Capabilities of Emission Control Technologies and their Impact on Air Quality

Expert Meeting of the EU Refining Forum

Brussels • 1 December 2017

AECC

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
  - AECC is # 78711786419-61 in EU Transparency Register and has consultative status with the UN Economic and Social Council (ECOSOC)

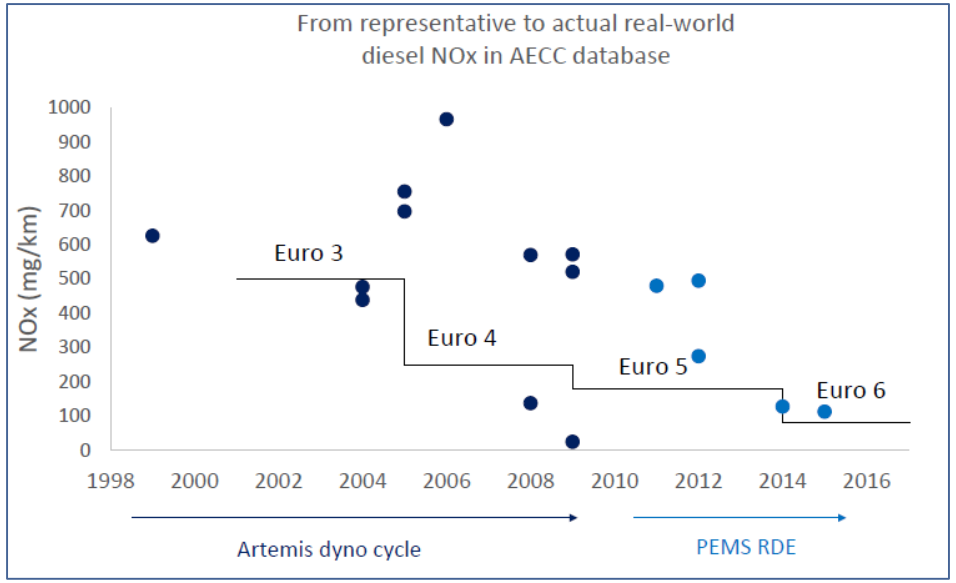
Capabilities of Emission Control Technologies

Diesel vehicles: the newer, the cleaner

AECC industry opinion – released on 21 April 2017

www.aecc.eu/wp-content/uploads/2017/05/170421-AECC-Industry-Opinion-Clean-Diesel.pdf

- The key message is: the newer the diesel vehicle, the cleaner; a new clean diesel is very different to older diesels.
- Diesel technology has evolved dramatically, especially with regards to its environmental impact. Modern, clean diesel cars combine a fuel economy and CO_2 advantage with near-zero emissions of ultrafine particles and nitrogen oxides, including NO_2, providing the foundation to meet European air quality objectives.
- Decisions on which vehicles are allowed or not to drive in cities should not just rely on the name of a technology – in this case "diesel" – but need to be based on the pollutant emissions that these vehicles produce. Only then will they contribute to accelerate the clean-up of the vehicle fleet and help improve urban air quality and lower CO_2 emissions.



