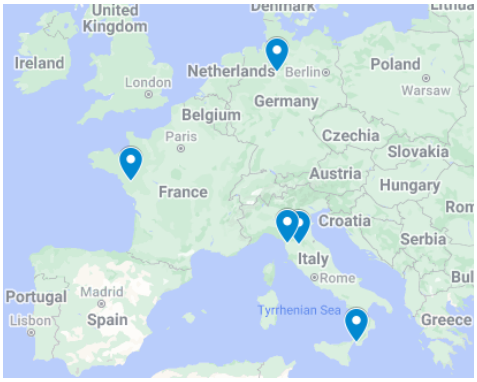
Table of Contents

LIFE E-VIA Project -Electric Vehicle noise control by assessment and optimization of tyre/road interaction



Reference: LIFE18 ENV/IT/000201

Beneficiaries: The project is coordinated by the Municipality of Firenze and involves as partners the Mediterranean University of Reggio Calabria, University Gustave Eiffel, Continental Reifen Deutschland GmbH, Vie en.ro.se Ingegneria S.r.l. and iPOOL S.r.l.

Period: from July 2019 to January 2023

Total budget: 1.797,030 €

55%EC co-funding: 933,295 €

Website: www.life-evia.eu

Introduction

NOISE POLLUTION IN URBAN AREAS

More than 100 million EU citizens are affected by high noise levels negatively impacting their health and wellbeing. Specifically, **traffic noise** alone is harmful to the health of almost every third person in the WHO (World Health Organization) European Region and 20% of Europeans are regularly exposed to night sound levels that could significantly damage health, especially in urban areas.

EU regulates environmental noise from the main sources. Key legislation can be found here.

However, to reduce noise pollution a combination of measures needs to be implemented; the increased stringency of EU at source standards needs to be balanced against other effective actions such as road surface and/or tyre improvements and urban planning measures.

THE SOUND OF THE FUTURE: NOISE REDUCTION FOR ELECTRIC VEHICLES

The introduction of **electric mobility** is recognized as one of the best solutions to reduce noise in urban areas. Substituting conventional vehicles with electric vehicles (EVs) is also expected to substantially reduce greenhouse gas emissions and air pollution.

Nowadays, the number of EVs is increasing and the international outlook for EV fleet is estimated to reach between 15% and 30% of the global vehicle fleet by 2030.

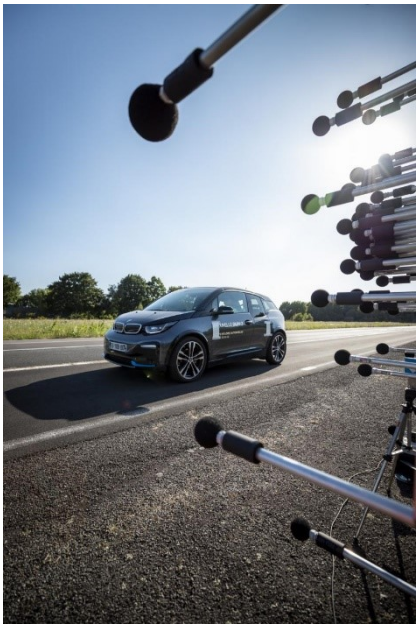
While EV motor noise is lower than on conventional vehicles, rolling noise caused by the friction between car tyres and road surfaces is one of the main specific noise contributions on EVs. For this reason, there is a need for in-depth investigations of **tyre/road interaction** and the development of low noise tyres and quiet road surface for noise reduction.

- *Which are the solutions to reduce noise in our cities?*
- *Are electric vehicles totally silent?*
- *How citizens can be involved in proactive good practices for noise reduction?*

These are some of the questions that the European LIFE E-VIA project aims to answer in depth.

Objectives

LIFE E-VIA addresses the problem of road traffic noise, focusing on a future perspective in which electric and hybrid vehicles will be a substantial portion of the traffic flow. The main objective is to test an optimised solution for **reducing noise in very populated urban areas c**ombining low noise road surfaces with the development of tyres for electric vehicles.



Additional objectives:

- To contribute to **effective implementation of EU legislation**[1],
- To contribute to national and Italian regional policies, issuing **guidelines** about use and application of the methodology output of the project.
- To **raise people's awareness** of noise pollution and health effects explaining the opportunities provided by EVs through specific dissemination and promotional events, also investigating people perception of noise and soundscape.
- To demonstrate and **promote electric mobility**, reducing noise emission by 5 dB(A) at receivers roadside and achieving also CO_2 emissions reduction.
- To **encourage low-noise surfaces implementation** demonstrating durability and sustainability.

