Introduction to the LENS project

Leonidas Ntziachristos
EMISIA & Aristotle University Thessaloniki

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LENS L-vehicles Emissions and Noise mitigation Solutions

suggestion that two-wheelers are a potential contributor to this enrichment. Considering the high use of two-wheelers in other European cities such as London or Barcelona if Europe is to decrease transport-related air pollution and inner city traffic, policy makers should consider finding alternatives to the conventionally-powered two-wheelers and supporting electric two-wheelers for example. © 2018 The Author(s)

Salameh et al., DOI: 10.1016/j.aeaoa.2018.100003

the period 1999–2012. Projections show that these vehicles will emit more than 7% and 20% of total road transport CO and HC, respectively, by the year 2012, if no additional regulatory measures are taken. In contrast, they will continue to be negligible NO_x (0.7%) and CO_2 (<1%) emitters, while their particulate matter (PM) emission contribution is expected to decline to below 1% in the future. The relative importance of their emissions,

Ntziachristos et al., DOI: 10.1016/j.atmosenv.2006.04.03

Transportation sector contributes as the second largest polluter of the air pollution in Indonesia. Of the transportation sector, road transport has generated 70% of the air pollution, 81% of which is attributable to motorcycles. The motorcycles are currently accounting for 79% of the total motor vehicles. It is predicted that the number of motorcycles will continue to grow at an annual rate of 9-26%. However, due to little attention to the motorcycle's environmental

Sopha et al., DOI: 10.52394/ijolcas.v1i1.3

Motorcyclists wrongly issued Aberdeen LEZ fines (bbc.com)

Motorcyclists wrongly issued Aberdeen LEZ fines

Aberdeen City Council has apologised after some motorcyclists were wrongly issued with Low Emission Zone (LEZ) fines.

Motorbikes and mopeds are exempt from the LEZ, which came into force in the city centre at the start of the month.

Belgian residents' groups take part in first international 'Motorcycle Noise Pollution' protest

Sunday 30 April 2023

By The Brussels Times with Belga

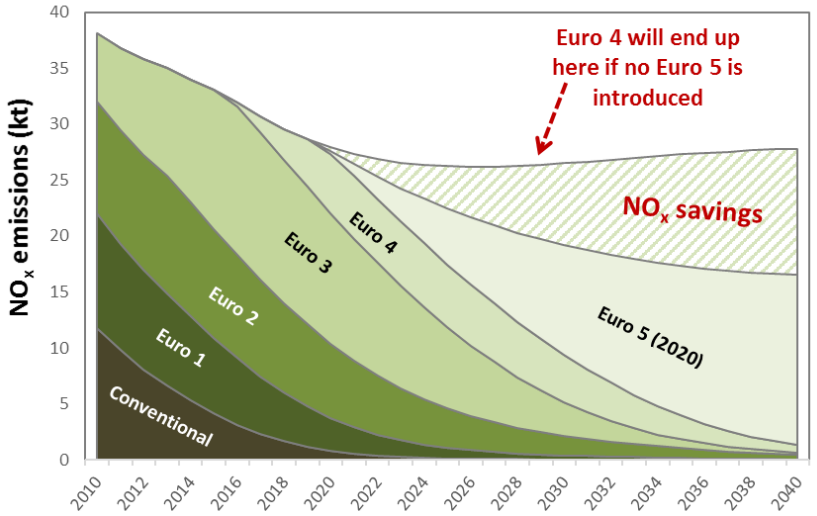
Germany Motorcycle Noise Bans

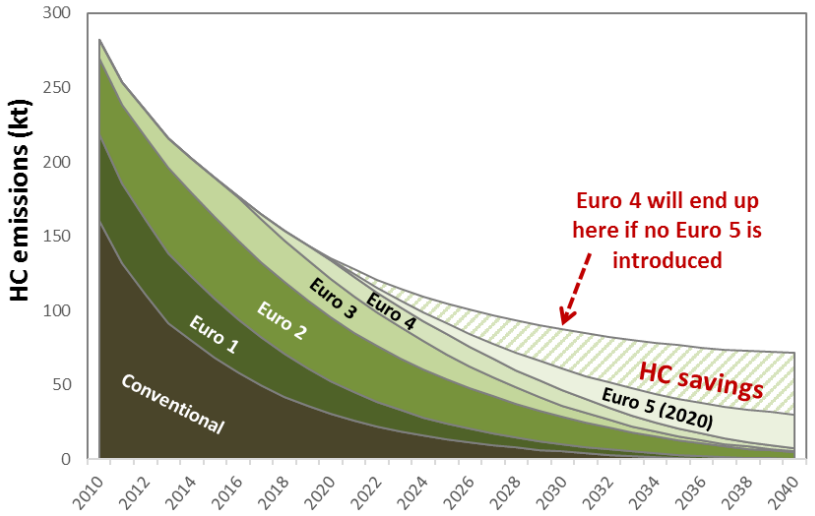
Access regulated by other requirements

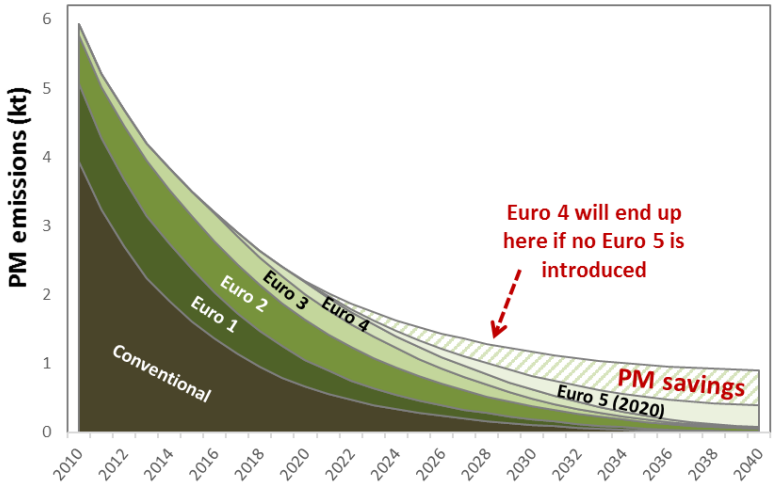
L-vehicles Emissions and Noise mitigation Solutions

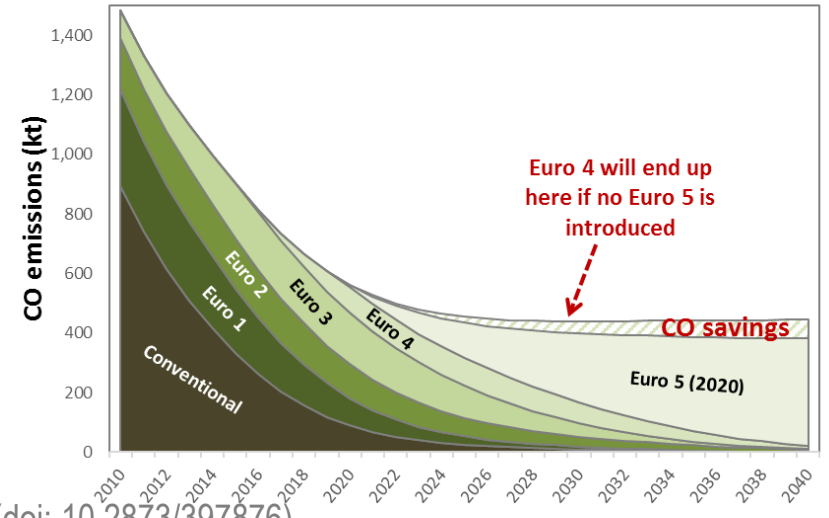
Emission standards may not address all operation conditions

Euro 5 emission standard design



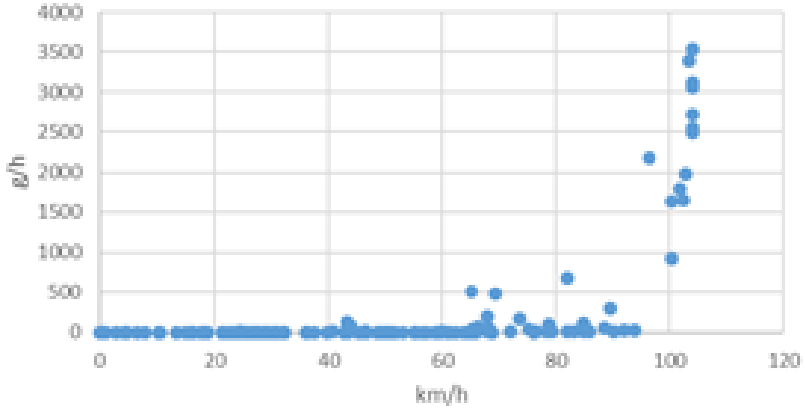






Euro 5 environmental effect study for DG GROW in 2016 (doi: 10.2873/397876)