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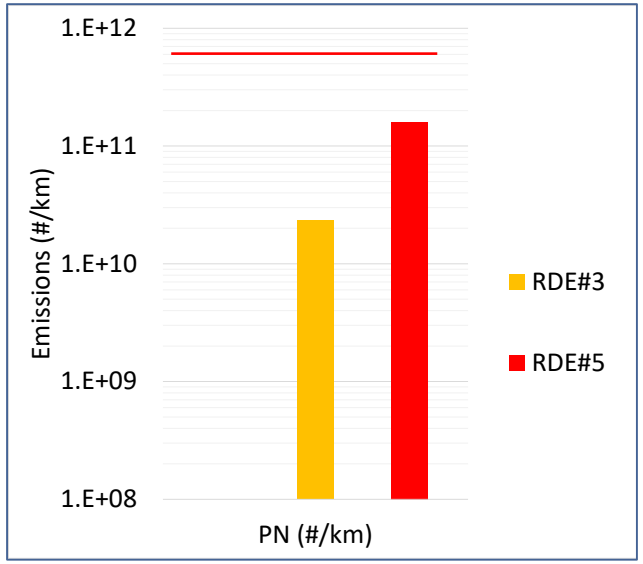
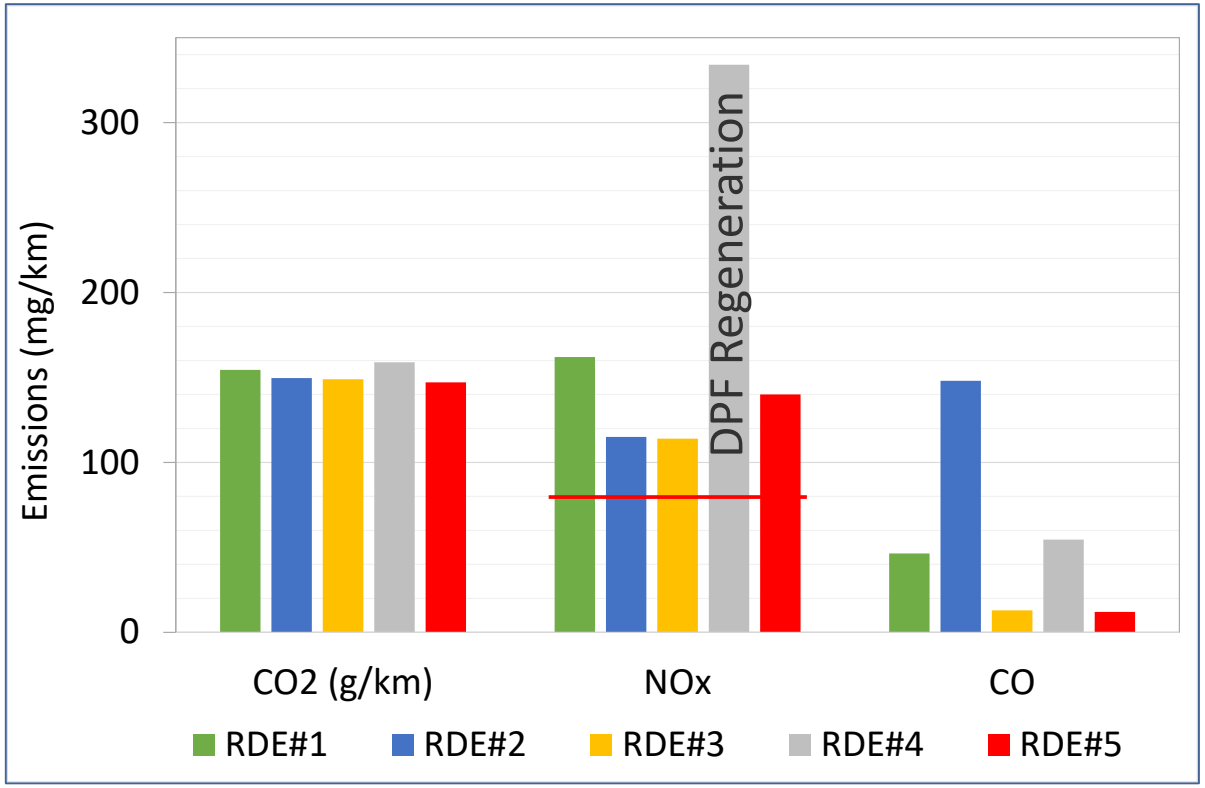
AECC RDE test programmes show low emissions

Diesel vehicles

- 2014: demonstrator with SCR on DPF
- 2015: series vehicle with SCR on DPF
- Results
  - NOx can already meet Euro 6d NTE (120 mg/km)
  - PN with DPF below $6x10^{11}$/km