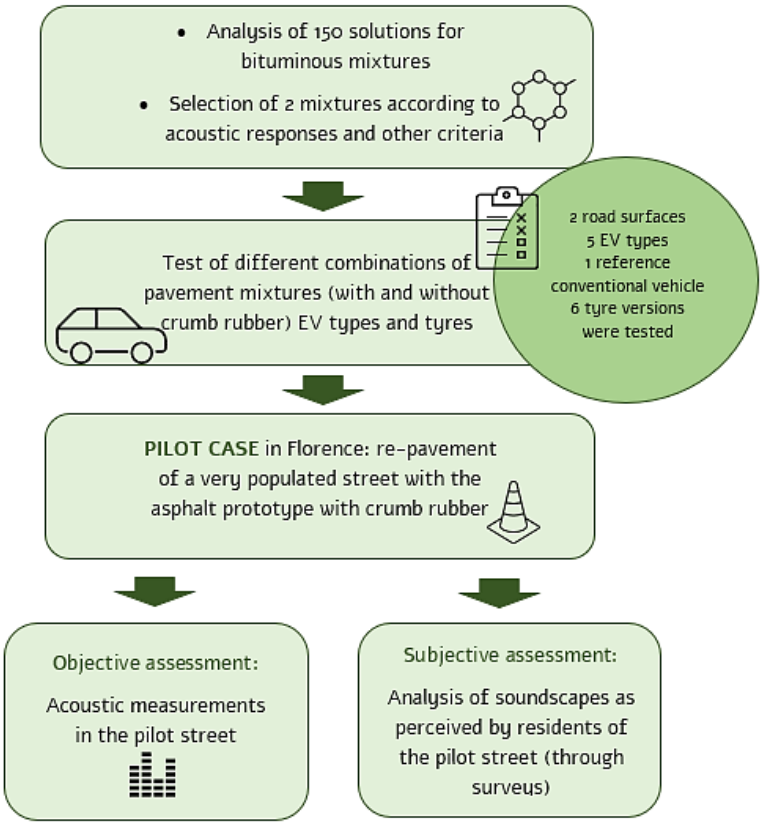
[1] EU Directives 2002/49/EC and 2015/996/EC

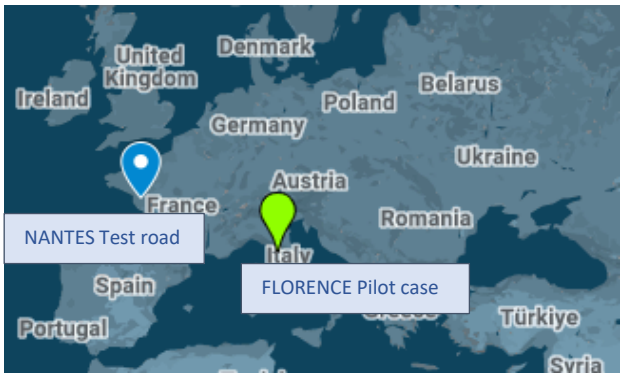
Key actions and achievements

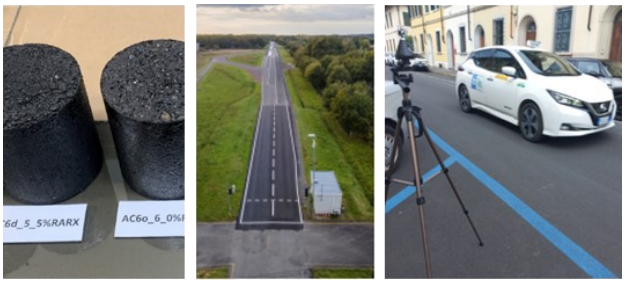
KEY PROJECT ACTIONS

The Life E-VIA project has:

- ✓ **Analyzed 150 solutions for bituminous mixtures** and selected 9 mixtures according to acoustic response and other criteria (e.g. mechanistic properties, permeability, satisfactory expected life). Based on additional considerations, 2 mixtures have been designed for further testing.
- ✓ built in Nantes a **test road surface** where two pavement mixtures (with and without crumb rubber) and different EV types and tyres have been tested to identify the optimal combination for noise reduction.
- ✓ designed **new tyres for EVs** with optimized performances.
- ✓ implemented the **pilot case in Florence** (Via Paisiello), with the construction of two road surfaces, an optimised and a reference one, carrying out further testing both in the ante-operam and in the post-operam scenario;
- ✓ estimated the **noise mitigation efficiency** and potential of tyres, road surfaces and traffic through a life-cycle and a life-cycle cost analysis;
- ✓ calculated the **rolling noise coefficients** according to the EU CNOSSOS model for the EV fleet;
- ✓ **involved citizens** through targeted information initiatives on electric and mobility and through surveys, soundwalk experiences and interviews on an electric taxi in the pilot street.







KEY ACHIEVEMENTS

Optimized asphalt

According to acoustic measurements performed one year after the intervention in the pilot street **an average reduction of 4.4 dB(A)** in the night period from 10 p.m. to 6 a.m. has been measured.

