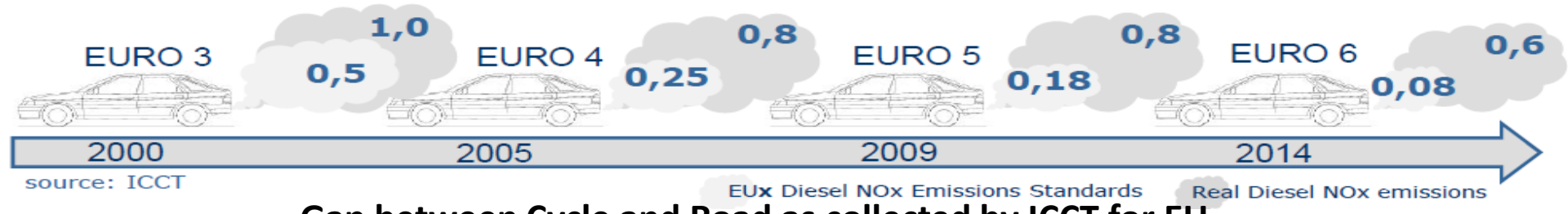
REAL WORLD DRIVING EMISSIONS (RDE)

REAL WORLD EMISSIONS IN EUROPE

REAL LIFE TESTING IN INDIA

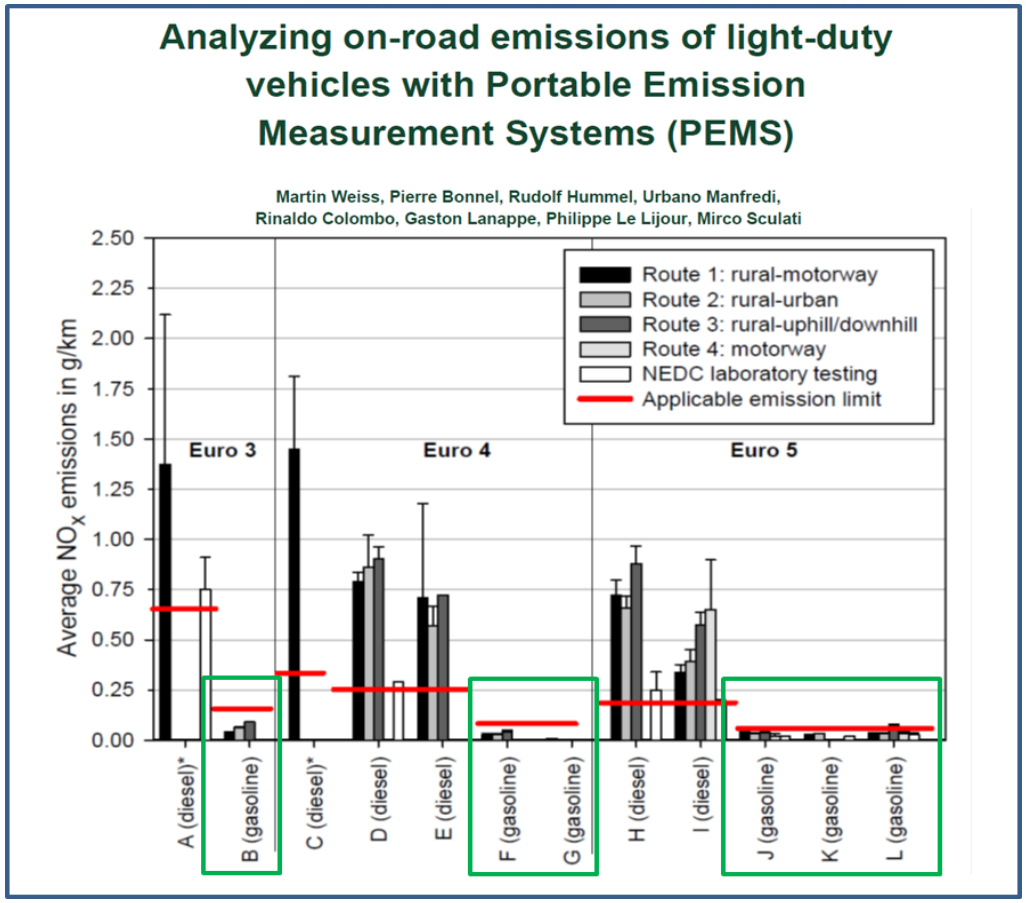
RDE – WHY DO WE NEED RDE (REAL-WORLD DRIVING EMISSION NORMS) ?

