Status European RDE emission legislation

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ASSOCIATION FOR EMISSIONS CONTROL BY CATALYST

Association for Emissions Control by Catalyst (AECC AISBL)

AECC members : European Emissions Control companies

- Exhaust emissions control technologies for original equipment, retrofit and aftermarket for all new cars, commercial vehicles, motorcycles, and non-road mobile machinery

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Content

- EU-RDE legislation
- Global RDE developments
- AECC RDE testing experience

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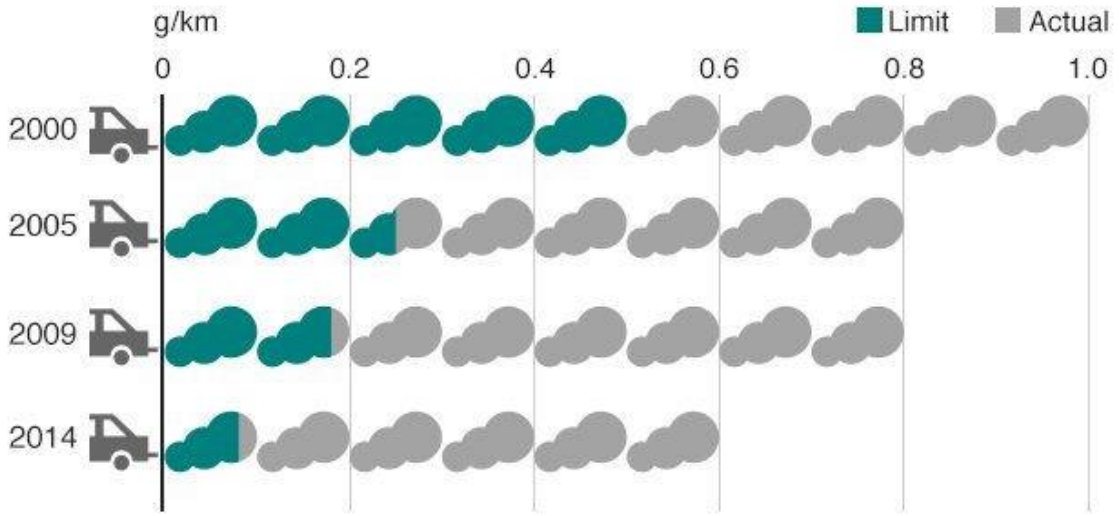
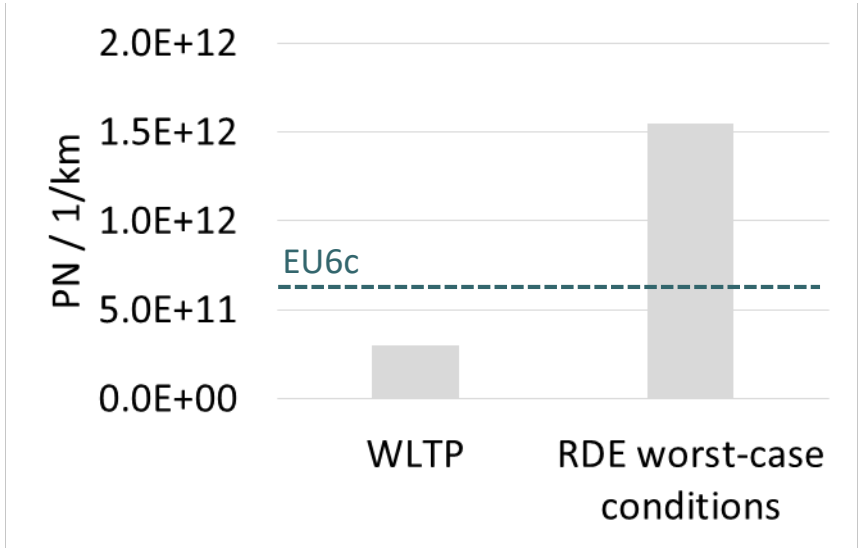
EU-RDE legislation to close the gap between lab and real-world emissions

Diesel NOx



Source: average on-road diesel NOx emissions, the ICCT

Gasoline Direct Injection (GDI) PN



Source: Gasoline Particulate Filters Market and Technology Trends and their Impact on Calibration, FEV, SIA powertrain 2017

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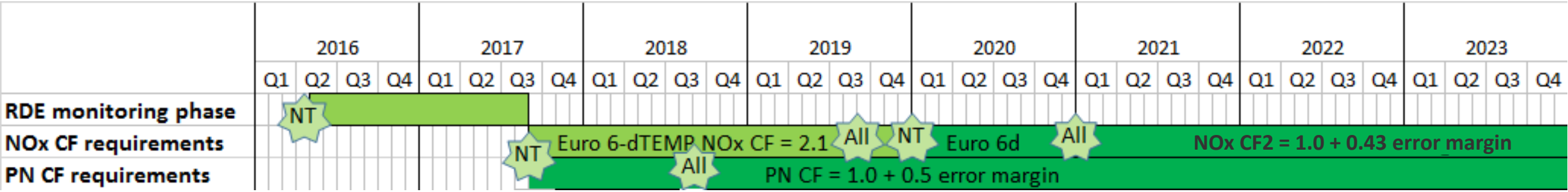
EU-RDE legislation to close the gap between lab and real-world emissions

- Not To Exceed limit (NTE) = Euro 6 limit x Conformity Factor (CF)
  - CF defined for NOx and PN
  - CF applies to urban part and total trip
  - CF in final step accounts for PEMS error margin (Portable Emissions Measurement Systems)
- Two stages added to Euro 6 legislation: 6dTemp and 6d



NT: New Types
All: All Types

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PEMS equipment used to measure emissions on the road

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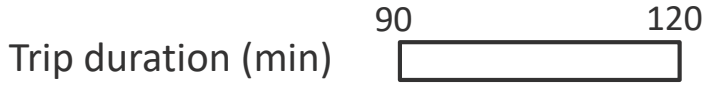
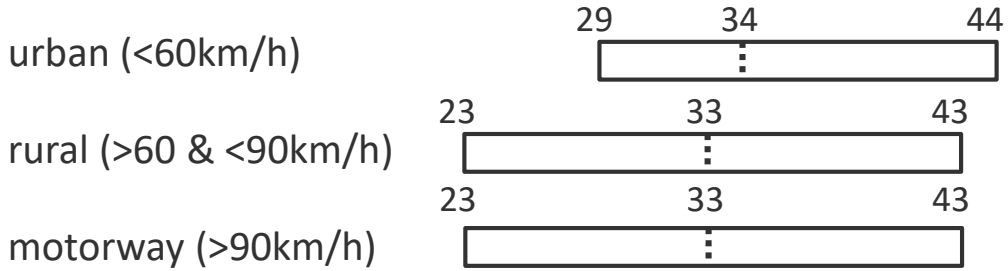
RDE boundary conditions define normal driving