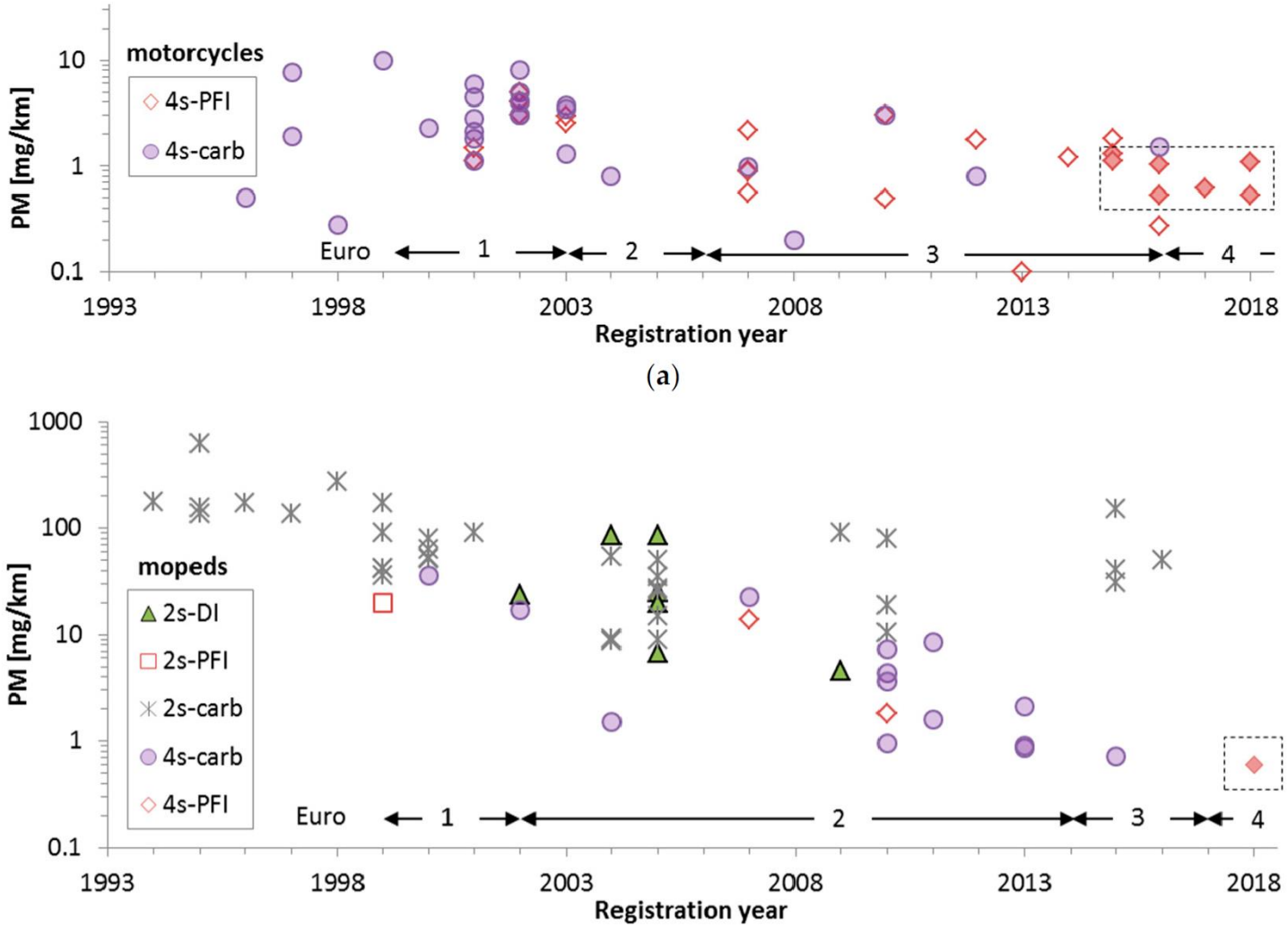
Example: <250 cc Euro 5 scooters



Dramatic increase of CO emissions at high speed due to fuel enrichment

LENS L-vehicles Emissions and Noise mitigation Solutions

Emission reduction can be achieved by technology improvement

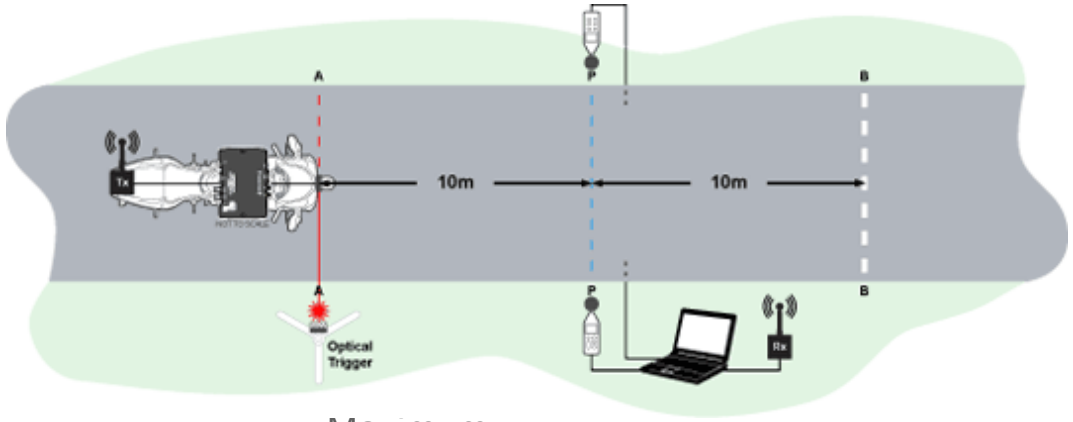


PM decreases are indirectly achieved by regulatory requirements addressing CO and HC

Source: Particulate Emissions of Euro 4 Motorcycles and Sampling Considerations, Atmosphere 2019, 10, 421; doi:10.3390/atmos10070421

L-vehicles Emissions and Noise mitigation Solutions

Noise does not only come from vehicle exhaust

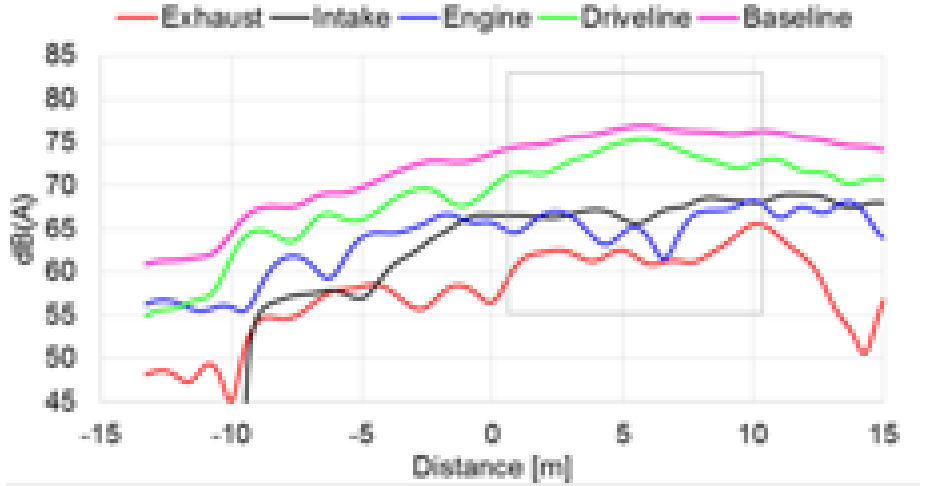


Maximum pass-by area

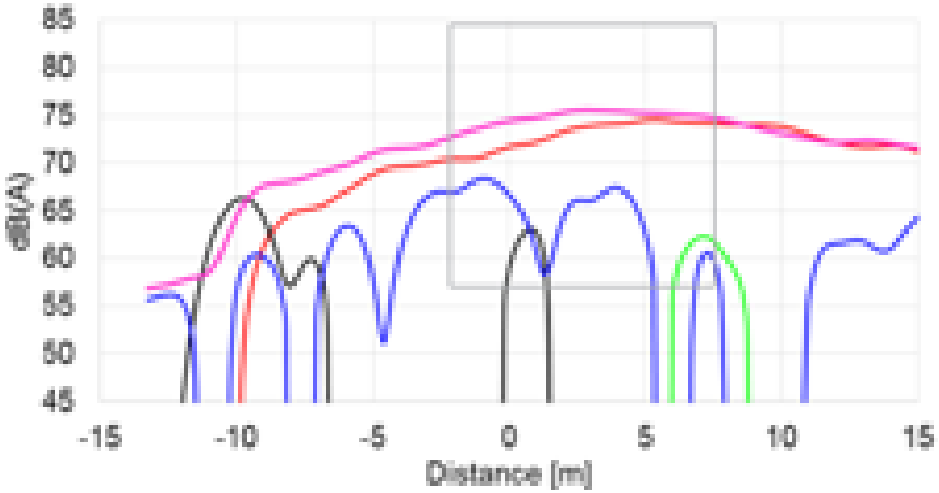
Contributions of:

- Exhaust
- Intake
- Engine
- Driveline

Baseline sound level in original configuration, also equivalent to the total of all contributions



Scooter 125cc
25<PMR≤50



Motorcycle
800cc
PMR>500

LVNS L-vehicles Emissions and Noise mitigation Solutions

LENS objectives

	What	Why
1	**Develop LVs emission & noise measurement techniques**	→ To measure emissions & noise → Real-world conditions → Cost-effectively
2	**Characterize noise & pollutant emissions performance of LVs**	→ Understand current fleet emissions → Non-regulated pollutants → High emitters? → Feed emission inventories (COPERT, HBEFA, etc.) → Feed noise inventories (TRANECAM, etc.)
3	**In-field identification of tampered LVs**	→ Understand the extend of the problem → Provide tools and methods able to capture tampered vehicles in the field.
4	**Provide recommendations for decreasing noise and pollutants from LVs, and expected impact**	→ Inform regulators, national, local authorities on how emissions and noise from LVs can be decreased