2015 AECC series vehicle results:
PN & NOx emissions on RDE total

RDE-compliant diesel cars are coming to the market

AECC press release on RDE and WLTP entry into force – 1 September 2017

Marke	Modell	Motorart	Hubraum	Leistung in kW	Abgasnorm	Start
DS Automobiles	DS 7 Crossback PureTech 225	Otto	1598	165	Euro6d-TEMP	01-Feb-18
DS Automobiles	DS 7 Crossback BlueHDi 130	Diesel	1499	96	Euro6d-TEMP	01-Feb-18
DS Automobiles	DS 7 Crossback BlueHDi 180	Diesel	1997	130	Euro6d-TEMP	01-Feb-18
Peugeot	208 1.2 PureTech 82	Otto	1199	61	Euro6d-TEMP	29-Nov-17
Peugeot	308 1.2 PureTech 110	Otto	1199	81	Euro6d-TEMP	28-Nov-17
Peugeot	308 1.2 PureTech 130	Otto	1199	96	Euro6d-TEMP	30-Okt-17
Peugeot	308 1.6 PureTech 225	Otto	1598	165	Euro6d-TEMP	28-Nov-17
Peugeot	308 1.5 BlueHDi 130	Diesel	1499	96	Euro6d-TEMP	30-Okt-17
Peugeot	308 2.0 BlueHDi 180	Diesel	1997	130	Euro6d-TEMP	30-Okt-17
Peugeot	308 SW 1.2 PureTech 110	Otto	1199	81	Euro6d-TEMP	28-Nov-17
Peugeot	308 SW 1.2 PureTech 130	Otto	1199	96	Euro6d-TEMP	30-Okt-17
Peugeot	308 SW 1.6 PureTech 225	Otto	1598	165	Euro6d-TEMP	28-Nov-17
Peugeot	308 SW 1.5 BlueHDi 130	Diesel	1499	96	Euro6d-TEMP	30-Okt-17
Peugeot	308 SW 2.0 BlueHDi 180	Diesel	1997	130	Euro6d-TEMP	30-Okt-17
Peugeot	3008 1.5 BlueHDi 130	Diesel	1499	96	Euro6d-TEMP	20-Nov-17
Peugeot	3008 2.0 BlueHDi 180	Diesel	1997	130	Euro6d-TEMP	20-Nov-17
Peugeot	5008 1.5 BlueHDi 130	Diesel	1499	96	Euro6d-TEMP	20-Nov-17
Peugeot	5008 2.0 BlueHDi 180	Diesel	1997	130	Euro6d-TEMP	20-Nov-17
Volvo	XC40 T3	Otto	1498	114	Euro6d-TEMP	01-Feb-18
Volvo	XC40 T5	Otto	1969	182	Euro6d-TEMP	01-Feb-18
Volvo	XC40 D4	Diesel	1969	140	Euro6d-TEMP	01-Feb-18
Volvo	XC60 D4	Diesel	1969	140	Euro6d-TEMP	01-Nov-17
Volvo	XC60 D5	Diesel	1969	173	Euro6d-TEMP	01-Nov-17
Volvo	XC90 D5	Diesel	1969	173	Euro6d-TEMP	01-Nov-17

ADAC

www.aecc.eu/wp-content/uploads/2017/09/170901-AECC-PR-WLTP-RDE-introduction.pdf

Make	Model	Fuel Type	Model Year	Engine Size L	Power Bhp	Drive Train	Driven Wheels	Transmission	Euro Stage	EQUA Aq Rating
Make	Model	diesel	Model Year	Engine S...	Power Bhp	Drive Train	Driven W...	Transmi...	Euro 6	a
Audi	A5	Diesel	2014	2.0	161	FWD	2	Manual	Euro 6	A
Audi	Q2	Diesel	2017	2.0	148	4WD	4	Automatic	Euro 6	A
BMW	3 Series	Diesel	2013	2.0	181	RWD	2	Manual	Euro 6	A
BMW	5 Series	Diesel	2016	2.0	187	RWD	2	Automatic	Euro 6	A
BMW	5 Series	Diesel	2017	3.0	261	RWD	2	Automatic	Euro 6	A
BMW	7 Series	Diesel	2016	3.0	316	4WD	4	Automatic	Euro 6	A
Mercedes-Benz	C Class	Diesel	2017	2.1	201	RWD	2	Automatic	Euro 6	A
Mercedes-Benz	E Class	Diesel	2017	2.0	191	RWD	2	Automatic	Euro 6	A
MINI	Hatch	Diesel	2015	2.0	168	FWD	2	Manual	Euro 6	A
Porsche	Panamera	Diesel	2017	4.0	415	4WD	4	Automatic	Euro 6	A
SEAT	Alhambra	Diesel	2016	2.0	148	FWD	2	Manual	Euro 6	A
Volkswagen	Golf SV	Diesel	2015	2.0	148	FWD	2	Automatic	Euro 6	A
Volkswagen	Passat	Diesel	2016	1.6	118	FWD	2	Manual	Euro 6	A
Volkswagen	Scirocco	Diesel	2015	2.0	148	FWD	2	Manual	Euro 6	A
Volkswagen	Tiguan	Diesel	2016	2.0	148	4WD	4	Automatic	Euro 6	A
Volkswagen	Tiguan	Diesel	2017	2.0	237	4WD	4	Automatic	Euro 6	A
Volkswagen	Touran	Diesel				FWD	2	Manual	Euro 6	A

