



CARES City demonstration measurement campaigns

Yoann Bernard

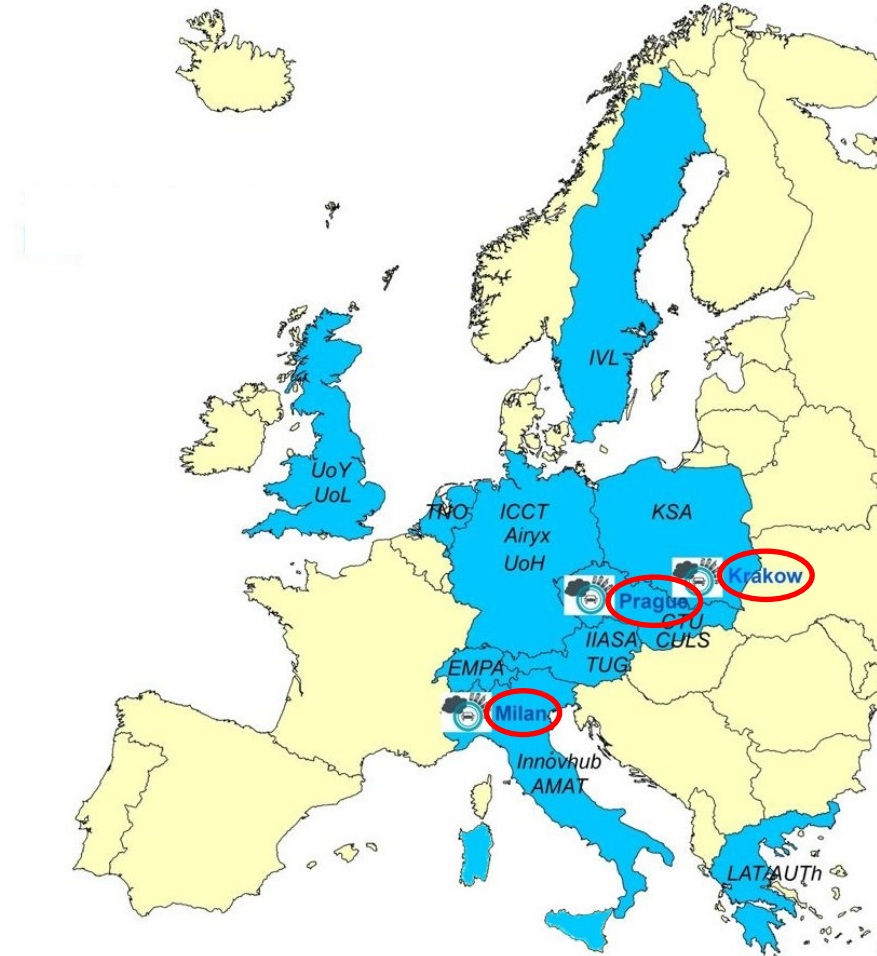
International Council on Clean Transportation (ICCT)
October 12th, 2022



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CARES – a H2020 project bringing together worldwide RES/RDE expertise



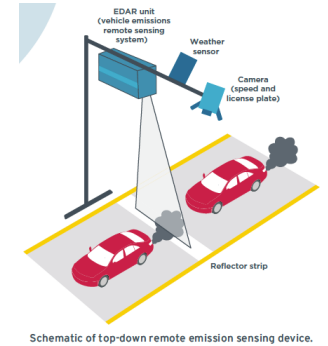
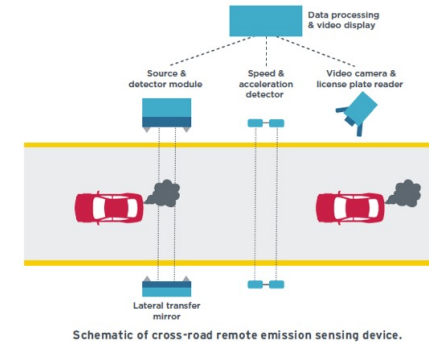
Commercial
remote sensing
service providers:



City demonstration's main objectives

For all three contactless measurements:

- Demonstration measurements in Milan, Krakow, Prague
- Applied further developed remote sensing hardware and software
- Feed back practical experience into further hardware and software developments
- Illustrate to interested cities how remote sensing can help in practice



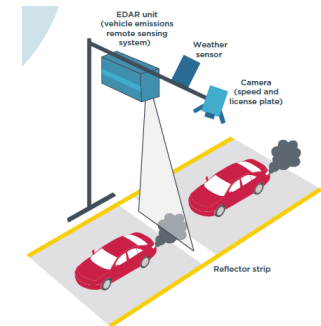
Remote-sensing campaign in Milan



CARES remote emission sensing campaign in Milan completed

November 5, 2021
News

CARES website: <https://cares-project.eu/cares-milan-res-complete/>



Schematic of top-down remote emission sensing device.



