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European policies to reduce CO_2 emissions and fuel/energy consumption from road transport

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Workshop on "JRC tools to support the reduction of CO2 emissions and fuel consumption from road transport in Europe: VECTO and CO2MPAS"

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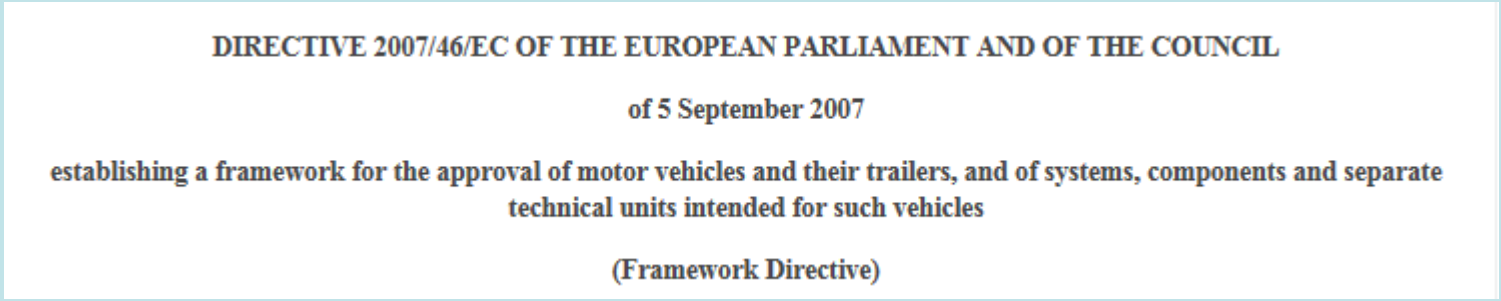
Agenda

- Type-Approval (TA) System in Europe
  - How it works?
  - TA Test Types;
  - CO_2 Targets;
- Introduction of WLTP in Europe
  - What has been changed (WLTP vs NEDC)?
  - CO_2MPAS in TA system
  - Future WLTP-based CO_2 targets
- CO_2 gap - present and future perspectives

Type-Approval (TA) System in Europe

TA System in Europe - General

- **Type-Approval** is the process in which the motor vehicle taken to be "representative" of "type" is tested on a number of tests to check its conformity to relevant environmental, safety, and security standards;
- TA can be done in any EU Member State. In most states the national **Type Approval Authorities (TAA)** don't have testing facilities and they designate **Technical Services (TS)** to test vehicle prototypes;
- TA methodology is outlined in EU **Directive 2007/46/EC.**



DIRECTIVE 2007/46/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 5 September 2007

establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles

(Framework Directive)

TA System in Europe – Test Types

- **Test Type I –** Vehicle emissions (HCs, CO, NO_x, particulates (PN and PM)) after cold start, CO_2 and fuel consumption;
- Test Type II – Low and high idle tests;
- Test Type III – Emissions of crankcase gases;
- Test Type IV – Evaporative emissions;
- Test Type V – Durability of control devices;
- Test Type VI – Emissions at low ambient temperatures.

CO_2 targets

- CO2 emission results from Type I test are used for (at least) 2 different purposes:
  - **A. CO2 target setting and compliance checking;**
  - **B. Consumer information/Labelling**
- Targets for fleet-wide average tailpipe CO2 emissions of all new vehicles registered in a given year

Cars	Vans
2015: 130 g CO_2/km	2017: 175 g CO_2/km
2020: 95 g CO_2/km	2020: 147 g CO_2/km

Note: CO_2 approach is fundamentally different from Euro standards
Pollutants: Not-To-Exceed

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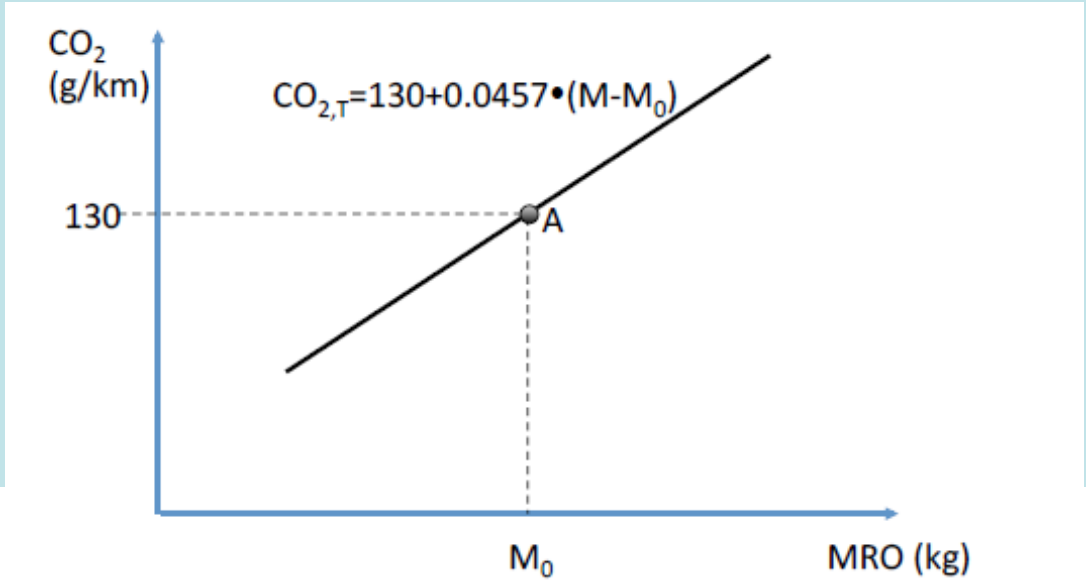
CO_2 targets

- In the EU CO_2 emission targets for LDVs are defined by the Regulations 443/2009 (PC) and 509/2011 (LCV)
- Regulations define overall targets (fleet-wide) and a function to relate CO_2 emission targets with the average vehicle mass for 2015-2020 (heavier vehicles are allowed higher CO2 emissions compared to the lighter vehicles).