LENS L-vehicles Emissions and Noise mitigation Solutions

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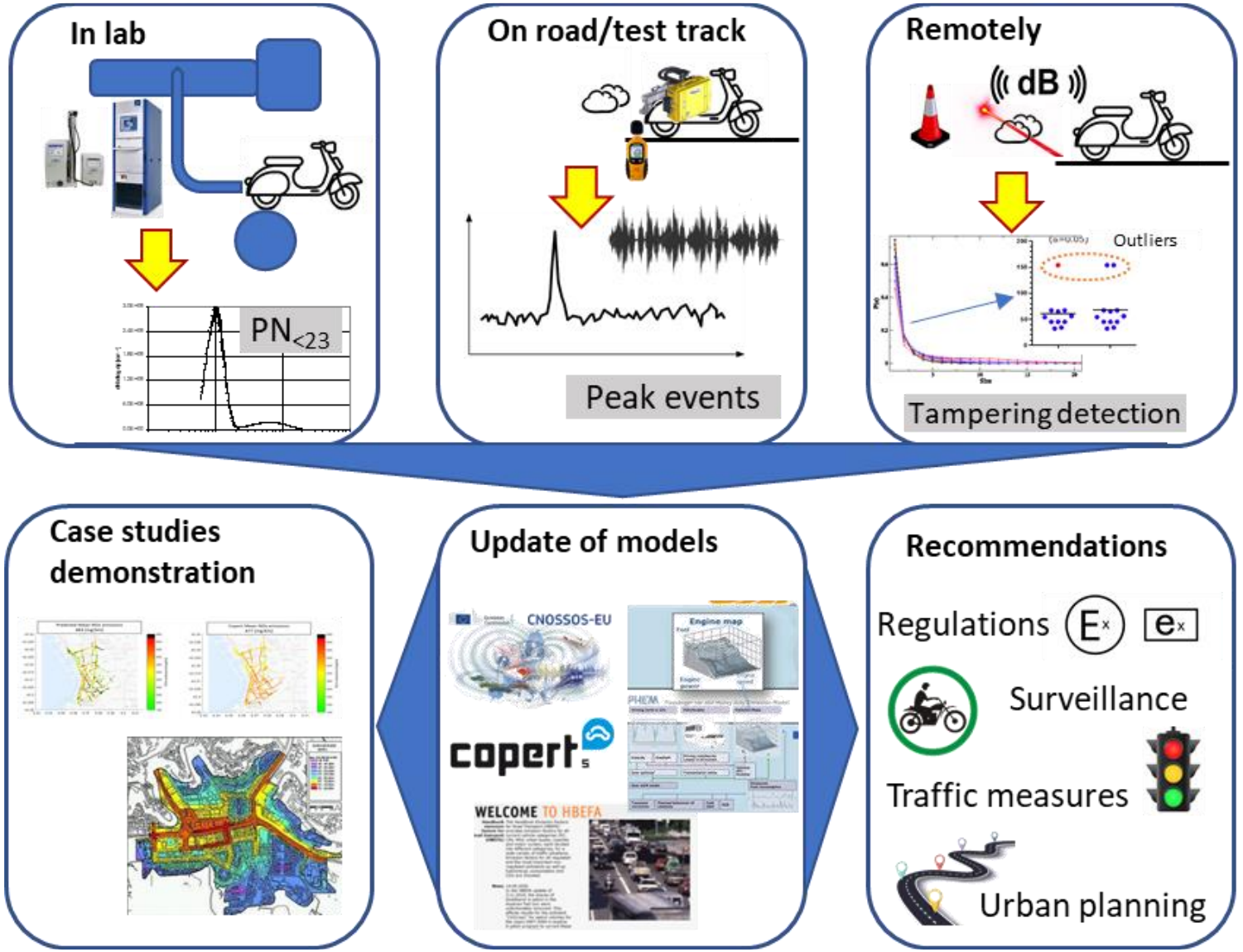
LENS Methodology



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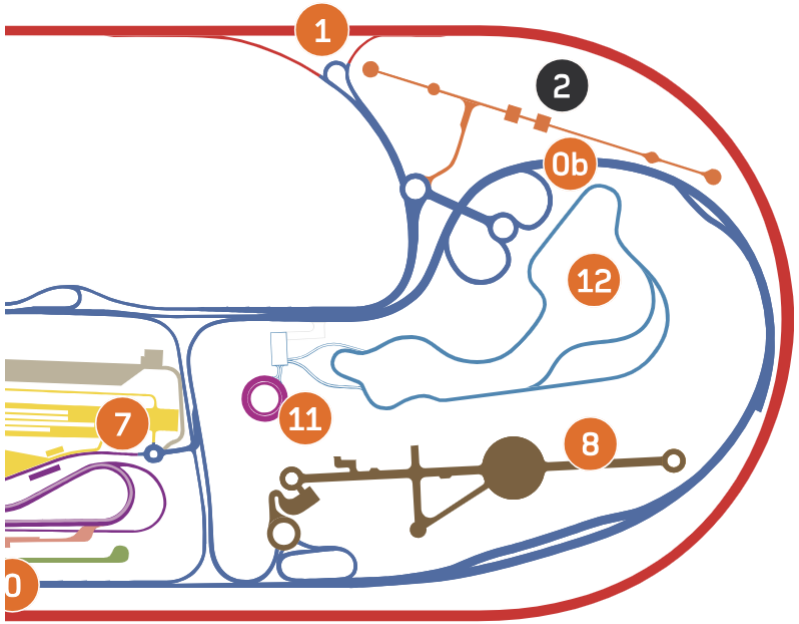
LENS L-vehicles Emissions and Noise mitigation Solutions

On track noise testing

- Noise TA testing on ISO certified track
- Noise testing of Real-world patterns on track
- Real-world patterns derived from on road noise measurements.
- Testing partners:
  - IKA RWTH
  - IDIADA
  - TUG



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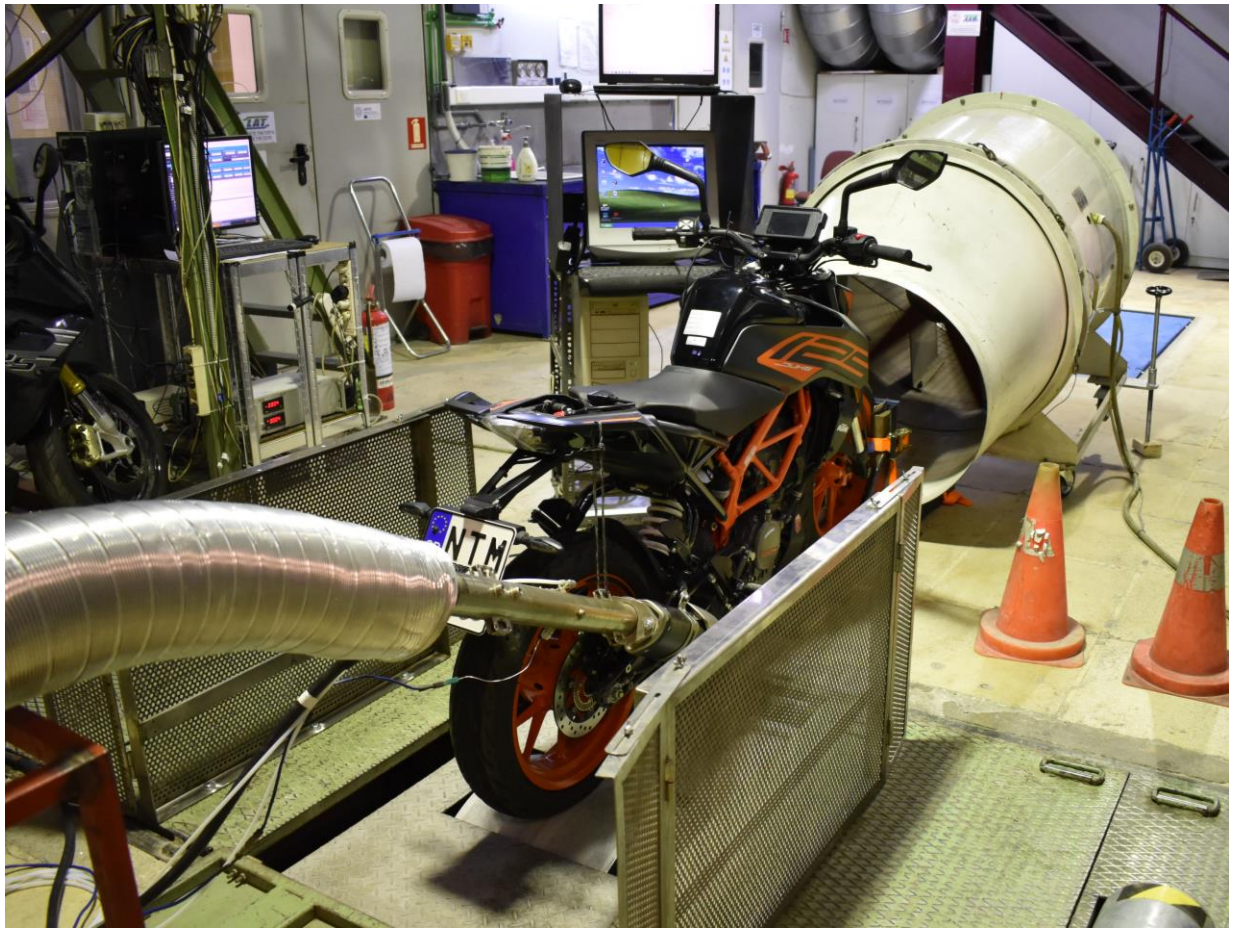
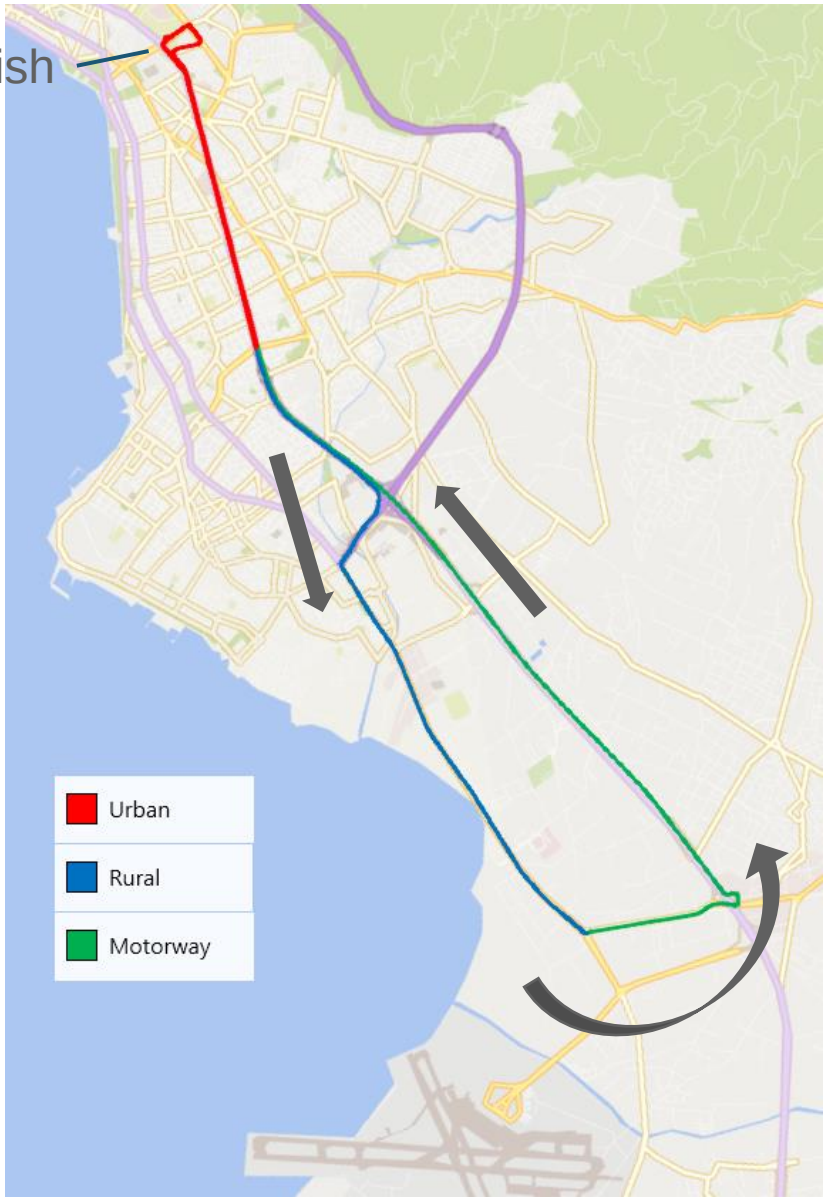
Pollutant emissions testing – In lab

