Project *Life*-NEEVE:

Innovative technologies to monitor and reduce Non-Exhaust Emissions, particles and microplastics of VEhicles and pavements to improve air quality and human health

LIFE-2023-SAP-ENV

(Circular Economy and Quality of LIFE-Standard Action Projects (SAP))

Deliverable D5.2:

# KPI mid-term monitoring


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| Deliverable No. | D5.2 |
| Deliverable Title | KPI mid-term monitoring |
| Dissemination | Public |
| Authors and partner acronyms | Zulkeefal Dar, RDT<br>Veronica Yunta Escribano, RDT<br>Francisco Jose Lara Garachana, RDT<br>Enrique Barrajón Catalán, UMH<br>Mats Gustafsson, VTI<br>Victor Garcia Rabadan, CTCON<br>Marie Lenz, HORIBA<br>Guido Weigt, HORIBA<br>Pedro Miguel Martinez, PAUDIRE<br>David Sanz, CIEMAT<br>Ana Aranda Carmona, CHM<br>Adrián Urdiáin Goñi, ICERBRAKES<br>María José Periáñez Ordóñez, US |
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| First version, date | 13/04/2026 |
| This version, date | 27/04/2026 |

# SUMMARY

This Deliverable has been developed within Work Package 5 and presents the mid-term monitoring and evaluation of the Key Performance Indicators (KPIs) of the LIFE NEEVE project. While Deliverable D5.1 established the common monitoring methodology, baseline values, and target indicators, the present document reports the KPI values collected from project start until the mid-term reporting period and assesses progress in relation to the expected results.

The KPIs contribute to evaluating the environmental, climate, socio-economic, governance, and dissemination-related impacts of the LIFE NEEVE project in line with the objectives of the LIFE Programme. The reported values are analysed against the initial targets, and, where needed, updates to KPI values or monitoring elements are identified and justified in order to improve consistency and measurability during reporting.

Overall, this deliverable supports a clear and structured mid-term assessment of project progress across the main KPI areas. It contributes to consistent KPI reporting within the project and to compliance with LIFE Programme requirements, while also supporting the continued monitoring of project progress for the remaining implementation period.

# List of abbreviations and symbols

In this Deliverable abbreviations or symbols in the table below are often used.

| Abbreviation | Explanation | Comment |
|---|---|---|
| **Partners, companies or institutions related to this project** | | |
| RDT | RDT Ingenieros Madrid S.L. | Partner |
| US | Universidad de Sevilla | Coordinator / Partner |
| CHM | CHM Obras e Infraestructuras S.A. | Partner |
| CIEMAT | Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas | Partner |
| HORIBA | HORIBA Europe GmbH | Partner |
| ICERBRAKES | ICER Brakes S.A. | Partner |
| PAUDIRE | Paudire Innova S.L. | Partner |
| UMH | Universidad Miguel Hernández de Elche | Partner |
| VTI | Statens Väg- och Transportforskningsinstitut | Partner |
| CTCON | Centro Tecnológico de la Construcción Región de Murcia | Partner |
| **Technical terminology** | | |
| RDT | Real driving tests | |
| RDE | Real Driving Emissions | |
| KPI | Key Performance Indicator | |
| WP | Work Package | |
| NEE | Non-exhaust emissions | |
| TSP | Total suspended particles | |
| FTE | Full-time equivalent | |
| PM10 | Particulate matter with aerodynamic diameter below 10 µm | |
| PM2.5 | Particulate matter with aerodynamic diameter below 2.5 µm | |
| CFD | Computational fluid dynamics | |
| NGO | Non-governmental organization | |
| ICE | Internal combustion engine | |
| LDV | Light-duty vehicle | |
| **Measures and units** | | |
| km² | Square kilometres | |
| m² | Square metres | |
| % | Percentage | |
| € | Euro | |
| g/year | Grams per year | Used for emissions |
| mg.km$^{-1}$.veh$^{-1}$ | Milligrams per kilometre per vehicle | Used for emission factors |
| #.km$^{-1}$.veh$^{-1}$ | Number of particles per kilometre per vehicle | Used for PN emission factors |
| #.km$^{-1}$.wheel$^{-1}$ | Number of particles per kilometre per wheel | Used for tyre/pavement emission factors |

| Abbreviation | Explanation | Comment |
|---|---|---|
| #.cm$^{-3}$ | Number of particles per cubic centimetre | Particle concentration |
| °C | Degrees Celsius | Temperature |
| km/h | Kilometres per hour | Vehicle speed |

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# 1. Introduction

The LIFE NEEVE project aims to improve air quality, strengthen regulatory frameworks, and enhance the sustainability of road transport by addressing non-exhaust emissions (NEE) from brakes, tyres, and road surfaces. Through the development, validation, and demonstration of innovative monitoring systems and technological solutions, the project contributes to reducing particulate matter and microplastic emissions while supporting evidence-based policymaking across Europe.

Within this framework, Work Package 5 establishes and monitors Key Performance Indicators (KPIs) to assess the environmental, socio-economic, and governance impacts of the project. Deliverable D5.1 defined the common monitoring methodology, baseline values, and expected results in alignment with the Grant Agreement and LIFE Programme requirements.

The present Deliverable D5.2 builds upon this foundation and reports the progress achieved during the mid-term of the project implementation period. It provides an updated assessment of KPI implementation status and reflects any necessary refinements to ensure consistency, transparency, and alignment with the project objectives and reporting obligations.

# 2. Purpose and objectives

The purpose of this deliverable. D5.2, is to report the Key Performance Indicators (KPIs) collected from project start until the mid-term reporting period, based on partial implementation and available data, and to assess these results against the initially expected outcomes as part of Task T5.1. While Deliverable D5.1 established the monitoring framework, KPI definitions, methodologies, and target values based on the indicators defined in the Grant Agreement (Part C), Deliverable D5.2 focuses on implementation progress and evaluation. The KPI framework developed in D5.1 was structured and refined in alignment with the recommendations of Dimas Ramos (KPIs manager of the Iberian LIFE project monitoring team) and subsequently reported through the LIFE KPI webtool as part of the project reporting (Deliverable D1.3), which was reviewed and approved by Dimas Ramos and CINEA..

This deliverable presents the mid-term KPI values together with their justification and assesses their consistency with the planned trajectory towards project-end and targets. To prevent duplication, the detailed methodological descriptions and full KPI definitions remain documented in Deliverable D5.1. In this deliverable, only concise descriptions and the updated values are presented, unless modifications to the monitoring methodology or KPI targets have been required. In such cases, updates are clearly identified and justified. Where relevant, specific KPIs have been revised to reflect updated assumptions, improved data availability, or methodological clarifications. Through this structured monitoring exercise, the deliverable supports evidence-based project management and facilitates compliance with LIFE Programme reporting requirements.

## 2.1. Objectives of Task T5.1

Task T5.1 aims to establish and implement a common methodology for monitoring the Key Performance Indicators (KPIs) of the LIFE NEEVE project, ensuring consistency across all

partners and work packages. Building on the framework defined in Deliverable D5.1, this task focuses on the systematic collection and evaluation of KPI data throughout the project, enabling comparison between baseline, mid-term, and target values. This approach supports a coherent assessment of project impacts while providing the basis for identifying deviations and enabling timely corrective actions where necessary.

## 2.2. Role of KPI monitoring in the NEEVE project

KPI monitoring plays a central role in the LIFE NEEVE project by enabling the quantitative assessment of its environmental, socio-economic, and technical impacts. It provides a structured link between the activities carried out in the different work packages (WP2–WP4 and WP6) and the overall project objectives, ensuring that progress is measurable and aligned with expected outcomes. By systematically tracking KPI values over time, the monitoring process supports both internal project management and reporting requirements, while also enabling the early identification of deviations from targets and guiding the implementation of corrective actions where necessary.

## 2.3. Link with LIFE programme reporting requirements

KPI monitoring in the LIFE NEEVE project is directly aligned with the reporting requirements defined in the LIFE Programme. The project commits to systematically collect, validate, and report KPI data to demonstrate its environmental and socio-economic impacts, using the KPIs described in Deliverable D5.1, based on indicators defined in Part C (from GA). In accordance with the impact monitoring and reporting framework, KPI values are periodically consolidated and reported through the LIFE reporting tools, ensuring consistency, traceability, and comparability over time.