To capture 90% of European driving conditions around WLTP reference

Route criteria



Distance share (%)
(>16 km)



Urban requirements

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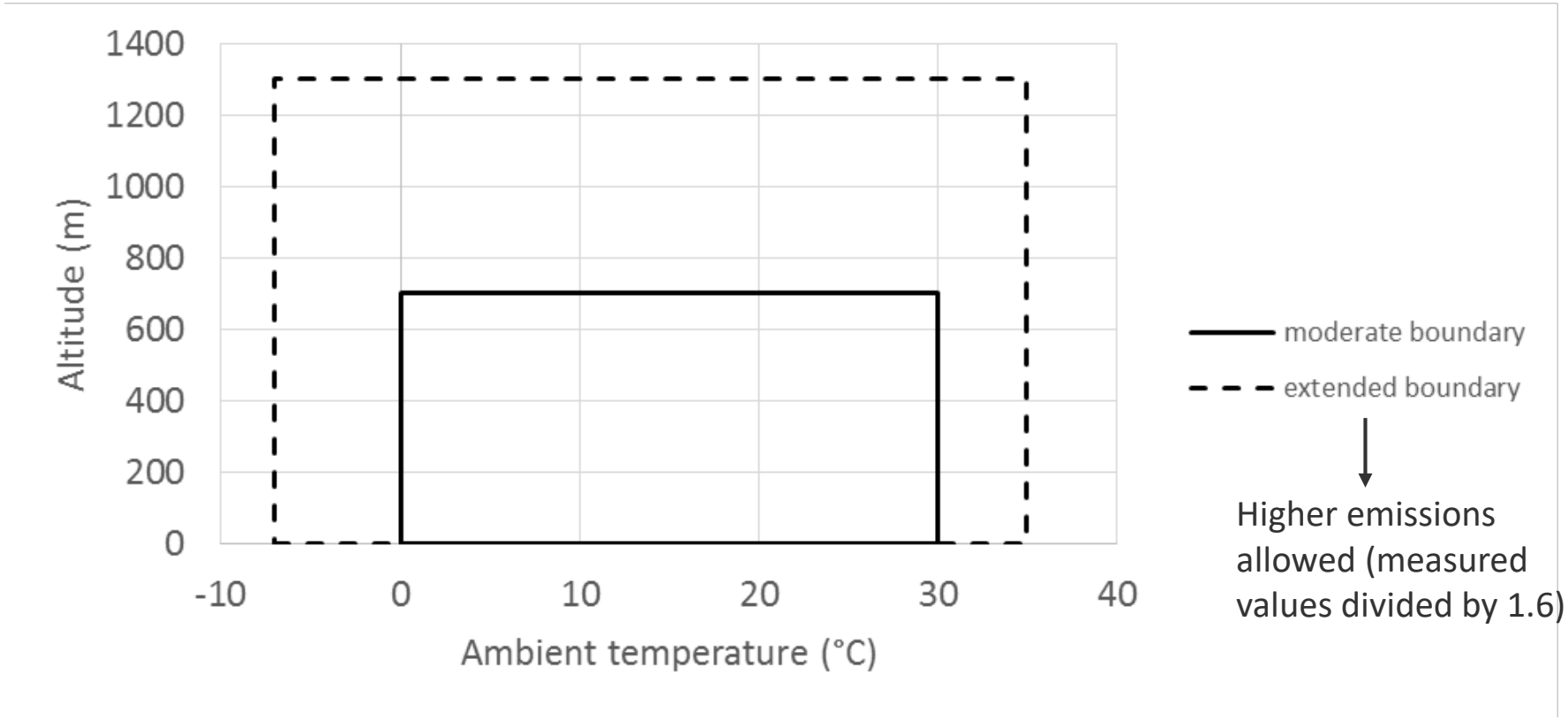
RDE boundary conditions define normal driving

To capture 90% of European driving conditions around WLTP reference

- Ambient conditions
  - Temperature
  - Altitude



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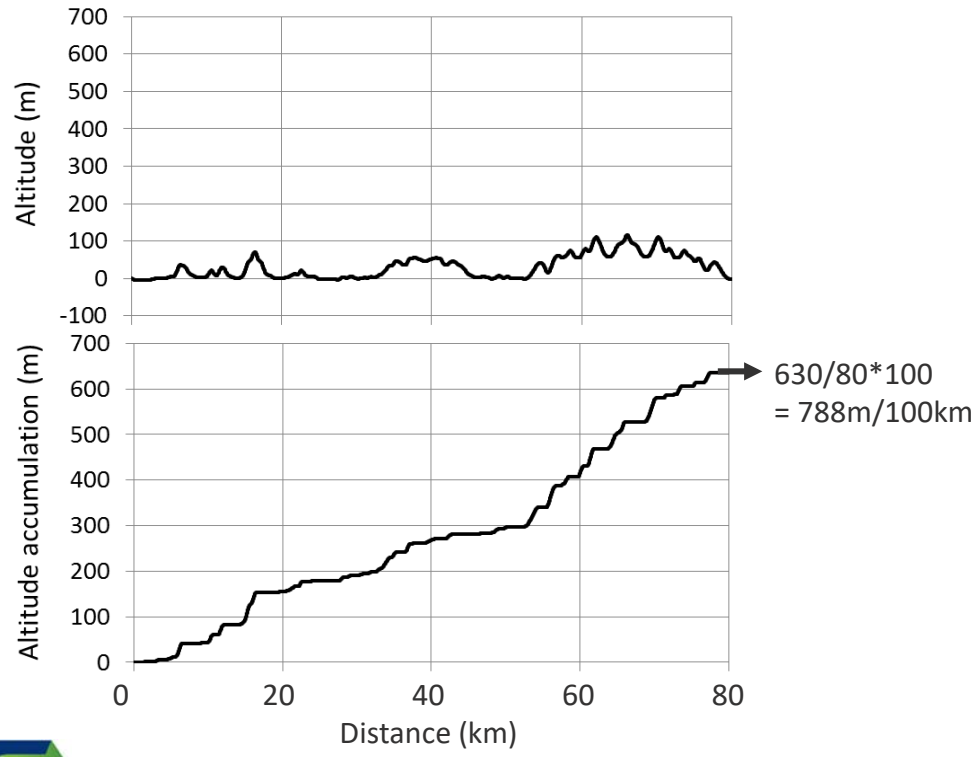
RDE boundary conditions define normal driving

