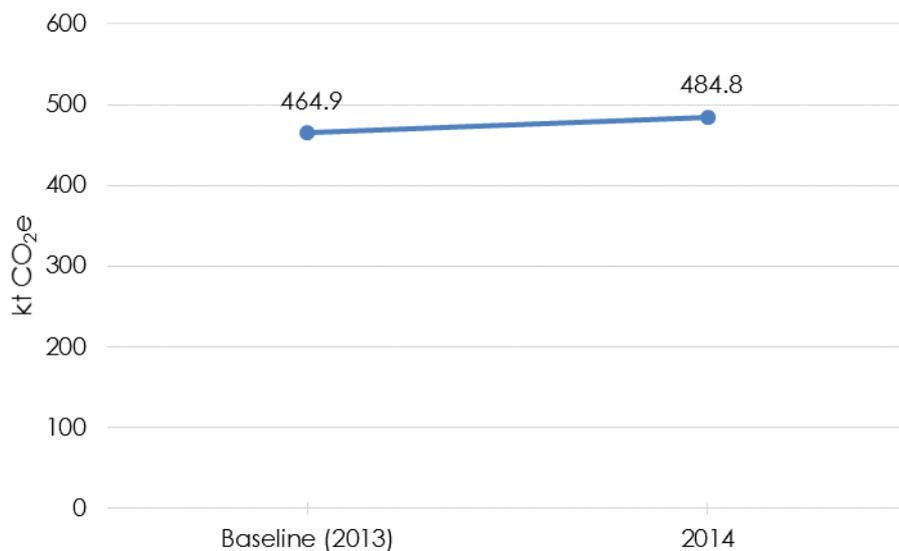
Source: Own elaboration.



Next figures presents the evolution of total emissions, including memo items (i.e. off-country emissions).

**Figure 11: Evolution of total emissions (including memo items).**

Source: Own elaboration.



## REFERENCES

- Ministry of Sustainable Development and Tourism. (2015). *The Second National Communication on Climate Change of Montenegro to the UNFCCC*. Podgorica: Nebojša Jablan.
- MONSTAT. (2015). *Foreign vessels on cruise in Montenegro 2014*. Podgorica: MONSTAT.
- MONSTAT. (2015). *Gross domestic product of Montenegro in 2014*. Podgorica: MONSTAT.
- MONSTAT. (2015). *Nautical tourism, 2014*. Podgorica: MONSTAT.
- MONSTAT. (2015). *Tourist arrivals and overnight stays 2014*. Podgorica: MONSTAT.
- MONSTAT. (2016). *Statistical Energy Balances 2014-2015*. Podgorica: MONSTAT.
- UNDP. (2014). *Towards Carbon Neutral Tourism in Montenegro*.
- UNWTO. Department of Economic and Social Affairs. (2010). *International Recommendations for Tourism Statistics 2008*. New York: UNWTO.
- World Travel & Tourism Council. (2015). *Travel & Tourism. Economic Impact 2015. Montenegro*. London: WTTC.

## ANNEX I: CALCULATION METHODOLOGY

### ➤ 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 scope is restricted to those emissions generated directly by the combustion of fuel, indirectly by the consumption of electricity (i.e. direct emissions from fuel combustion for the production of the consumed electricity) and the direct emissions from waste; due to tourist activities.

The methodology does not account for all other life-cycle emissions of fuels or products, nor emission sinks and removals.

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. Department of Economic and Social Affairs, 2010).

The detailed sources of GHG emissions considered are the following:

**Table 7. Sources of GHG within scope.**

Source: Own elaboration.

Geographical distribution	Sector	Source
<b>IN-COUNTRY EMISSIONS</b>	Accommodation and other services	Fuel consumption by tourists in: <ul style="list-style-type: none"> <li>• Accommodation services.</li> <li>• Food and beverage services.</li> <li>• Travel agencies services.</li> <li>• Cultural services.</li> <li>• Sport and recreational services.</li> <li>• Other services.</li> </ul>
	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: <ul style="list-style-type: none"> <li>• Inland navigation for tourists transportation.</li> <li>• Cruises at berth.</li> </ul>
	Waste	Degradation of waste generated by tourists during their stay in Montenegro: <ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Wastewater</li> </ul>
<b>MEMO ITEMS</b>		
<b>OFF-COUNTRY EMISSIONS</b>	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<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O). The three of them are converted into CO<sub>2</sub> equivalents (CO<sub>2</sub>e) using the global warming potential (GWP) established by the IPCC for a time horizon of 100 years in the 4<sup>th</sup> Assessment Report:

**Table 8. Global warming potential of GHG within scope.**

Source: Own elaboration based on IPCC.