- Motorcycle dyno with CVS system
- Driving cycles: official WMTC & real-world alike RDC (Real Driving Cycle)
- Regulated pollutants: PM, CO, CO2, NOx, HC
- Non-regulated gaseous pollutants: NH3, N2O, etc.
- PN: 23nm, 10nm, 2.5nm, Solid & total
- Testing labs:
  - EMISIA/LAT
  - TUG
  - IFPEN
  - IDIADA
- Round-robin with 2 motorcycles in all labs → DONE



On road trips

- Standard RDE trip (20-60 min)
  - Cold starting
  - Casual driving
  - Urban, Rural & Motorway (not for L1,L2,L3-A1)
- Extreme RDE trip (20-60 min)
  - Cold starting
  - Strong accelerations, including from standstill
  - Engine revving
  - Engine RPM fluctuations,
  - Constant max speed (mopeds)
  - Backfire
  - Acceleration – Deceleration transition.



Standard RDE trip in Thessaloniki

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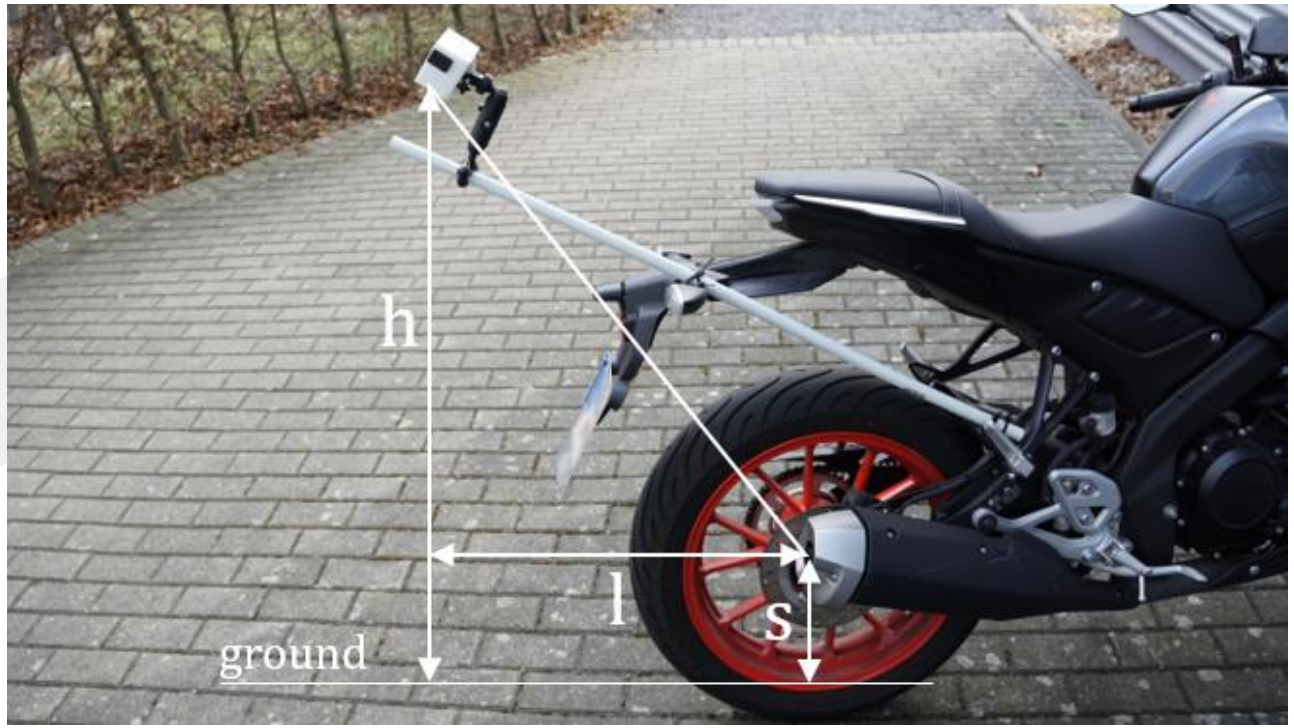
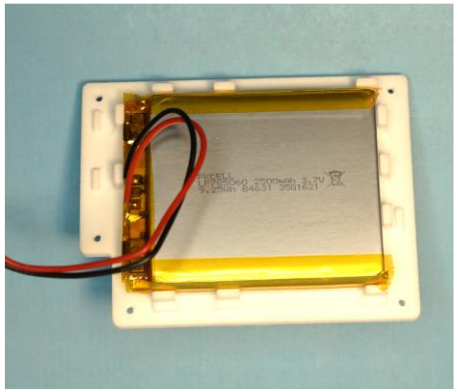
On road noise testing

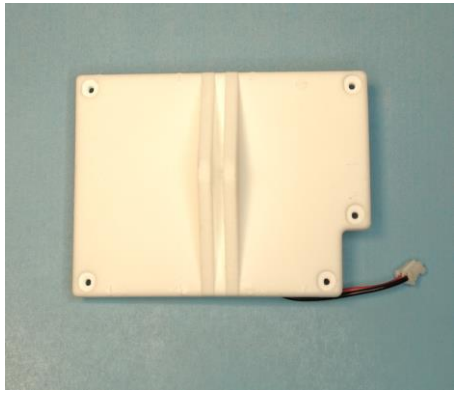
- On-board noise measurement device
- ECU data recorder (OBD)
- Locations:
  - IKA RWTH – Aachen
  - EMISIA – Thessaloniki
  - TUG – Gratz
  - IDIADA – Barcelona
  - IFPEN – Paris

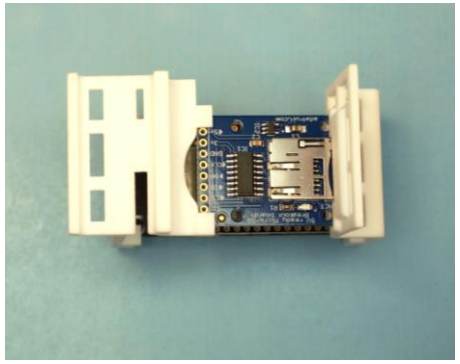
On road noise measurements device

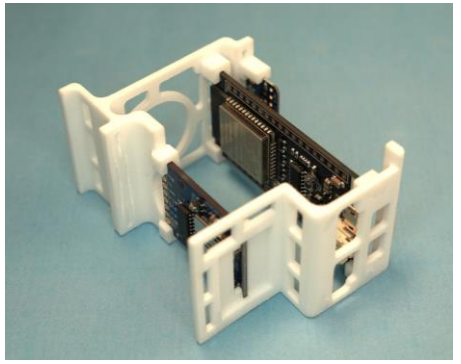
- Developed by IKA RWTH
- Sound recording
- GPS data
- Defined noise testing procedure, mounting position, etc.

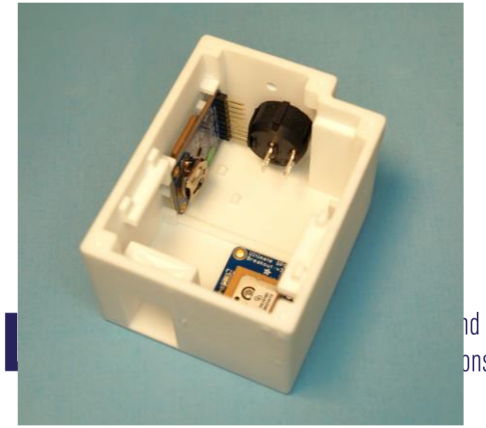












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On road pollutant emissions testing

- Portable emission measurement equipme
- GPS
- ECU data recorder (OBD)
- Locations:
  - EMISIA – Thessaloniki
  - TUG – Gratz
  - IDIADA – Barcelona
  - IFPEN – Paris
  - CZU – Prague

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Emission measurement equipment

- Commercial PEMS for heavy motorcycles & quads
- SEMS devices
  - Novel prototypes
  - Gaseous pollutants (CO2, CO, NOx, HC, NH3, BCPM)
  - Particles (PN, BCPM)
- On-board FTIR
- OBD
- GPS