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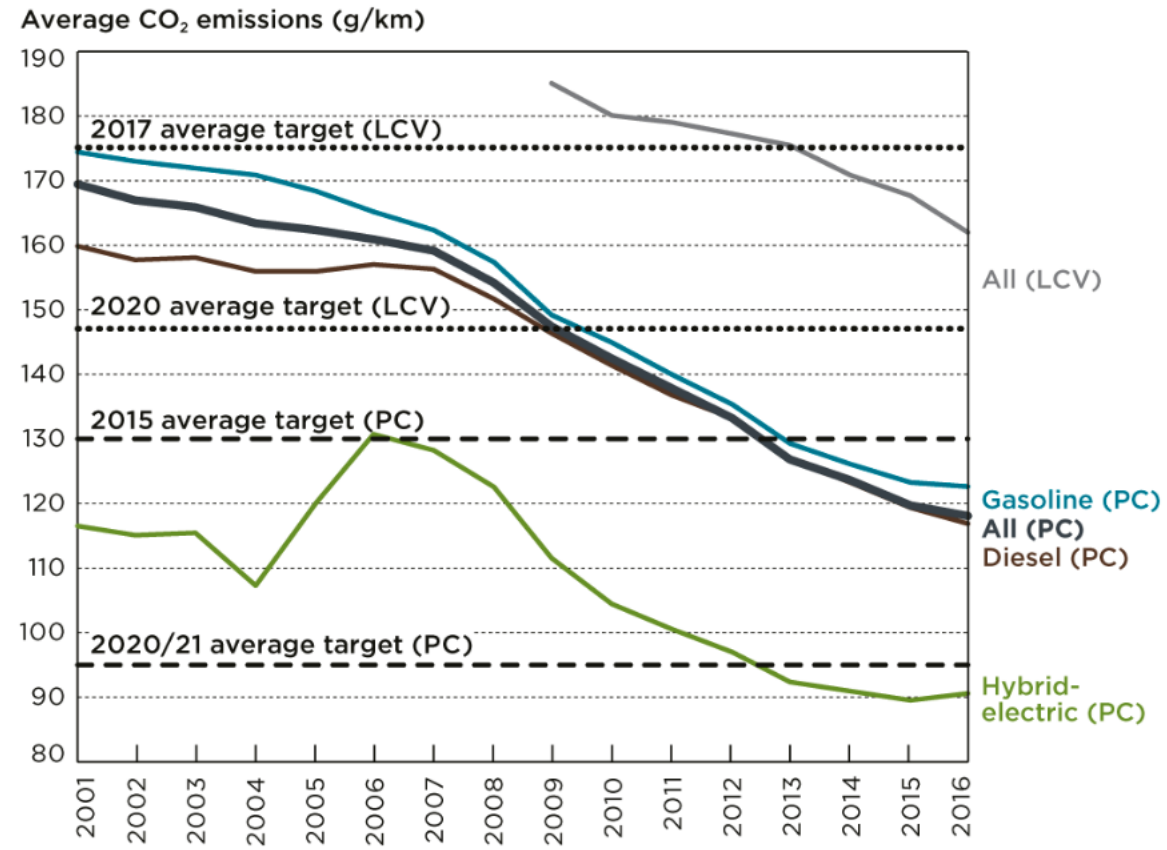
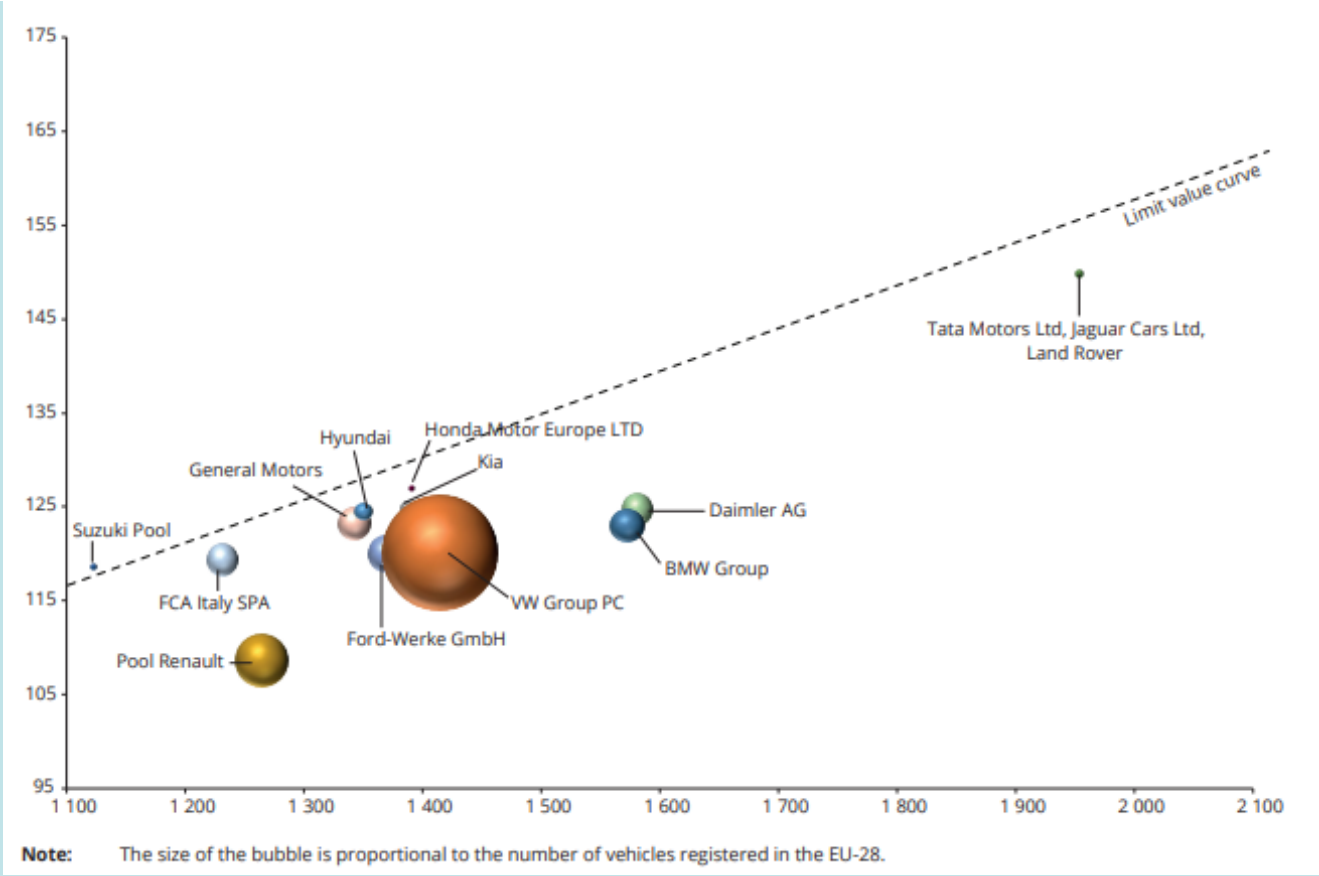
CO_2 targets

- Compliance against the targets is assessed by the EU-wide monitoring system where the data for the number of new vehicle registrations in all EU Member States are collected together with its corresponding TA CO_2 emissions.
- If the annual target is exceeded, an OEM is required **to pay** an excess emission premium equal to **95 euro for each gram of CO_2** (from 2019, before fines were lower) exceeding the target and per each vehicle sold by the same OEM in the same year. The monitoring of CO_2 started in 2012.
- So far the Commission imposed fines in three cases (for a total of one million euros). However, in general OEMs are meeting successfully their annual CO_2 targets (NEDC-based currently).

CO_2 targets





SOURCE: ICCT

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Introduction of WLTP in Europe

Introduction of WLTP in Europe

- NEDC was the previous test procedure applied in Europe and there was increasing evidence that is not representative of real-world emissions
- Roadmap for the development of World-wide harmonized Light-duty Test Procedure (WLTP) started in November 2007 (World Forum for the Harmonization of Vehicle Regulations (WP.29) of the United nations Economic Commission for Europe (UNECE));
- The following working groups were established in 2009:
  - Development of harmonized cycle (DHC): new World-wide harmonized Light-duty Test Cycle (WLTC); and
  - Development of test procedures (DTP)

Introduction of WLTP in Europe

- The European Commission had targeted the introduction of the WLTP in the European Type-Approval scheme by 1st September 2017 at the latest (also EU is the first party that adopted it) together with the introduction of the final Euro 6c emission limits and with the introduction of Real Driving Emissions (RDE) test procedure.
- So-called "WLTP Regulation" is actually EU Regulation 2017/1151

