LIFE MOONSET
SUSTAINABLE NIGHTIME MOBILITY

D3.1 Environmental Impact Monitoring Plan

Work Package 3

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Executive Summary

The LIFE MOONSET project is a comprehensive initiative focused on evaluating the environmental and social impacts of innovative on-demand electric vehicle shuttle services designed for night workers in Vienna, Lisbon, and Ruse. This project plan outlines the methodology for an in-depth environmental impact assessment aimed at quantifying the benefits of these services across several critical areas. By establishing baseline measurements and continuously monitoring changes during the pilot service implementation, LIFE MOONSET seeks to provide robust data and analysis that will inform the wider adoption of sustainable transportation solutions for night workers across Europe.

The core rationale behind the LIFE MOONSET project stems from the pressing need to transition towards more environmentally friendly and socially inclusive urban mobility options. Night workers often face limited transportation choices, leading to a reliance on private vehicles with associated negative environmental consequences such as greenhouse gas emissions and air pollution. This project addresses this challenge by piloting and rigorously evaluating on-demand electric vehicle shuttle services as a sustainable alternative. The insights gained from this environmental impact analysis are expected to demonstrate the tangible benefits of these services, including a measurable decrease in greenhouse gas emissions, a noticeable improvement in air quality through the elimination of tailpipe emissions in the service areas, and a reduction in overall energy consumption compared to traditional transportation methods. Furthermore, the project anticipates showing a positive impact on urban traffic congestion by offering a shared mobility solution, and a significant shift towards more sustainable transportation choices among night shift workers.

Beyond the direct environmental benefits, the LIFE MOONSET project places a strong emphasis on understanding the broader social implications of these on-demand shuttle services. The environmental impact analysis will be complemented by a thorough evaluation of improvements in transportation accessibility for night workers, a key demographic often underserved by existing public transport, particularly during non-standard hours of operation. User satisfaction with the new service model will be a crucial metric, providing insights into the viability and user acceptance of such solutions. Additionally, the project will examine potential alterations in urban land use patterns, particularly concerning parking infrastructure, as reduced reliance on personal vehicles could free up valuable urban space as well as valuable space on sites of employers, important for other business purposes. This holistic approach, encompassing both environmental and social dimensions, will provide a comprehensive understanding of the overall impact and potential for scalability of the LIFE MOONSET model.

The methodological framework of the LIFE MOONSET project is structured around a rigorous and data-driven approach. Initially, comprehensive baseline measurements of current environmental and social conditions will be established in each of the three pilot cities. This will involve collecting data on existing transportation patterns, air quality levels, greenhouse gas emissions, energy consumption, and accessibility for night workers. Following the launch of the on-demand electric vehicle shuttle services, a period of continuous monitoring will track changes and impacts across the identified key performance indicators. The collected data will then undergo thorough analysis to quantify the environmental benefits and social impacts of the implemented services. Statistical methods will be employed to extrapolate the findings and draw broader conclusions about the effectiveness and overall impact of the on-demand electric vehicle shuttle model.

The ultimate long-term objective of the LIFE MOONSET EIE (Environmental Impact Evaluation) is to develop a resilient and adaptable framework that can be readily adopted by other European cities and regions. This framework will encompass both the detailed methodology for conducting similar environmental impact assessments and a set of clearly defined key performance indicators identified throughout the project lifecycle. By providing a well-defined, tested, and documented approach, LIFE MOONSET aims to significantly contribute to the wider uptake of sustainable transportation options for night workers across Europe. The project anticipates that the evidence-based insights generated by the environmental impact analysis will serve as a compelling case for the implementation of similar on-demand mobility solutions in diverse urban settings, ultimately leading to tangible environmental improvements and enhanced social equity in transportation access for a significant segment of the European workforce. The comprehensive nature of the LIFE MOONSET assessment ensures a deep and multifaceted understanding of the impacts, thereby maximizing the potential for the model's successful replication and widespread applicability across the continent.

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Introduction

LIFE MOONSET

LIFE MOONSET is an innovative and sustainable transportation solution designed for night workers and those with demanding work schedules. The project aims to reduce greenhouse gas emissions, enhance mobility accessibility, and promote sustainable transportation behaviors across Europe. With a focus on creating positive impacts for both workers and the environment, LIFE MOONSET provides a practical solution for cities striving to achieve climate neutrality.

The project's main objectives are to test pilots of on-demand services during the night which aim to meet the transport demand of people who start or end their working lives during the early hours of the morning, when the public transport network has no supply, such as public transport drivers and people who work at airports.

A consortium on partners works on LIFE MOONSET:

- Wiener Linien (coordinator)
- ANA Aeroportos | VINCI Airports
- Municipal Transport Ruse
- TML - Transportes Metropolitanos de Lisboa
- University of Innsbruck | Centre for Mobility Change.
- Via

LIFE MOONSET is co-funded by the European Union as part of the LIFE Program with a total budget of 2,9 million Euro and co-financing share of 60%.

