LIFE E-VIA

Electric Vehicle noIse control by Assessment and optimisation of tyre/ road interaction

www.life-evia.eu

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With the contribution of the LIFE programme of the European Union

LIFE18 ENV/IT/000201

Project overview

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MAIN OBJECTIVE:

To reduce noise for roads inside very populated urban areas through the implementation of mitigation measures aimed at providing optimized road surfaces and tyres for modern EVs.

PILOT AREA LOCATION: Florence, Italy

DURATION: 07/2019 – 01/2023

BUDGET: 1.8 Mio € (55% EC-funded)

PROJECT PARTNERSHIP

Coordinating Beneficiary: Florence Municipality

Associated Beneficiaries: Ipool S.r.l., Université Gustave Eiffel, University of Reggio Calabria, Vie en.ro.se Ingegneria S.r.l., Continental Reifen Deutschland GmbH

Motivation

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- The LIFE E-VIA project focuses on **noise pollution** due to **road traffic**, looking at a **future perspective** in which **electric and hybrid vehicles (EVs)** will be a consistent portion of the traffic flow.

- One of the **best solutions** universally recognized to **reduce noise in urban areas**, from both the point of view of **noise** and **air quality**, is the introduction of **electric mobility**.

- **Traffic noise** mainly consists of **powertrain noise** and **tyre/road noise** (i.e. rolling noise). With the progress of modern Internal Combustion Engines (ICE) and EVs, **tyre/road noise dominates after 40 kph** for steady-speed traffic.

Why special requirements for tyres and roads for EV applications?

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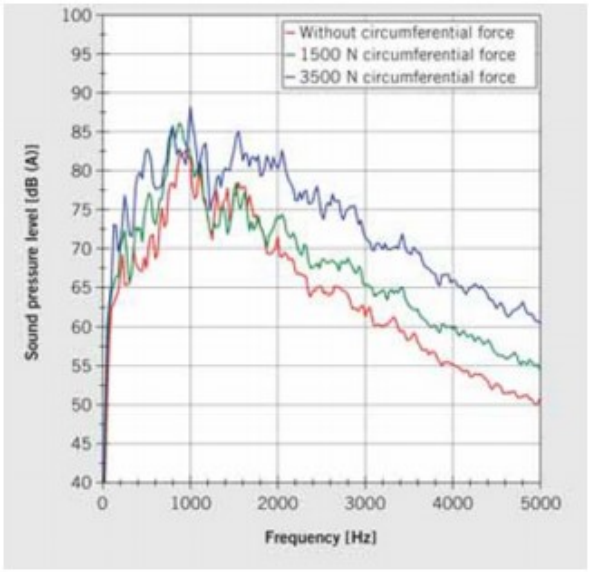
Compared to classical ICE vehicles…

- …are EVs heavier.

  - Higher tyre load → higher tyre/road noise.



Source: F. Stalter et al.; Influence of driving torque on tyre noise, Auto Tech Review 10/2013, 34-38.

- …exhibit EVs high torque values in a wide range of RPMs.

  - Additional tyre/road noise generation mechanisms.

- …is there an even increased focus on low rolling resistance for EVs.

  - Reduced rolling resistance → increased milage → increased customer acceptance.

Stakeholders

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NGOs involved in noise and air pollution

Citizens as beneficiaries of the mitigation actions and raising awareness initiatives

Road managers, private and public authorities responsible for laying roads and its management

Companies involved in the market of asphalt production, laying and in the recycling of materials for asphalt production

Young people and **schools**

Researchers and **Technicians**

Objectives

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1. To **reduce noise** for roads inside very populated urban areas through the implementation of a mitigation measure aimed at providing **optimized road surfaces and tyres for EVs**.