	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O
GWP 100-yr	1	25	298

## ➤ Methodology completeness and key categories identification

The present methodology allows the calculation of the emissions **originated from tourism activities exclusively**. 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 9. Methodological approach per sector.**

Source: Own elaboration.

Sector	Subsector	Methodological approach	
		Applicable	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
Railway transport	In-country	Top-down	Bottom-up
Air transport	Airports	Bottom-up	Bottom-up
Ship transport	Inland navigation	Top-down	Bottom-up
	Cruises at berth	Bottom-up	Bottom-up
Waste	Solid waste	Bottom-up	Bottom-up
	Wastewater		
<b>Memo items</b>			
Road transport	Off-country	Bottom-up	Bottom-up
Railway transport	Off-country	Bottom-up	Bottom-up
Air transport	Flights	Bottom-up	Bottom-up
Ship transport	Maritime navigation	Bottom-up	Bottom-up

The following table shows the correlation between the categories as described in the inventory and the categories of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories:

**Table 10. Correlation among the accounting methodology and the 2006 IPCC Guidelines categories.**

Source: Own elaboration.

Accounting methodology			2006 IPCC Category
Sector	Source		
<b>IN-COUNTRY EMISSIONS</b>	Accommodation and other services	Fuel and electricity consumption by tourists in: <ul style="list-style-type: none"> <li>• Accommodation services.</li> <li>• Food and beverage services.</li> <li>• Travel agencies services.</li> <li>• Cultural services.</li> <li>• Sport and recreational services.</li> <li>• Other services.</li> </ul>	1.A.1.a Electricity and Heat Production (from electricity consumption) 1.A.4.a Commercial/Institutional (Collective accommodation & other services) 1.A.4.b Residential (private accommodation)
	Road transport	Fuel consumption of vehicles used for tourists transportation within Montenegro.	1.A.3.b Road Transportation
	Railway transport	Fuel and electricity consumption due to tourists using the railway system within the Montenegro.	1.A.1.a Electricity and Heat Production (from electricity consumption) 1.A.3.c Railways
	Air transport	Fuel and electricity consumption in land activities and airport facilities due to tourists visiting Montenegro.	1.A.1.a Electricity and Heat Production (from electricity consumption) 1.A.3.e Other Transportation
	Ship transport	Fuel and electricity consumption due to: <ul style="list-style-type: none"> <li>• Inland navigation for tourists transportation.</li> <li>• Cruises at berth.</li> </ul>	1.A.1.a Electricity and Heat Production (from electricity consumption) 1.A.3.d.ii Domestic water-borne Navigation
	Waste	Degradation of waste generated by tourists during their stay in Montenegro: <ul style="list-style-type: none"> <li>• Solid waste</li> <li>• Wastewater</li> </ul>	4.A.1 Managed Waste Disposal Sites 4.D.1 Domestic Wastewater Treatment and Discharge
<b>MEMO ITEMS</b>			
<b>OFF-COUNTRY EMISSIONS</b>	Road transport	Fuel consumption of vehicles used for foreign tourists transportation from origin country to Montenegro and back.	Not categorised in 2006 IPCC Guidelines.
	Railway transport	Fuel and electricity consumption due to foreign tourists using the railway system from origin country to Montenegro and back.	Not categorised in 2006 IPCC Guidelines.
	Air transport	Fuel consumption of planes due to foreign tourists transportation from city of origin to Montenegro and back.	1.A.3.a.i International Aviation (International Bunkers)
	Ship transport	Fuel consumption of ships used for foreign tourists transportation from origin country to Montenegro and back.	1.A.3.d.i International waterborne navigation (International Bunkers)

Certain sources/sinks of emissions have not been included into the accounting methodology, either because those emissions don't take place directly due the tourism activity (i.e. **not occurring, NO**) or because not enough data is available for their estimation (i.e. **not estimated, NE**). CO<sub>2</sub> emissions from biomass combustion for energy use are not estimated, since are considered as life-cycle emission that are out of the scope. Likewise, no emissions/absorptions from the AFOLU sector are estimated, since it is considered as out of the scope. The following table shows the exclusion from the methodology, following 2006 IPCC Guidelines categorisation.