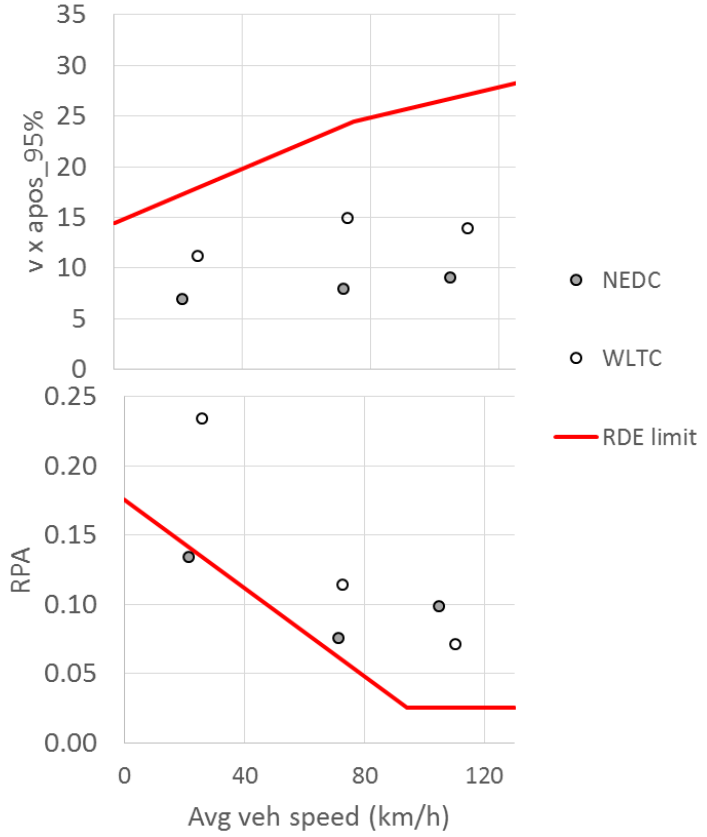
To capture 90% of European driving conditions around WLTP reference

Driving dynamic conditions

Altitude accumulation (<1200m/100km)



Excess or absence of accelerations



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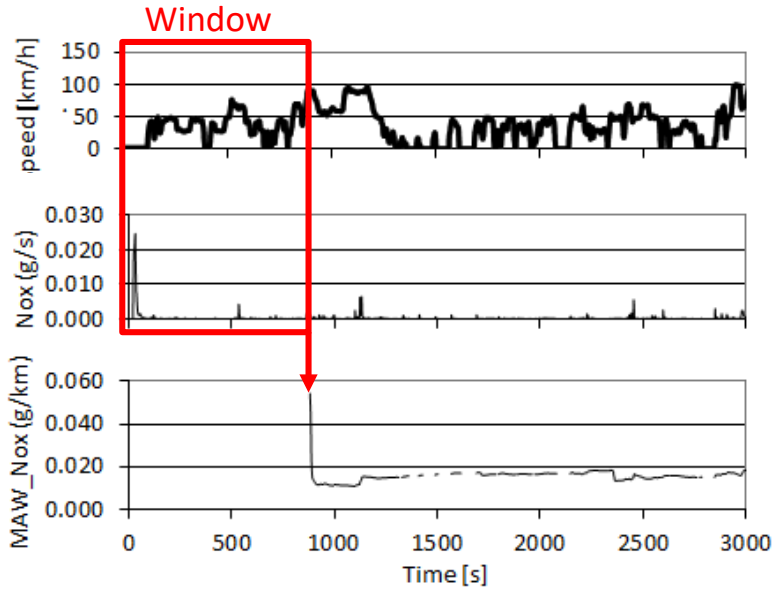
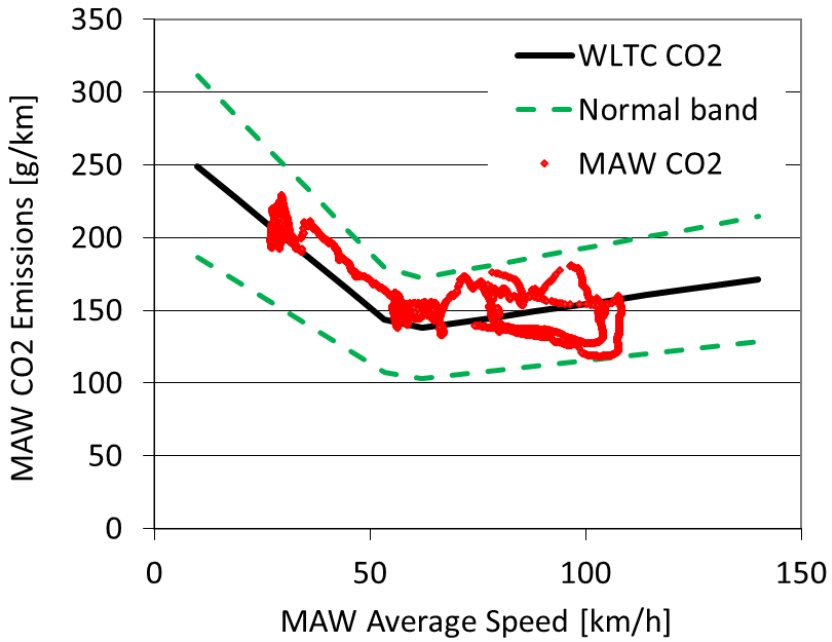
RDE boundary conditions define normal driving

To capture 90% of European driving conditions around WLTP reference

- Driving dynamic conditions
  - Based on measured CO_2 emissions
    - Moving Average Window principle (EMROAD tool)
    - 50% of Windows need to be within normal band around WLTC reference





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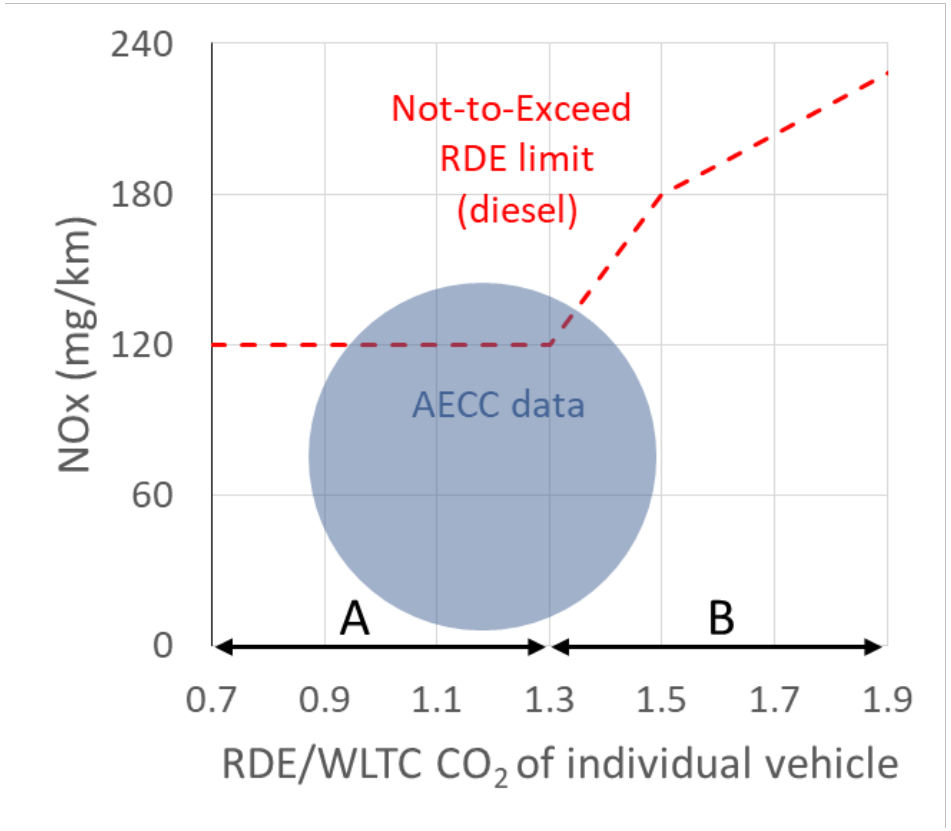
RDE post-processing of PEMS data