## 2.4. Structure of the report

This deliverable is structured to provide a clear and consistent overview of KPI monitoring at mid-term. It first outlines the objectives and role of KPI monitoring within the project, followed by a description of the methodology applied for data collection, validation, and reporting. The main body of the report presents the mid-term status of all KPIs, including their current values, updates to D5.1 values and supporting justifications. Finally, the deliverable includes an assessment of progress towards project targets, identifying any deviations and defining corrective measures and adjustments to ensure alignment with the expected impacts and reporting requirements.

# 3. Methodology for KPI Monitoring

## 3.1. Definition of NEEVE KPIs (based on Part C)

The KPIs monitored in the LIFE NEEVE project are based on those defined in the Grant Agreement (Part C) and as outlined in Section 2, were further refined into a more structured and measurable framework in Deliverable D5.1. These indicators are designed to quantify the environmental, socio-economic, and governance impacts of the project, ensuring alignment with

LIFE Programme objectives. Each KPI is associated with a baseline value, primarily derived from WP2 data or existing references, as well as target values at project completion and, where relevant, projections for 3–5 years beyond the project to reflect long-term impact. At mid-term stage, the same set of KPIs is maintained to ensure consistency and comparability over time, with clarifications introduced where necessary based on implementation experience and data availability, without altering the original intent or scope of the indicators.

## 3.2. Sources of KPI data and verification methods

KPI data in the LIFE NEEVE project is collected from multiple sources across the different work packages, ensuring alignment with the definitions and verification approach established in Deliverable D5.1. Primary data sources include experimental and laboratory results (WP2 and WP3), pilot and demonstration activities (WP4), and dissemination and stakeholder engagement activities (WP6), as well as partner-reported data. In line with the requirements defined in the Grant Agreement, each KPI is supported by appropriate sources of verification to ensure credibility of the reported values, maintained by the responsible partners. These include, where applicable, measurement datasets, laboratory and technical reports, attendance lists, dissemination records, and internal documentation maintained by the responsible partners. This approach ensures that all KPI values reported at mid-term are evidence-based and consistent, while allowing sufficient flexibility to accommodate the diversity of indicators within the project.

## 3.3. Monitoring framework and data collection procedures

The monitoring framework for KPI tracking in the LIFE NEEVE project follows the structured approach defined in the Grant Agreement and further detailed in Deliverable D5.1, ensuring consistent data collection and reporting across all partners. KPI data is collected from the partners responsible for each indicator, in line with their respective contributions within the project work plan. Data is periodically gathered across the relevant work packages using standardised templates and consolidated at project level to enable a coherent assessment of progress. The framework is based on the continuous tracking of KPI values against baseline and target values, allowing for timely identification of trends and potential deviations. In line with the impact monitoring and reporting approach described in the Grant Agreement, this process supports coordinated data collection, ensures comparability of results over time, and provides the basis for reporting through the LIFE KPI webtool and other project reporting activities. This process is supported by regular coordination with project partners, including targeted exchanges and meetings where necessary, to ensure completeness, consistency, and timely provision of KPI data.

## 3.4. KPI datasheets and monitoring tools

KPI monitoring in the LIFE NEEVE project is supported by structured datasheets and spreadsheet-based tools used to collect, organise, and track KPI values across partners. Standardised Excel-based templates are used to gather and maintain the numerical values of the

KPIs, including baseline, mid-term, and target data. In parallel, structured tables in document format are used as an internal supporting tool to organise qualitative information for each KPI, including descriptions and justifications, facilitating consistent and efficient reporting. The use of common templates facilitates the aggregation, comparison, and validation of KPI values, while supporting traceability of the reported information. Alignment between numerical datasets and reported values is ensured to avoid inconsistencies. These tools are complemented by the LIFE KPI webtool for formal reporting of indicators.

## 3.5. Quality control and data validation procedures

Quality control and data validation in the LIFE NEEVE project are ensured through a combination of partner-level verification and central consistency checks at project level. Each partner is responsible for reviewing and validating the KPI data they provide, ensuring alignment with the defined methodologies, assumptions, and sources of verification. At the same time, a cross-checking process is carried out to verify consistency between reported values, supporting documentation, and the overall KPI framework. Where discrepancies or uncertainties are identified, clarifications are requested and data is updated accordingly. This iterative validation process ensures that the reported KPI values, consistent, and supported by appropriate evidence, in line with the requirements for traceability and reliability defined in the Grant Agreement.

# 4. KPIs mid-term Status

Below the KPIs and their mid-term status are presented, classified following the guidance document for Life KPIs.

## 4.1. Project work area

The project work area is the total spatial extent of the work area in which its concrete actions of the project take place. It is where the project's budget is used to achieve objectives. In the NEEVE project, we have three different work areas of implementation actions (e.g. development, testing, demonstration, application of best practices/innovations).

These KPIs correspond to the 1.5 Webtool indicators.

### *4.1.1. Madrid (Spain)*

This KPI evaluates the validation and use of a prototype system to measure non-exhaust emissions during regulatory Real Driving Emission (RDE) tests along a diverse set of routes in Madrid.

*Table 1: KPI Project work area – Madrid*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 0.21 | 0.21 | 0 | $Km^2$ |

**Description of mid-term monitored value:**

**CIEMAT:** At mid-term, the monitored value of this KPI is 0, which is consistent with the project schedule. This KPI is associated with the validation of the prototype for measuring non-exhaust emissions during a complete Real Driving Emissions (RDE) cycle on the defined Madrid-route. The main driving activities required to achieve this KPI are planned within the task "optimizing real conditions operation of the onboard module with NEE measurement instrument", scheduled between Months 22 and 27, which includes the execution of the RDE cycle. As these activities are ongoing or pending completion at mid-term, the experimental area corresponding to the 60 km route has not yet been covered. The KPI is therefore progressing as expected and is on track to reach the target project-end value (0.21 km²) by the end of the project, with no foreseen risks or delays.

### *4.1.2. Oberursel (Germany)*

This KPI represents the work area of the validation tests of the innovative technologies of the NEEVE T.4.4. HORIBA will provide additional demonstrations and real driving tests (RDT) on a Germany road and highway. The onboard measuring equipment will be verified with comparison-test on the chassis dyno bench provided in T2.2.

*Table 2: KPI Project work area – Oberursel*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 0.31 | 0.31 | 0 | $Km^2$ |

**Description of mid-term monitored value:**

**HORIBA:** Achievement of the KPI is not expected until later in the project.

### *4.1.3. Murcia (Spain)*

During the project, a demonstrator will be installed with two test sections in the city of Murcia (250 linear meters each). These sections will allow conclusions to be drawn on the effect of the new formula developed during the project on particulate emissions into the environment, caused by the contact between the asphalt and the tyres.

*Table 3: KPI Project work area – Murcia*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 5 000 | 500 000 | 0 | $m^2$ |

**Description of mid-term monitored value:**

**CTCON:** At mid-term, the monitored value for this KPI is 0 $m^2$. This value is fully consistent with the project time schedule, as no physical implementation activities are planned before the execution of the pilot section in WP4.

According to the project planning, this KPI refers to the surface area of pavement solutions effectively implemented on-site. Such activities are scheduled for later stages of the project, specifically within WP4, when the pilot in Murcia will be executed.

## 4.2. Humans impacted by the project

These KPIs correspond to the 1.6 Webtool indicators.

### *4.2.1. Persons whose quality of life was positively impacted by improved Air Quality achieved by project actions*

This KPI estimates the number of people positively affected by improved air quality resulting from the implementation of low-emission materials and technologies in a pilot urban area. The calculation is based on the extent of deployment and the population living and working in the affected zones during and after the project.

*Table 4: KPI Persons whose quality of life was positively impacted by improved air quality*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 325 | 32 426 | 0 | Number of persons impacted |

**Description of mid-term monitored value:**

**CTCON:** At mid-term, the monitored value of this KPI is 0, which is consistent with the current stage of the project. This KPI refers to the number of persons whose quality of life is positively impacted by improved air quality resulting from project actions

At this stage, no measurable impact can yet be reported, as the main activities contributing to air quality improvement, including the Murcia pilot project are scheduled for later phases of the project, particularly within WP4.

### *4.2.2. Persons with improved capacity or knowledge due to project actions*

*Table 5: KPI Persons with improved capacity or knowledge due to project actions*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 343 | 393 | 41 | Number of persons impacted |

**Description of mid-term monitored value:**

**VTI:** We have disseminated the NEEVE work within VTI and engaged both technical, scientific and communication staff. The midterm value of person with improved capacity is estimated to 5.

