How to Meet Bharat VI in India Successfully

ECT-2016

November 2016

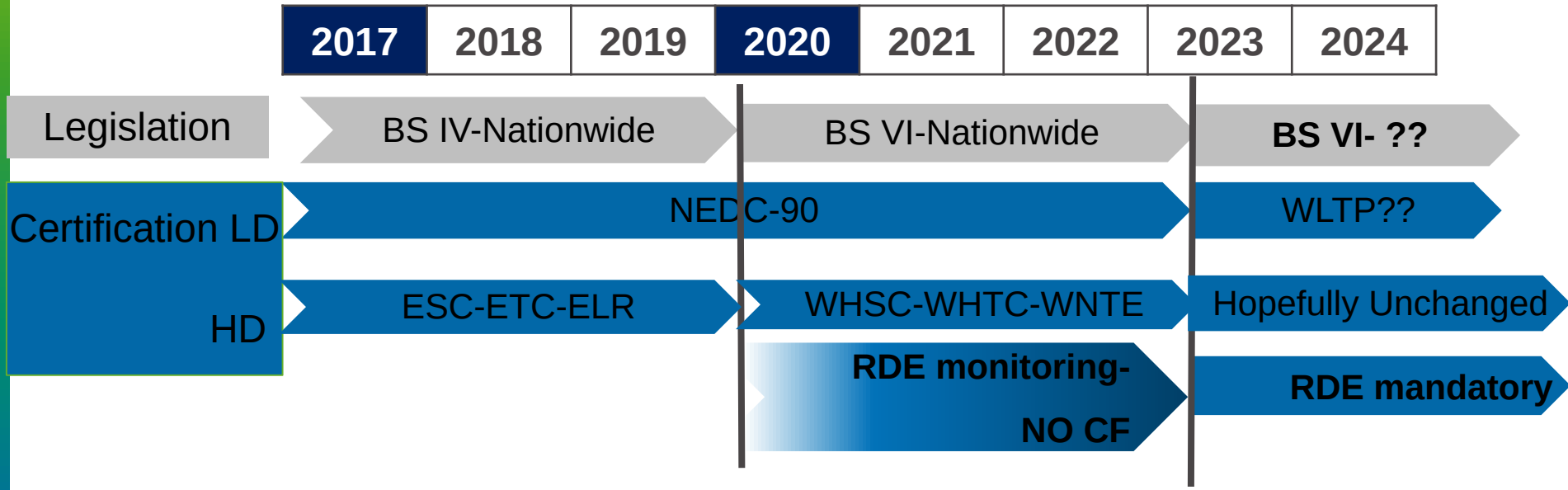
Alain Ristori

Rajesh Maynal

BSVI….A Fusion of Clean Air Movement (Source: by Sumantra B Barooah Jan 10, 2015)

- Swachh Bharat (clean India) campaign
- Pradushan-mukt Bharat (pollution-free India) in the coming years
- Promoting clean automotive propulsion technologies.

BS Emissions Legislation Roadmap for LD/HD Vehicles



Real driving emissions (RDE)

- Real world driving
- Use of "Portable Emissions Measurement Systems" (PEMS)
- Vehicle certification
- In-service-conformity (For LD-C.F-3.0??,2.1??,1.5?? And For HD- 2.0??,1.2??)

A Big Leap…..A Big challenge

A Big Leap…..A Big challenge…..LD Segment

umicore
Automotive Catalysts

New Species……
For GDi
Gasoline…**PM & PN**
For Diesel…**PN**

Engine Out Emissions

Gasoline NOx	⟷	25% ↓
Diesel NOx	⟷	68% ↓
Diesel TPM	⟷	82% ↓

A Big Leap…..A Big challenge…..HDD

umicore
Automotive Catalysts

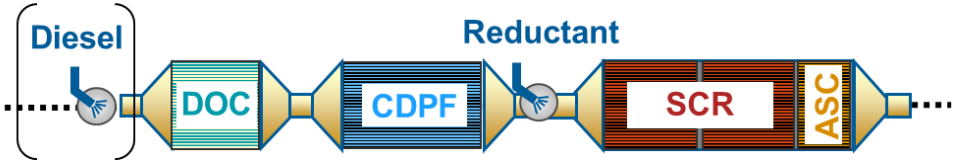
New Methods
WHSC,WHTC &
WNTE emission
cycles
& Species……
PN

Engine Out Emissions

Diesel NOx ⟷ 88.6% ↓

Diesel TPM ⟷ 50% ↓

BS VI Compliance…..HDD way



Both active and passive systems can be used to meet BSVI.