- Correction of pollutant emissions depending on RDE/WLTC CO_2 ratio
  - Area A: no correction, raw measured PEMS data to be reported
  - Area B: correction based on RDE/WLTC CO_2 ratio
- Additional factor for Plug-In Hybrids
  - RDE/WLTC CO_2 x WLTC/RDE distance share on ICE
  - WLTC reference distance share on ICE: 85%



ICE: Internal Combustion Engine

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In-Service Conformity and Market Surveillance are key

Defined in 4th legislative EU-RDE package

- Applies to New Types as of 1 January 2019 and All New Vehicles as of 1 September 2019
- Mandatory tests
  - Type 1: RDE
  - Type 1: WLTP
- Optional tests
  - Type 4: evaporative emissions
  - Type 6: low ambient temperature
- Some examples of process flow in next 2 slides

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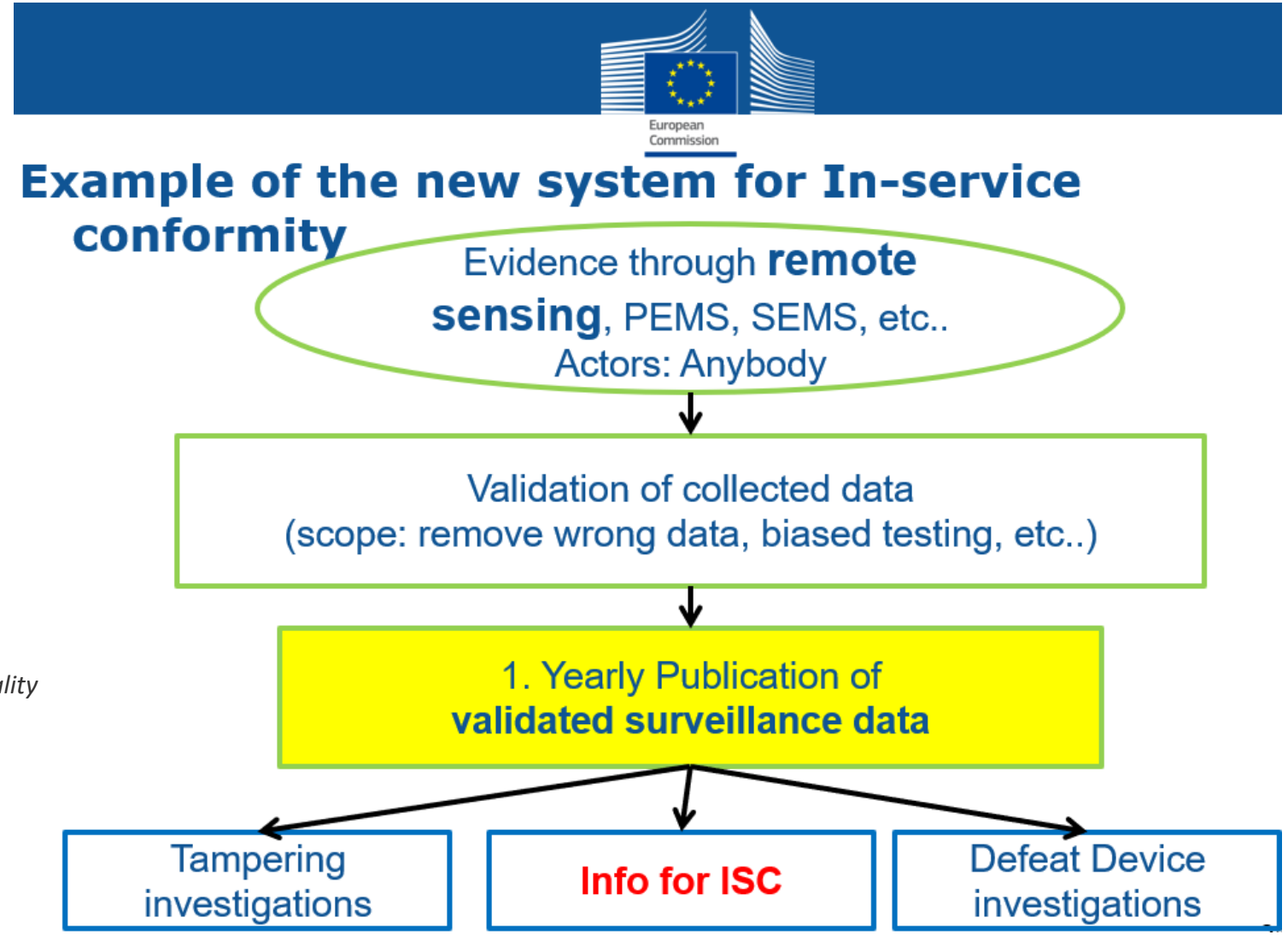
In-Service Conformity and Market Surveillance are key

Defined in 4th legislative EU-RDE package



Source: Z. Kregar, "Update on EU Air Quality and vehicle emissions policies", EIONET meeting on environment and transport, 2018, Copenhagen

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In-Service Conformity and Market Surveillance are key

