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EUROPEAN RESEARCH ON MOBILE EMISSION SOURCES

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LENS project
L-vehicles Emissions and Noise mitigation Solutions

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Emisia

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LENS L-vehicles Emissions and Noise mitigation Solutions

Project Fiche

Grant Agreement number	101056777
Framework Programme	HORIZON Europe
Call	Clean and competitive solutions for all transport modes (Topic ID: HORIZON-CL5-2021-D5-01-16)
Type of action	Research and Innovation Action
Duration	36 months (started: 9.2022)
Budget	4 995 098 €
Total partners	15
Coordinator	Emisia S.A.

L-vehicles Emissions and Noise mitigation Solutions

Consortium

emisia
CONSCIOUS OF TRANSPORT'S IMPACT

Applus IDIADA

TU Graz

ivl
Swedish Environmental Research Institute

ika | RWTH AACHEN UNIVERSITY

KU LEUVEN

CZU Czech University of Life Sciences Prague

TNO innovation for life

ifp Energies nouvelles

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POLIS
CITIES AND REGIONS FOR TRANSPORT INNOVATION

LENS L-vehicles Emissions and Noise mitigation Solutions

Background

Need 1	Emissions from LVs degrade air quality in cities, but we lack **reliable emission factors** to assess their contribution, especially for some special LV subcategories
Need 2	**Nanoparticles** have attracted attention on their health effects, but we have very little – if any information on nanoparticle emissions from LVs, especially below 23 nm due to measurement challenges on small vehicles
Need 3	A large share of the EU population complains about **noise caused by LVs**, both in cities as well as in rural areas, such as the infamous Alpine valleys and touring routes which are popular with motorcycle riders. Measures and policy options to moderate such phenomena – further to access restrictions – are lacking
Need 4	LVs are known to be widely **tampered** by actual users and there is a need for anti-tampering measures and actual infield performance
Need 5	Emission and noise control regulations need to be inclusive of critical **operating conditions** that are prevalent in actual on-road driving of LVs causing the most impact

LENS Main Objectives

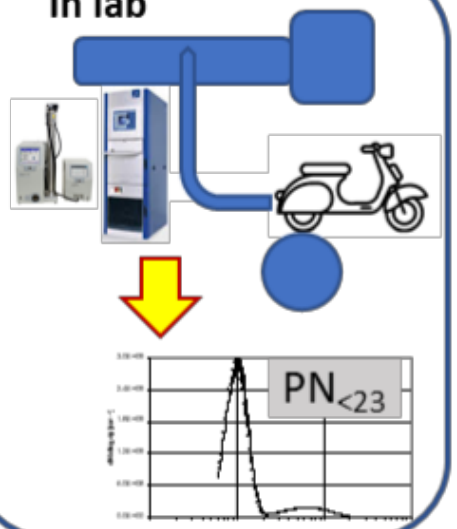
	What	Why
O.1	**Beyond state-of-art LVs emission and noise measurement techniques**	To be able to measure emissions and noise under real world conditions, cost-effectively
O.2	**Characterise noise and pollutant emissions performance of LVs**	Understand latest status of fleet emissions, identify LV subcategories that may be an issue, understand emission levels of non-regulated pollutants, feed air pollutant emission inventories and policy decision tools
O.3	**In-field identification of tampered LVs**	Understand the extend of the problem, identify tampering methods, provide tools and methods able to capture tampered vehicles in the field to enforce regulations
O.4	**Recommendations and expected impact of decreasing noise and pollutants from LVs**	Policy recommendations for various stakeholders, including regulators, national, local authorities, NGOs, etc on how emissions and noise from LVs can be decreased in the field

LENS overall methodology

LENS Project State-of-Art

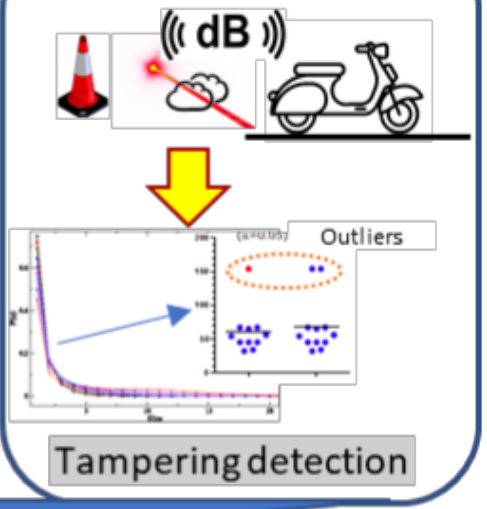
DIAS ELVITEN · SUREAL-23 · PEMs 4Nano · DOWN TO 10 · CARES · ermes