1) Active regeneration
- EGR
- Raw NOx emission 3 → 6g/kwh
- >90% NOx conversion needed

ATS system:
DOC:
- Pd rich
- 25-40g/ft3
- Pt/Pd ratio depending on heat up and NO2 make requirements

SCR:
- Cu-SCR (main stream)
- Fe-SCR

2) Passive regeneration
- Low EGR or no EGR
- High NOx emission 7 → 9g/kwh
- >95% NOx conversion needed

ATS system:
DOC:
- Pt only on Pt rich
- 10-20g/ft3
- Pd needed for special stand still regeneration

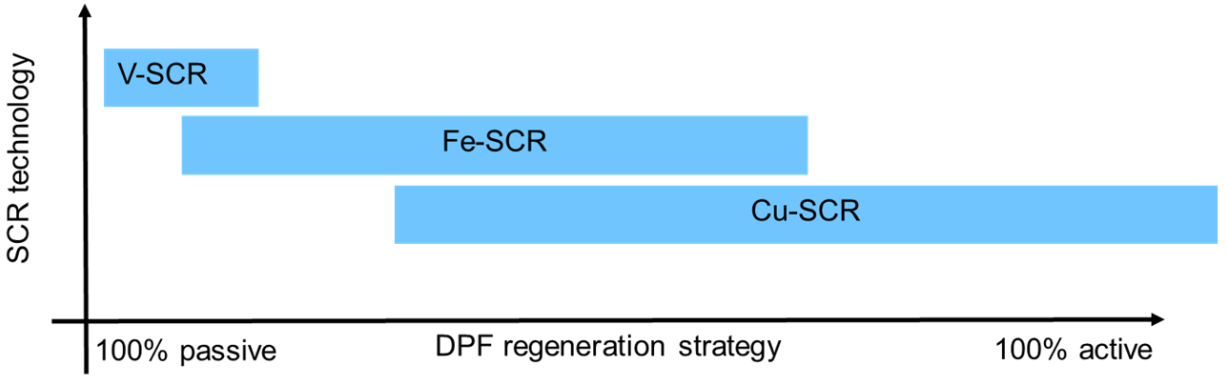
SCR:
- Fe-SCR
- CuSCR (T° means required)
- V-SCR