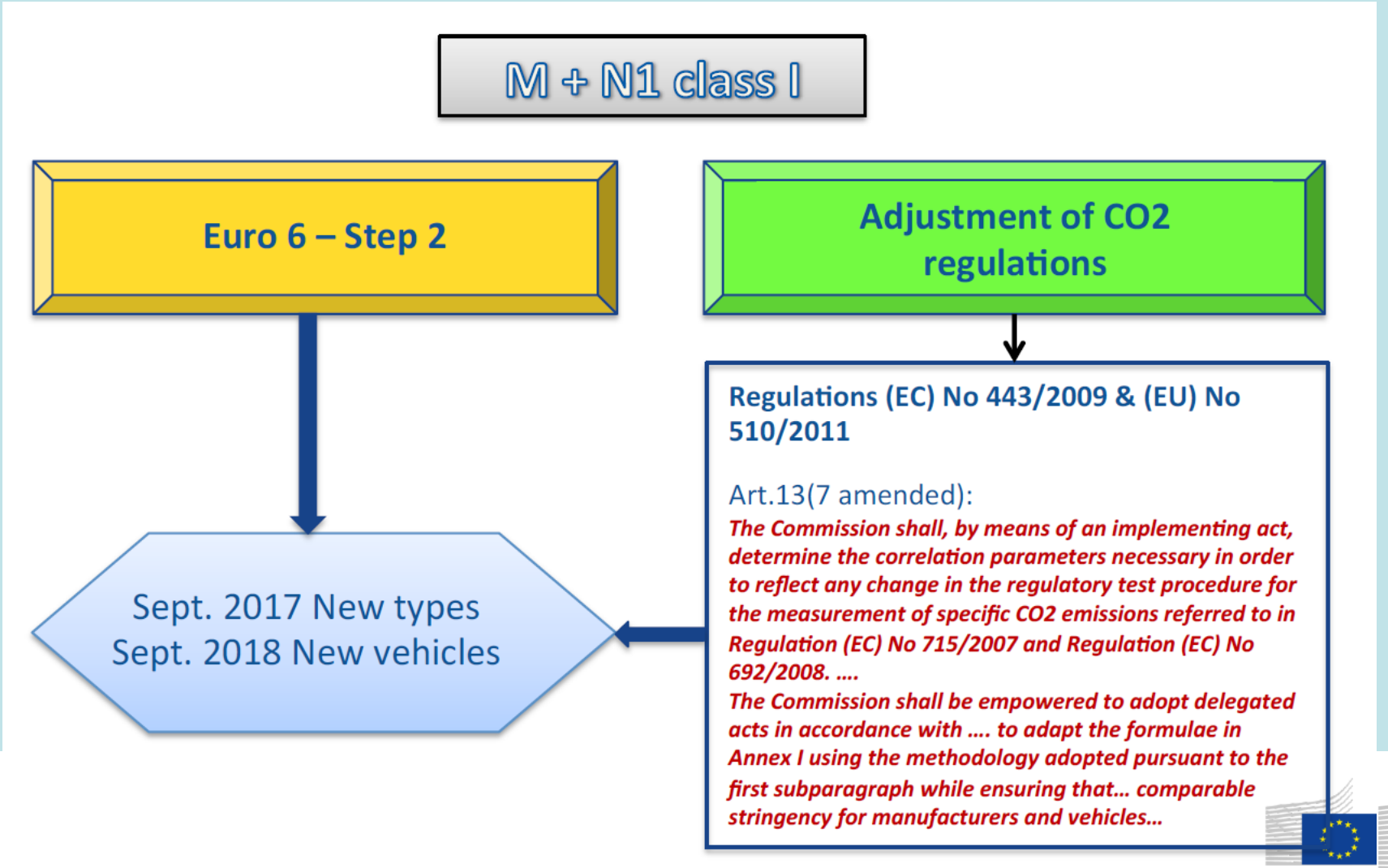
COMMISSION REGULATION (EU) 2017/1151

of 1 June 2017

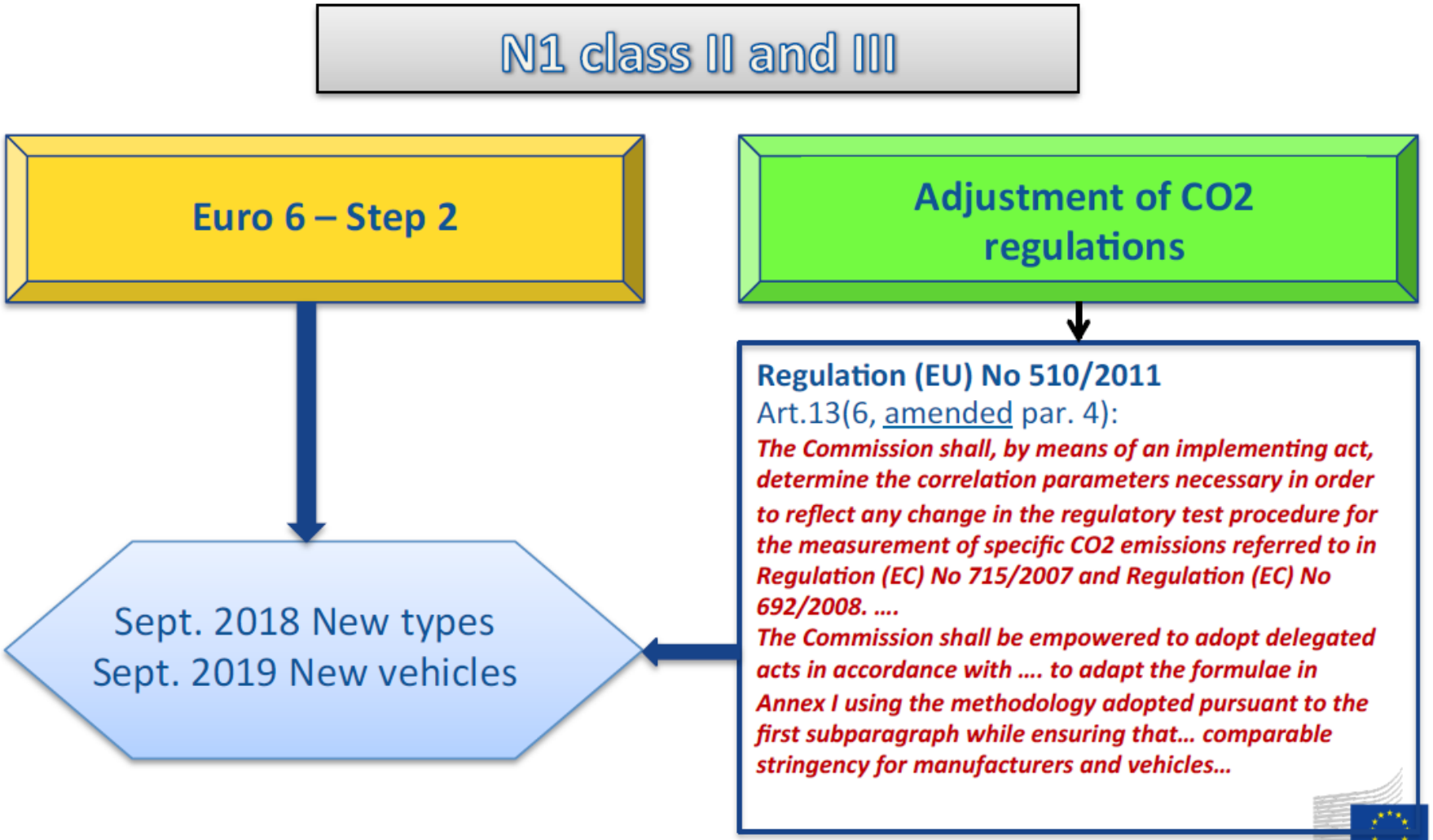
supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Commission Regulation (EC) No 692/2008

(Text with EEA relevance)