EQUA INDEX
POWERED BY EMISSIONS ANALYTICS

Note: EQUA index does not demonstrates RDE-compliance but indicates low real-world emissions

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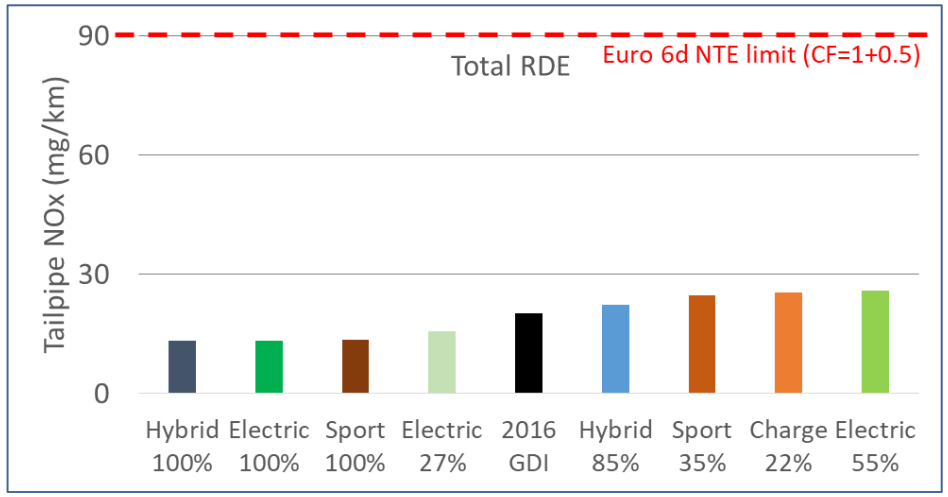
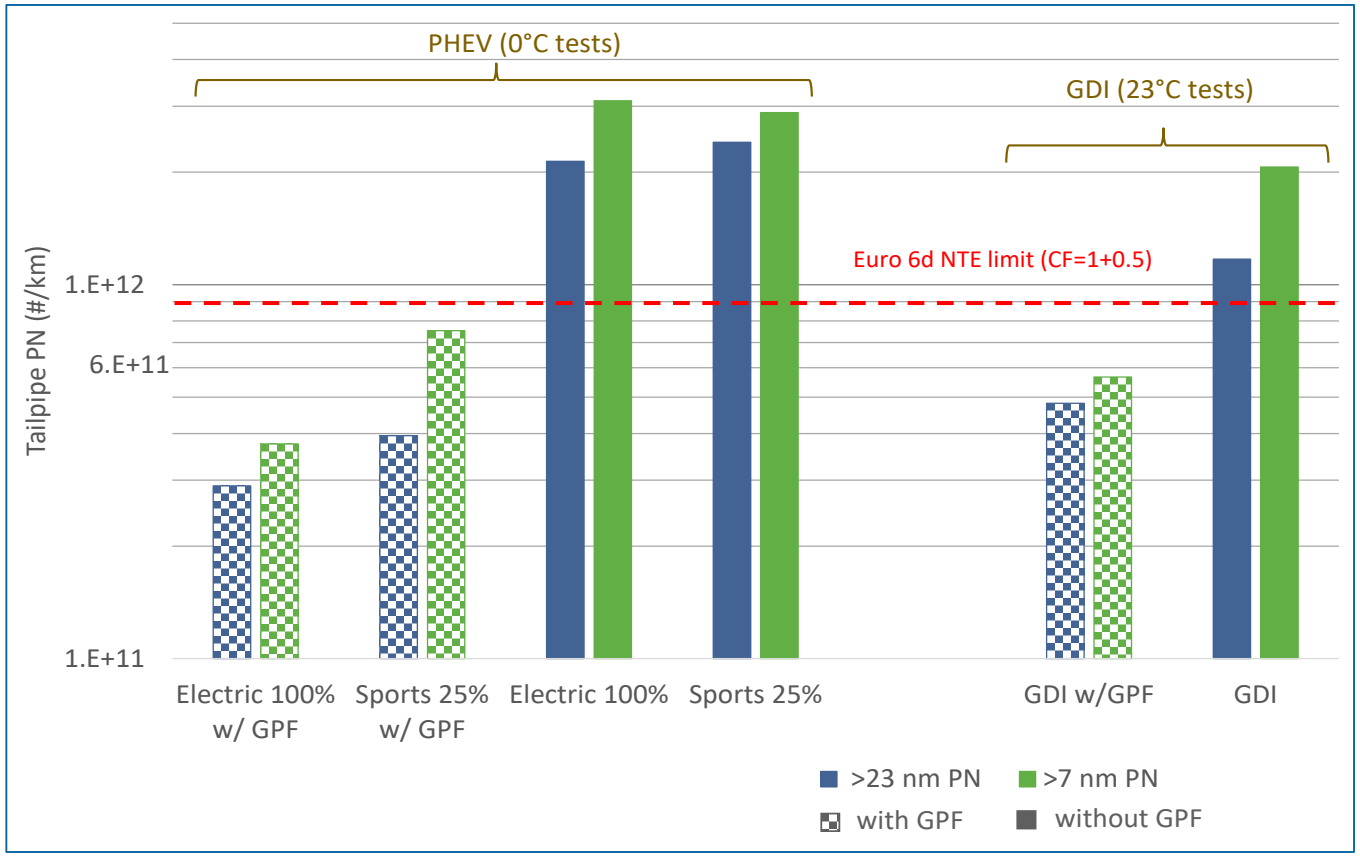
AECC RDE test programmes show low emissions

