Interreg CENTRAL EUROPE

Co-funded by the European Union

Green LaMiS

# Transnational methodology co-design

for the estimation of the Carbon Footprint in the Green LaMis project

Version 5

11 2024

# D 1.1.1. Transnational methodology co-design

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| revision by: | *Luca Studer, Politecnico di Milano* | date: 19/11/2024 | version n° X |
| FINAL VERSION approved by: | *Daniele Bignami FPM - LP (WP.1 leader)* | date: 30/11/2024 | |

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# 1. Introduction

This document represents the Deliverable 1.1.1 of the Interreg CENTRAL EUROPE 2021-2027 CE0200590 - Green LaMiS Project. The document is developed within the Activity 1.1 - *Joint sustainable mobility methodology* of the *WP1 -Assessment and monitoring of services' environmental impact for a Joint Action Plan*

It is intended to present the methodology approach shared and adopted by the Partners of the Project to assess and monitor the environmental impacts of Home Delivered Social Services (HDSS), with specific focus on their carbon footprint related to mobility needs.

This methodology constitutes the theoretical reference for the incoming Project activities. Particularly, it underlies the definition and design of the tool for the estimation of the carbon footprints of HDSS for the Social Enterprises (SE) involved.

# 2. State of the art

The Interreg CENTRAL EUROPE 2021-2027 CE0200590 - Green LaMiS Project focuses on developing a joint transnational solution to green the last mile of HDSS in medium to small sized cities in Central Europe. In particular, the main goal is the reduction of the carbon footprint determined by the mobility dimension of these services.

## 2.1. Carbon Footprint

The carbon footprint represents the total amount of greenhouse gases, primarily carbon dioxide ($CO_2$), that are released into the atmosphere as a direct or indirect consequence of any activity. The estimations of carbon footprints are getting more and more common, being deployable for individuals, products, organizations and companies, …

An extensive set of regulations and references deals with the topic of carbon footprint. An overview of this set is reported hereby.

### 2.1.1. International regulations

At international level, regulations that standardise carbon footprint are often addressed to specific production sectors or large industries, but can also be applied to service providers through corporate sustainability policies and environmental impact management.

- **International protocols on climate change.** The main global references are the Kyoto Protocol and the Paris Agreement, setting global targets for the reduction of greenhouse gas emissions.
- **ISO 14064.** This international standard provides guidelines for the calculation and management of greenhouse gas emissions at company level, including the quantification of the carbon footprint and the verification of compliance. It is relevant for companies willing to assess and reduce their carbon footprint.
- **ISO 50001.** This international standard provides organizations with a framework for establishing effective energy management systems (EnMS). It supports companies systematically track, analyse, and improve their energy performance through a "Plan-Do-Check-Act" cycle, leading to reduced energy costs and environmental impact.

### 2.1.2. European legislation

The European Union recently worked on advanced policies dealing with environmental sustainability.

- **Fit for 55.** It is a set of EU legislative proposals aimed at reducing net greenhouse gas emissions by 55% by 2030 compared to 1990 levels. It includes measures on renewable energy, energy efficiency, transport, buildings, land use and energy taxation [1].
- **European Green Deal.** It is a general EU strategy to achieve climate neutrality by 2050. It includes emission reduction measures for all economic sectors, including service companies [2].
- **EU Industrial Emissions Directive.** Although specific to industrial activities, this directive establishes requirements for emission reduction that can be adopted as a reference for sustainable business practices [3].
- **Environmental certifications.** In Europe, the EMAS (Eco-Management and Audit Scheme) [4] certification promotes a voluntary environmental management system to reduce the environmental impacts of

activities. The subjects adopting this certification can meet a decrease over time on their carbon footprints.

European legislation then finds its transposition within the national regulatory system of each member State.

## 2.2. Carbon emissions for the health and care sector

The whole health and care sector, which includes the HDSS, is responsible of the 4.4% of the global total carbon footprint, emitting 2.0Gt of $CO_{2e}$ in 2014. The transport activities developed within this sector are estimated to cover around the 7% of this amount [5].