HORIBA System

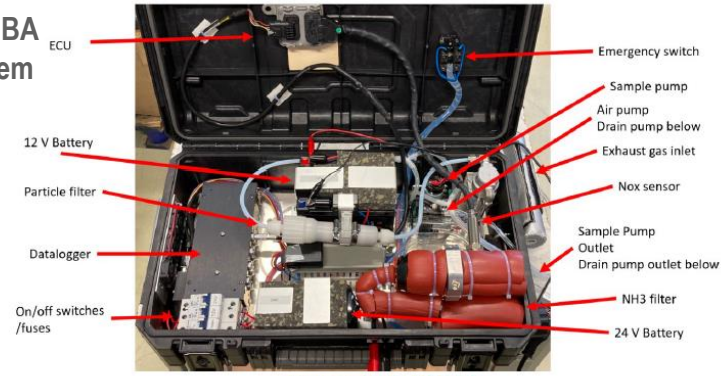

Figure 6-3: Horiba SEMS Unit

Commercial PEMS

CZU FTIR

Commercial PEMS

IFPEN System

EMISIA System

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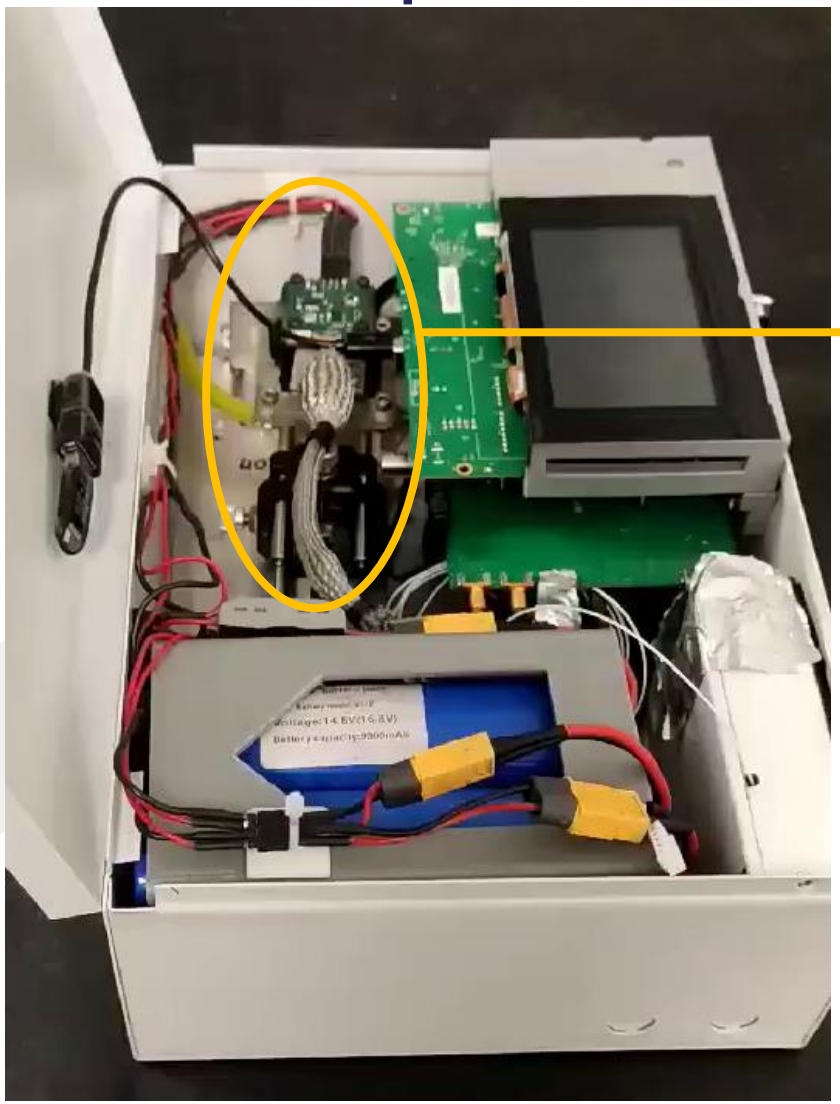
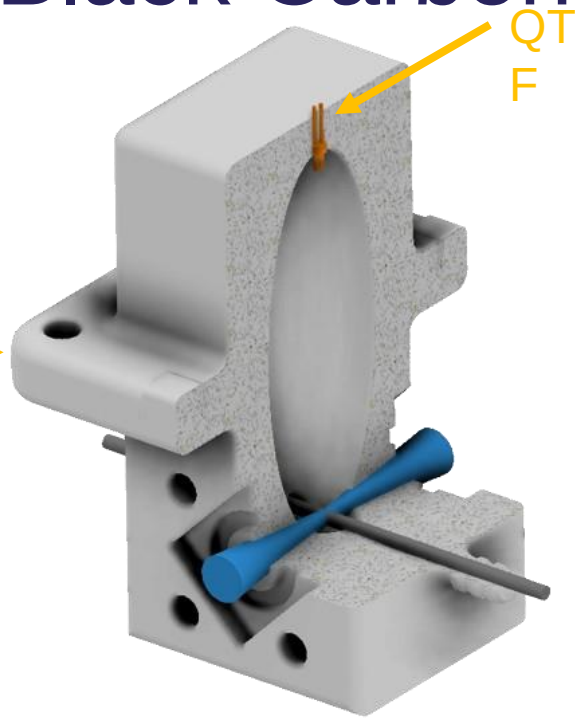
Novel Optoacoustic Black Carbon sensor - RSENSE





- Optoacoustic principle
- 808 nm Laser Diode for BC detection
- Ellipsoid chamber for sound refocusing

	Current version	Potential
Weight	4 kg	2 kg
Dimensions	33 x 22 x 12 cm	20 x 20 x 10 cm
Cost	4k €	1.5k €

- The sensor was provided pro bono by LAT/RSENSE to EMISIA for the LENS project

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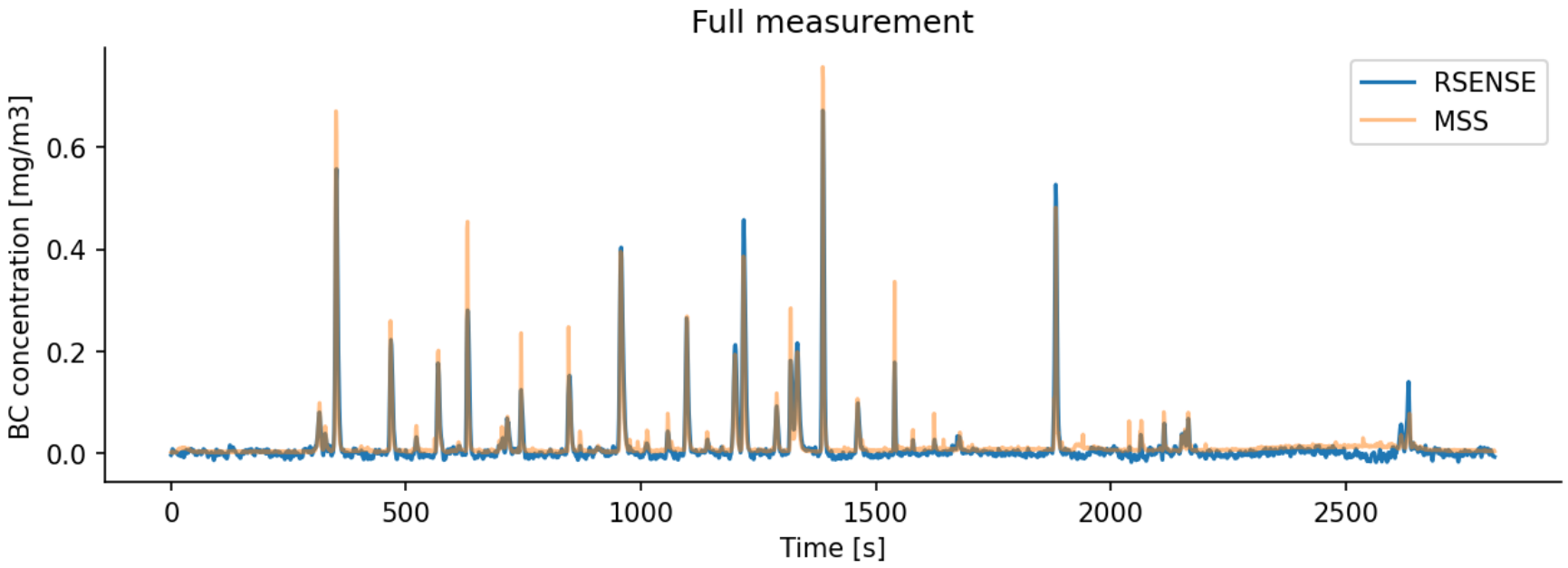
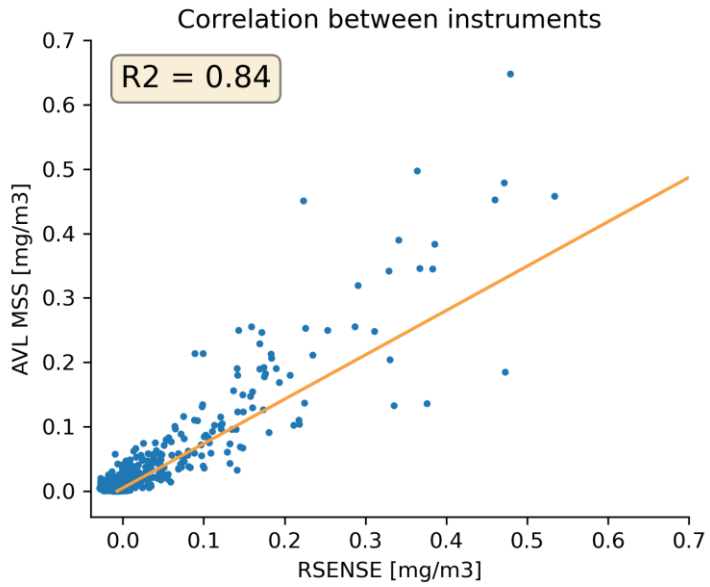
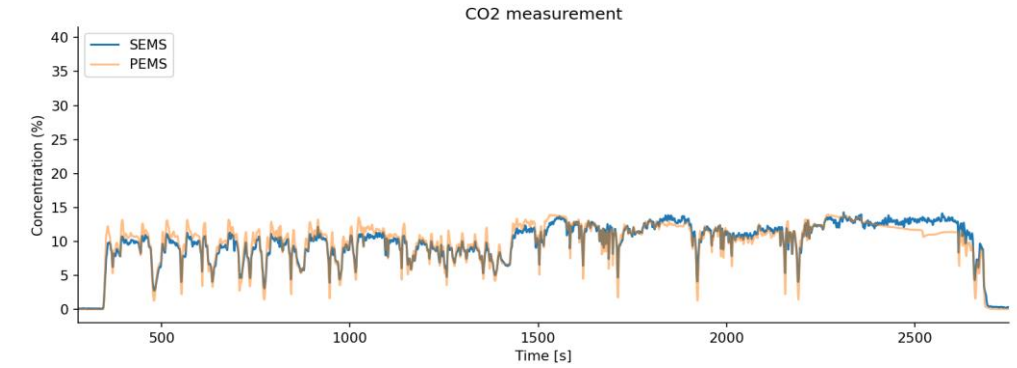
Novel SEMS device evaluation