Gasoline vehicles

- 2016: GDI with TWC and coated GPF
- 2017: PHEV with TWC and coated GPF
- Results
  - NOx below 60 mg/km
  - PN below NTE (incl. sub-23 nm)



Severitized RDE test



AECC industry position on the Combustion Engine (ICE)

Part of the solution for low-emission mobility – 8 November 2017

https://www.aecc.eu/wp-content/uploads/2017/11/171108-AECC-Indus-Pos-ICE-for-low-emission-mobility.pdf

- To reduce GHG emission from road transport, **several vehicle technology options** are required.
  - Road transport decarbonisation technologies, including pure electric and hybrid vehicles (combined electric and liquid fuel) are becoming available along with an electric charging infrastructure.
  - Lower carbon liquid fuel sources and fuel efficiency improvement will also contribute.
  - Low-emission diesel and gasoline engines will therefore play a role in reducing greenhouse gas emissions from road transport for some time to come.
- In a **Well-to-Wheel context**, the ICE can, in the long term, continue to be a key contributor to climate-friendly mobility not only by using non-fossil, synthetic liquid or gaseous fuels produced from renewable sources, but also through technological improvements in the engine fuel efficiency.
- Thanks to **efficient aftertreatment technologies**, the reduction of greenhouse gas emissions from conventional and hybrid vehicles can be combined with ultra-low particulate and nitrogen oxide (NOx) emissions enabling climate change and air quality to be tackled simultaneously.

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Impact of Emission Control Technologies on Air Quality

Air quality modelling study

Impact of Euro 6d/ RDE legislation investigated by IIASA for AECC

- Scenario
  - Same as in impact assessment of the EU's Thematic Strategy on Air Pollution (PRIMES 2013), including Euro 6d, but extended for developments up to 2040
- Assumption
  - Emissions factors = RDE Conformity Factors

Average NOx emissions and share of primary NO_2 for diesel passenger cars

	average NOx emission rate in on-road driving [mg/km]	share of primary NO_2
Euro 4 and older	~600	range: 7% to 49%
Euro 5 – until 09/15	~750	37%
Euro 6b – 09/15-08/19	~350 (CF:4.4)	32%
Euro 6dTEMP – 09/19-12/20	linear combination of Euro 6b and Euro 6d	
Euro 6d – from 01/21	~120 (CF:1.5)	32%

Average NOx emissions and share of primary NO_2 for diesel heavy-duty trucks

	average NO_x emission rate in on-road driving [mg/km]	share of primary NO_2
Euro III	~5000	7%
Euro IV	~3500	9%
Euro V	~2000	20%
Euro VI	~250	36%

- Uncertainties
  - NOx control tampering issues (e.g. AdBlue® emulator) not included: effects?