The project started in September 2024 and is scheduled to run through August 2027

Purpose and Scope of the Environmental Impact Evaluation (Work Package 3)

In Work Package 3 of the LIFE MOONSET project, an Environmental Impact Evaluation (EIE) will comprehensively quantify direct and indirect environmental impacts of the on-demand shuttle services implemented in Vienna, Lisbon and Ruse. It aims to identify and measure potential positive and negative environmental effects throughout the service lifecycle, understand their scope and propose mitigation strategies for adverse impacts. A key goal is to create a transferable methodological blueprint for EIE application to similar services across Europe, promoting standardized environmental impact assessment for sustainable urban mobility.

"Environmental Impact" as used in this project specifically includes

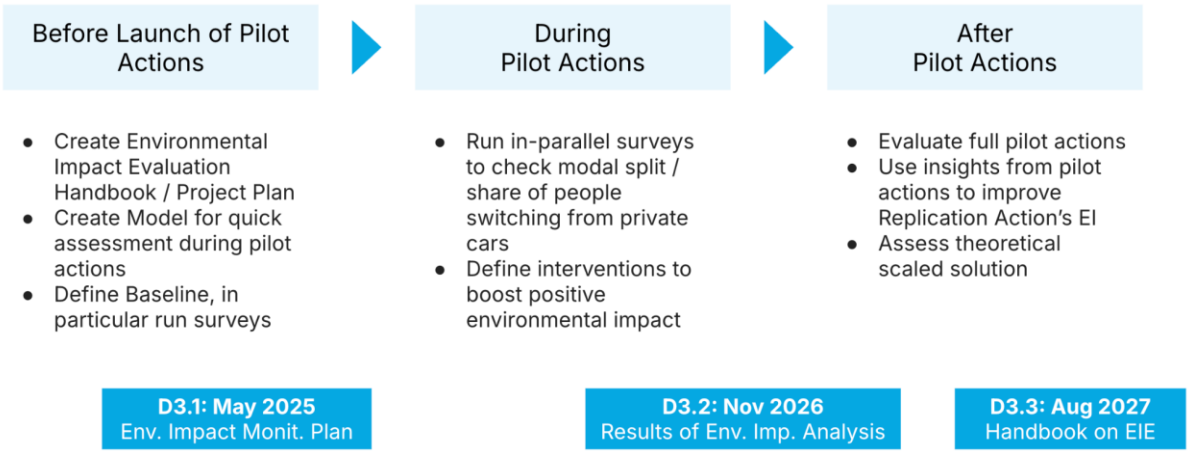
- greenhouse gas emissions (CO_2, CH_4, N_2O) from the fleet, infrastructure, and indirect energy use
- air quality changes
- total energy consumption for vehicle operation and associated facilities
- and land use and infrastructure requirements.

This document, the Environmental Impact Monitoring Plan, is part of the effort in the Work Package and provides a plan for performing an Environmental Impact Evaluation. Within LIFE

MOONSET, this plan will be followed to identify, measure and create mitigation strategies for the three pilot actions.

Project Overview

Within this Environmental Impact Monitoring Plan, the approach to measuring the environmental impact of the pilot actions is documented. Additionally, this Plan serves as a project plan for the execution of the environmental impact analysis throughout the LIFE MOONSET project.



Project Description

Project Components and Expected Impact

In general, the LIFE MOONSET project aims to show positive environmental impact by offering a shared mobility option to a subset of night-time workers. By sharing a vehicle from home to work location and back, and by using battery-electric vehicles with zero emission (locally), the environmental impact of the individual journey to and from work is expected to be lower than the journey by each worker using an individual mobility mode. In all cases, there is no public transportation and the project is set-up to address mostly workers who take a private car to and from work.

Pilot Actions - Project Locations and Settings

The project's goals will be realized in three pilot actions for these populations:

1. tram and bus operator transportation in Vienna, Austria; for more information see https://www.lifemoonset.com/pilot-action-in-vienna.html
2. airport employee transportation in Lisbon, Portugal; for more information see https://www.lifemoonset.com/pilot-action-in-lisbon.html
3. bus operator and general employee population in Ruse, Bulgaria; for more information see: https://www.lifemoonset.com/pilot-action-in-ruse.html

In all cities, between 2 and 4 vehicles will be operated in night-time scenarios in a geographically distinct service area, serving a small number of work locations. This allows for clear boundaries between served and not served employee population.

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Environmental Impact Categories

To focus on measurable factors, for the purpose of LIFE MOONSET Environmental Impact is assessed along these environmental, social and land use key performance indicators (KPIs).