**US:** In total, there are eight people involved: four lecturers participating in the project and four staff members employed by LIFE-NEEVE on a contractual basis.

**CIEMAT:** Three people. We have disseminated the NEEVE work within CIEMAT, engaging technical, scientific, and communications staff. In addition, a UPM student completed their Bachelor's thesis in the field of NEE. The mid-term number of personnel with improved capacity is three.

**UMH:** We have disseminated the project activities within our institute (IDIBE) and provided training to new students on organoid development and their applications in research. In addition, the project has been integrated into the EMOTION Master programme (https://www.emotion-master.eu/), involving 14 students. Considering these activities, we propose increasing the UMH contribution to a total of 25 persons with improved capacity or knowledge.

### 4.2.3. *Persons reached (via dissemination or awareness raising project-actions)*

*Table 6: KPI Persons reached (via dissemination or awareness raising project-actions)*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 8 020 | 11 020 | 5 000 | Number of persons impacted |

**Description of mid-term monitored value:**

**VTI:** The NEEVE project keeps a dissemination sheet, where all dissemination activities are recorded and the number of persons reached estimated. Sometimes the number is well-known, but in most cases, this is based on best-guesses, such as conferences, publications and media where a fraction of the number attendees, readers or listeners/viewers must be estimated. To estimate the mid-term value of 5000, the sum of known number of attendees at dissemination activities has been combined with estimates based on total number of meeting or conference attendees, number of parallel sessions, readers and listeners etc.

## 4.3. Air

These KPIs correspond to the 6.1 Webtool indicators.

### 4.3.1. *Reduction of polluting air emissions*

This KPI measures reduction in total suspended particles (TSP) of transport-related NEE.

*Table 7: KPI Reduction of polluting air emissions*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 22 | 54 | 0 [1] | Percentage of reduction |

### 1. Measuring non-exhaust emissions for PM10/PM2.5 through an improved onboard monitoring system with a low uncertainty.

The development of new measurement protocols and prototype module will result in technological advancements in measurement of the non-exhaust emissions from the automotive industry, leading to a better understanding of how these particles originated.

KPI: Develop and demonstrate onboard monitoring system for measuring non-exhaust emissions with an uncertainty for PM10 and PM2.5 of nearly 30%.

KPI (5-year): Improved onboard monitoring system for measuring non-exhaust emissions with an uncertainty for PM10 and PM2.5 of nearly 10%.

*Table 8: KPI onboard measurement uncertainty*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 100 | 30 | 10 | 100 | % |

### 2. Tyres reductions

KPI: Achieve approximately 10% reduction [1] in particle emissions from new selected tyres in comparison with commercial conventional tyres during the project's implementation phase.

KPI (5-year): Sustain at least a 50% reduction [1] in particle emissions from improved tyres in comparison with commercial conventional tyres.

*Table 9: KPI Reduction of tyres emissions*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 10 | 50 | 0 | % |

### 3. Reduce NEE in a new asphalt

KPI: At the end of the project approximately 20% reduction of NEE of the new asphalt pavement solution compared to the current asphalt solutions.

KPI (5 years): After 5 years after the end of the project will maintain at least 50% reduction of total

[1] Based on dynamometer tests performed by ICER Brakes using WLTP cycles and measuring PM10 emissions, a reduction of 79.5% has been observed for the improved design. However, this result is preliminary and will be validated through on-vehicle tests planned in WP4 before reporting the final KPI value.

suspended particulate matter (PM10, PM2.5) of the new asphalt solutions compared to the current asphalt solutions.

*Table 10: KPI Reduction of asphalt emissions*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 20 | 50 | 0 | % |

### 4. NEE reduction in Brake Pad/Disc

KPI: At the end of the project, aim to achieve an approximate 30% reduction in TSP from the braking system during the project implementation phase.

K/PI (5 years): After 5 years after the end of the project, it is intended to maintain at least a 60% reduction of the TSP from the braking system compared to the current braking systems.

*Table 11: KPI Reduction of Brake emissions*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 30 | 60 | 0 | % |

## Revision of KPI Values:

**CIEMAT, RDT:** This KPI has been revised from an absolute (g/year), which is difficult to measure reliably, to a relative (%) formulation. Therefore, the KPI has been revised to improve measurability, robustness, and consistency with component-level developments.

The overall reduction is computed as a weighted sum of reductions from tyres, brakes, and pavements, using their relative contribution to total emissions in $mg.km^{-1}.veh^{-1}$ (provided by CIEMAT):

$$\text{Total \% reduction} = \%\ \text{reduction Tyres} * \frac{\text{Tyres Emissions } (mg.km^{-1}.veh^{-1})}{\text{Total Emissions } (mg.km^{-1}.veh^{-1})}$$

$$+\%\ \text{reduction Brakes} * \frac{\text{Brakes Emissions } (mg.km^{-1}.veh^{-1})}{\text{Total Emissions } (mg.km^{-1}.veh^{-1})}$$

$$+\%\ \text{reduction Pavement} * \frac{\text{Pavement Emissions } (mg.km^{-1}.veh^{-1})}{\text{Total Emissions } (mg.km^{-1}.veh^{-1})}$$

$$\text{Total \% reduction} = 10\% * \frac{6.4}{23.9} + 30\% * \frac{10}{23.9} + 20\% * \frac{7.5}{23.9}$$

$$\text{Total \% reduction} \approx 22\ \%$$

Thus, the revised KPI indicates an overall expected reduction of ~22%, reflecting contributions from all components. It must be noted that, as different % reduction values were stablished for each source, overall reduction value may be affected if the relative importance of the sources differs from that assumed. Currently, there is some uncertainty in emission factors' values and they depend also on local conditions. Emission factors for the above computation were taken from

inventory guidelines [EMEP/EEA] and review reports [AQEG, EIT]. They may be updated in the second part of the project reflecting the state of the art or values obtained under real local operating conditions. Please refer to the Section 8: Appendix for a short discussion on the selection of emission factors for above computation.

This formulation provides a more robust and transparent approach for monitoring emission reductions and aligns with the project methodology.

### Description of mid-term monitored value:

**CIEMAT, RDT**: The mid-term value for total suspended particles (TSP) from transport-related non-exhaust emissions is reported as 0, as none of the components (tyres, brakes, and pavement) have yet achieved validated emission reductions under real operational conditions.

**ICERBRAKES:** Based on dynamometer tests performed by ICER Brakes using WLTP cycles and measuring PM10 emissions, a reduction of 79.5% has been observed for the improved design. However, this result is preliminary and will be validated through on-vehicle tests planned in WP4 before reporting the final KPI value.

**HORIBA**: Currently 100% uncertainty in the onboard measurement. Achievement of the KPI is not expected until later in the project.

**CTCON:** No pavement NEE reduction achieved at this stage of the project, not expected to be obtained until pilot deployment in WP4.

**VTI:** The tyre tests have just been started, that's why we currently cannot claim any reductions in air pollution due to NEEVE activities on tyres.

## 4.4. Governance

These KPIs correspond to the 10.2 Webtool indicators.

### *4.4.1. Involvement of other stakeholders (not duty holders or enforcement/supervisory bodies) in project activities - NGOs and other civil society organisations (stakeholder entities)*

*Table 12: KPI Involvement of other stakeholders NGOs and other civil society organisations (stakeholder entities)*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 10 | 15 | 5 | No. of stakeholder entities involved |

### Description of mid-term monitored value:

**VTI:** Defining involvement as stakeholders reached, we estimate that we have involved at least 5 stakeholders being NGOs and other civil society organisations.

### 4.4.2. Involvement of other stakeholders (not duty holders or enforcement/supervisory bodies) in project activities - Policy makers (individuals)

*Table 13: KPI Involvement of other stakeholders - Policy makers (individuals)*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 880 | 1 000 | 50 | No. of stakeholder individuals involved |

**Description of mid-term monitored value:**

**VTI:** Defining involvement as stakeholders reached, we estimate that we have involved at least 50 policy makers in Spain, Sweden and Germany. These are stakeholders taking part in meetings and conferences where NEEVE has been disseminated.

## 4.5. Information and awareness

These KPIs correspond to the 11.1 Webtool indicators.

### 4.5.1. Website

The number of unique visits to the website is based on experience from other EU-project web pages. Google Analytics or Matamo is used for web site statistics.