**Table 11. Categories of GHG sources and sinks excluded from the accounting methodology.**

(NO: not occurring in tourism sector; NE: not estimated)

Source: Own elaboration.

Sector/Source category by 2006 IPCC	Type of exclusion
<b>1. ENERGY</b>	
1.A.1.b Petroleum Refining	NO
1.A.1.c Manufacture of Solid Fuels and Other Energy Industries	NO
1.A.2 Manufacturing Industries and Construction	NO
1.A.4.c Agriculture / Forestry / Fishing / Fish farms	NO
1.B. Fugitive emissions from fuels	NO
<b>2. INDUSTRIAL PROCESSES AND PRODUCT USE</b>	
2A Mineral Industry	NO
2B Chemical Industry	NO
2C Metal Industry	NO
2D Non-Energy Products from Fuels and Solvent Use	NE
2E Electronics Industry	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NE
2G Other Product Manufacture and Use	NO
2H Other	NO
<b>3. AGRICULTURE, FORESTRY AND OTHER LAND USE</b>	
	<b>NO</b>
<b>4. WASTE</b>	
4A2 Unmanaged Waste Disposal Sites	NE
4A3 Uncategorised Waste Disposal Sites	NE
4B Biological Treatment of Solid Waste	NO
4C1 Waste Incineration	NO
4C2 Open Burning of Waste	NE
4D2 Industrial Wastewater Treatment and Discharge	NO
4E Other	NE
<b>5 OTHER</b>	
	<b>NE</b>
<b>NON - 2006 IPCC Category</b>	
<b>Emissions from informal tourism sector</b>	<b>NE</b>

Regarding the type of GHG and GHG precursors, only carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) emissions are considered in the methodology for their accounting. The rest of the gases are excluded due to no occurrence or insufficient available data for estimation.

**Table 12. GHG not controlled by the Montreal Protocol and GHG precursors excluded from the accounting methodology.**

(NO: not occurring in tourism sector; NE: not estimated)

Source: Own elaboration.

Greenhouse gas	Type of exclusion
CO <sub>2</sub> removals	NO
CO	NE
NO <sub>x</sub>	NE
NMVOC <sub>s</sub>	NE
SO <sub>x</sub>	NE
HFC <sub>s</sub>	NE
PFC <sub>s</sub>	NE
SF <sub>6</sub>	NO

For the **identification of the key emission sources**, the methodological approach used is **Level Assessment (Approach 1)**, as presented in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 1 General Guidance and Reporting*. The assessment only includes in-country emissions, since off-country emissions are considered as memo items.

**Table 13. Key GHG sources analysis.**

(Key sources in bold).

Source: Own elaboration.

Emission sources	CO <sub>2</sub> e emissions estimate (t)	Level assessment	Cumulative total
<b>Accommodation and other services</b>	<b>50,872.9</b>	<b>0.58</b>	<b>0.58</b>
<b>In-country road transport</b>	<b>17,188.2</b>	<b>0.20</b>	<b>0.78</b>
<b>Waste</b>	<b>11,692.5</b>	<b>0.13</b>	<b>0.92</b>
<b>Ship transport</b>	<b>4,848.7</b>	<b>0.06</b>	<b>0.97</b>
Air transport (airports)	1,973.6	0.02	0.99
In-country rail transport	503.7	0.01	1.00
Total	87,079.6	1.00	-

## ➤ 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 II.

## ➤ 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:

$Total\ emissions_{CO_2e}$  = total CO<sub>2</sub>e emissions from Montenegro's tourism sector (t CO<sub>2</sub>e)

$Accom\&\ other_{GHG}$  = 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.

- **In-country emissions**
  - **Accommodation and other services**

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).