Name	Actual KPI Measured	Description
Environmental - Emissions, Traffic & Mobility Transition		
Reduction in GHG Emissions	Change in CO2 and other greenhouse gases emitted	Measures the decrease in greenhouse gas emissions due to reduced private car usage by nocturnal workers.
Reduction in GHG Emissions on Trip Level	Change in CO2 and other greenhouse gases emitted on a personal level	Measures the decrease in greenhouse gas emissions on a personal level for nocturnal workers
Energy Consumption	Change in energy usage	Measures the difference in energy consumption between using the DRT service and private vehicles.
Air Quality Improvement	Change in levels of local air pollutant NOx and PM2.5	Assesses improvements in air quality due to reduced emissions from private vehicles.
Vehicle Kilometers Traveled (VKT)	Change in total kilometers traveled by private vehicles	Tracks the decrease in distance traveled by vehicles as workers shift to the DRT service.
Pooling Efficiency	Average occupancy rate of DRT vehicles	Monitors how effectively the DRT service pools passengers, optimizing vehicle usage.
Modal Shift	Percentage of workers shifting to environmentally-friendly mobility options	Evaluates the proportion of the target population that switches from using private cars to the DRT service (or other environmentally friendly modes).
Social		
Accessibility Improvement	Change in workplace accessibility for target workers	Measures the enhancement in access to workplaces for workers who previously lacked an option besides their car to get to work
User Satisfaction and Acceptance	Satisfaction level with DRT service	Assesses user satisfaction and acceptance of the DRT service, focusing on convenience and reliability.
Land Use		

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Name	Actual KPI Measured	Description
Parking Utilization and Necessary Parking Area	Changes in parking demand and utilization, translated into changes in necessary area dedicated to parking	Measures the change in parking demand and how it affects the area required for parking facilities.
Overall Dedicated Land Use for the Service	Measures the area used for the operation of the service	Assesses the total land area required for the operation of the DRT service, including vehicle parking and stopping areas.

Environmental KPIs

Fostering a Sustainable Transportation Solution

Emissions

Quantifying the Reduction in Greenhouse Gases and Air Pollutants

Reduction in Greenhouse Gas (GHG) Emissions (Overall)

This critical metric evaluates the overall effectiveness of the Demand Responsive Transit (DRT) service in mitigating climate change by quantifying the total annual decrease in carbon dioxide equivalent emissions directly attributable to the reduced reliance on private vehicles by nocturnal workers. A substantial reduction signifies a significant positive environmental impact.

- **Baseline:** A comprehensive data collection effort is essential to establish an accurate baseline of current GHG emissions from private vehicle usage among the targeted nocturnal worker population. This involves gathering data on vehicle types, fuel efficiency, average trip distances, and frequency of commutes.
- **Baseline Calculation:** To estimate the baseline CO2 equivalent emissions, we will utilize the most recent and relevant European Environment Agency (EEA) averages for emissions per year for the demographic currently driving their own cars to work. This calculation will assume zero contribution from individuals not currently driving. The analysis will focus specifically on the direct home-to-work trip distance to isolate the impact of the commute. Data on the number of commuters within the target group and the average number of working nights per year will be incorporated. Furthermore, we will consider various GHG pollutants beyond just CO2 (e.g., methane, nitrous oxide) and convert them to CO2 equivalents using established global warming potential factors.

Reduction in Greenhouse Gas (GHG) Emissions (Trip Level)

This metric provides a more granular view of the environmental benefits by measuring the decrease in CO2-equivalent emissions per person per kilometer traveled when nocturnal workers utilize the DRT service instead of their private vehicles. This highlights the efficiency gains on an individual trip basis.

- **Baseline:** Similar to the annual GHG emissions baseline, this requires collecting detailed data on the current commuting habits of the target nocturnal workers, including precise

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home-to-work trip distances for each individual. Information on the types and ages of their personal vehicles is crucial for accurate emissions estimations.

- **Baseline Calculation:** The calculation will follow a similar methodology to the annual GHG emissions, using EEA averages for emissions per year for the population driving their own cars (assuming zero contribution from others). The crucial difference is that the estimated emissions will be directly linked to the specific home-to-work trip distance of each worker, allowing for a per-person-kilometer comparison. We will need to estimate the average occupancy of private vehicles during these commutes to accurately compare with the potential occupancy of the DRT service.

Energy Consumption

This indicator focuses on the broader energy implications of the modal shift, measuring the annual difference in total energy consumed by the transportation of nocturnal workers, comparing the DRT service operation with the energy previously consumed by their private vehicles. A reduction in overall energy consumption underscores the efficiency of the DRT system.

- **Baseline:** A thorough analysis of the current energy consumption patterns associated with private vehicles used by the target nocturnal worker population is required. This includes understanding the types of fuel used (gasoline, diesel, electric), the fuel efficiency of the vehicles, and the average annual mileage driven for commuting purposes.
- **Baseline Calculation:** Estimating the baseline energy consumption will involve using EEA averages for emissions per year for the population driving their own cars (assuming zero contribution from others) and converting these emissions figures into equivalent energy units based on fuel type. Again, the direct home-to-work trip distance is the primary focus. We will need to consider the energy intensity of different fuel sources and the energy used in the production and distribution of these fuels to provide a comprehensive assessment. The energy consumption of the DRT service itself (including electricity for electric vehicles or fuel for conventional vehicles, as well as operational energy) will be factored into the "after" scenario to calculate the annual change.