As all the other sectors, also the health and care one, is meeting an increasing attention towards environmental sustainability, particularly in terms of reducing greenhouse gas emissions from health facilities and services. In this context, the following initiatives/best practices can be mentioned:

- WHO Strategy for Health and the Environment [6]. It is a comprehensive global framework launched by the World Health Organization to address environmental factors that impact human health. The strategy focuses on preventing diseases and deaths caused by environmental risks like air pollution, unsafe water, poor sanitation, chemical exposure, and climate change. It aims to strengthen health systems, promote sustainable development, and enhance collaboration between health and environmental sectors.
  The strategy emphasizes three main priorities: addressing climate change and health emergencies, reducing environmental risk factors for diseases, and creating healthier settings in communities. WHO works with governments, organizations, and communities to implement evidence-based interventions, develop policies, and build capacity for environmental health protection.
  It promotes strategies to reduce the environmental impact of health services, including recommendations to reduce the carbon footprint through energy efficiency, sustainable transportation and waste management. These principles can also be applied to home care providers.
- Sustainable Healthcare Coalition [7]. It is a UK-based alliance of healthcare organizations, pharmaceutical companies, and medical device manufacturers working together to reduce the environmental impact of healthcare delivery. Founded in 2010, the coalition focuses on developing sustainable practices in healthcare while maintaining high-quality patient care.
  Their key initiatives include measuring and reducing carbon footprints in healthcare supply chains, promoting circular economy principles in medical product design and disposal, and sharing best practices for sustainable healthcare operations. The SHC collaborates with NHS trusts and private healthcare providers to implement green solutions, such as reducing medical waste, improving energy efficiency, and developing more environmentally friendly medical products.
  The coalition also works to influence healthcare policy and provides resources and tools to help healthcare organizations measure and improve their environmental performance.

Focusing on HDSS, even if a specific regulation exclusively dedicated to tackle the issue of their carbon footprint is not available, the general framework of existing environmental policies and regulations provides a solid starting point for developing more sustainable business practices. Compliance with international standards, adoption of sustainable technologies, and access to environmental incentives and certifications represent the main ways to reduce the environmental impact and contribute to the fight against climate change in this sector as well.

# 3. Adopted Co-Design methodology

Among the available international standards, the Green LaMiS Project WP1 adopted as main reference the GHG Protocol (Greenhouse Gas Protocol) [8] to design a methodology intended to assess and monitor the carbon footprint related to mobility needs of HDSS in the three cities involved by the Project: Bergamo (Italy), Szombathely (Hungary) and Klis (Croatia). The GHG Protocol represents an essential global standard for organizations aiming to reduce their environmental impact, improve transparency, and address the challenges of climate change. Its adoption helps companies make informed decisions, demonstrates their commitment to sustainability, and prepares for a low-carbon future.

## 3.1. GHG Protocol

The GHG Protocol (Greenhouse Gas Protocol) is the most widely used international framework for measuring and managing GHG emissions of companies and organizations. Developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the GHG Protocol provides practical tools for businesses, governments, and institutions to quantify, reduce, and manage their GHG emissions.

### 3.1.1. Objectives and Purpose of the GHG Protocol

The GHG Protocol was created to standardize GHG emissions reporting and promote transparency, comparability, and reliability of emission data. Its main objectives include:

- Providing a global standard for measuring and managing GHG emissions.
- Supporting companies in monitoring and reducing emissions across the value chain.
- Facilitating the implementation of public policies and environmental regulations.
- Driving the transition to a low-carbon economy through corporate accountability.

### 3.1.2. Guiding Principles

Five fundamental principles feature the GHG Protocol, ensuring the quality of data and information gathered:

- Relevance: Information should be relevant to support effective corporate decision-making and align with climate goals.
- Completeness: All relevant GHG emissions should be included, avoiding significant omissions.
- Consistency: Consistent calculation methods should be applied to ensure comparability over time.
- Transparency: All information and calculation methods should be documented clearly and accessibly.
- Accuracy: Measurements should be sufficiently precise to provide reliable data.

### 3.1.3. Scopes of Emissions

GHG emissions are categorized into three scopes that cover the full range of corporate activities:

- Scope 1 (Direct Emissions): These emissions come from sources directly controlled by the organization, such as production facilities, company vehicles, and combustion equipment.

- Scope 2 (Indirect Emissions from Purchased Energy): These are emissions associated with the generation of electricity, heat, and cooling purchased by the organization for its operations.
- Scope 3 (Other Indirect Emissions): This category includes all other indirect emissions across the value chain, such as suppliers, logistics, business travel, customer product use, and waste disposal. Scope 3 often represents the largest portion of a company's carbon footprint and includes 15 categories of emissions.