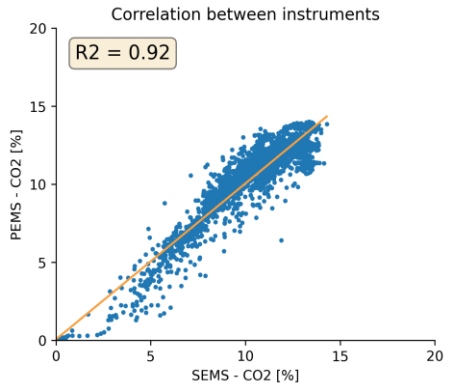
- RSENSE Optoacoustic BC SEMS against MSS (commercial BC analyzer)

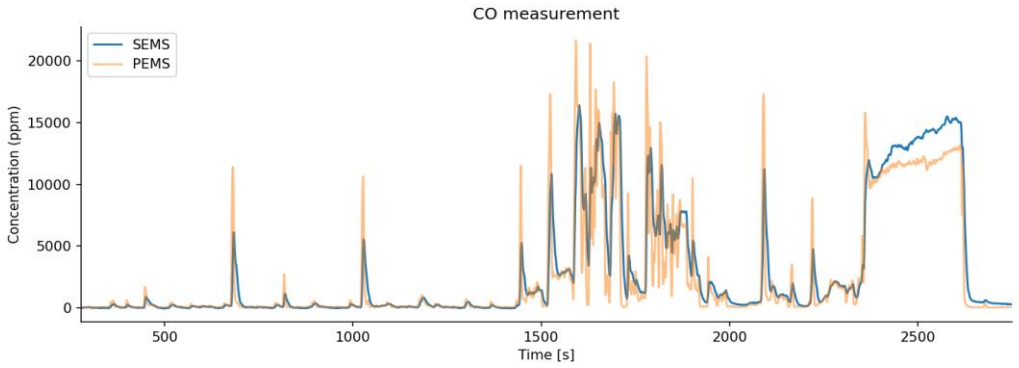


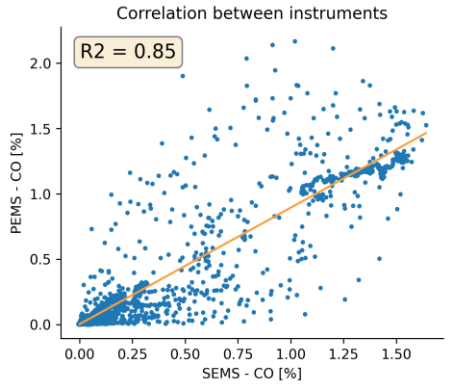


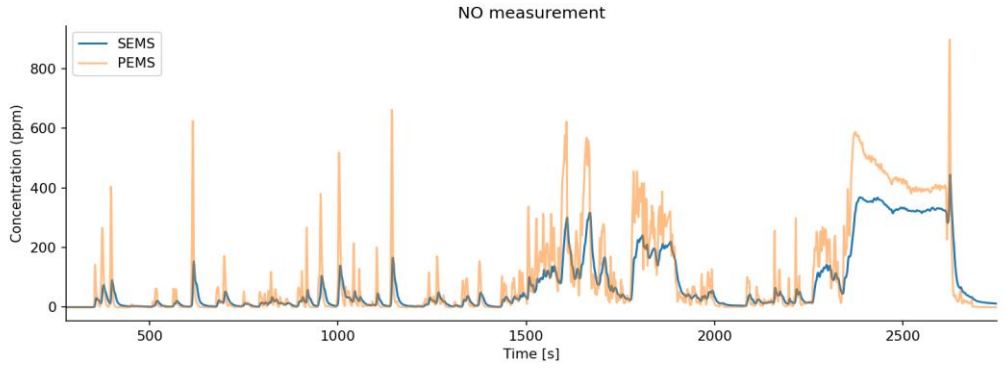
Novel SEMS device evaluation

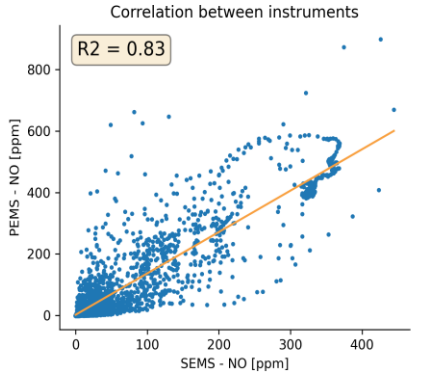












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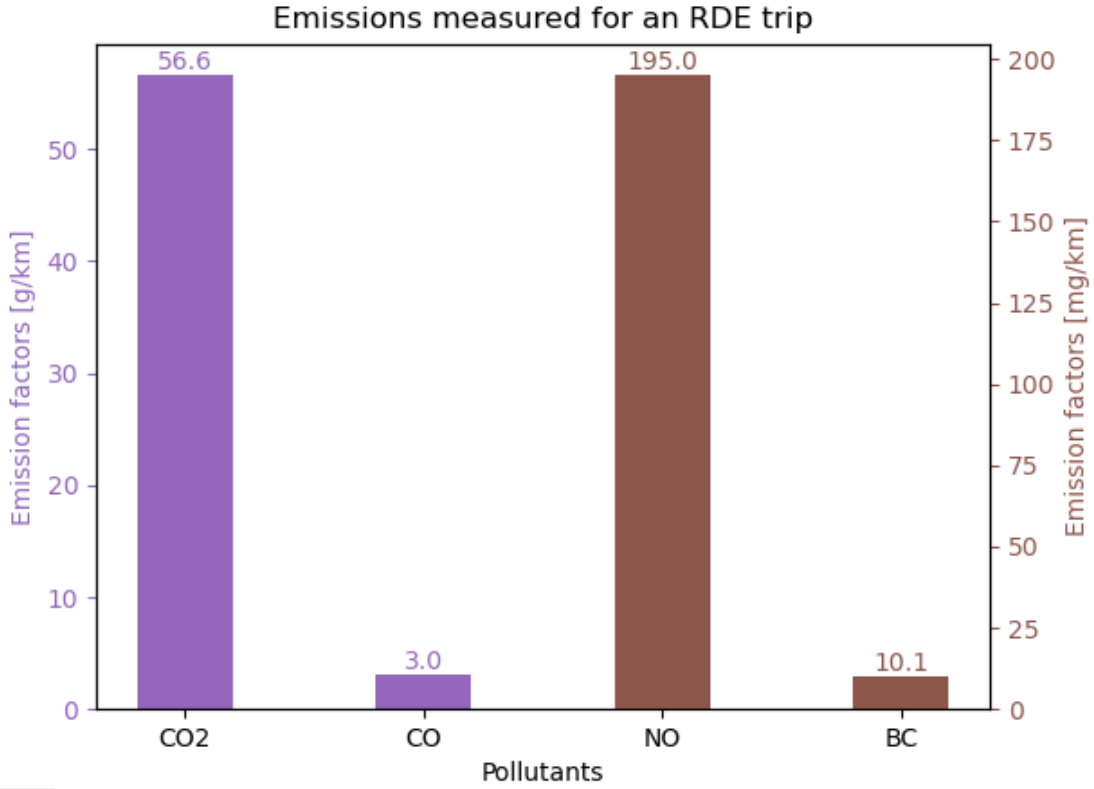
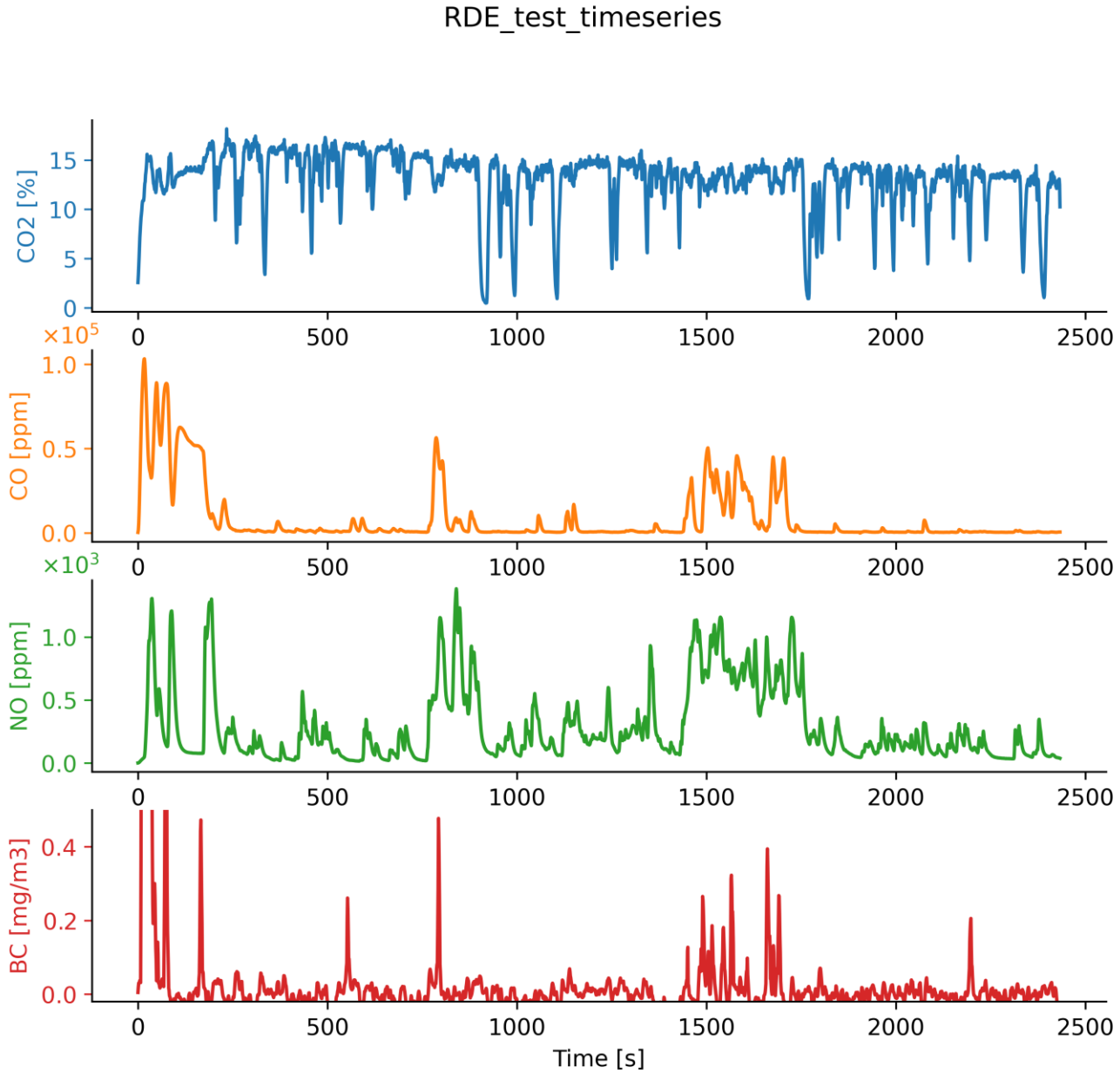
Euro 5 L3-A1 RDE test result using SEMS