This benefit affects about 2.000 residents of the pilot area.

This result is in line with the subjective assessment: results of the survey conducted to assess noise perception of the residents showed that after the realization of the interventions the intensity of traffic noise decreased and the quality of the soundscape improved. Also, **a significant majority of respondents (77%) positively assessed the effects on traffic noise of the re-paving with the optimized asphalt.**

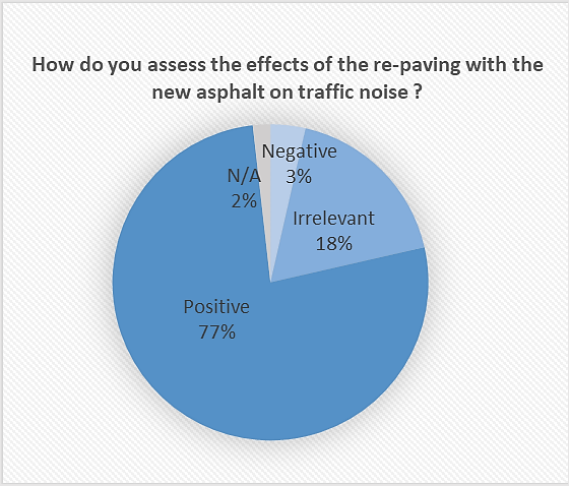
The Pilot street

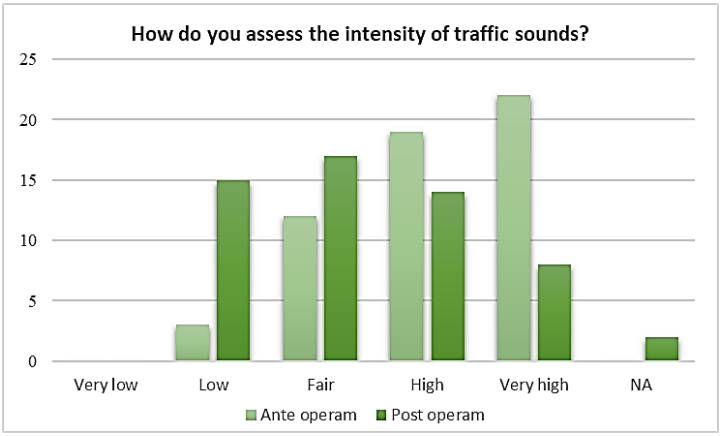
Paisiello street in Florence is a busy road due to traffic toward the city center. It is characterized by a significant population density, and it is close to public offices, to the largest public park in Florence and to one of the most important interventions of urban requalification (ex Manifattura Tabacchi).

What is a decibel (dB)?

Decibels measure sound intensity. Decibels are measured logarithmically which means that 10 db increase is equal to a 10-fold increase in sound pressure level *(10 times louder).* Sound studies tell us that after a 5dBA increase in sound level listeners report a noticeable or significant change.

Soundwalks experience, interviews on an electric taxi and listening sessions were also organized in the pilot street. Participants pointed out the benefits that the re-pavement with the LIFE E-VIA optimized asphalt can bring in terms of soundscape perception.





Interventions in the pilot street in Florence

LCPX measurements were carried out to assess the behaviour of the pavements right after they were laid and with a significant traffic load. This parameter evaluates the noise contribution of the road alone, so not including other possible noise sources as the engine or the exhaust pipe. The last measurement session gave the following results for the E-VIA pavements:

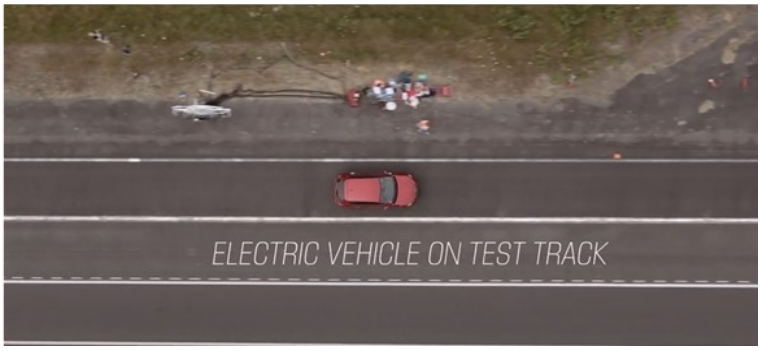
- 90.4 dBA (with 1 dBA uncertainty) for the reference pavement and 89.3 dBA (with 0.9 dBA uncertainty) for the special pavement that includes crumb rubber, giving a further environmental advantage in the recycle and reuse of exhausted tyres.

Green Public Procurement Criteria for Road Design, Construction and Maintenance issued by the European Commission gives some reference value that newly laid pavements have to observe to reflect higher environmental standards that the EU is striving to achieve, firstly to directly benefit its citizens: a 93 dBA reference value is imposed for LCPX road emission at 50 km/h within its first 5 years of duty.