### 3.1.4. Emission Calculation Methods

The GHG Protocol provides various methodologies for calculating emissions, based on primary data (direct measurements) or standardized emission factors. Companies can rely on:

- Activity data: Such as energy consumption or kilometers travelled.
- Emission factors: Predefined values that link an activity (e.g., fuel combustion) to a certain amount of GHG emissions.

### 3.1.5. Reporting and Verification

Companies are required to periodically report their GHG emissions according to GHG Protocol guidelines. Reporting may be independently verified by third parties to ensure compliance with standards and enhance the credibility of the data.

GHG reports include:

- A breakdown of emissions by scope.
- The company's activities and calculation methodologies used.
- Emission reduction targets and progress made.

### 3.1.6. Benefits of Adopting the GHG Protocol

Adopting the GHG Protocol offers several benefits, including:

- Better climate risk management: Companies can identify climate-related risks and develop strategies to mitigate them.
- Competitive advantages: Companies that reduce emissions can improve their reputation, attract investors, and meet consumer demand for more sustainable products and services.
- Regulatory compliance: It helps companies to meet evolving environmental regulations and climate policies.

### 3.1.7. Challenges in Implementation

Despite its advantages, implementing the GHG Protocol can present some challenges, such as:

- Data collection: Accurately measuring Scope 3 emissions, in particular, can be complex as it requires data from suppliers, partners, and customers.
- Initial costs: The adoption of monitoring and management technologies may require significant upfront investments, especially for small and medium-sized enterprises.

## 3.2. GHG Protocol tailored for Green LaMis

The application of the GHG Protocol within the Green LaMiS Project involves a process of customization, so to design a methodology specifically intended for the assessment of the carbon footprint related to mobility needs of HDSS.

This methodology should provide, as far as possible, the following main features, being:

- Agreed among the Partners: It is defined as "co-designed", highlighting the process of engagement of all the subjects involved in the Project in its definition.
- Transferable:
  - It should be deployed in the contexts of the three cities involved in the Project, which are presenting different features from a wide set of perspectives (population, morphology, transport supply, etc.).
  - It should be applied to different typologies of HDSS.
  - It should be possible to allow its application to HDSS in sites not included in the Project.
- Modular: It should be able to be suitably applied with a minimum and easy-to-collect data set, with the possibility of refinements and fine tuning in case of availability of detailed information.
- Replicable over time: After a first application intended to define a baseline for a reference year (i.e. inventory year 2023), it should be easy to apply in the incoming years for benchmarking and monitoring purposes.
- Functional for the assessment of scenarios: It should allow the possibility to evaluate the impacts of single measures of intervention as well as bundle of measures and actions.

### 3.2.1. Operational boundaries of the carbon footprint

The Green LaMiS Project is intended to increase the sustainability of the last mile of public home services delivery. Then, the target of the initiative is represented by the activities of mobility of the involved SE.

Such target determines the operational boundaries of the carbon footprint, that include considering - as source of emissions - those referred to transports, i.e. the movements, whether carried out by private vehicles or by Public Transport (PT) systems.

Sources within the boundaries are then:

- Fleet's vehicles of the SE.
- Individual vehicles used for HDSS.
- Movements carried out with PT.

Other sources of emissions in charge of the involved SE are not targeted by the project and are then outside the operational boundaries of the adopted methodology.

### 3.2.2. Methods

Referring to GHG protocol and considering its application to the Green LaMiS Project, emissions related to the sources within operational boundaries can be estimated by two different methods:

- **Fuel-based method**, which consists of determining the amount of fuel consumed and applying the appropriate emission factor for that kind of fuel.

- **Distance-based method**, which consists of determining the distance, and mode of the movements, then applying the appropriate distance emission factor for the used vehicle.

Considering the emissions by fleet's vehicles and individual vehicles, both methods are fully suitable for the estimation of the carbon footprints in the Green LaMiS Project, even if the fuel-based method should be chosen as a priority, since fuel consumptions is directly related to emissions.

For possible movements carried out with PT, the distance-based method appears as the most suitable solution.

Both methods involve the collection of activity data to be multiplied by appropriate emission factors.

### 3.2.3. Activity data

Activity data to be collected are different, based on the adopted method.

**Fuel-based method**

Quantities of fuel (e.g., diesel, gasoline, biofuels) consumed, to be collected based on aggregated fuel receipts or purchase records.

Indirect estimation that considers the amount spent on fuels and their unitary cost is also allowed.

**Distance-based method**

Actual distances covered with different vehicles/PT, recorded by internal management systems. Estimation based on online maps or calculators is also allowed.