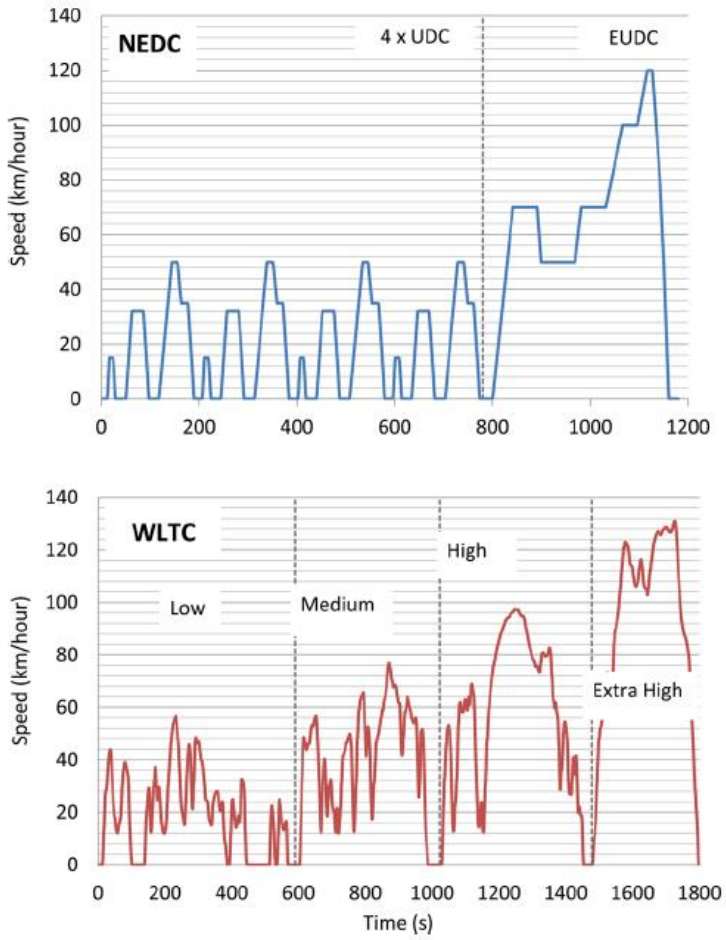
Introduction of WLTP in Europe



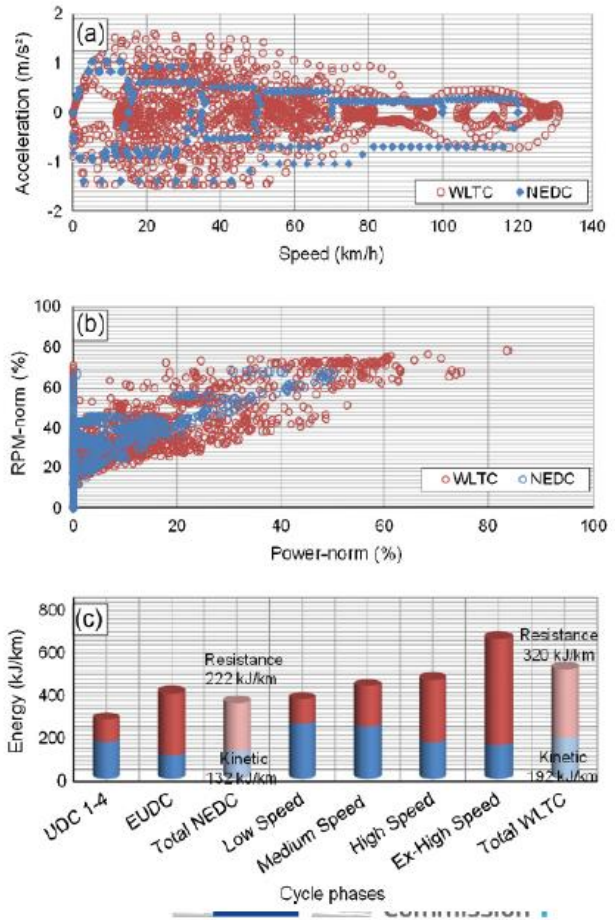
Introduction of WLTP in Europe



WLTP vs. NEDC – the cycle



Key Parameters of the Driving Cycles NEDC and WLTC		
Parameters	**NEDC**	**WLTP**
Duration (s)	1180	1800
Distance (km)	11.03	23.27
Av. speed (km/h)	33.6	46.5
Max. speed (km/h)	120	131.3
Stop duration (%)	23.7	12.6
Constant driving (%)	40.3	3.7
Acceleration (%)	20.9	43.8
Deceleration (%)	15.1	39.9
Av. positive acc. (m/s2)	0.59	0.41
Max positive acc. (m/s2)	1.04	1.67
Avg. positive "speed*acc." (m2/s3)	1.04	1.99
Max. positive "speed*acc." (m2/s3)	9.22	21.01
Avg. deceleration (m/s2)	−0.82	−0.45
Minimum deceleration (m/s2)	−1.39	−1.50



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WLTP vs. NEDC – the testing procedure

Category	Item	in NEDC	in WLTP	Impact on CO_2
Road Load Determination	Vehicle test mass	Present	Modified	↑
	Tire selection	Present	Modified	↑
	Tire pressure	Present	Modified	↑
	Tire tread depth	Present	Modified	↑
	Calculation of resistance forces	Present	Corrected	↑
	Inertia of rotating parts	Absent	Introduced	↑
Laboratory test	Driving cycle	Present	Modified	±
	Test temperature	Present	Modified	↑
	Vehicle inertia	Present	Modified	↑
	Preconditioning	Present	Modified	↑
	Gear Shift strategy	Present	Modified	↓
Post-processing test results	SOC correction	Absent	Introduced	↑
	Correction of speed and distance	Absent	Introduced	±
Declared value	Declaration of CO_2 emissions	Present	Modified	↑

Amending CO_2 targets

- While the introduction of WLTP as Type 1 test for measurement of gaseous pollutants and particulates is straightforward (as soon as WLTP is in force vehicles need to comply with emission limits over the WLTP), **the replacement of NEDC in the CO_2 Regulations and for monitoring is happening gradually;**

- **A WLTP phasing-in** (2017-2020) is managed, for what concerns CO_2 Regulations, using CO2MPAS (CO2 Model for PAssenger and commercial vehicles Simulation) developed by the JRC-STU.

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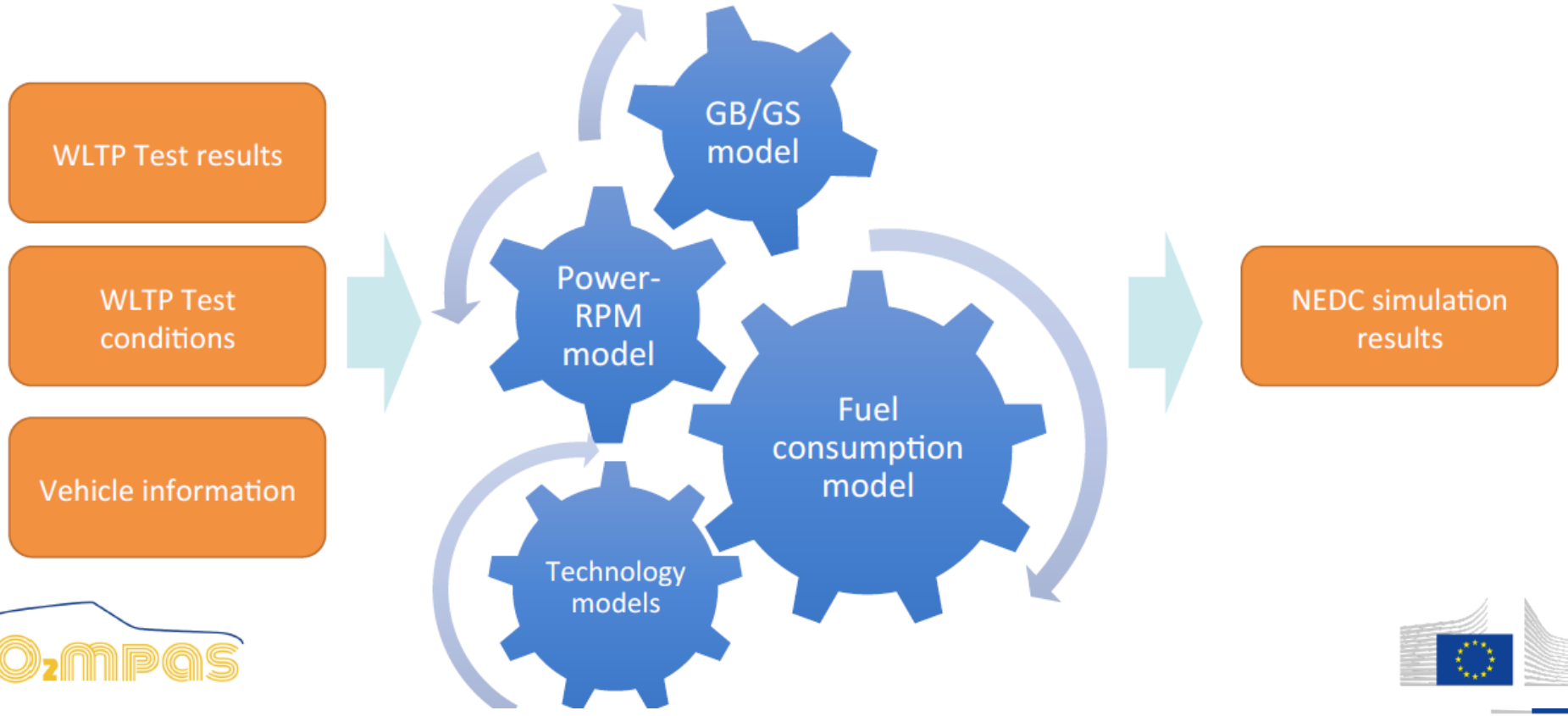
CO2MPAS in TA system