Optimized tyres for electric vehicles

Within LIFE E-VIA existing, validated technologies were combined in a smart and novel way to develop a noise optimized EV tyre compared to state-of-the art premium summer tyres.

The noise optimized tyre for electric vehicles led to a reduction of rolling noise of 0.8 dB(A) under typical urban driving conditions. This was achieved without noticeable impact on other important performances such as rolling resistance and wet grip.



Policy contributions

A new tool has been developed to evaluate the acoustic impact of a new mobility characterized by the use of EVs and innovative low noise pavement. Experimental results obtained on the two test track in the pilot street were used to improve the EU-CNOSSOS Common Noise aSSessment methOdS model (e.g. rolling noise coefficients for EVs

The implemented database and the coefficients for electric vehicles and asphalt will be used in the IV Round of Action Plans in Italy.

CNOSSOS-EU Common NOise aSSessment methOdS for road, railway, aircraft and industrial noise, aims at improving the reliability, consistency and comparability of noise assessment results across the EU Member States.

Publications and events

Moreover, more than 15 scientific papers have been published and more than 20 presentations have been given during conferences (about 900 people reached), together with more than 20 brief articles on Italian magazines mainly concerning the pilot case. An overall number of about 60 students has been directly informed about project activities. A contest for High School students was also organized.

All the LIFE E-VIA project publications and promotional videos can be found at: https://life-evia.eu/documents/

A series of events, meetings and webinars were held including the participation at the 2021 Expomove in Florence and the organization of the large scale final event "*Electric mobility and low-noise asphalts: results of the LIFE E-VIA project and contributions from other projects*" as part of Expomove that took place in Florence in October 2022. The main goals of these events were the following:

- Communicate project progress and results.
- Demonstrating results and benefits to policy makers.
- Raising awareness on the project to new stakeholders who could become part of the broader coalition working on traffic noise mitigation strategies.
- Networking with other European projects on the same topics.

The LIFE E-VIA PROJECT was also presented in the Eurocities Environment Forum of Oslo in October 2019. Networking activities with LIFE projects (LIFE+15 NEREIDE, LIFE+15 MONZA and LIFE+16 CLOWN projects) have been activated and will be maintained also after the project conclusion.

Participation at Expomove, Florence 2021

Participation at Europe Festival 2022

Final event at ExpoMove Florence 2022

Benefits and impacts

Environmental and social benefits

A low noise, low rolling resistance tyre as the one developed by the project is considerably more beneficial for EVs than for comparable ICE vehicles. Indeed, in EVs the relative contribution of the tyre noise to the overall vehicle noise is considerably higher compared to the one in ICEV, due to the nearly non-existent drivetrain noise. Moreover, the tyre rolling resistance has a relatively higher contribution to the energy consumption and a large impact on the achievable mileage of an EV which, in turn, is crucial for the public acceptance of EVs as means of transportation.

The LIFE E-VIA optimized tyre has an excellent rolling noise behavior for EVs in urban scenarios, while also maintaining rolling resistance label class A. The **reduction in fuel consumption** going from tyres of rolling resistance label class B to tyres of class A is roughly 0,1l/100km. Consequently, Greenhouse gases and other local pollutants are reduced.

Social benefits resulting for the optimization of asphalt and EV tyres primarily include **health benefits**: the resulting reduction of traffic noise will decrease the likelihood for cardiovascular diseases, cognitive impairment in children, sleep disturbance, tinnitus and annoyance among other physiological and psychological impacts. Additional analysis based on the Life Cycle Assessment approach suggest that the LIFE E-VIA solutions reduce the DALY (Disability-adjusted life years) by 24%.

Indicator	**Value**
%HSD (Self-reported sleep disturbance)	From 8,3% to 6%
Relative risk for hypertension	Reduction of 9%
Percentage of the population highly annoyed (HA)	From 10,7 % to 9,4%
Persons whose lives were directly, positively impacted by MAIN environmental actions of project	*2000 (8000 3 years after project end)*

Impact monitoring:

Life Cycle Assessment and Life Cycle Costing to assess track efficiency from a comprehensive point of view were conducted. The internal costs and external costs were considered, as well as the durability of acoustic performance.

Transferability and Replication

The City of Florence has planned to lay LIFE E-VIA asphalt in 6 different sites in 2023, as part of the ordinary road maintenance programs and of its Noise Mitigation Plan

Furthermore, in the frame of the implementation of Action Plans for Agglomerations and Major Roads as indicated in the Environmental Noise Directive 2002/49/EC, project partners will adapt and propose as possible solutions to mitigate noise in the cities and major roads, the ones developed in the frame of the LIFE E-VIA project.