Remote-sensing campaign in Milan

- Primary objective: track policy effectiveness of the Milan Low Emission Zone (LEZ)
- Second key objective: test and compare a variety of remote-sensing instruments in practice
- Third objective: comparison remote sensing measurements with PEMS in real-world
- Additionally: Volatile Organic Compounds (VOC) monitoring, advanced air monitoring stations
- Practical lessons from preparing the measurements (GDPR, permissions, electricity access, ...)



Remote sensing testing in Milan

- Testing period: Fall 2021 (Sep – Oct)
- HEAT's EDAR remote sensing systems
 - Deployed in Via Cilea, Via Madre Cabrini (with similar driving conditions)
 - > 35,000 measurements
- Point sampling
 - Via Madre Cabrini, Via Bazzoni
 - Enable real-world measurements of particulate number (PN) and black carbon
- Concurrent portable emissions measurement system (PEMS) testing on certain vehicles
- Air quality monitoring instruments and advanced sensors
- Ambient ammonia concentration and resuspension particle measurements



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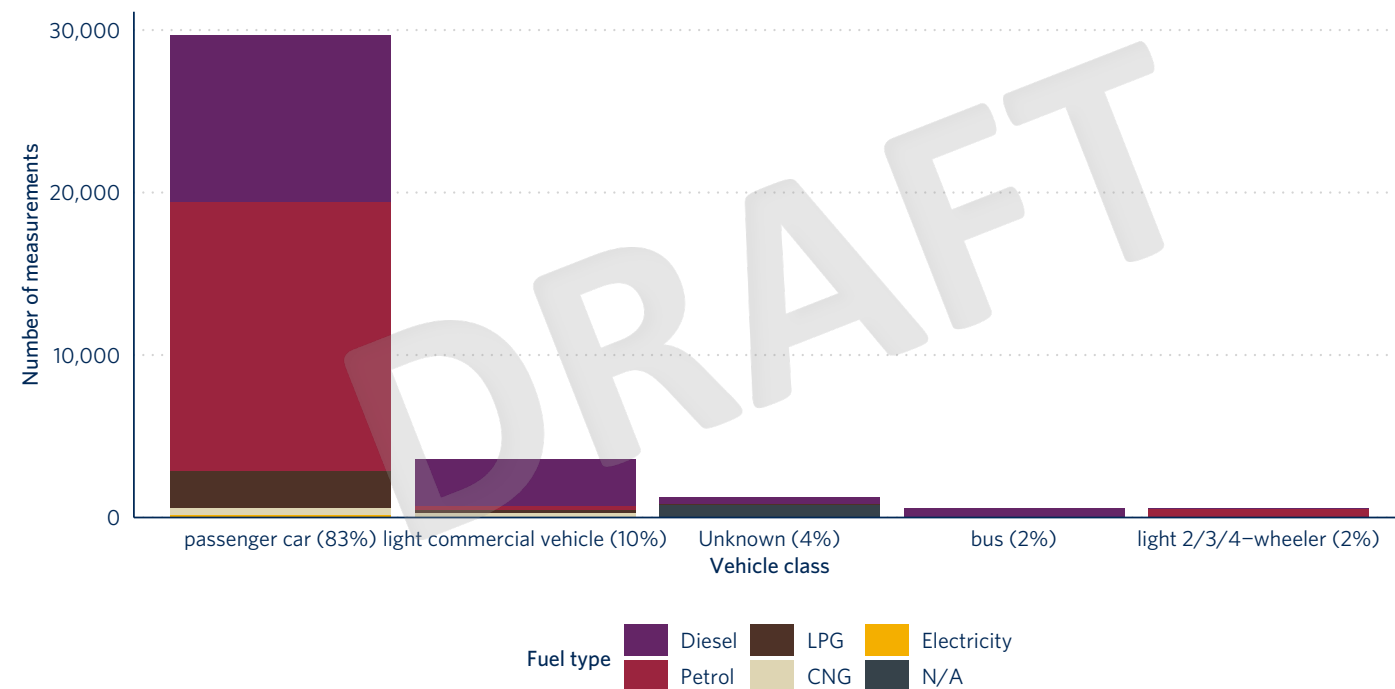
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Airborne concentrations & meteo measurements