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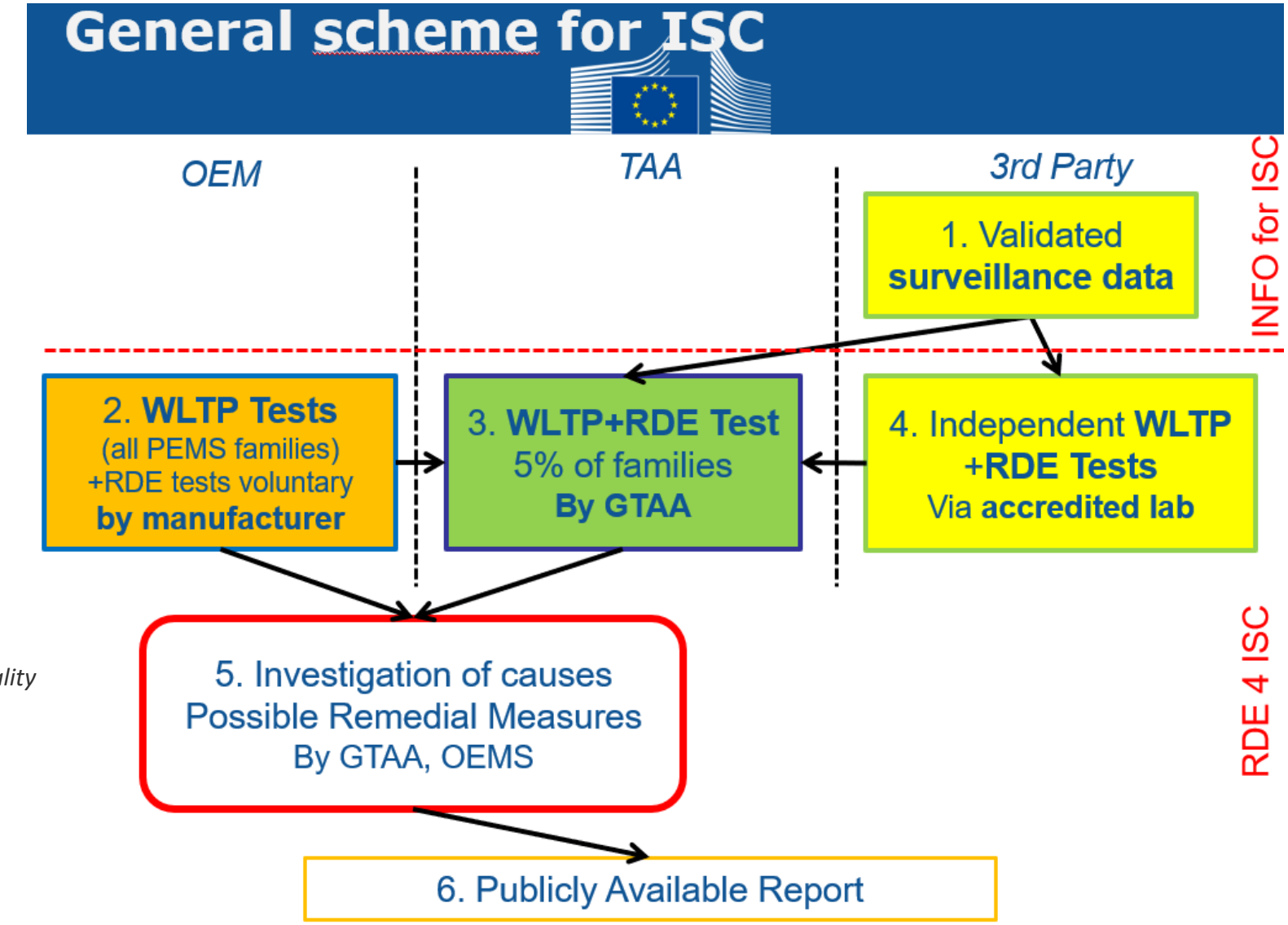

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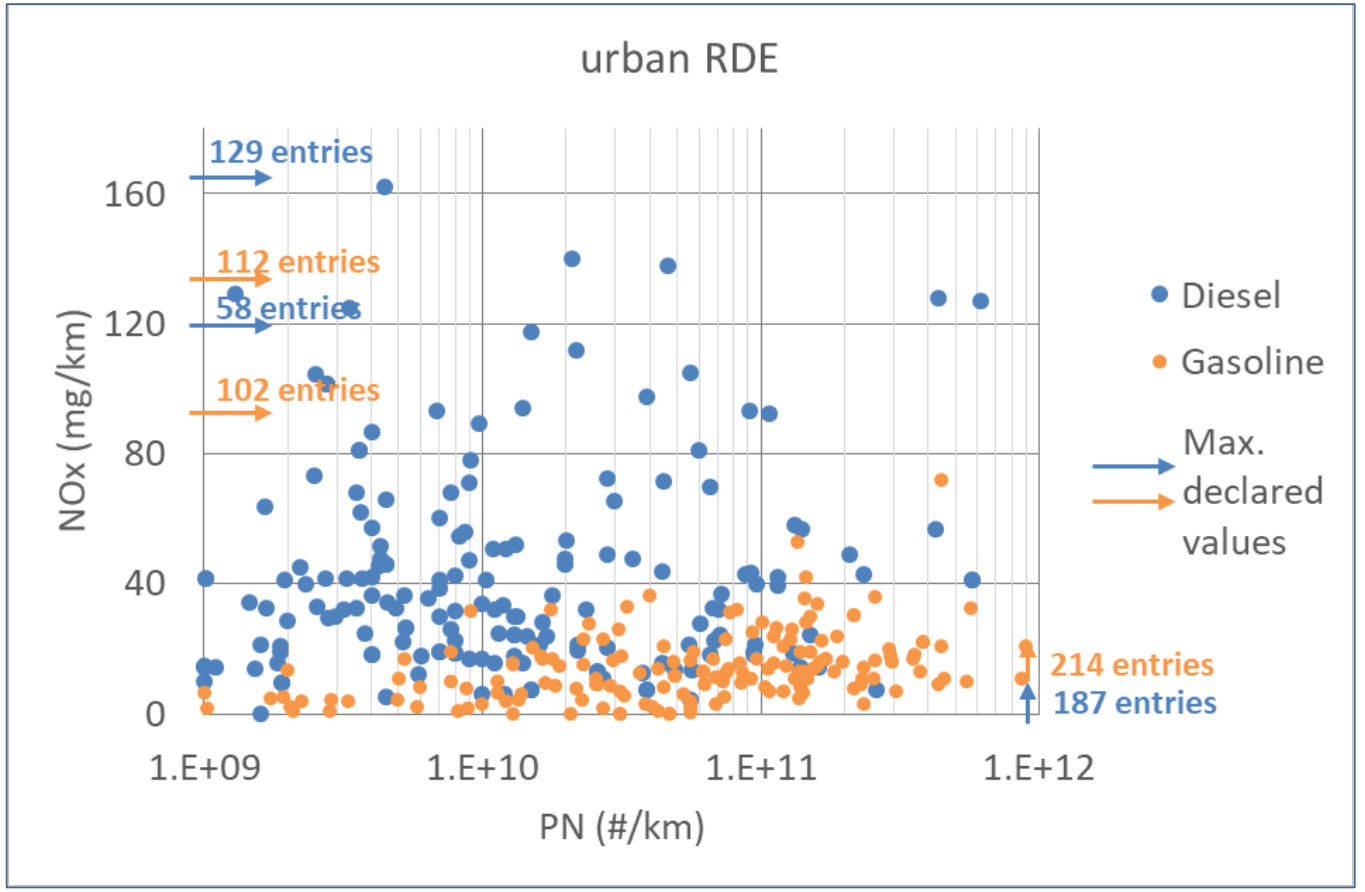
EU-RDE significantly reduces real-world gap