*Table 14: KPI Website*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 7 000 | 10 000 | 646 | Number of unique website visits |

**Description of mid-term monitored value:**

**VTI:** The webpage has been frequently updated and all partners are encouraged to disseminate the web page as often and broadly as possible. The midterm number of unique visits is 646 and are coming mainly from research, environmental and industrial sectors.

## 4.6. Networking and synergies

These KPIs correspond to the 12.1 Webtool indicators.

### 4.6.1. Networking and synergies with projects/initiatives - LIFE projects

*Table 15: KPI Networking and synergies with projects/initiatives - LIFE projects*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 3 | 6 | 2 | No. of projects/initiatives |

**Revision of KPI Values:**

**RDT:** The project-end value has been revised from 6 to 3, reflecting the expectation to interact with 3 LIFE projects by the end of the project. An additional 3 interactions are anticipated within 3–5 years after project completion, bringing the total to 6.

**Description of mid-term monitored value:**

**VTI:** NEEVE partner UMH participated in a LIFE networking activity and found possible synergies with at least 2 other LIFE projects.

### 4.6.2. Networking and synergies with projects/initiatives - Horizon Europe Projects

*Table 16: KPI Networking and synergies with projects/initiatives - Horizon Europe Projects*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 4 | 7 | 5 | No. of projects/initiatives |

**Description of mid-term monitored value:**

**VTI:** NEEVE has synergies and connections to partners through former Horizon projects LEON-T, NPETS and ULTRAHS. Partner VTI is involved in two consortia for new Horizon projects on non-exhaust emissions connecting to Life-NEEVE.

### 4.6.3. Networking and synergies with projects/initiatives – Other Projects

It is a new KPI added to report on the networking and synergies with projects/initiatives beyond LIFE and Horizon Europe Projects.

*Table 17: KPI Networking and synergies with projects/initiatives - Other Projects*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 4 | 7 | 2 | No. of projects/initiatives |

**Description of mid-term monitored value:**

**VTI:** NEEVE partners working on pavement designs have interacted with a Danish project called CityFresh aiming at improving air quality by changing to low-emitting pavements in Copenhagen. Horiba and UMH and additional American partner have applied for an international project (https://tireindustryproject.org/open-call-for-projects/). The selected projects are expected to be announced by May15th

## 4.7. New jobs created

These KPIs correspond to the 13 Webtool indicators.

Each partner will hire employees as part of the project, assuming that 1 FTE corresponds to 48months of full-time work on the project.

### *4.7.1. New jobs created within the project consortium*

*Table 18: KPI New jobs created*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 9.9 | 1 007 | 1.4 | No. of FTE |

Partners will hire employees as part of the project, assuming that 1 FTE corresponds to 48 months of full-time work on the project.

*Table 19: KPI at the end of the project for each partner*

| Partners | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value |
|---|---|---|---|
| US | 1.59 | 0 | 0.38 |
| CHM | 0.5 | 1 | 0 |
| CTCON | 0.5 | 1 | 0 |
| CIEMAT | 0.75 | 1 | 0.06 |
| HORIBA | 1.25 | 3 | 0.47 |
| VTI | 0.25 | 0 | 0.12 |
| RDT | 0.15 | 1.5 | 0 |
| UMH | 0.4 | 0 | 0.3 |
| PAUDIRE | 0.5 | 0 | 0.06 |
| ICERBRAKES | 0 | 3 | 0 |
| Indirect | 0 | 1 000 | 0 |
| **Total** | **5.9** | **1 010.5** | **1.4** |

**Revision of KPI Values:**

**RDT:** The project-end value has been revised from 0.75 to 0.15 to reflect a more realistic estimate based on current project implementation. The activities are being carried out by existing staff, as

onboarding new personnel would require significant training and familiarization with the project, making it inefficient at this stage. Any additional contribution from new hires is expected only in later phases or after project completion. Consequently, the 3–5 years beyond project-end value has also been increased from 1 to 1.5.

**ICERBRAKES:** The KPI values for new jobs created have been updated to correct a previous inconsistency. The values communicated in the Grant Agreement were correct; however, during the preparation of Deliverable D5.1, an inconsistency was introduced, where 3 FTE were indicated during the project and 0 FTE after the project. Therefore, the values have been revised in Deliverable D5.2 to 0 FTE during the project and 3 FTE at project-end, ensuring consistency with the expected post-project market uptake and scaling activities.

**US**: The project-end value has been updated from 2 to 1.59. The change from 2 to 1.6 is because the plan was to hire someone for more hours, but they were ultimately hired for fewer hours than originally estimated.

Project End-Value Revision:

Person 1: (27.5/48)×1 =0.573 FTE

Person 2: (41/48)×0.5 = 0.427 FTE

Person 3: (28.5/48)×0.5 = 0.297 FTE

Person 4: (33/48)×0.425 = 0.292 FTE

0.573+0.427+0.297+0.292 = 1.589 FTE

### Description of mid-term monitored value:

**US**: Four people have been hired: one full-time, two part-time, and one working fewer hours than a standard part-time role. The FTE calculations are as follows:

Mid-term value

Person 1: (3.5/48)×1 = 0.073 FTE

Person 2 (17/48)×0.5 = 0.177 FTE

Person 3: (4.5/48)×0.5 = 0.047 FTE

Person 4: (9/48)×0.425 = 0.080 FTE

0.073+0.177+0.047+0.080 = 0.377 FTE

**CHM:** The current value is 0, as activities have been focused on the validation of the formula during this phase of the project. No recruitment was planned at this stage. New hires are expected to take place in the upcoming stages, particularly during Work Package 4 (WP4) and the demonstrator phase.

**CTCON:** The current value is 0, as no recruitment was scheduled at this stage of the project. New hires are expected to take place during the second half of the project.

**CIEMAT**: This project has enabled the full-time recruitment of one person, with 100% exclusive dedication, since February 2026.

**HORIBA:**

Two employees were hired for additional 10 hours per week (25% commitment) solely for the project from Jan 2025. One Employee was hired full time for the project from Jan 2025. The FTE calculations are as follows:

Mid-term value

Person 1: (15/48)×0.25 = 0.078 FTE

Person 2: (15/48)×0.25 = 0.078 FTE

Person 3: (15/48)×1 = 0.313 FTE

0.078 + 0.078 + 0.313 = 0.47 FTE

**VTI:** At halftime half of the work by the person hired to work 25% with the project over

the project time is accomplished, resulting in 12%**.**

**RDT:** The current value is 0, as no new hires have been made to date. The FTE contribution from new hires is expected to be reflected in the second half of the project.

**UMH:** We have hired 1 researcher from January 1st of 2025, who has been a part of the project for 16 months now. So, the corresponding mid-term value is 0.33 FTE.

**PAUDIRE:** This project has enabled the recruitment of one person who has been involved in the project. In the coming years, greater involvement in the project is expected from the new recruitment, and therefore a higher level of dedication to the project.

**ICERBRAKES:** The current figure is 0, as no new staff have been recruited to date.

## 4.8. Economic sustainability and catalytic effect

These KPIs correspond to the 14 Webtool indicators

### *4.8.1. Revenue during or after project end, due to project outcomes - Revenue from sales*

This KPI corresponds to the 14.1 Webtool indicator.

*Table 20: KPI Revenue from sales*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 111 352 | 5 070 032 | 0 | € |

### Revision of KPI Values:

**UMH:** We expect to commercialize the organoids by the end of the project. The projected revenues are €11 352 during the project and €175 032 within 3–5 years after completion. The total value has been updated accordingly to reflect these estimates.

### Description of mid-term monitored value:

**CHM:** The current value is 0, as the mixture has not yet reached industrial-scale production and no commercial activities have been carried out. Current efforts are focused on formula validation. Revenue generation is expected in later stages of the project, particularly during WP4 and the demonstrator phase.

**HORIBA:** Current value is 0. Achievement of the KPI is not expected until later in the project.

**RDT:** The current value is 0. The modelling services for dispersion patterns and the modelling of NEE impact in urban areas is still under development as part of T3.6. The capabilities need to be developed in order to later offer services and generate revenue.

**UMH:** The current value is 0. We have been contacted by two companies to hire our services with organoids recently, but we are still negotiating the project and objectives to be developed**.**

**ICERBRAKES:** Current value is 0. The final design and formulation have not yet been finalised, so nothing has been launched on the market.