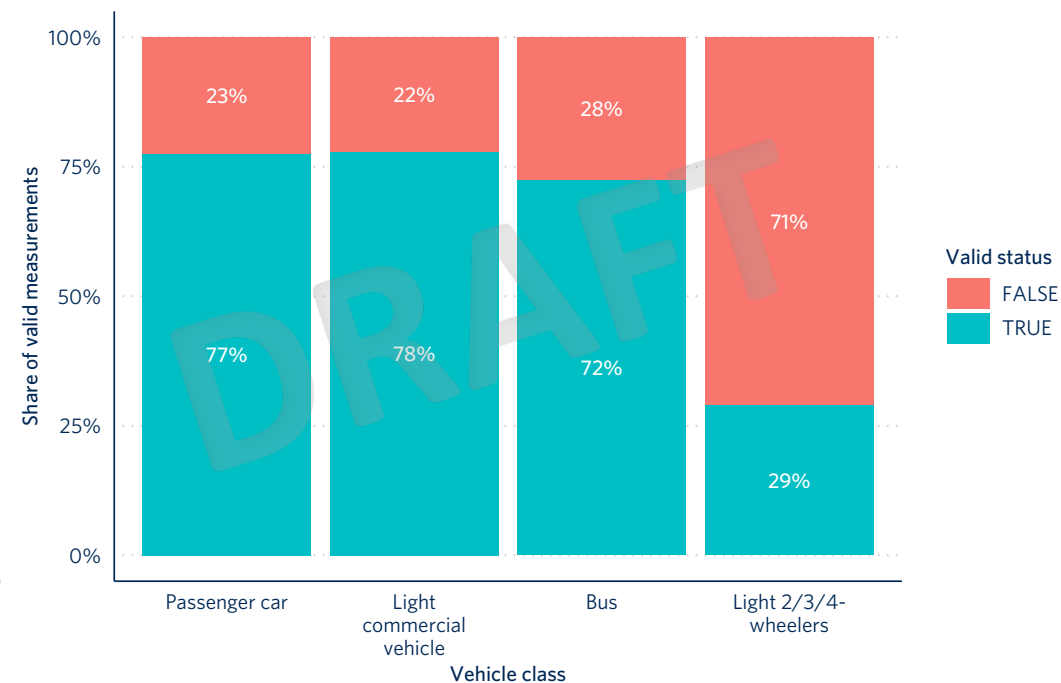
Milan's RS measurements from commercial systems