Declared emissions from Euro6d-Temp vehicles well within standards



Source: PEMS results and maximum declared values from ACEA RDE database consulted on 28 August 2018

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Global RDE developments at UNECE

- A new GRPE Informal Working Group on Real-Driving Emissions (IWG on RDE) was created after approval by WP.29 in June 2018.
- The kick-off meeting was held on 11-12 September 2018 in Brussels. It explored interests from contracting parties and possible development of a new Global Technical Regulation (GTR) under the UN 1998 Agreement to address 'Global RDE'.
- The new RDE IWG is chaired by the European Commission with Japan and Korea as co-vice-chairs. The technical secretariat is held by OICA and Japan (JASIC).
- An initial draft GTR text, prepared by the European Commission services, was already considered. Further work will continue.
- Information and documents can be found at https://wiki.unece.org/pages/viewpage.action?pageId=63308214

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AECC RDE testing experience

Vehicle	Year	Type	Series production/ demonstrator	Comment
5	2014	Diesel	Demonstrator NOx CF<1.5	SCR on DPF
6	2015	Diesel	Series NOx CF<1.5	SCR on DPF
7	2015	GDI	Series NOx and PN CF<1	With GPF
8	2016	GDI	Series + Demonstrator	Without GPF With GPF
9	2017	PHEV	Series + Demonstrator	Without GPF With GPF

GDI: Gasoline Direct Injection
GPF: Gasoline Particulate Filter
SCR: Selective Catalytic Reduction
DPF: Diesel Particulate Filter

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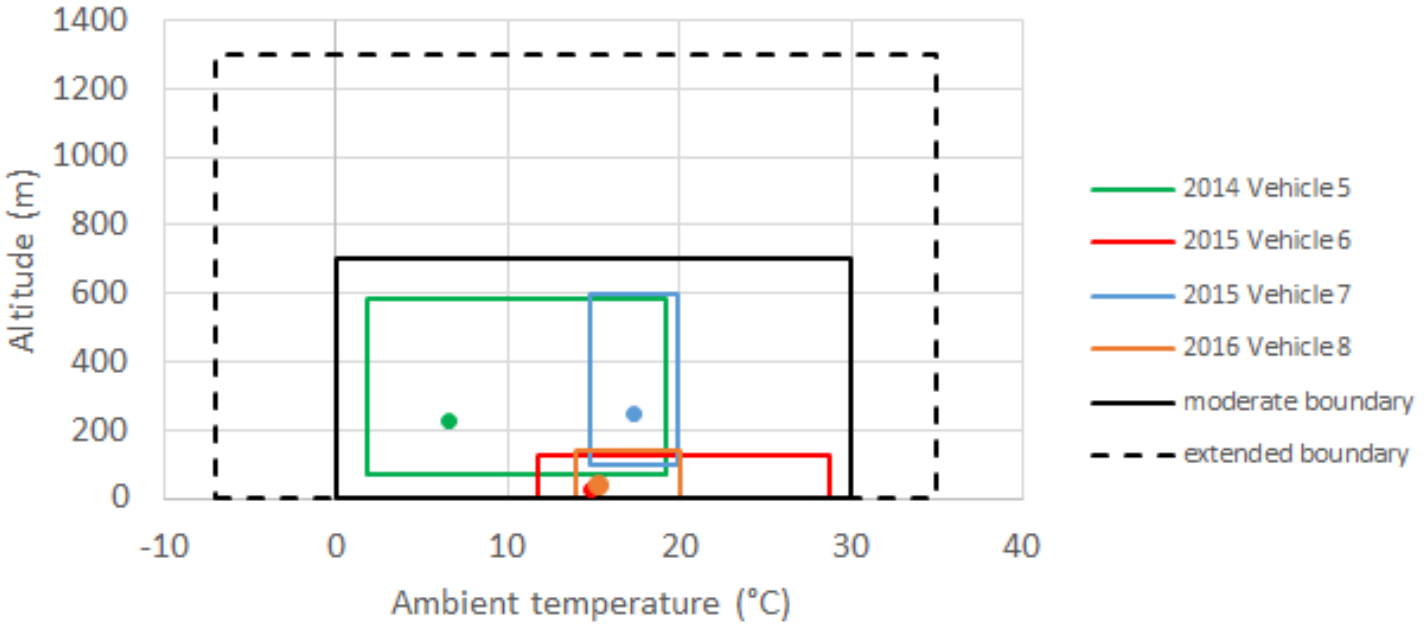
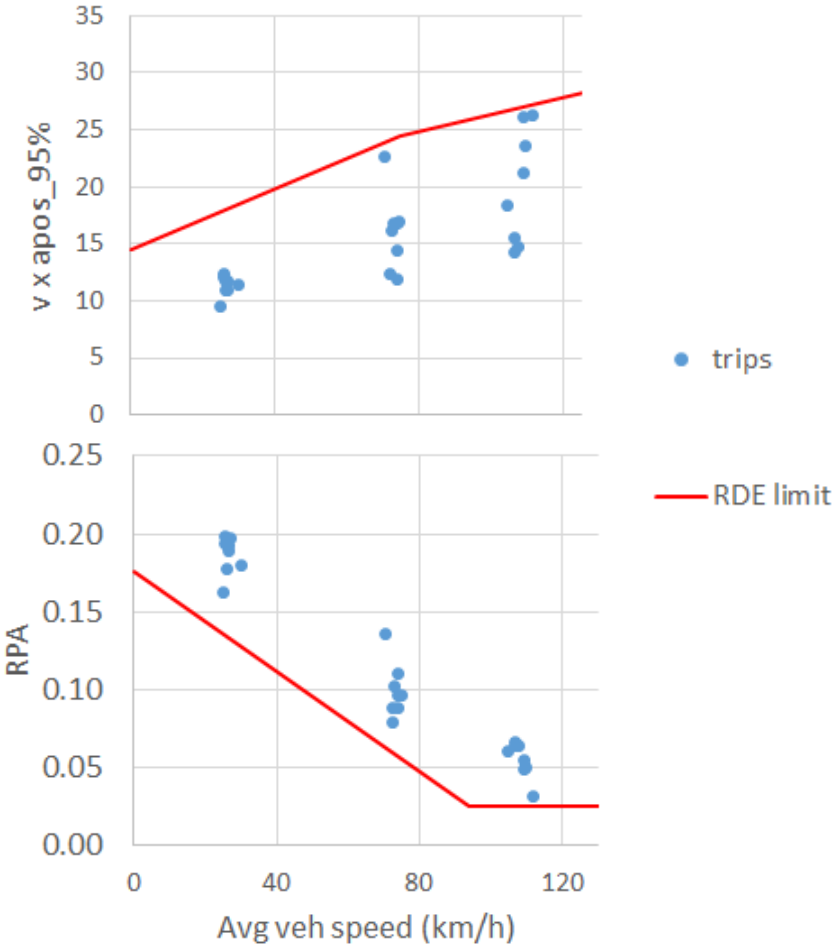
AECC RDE testing experience