BS VI DeNOx Compliance…..HDD way

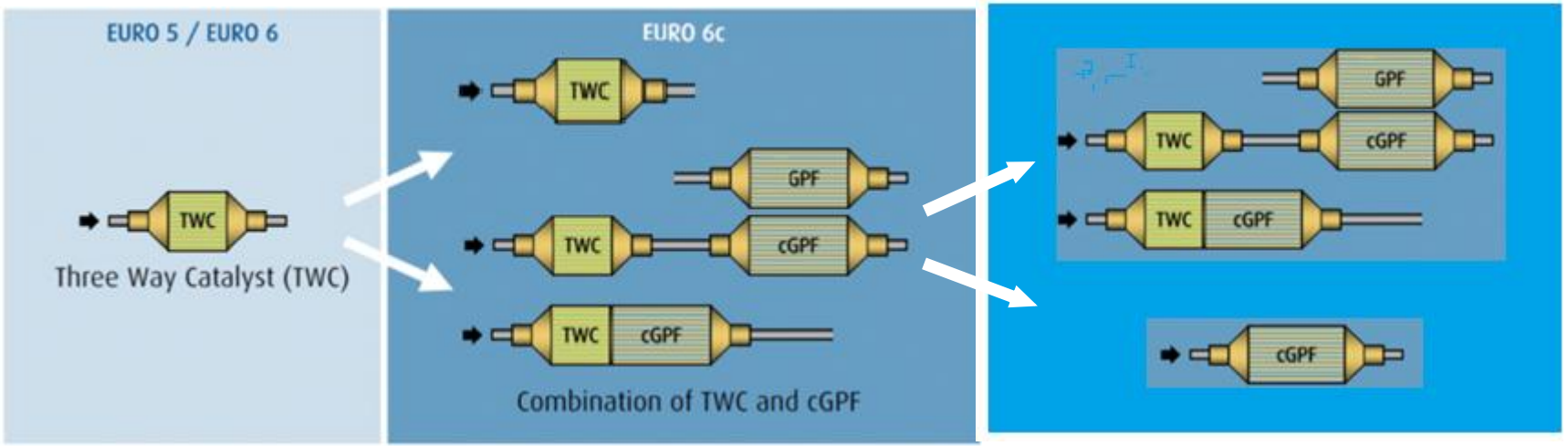
umicore
Automotive Catalysts

Which SCR path to choose, iron zeolites, copper zeolites or vanadium based?

SCR Technology	Thermal resistance	Sulfur resistance	NOx conv. Low NO2 Low T°/High T°	NOx conv. 75% NO2 Low T°/High T°
V-SCR	Max 580°C	Excellent	Medium/Medium	Low/Medium
Cu-SCR	> 700°C	> 500°C needed for desulfation	Good/Medium	Medium/Medium
Fe-SCR	> 700°C	Good	Medium/Excellent	Excellent/Excellent