Fleet measurements



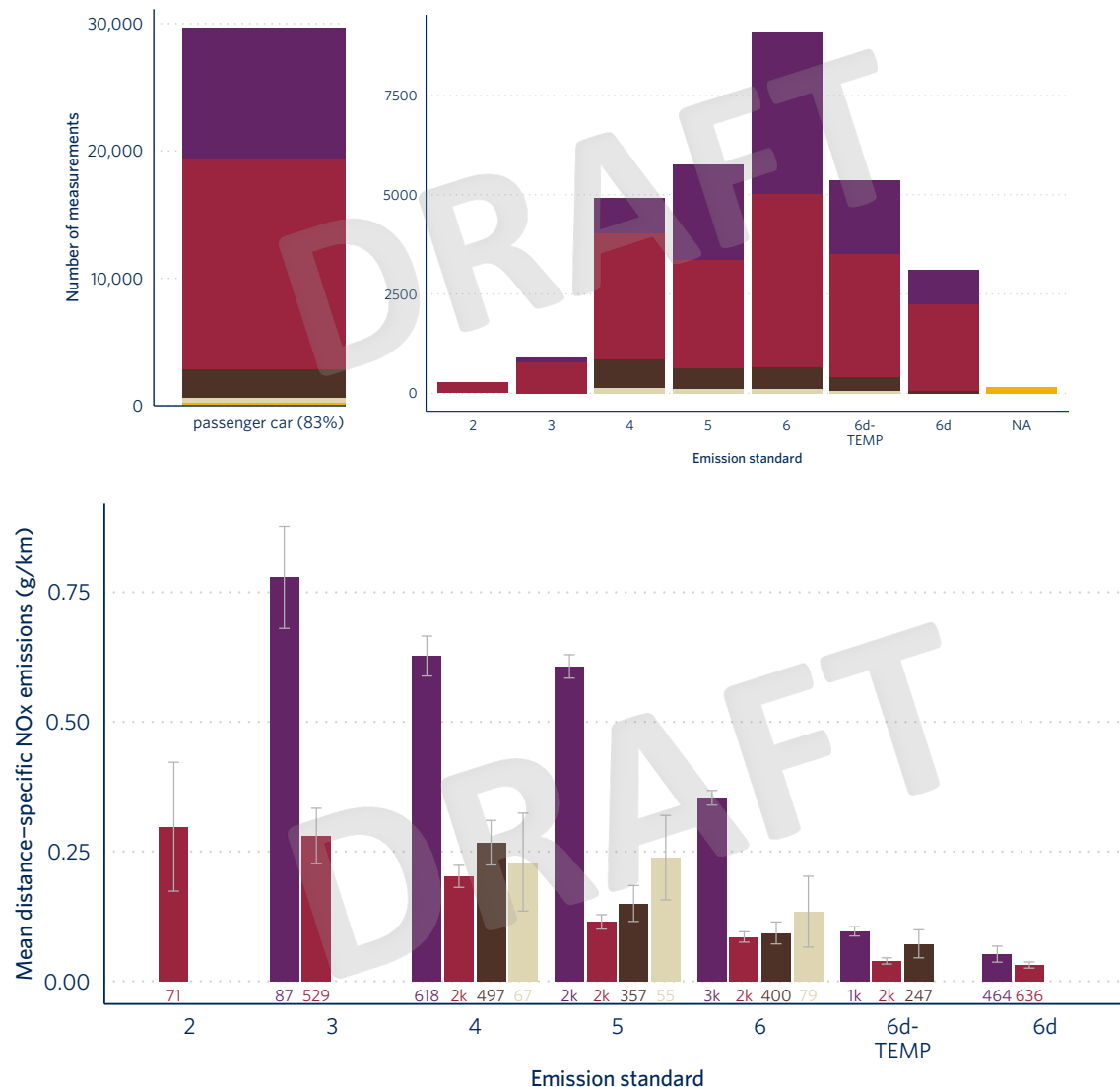
- Passenger car most commonly found
- Significant shares of LPG/CNG vehicles relative to other cities
- Lower share of valid emission measurements of scooters and motorcycles due to driving pattern and small plumes*