Air Quality Improvement

This crucial category assesses the positive impact of the DRT service on local air quality by quantifying the anticipated reduction in harmful air pollutants, specifically Nitrogen Oxides (NOx) and Particulate Matter (PM2.5), resulting from decreased emissions from private vehicles. Improved air quality directly benefits public health.

- **Baseline:** Establishing a baseline requires utilizing known average emission rates for the types and ages of vehicles currently used by the target nocturnal workers. This data can be sourced from regulatory bodies and vehicle emission standards.
- **Baseline Calculation:** The estimation of NOx and PM 2.5 emissions will utilize EEA averages per year for the population driving their own cars (assuming zero contribution from others). This will be linked to the direct home-to-work trip distance. We will need to consider the different emission standards of the vehicles in the baseline fleet (e.g., Euro standards) to provide a more nuanced and accurate estimation of the current air pollutant load. The potential impact on localized air quality hotspots (e.g., near major

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roadways or industrial areas where nocturnal workers commute) should also be considered.

Traffic

Alleviating Congestion and Optimizing Vehicle Usage

Vehicle Kilometers Traveled

This metric directly measures the reduction in overall traffic volume resulting from the shift of nocturnal workers to the DRT service. A significant decrease in VKT translates to less traffic congestion, reduced wear and tear on infrastructure, and lower fuel consumption on a broader scale.

- **Baseline:** Gathering detailed information on the average daily or weekly commuting distance traveled by private vehicles for the target population is essential. This can be obtained through surveys, travel diaries, or analysis of existing transportation data.
- **Baseline Calculation:** The weekly distance traveled by private car will be calculated based on the collected data on average commuting distance and the number of workdays per week. The calculation will initially assume no additional vehicle kilometers traveled through other modes as a direct consequence of the modal shift away from private cars for commuting. However, in a more detailed analysis, potential increases in other types of travel due to increased convenience or freed-up time could be considered.

Pooling Efficiency

This indicator monitors the average number of passengers per DRT vehicle during operation. A higher pooling efficiency indicates effective route optimization, reduced vehicle trips required to serve the same number of passengers, and consequently, lower operational costs and environmental impact per passenger.

- **Baseline:** Establishing a baseline for current vehicle occupancy rates requires collecting data on the average number of passengers per private vehicle during the typical nocturnal commute of the target population. This can be challenging to obtain accurately and might rely on estimations or assumptions based on household size and vehicle usage patterns.
- **Baseline Calculation:** The calculation will involve estimating the total weekly distance traveled by people making direct home-to-work trips and comparing it to the total weekly distance traveled by the DRT vehicles (including any travel related to reaching the first passenger or returning to a depot after the last passenger). If parking mileage is significant (e.g., workers driving around looking for parking), a realistic average for this additional distance should be defined and included in the vehicle kilometer calculation. The ratio of passenger-kilometers to vehicle-kilometers will provide a measure of pooling efficiency.

Mobility Transition

Facilitating a Shift Towards Sustainable Modes

Modal Shift Rate

This key performance indicator evaluates the success of the DRT service in achieving its primary

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objective of encouraging a shift away from private car dependency. It measures the proportion of the target nocturnal worker population that transitions from using their private cars as their primary mode of transportation for commuting to utilizing the DRT service or other forms of public transportation or micromobility.

- **Baseline:** Conducting comprehensive surveys among the target worker population is necessary to accurately determine their current primary mode of transportation for commuting. This will establish the baseline modal split, indicating the percentage of workers relying on private cars versus other options.
- **Baseline Calculation:** The baseline calculation is straightforward: the share of modes will represent the initial modal split within the target population. After the implementation of the DRT service, follow-up surveys will be conducted to measure the change in these shares, allowing for the calculation of the modal shift rate towards the DRT and potentially other sustainable modes.

Social KPIs

Enhancing Accessibility and User Experience

Accessibility Improvement

This crucial social impact category assesses the extent to which the DRT service improves access to workplaces, particularly for nocturnal workers who do not own private cars and previously faced significant transportation barriers or had limited commuting options. Enhanced accessibility promotes social equity and economic opportunity.

- **Baseline:** A thorough assessment of the current level of access to workplaces for the target population without private cars is required. This involves identifying existing transportation gaps, challenges (e.g., lack of suitable public transport during night hours), and the impact of these limitations on their ability to reliably commute. Qualitative data through interviews and focus groups can provide valuable insights.
- **Baseline Calculation:** The baseline calculation will focus on the share of people within the target population without private cars who report significant difficulties or inability to access their workplaces due to transportation limitations. This will be categorized by the specific reasons for their lack of access (e.g., absence of public transport, unaffordable taxi fares, inconvenient routes). Post-implementation surveys will assess the change in this share and the perceived improvement in accessibility due to the DRT service.