In lab

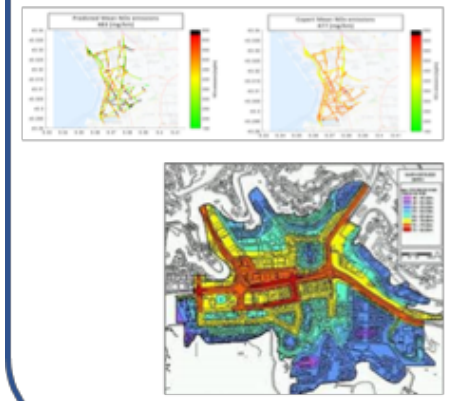


On road/test track

Remotely



Case studies demonstration



Update of models

Recommendations

Regulations

Surveillance

Traffic measures

Urban planning

Undesirable tampering effects

- Identified common LV modifications & tampering methods, through field research
- Identified actual frequency of modifications, through online questionnaire and face-to-face interviews with riders conducted in 20 EU MSs
- As first step, estimated modifications effects on noise and air pollution, through literature review, engineering judgement of emissions testing experts & OEMs

Modification	Effect on				
	CO	CO_2	NO□	HC	Noise level
Removal of silencer	-	-/↓	-	-	↑↑↑
Catalyst removal	↑↑↑	↓	↑↑	↑↑↑	↑
Adjustable muffler valve	-	-/↓	-	-	↑↑
Air filter removal	↓	-	↑	-/↓	↑/↑↑
After-market ECU	↑/↑↑	↑↑	↑	↑↑	↑
After-market carburettor	↑↑	↑↑	↓	↑↑↑	↑

Common tampering practices with large effects identified in LENS (D5.1)

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Frequency of modifications

- More than 75% of the vehicles were not in their original configuration
- Muffler replacement was the most common practice
- Large number of vehicles with modifications that may significantly affect noise/emissions:
  - Software modified ECU (20%), removed catalyst (15%), replaced ECU (6%)

	Online Questionnaires	Face-to-face interviews	Total
Questionnaires completed	602	64	666
No modifications mentioned	157	3	160
Reviewed Questionnaires	445	61	506

Real world driving conditions and requirements for the LENS test programme

- **Literature review and analysis** of available RWD data performed to identify critical conditions for noise and pollutant emissions
- **Roadside measurements** performed to verify conditions
- Recommendations provided to include in the LENS **test programme**
- Recommendations **of data** that have to be recorded during measurements

- Cold engine start
- Driving at max rated speed (mainly for mopeds)
- Strong accelerations, including from standstill
- Transition from constant speed or acceleration phases to deceleration phases
- Restarting during the test
- Testing at max technically permissible mass
- Stop and go testing simulating traffic congestion
- Engine revving

Recommendations for testing conditions in LENS (D6.1)

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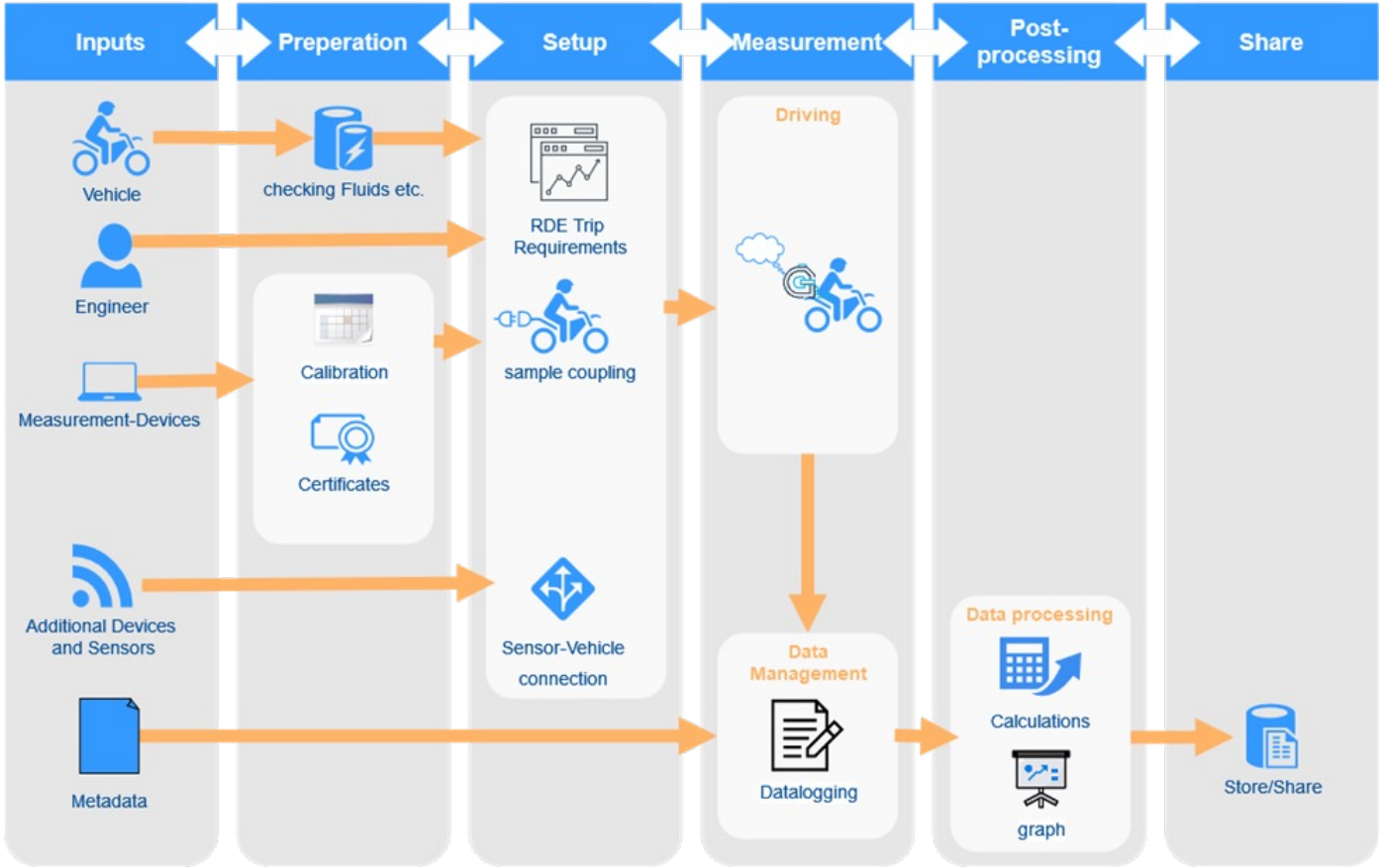
On-board measurement protocol definitions