Emissions measurements



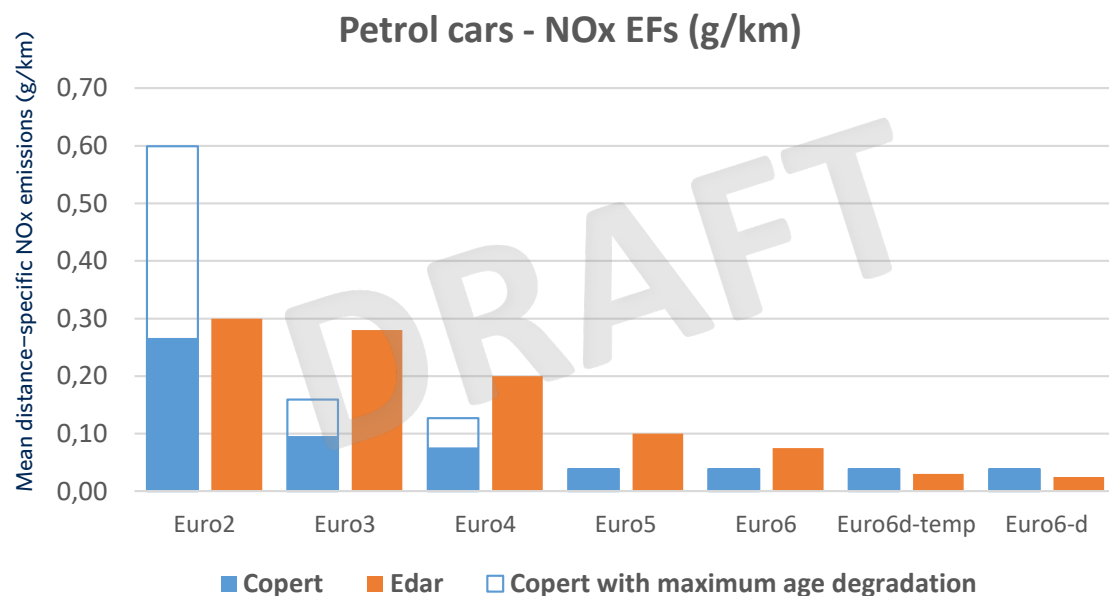
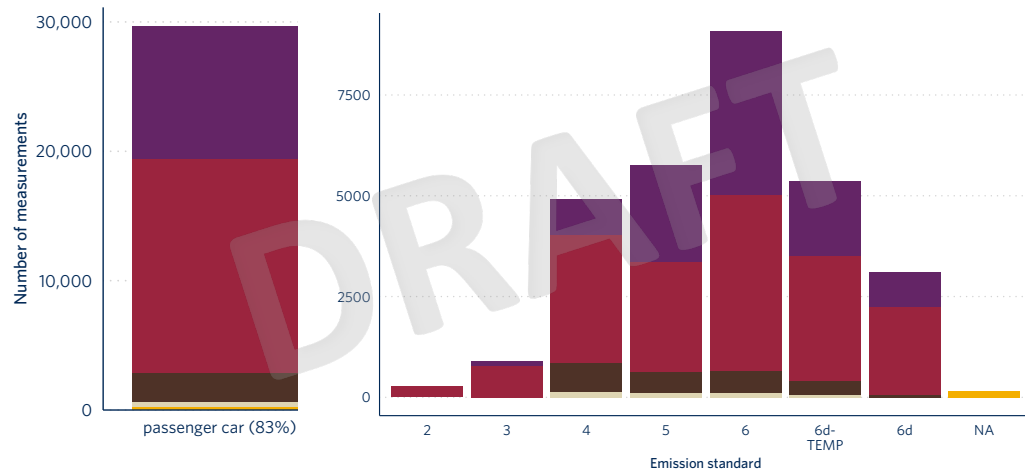
*Milan is completely flat, which is sub-optimal to foster larger plumes during the measurement

Milan's passenger car emissions



- Fair share of old diesel vehicles (< Euro 6), whose NO_x emissions
 - Multiple times higher than emissions from petrol, LPG, or CNG
 - Do not improve significantly until Euro 6d-TEMP (manufactured after 2019)
- Presence of LPG & CNG vehicles (exempted from the LEZ access restrictions)
 - Whose NO_x emissions higher than petrol counterparts
 - Responsible for high CO emissions (LPG) and high HC and CH₄ emissions (CNG)
 - Point sampling results point to the same direction for black carbon and NO_x

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*Cold start fraction hypothesis of 36%

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- NO_x emissions from EDAR (and Point sampling) from Euro 6 and older gasoline higher than COPERT* emission factors used by AMAT colleagues