BS 6 Compliance…..LD Gasoline way



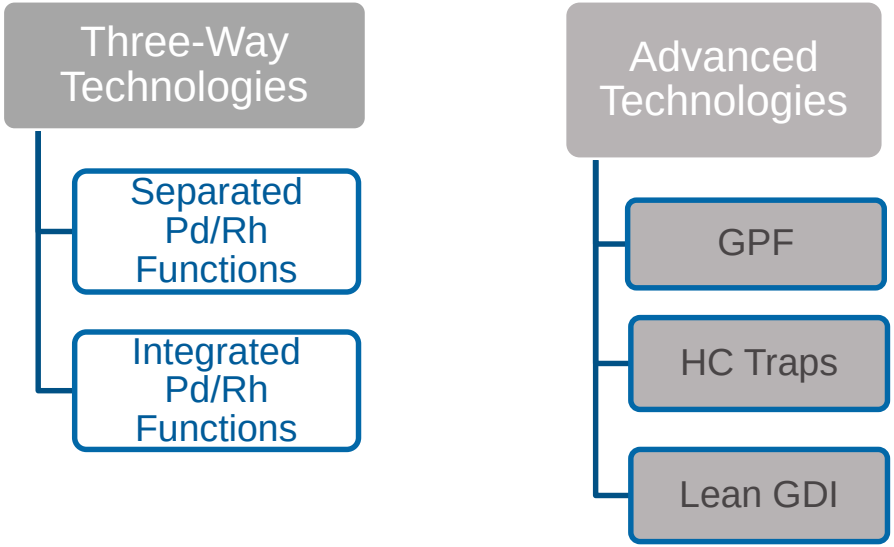
RDE + PEMS

Mild CF

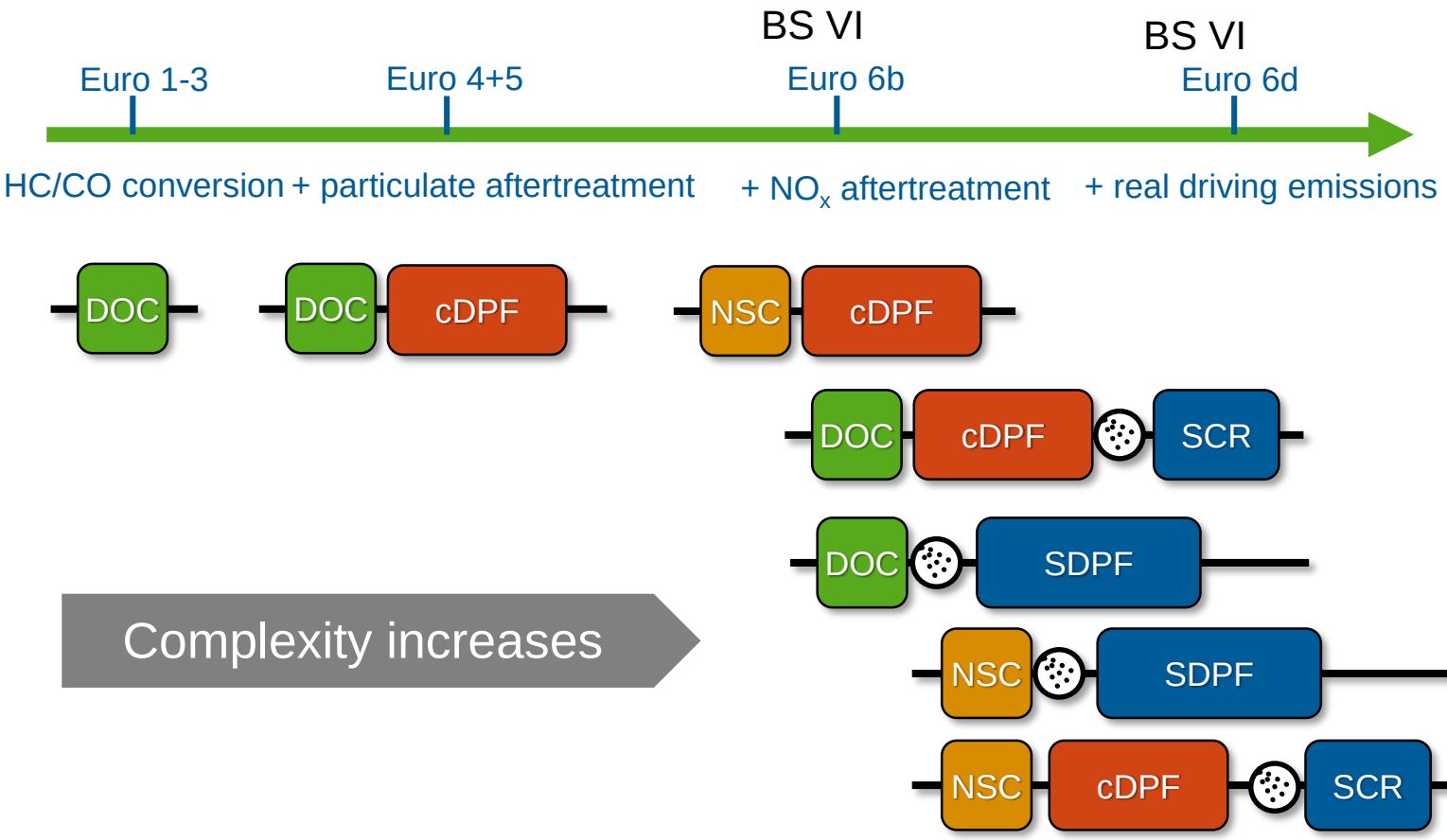
Strengthen CF

Matured engine measures

BS 6 Compliance…..LD Gasoline way

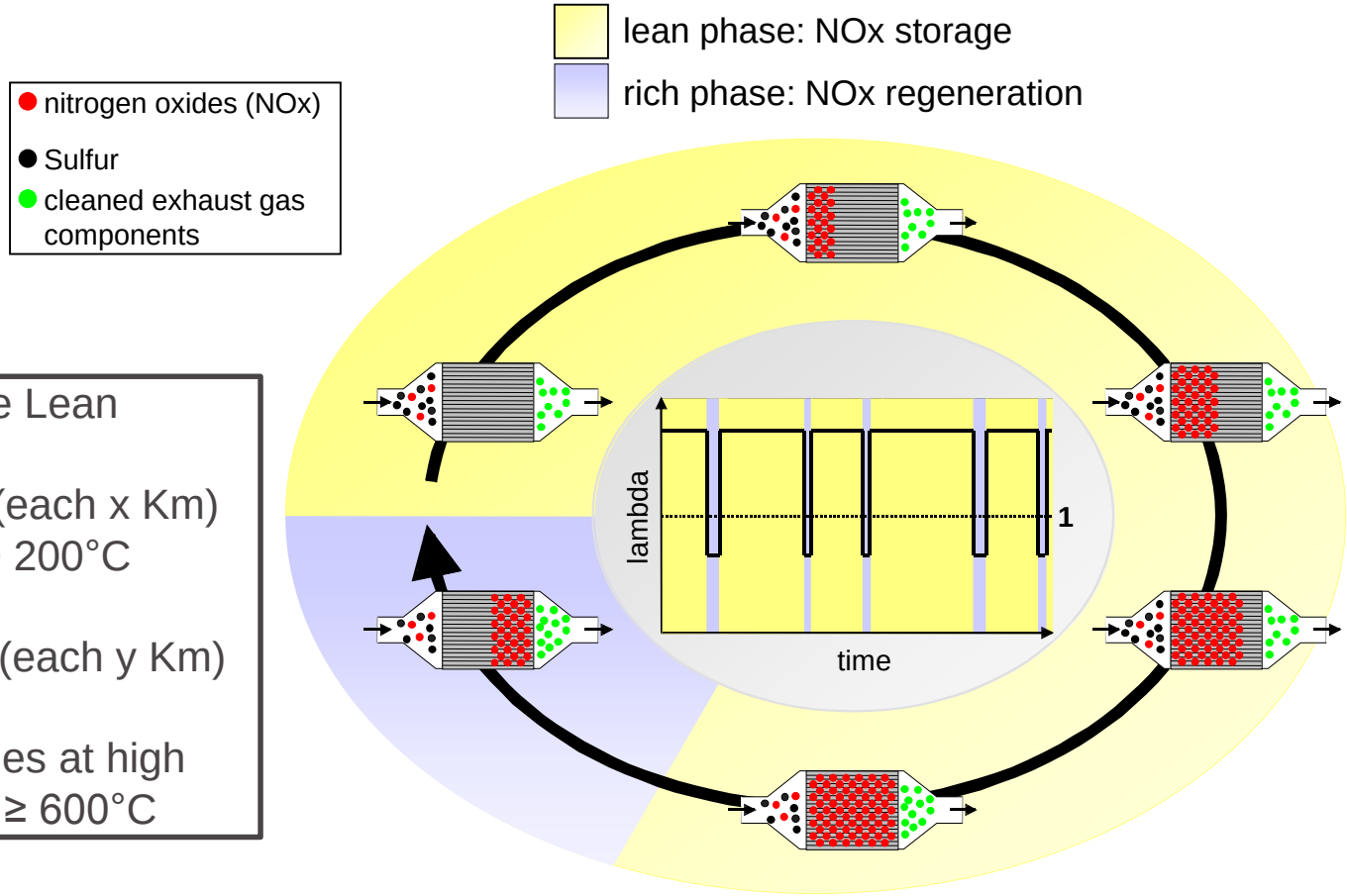


BS 6 Compliance…..LD Diesel way



NOx Storage catalysts
simplified mechanism of NOx storage/regeneration

umicore
Automotive Catalysts



1: NOx storage Lean

2: NOx purge (each x Km)
Rich λ < 1; T > 200°C

3: Desulfation (each y Km)