Objectives

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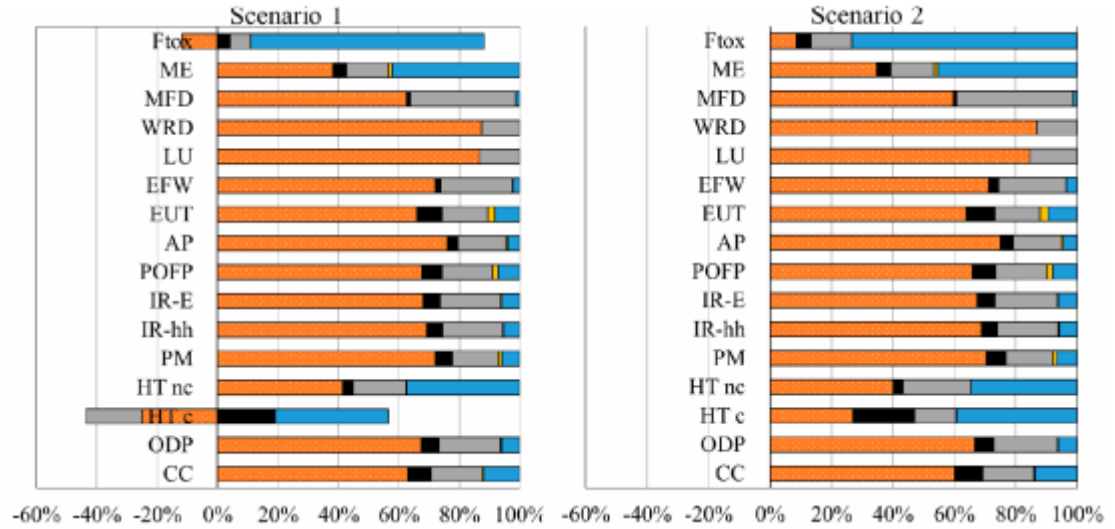
2. To **estimate the mitigation efficiency** and **potential** of **tyres**, **pavements** and **traffic** at a higher comprehensive level: Life Cycle Analysis (**LCA**) and Life Cycle Cost Analysis (**LCCA**) is performed to demonstrate the individual and synergistic efficiency of pavement surfaces, tyres and vehicles.



Source: F. Praticò *et al.*, Energy and Environmental Life Cycle Assessment of Suistainable Pavement Materials and Technologies for Urban Roads, Suistainability 2020, 12, 704

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3. To contribute to effective **EU legislation implementation** by providing specifically tuned rolling noise coefficients for EVs within the Common Noise Assessment Method (**CNOSSOS-EU**) with the aim to help developing **future scenarios.**

Objectives

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4. To contribute to **Italian national and regional policies**, issuing **guidelines** about use and application of the methodology output of the project. The Tuscany Region, through the Regional Env. Agency (ARPAT), will be the first to adopt the outcome of E-Via. Calabria Region and Città of Reggio Calabria also expressed their interest.

Source: https://www.flickr.com/photos/44534236@N00/17185363123/in/photostream/

Objectives

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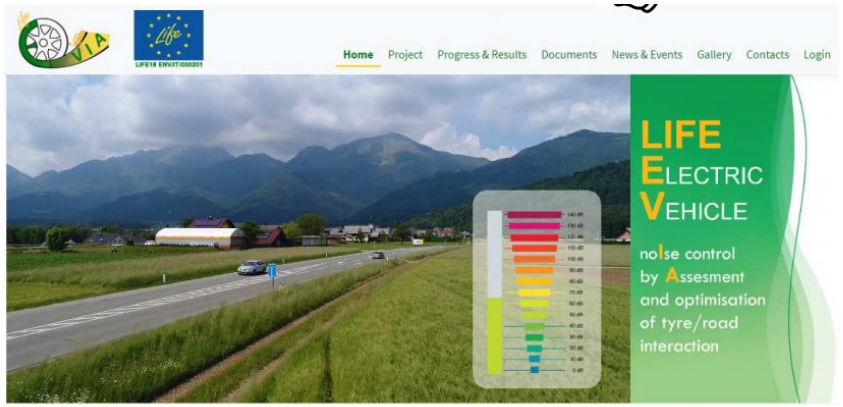
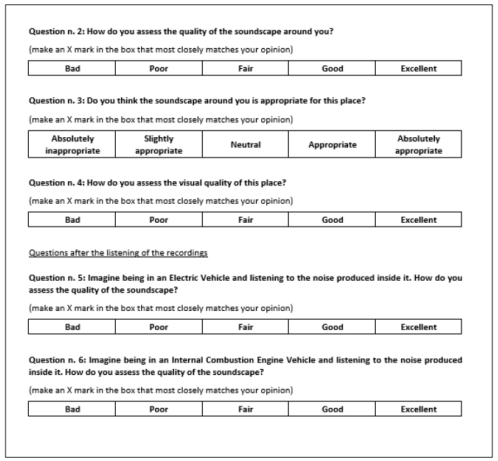
5. To **raise people's awareness** of noise pollution and health effects explaining the opportunities provided by EVs through specific dissemination and promotional events, also investigating people perception regarding noise in terms of soundscape methodology and involving them in noise data acquisition.


intoscana

ATTUALITÀ /

Firenze città pilota in Europa per la sperimentazione dell'asfalto anti-rumore




Question n. 2: How do you assess the quality of the soundscape around you?