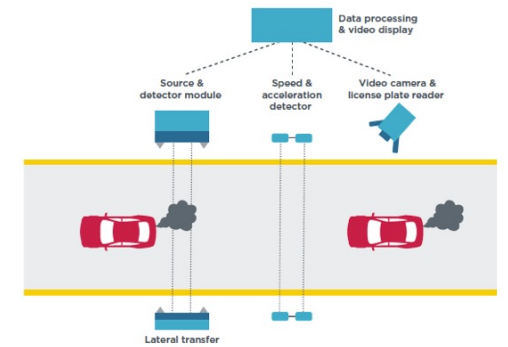
Remote-sensing campaign in Krakow



Krakow remote
emission sensing
measurement
campaign
successfully
completed

December 17, 2021
News

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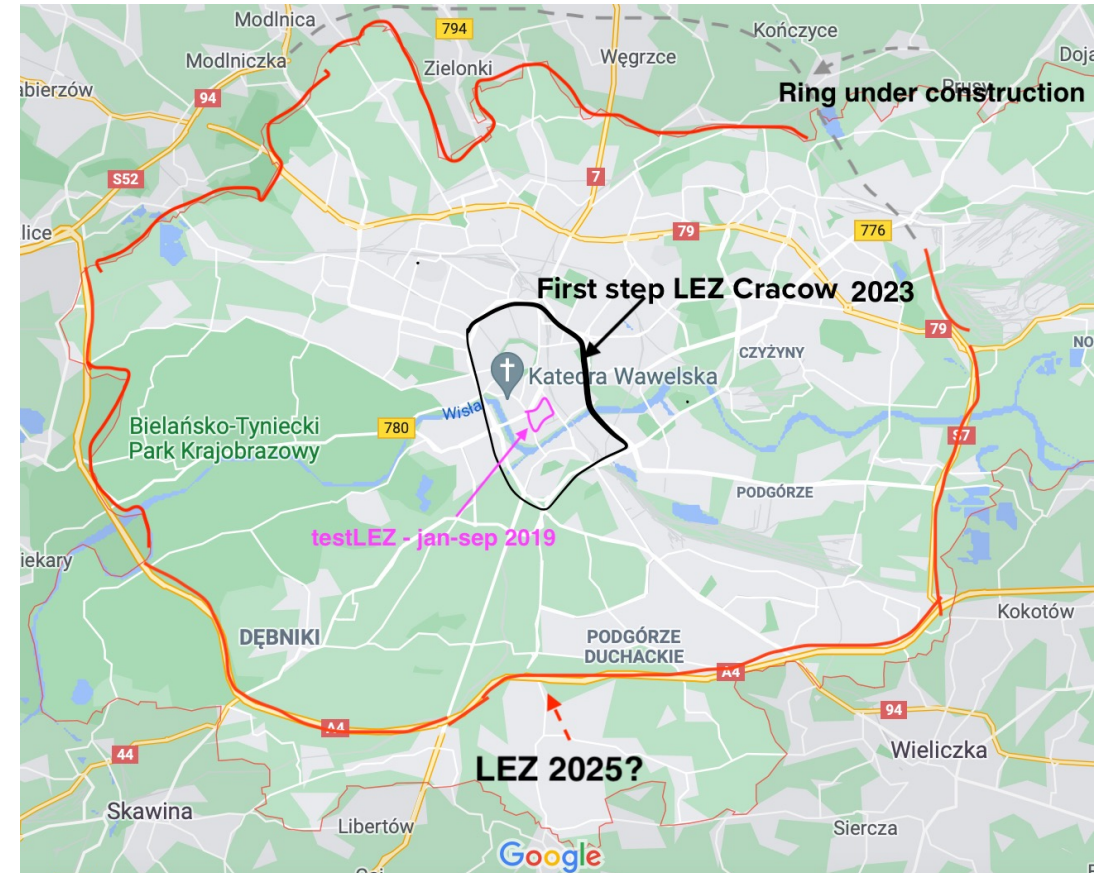


Schematic of cross-road remote emission sensing device.



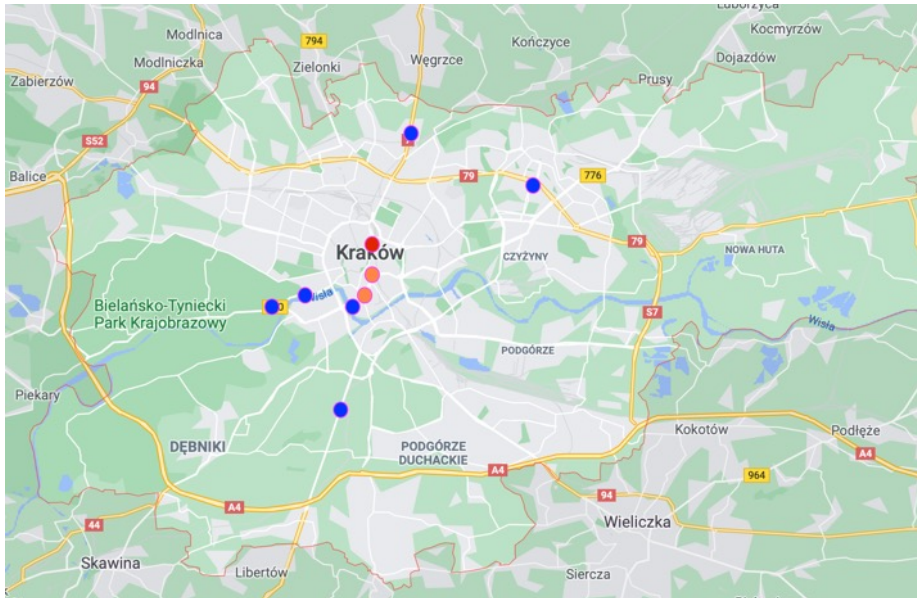
Krakow LEZ context

- Test LEZ in Krakow (since jan - sept 2019) led to introduce efficient national provisions on LEZs
- These new national provisions will allow cities in Poland to implement LEZ, and distinguish by fuel type and euro standard
- RS data is key to inform policy makers in charge of designing the upcoming LEZ
- Data collected in December 2021 will be compared with May 2019 (first remote sensing campaign)