- **CO2MPAS** (CO2 Model for PAssenger and commercial vehicles Simulation) is the tool developed to calculate the NEDC CO2 emissions of the vehicles tested under WLTP conditions following the new type-approval legislation (EC 1151/2017)



CO2MPAS

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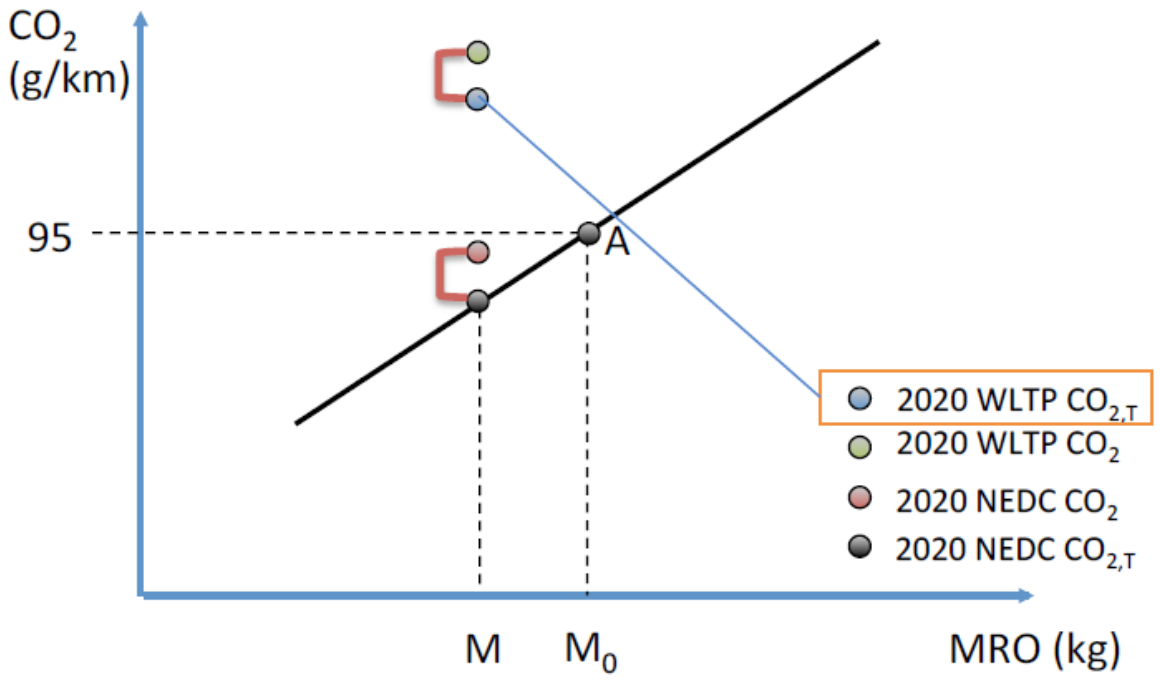
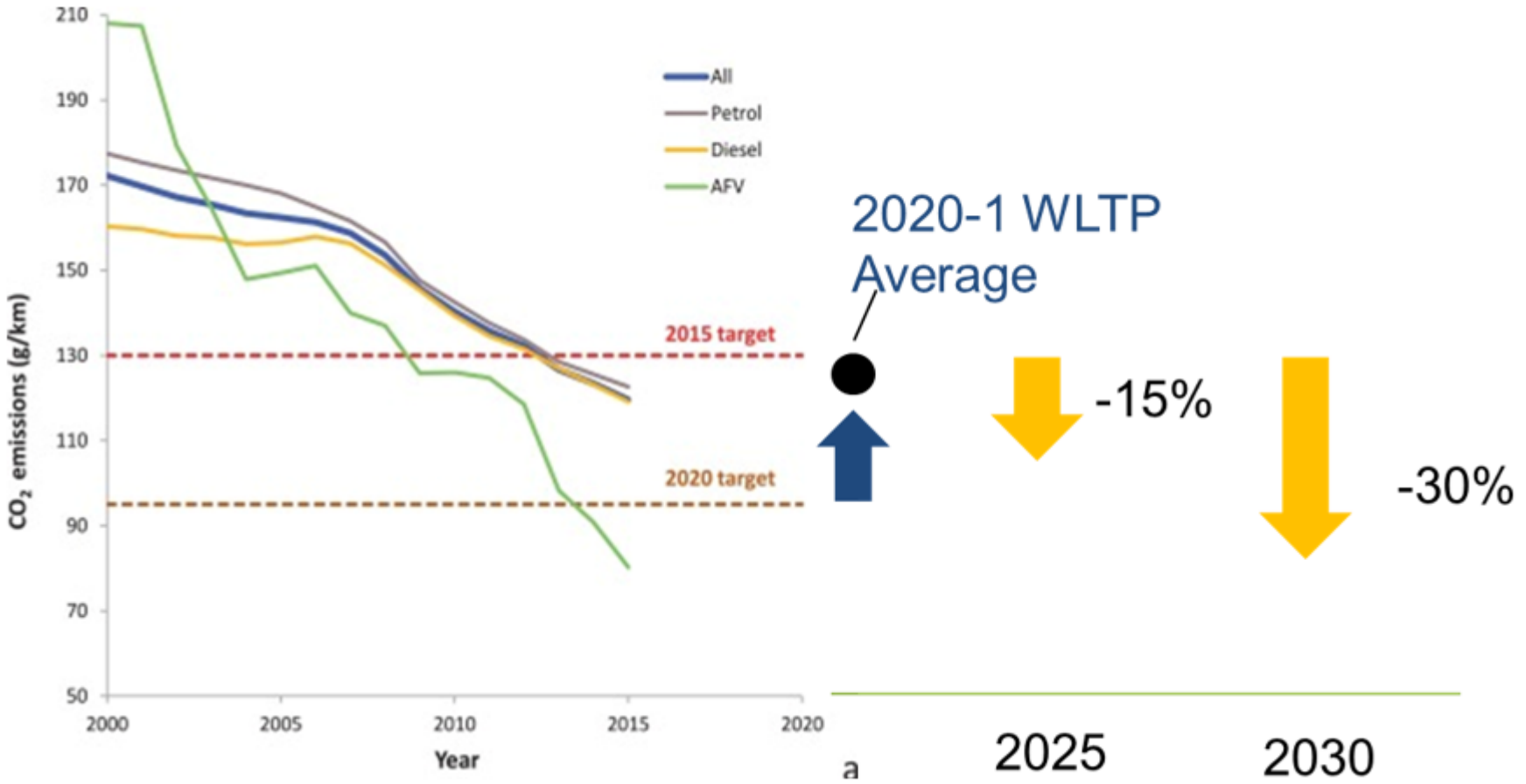
WLTP-based CO_2 targets