$Emission\ factor_{GHG, fuel\ i}$  = 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.

$$\text{Energy intensity}_{\text{services}; \text{fuel } i} = \frac{\text{Consumption fuel } i_{\text{services}}}{\text{Gross output}}$$

Where:

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

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

$\text{Gross output}_{\text{services}}$  = 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.

$$\text{Energy intensity}_{\text{services}; \text{electricity}} = \frac{\text{Consumption electricity}_{\text{services}}}{\text{Gross output}_{\text{services}}}$$

Where:

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

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

$\text{Gross output}_{\text{services}}$  = 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 14. 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
<b>TOTAL</b>	<b>568,988,337</b>	<b>1</b>

The share is used to calculate the expenditure in **Food and beverage services; Travel agencies services, Cultural services and Sport and recreational services**<sup>2</sup>, 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:

<sup>2</sup> The shares of Local passenger transport services, Air passenger transport services and Other consumption products are not used for these calculations.

## Equation 7. Expenditure in collective accommodation services.

Source: Own elaboration.

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

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*<sub>private, fuel i</sub>

$$= \text{Consumption fuel } i_{\text{households}} \cdot \frac{\text{Overnight stays}_{\text{foreign, private}}}{\text{Total population} \cdot 365 + \text{Overnight stays}_{\text{foreign, private}}}$$

Where:

*Fuel consumption*<sub>private, fuel i</sub> = amount of fuel type i consumed in private accommodation (TJ).

*Consumption fuel* *i*<sub>households</sub> = consumption of fuel type i for the category "Households" in the energy balances (TJ).

*Overnight stay*<sub>foreign, private</sub> = 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*<sub>private</sub>

$$= \left( \sum_{m=1}^8 \text{Consumption electricity}_{\text{hhls, city } m} \right) \cdot \frac{\text{Overnight stays}_{\text{foreign, private}}}{\sum_{m=1}^8 \text{Population}_{\text{city } m} \cdot 365 + \text{Overnight stays}_{\text{foreign, private}}}$$

Where:

*Electricity consumption*<sub>private</sub> = amount of electricity consumed in private accommodation (GWh).

*Consumption electricity*<sub>hhls, city m</sub> = consumption of electricity in the households of city m.

*Overnight stay*<sub>foreign, private</sub> = overnight stays of foreign tourists in private accommodation facilities in the year of inventory.

*Population*<sub>city m</sub> = total population of city m in the year of inventory.

- **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.

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

The GHG emissions from in-country road transport, in-country railway transport and inland navigation are 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:

$Emissions_{GHG, fuel, transport j}$  = 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).

$Emission\ factor_{GHG, fuel\ i}$  = 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 *Error! No se encuentra el origen de la referencia.*

**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.

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

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.

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

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).

$Energy\ consumption_{tourists,\ in-transport}$  = 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).

$Energy\ consumption_{tourists,\ in-transport}$  = 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).

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

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 18. GHG emissions from tourist in-country air transport (airports).**

Source: Own elaboration.

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

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).

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

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 equation:

**Equation 19. 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).

$Cruise_i \text{ tonnage}$  = cruise i gross tonnage (t).

$Avg \text{ time at berth}$  = average time of ships at berth (hr).

$Fuel \text{ consumption}_{hr,t}$  = 9.2 kg of fuel oil/hr/1,000 tonnage; hourly fuel consumption of cruise at berth<sup>3</sup>.

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

- **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.

- **Solid waste**

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 20. CH<sub>4</sub> emissions from tourists' SWD.**

Source: Own elaboration based on IPCC.

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

Where:

$CH_4 \text{ Emissions}_{SWDS, tourists}$  = CH<sub>4</sub> emissions from tourist's solid waste managed in landfills in the year of inventory (t CH<sub>4</sub>).

$CH_4 \text{ generated}$  = CH<sub>4</sub> generated from the solid waste of tourists managed in landfills (t).

$R$  = recovered CH<sub>4</sub> (fraction).

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

The recovered CH<sub>4</sub> is calculated in base of the figure of CH<sub>4</sub> burned in landfills provided by EPA and the total CH<sub>4</sub> generated from SWD provided by the National Inventory Report.

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<sup>3</sup> 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>).

### Equation 21. Recovered CH<sub>4</sub> from tourists' SWD.

Source: Own elaboration based on IPCC.

$$R = \frac{CH_4 \text{ burned}}{CH_4 \text{ generated}_{Montenegro}}$$

Where:

$R$  = recovered CH<sub>4</sub> (fraction).

$CH_4 \text{ burned}$  = CH<sub>4</sub> burned in landfills' torches (t).

$CH_4 \text{ generated}_{Montenegro}$  = total CH<sub>4</sub> generated in landfills of Montenegro according to the NIR (t).