## *4.8.2. Catalytic effect - Financial - Cumulative investments triggered or finance accessed - Beneficiary own contribution (other than project co-financing and not included in project budget)*

This KPI corresponds to the 14.2 Webtool indicator.

*Table 21: Catalytic effect - Financial - Cumulative investments triggered or finance accessed - Beneficiary own contribution*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Units |
|---|---|---|---|---|
| 0 | 0 | 50 000 | 0 | € |

### Description of mid-term monitored value:

**RDT:** No investments expected till the project end.

### *4.8.3. Continuation after the project-end in the same premises/area(s) as those used during the project - Continuation at same scale (compared to the scale during project implementation)*

**Description of mid-term monitored value:**

**HORIBA:** HORIBA will continue selling and developing equipment at the same scale as during the project.

**RDT:** RDT will provide modelling simulation services at the same scale as in the project.

### *4.8.4. Continuation after the project-end in the same premises/area(s) as those used during the project - Continuation at higher scale (compared to the scale during project implementation)*

**CHM:** Upon completion of the project, CHM will move to large-scale production of the verified formula, as we have the necessary means and suitable facilities to carry out this type of asphalt mixture production.

## 4.9. Specific KPIs for the project

These KPIs are not reported in the webtool, but we considered it in the Gran Agreement. For this reason, we are going to maintained it for evaluate internally the progress of the project.

### *4.9.1. Novel Asphalt Pavement*

#### 4.9.1.1. Develop, produce and deploy a new asphalt pavement

**KPI:** Develop, produce and deploy a new asphalt pavement during the project's execution.

**KPI (5-year):** Demonstrate that the asphalt project solution is able to maintain its NEE reduction properties over time, without compromising safety of vehicles. Develop one new maintenance strategy to reduce the negative effects and resuspension dust that may appear during its time-life.

*Table 22: KPI Develop, produce and deploy a new asphalt pavement*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 1 | 1 | 0 | Number of product |

**Description of mid-term monitored value:**

**CTCON:** While significant progress has been achieved in the development phase, including material design, formulation, and laboratory-scale validation of the new asphalt pavement, the solution has not yet reached the stage of full-scale production and real-world deployment.

The activities carried out so far have focused on optimizing the material properties, assessing performance under controlled laboratory conditions, and ensuring compliance with technical specifications. The asphalt deployment under real operational environments will be addressed later during WP4.

#### 4.9.1.1. Number of the tons produced and sold of novel pavements for low NEE

**KPI:** Number of the tons produced and sold of novel pavements for low NEE according to the exploitation plan described in section 2.4 of GA.

*Table 23: KPI Number of the tons produced and sold of novel pavements for low NEE*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 900 | 50 000 | 0 | Number of tons for low-NEE pavement produced |

**Description of mid-term monitored value:**

**CTCON:** While significant progress has been achieved in the development of novel pavements for low non-exhaust emissions (NEE), including material design, formulation, and laboratory-scale validation, no tons have yet been produced or sold. The work to date has focused on optimizing material properties and validating performance under controlled conditions. Production and commercialization, which will determine the reported tons, are planned for later stages of the project, particularly within WP4.

### *4.9.2. Novel Brake Pad/Disc*

#### 4.9.2.1. Advanced Brake Pad/Disc Materials formulation

Enhanced brake pads and discs directly contribute to lower non-exhaust particle emissions (PM10 to PM2.5) during braking, positively impacting air quality in urban and suburban environments. The activities contribute to reducing the environmental impact of vehicles' braking systems, which is a crucial step in addressing air quality and climate concerns.

**KPI:** Develop and validate at least two new brake material formulations for pads and discs during the project's implementation phase.

**KPI (5-year):** Demonstrate the market adoption of the developed brake pad materials, with at least two formulations incorporated by major automotive manufacturers into their production lines.

*Table 24: KPI Advanced Brake Pad/Disc Materials formulation*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 2 | 2 | 1 | Brake formulations |

**Description of mid-term monitored value:**

**ICERBRAKES:** Work has been carried out on two formulations, and one has already met the emissions target. However, we will complete testing on the few remaining variants of that formulation.

The second formulation is close to meeting the target, but there is still work to be done.

#### 4.9.2.2. Number of the produced and sold new brake pads/disks of low NEE

Number of the produced and sold new brake pads/disks of low NEE according to the exploitation plan described in section 2.4 of GA.

*Table 25: KPI Number of the produced and sold new brake pads/disks of low NEE*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 48 | 90 000 | 0 | Number of products |

**Description of mid-term monitored value:**

**ICERBRAKES:** Current value is 0. The final design and formulation have not yet been finalised, so nothing has been launched on the market.

### *4.9.3. Novel equipment for NEE*

#### 4.9.3.1. Equipment for NEE

Equipment for real-time measurement of particulates non-exhaust sources. Number of the produced and sold units according to the exploitation plan described in section 2.4 of GA.

*Table 26: KPI Equipment for NEE*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 1 | 20 | 0 | Number of products |

**Description of mid-term monitored value:**

**HORIBA:** Achievement of the KPI is not expected until later in the project.

### *4.9.4. CFD-based particle dispersion modelling:*

CFD-based particle dispersion modelling will be used to simulate the dispersion of non-exhaust particles and associated gases (e.g., $CO_2$) under varying urban layouts and weather conditions, enabling assessment of their air quality and climate impacts. The task will also optimize computational efficiency to reduce energy use and modelling costs.

#### 4.9.4.1. Accuracy of particle dispersion modelling

Compare the results with reality, real data from the city of Murcia is needed, which will be provided by the city authorities and the measurements from other partners.

KPI: Achieve particle dispersion modelling with an accuracy of at least 70%.

KPI (5year): Improve particle dispersion modelling with an accuracy of at least 90%.

*Table 27: KPI Accuracy of particle dispersion modelling*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 70 | 90 | 0 | Percentage of accuracy |

**Description of mid-term monitored value:**

**RDT:** A preliminary CFD study has already been conducted to verify that the simulation setup performs correctly for a representative test scenario as part of T3.6. However, a proper assessment of model accuracy requires a direct comparison between CFD results and measured data from the city of Murcia, using simulations of the exact geographical area for which measurements are available.

For this purpose, Manuel Valls from the City of Murcia has been contacted to obtain the relevant measurement data. Once all required information is available, the accuracy of the dispersion model will be systematically evaluated. No delays are anticipated in achieving the final KPI.

#### 4.9.4.2. Reduce computational costs

The computational cost in terms of time and resources for this type of simulation is very high. For this reason, this KPI measures the reduction in computational cost from the initial step of the simulation. For example, costs can be reduced by optimizing the mesh.

KPI: Optimization of particle dispersion modelling to reduce computational costs by 20%

KPI (5year): Optimization of particle dispersion modelling to reduce computational costs by 30%

*Table 28: KPI Reduce computational costs*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 20 | 30 | 0 | Percentage of computational cost reduction |

**Description of mid-term monitored value:**

**RDT:** A preliminary CFD study has already been conducted under Task T3.6 to verify that the simulation setup performs correctly for a representative test scenario. However, a robust assessment of the reduction in computational cost requires a comparison between baseline and optimized simulation configurations. This comparison is planned to be carried out using CFD studies for the city of Murcia within the scope of Task T3.6. For this purpose, Manuel Valls from the City of Murcia has been contacted to obtain the required local data needed to perform the simulations. No delays are currently anticipated in achieving the final KPI.

### *4.9.5. Analysing particle effects in human health using new organoids:*

This KPI evaluates the development and application of advanced laboratory-based organoid models to assess the potential health impacts of non-exhaust emission pollutants. The results will improve understanding of exposure risks and support the design of safer materials and mitigation strategies while promoting alternatives to animal testing.

#### 4.9.5.1. Development of new organoids

KPI: Development of 3 new organoids for testing the particle influence on human health (i.e. ocular, skin, lung) supported by the detailed methodology and guidance to use them.

*Table 29: KPI Development of new organoids*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 3 | - | 1 | Number of products |

**Description of mid-term monitored value:**

**UMH:** The results related with this KPI are satisfactory and 1 organoid is already ready. The other 2 are programmed and expected to be obtained according to the schedule.

#### 4.9.5.2. Quantifying the reduction of harmful effects

KPI: Quantifying the reduction of approximately 30% of harmful effects on human health after the improvements on tyres, brakes and/or pavements measured using the new organoids.