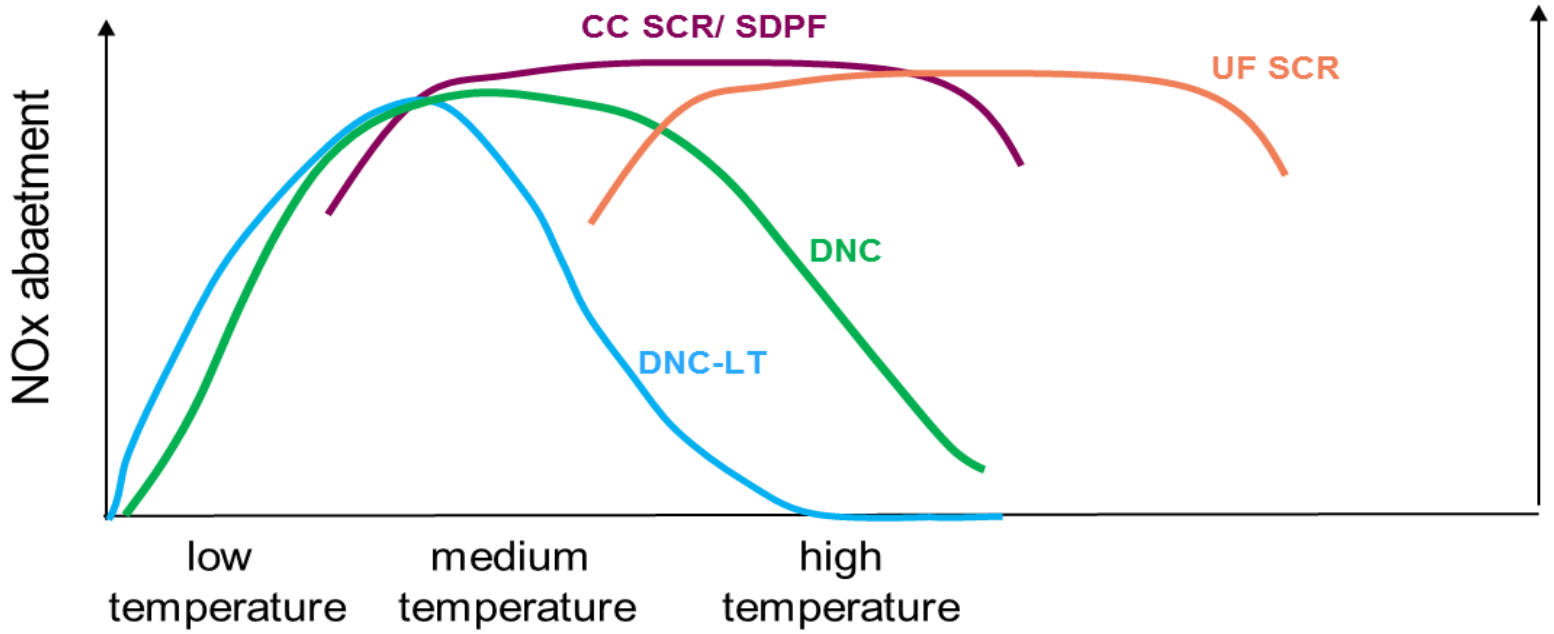
Lean/Rich cycles at high temperature T ≥ 600°C

Production of H2S and H2S trap filter is requested

System Approach for Euro 6d

umicore
Automotive Catalysts

Catalysts with NO_x-storage function:



BSVI Compliance……..What are noises

Noise#1--Fuel Quality

Sulfur fuel levels

- The Ministry of Petroleum and Natural Gas (MoPNG) announced nationwide supply of BSVI fuel in conjunction with the proposed BS VI emission standard implementation date of 1st Apr 2020.

- However, a transition phase of one year is expected before the 10 ppm S diesel fuel will be fully available nationwide.

? How to bridge this one year phase ?

What about the fuel quality

Adulterated fuel; the misuse of kerosene

- Kerosene in India is subsidized with the intention of stabilizing prices and providing poor households with sufficient fuel for cooking and lighting.

- Today, however, the subsidy is subject to widespread abuse.

- Kerosene is a thin, clear liquid formed from hydrocarbons obtained from the fractional distillation of petroleum between 150°C and 275°C, composed of carbon chains that typically contain between 6 and 16 carbon atoms per molecule. In India it is specified in accordance to IS 1459 : 1974 and can contain up to 2500 ppm S. Other potential SCR poisoning elements like e.g. sodium are not specified at all.

Superior Kerosene Oil / Kero
IndianOil Kerosine meets the requirements of
IS 1459 : 1974 (2nd Revision) with Amendment (No 1 thru 3)

Sr No	Characteristics	Requirement	Method of Test IS : 1448
(i)	Acidity, inorganic	Nil	P:2
(ii)	Burning quality a) Char value, mg/kg of oil consumed, Max b) Bloom on glass chimney	 20 Not darker than grey	P:5
(iii)	Colour (Saybolt)*, Min	*10	P:14
(iv)	Copper strip corrosion for 3hr at 50°c	Not worse than No. 1	P:15
(v)	Distillation		P:18
	a) Percent recovered below 200°C, Min	20	
	b) Final boiling point °C Max	300	
(vi)	Flash point (Abel)°C, Min	35	P:20
(vii)	Smoke point, mm, Min	18**	P:31
(viii)	Total Sulphur, percent by mass, Max	0.25#	P:34

Kerosene can contain up to 2500ppm S!