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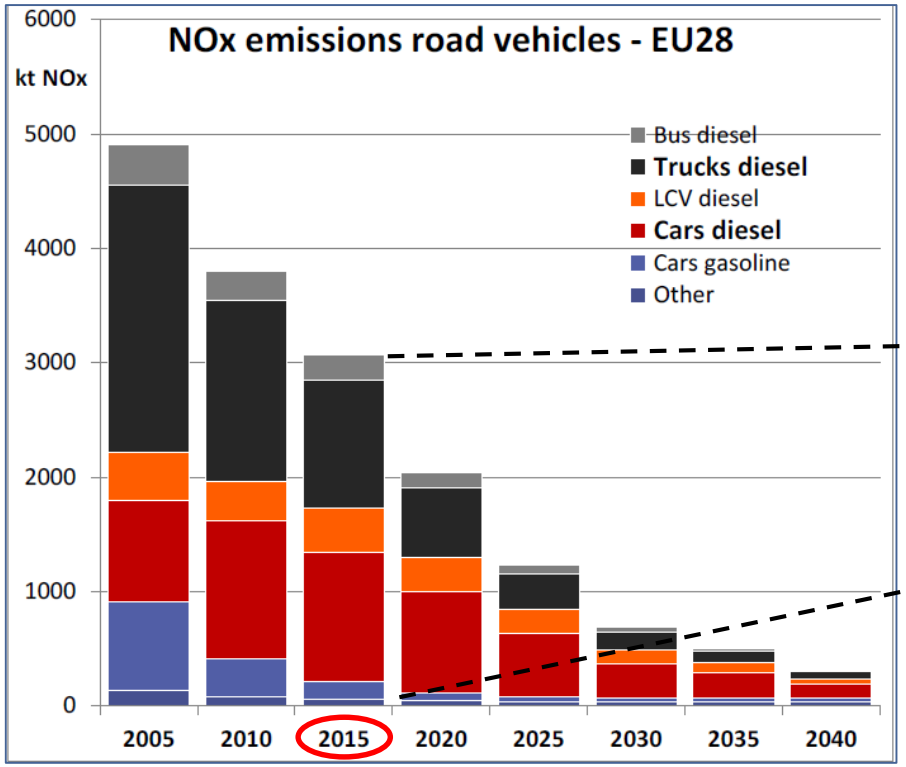
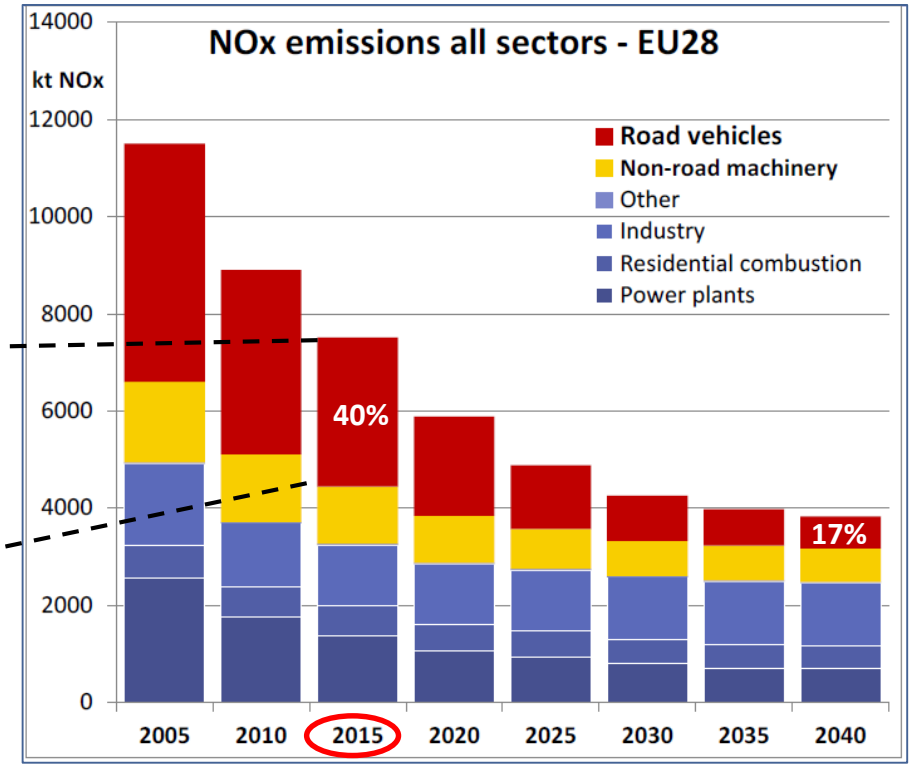
NOx inventory modelling by IIASA up to 2040