(make an X mark in the box that most closely matches your opinion)

Bad	Poor	Fair	Good	Excellent

Question n. 3: Do you think the soundscape around you is appropriate for this place?

(make an X mark in the box that most closely matches your opinion)

Absolutely inappropriate	Slightly appropriate	Neutral	Appropriate	Absolutely appropriate

Question n. 4: How do you assess the visual quality of this place?

(make an X mark in the box that most closely matches your opinion)

Bad	Poor	Fair	Good	Excellent

Questions after the listening of the recordings

Question n. 5: Imagine being in an Electric Vehicle and listening to the noise produced inside it. How do you assess the quality of the soundscape?

(make an X mark in the box that most closely matches your opinion)

Bad	Poor	Fair	Good	Excellent

Question n. 6: Imagine being in an Internal Combustion Engine Vehicle and listening to the noise produced inside it. How do you assess the quality of the soundscape?

(make an X mark in the box that most closely matches your opinion)

Bad	Poor	Fair	Good	Excellent


LIFE/ENV/IT000201 LIFE E-VIA

Project co-funded by the European Commission into the LIFE+2018 Programme.

COMUNE DI FIRENZE

Vie en.ro.se. Ingegneria

Università degli Studi Mediterranea di Reggio Calabria

Con il patrocinio di

Associazione Italiana di Acustica

organizzano il

WEBINAR

Mobilità elettrica e asfalti a bassa emissione di rumore: il progetto LIFE E-VIA e altri contributi

14 maggio 2021 h 14.00-16.10

Objectives

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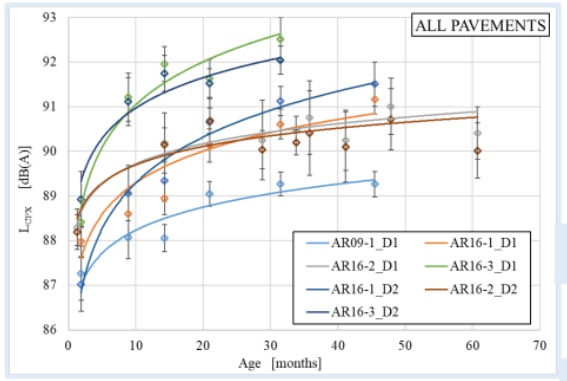
6. To demonstrate and **promote sustainable (electric) road transport mobility**, reducing noise emission by up to 5 dB(A) at receivers' roadside façades while also reducing CO_2 emissions reduction. (Scenario: Italian traffic mix).

7. To **encourage low-noise surfaces implementation in further EU and extra-EU scenarios**, demonstrating durability and sustainability, through in-depth LCA&LCCA.



G. Licitra, A. Moro, L. Teti, A. Del Pizzo, F. Bianco (2019). "Modelling of acoustic ageing of rubberized pavements". Applied Acoustics 146 (2019) pp. 237–245.

$$L_{CPXi} = Y_{0i} + \alpha_i * ln\left(\frac{1+A}{A_0}\right) + \alpha_T \Delta T + \alpha_H \Delta H$$

age of the pavement

initial L_{CPX} value

Air temperature correction

Rubber Hardness correction

The coefficient α_i refers to the interaction of three factors: **pavement type**, **traffic actions** and **climatic parameters**.

Technical solutions – tyre

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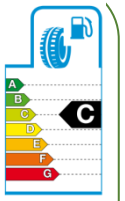
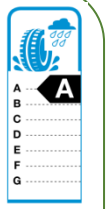
"Within action B7 [..] EV tyres [are developed and build] which are designed to give an optimal holistic relation between low exterior noise and other key performances."

Rolling resistance



- Affects the energy efficiency of a vehicle.
  - Contribution to CO_2 emission (depending on vehicle type/energy source).
  - High achievable mileage is crucial for user acceptance of EVs.