*Table 30: KPI Quantifying the reduction of harmful effects*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 30 | - | 0 | Quantifying the reduction of harmful effects |

### Description of mid-term monitored value:

**UMH:** The results for this KPI will be obtained during the second half of the projects when the partners send to UMH the particles derived from the new developed materials.

#### 4.9.5.3. Identify new molecular targets or mechanisms to be addressed by new strategies to combat the negative impact of NEE particles on human health.

KPI: Identify 2 new molecular targets or mechanisms to be addressed by new strategies to combat the negative impact of NEE particles on human health.

KPI (5-year): Reduce the animal use for the study of the impact of NEE particles on human health in a 10% worldwide by creating a reliable new alternative methodology to address them.

KPI (5-year): Develop 2 new medical or cosmetical treatments to overcome the negative effect of polluting particles using the results obtained during the project.

*Table 31: KPI Identify new molecular targets or mechanisms to be addressed by new strategies to combat the negative impact of NEE particles on human health.*

| Project-Start Value (Baseline) | Project-End Value | 3/5 years beyond Project-End Value | Mid-term value | Unit |
|---|---|---|---|---|
| 0 | 2 | 2 | 0 | new mechanisms or molecular targets that can be used for future pharmacological interventions |
| 0 | 5% reduction | 10 % reduction | 0 | Percentage of use of animals on activities related to NEE emissions |
| 0 | 1 | 2 | 0 | New treatments to reduce the impact of NEE on human health |

### Revision of KPI Values:

**UMH:** The project-end value for new treatments to reduce the impact of NEE on human health has been updated from 0 to 1. A potential inhibitor based on a vegetal extract has been developed to mitigate the harmful effects of pollutant particles on skin organoids.

**Description of mid-term monitored value:**

**UMH:** Although we have progressed in the identification of new molecular targets, we are still on a preliminary stage of this KPI which is expected to be fully accomplished by the end of the project as expected.

# 5. Corrective Measures and Adjustments

## 5.1. Assessment of progress towards project targets

At mid-term, the overall progress of the LIFE NEEVE project towards its KPI targets is satisfactory and consistent with the planned evolution of the project. The results reported in Section 4 show a balanced picture across the different KPI areas. Indicators linked to dissemination and outreach, capacity building, website activity, stakeholder engagement, and networking already show tangible progress at this stage. Furthermore, indicators related to demonstration-dependent results, such as project work area, improved air-quality impact, and validated reductions in non-exhaust emissions, currently exhibit low or zero values as they are expected to develop mainly in the second half of the project, in line with the timing of the main validation, deployment, and pilot activities foreseen in WP4.

Overall, the mid-term assessment confirms that the project is progressing coherently across its different impact dimensions, with early progress being more visible in awareness, governance, and networking indicators, and later progress expected in the technical, environmental, and deployment-related KPIs. The assessment also confirms that the monitoring framework established in Deliverable D5.1 remains appropriate for tracking project progress, while the mid-term reporting exercise has helped identify a limited number of cases where further clarification or refinement was beneficial to improve consistency and robustness of the reported indicators, in line with the role of Deliverable D5.2 in the Grant Agreement.

## 5.2. Indicators with satisfactory progress

At mid-term, the progress of all the KPIs can be considered satisfactory. This includes both indicators that already show measurable non-zero values and those whose main outcomes are expected to emerge in later project stages. Among the KPIs already showing satisfactory progress are those related to capacity building, dissemination and awareness, governance, website activity, networking and synergies, and new jobs created within the consortium. In particular, the project already reports 41 persons with improved capacity or knowledge, 5,000 persons reached through dissemination or awareness-raising actions, 5 NGOs and other civil society organizations involved, 50 policy makers reached, 646 unique website visits, active synergies with LIFE, Horizon Europe and other initiatives, and around 1.4 FTE of new jobs created within the consortium.

Satisfactory progress is also observed in part of the technical and project-specific KPI set. The project already reports progress in specific technical developments, including 1 advanced brake pad/disc formulation and 1 new organoid developed at mid-term. These results, together with the

broader progress already visible across awareness, governance, collaboration, employment, and selected technical developments, support an overall assessment of satisfactory progress at mid-term.

## 5.3. Indicators requiring corrective actions

At mid-term, no KPI is considered to require major corrective action in terms of a substantial change to the project strategy or the overall implementation pathway. However, some indicators do require targeted follow-up and adjustment, as reflected in the deviations summarised in Section 5.4. These mainly concern KPIs where the current values differ from initial expectations due to updated implementation conditions, refined assumptions, or clarified reporting methodology. In particular, targeted clarification or refinement was required for “Reduction of polluting air emissions”, “New jobs created within the project consortium”, and “Networking and synergies with LIFE projects”, in order to improve consistency, measurability, and alignment between the KPI definition and the actual implementation logic of the project.

## 5.4. Justification of deviations from expected values

At mid-term, the updates addressed in this deliverable include both corrective refinements to selected KPI formulations or values and positive updates reflecting improved information, stronger progress, or a more complete representation of project impacts. These updates do not indicate a deviation from the project objectives or implementation pathway, but rather a more robust basis for KPI definition and reporting at the current stage of the project.

For Reduction of polluting air emissions, the KPI was revised from an absolute formulation in g/year to a percentage-based formulation. The original approach was considered difficult to monitor reliably and less robust for reflecting the combined contribution of tyres, brakes, and pavement-related developments. The revised percentage-based formulation provides a more transparent and measurable approach for tracking progress.

For the KPI “New jobs created within the project consortium”, the updated values reflect a more consistent interpretation in Full-Time Equivalent (FTE) terms and a more realistic representation of actual recruitment plans, timing, and dedication levels across the consortium. The revisions were introduced to correct earlier inconsistencies and to better align the reported values with the agreed FTE-based approach and the effective implementation of the project. While the revised estimate (~5.9 FTE) is lower than the initial value indicated in the Grant Agreement (12), this does not imply a reduction in impact. Although FTE was used as the unit in the Grant Agreement, its explicit definition was not initially specified; it has since been clarified as 1 FTE corresponding to 48 person-months. Under this definition, the updated value still represents a substantial cumulative employment effort and therefore maintains a meaningful and comparable level of impact in terms of job creation.

For Networking and synergies with projects/initiatives: LIFE projects, the project-end and post-project values were adjusted to better reflect the expected timing of these interactions, with part of the synergies now expected to materialize after project completion rather than during implementation.

For Networking and synergies with projects/initiatives: Other Projects, a new KPI was introduced in Deliverable D5.2 to better capture relevant collaboration, replication, and networking activities beyond LIFE and Horizon Europe projects. This represents a positive extension of the monitoring framework and is consistent with the flexibility foreseen in WP5 to incorporate additional relevant KPIs when needed.

For Revenue from sales, commercialization of organoids was already foreseen as a potential project outcome, but the corresponding revenue estimates had not yet been included in the original KPI values. At mid-term, this potential has been assessed more concretely, and the KPI has been revised positively to reflect the additional revenue expected from UMH in relation to organoid commercialization. This update therefore represents a more complete and realistic estimation of the project's revenue potential rather than a corrective adjustment.

For the human-health-related project-specific KPI Identify new molecular targets or mechanisms to be addressed by new strategies to combat the negative impact of NEE particles on human health, the project-end value was revised from 0 to 1. This update reflects positive scientific progress already achieved at mid-term through the identification of a potential inhibitor based on a vegetal extract.

Overall, these updates represent targeted refinements and positive developments within the KPI framework, introduced to improve realism, internal consistency, and reporting quality, while providing a more accurate representation of project progress at mid-term

## 5.5. Identification of monitoring gaps

At mid-term, no major monitoring gaps have been identified in the overall KPI framework. The already defined monitoring methodology remains suitable for tracking project progress, and the mid-term reporting exercise has confirmed that the main KPI areas can be monitored in a coherent and structured manner.

The main gaps identified relate instead to the need for further clarification, harmonisation, and evidence consolidation for selected indicators discussed in the Sections 5.3-5.4. The mid-term exercise highlighted the importance of ensuring that KPI formulations remain sufficiently measurable and consistent, that reported values are clearly aligned with their assumptions and definitions, and verifiable via corresponding supporting evidence by the responsible partners. This stronger and more standardised application of the monitoring framework will further improve traceability and robustness during the second half of the project.

## 5.6. Adjustments to monitoring methodology

At mid-term, no major changes to the overall monitoring methodology defined in Deliverable D5.1 have been required. The framework remains valid for KPI collection, validation, and reporting.