The CH<sub>4</sub> 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 22. CH<sub>4</sub> generated from tourists' SWD.

Source: Own elaboration based on IPCC.

$$CH_4 \text{ generated}_t = L_0 \cdot W_{tourist} \cdot k \cdot \left( \frac{1 - e^{-k}}{k} \right) \cdot \sum_{i=0}^{30} e^{-k \cdot i}$$

Where:

$CH_4 \text{ generated}$  = CH<sub>4</sub> generated from the solid waste of tourists managed in landfills (t).

$L_0$  = CH<sub>4</sub> 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 23. CH<sub>4</sub> generation potential from tourists' SWD ( $L_0$ ).

Source: Own elaboration based on IPCC.

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

Where:

$L_0$  = CH<sub>4</sub> generation potential (fraction).

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

$F$  = 0.5; fraction of CH<sub>4</sub> in generated landfill gas (IPCC default) (fraction).

$16/12$  = molecular weight ratio CH<sub>4</sub>/C (ratio).

**Equation 24. Decomposable fraction of degradable organic carbon deposited (DDOC<sub>m</sub>).**

Source: Own elaboration based on IPCC.

$$DDOC_m = DOC \cdot DOC_f \cdot MCF$$

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<sub>4</sub> 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 25. 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.

- **Waste water**

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 26. CH<sub>4</sub> emissions from tourists' wastewater treatment.**

Source: Own elaboration based on IPCC.

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

Where:

$CH_4 \text{ Emissions}_{WW,tourists}$  = CH<sub>4</sub> emissions from tourists' wastewater treatment (t CH<sub>4</sub>).

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

$B_0$  = maximum CH<sub>4</sub> producing capacity (kg CH<sub>4</sub>/kg BOD).

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

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

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

$R = 0$ ; fraction of CH<sub>4</sub> recovered (IPCC default) (fraction).

**Equation 27. Organics from tourists in waste water.**

Source: Own elaboration based on IPCC.

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

Where:

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

$\text{Overnight stays}$  = 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 28. N<sub>2</sub>O emissions from tourists' wastewater treatment.**

Source: Own elaboration based on IPCC.

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

Where:

$N_{2O} \text{ Emissions}_{\text{WW,tourists}}$  = N<sub>2</sub>O emissions from the wastewater generated by tourists (t N<sub>2</sub>O).

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

$EF_{\text{effluent}}$  = 0.005 emission factor for N<sub>2</sub>O from nitrogen discharged to wastewater (IPCC default) (kg N<sub>2</sub>O-N/kg N).

44/28 = conversion factor from kg N<sub>2</sub>O-N to N<sub>2</sub>O.

**Equation 29. Nitrogen from tourists in the wastewater effluent ( $N_{\text{effluent}}$ ).**

Source: Own elaboration based on IPCC.

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

Where:

$N_{\text{effluent}}$  = 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).

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

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

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

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

- **Memo items: Off-country transport emissions**

All the off-country GHG emissions accounted are those generated by off-country transport and are to be reported as memo items, separately from the in-country emissions. Off-country 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.

- **Estimation of foreign tourists' transport mode**

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 30. General equation of transport modes.**

Source: Own elaboration.

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

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 31. Foreign arrivals by road.**

Source: Own elaboration.

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

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 32. Foreign arrivals by train.**

Source: Own elaboration.

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

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.

- **Off-country road transport**

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

**Equation 33. 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 34. 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<sup>(4)</sup>.

$Roundtrip_{country\ m}$  = 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).

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<sup>4</sup> Calculated on base of surveys of travel company and travel modes in MTO Guest Survey 2014.

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.

- **Off-country railway transport**

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 35. 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:

$Emissions_{GHG,off-train}$  = 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 36. 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 16. 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.

- **Off-country air transport**

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 consider 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 37. 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/](https://www.webflyer.com/travel/mileage_calculator/) or <http://www.flightmanager.com/content/timedistanceform.aspx>).

**Equation 38. 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).

- **Maritime navigation**

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 39. 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).