- In 2021 **WLTP-based target** are identified, per each OEM, on the basis of the distance in 2020 of their average CO_2 emissions from the NEDC-based target



WLTP-based CO_2 targets



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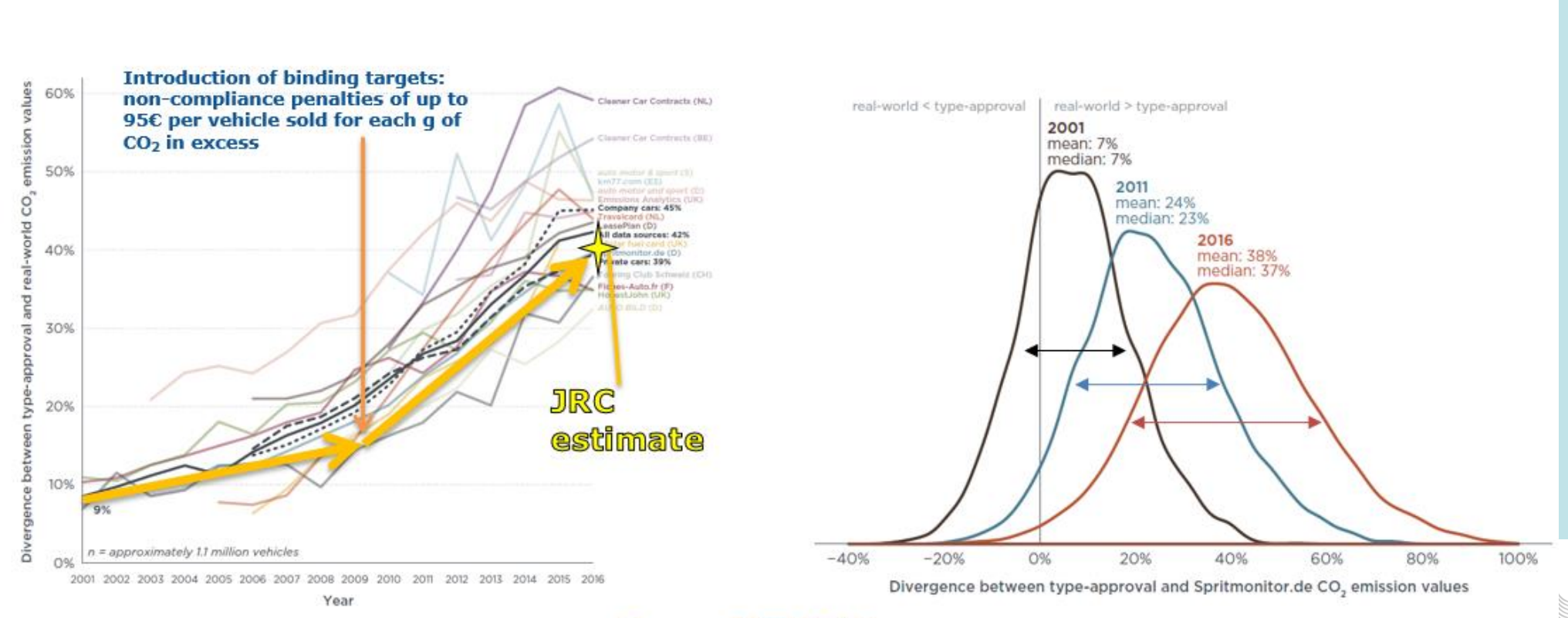
CO_2 gap (present and future perspectives)

CO_2 gap

- Increasing "gap" between Type Approval over the NEDC and the average real-world CO_2;
- Intrinsic and significant real-world individual variability increasing with time.



Source: ICCT 2016

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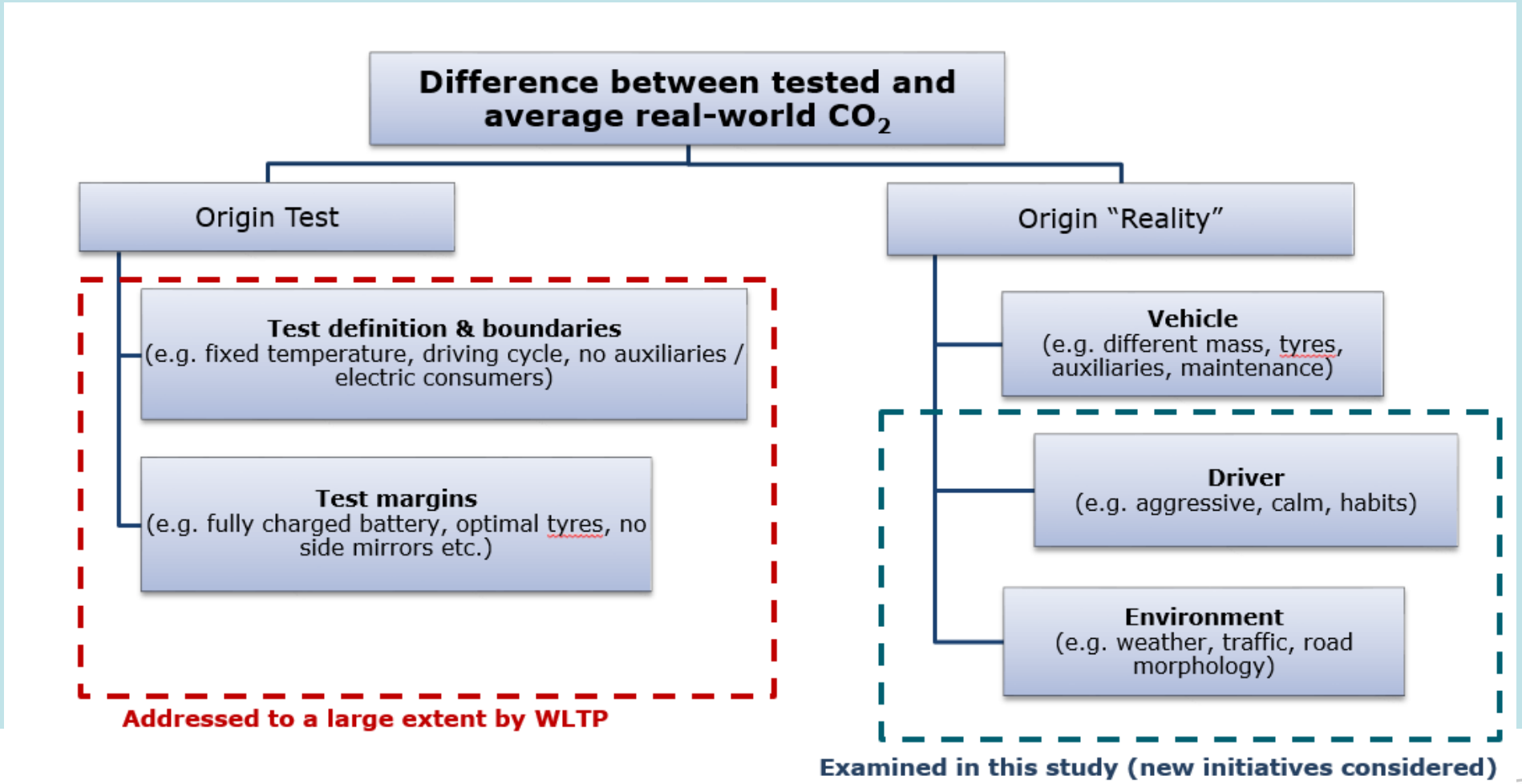
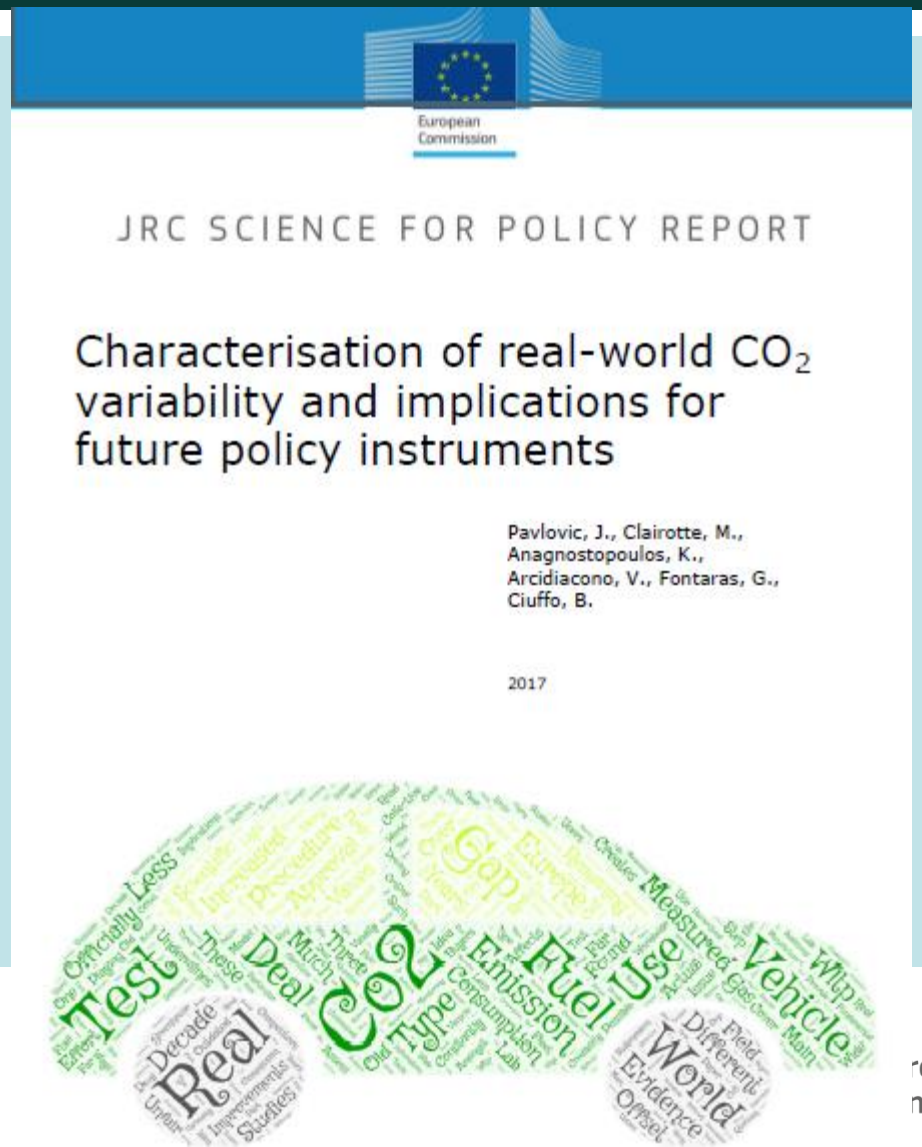
CO_2 gap - origins