What are controls……..To minimize this noise

- Sulfur tolerance Technologies for LD/HD
- DeSOx Strategies from OEM
- Lower DeSOx temperature from Catalyst technology
- Better Recovery after DeSOx Technologies for LNT/DOC/TWC/SCR for LD/HD Applications
- **No solution for Kerosene adulteration….It simply kills….your Catalyst**

Noise#2 Indian Powertrains
Source: ICCT

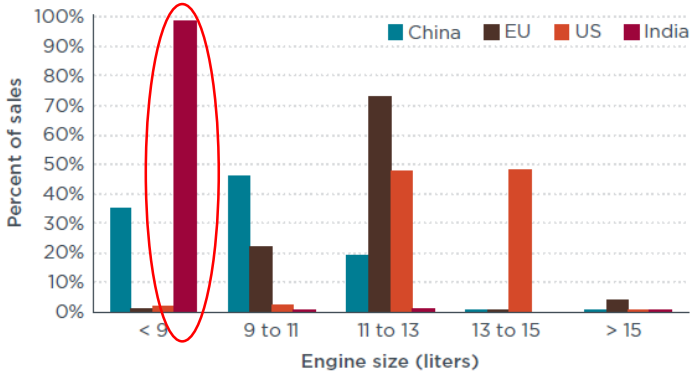


Figure 10: Regional engine size distribution for vehicles over 15 metric tonnes

In India,

- The trucks are smaller
- The engines used are smaller for the same category
- The engine power rating is low
- Trucks are often heavily overloaded

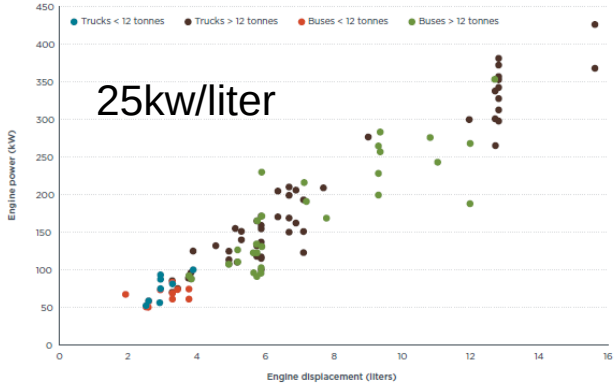
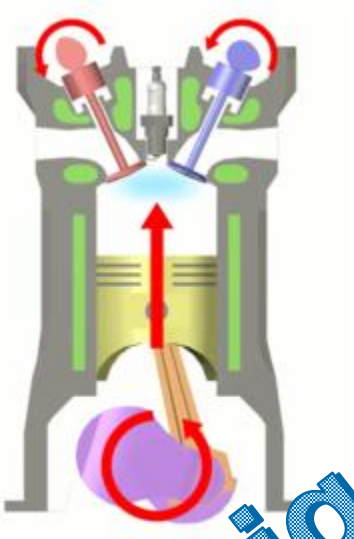


Figure 15: Unique engine size and power points for heavy-duty vehicles in India

BSVI Compliance……..What are noises

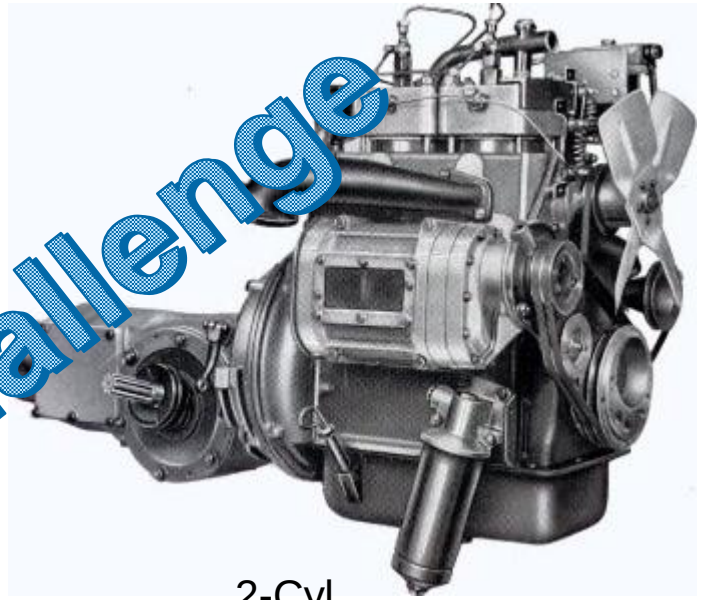
Noise#2 Indian Powertrains
Sub 1.0 L Engine for LDD and LDG applications

umicore
Automotive Catalysts



1-Cyl.