User Satisfaction and Acceptance

The long-term success and sustainability of the DRT service depend heavily on user satisfaction and acceptance. This category assesses the level of contentment and positive perception among users regarding the DRT service, particularly focusing on aspects such as convenience, reliability, comfort, safety, and overall user experience.

- **Baseline:** Initial surveys, focus groups, or in-depth interviews should be conducted with the target nocturnal worker population prior to or shortly after the launch of the DRT service to gauge their current satisfaction levels with their existing transportation options and their initial perceptions and expectations of the new service.
- **Baseline Calculation:** There is no baseline for this KPI.

Land Use KPIs

Enhancing optionality in land use

Parking Utilization and Necessary Parking Area

This KPI assesses the impact of the DRT service on parking infrastructure by measuring the change in parking demand and the corresponding area needed for parking. A reduction in parking demand can free up valuable urban space and potentially decrease the need for extensive parking facilities.

- **Baseline:** Collect data on current parking utilization rates for the target demographic at their workplaces and residential areas. This includes the number of parking spaces available and the average occupancy rates during typical commuting hours. Also gather data on the total land area currently dedicated to parking for this group.
- **Baseline Calculation:** This calculation will involve analyzing the collected data to determine the average parking space occupancy rates and the total parking area used by the target group before the DRT service implementation. Factors like the number of commuters, their work schedules, and the availability of alternative transportation options will be considered.

Overall Dedicated Land Use for the Service

This KPI quantifies the total land footprint required for the operation of the DRT service. This includes the area needed for parking the DRT vehicles when not in service, as well as the space occupied by designated stopping areas or any other infrastructure directly related to the DRT service operation.

- **Baseline:** Assume as 0 for baseline, as the land use is directly attributable to the new service. Data will be collected on the area required for parking the DRT fleet and the footprint of any dedicated stopping infrastructure.
- **Baseline Calculation:** This calculation will involve summing the area allocated for DRT vehicle parking (based on the number and size of vehicles) and the total area of all designated DRT stopping areas. This will provide a measure of the new land dedicated to the DRT service.

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Environmental Impact Evaluation Methodology

Impact Evaluation Framework

The environmental impact evaluation within LIFE MOONSET follows a structured framework. First, a **baseline** of the current environmental conditions for the target populations in each pilot city is established. The project then introduces a **change** through the implementation of the pilot actions, the local on-demand electric vehicle services. The core of the evaluation involves **measurement** of the key environmental indicators (see section Environmental Impact Categories) - before, during and after the pilot action, to reflect the baseline, affected change and longer-term behavior, respectively. By comparing these measurements, the environmental **consequences** of the basic introduction and possible interventions can be determined. Finally, the results of these pilot evaluations will be used for **extrapolation**, aiming to understand the potential wider impacts and applicability of this type of sustainable mobility solution in other European cities and contexts.

The baseline or reference situation is the current state of transportation and related environmental conditions in Vienna, Lisbon, and Ruse before the implementation of the LIFE MOONSET on-demand shuttle services. This includes for example the existing levels of GHG emissions, air pollutants, energy consumption, traffic volume, and modal split for the target populations of night workers in each city. Surveys are used to generate the relevant data.

During the project, the environmental impact evaluation will assess the *changes* in these baseline conditions as a direct and indirect result of the introduction and operation of the DRT services. This involves measuring for example shifts in transportation modes, alterations in vehicle kilometers traveled, the energy consumption of the electric vehicle fleet, and the resulting changes in emissions and air quality within the defined service areas. The evaluation will compare pre-project data with data collected during and after the pilot actions to quantify these changes.

After the project, the results from the pilot actions are carefully extrapolated to allow for an estimation of the environmental impact of a roll-out of similar services in varied locations and scales. To achieve this, impacting variables need to be defined and assessed that need to be accounted for during this extrapolation.

Data Collection Methods

To allow measurements, the KPIs need a variety of data collection methods.

For **emissions**, the information for baseline is collected through survey data on current model year of the private vehicle used. Combining this with existing EEA data on actual emissions of the local private car fleet of this year all emissions KPIs can be calculated. The lack of specificity with regard to the actual vehicle used is necessary to preserve privacy and enable a high survey response rate. An assumption made in this section is that the overall private vehicle fleet is representative of the vehicles used by the workers transported as part of the pilot actions.

For **traffic and mobility transition** KPIs, actual location data for home and work is used to define likely travel paths and driving distances. Combined with survey data for shared rides as well as transportation mode, the relevant KPIs can be calculated

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The **social** impact is exclusively measured through survey data. Here, standard survey methods need to be used to ensure unbiased information on the relevant soft factors, in particular for satisfaction.

Land use is most directly measurable through actual on-the-ground operational information.

Evaluation Criteria

For each of the KPIs, an improvement direction is defined.