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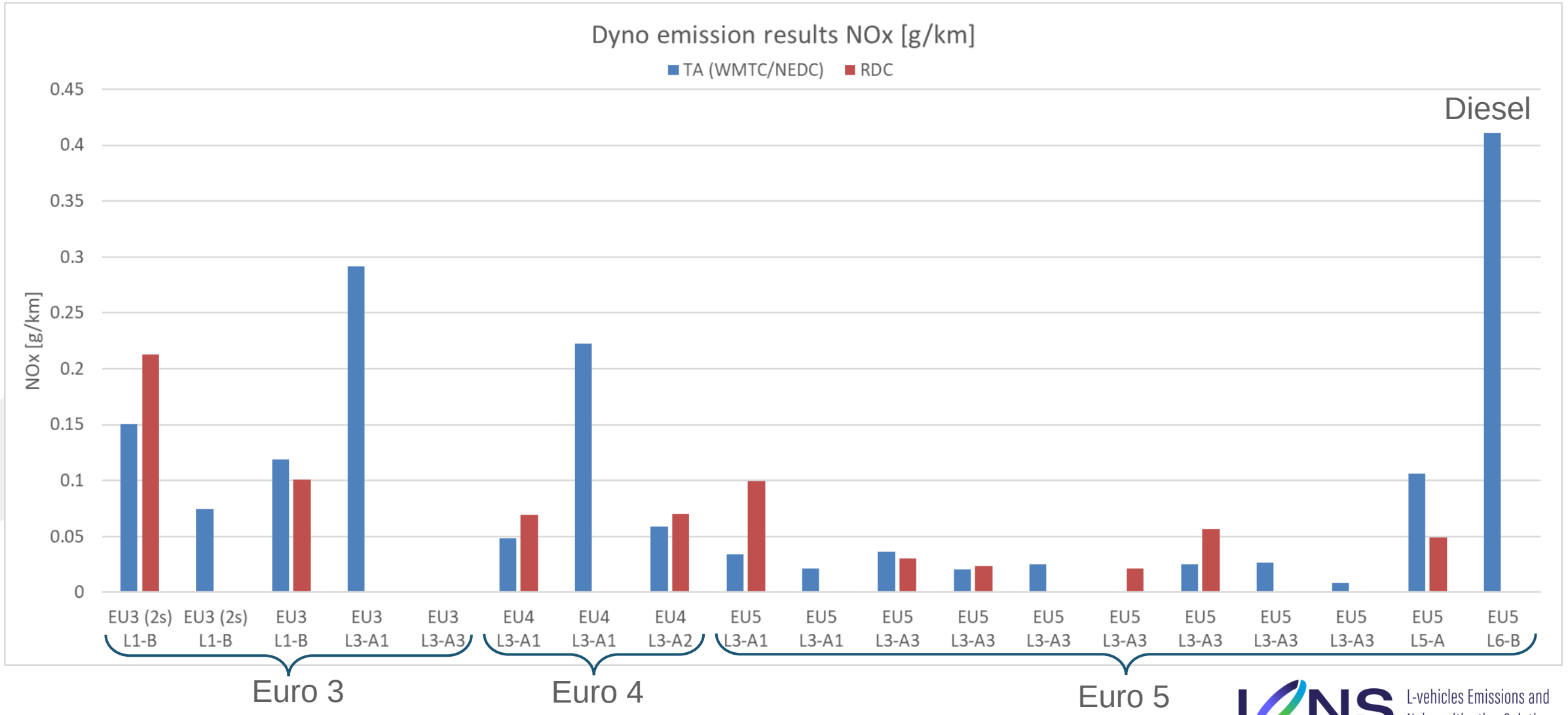
Pollutant emissions testing in the lab

Euro 5 NOx limit = 0.06 g/km



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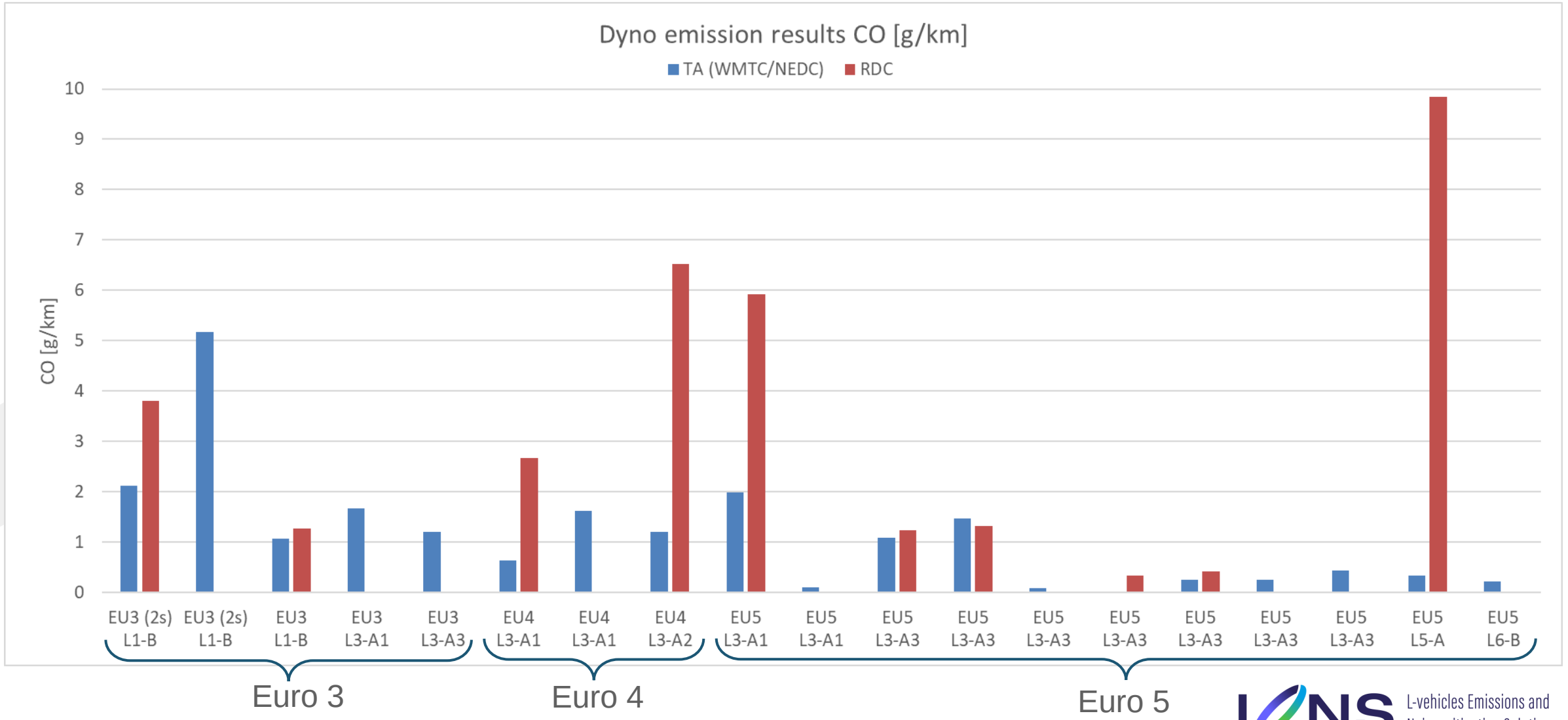
Pollutant emissions testing in the lab

Euro 5 CO limit = 1 g/km



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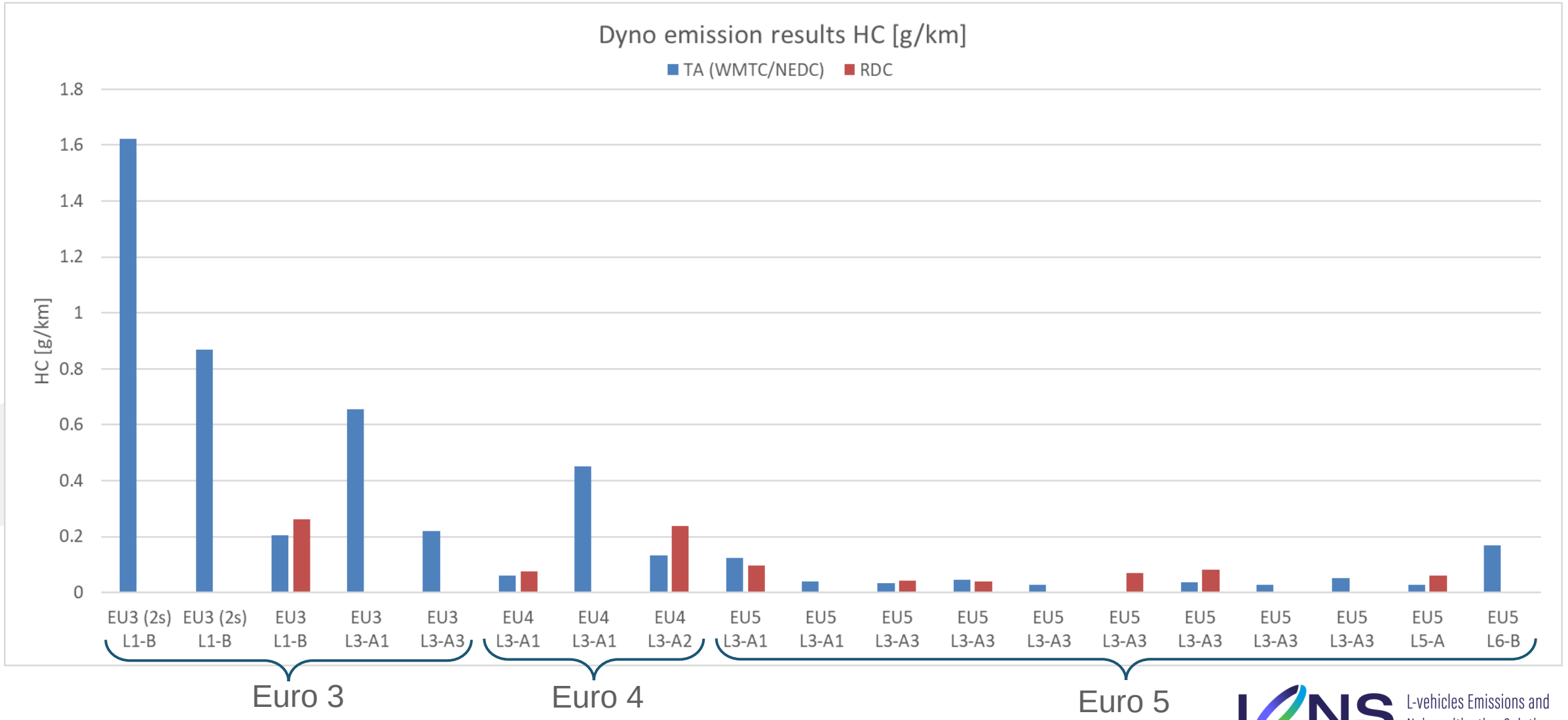
Pollutant emissions testing in the lab