Big Challenge



2-Cyl.

- **LNT/ SCR for Diesel**
- **Downsized Catalyst, Lower PGM loading for Gasoline applications**

Noise#2 Driving pattern and cycles
Source: ICCT

umicore
Automotive Catalysts

- Slow Speeds
- Peak torque operating zone
- RDE Challenge
- DPF Passive Regen
- LNT DeNOx Regen.

Low Light OFF Catalyst

Better low temp. activity

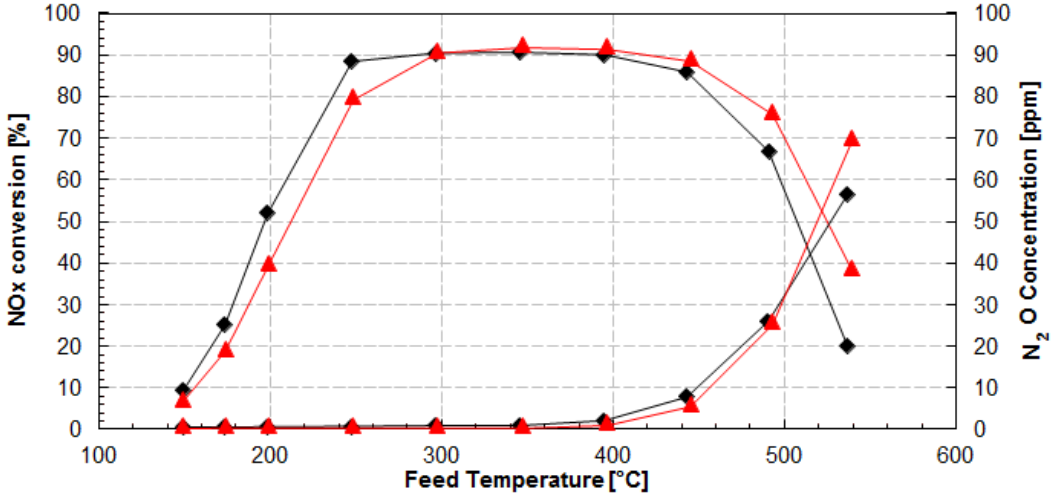
Wide Operating Temp.

Noise#3 “DURABILITY & RELIABILITY(B5/B10 Life)”

umicore
Automotive Catalysts

- Many OEMs have stringent demands for B10 life expectancy
- Robust Catalyst design and process to ensure performance
- Better & realistic Ageing procedures are required

e.g. SCR Performance After severe ageing of 1000 Hours @580 Deg.C showing Performance robustness of Catalyst



Noise#4 “CO2 & Fuel Economy ”

umicore
Automotive Catalysts

Notification	Compliance Year	Corporate Fuel Consumption Standard
Fuel Consumption Standard	April-2020	5.5 l/100 km (129.8 gmCO2/km) @1037 kg
	April 2023	4.78 l/100 km (113.0 gmCO2/km) @1145 kg

FOR HDD

CO_2 emissions and fuel consumption

1. Introduction

1.1. This chapter sets out the provisions and test procedures for reporting CO_2 emissions and fuel consumption.

2. General requirements

2.1. CO_2 emissions and fuel consumption shall be determined over the WHTC and WHSC test cycles in accordance with paragraphs 7.2 to 7.8 of chapter 3

2.2. The test results shall be reported as cycle averaged brake specific values and expressed in the unit of g/kWh.

3. Determination of CO_2 emissions

3.1. Raw measurement

This paragraph shall apply, if CO_2 is measured in the raw exhaust gas.

"115F. Fuel consumption standard.-

(1) Every manufacturer or importer of M1 motor vehicles which are type approved under rule 126, with ...st four wheels, other than quadricycles, used for carriage of passengers and their luggage and ... more than nine seats including driver's seat, and of gross vehicle weight not exceeding ...ufactured or imported for sale in India, shall on and from the 1st day of April, ... Fuel consumption Standard, notified under the Energy Conservation Act, ...t of India in the Ministry of Power number 1072 (E), dated the 2...

India Pledges to Reduce Carbon Emissions 33%-35% by 2030

Thank You