For **emissions**, each of the KPIs is defined as a change with respect to the baseline. For an improvement, these numbers need to be negative.

For the **traffic**-related KPIs, vehicle kilometers should be minimized and the relevant KPI defines a change vs. the baseline and should therefore be negative. Pooling efficiency however should be higher than the baseline meaning more sharing of vehicles.

The indicator of the **mobility transition** is the modal shift into environmentally friendly mobility options and the relevant KPI should be higher than the baseline value.

The **social** KPIs are reflecting an improvement through a positive change in accessibility and a high satisfaction level of more than 90%.

Land use for parking and operations should be minimized and thus the relevant indicators negative as low as possible.

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Activities

Work Package 3 on evaluating the environmental impact is operational along the full project duration, from before launch until after conclusion of all pilot actions. This includes activities around baselining for the pilot actions, the monitoring, evaluation and possibly interventions throughout the duration of the pilot actions, as well as defining the environmental impact of the actions after conclusion of their pilot project duration and an extrapolation of this impact to larger-scale projects in the same or different regions. Lastly, the results and insights are reported as one of the last tasks in the LIFE MOONSET project.

Impact Calculation Model

As a key component of Work Package 3 and separate from pilot action-related activities, a comprehensive calculation model for all Key Performance Indicators (KPIs) will be developed. This process includes defining the calculation methods for each KPI based on the anticipated survey data. External data on emissions from the European Environment Agency (EEA) will be integrated into these calculations. As additional input, a methodology for determining travel paths will be established, based on home and work GPS locations.

Baselining

The initial baseline data collection and analysis will involve several key steps.

First, surveys will be designed, including the formulation of specific questions and the identification of the target participants. This will be done in collaboration with UIBK/AIT and the pilot action leads to coordinate with other surveys performed as part of LIFE MOONSET. Following survey administration, the collected responses will undergo a validation process to ensure accuracy and reliability before using them as the main input into KPI calculations.

In parallel, the initial land use conditions relevant to the pilot actions will be established by the consortium partners Wiener Linien, ANA and MTR.

During Project

While the full environmental impact analysis will only be delivered after the full project duration is concluded, it is essential to monitor and evaluate the impact throughout the project and intervene when service performance can be improved.

Monitoring and Evaluation

Throughout the pilot project, the environmental impact will be actively monitored and evaluated. This will involve the use of short, targeted in-app surveys, designed to gather the most valuable information, with specific questions tailored to each pilot action and defined after the initial baselining phase. A more comprehensive survey may also be conducted mid-pilot to obtain holistic feedback on the project's status. Where complete data is unavailable, an approximation of the environmental change will be calculated by multiplying the number of service users by the average impact of a single trip in the on-demand service. Furthermore, a cost-per-impact analysis will be performed to identify potential additional steps that can be implemented within the project's budgetary constraints.

Interventions

During the pilot project, interventions may be necessary to optimize the service. These adjustments could involve modifying the service design, such as including a different mix or number of users (e.g. geographically) or implementing pricing changes as already planned in Vienna and under discussion in Lisbon. Efficiency can be further enhanced by optimizing demand and supply matching, refining service times, and strategically locating wait areas. A crucial aspect of these adjustments is balancing the cost of operation with the desired environmental impact and user up-take and long-term satisfaction. Furthermore, targeted marketing efforts can be used to attract the intended rider population, ensuring the service effectively addresses their needs and contributes to the project's goals.

After Project

Following the pilot actions, comprehensive surveys will be conducted to measure the full impact of the initiatives. The questions and target survey population will be carefully defined and may be different from the initial baseline questions and survey population, leveraging insights gained during the monitoring and intervention phases to ensure relevance. These surveys will then be administered, and the collected responses will again undergo a thorough validation process to ensure data accuracy and reliability. Concurrently, the pilot action implementers will define the changes in land use resulting from the project. The after-project Key Performance Indicators (KPIs) will be calculated using the established model, and finally, all gathered data and analyses will be compiled to generate comprehensive insights into the environmental impact of the LIFE MOONSET project.

Reporting

The reporting of the Environmental Impact Evaluation is a continuous process throughout the LIFE MOONSET project:

- Initial reports will be generated at the commencement of each pilot action, focusing on the baseline results gathered prior to implementation. These reports will serve to establish the initial conditions and provide a foundation against which the impact of the interventions can be measured.
- Subsequent reporting will occur at the conclusion of each pilot action, detailing the specific outcomes and environmental effects observed in Vienna, Lisbon, and Ruse.
- A final comprehensive report will be produced at the end of the entire LIFE MOONSET project, consolidating the findings from all pilot actions and offering a holistic view of the project's overall environmental impact and key insights.

For the initial baseline reports, the emphasis will be on presenting predictions and crucial insights about the target populations in each pilot city based on the collected data. This will provide valuable context for understanding the potential for impact and the specific characteristics of the communities being served.