## ANNEX II: ACTIVITY DATA

### ➤ Economic

Gross Output 2014. Source: MONSTAT

Nace rev 2		Gross output 2014, current prices, in 000 EUR
A	Agriculture, forestry and fishing	451,061
B	Mining and quarrying	66,065
C	Manufacturing	478,261
D	Electricity, gas, steam and air conditioning supply	239,660
E	Water supply; sewerage, waste management and remediation activities	97,363
H	Transportation and storage	504,028
F	Construction	805,994
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	322,570
I	Accommodation and food service activities	448,263
J	Information and communication	271,964
K	Financial and insurance activities	253,653
L	Real estate activities	309,216
M	Professional, scientific and technical activities	240,126
N	Administrative and support service activities	132,110
O	Public administration and defence; compulsory social security	367,649
P	Education	180,773
Q	Human health and social work activities	189,183
R	Arts, entertainment and recreation	96,935
S+T	Other service activities; Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	44,281
U	Activities of extraterritorial organisations and bodies	-

2014 Tourism's GDP: Total contribution. Source: World Travel & Tourism Council

Tourism's GDP: Total contribution in 2014. Million €.	733.2
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➤ **Tourism**

Arrivals and overnight stays 2014. Source: MONSTAT

Type of accommodation 2014. Source: MONSTAT	Arrivals		Overnight stays		
	Foreign	Domestic	Foreign	Domestic	Total
Collective accommodation (Hotels, resorts, etc.)	594,841	81,501	2,720,818	364,816	3,085,634
Individual accommodation (Private houses)	755,456	85,578	5,875,838	592,311	6,468,149

## ➤ Energy

Energy balances 2014. Source: MONSTAT

Energy balance of Montenegro, 2014. Source: MONSTAT														
	Electricity	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 briquette	Wood pellets	Charcoal
	GWh	kt							m3		t			
<b>Final energy consumption</b>	1,322.1							1,597.0						
<b>Industry</b>	1,718.0													
<b>Transport</b>	2,610.2	15.7	35.1	17.2	169.8	3.6	33.2	33.5	710,441.0	37,094.0		190.0	2,596.0	802.0
Railways	760.4	6.9	1.0		32.9	1.9	23.3	13.7	39,596.0			54.0	542.0	2.0
Road transport	32.3	6.8	33.4	17.2	126.6	0.9	5.0							
Air transport	18.0						2.0							
Inland navigation		6.8	33.4		124.6		3.0							
Other transport	4.3			17.2										
<b>Households, commerce, pub. auth. etc.</b>	10.0				2.0	0.9								
Households														
Agriculture	1,817.5	2.0	0.7		10.3	0.8	4.9	19.8	670,845.0	37,094.0		136.0	2,054.0	800.0
Other sectors	1,181.5	0.8	0.2					13.9	653,278.0	36,156.0			828.0	537.0

Households' electricity consumption in the 8 most touristic cities (cities with most foreign tourist's overnight stays) in 2014. Source: MONSTAT

City	Local population (inhabitants)	Foreign Overnight stays (No.)	Households' electricity consumption (kWh)
Bar	43,076	1,163,929	101,977,776
Budva	19,837	4,356,139	95,106,638
Herceg Novi	30,763	1,336,455	84,877,325
Kolasin	7,954	31,838	10,354,741
Kotor	22,618	275,447	64,340,259
Podgorica	192,225	112,731	418,480,243
Tivat	14,286	420,414	42,734,210
Ulcinj	20,073	832,836	46,016,772

Energy consumption in airport facilities and land activities in 2014. Source: Podgorica and Tivat airports.

Energy consumption in airport facilities and land activities. Source: Podgorica and Tivat airports			
	Electricity (MWh)	Gasoline (t)	Diesel (t)
Podgorica	3,220.0	1.1	36
Tivat	1,269.7	0.3	28
Total	4,490	1.4	64

## ➤ Transport

Border crossings in 2014. Source: Police authority

Border crossings	Domestic		Foreign	
	In	Out	In	Out
Road	1,133,774	1,211,569	4,415,258	4,033,830
Rail	33,029	34,345	66,607	64,886
Air	119,771	128,777	673,406	700,470