- Standards and procedure for on-road measurements within LENS
- Tests with various on-board suitable measurement equipment
- Definition of RDE trip requirements
- Suggestions for future test protocols



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Systems and challenges for on-board emission measurements

Systems available:

- Standard automotive PEMS with EFM
- SEMS with selected sensors for NOx, CO_2, CO, NH_3, O_2, HC, BC, PM, ...
- On-board FTIR

Challenges to be addressed:

- Can-bus access for vehicle data (rpm, gear, ...)
- Difficult access to exhaust gas at tailpipe
- Exhaust gas flow measurement
- Suitability of measurement systems for small LVs

Method and system for on-board noise measurement

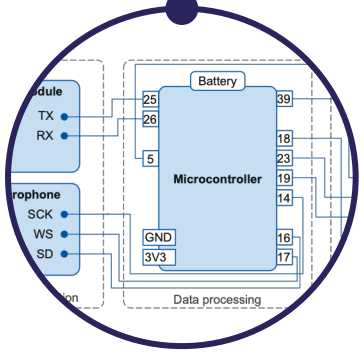
[1]

Components

Selection

- Microcontroller
- GPS Module
- Microphone
- SD card module

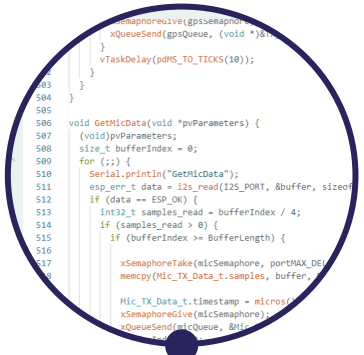
Circuit



Software

Wiring & Soldering

- Drawing of circuit diagram
- Soldering of components



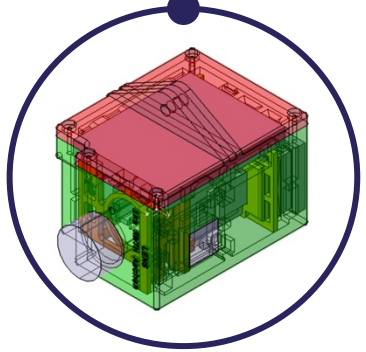
Development & Implementation

- Arduino IDE

CAD

Mechanical housing design

- CATIA Software



3D Print

3D Printing

- Material: PA12

Inserting of components

[1] https://www.dfrobot.com/product-1590.html

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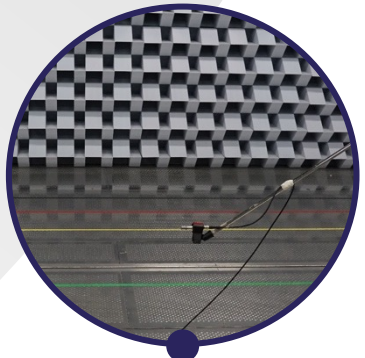
Method and system for on-board noise measurement



Verification

Comparison

- MEMS Microphone and microphone of a high accuracy class in semi-anechoic chamber

Sensor position

Measurements

- Identification of suitable sensor position on L-category vehicles

Measurement campaign

Purpose

- Detection of driving scenarios that cause high noise emissions
- Mounting of sensor system on 14 L-category vehicles
- Definition of real-world driving cycles

Conclusion

- Sensor system is suitable for on-road (on-board) measurements in comparison to a microphone of a high accuracy class
- A suitable mounting position on L-category vehicles could be found

Measurement campaign can start

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Overall status and path

- Main testing campaign in the lab has started (in total: 150 LVs)
- On road SEMS systems are being finalized for on-road tests
- Evaluation protocol and database for storing measured data finalized
- 3 Remote sensing campaigns are being planned for 2024
- Impact assessment of different approaches being planned

RTR CONFERENCE

You may learn more from us in the upcoming RTR conference, Brussels, 5-7.2.2024

Home - RTR Conference 2024

LENS L-vehicles Emissions and Noise mitigation Solutions

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All deliverables can be found at:

https://www.lens-horizoneurope.eu/resources

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