- To address the environmental needs & take action now to enable confidence in Euro6
- COM **(EU) 2016/427** Communication - A Clean Air Program for Europe
- Completing unfinished business: **fixing the light-duty diesel emissions problem**
  - ❑ "The required reductions have been delivered, with one exception: **NOx emissions from light-duty diesel engines**."
  - ❑ "In its CARS 2020 Communication, the Commission noted the shortcomings of the current procedures and committed **to a new test procedure** in the type approval framework to assess NOx emissions of light-duty vehicles under real-world driving conditions."
  - ❑ "This will ensure the substantial reduction of real-world NOx emissions required to achieve Euro 6 NOx emission limits **under normal driving conditions."**



Gap between Cycle and Road as collected by ICCT for EU

ON ROAD EMISSIONS – EU SITUATION



Problem Area :

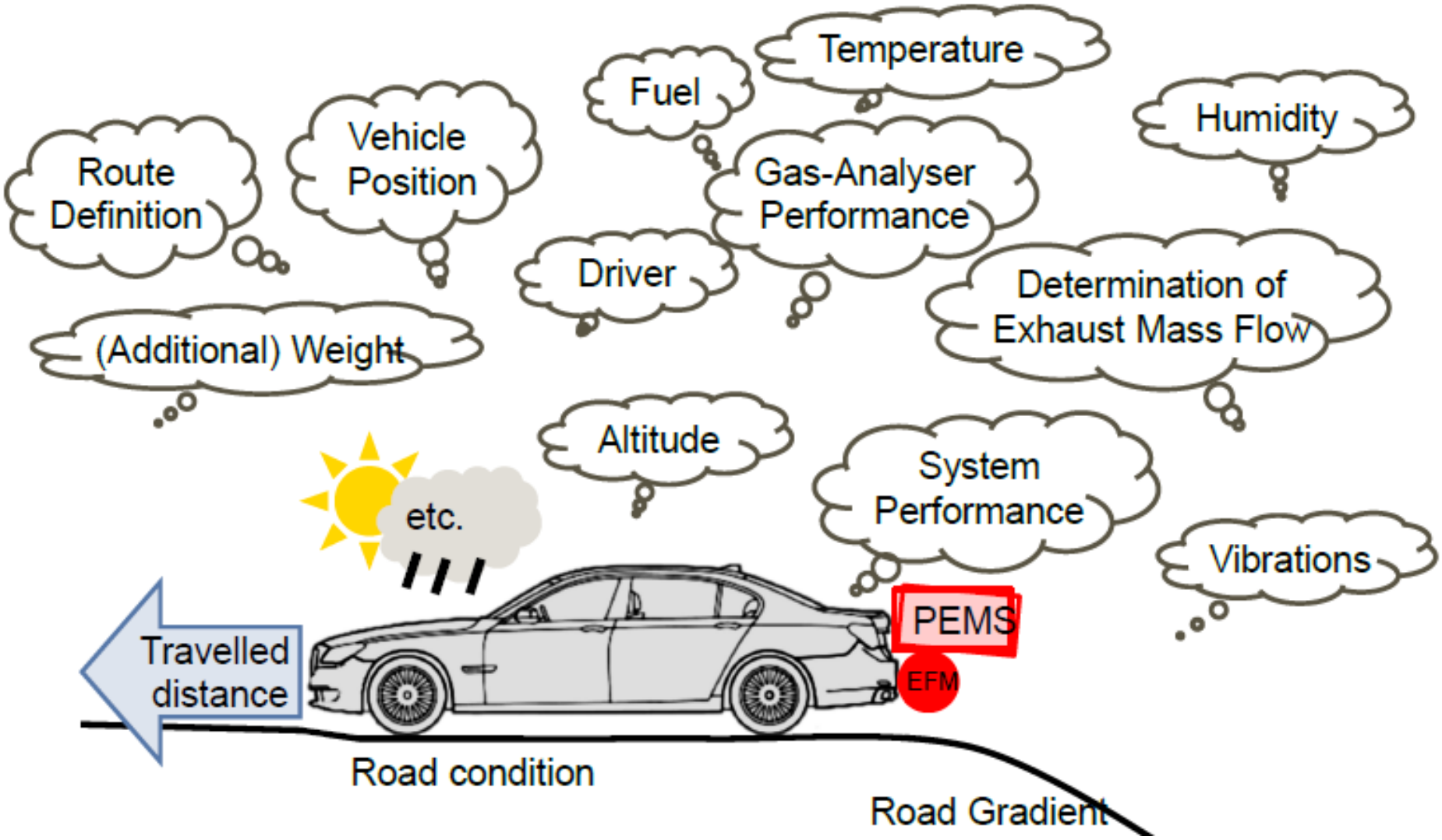
Diesel : Yes

Gasoline : No!