Euro 6d/RDE scenario demonstrates the benefit of the clean ICE



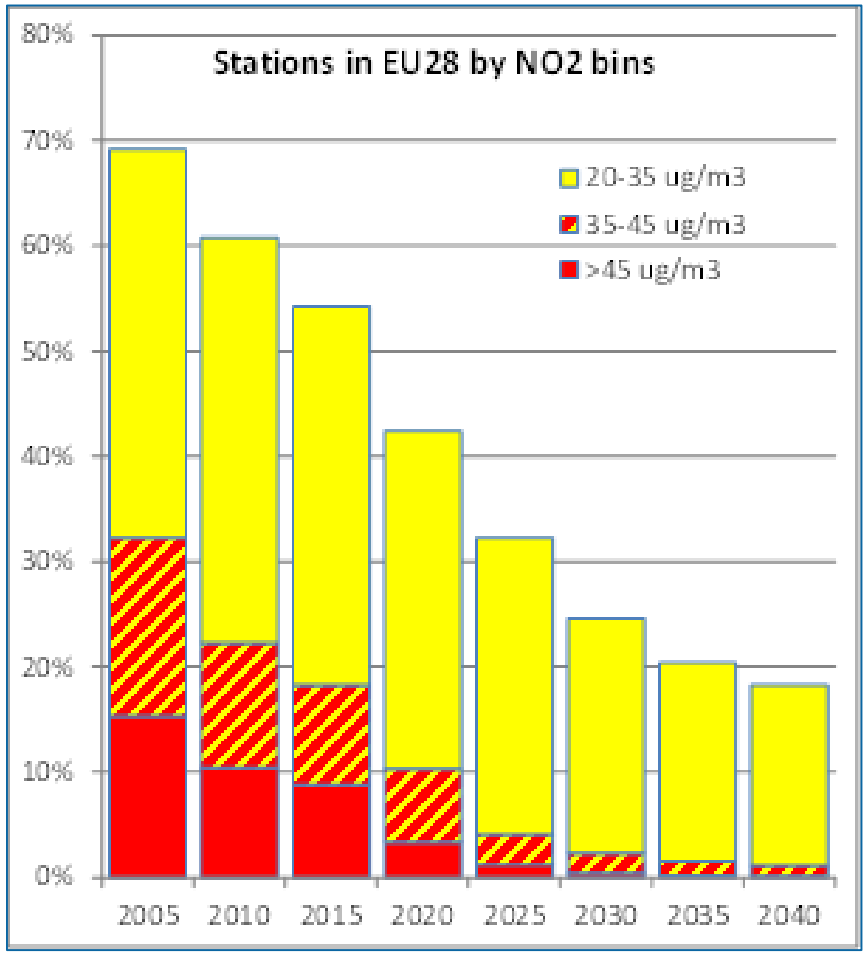


- Road vehicles contribution to EU NOx emissions inventory
  - 2015: 40% & 2040: 17% (provided Euro 6d Emissions Factors = Conformity Factors)