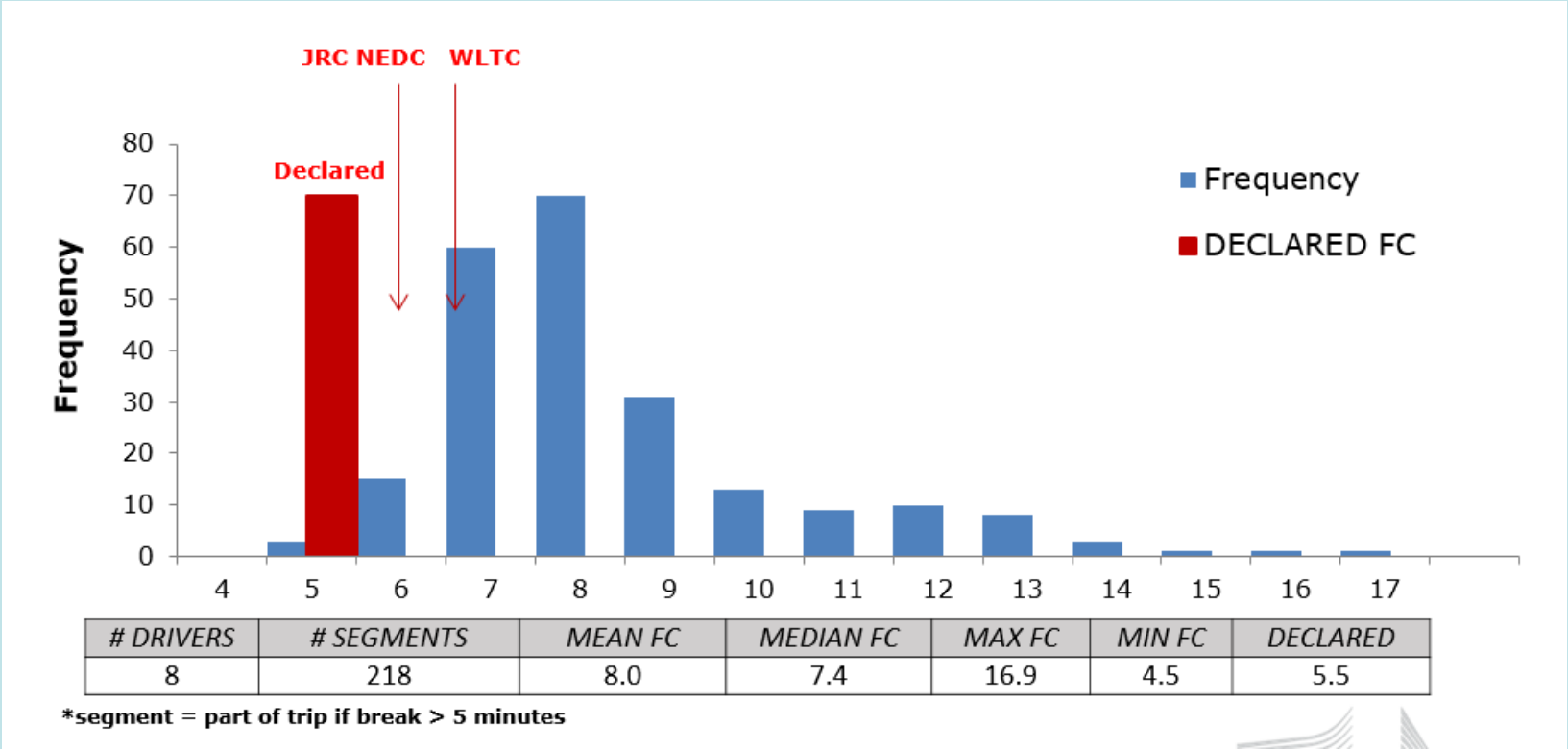
CO_2 gap – JRC study

- DATA SET 1. Data collected during a period of 6 months from **one vehicle** driven by **different drivers** for various trips with different origin and destination and under different environmental conditions;
- DATA SET 2. Data collected from the RDE tests carried out at the JRC during the last years using different vehicles with a few drivers and considering a limited number of routes



CO_2 gap – JRC study

- DATA SET 1 Results.
- TA value at the lower end of distribution;
- The average FC is ~ 45% higher compared to the TA FC