Studies by JRC suggest that Gasoline vehicles show emissions within regulatory limits even when tested on road. For Diesel Vehicles emissions are higher

For Diesel On road emissions are upto 14 times higher as per recent T&E reports

RDE: WHAT WE GAIN



Source: BMW

RDE: REAL DRIVING EMISSIONS IN EUROPE

Real Driving Emissions

- Emission testing under normal conditions of use in real world driving
- Portable Emission Measurement System (PEMS)
  - ❑ CO2, CO, NOx and PN
  - ❑ Exhaust flow rate, Speed and GPS data

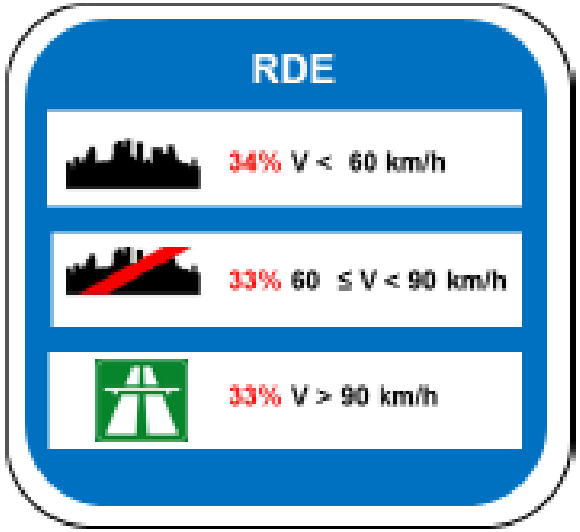
RDE Test Procedure

Temperature
Moderate 0°C to 30°C / Extended (-7°C to 35°C)

Altitude
Moderate < 700 m / Extended < 1300m

Trip / Driver / Dynamics
City (34%) / Rural (33%) / Motorway (33%), up to 160 km/h, 90-120 min, min. share of accelerations

Load
no „empty" vehicle, <90% payload, heating or air condition on

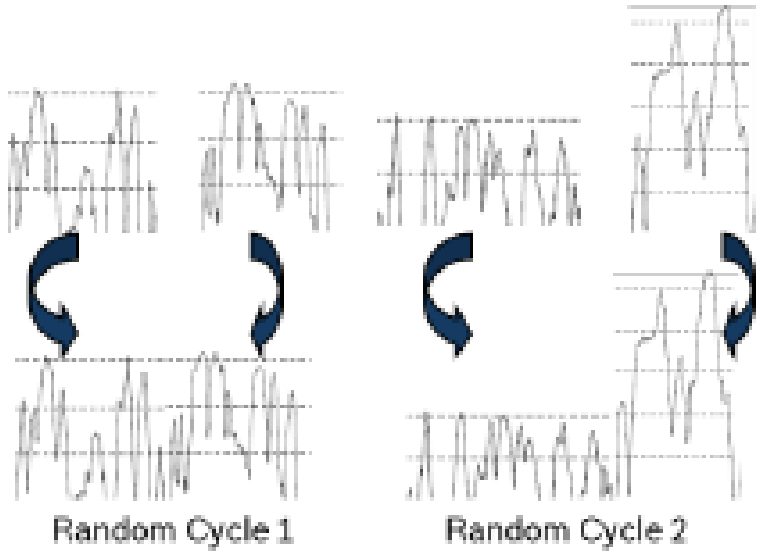


EVOLUTION OF RDE REGULATION IN EUROPE

Portable Emission Measurement System (PEMS)