### 3.2.4. Emission Factor

Both methods reported are involving the multiplication of the activity data by suitable emission factors.

**Fuel-based method**

Fuel emission factors, expressed in units of emissions per unit of fuel consumed (i.e. kg $CO_2$/liters or kg $CO_2$/liters)

A useful reference for emission factor for fuel-based method is represented by the EMEP/EEA air pollutant emission inventory guidebook 2023, section 1.A.3.b.i-iv Road transport 2024, Table 3-12 [9].

**Distance-based method**

Emission factor by mode of transport and vehicle types expressed in units of greenhouse gas per distance travelled (i.e. kg $CO_2$/kilometer)

Considering the emissions by fleet's vehicles, emission factors specifically referred to each single vehicle are typically easily accessible, relying on national agencies that store environmental performance of the vehicle parc or on technical information provided by the car manufacturers. However, even in this case, a useful reference is represented by the EMEP/EEA air pollutant emission inventory guidebook 2023, section 1.A.3.b.i-iv Road transport 2024, Table 3-15 [9].

For possible movements carried out with PT, emission factor should consider the distribution of the emissions over the average amount of passengers transported by the vehicle. A suitable reference for this task is represented by the EEA Report No 7/2014 - TERM 2014: transport indicators tracking progress towards environmental targets in Europe, Table A6.2 [10].

### 3.2.5. Managing emission factors for electric vehicles

Emissions determined by electric vehicles are locally null. Nevertheless, emissions caused by the production of electricity consumed by these vehicles must be properly considered.

Activity data should be reported using the **fuel-based** method, providing the quantification of the kWh recharged, based on direct monitoring systems or on estimations that rely on proper conversion factors.

Electricity emission factors, expressed in units of emissions per unit of electricity consumed (i.e. kg $CO_2$/kWh), should be managed referring to two different approaches:

**Location-based**

The location-based method relies on the average emission factor of the electricity grid in the geographical area where electricity consumption occurs. Therefore, it uses a national or regional average emission factor, regardless of the organization's energy procurement choices.

This emission factors specifically referred to each single Country is typically easily accessible, relying on national agencies. A suitable reference at European level is represented by the tool GHG Emission Factors for Electricity Consumption [11].

**Market-based**

The market-based method considers the organization's specific electricity purchasing choices, taking into account:

- Direct contracts with renewable energy providers
- Purchase of renewable energy certificates (GO, REC, etc.)
- Power Purchase Agreements (PPA)
- Energy mix declared by the chosen supplier

The certified share of electricity produced by renewable sources results in zero emissions. The residual amount results in emissions, to be estimated using a residual mix emission factor. The electricity residual mix of a country represents the share of electricity supply for which the energy source is not proven through cancellation of Guarantees of Origin or other Reliable Tracking Mechanisms.

The residual mix emission factor is generally higher than the average grid factor (location-based) because it excludes renewable energy that has already been claimed through contractual instruments.

A suitable reference at European level is represented by the AIB - European Residual Mixes 2023 Report, subject to yearly updates [12].

### 3.2.6. Indicators beyond the Carbon Footprint

The estimated carbon footprint concerning the mobility issues for HDSS represents the main outcome of the application of the methodology.

Nevertheless, additional analysis could be fruitfully developed, to provide further indications on the environmental performances of the SE involved in the Green LaMiS Project. Particularly, the assessment of measures of carbon intensity could be interesting.

Further analyses that correlate carbon footprint with territorial data and the spatial distribution of SE headquarters, SE operators, service users, and the destinations they may need to reach could also be developed. The actual elaboration of such analyses is subordinated to the current possibility of accessing this type of data and their quality.

A set of possible KPIs are reported hereby, structured referring to the topics **carbon intensity** and **territorial analysis.**

Table 1 – KPIs of Carbon Intensity

| Carbon Intensity | | |
|---|---|---|
| KPI | | Notes |
| CI.1 | kg $CO_2$/Service Users | Distribution of the total carbon footprint over the number of Service Users, to allow a fair year by year comparison. Indeed, variation of the number of service users over time can be properly managed. |
| CI.2 | kg $CO_2$/SE Operator | Distribution of the total carbon footprint over the number of the SE operators, to allow a fair year by year comparison. Indeed, variation of the number of the SE operators over time can be properly managed. |
| CI.3 | kg $CO_2$/Vehicles used by the SE | Distribution of the total carbon footprint over the number of the vehicles used by the SE.<br>It lets the definition of the average carbon footprint per vehicle of the fleet. This allows assessments of deviations from this average value of the carbon footprint related to each vehicle, leading to possible strategies to improve efficiency. |
| CI.4 | kg $CO_2$/kms travelled by the vehicles used by SE | Distribution of the total carbon footprint over the overall distance covered by the vehicles used by the SE.<br>Connecting this activity data to other KPIs (primarily KPI nr. 1), a fair year by year comparison can be performed and possible strategies to improve efficiency can be considered. |