Data within moderate boundary conditions



Excess or absence of driving dynamics (e.g. PHEV, vehicle 9)



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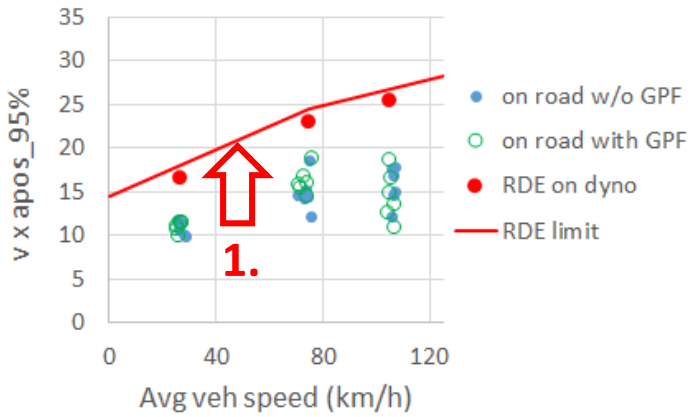
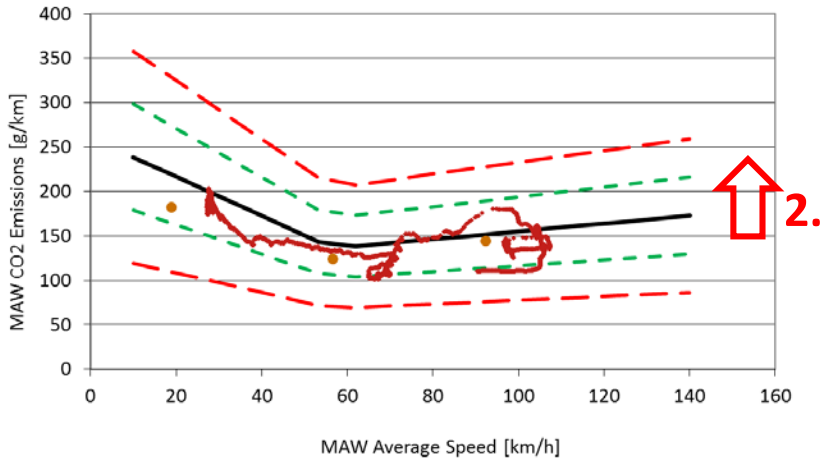
AECC RDE testing experience

Impact of RDE boundary conditions tested on the chassis dyno (visualized with GDI data, vehicle 8)

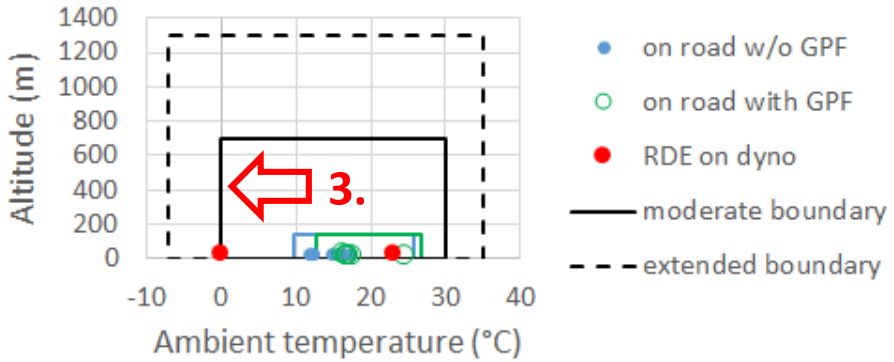
1. Change accelerations



2. Change dyno load



3. Change ambient temperature



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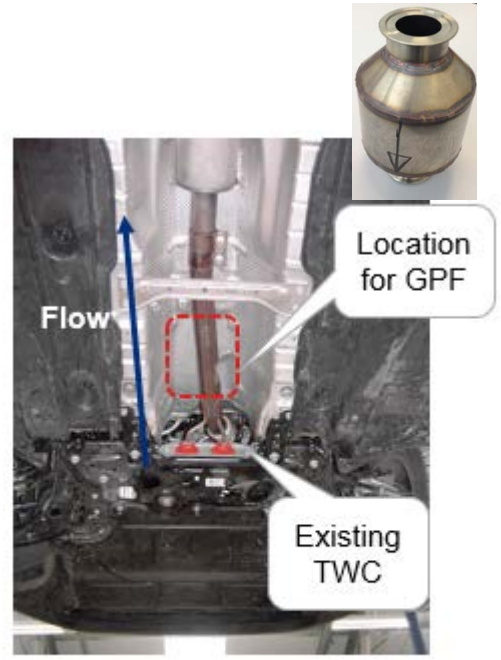
GDI test programme set-up (vehicle 8)

- Objective: investigate NOx & PN RDE without and with Gasoline Particulate Filter (GPF)
- Vehicle
  - C-segment, 1.4l engine
  - Market representative GDI technology targeting Euro 6c → only Euro 6b available
  - Original configuration w/o GPF
  - Add coated GPF demonstrator underfloor
- HORIBA PEMS equipment
  - Gaseous PEMS (CO_2, CO, NOx)
  - PEMS-PN demo unit