- Real on-road driving
- On-board measurement
- Wide range of boundary conditions

Random Test Cycle (RTC)



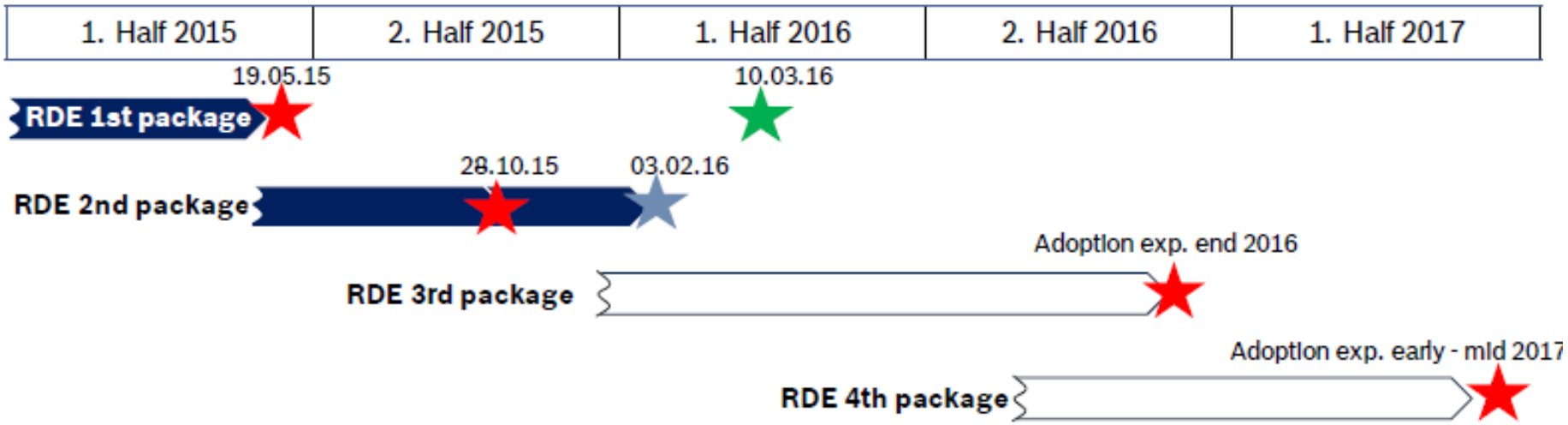
- Vehicle dynamometer measurement
- Randomized cycle based on EU-database

RDE Regulation/Development split into 4 packages

1st Package	• PEMS test procedure and test equipment • Boundary Conditions • Data evaluation methods (EMROAD / SPF formerly known as CLEAR)
2nd Package	• Introduction dates • Conformity Factor for NOx • Additional Boundary Conditions
3rd Package	• PEMS test procedure and test equipment for PN • Conformity Factor for PN • Cold start evaluation • Special RDE testing conditions for hybrids
4th Package	• In-service conformity (ISC) testing • [Transfer Function]