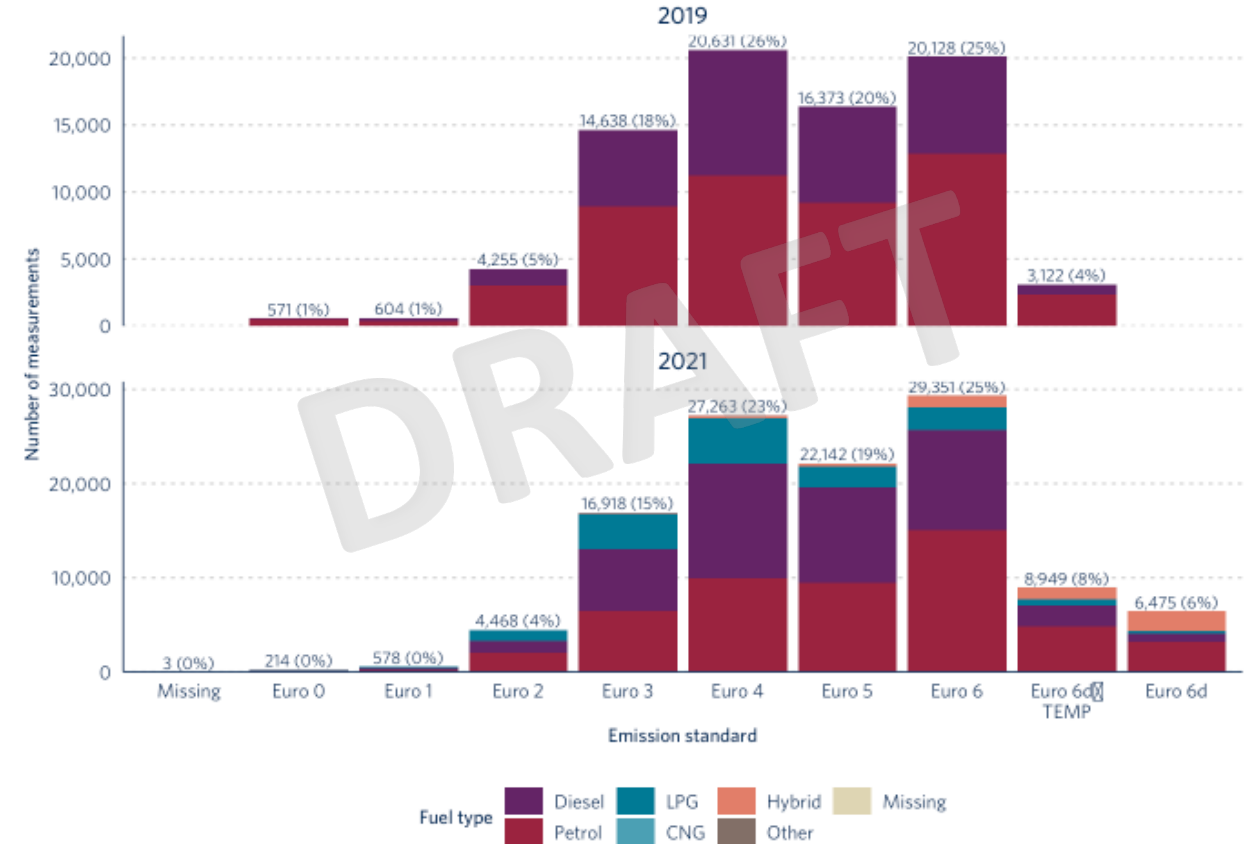
Remote-sensing campaign in Krakow

- Primary objective: assist the preparations of the city for introducing a Low Emission Zone
- Secondary objective: validation of previous measurement campaign, using winter data
- Key learnings include measurements during winter time: (snow covered license plates, wet roads with dirt which covered plates, worsened translucency of the OPUS unit, ...)
- Linking of measurement data and license plate data only recently, now analysis ongoing