Underfloor view

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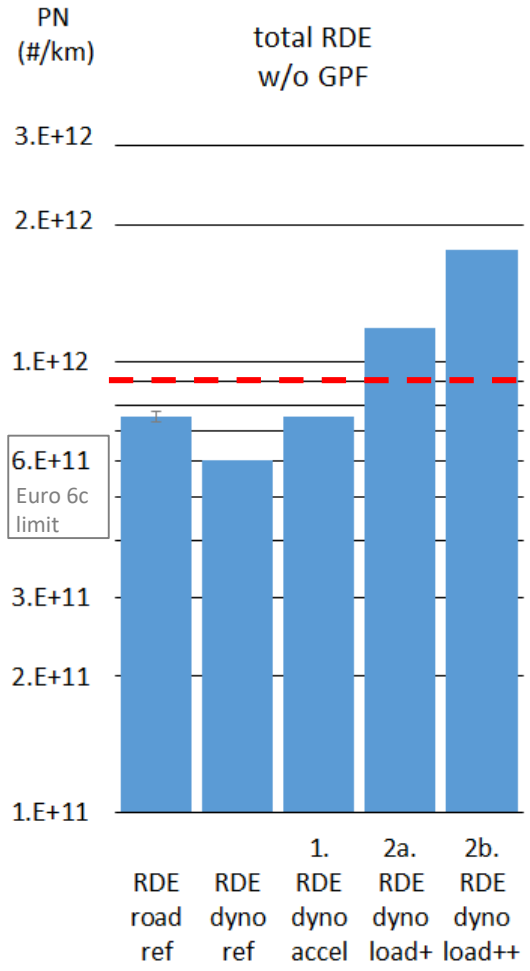
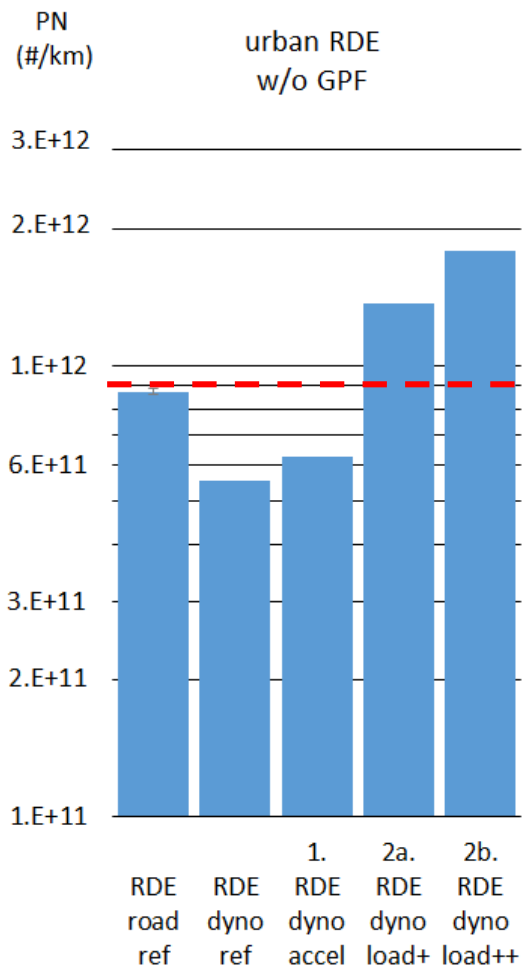
PN w/o GPF increases above NTE limit towards RDE boundary

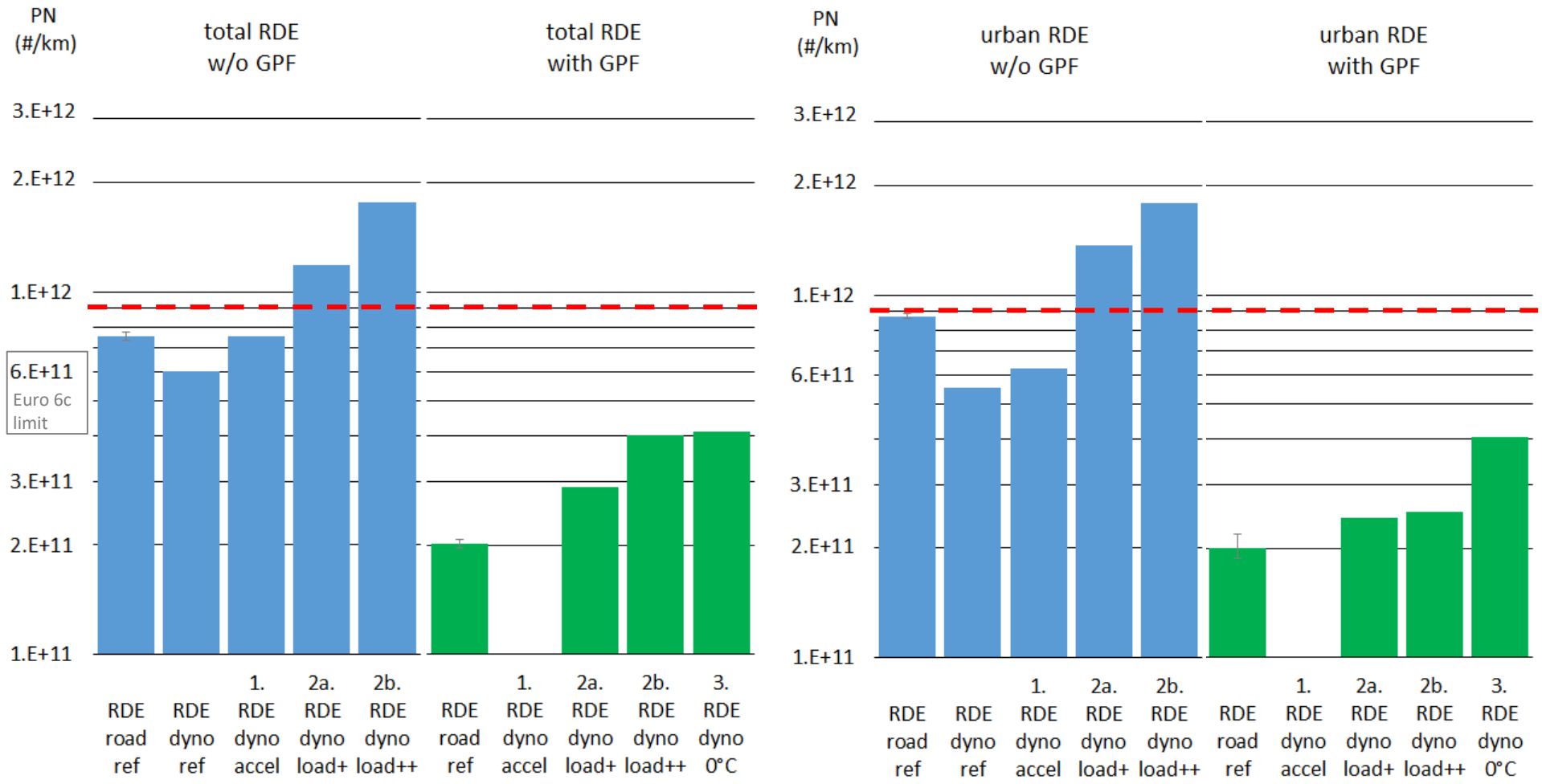




Euro 6d NTE limit

Measurement range 3x RDE

PN with GPF remains below Euro 6d NTE limit



Euro 6d NTE limit

Measurement range 3x RDE

THANK YOU !

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