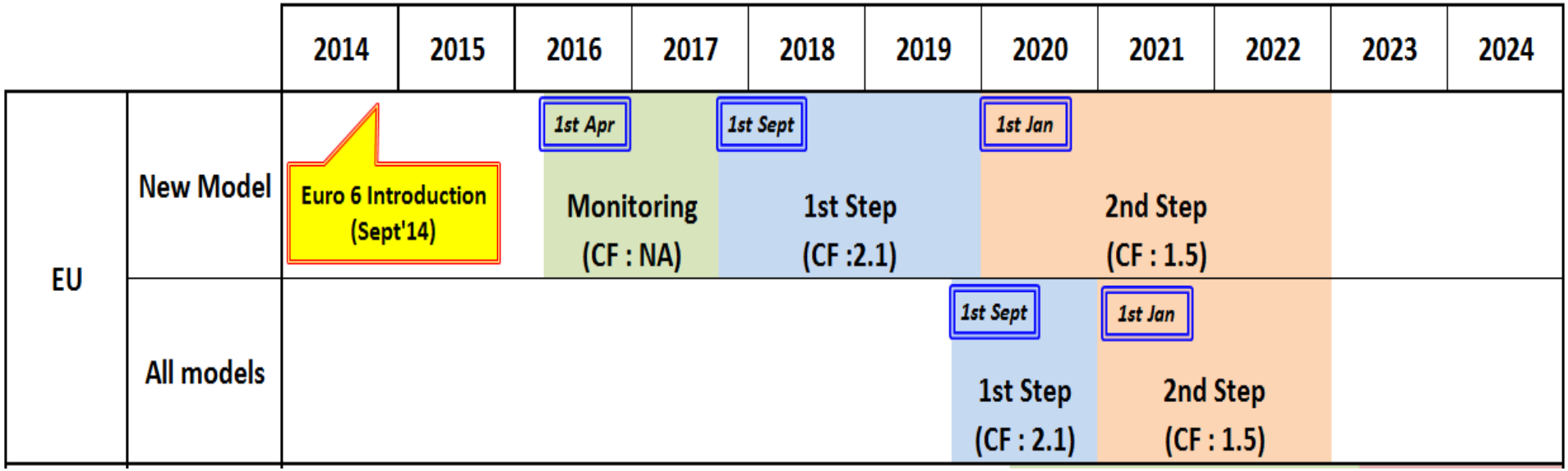
Source: TCMV_47_19.05.2015; TCMV_51_28.10.2015; DG Growth Work Program

EVOLUTION OF RDE REGULATION IN EUROPE



- 1st Regulatory RDE package published as COM Regulation (EU) 2016/427
- 2nd Regulatory RDE package was adopted and is currently in process of being published as COM Regulation
- 3rd & 4th Regulatory RDE package in processing

RDE – REGULATION STATUS



Vehicle Classes M1 & N1	CF (NOx-moderate)	NTE (M1, CI) (NOx-moderate)
Euro 6d – Temp – 1st Sep 2017	2.1	168mg/km
Euro 6d – 2nd Sep 2020	1.5	120mg/km

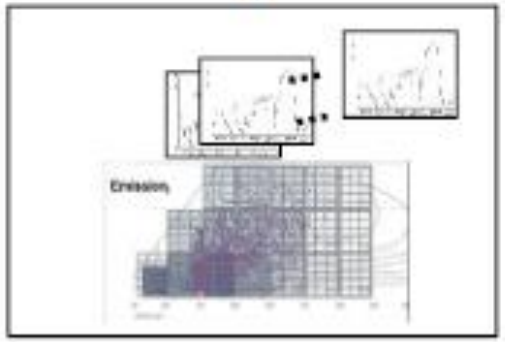
HOW TO MEASURE REAL DRIVING EMISSIONS

Application of Real-World Driving Emissions (RDE)