The core of the subsequent reporting will be the analysis of environmental impact in relation to the implemented pilot action measures. This comparative approach will allow for the identification of the beneficial strategies and service design choices that contributed to positive environmental outcomes. Furthermore, the reporting will highlight variables that demonstrated low environmental impact, indicating areas where decisions can be made without detailed

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evaluation of environmental impact. Lastly, the findings will be abstracted from direct measurements to more accessible and high-level service design recommendations, facilitating easy communication and application of the project's lessons learned.

The project will also generate several key documents to disseminate its findings, including a best practice guide for broader distribution and publication, an executive summary for concise communication of key results, a website blog entry for public engagement, and a press statement for media outreach. Additionally, detailed, low-level documentation of all results will be created, with references to underlying data in spreadsheets to ensure transparency and allow for in-depth review.

Project Management

Team Roles and Responsibilities

The evaluation of environmental impact within the LIFE MOONSET project is a collaborative effort, with clearly defined roles and responsibilities distributed among the participating partners. Via, as the leader of Work Package 3, holds the central role in this endeavor. This encompasses the coordination of all team members involved in the environmental impact assessment, the crucial task of creating and maintaining the calculation model for the Key Performance Indicators (KPIs), and ensuring the integrity and quality of the input data. This data quality assurance is conducted in close collaboration with both UIBK/AIT and the partners leading the individual pilot actions. Furthermore, Via is responsible for deriving meaningful insights from the calculated KPI results and for the creation of comprehensive reports detailing the findings of the environmental impact evaluation.

The responsible parties for each of the pilot actions in Vienna, Lisbon, and Ruse play a vital role in supporting the data collection and the practical application of the evaluation framework. Their responsibilities include actively supporting the distribution of surveys to the target populations, undertaking the necessary measurements related to land use within their respective pilot locations, and facilitating the coordination and implementation of any interventions deemed necessary during the course of the project. Perhaps most importantly, these local partners are tasked with fostering an understanding of the environmental insights generated and acting as multipliers, promoting the long-term sustainable establishment of the on-demand services to ensure lasting environmental benefits.

The University of Innsbruck | Centre for Mobility Change (UIBK/AIT) contributes its expertise in survey design and distribution to the project. This includes the co-creation of surveys for both the initial baselining phase and the post-project evaluation, as well as providing support in the definition of concise in-app survey questions that can be used for monitoring during the pilot actions. UIBK/AIT also plays a critical role in aligning the survey timelines to ensure effective engagement and data collection from the target populations in each pilot city. Finally, TML - Transportes Metropolitanos de Lisboa takes the lead in the communication of the project's results and insights. This involves supporting the preparation of publications based on both intermediate findings and the final comprehensive report for each of the pilot actions, ensuring that the valuable knowledge gained is effectively disseminated to relevant stakeholders and the wider public.

Schedule and Timeline

Year	2024		2025				2026				2027		
Quarter	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**
LIFE MOONSET Project	*September 2024 - August 2027*												
Impact Calculation Model													
Pilot Action Vienna													
Baselining													
Monitoring, Evaluation & Intervention													
After Project Evaluation													
Pilot Action Lisbon													
Baselining													
Monitoring, Evaluation & Intervention													
After Project Evaluation													
Pilot Action Ruse													
Baselining													
Monitoring, Evaluation & Intervention													
After Project Evaluation													
Reporting													
Milestones				Environ- mental Impact Monitoring Plan	Baseline Surveys		Mid-Point Surveys		End-of-Pilot / Baseline Surveys	End-of- Pilot Report for Vienna and Lisbon	Mid-Point Survey	End-of-Pilot Survey	End-of- Pilot Report for Ruse and End-of- Project Report

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Appendix: KPI Overview

Name	Actual KPI Measured	Dimension of Metric	Description	Baseline Requirement	Specific Baseline Survey Questions	Calculation of Baseline (and future updates)
General Mobility					How do you get to work on most days during the last week you worked? "I drove my car/a car sharing car", "I rode with somebody else", "I used a bike", "I used public transit", "I walked"	
Environmental - Emissions, Traffic and Mobility Transition						
Reduction in GHG Emissions	Change in CO2 and other greenhouse gases emitted	Metric tons of CO2 equivalent/ year	Measures the decrease in greenhouse gas emissions due to reduced private car usage by nocturnal workers.	Collect data on current CO2 and other greenhouse gas emissions from private vehicle usage among target workers.	If you took your own car: What year was your car initially registered?	Use EEA averages for emissions per year to estimate CO2 equivalent emissions for the population driving their own car. Assume 0 contribution from the rest for baseline numbers. Use trip distance for direct trip from home to work
Reduction in GHG Emissions on Trip Level	Change in CO2 and other greenhouse gases emitted on a personal level	gCO2e per person-kilometer	Measures the decrease in greenhouse gas emissions on a personal level for nocturnal workers	Collect data on current CO2 and other greenhouse gas emissions from private vehicle usage among target workers, as well as current trip distan-ces for their commute	see reduction in GHG emissions	Use EEA averages for emissions per year to estimate CO2 equivalent emissions for the population driving their own car. Assume 0 contribution from the rest for baseline numbers. Use trip distance for direct trip from home to work