NO_2 air quality modelling by IIASA up to 2040

Euro 6d/RDE scenario benefit on NO_2 monitoring stations exceedances

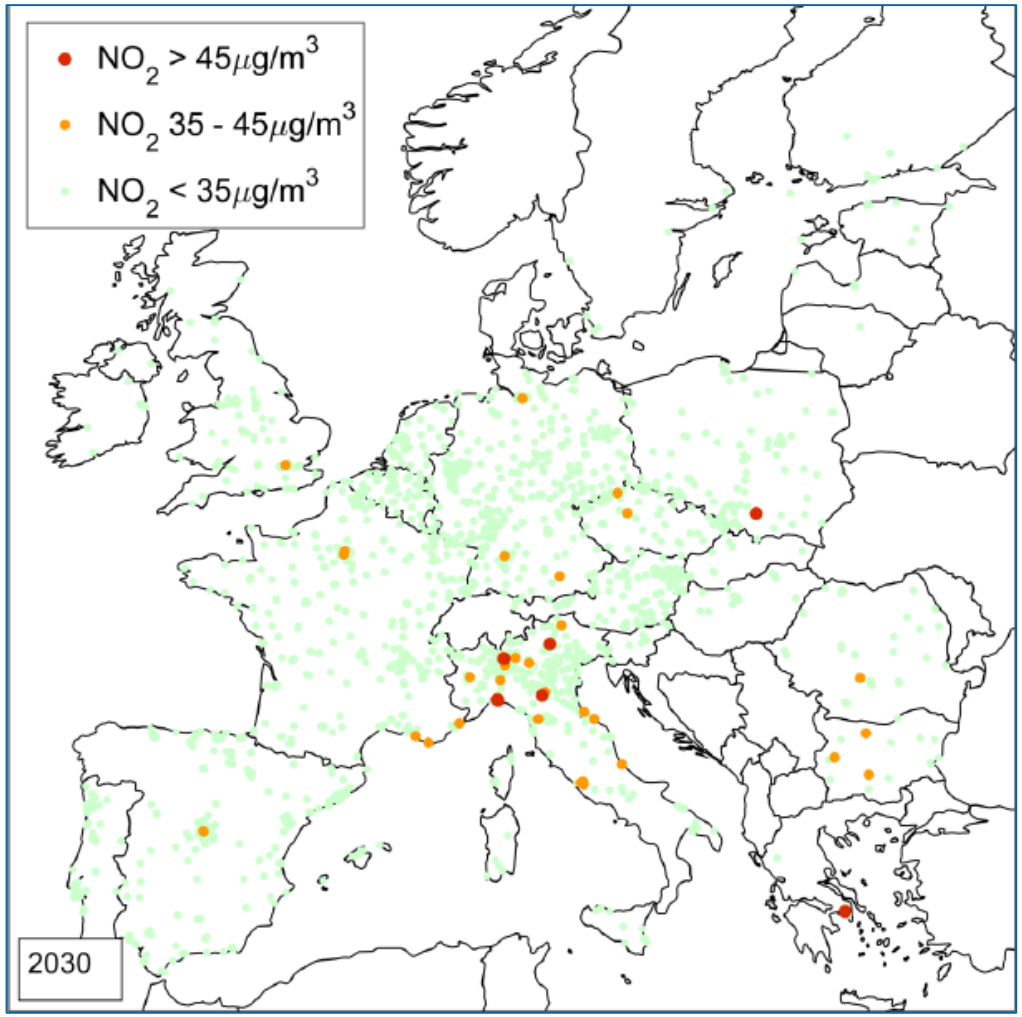
- WHO Global Air Quality Guideline for annual NO_2 concentration
  - Current guideline 40 µg/m³
  - On-going update of the WHO guidelines may lower the guideline value
  - NO_2 classes: Severe – problematic – potentially
- Strong decline of number of NO_2 stations >35 µg/m³
- Cities & urban population impacted by remaining stations in exceedance?



NO_2 air quality modelling by IIASA

Remaining NO_2 monitoring stations exceedances in 2030

- Typically located in big cities at major roads (e.g. Athens, London, Paris, Madrid, Hamburg, Munich, Stuttgart) or in areas with high industrial activity and bad air exchange (e.g. Northern Italy, Southern Poland, areas in Bulgaria and Romania)



Conclusions and outlook

- Euro 6d RDE legislation needs to be finalized first
  - The 4th RDE package under Euro 6d needs to be realistic, robust and transparent to deliver the air quality benefits needed by EU citizens, local authorities and Member States
- The Internal Combustion Engine has a future
  - Decarbonisation of road transport will take place by a number of technology pathways including liquid and gaseous fuels, hybrid and electric vehicles
  - Thanks to efficient aftertreatment technologies, the reduction of greenhouse gas emissions from conventional and hybrid vehicles can be combined with ultra-low particulate and NOx emissions, enabling climate change and air quality to be tackled simultaneously
- What's next ?
  - DG Growth has announced a study on 'post Euro 6/VI' in 2018
  - DG Environment is conducting a fitness check of the EU Air Quality legislation
  - WHO is reviewing Air Quality guidelines; it may require further emissions reduction from road transport
  - 'Post Euro 6/VI' standards should be Fuel-, Technology- and Cycle-neutral

THANK YOU!

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