Installation of PEMS

Vehicle and PEMS validation on dyno

PEMS test



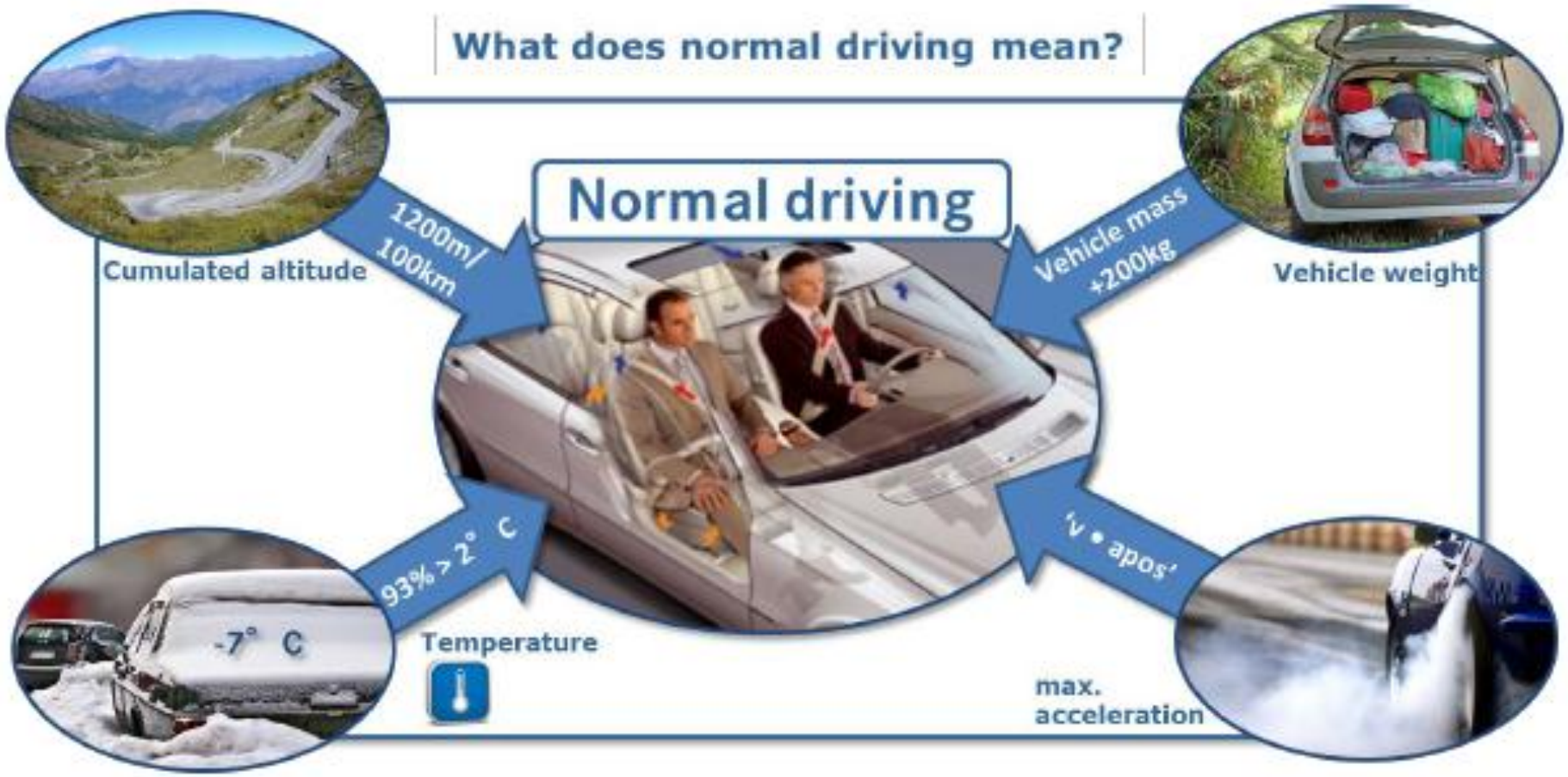
Data evaluation, including normalisation