Table 2 - KPIs of Territorial Analysis

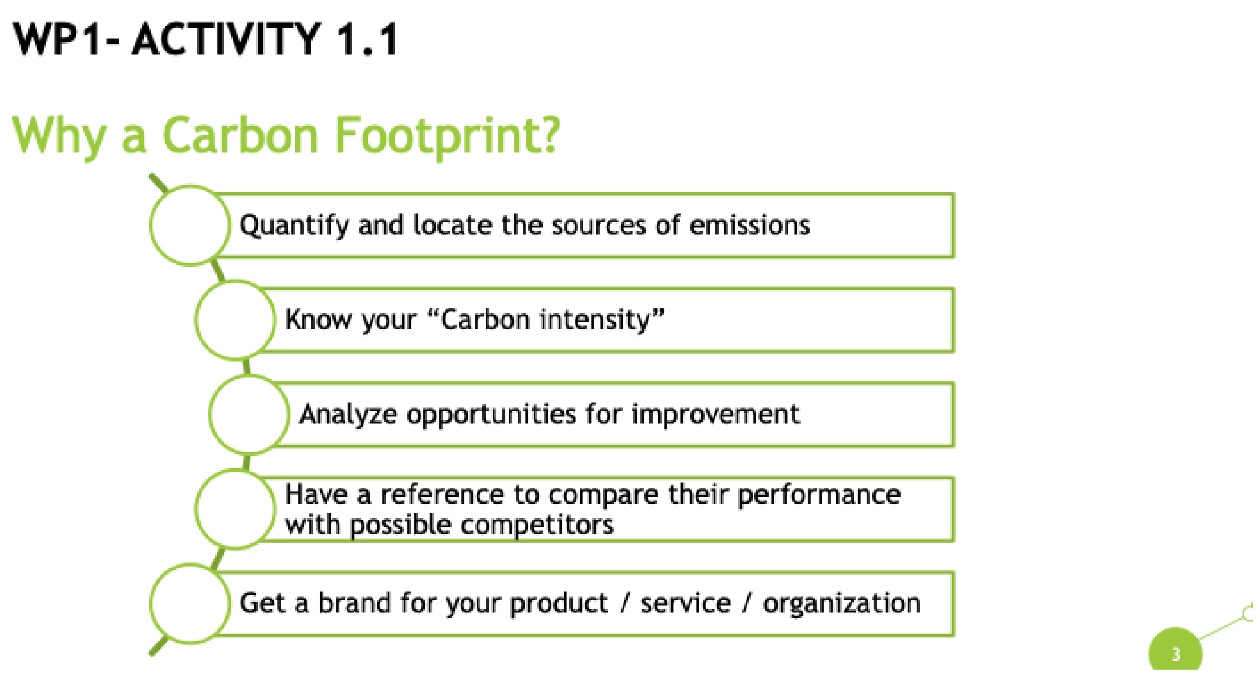
| Territorial Analysis | | |
|---|---|---|
| KPI | | Notes |
| TA.1 | $\frac{kg\ CO_2}{\sum \text{Nr. Service Users within isodistance areas x isodistance thresholds}}$ | Distribution of the total carbon footprint over a territorial elaboration concerning the spatial distribution or Service Users.<br><br>Steps required to define the denominator:<br>1. Definition of isodistance areas originating from the starting point of the services<br>2. Assignment of Service Users to the isodistance areas, based on their address/location<br>3. Calculation of the parameter number of Service Users per isodistance threshold for each isodistance area<br>4. Summation of the parameter calculated considering all the isodistance areas<br><br>The KPI is intended to relate the carbon footprint to the actual localizations of the Service Users on the territory.<br>Such localizations can differ among services and change over time resulting in increases or decreases of the kms travelled not directly under the control of the SEs, leading to variations in the carbon footprint.<br>The KPI aims to allows a more fair and correct comparison between service and over time for each single, limiting the relevance of the actual location on the evaluations.<br><br>This KPI is relevant whatever is the method of evaluation of the carbon footprint (fuel-based or distance-based). |
| TA.2 | $\frac{kg\ CO_2}{\sum \text{Nr. Service Users within isochrone areas x isochrone thresholds}}$ | Distribution of the total carbon footprint over a territorial elaboration concerning the spatial distribution or Service Users.<br><br>Steps required to define the denominator:<br>1. Definition of isochrone areas originating from the starting point of the services<br>2. Assignment of Service Users to the isochrone areas, based on their address/location<br>3. Calculation of the parameter number of Service Users per isochrone threshold for each isochrone area<br>4. Summation of the parameter calculated considering all the isochrone areas<br><br>The KPI is intended to relate the carbon footprint to the actual localizations of the Service Users on the territory.<br>Such localizations can differ among services and change over time resulting in increases or decreases of the minutes travelled not directly under the control of the SEs, leading to variations in the carbon footprint.<br>The KPI aims to allows a more fair and correct comparison between service and over time for each single, limiting the relevance of the actual location on the evaluations.<br><br>This KPI is particularly relevant in case of adoption of the fuel-based method for the evaluation of the carbon footprint. |