# DRIVERS	# SEGMENTS	MEAN FC	MEDIAN FC	MAX FC	MIN FC	DECLARED
8	218	8.0	7.4	16.9	4.5	5.5

*segment = part of trip if break > 5 minutes

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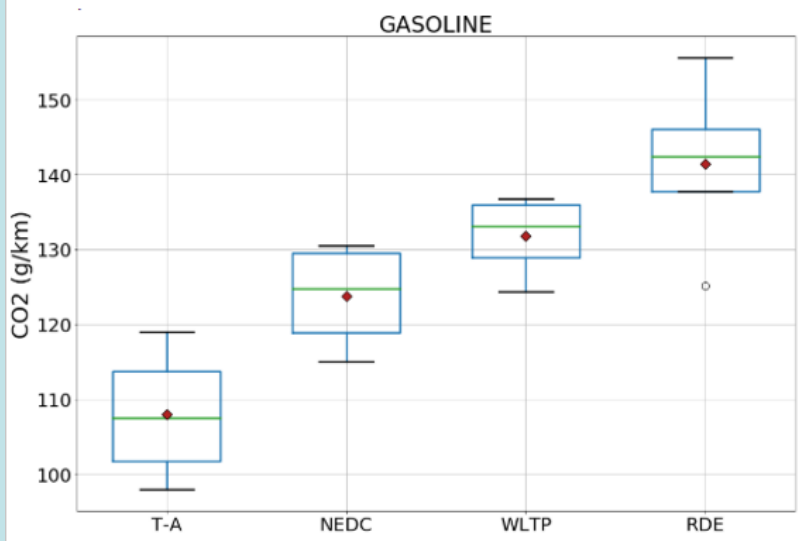
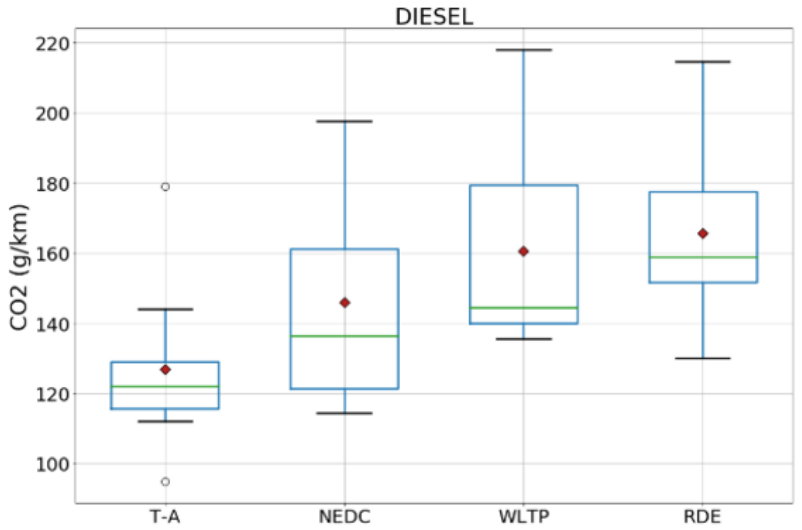
CO_2 gap – JRC study

- DATA SET 2 Results.
- RDE CO_2 ~ 30% higher compared to TA CO_2
- WLTP CO_2 ~ 25% higher compared to TA CO_2





4 Gasoline vehicles CO_2:

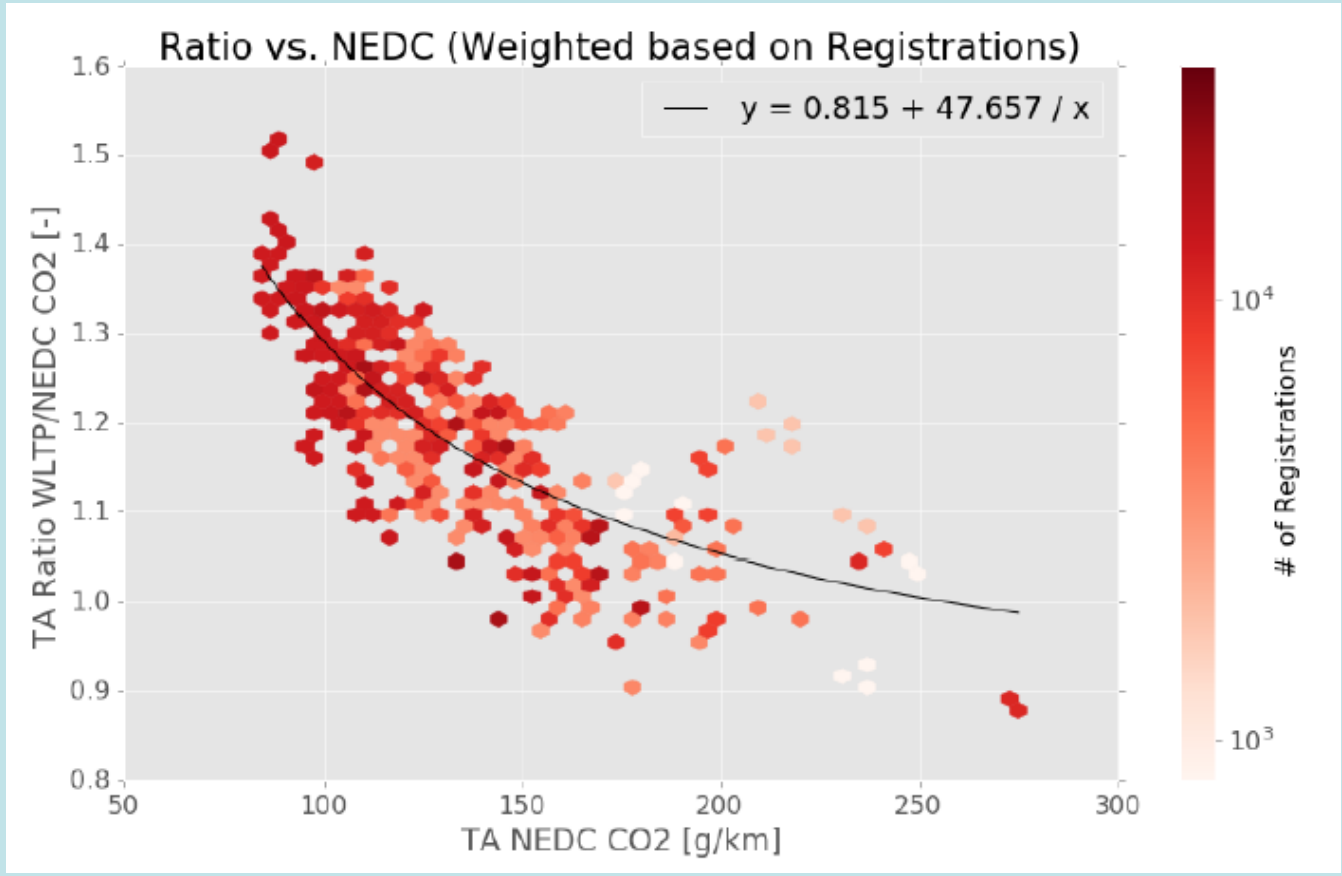
- Type-approval avg = 108 g/km
- NEDC avg = 124 g/km
- WLTP avg = 132 g/km
- RDE avg = 141 g/km

8 Diesel vehicles CO_2:

- Type-approval avg = 127 g/km
- NEDC avg = 146 g/km
- WLTP avg = 161 g/km
- RDE avg = 166 g/km

CO_2 gap – Benefits of WLTP

- The WLTP represents a **considerable step forward** in addressing the problem. Whether it will suffice alone or additional measures are necessary is difficult to predict now;
- With WLTP the official TA CO_2 emissions are expected to **increase ~ 20%** and the WLTP will therefore cut the present "gap" by half;
- In addition, the effect of WLTP introduction is expected to be higher for vehicles with lower CO_2 emissions.



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CO_2 gap – Future perspectives

- There will always be a certain difference between emissions measured in a laboratory and those measured under real driving conditions;
- However, as long as that difference is small **and remains constant**, it can be adequately taken into account both with regard to setting CO_2 targets as well as for consumer information purposes;
- A mechanism to monitor the evolution of any remaining gap is already in its adopting phase (will enter into regulation by the end of this year) through **on-board fuel consumption (OBDFC)** measurement;
- Field is also preparing for the **In-Service Conformity (ISC) of the CO_2** that will ensure that production and in-service vehicles are in conformity with reference vehicles tested and flexibilities are not abused.

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