Selection of CF factor based on boundary conditions

$RDE_{pollutant} = CF_{pollutant} \times Euro\ 6,$

Pass or Fail

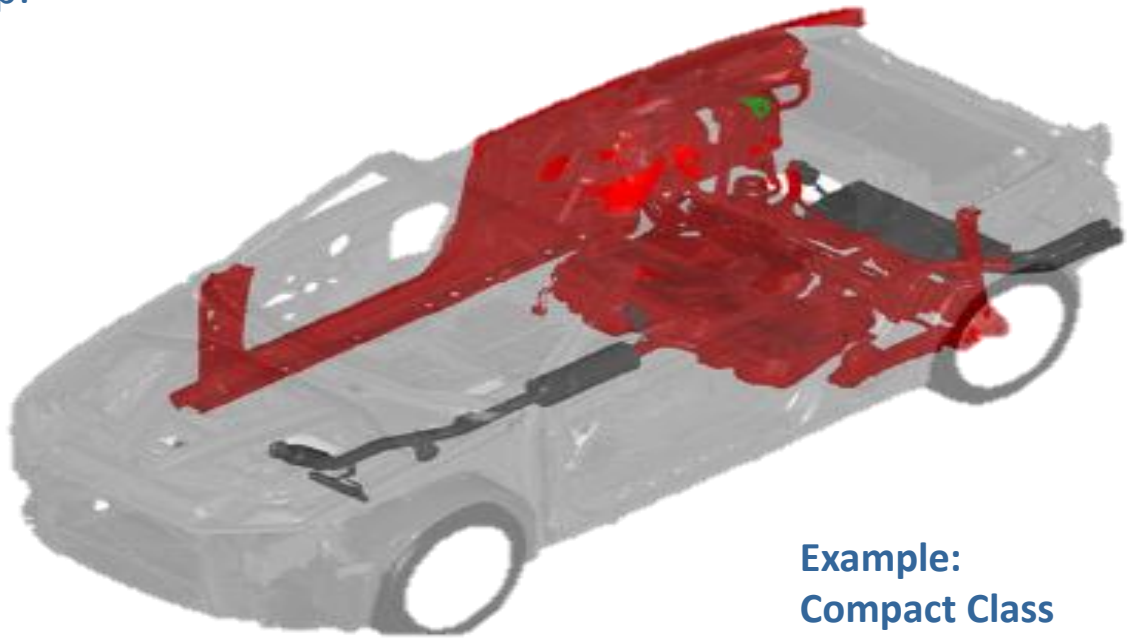
BOUNDARY CONDITIONS



- The scope of RDE testing must be defined on a sound scientific and techno-legal basis so that it results in the same stringency of RDE test for all OEMs and such that testing by 3rd parties are within reasonable boundaries.
- This has to be defined by clear unambiguous boundary conditions

RDE - Technical Integration in vehicle

- Designs for Euro 6c [from Sept 2017] have already been signed off, huge investments have been made, suppliers and contracts are all ready.
- Significant effort to implement appropriate software changes to address RDE can be accommodated in Euro 6c.
- Further significant Hardware changes will be needed to comply with RDE regulation in a second step.



Example:
Compact Class

Purpose of Current Proposal for “On Road Tests” by Test Agencies?

NOx Emission

- Need to check Emissions in Normal Driving conditions (will anyway be different from Europe)
- PEMS test a requirement

OR

Defeat Device

- Could be checked in many possible ways (Needs further studies):
- Emission Check in a Simulated Test on road
- ECU Data on OBD may be used for checking

Above two issues are very different and solution need not be same

India needs to define the purpose before preparing a Procedure

RDE ADOPTION IN INDIA

- Indian Driving / Road conditions / Ambient conditions are different
- Boundary conditions in India need to be defined close to the actual road driving behaviour
- RDE adoption means developing compatible vehicles
  - ❑ Hardware Development
  - ❑ Calibration / Validation efforts
  - ❑ Verifying the repeatability and consistency of test results
- Adoption of RDE will mean additional efforts beyond BSVI

Situation In India Regarding On Road NOx

- There is no data available. ARAI has done some data collection lately.
- There is a Need to Study : Elaborate Data collection required.
- On Road Reduction of Emissions by implementing BSIV from previous regulations

BOUNDARY CONDITIONS (INITIAL PROPOSAL FOR DISCUSSION)

- **RDE based on MIDC**

Boundary Conditions	Min	Max
Altitude, m asl	0	700
Temperature oC	15	40
Accelerations, m/s 2		0.833
Payload		Reference Mass

Driving Conditions	City	Highway
Speeds [km/h]	V ≤ 50 15 < Vavg (including stops) < 30	50 < V < 90
Max. speed [km/h]	Vmax ≤ 90 km/h	
Min. Distance [km]	16	26
Trip duration [min]	90 - 120	
Share [of total trip distance]	40% (±10%) Shall never be less than 55%	60% (±10%)