# 4. The path towards a Co-Design methodology

The definition of the co-design methodology presented in this document was the result of a process of sharing and comparison with the partners of the Green LaMiS Project.

This path, which has already started from the Project kick-off meeting, was articulated through brainstorming and work phases and through periodic and specific telcos, which saw the active collaboration of the subjects involved.

Hereby a selection of the most significant slides for the definition of the methodology discussed in the working meetings is reported.



## WP1- ACTIVITY 1.1

### GHG accounting and reporting principles


## WP1- ACTIVITY 1.1

### Identify Sources

- ❑ **SCOPE 1: DIRECT GHG EMISSIONS**
  Direct GHG emissions occur from sources that are owned or controlled

- ❑ **SCOPE 2: INDIRECT GHG EMISSIONS**
  Scope 2 accounts for GHG emissions from the generation of purchased electricity, steam, and heating/cooling consumed by the company.

- ❑ **SCOPE 3: OTHER INDIRECT GHG EMISSIONS**
  Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain. Scope 3 emissions include all sources not within an organization's scope 1 and 2 boundary.

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# WP1- ACTIVITY 1.1

## Calculation approach

Whatever is the source ($i$) considered, the methodological approach for the assessment of its emissions is the same:

$$CO_2\ emissions_i = Consumptions_i * Emission\ Factor_i$$

$$Overall\ CO_2\ emissions = \sum_{i=1}^{n} CO_2\ emissions_i$$

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# WP1- ACTIVITY 1.1

## Design of data collection


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# 5. Conclusions

This document represents the Deliverable 1.1.1 of the Interreg CENTRAL EUROPE 2021-2027 CE0200590 - Green LaMiS Project. The document is developed within the Activity 1.1 - *Joint sustainable mobility methodology* of the *WP1 -Assessment and monitoring of services' environmental impact for a Joint Action Plan*

The document resumes the co-design methodology adopted for the assessment of the carbon footprint of HDSS referred to their mobility needs. The methodology results compliant with the GHG Protocol, recognized reference for this topic.

The methodology presents the following features. It is:

- Agreed among the Partners.
- Transferable, meaning appliable to the three cities involved in the Project and to different typologies of HDSS.
- Modular, meaning appliable with a minimum and easy-to-collect data set, but granting refinements and fine tuning in case of availability of detailed information.
- Replicable over time.
- Functional for the assessment of scenarios.

Dealing with the operational boundaries, the methodology is intended to consider $CO_2$ emissions arising from fleet's vehicles of SEs operating the HDSS as well as those coming by the use of PT services.

Related to the actual availability of data, both fuel-based method and distance-based method are appliable.

References are provided to help an effective management of emission factors and, in this context, indications are provided for a fair consideration of emissions determined by electric vehicles, referring to both the location-based and market-based approaches.

Finally, guidelines for analysis beyond the definition of the carbon footprint are reported, with the description of a set of possible KPIs. These are classified into two categories: KPIs of Carbon Intensity and KPIs of Territorial Analysis.

This methodology constitutes the theoretical reference for the incoming Project activities. Particularly, it underlies the definition and design of the tool for the estimation of the carbon footprints of HDSS for the SE involved.

# References

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