An overview of measuring and modelling real-world vehicle emissions in Australia

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A/A Prof Dr Robin Smit, 11 March 2021
Australian on-road fleet – some statistics

- About 19 million vehicles (2018)
- PV petrol ~ 60% total VKT (about 25% SUV)
- PV Diesel ~ 10% total VKT (about 75% SUV)
- LCV ~ 20% total VKT (about 75% diesel)
- LPG LDV ~ 5%
- Diesel trucks and buses (~10%)
Fleet model = essential
Emission Measurement

Emission Modelling

Lab	Tunnel	PEMS	On-road
Several in-service vehicle emission test programs have been conducted in Australia (laboratory, chassis dyno):

- 1996, NISE1, 634 vehicles (petrol)
- 1997, NISE-LPG, 37 vehicles (LPG)
- 2000, DNEPM, 75 vehicles (diesel)
- 2001, CVES, 46 vehicles (petrol, LPG)
- 2008, SATR, 393 vehicles (diesel)
- 2008, EthS, 21 vehicles (petrol, E5/10)
- 2009, NISE2, 410 vehicles (petrol)

This large combined database has enabled the development of Australian vehicle emission software.
Vehicle emission measurements in Australia

• Australia lacks a **nationally coordinated** vehicle emission and model development program, in contrast to e.g. EU, Asia, USA.

• This poses challenges with regard to:
  o consistent
  o up-to-date
  o reliable assessment of motor vehicle emissions.

• 2015 to date – targeted measurement programs to validate and update models.

• Real-world vehicle emission measurements are essential for:
  o accurate emission estimation
  o identification of emerging new issues.
Tunnel study

• CLEM7 tunnel BNE 2014

• Validation COPERT Australia + PΔP software.

• Prediction errors:
  - PM within 20%
  - NOx and CO within 40%

• Speciated hydrocarbons large uncertainty.
Remote sensing

Remote sensing

Combined PER-BNE database (100,000+ valid emission measurements) 2009-2019
Remote sensing

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HOT  COLD
Remote sensing

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Over a decade of remote sensing data

- Poor real-world NO\textsubscript{x} performance of Euro 4/5 light-duty diesel vehicles observed around the world is also evident in Australian measurements.

- General lack of statistically significant reduction in NO\textsubscript{x}/CO2 ratio with progressive Euro standards for diesel LDVs.

- UVsmoke – pooled data (Euro 5) for the two most recent years of manufacture (2017–2018) suggest that 1% of one-two year old diesel SUVs and 2% of one-two year old diesel LCVs have malfunctioning or potentially modified DPFs.
On-board emissions testing with PEMS

- Completed 9 March 2021.
- 5 compact and large SUVs (petrol/diesel), GVW ~ 2-3 tonne, MY 2014+, Euro 5.
- Sample selection based on vehicle sales and GHG emissions data (contribution to fleet total emissions: ‘emission-weighted’ sales statistics)
- Commercially available fuels, fuel quality testing conducted
- AVL 493 Gas PEMS iX, + AVL 496 PN PEMS.
- OBD II scanning tool, Met sensors, GPS, Video.
On-board emissions testing with PEMS

- Test protocol developed - broadly RDE compliant.
  - Cold start test (urban, rural, motorway) D = 88 km
  - 4 hot start tests with 2 hours, then 5, 15, 30 minutes engine off periods (D = 4 km)
  - Coast-down testing

- Data analysis: will include machine learning methods for anomaly detection and data quality control.

- Collaboration and data sharing = welcome.

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