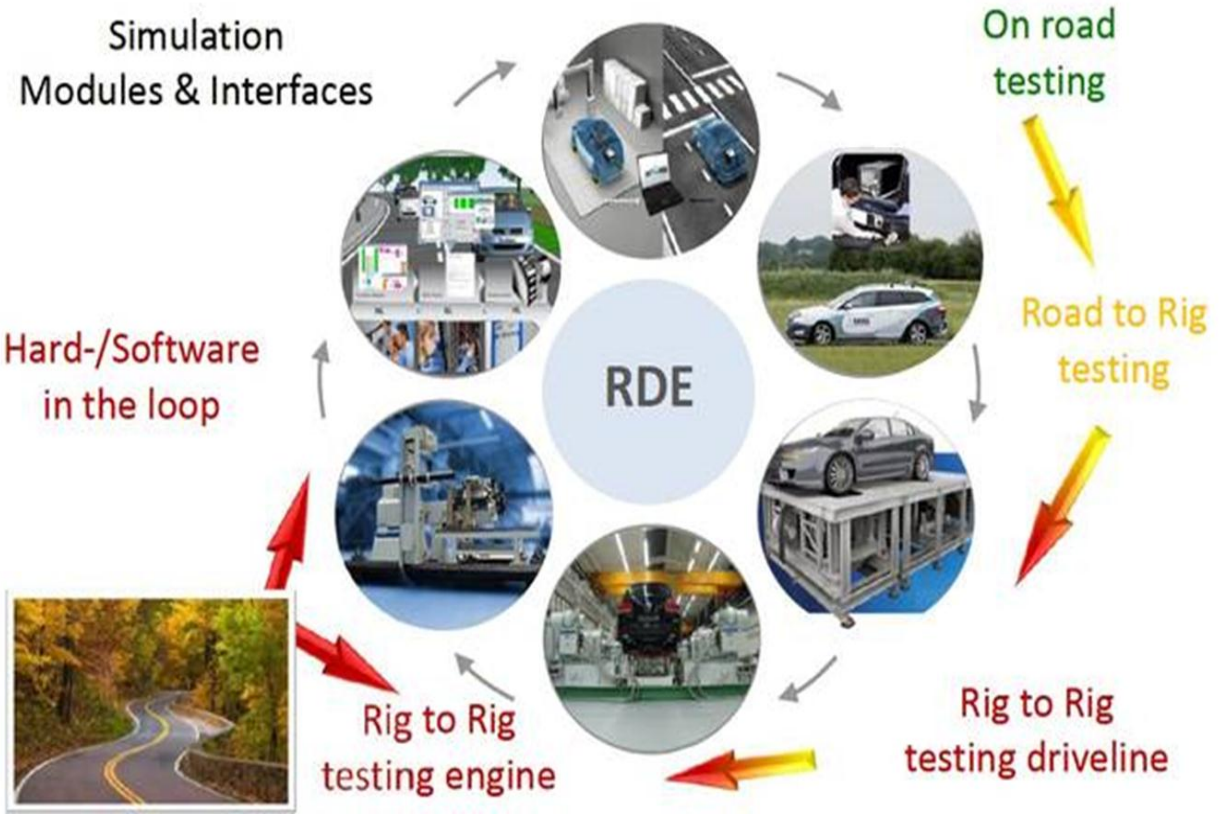
COMPARISON : OPTION1 VS OPTION2

OPTIONS	MERITS	DEMERITS
Option1 (PEMS)	• On Road Emission Measurements	• Test Accuracy, Repeatability & Validity Issues • Equipment Safety and Test Implementation Concerns in Indian Conditions • Testing Time and Effort
Option2 (Supplementary Tests)	• Excellent Accuracy & Repeatability • Existing Test Equipment Can be used (No additional Investment Required) • Possible to Implement faster as Compared to Option1.	• Capturing Indian Driving Conditions, may be a Challenge

Supplementary Test seems to be a Practical Approach to Implement RDE as a Part of Vehicle Certification.

CONCLUSION AND SUMMARY

- Being “RDE Ready“ is truly a Challenge
- Change of environment is the key challenging factor
- RDE is influencing all development areas
- Unified RDE post processing is key for fast RDE calibration



- RDE needs Development Effort (hardware and Calibration)
- In view of BSVI timelines it is extremely difficult to do additional development within BSVI timeline
- High Risk to Industry Growth

END OF THE PRESENTATION