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Name	Actual KPI Measured	Dimension of Metric	Description	Baseline Requirement	Specific Baseline Survey Questions	Calculation of Baseline (and future updates)
Energy Consump-tion	Change in energy usage	Megajoules or Kilowatt-hours/year	Measures the difference in energy consumption between using the DRT service and private vehicles.	Analyze current energy consumption patterns of private vehicles used by target workers.	see reduction in GHG emissions	Use EEA averages for emissions per year to estimate energy consumption for the population driving their own car. Assume 0 contribution from the rest for baseline numbers. Use trip distance for direct trip from home to work
Air Quality Improvement	Change in levels of local air pollutant NOx and PM2.5	Micrograms per cubic meter ($\mu g/m^3$)	Assesses improvements in air quality due to reduced emissions from private vehicles.	Utilize known avg. emissions of vehicles workers currently use	see reduction in GHG emissions	Use EEA averages for NOx and PM 2.5 emissions per year to estimate energy consumption for the population driving their own car. Assume 0 contribution from the rest for baseline numbers. Use trip distance for direct trip from home to work
Vehicle Kilometers Traveled (VKT)	Change in total kilometers traveled by private vehicles	Motor Vehicle Kilometers (non-fixed route) for all workers/ year	Tracks the decrease in distance traveled by vehicles as workers shift to the DRT service.	Gather information on the average distance traveled by private vehicles for commuting purposes by the target population.	How many times per week have you made the trip between home and work (there and back) during the last 7 days? If you took your own car: What is the distance between your place of work and home you take per day (your typical driving distance, without detours for running errants)	Calculate weekly distance traveled with private car. Assume 0 additional vehicle km through other modes of transport

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Name	Actual KPI Measured	Dimension of Metric	Description	Baseline Requirement	Specific Baseline Survey Questions	Calculation of Baseline (and future updates)
Pooling Efficiency	Average occupancy rate of DRT vehicles	Passenger-km / Vehicle-km for DRT service	Monitors how effectively the DRT service pools passengers, optimizing vehicle usage.	Establish a baseline for current vehicle occupancy rates by collecting data on the number of passengers per vehicle.	If you took your own car or shared a car with others: How many people were on average in your vehicle driving to or from your place of work? If you took your own car: On how many days did you find a parking spot at work and at home without needing to search for more than 2 minutes, during the last week you worked?	Calculate weekly distance traveled by people (direct trip) and by vehicles (incl. parking travel: see if we need to define a realistic avg. if there is lots of parking mileage)
Modal Shift	Percentage of workers shifting to environ-mentally-friendly mobility options	Percentage (%)	Evaluates the proportion of the target population that switches from using private cars to the DRT service (or other environmentally friendly modes).	Conduct surveys to determine the current mode of transportation used by the target workers.	See initial question	Share of modes = modal split
Social						
Accessibility Improvement	Change in workplace accessibility for target workers	Access score or percentage improve-ment	Measures the enhancement in access to workplaces for workers who previously lacked an option besides their car to get to	Assess current access to workplaces for the target population, identifying any transportation gaps or challenges.	Do you have another way to reach your place of work, other than a car? If no: What is missing? "no Fixed Route connection at the time I need it", "fixed route connection takes too long", "too far to use a bike", "too far to walk" [include DRT in follow-up surveys]	Share of people who say no, split by reasons.

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Name	Actual KPI Measured	Dimension of Metric	Description	Baseline Requirement	Specific Baseline Survey Questions	Calculation of Baseline (and future updates)
			work			
User Satisfaction and Acceptance	Satisfaction level with DRT service	Satisfaction score (e.g., Likert scale)	Assesses user satisfaction and acceptance of the DRT service, focusing on convenience and reliability.	Conduct initial surveys or focus groups to gauge current satisfaction levels with existing transportation options.	[pilot actions to define specific questions depending on addressed target populaton]	
Land Use						
Parking Utilization and Necessary Parking Area	Changes in parking demand and utilization, translated into changes in necessary area dedicated to parking	Square meters or percentage change	Measures the change in parking demand and how it affects the area required for parking facilities.	Collect data on current parking utilization rates and the total area dedicated to parking for the target demographic.		[to be generated by local infrastructure teams]
Overall Dedicated Land Use for the Service	Measure the area used for the operation of the service (parking of	Square meters	Assesses the total land area required for the operation of the DRT service, including vehicle	Assume as 0 for baseline		[to be generated by local infrastructure teams]

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Name	Actual KPI Measured	Dimension of Metric	Description	Baseline Requirement	Specific Baseline Survey Questions	Calculation of Baseline (and future updates)
	vehicles + stopping areas)		parking and stopping areas.			

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Contact Information

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