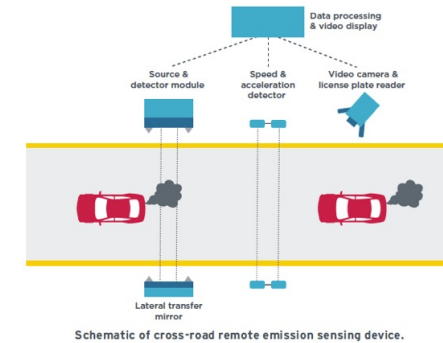


Krakow's passenger car fleet composition between 2019 and 2021

- Over 100,000 records collected
- In 2021, the vehicles database received more detailed information on the fuel and powertrain types
- Slow retirement of Euro 3-4
- Little change in Euro 2
- Increase in 6d-TEMP and emergence of Euro 6d, a standard introduced in 2020 and obligated from 2021
- Emissions analysis is in progress



Remote-sensing campaign in Prague



CARES remote emission sensing campaign in Prague completed

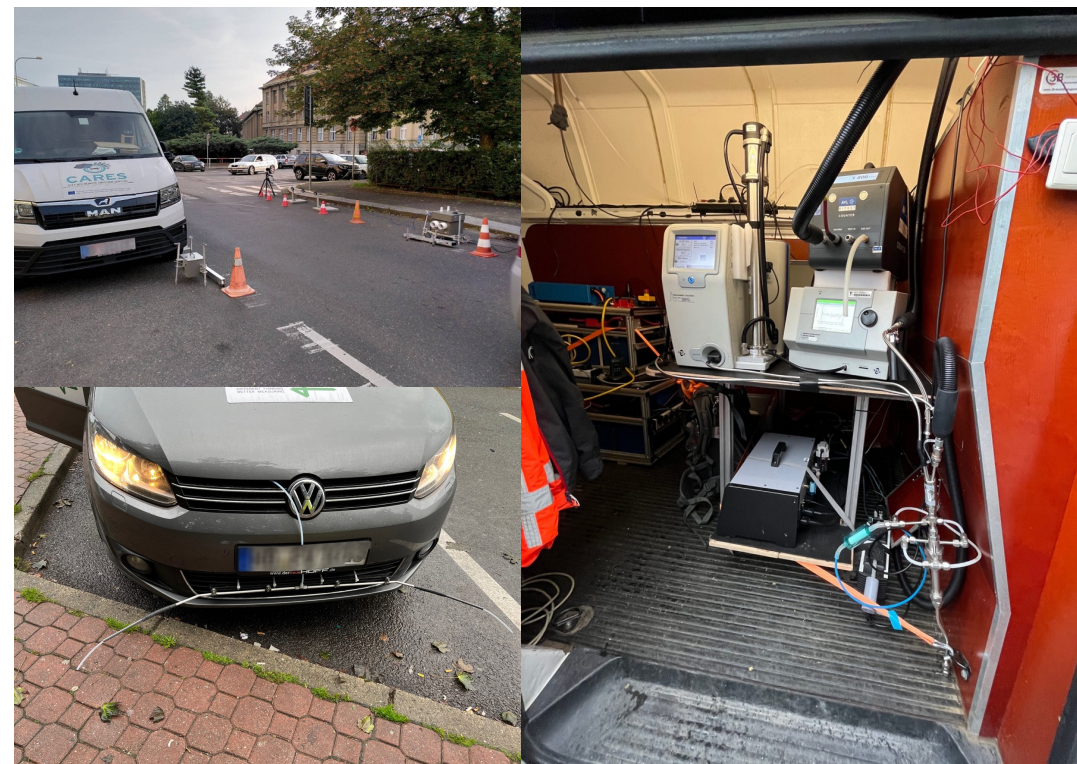
October 7, 2022
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Remote-sensing campaign in Prague

The campaign focuses on high-emitter identification:

- Point sampling and cross-road OPUS instruments were collocated
- Demonstration of plume chasing
 - “Simple” set up in a car equipped with NO, NO₂, CO₂
 - A van equipped with lab-grade analyzers and affordable PN-meters.
 - Investigation of the share of high-emitting HDV in the fleet



Plume chasing for HDV emission screening and enforcement

Involvement of the Traffic Police Service Department and OBD expert from “NO_x consulting”, and partially funded by TU Dresden.

- Over 1,000 HDV measured with plume chasing
 - Over 12% measured with very high emission levels
 - A small fraction pulled over
 - Cases of manipulation, defects, and suspicious engine software issues were discovered.





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CONSORTIUM PARTNERS