**Air**

**Arrivals and departures from Podgorica and Tivat airports 2014. Source: Podgorica's and Tivat's Airport Authority.**

Origin/Destination	Podgorica (No. of Passengers)		Tivat (No. of Passengers)	
	Arrivals	Departures	Arrivals	Departures
Baku			1,289	1,260
Bari	2,211	5,030	3,802	1,081
Belgrade	128,886	128,729	111,095	114,237
Brno	2,852	2,765		
Brussel	9,546	9,839	6,140	6,136
Budapest	365	375		
Copenhagen	2,664	2,689		
Dnepropetrovsk			4,879	4,745
Ekaterinburg			3,143	3,304
Frankfurt	11,133	11,982	53	
Graz			35	35
Istanbul	30,304	32,280		
Kharkov	35	88	8,098	8,130
Kiev	165	136	27,586	27,640
Ljubljana	12,407	13,217		
London	12,983	12,817	5,672	5,573
Lvov			8,986	8,938
Minsk	8,699	8,867	6,186	6,332
Moscow	17,905	17,922	207,531	208,869
Munich			2,374	2,350
Naples	1,286	2,302	1,631	607
Nizhny Novgorod	1,208	1,133		
Odessa			5,618	5,105
Oslo			3,357	3,067
Ostrava	3,444	746		
Pardubice		2,788		
Paris	16,026	15,971	5,660	5,900
Perm			1,489	1,509
Prague	3,728	3,716		
Rome	16,646	17,724		
Salzburg			74	74
Samara			1,852	1,901
Stockholm			1,455	1,412
St. Petersburg	5,075	5,373	30,488	28,934
Tyumen	1,458	1,496		
Ufa	299	242		
Vienna	33,772	34,454	100	100
Warsaw	2,975	3,040		
Yerevan			333	350
Zurich	11,537	12,642		
Other	7,678	7,946	7,300	6,719

## Maritime

**Number of people arrived by vessels 2014. Source: MONSTAT.**

Number of people arrived by vessels, 2014. Source: MONSTAT	
Total	18,129

**Cruises of foreign vessels in Montenegro 2014. Source: MONSTAT**

Cruises of foreign vessels in Montenegro, 2014. Source: MONSTAT	
Cruises	350
Passengers	306,397

## Tonnage of passenger ships arriving at Port of Kotor in 2014. Source: Port Authority

Tonnage (t, average). Source: Port of Kotor	250	750	3.000	7.500	15.000	25.000	35.000	45.000	75.000	125.000
Passenger ships arriving at Kotor	5	17	99	13	37	4	25	24	70	30

## Average stay at berth at Port of Kotor in 2014. Source: Port Authority

Cruises at berth	
Average stay in port (hours). Source: Port of Kotor	12 hr 25 min

## ➤ Waste

Total quantity of collected Municipal solid waste in 2014. Source: MONSTAT

Total annual quantity of collected MSW (tons)	286,886
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Total CH<sub>4</sub> emitted from Solid Waste Disposal in Montenegro in 2013. Source: NIR

Total CH <sub>4</sub> emitted from SWD (tons)	8,488
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Total CH<sub>4</sub> burned or recovered from landfills in 2014. Source: EPA

CH <sub>4</sub> burned (tons)	236
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## ANNEX III: 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
<b>CO<sub>2</sub> Emission factor (t CO<sub>2</sub>/TJ). Source: NIR</b>	63.1	68.6	70.8	68.6	76.6	73.3	99.2	-	-	-	-	-	-
<b>CH<sub>4</sub> Emission factor (t CH<sub>4</sub>/TJ). Source: IPCC</b>	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
<b>N<sub>2</sub>O Emission factor (t N<sub>2</sub>O /TJ). Source: IPCC</b>	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 <sub>2</sub> Emission factor (t CO <sub>2</sub> /GWh)	479.8
CH <sub>4</sub> Emission factor (t CH <sub>4</sub> /GWh)	0.048
N <sub>2</sub> O Emission factor (t N <sub>2</sub> O /GWh)	0.007

## Road transport (IPCC adjusted)

Emission factors Source: DEFRA	kg CO <sub>2</sub> /unit	kg CH <sub>4</sub> /unit	kg N <sub>2</sub> O/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	kg CO <sub>2</sub> /pass- km	kg CH <sub>4</sub> /pass- km	kg N <sub>2</sub> O/pass- km
Rail	0.01	0.00001	0.00008

## Air transport (IPCC adjusted)

Emission factor Source: DEFRA	kg CO <sub>2</sub> /pass- km	kg CH <sub>4</sub> /pass- km	kg N <sub>2</sub> O/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	kg CO <sub>2</sub> /pass- km	kg CH <sub>4</sub> /pass- km	kg N <sub>2</sub> O/pass- km
Boat	0.12	0.00002	0.000001