Safety



- Wet/dry braking
- Aquaplaning
- Safe driving is a paramount requirement a tyre has to fulfill.

Wear

- High achievable mileage is crucial for user acceptance of a tyre.

The sustainability of a low noise tyre is only given when a holistic performance is assured.

Technical solutions – road surface

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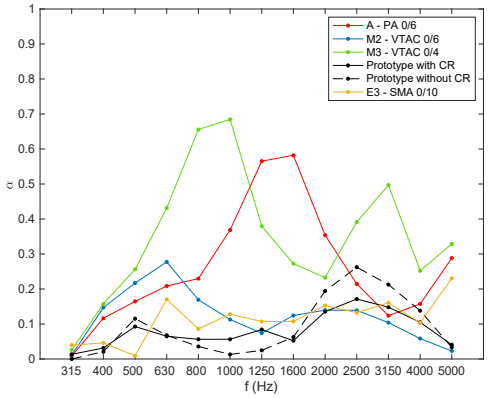
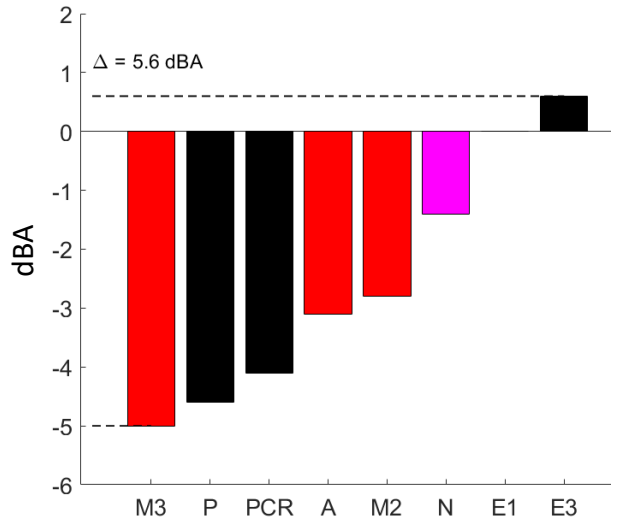
Road surface:

- Very thin asphalt concrete (VTAC) with max. aggregate size 6mm.
- With/without crumb rubber (PCR/P).
- MPD: ~0.3mm (PCR) / ~0.4 mm (P)
- Effective absorption 1.5 kHz to 5 kHz.

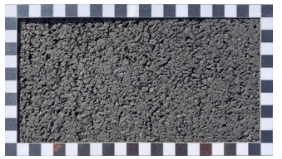


→ Based on prototype noise measurements:
3.5 dBA to 4.5 dBA with respect to reference DAC 0/10.



E1
DAC 0/10

P



PCR

Pilot Area Florence

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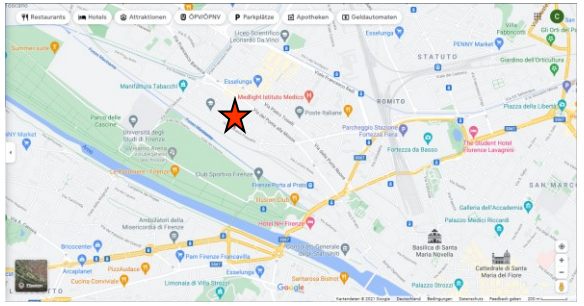
- As a pilot implementation a section of a road in Florence is paved with the new low-noise road surface.

- The pilot area is the focus of further actions relating to
  - performance and wear/ageing monitoring of the new surface,
  - LCA/LCAA analysis,
  - Soundscape analysis,
  - …



- The re-pavement of the road is linked to the *Expomove* festival which promotes Electric Mobility and will be held in Florence in May 2022.

Conclusion

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In Europe, the acoustic scenario in urban environments is mainly characterized by road traffic noise.

In this framework, the LIFE E-VIA project proposes **prototypal solutions** in form of optimized **road surfaces** and **tyres** for the specific context of **EV fleets**. These are developed in order to give an **optimal holistic relation** between **low exterior noise** and **other key performances**.

These solutions are accompanied by soundscape analysis activities, estimation of EV rolling noise coefficients for the local fleet in order to support implementation of EU legislation, Life Cycle and Life Cycle Cost Analysis to evaluate the track efficiency from a comprehensive point of view.

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Thank you for your attention

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