Euro 5 HC limit = 0.1 g/km



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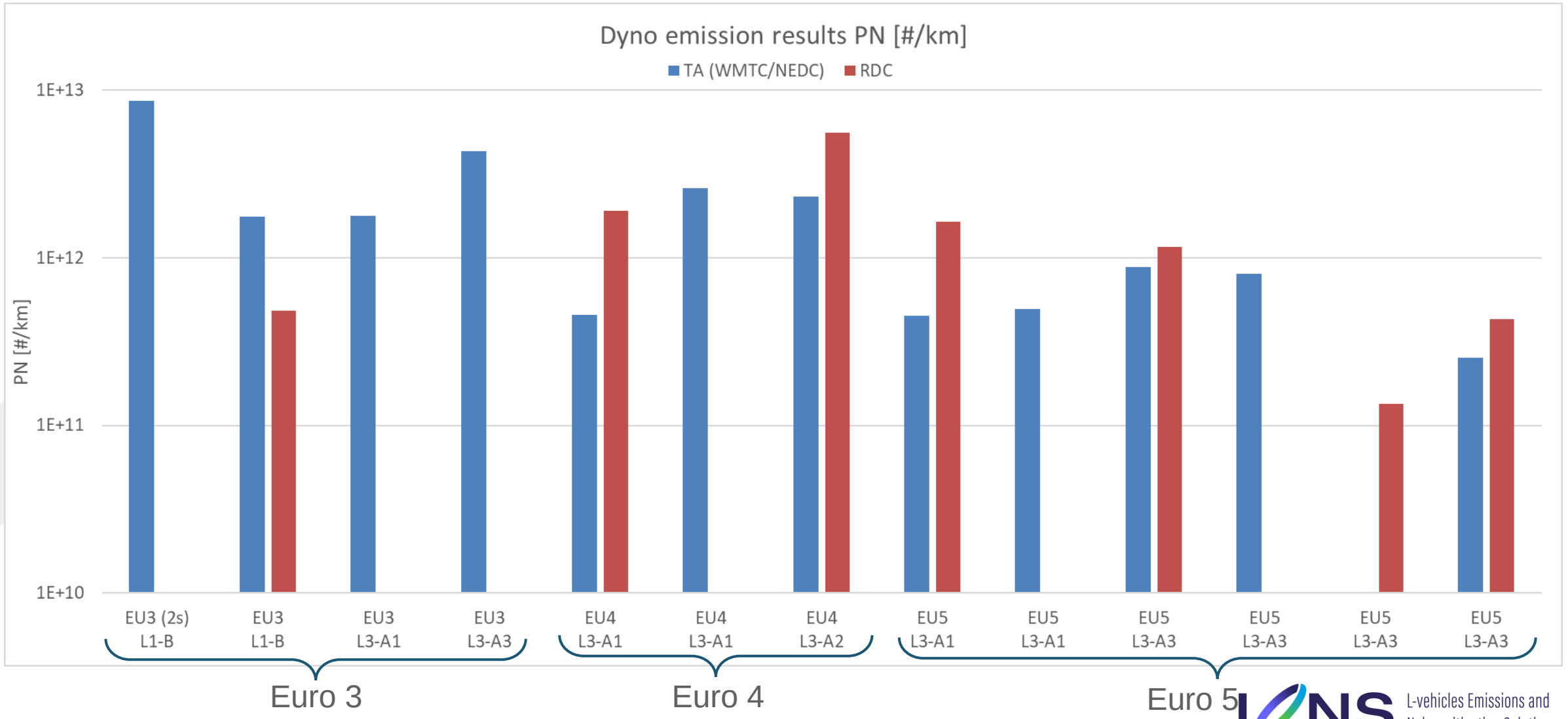
Pollutant emissions testing in the lab



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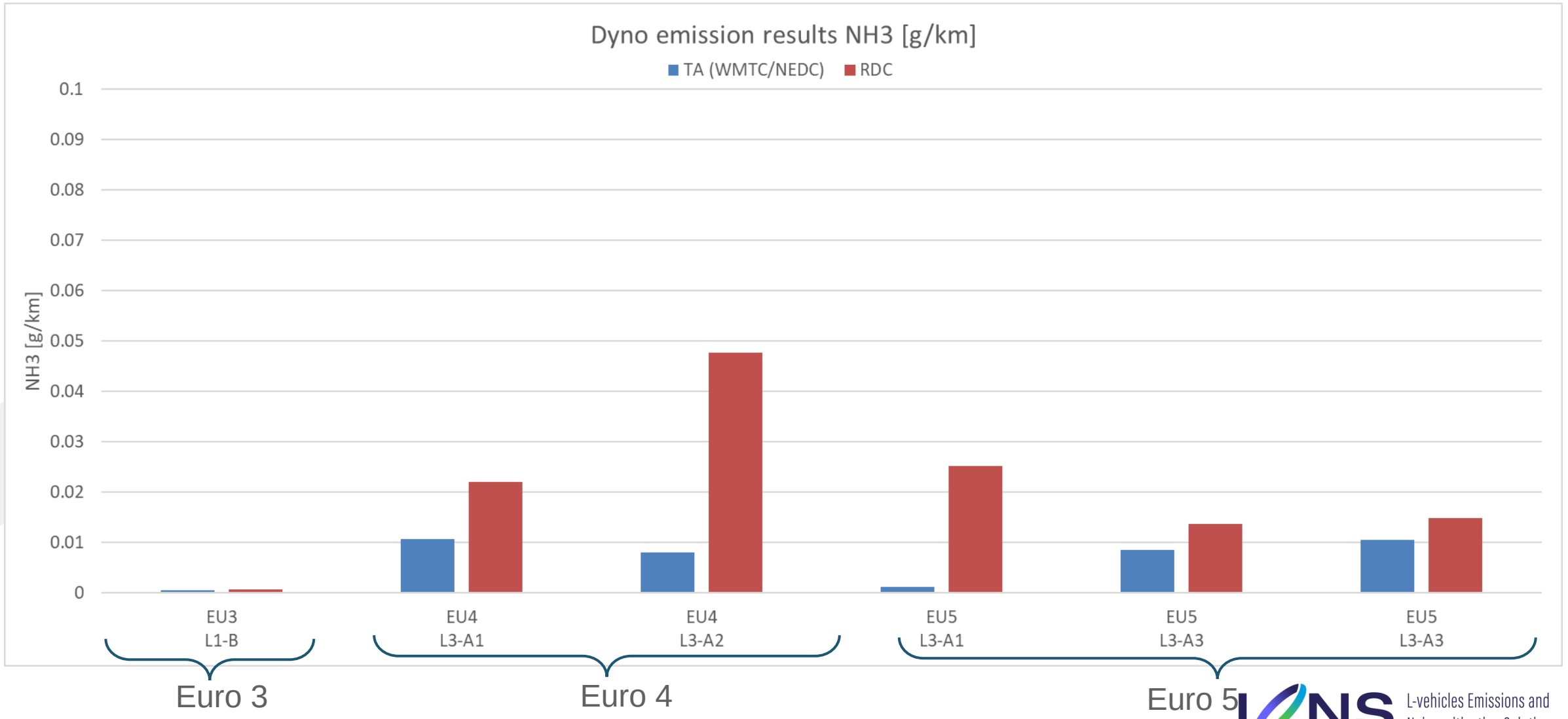
Pollutant emissions testing in the lab



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Tempering detection & Remote sensing

- Roadside measurement of noise & pollutant emission.
- Field survey locations:

1. Flanders - Leuven [done in May]
2. France - Paris region [done in September]
3. Spain - Barcelona [ongoing]

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LENS L-vehicles Emissions and Noise mitigation Solutions

Noise & pollutant reduction measures to be simulated

- Mitigation measures currently being investigated:
  - Stricter TA standards
    - Assuming technical advances
  - Anti-tampering measures
    - strengthening roadside inspections (increase number & fines)
    - Make modifications difficult to carry out (prohibit sale and use of modification parts)
  - Local measures
    - access restrictions
    - Speed limits
    - Surveillance/noise cameras
  - Behavioral changes (usage-oriented, standards and fleet remaining the same)
    - Enforcement of vehicle condition standards by law enforcement
    - Warning sign
    - Deterrent (escalating penalties, fines etc.)

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LENS L-vehicles Emissions and Noise mitigation Solutions

Summary

- LENS provides evidence needed for effective policy in terms of PTW noise and emissions
- Development of devices and methods for real world characterization and monitoring of emissions and noise
- Calculate cost-benefit scenarios for different potential measures [*pending*]

Thank you!

Giorgos Triantafyllopoulos, Mech. Eng., PhD

EMISIA SA
PO Box 8138, GR 57001, Thessaloniki, Greece

T: +30 2310 473374
E: giorgos.t@emisia.com
W: www.emisia.com

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