The adjustments introduced concern only selected indicators and are mainly related to refined KPI formulations and clearer interpretation criteria where needed (already discussed in Sections

5.3-5.5). These adjustments strengthen the practical application of the methodology and support a more robust monitoring process for the second half of the project.

## 5.7. Operational corrective actions in project activities

From the perspective of KPI monitoring, no major operational corrective actions requiring substantial changes to project activities are considered necessary at mid-term. However, some targeted follow-up actions are needed to address the deviations and clarifications identified for specific indicators, particularly those related to FTE reporting and selected KPI definitions summarized in Section 5.4. For the second half of the project, the main operational priority is therefore to maintain close coordination across partners and work packages, while ensuring timely data updates, methodological consistency, and proper supporting justification for those validation, pilot, demonstration, exploitation, and staffing-related activities that will directly support the achievement of the main technical, environmental, and impact-related KPIs by project end.

# 6. Conclusions

This deliverable presents the mid-term assessment of the LIFE NEEVE KPI framework established in Deliverable D5.1 and confirms that the project has a coherent and operational basis for monitoring progress across its technical, environmental, socio-economic, governance, and project-specific dimensions. In line with the role of Deliverable D5.2 defined in the Grant Agreement; the report combines the collection and assessment of mid-term KPI values with the necessary refinements to selected monitoring elements introduced during implementation.

At mid-term, the overall progress of the KPIs can be considered satisfactory. Measurable progress is already visible in indicators related to capacity building, dissemination and awareness, stakeholder engagement, website activity, networking and synergies, new jobs created and selected technical and project-specific developments. At the same time, several impact-oriented KPIs are expected to evolve mainly in the second half of the project, in line with the timing of the main validation, pilot, and demonstration activities foreseen in WP4 and the broader implementation logic of the action.

The mid-term exercise has also confirmed that no major monitoring gaps or major operational corrective actions are required at this stage. The main outcome of the assessment has instead been the introduction of targeted clarifications and refinements to selected KPIs to improve measurability, consistency, and reporting robustness. These updates strengthen the suitability of the KPI framework for the remaining project period and provide a more reliable basis for the continued monitoring of project results and impacts up to project completion

# 7. Acknowledgements

This LIFE-2023-SAP-ENV project number 101148428 (LIFE23-ENV-ES-LIFE NEEVE) is sponsored by the EUROPEAN COMMISSION Programme LIFE according to the information on the title page. It is also partly sponsored by the partners represented by the authors, in this case PAUDIRE INNOVA, VTI, HORIBA, ICER-BRAKES, RDT, CIEMAT, CTCOM, CHM, UMH and US.

# 8. Appendix

## 8.1. Determination of Emissions Factor for Calculating Reduction of Air Polluting Emissions

### *8.1.1. Break Wear Emissions Literature*

Table 32: Break Wear Emissions Literature Values

| Emission factor | Particle concentration | Reference | Notes |
|---|---|---|---|
| 2.9 – 8.1 mg.km$^{-1}$.veh$^{-1}$ | | Piscitello (review) | PM10 |
| 7.4 mg.km$^{-1}$.veh$^{-1}$ | | Piscitello | PM10 median |
| 2.3 mg.km$^{-1}$.veh$^{-1}$ | | Piscitello | PM2.5 median |
| 1.6 – 8.1 mg.km$^{-1}$.veh$^{-1}$ | | Grigoratos (review) | PM10 |
| 5.9 mg.km$^{-1}$.veh$^{-1}$ | | Grigoratos | PM10 mean |
| 11.7 mg.km$^{-1}$.veh$^{-1}$ | | AQEG (inventory guideline) | PM10 cars, urban drive |
| 5.5 mg.km$^{-1}$.veh$^{-1}$ | | AQEG | PM10 cars, rural drive |
| 13.2 mg.km$^{-1}$.veh$^{-1}$ | | EIT (review) | PM10 GTR24 |
| 5.3 mg.km$^{-1}$.veh$^{-1}$ | | EIT | PM2.5 GTR24 |
| 11.65 mg.km$^{-1}$.veh$^{-1}$ | | Zhang (individual work) | PM10 car |
| 2.66 mg.km$^{-1}$.veh$^{-1}$ | | Zhang | PM2.5 car |
| | | | |
| 2 x 10$^{9}$ #. km$^{-1}$.brake$^{-1}$ | | Mamakos (individual work) | |
| 9 x 10$^{9}$ #. km$^{-1}$.veh$^{-1}$ | | EIT (review) | GTR24 |
| 5 x 10$^{9}$ #. km$^{-1}$.brake$^{-1}$ | | Ricardo 2023 (indiv. work) | PG42 cycle |
| 1.9 x 10$^{9}$ – 4.1 x 10$^{9}$ #.km$^{-1}$.veh$^{-1}$ | | Feissel (individual work) | RDE cycle |
| | 1 x 10$^{4}$ - 1 x 10$^{7}$ #.cm$^{-3}$ | Al Wasif (individual work) | |
| | 1 x 10$^{5}$ - 1 x 10$^{7}$ #.cm$^{-3}$ | Ricardo 2025 (indiv. work) | From plots in figures |
| Temperature | | | |
| <200 C | | Al Wasif | Brake disc temp. |
| 50 – 140 C | | Feissel | |
| 50 – 200 C | | Ricardo 2025 | Brake enclosure temp. |

### 8.1.2. Tyre Wear Emissions Literature

Table 33: Tyre Wear Emissions Literature Values

| Emission factor | Particle concentration | Reference | Notes |
|---|---|---|---|
| 1.1 – 2.7 mg.km$^{-1}$.veh$^{-1}$ | | Saladin (review) | PM10 |
| 8.7 mg.km$^{-1}$.veh$^{-1}$ | | AQEG (inventory guideline) | PM10 cars, urban drive |
| 6.8 mg.km$^{-1}$.veh$^{-1}$ | | AQEG | PM10 cars, rural drive |
| 5.8 mg.km$^{-1}$.veh$^{-1}$ | | AQEG | PM10 cars, motorway drive |
| 3.6 mg.km$^{-1}$.veh$^{-1}$ | | EIT (review) | PM10 cars |
| 1.6 mg.km$^{-1}$.veh$^{-1}$ | | EIT (review) | PM2.5 cars |
| 6.4 mg.km$^{-1}$.veh$^{-1}$ | | EIT (inventory guideline) | PM10 |
| 4.5 mg.km$^{-1}$.veh$^{-1}$ | | EIT (inventory guideline) | PM2.5 |
| | | | |
| 4x10$^{10}$ #.km$^{-1}$.veh$^{-1}$ | | EIT (review) | PN10 cars |
| 1x10$^{9}$ #.km$^{-1}$.wheel$^{-1}$ | | Ricardo 2023 (indiv. work) | PG42 cycle |
| 5x10$^{9}$ #.km$^{-1}$.wheel$^{-1}$ ± 44% | | Ricardo 2025 (indiv. work) | PN10 non-volatile |
| 1.1x10$^{10}$ #.km$^{-1}$.wheel$^{-1}$ ± 76% | | Ricardo 2025 | PN10 total |
| 2.1x10$^{10}$ #.km$^{-1}$.wheel$^{-1}$ ± 48% | | Ricardo 2025 | PN4 |
| | 1 x 10$^{3}$ #/cm$^{3}$ | Ricardo 2025 | PN10 non-volatile |
| | 1 x 10$^{4}$ #/cm$^{3}$ | Ricardo 2025 | PN10 total |
| | 4 x 10$^{4}$ #/cm$^{3}$ | Ricardo 2025 | PN4 |
| | | | |
| 0.19 mg.km$^{-1}$.wheel$^{-1}$ ± 103% | | Ricardo 2025 | PM2.5 |
| 0.38 mg.km$^{-1}$.veh$^{-1}$ | | Ricardo 2025 | PM2.5 |
| Temperature | | | |
| <40 C | | Ricardo 2025 | |

### 8.1.3. Pavement wear emissions Literature

Table 34: Pavement Wear Emissions Literature Values

| Emission factor | Particle concentration | Reference | Notes |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | | ten Broeke (review) | Passenger cars |
| 15 mg.km$^{-1}$.veh$^{-1}$ | | " | TSP |
| 7.5 mg.km$^{-1}$.veh$^{-1}$ | | " | PM10 |
| | | | |
| 3 to 40 mg.km$^{-1}$.veh$^{-1}$ | | EIT (review) | PM10, cars, Including Resuspension |
| | | | |
| 5 to 10 mg.km$^{-1}$.veh$^{-1}$ | | Fussell (review) | PM10 cars |
| | | | |
| | | EMEP/EEA (inventory guideline) | Passenger cars, ICE, medium |
| 15 mg.km$^{-1}$.veh$^{-1}$ | | " | TSP |
| 7.5 mg.km$^{-1}$.veh$^{-1}$ | | " | PM10 |
| 4.1 mg.km$^{-1}$.veh$^{-1}$ | | " | PM2.5 |
| | | | |
| | | UK/NAEI (inventory guideline) | LDV |
| 7 mg.km$^{-1}$.veh$^{-1}$ | | " | PM10 |
| 4 mg.km$^{-1}$.veh$^{-1}$ | | " | PM2.5 |
| | | | |
| 3 mg.km$^{-1}$.veh$^{-1}$ | | Gehrig | PM10, LDV, asphalt concrete |
| 3.1 mg.km$^{-1}$.veh$^{-1}$ | | Luhana | PM10, LDV |
| 6.8 mg.km$^{-1}$.wheel$^{-1}$ | | Muresan | Urban route |
| | | | |
| | | Kupiainen | |
| 9 mg.km$^{-1}$.wheel$^{-1}$ | | " | PM10, road simulator |
| 2 mg.km$^{-1}$.wheel$^{-1}$ | | " | PM2.5, road simulator |

### *8.1.4. Motivation*

CFD simulations of ambient dispersion of NEE are to be conducted during NEEVE project. In order to provide initial input data, inventory guidelines, previous research projects' reports, research literature and review reports were search for relevant emission factors. Although the search was far from exhaustive, it was thought to be adequate for the purpose, more so when it included reports based on exhaustive reviews themselves.

As experimental work in NEEVE project progresses, values relevant to local conditions will be available.

Subsequently, it was felt that this work could be also useful for initial computation of "Reduction of polluting air emissions" KPI.

The following pages summarise the outcome from this exercise.

### 8.1.5. Brake Pads and Discs Wear Emissions

The widespread consensus is that between 30 and 50% of brake pad mass wear become airborne as TSP.

98% by mass of TSP lies in the PM10 range [USEPA, 1995]

39% by mass of TSP lies in the PM2.5 range [Thorpe, 2008]

Brake particle emissions are characterised by their variability, depending on vehicle mass, driving stile, brake pad formulation, etc. The emission is also of transient nature, correlating with braking events.

PM emission factors can be found in Inventory Guidelines, as cited by [AQEG, 2019]. PM emission data is also available in reviews such as those by [Piscitello, 2021] or [Grigoratos, 2015].

Unfortunately, PN emission factors are more difficult to find. In some cases, such as the work by Zhang, PN measuring instruments are used but only the PM values derived from PN measurements are reported.

A recent comprehensive review by [EIT, 2025], prepared for the City of London, reports an average number emission factor of $9 \times 10^9$ #. $km^{-1}.veh^{-1}$, although with large variability between studies.

Particle concentrations are not normally reported. [Ricardo, 2023] for instance, report results in #/s rather than concentration. Nonetheless, some figures in Ricardo's documents show plots of particle concentration vs time for different measuring instruments.

The temperature of the emission is highly dynamic, correlating with braking events. Normally, it seems not to exceed 200 C and not to fall below 50 C once the system has warmed up.

According to the discussion above, the following values are suggested as inputs for CFD simulations of brake particle emissions:

| | |
|---|---|
| PN emission factor: | $6 \times 10^9$ #.$km^{-1}.veh^{-1}$ |
| Concentration: | $7 \times 10^5$ #.$cm^{-3}$ |
| TSP/PM10 emission factor: | 10 mg.$km^{-1}.veh^{-1}$ |
| PM2.5 emission factor: | 3 mg.$km^{-1}.veh^{-1}$ |
| Temperature: | 120 C |

### 8.1.6. Tyre Wear Emissions

General consensus is that between 2 and 5% of tyre mass wear become airborne as Total Suspended Particulate (TSP).

40% by mass of TSP lies in the PM2.5 range

”Microplastics” emissions would encompass both the non-airborne fraction of the emission which remains on the surface of the road plus the airborne fraction.

PM emission factors can be found in Inventory Guidelines.

Saladin claims that PM10 emission factors cited in literature reviews and inventory guidelines are overestimated and propose lower values based on their own review of primary literature. [EIT, 2025] in their review study also found that emission factors from recent literature are noticeably lower than those indicated in European and British emissions inventory guidelines.

The work by [Ricardo, 2025], undertaken in a dynamometer (so, free of pavement/resuspension interference) and with careful avoidance of brake particles contamination, also found very low PM2.5 emission factors. However, we believe this could be partly due to the impossibility of undertaking steering manoeuvres that would contribute to emissions.

For the time being, we recommend a conservative approach adopting emission factors recommended for inventories, pending our own experimental results.

PN emission factors were determined by Ricardo across a variety of driving cycles and tyre types. The table above shows average values, with indication of the dispersion of individual experiment values. They found a large number of very small and volatile particles.

Particle concentration values in the table are surmised from various plots in the work by [Ricardo, 2025].

Ricardo recorded tyre temperatures not higher than 40 C during the experiments. When selecting a temperature value, both Murcia’s weather and the slow speeds in urban traffic have to be taken into account.

According to the discussion above, the following values are suggested as inputs for CFD simulations of tyre particle emissions:

Total PN10 emission factor: $4 \times 10^{10}$ #.km$^{-1}$.veh$^{-1}$

Total PN10 concentration: $1 \times 10^{4}$ #.cm$^{-3}$

TSP/PM10 emission factor: 6.4 mg.km$^{-1}$.veh$^{-1}$

PM2.5 emission factor: 4.5 mg.km$^{-1}$.veh$^{-1}$

Temperature: 35 C

Vehicle speed: 30 km/h

### *8.1.7. Pavement Wear Emissions*

Pavement wear emissions are hard to study because they are difficult to distinguish from tyre wear emissions and resuspension of material previously deposited on the road surface. The resuspended material can in turn be of various nature (brakes wear, tyres wear, dust, etc …).

The wear of the road surface depends on such factors as the moisture level of the pavement, salting of the road, since the surface remains wet for longer periods. Vehicle speed, tyre pressure

and air temperature also affect road wear. Vehicle weight can also affect road wear emissions, leading to a 10-15% increase in PM10 and PM2.5 emissions of electric vehicles compared to equivalent ICE vehicles based on the work of [Beddows and Harrison, 2021].

Emission factors for road wear can be found in guidelines for emissions inventories. [EMEP/EEA, 2023] Air Pollutant Emissions Inventory Guidebook uses the estimation methodology originally proposed by [Klimont, 2002].

Some review works are also available. The highest values indicated in [EIT, 2025] are probably attributable to resuspension. Unfortunately, we have no Access to tables in the Annex of this work.

[Gehrig, 2010] adopted a mobile load simulator. The device is placed on a spot of the pavement, and wheels are repeatedly pulled over it at specific speed and loading conditions, inside an enclosure. After some minutes of operation, all initially present dust is supposed to have been resuspended. So, all subsequently emitted particles were attributed to road abrasion, though tyre wear cannot be ruled out.

[Muresan, 2025] used mercury spiked tyres to discriminate between tyre and road originated particles. Emissions were collected with an on-board system during road tests. Therefore, resuspension could be included in road emissions.

[Kupiainen, 2005] used a road simulator for the study of road wear emissions. The values indicated in the table are the ones corresponding to friction (summer) tyres running at 30 km/h.

The temperature of the pavement depends on the local weather, season of the year, time of the day and the pavement's nature. In a previous Life Project, pavement temperatures in Murcia as high as 65 C were observed (https://heatlandlife.eu/wp-content/uploads/2022/05/LAYMAN-REPORT-17-3-22.pdf), with minimum temperature of 30 C at night.

According to the discussion above, the following values are suggested as inputs for CFD simulations of road wear particle emissions:

| | |
|---|---|
| TSP/PM10 emission factor: | 7.5 $mg.km^{-1}.veh^{-1}$ |
| PM2.5 emission factor: | 4 $mg.km^{-1}.veh^{-1}$ |
| Temperature: | 45 C |
| Vehicle speed: | 30 km/h |

### *8.1.8. References*

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