



DEMYSTIFYING BS VI

Agenda

- **About BS-VI**
- **Technology Overview**
- **Customer Perceptive**
- **Product Portfolio**
- **World-class Ecosystem**
- **Key Success Factor**

Outline

- **About BS-VI**
- Technology Overview
- Customer Perceptive
- Product Portfolio
- World-class Ecosystem
- Key Success Factor

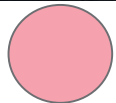
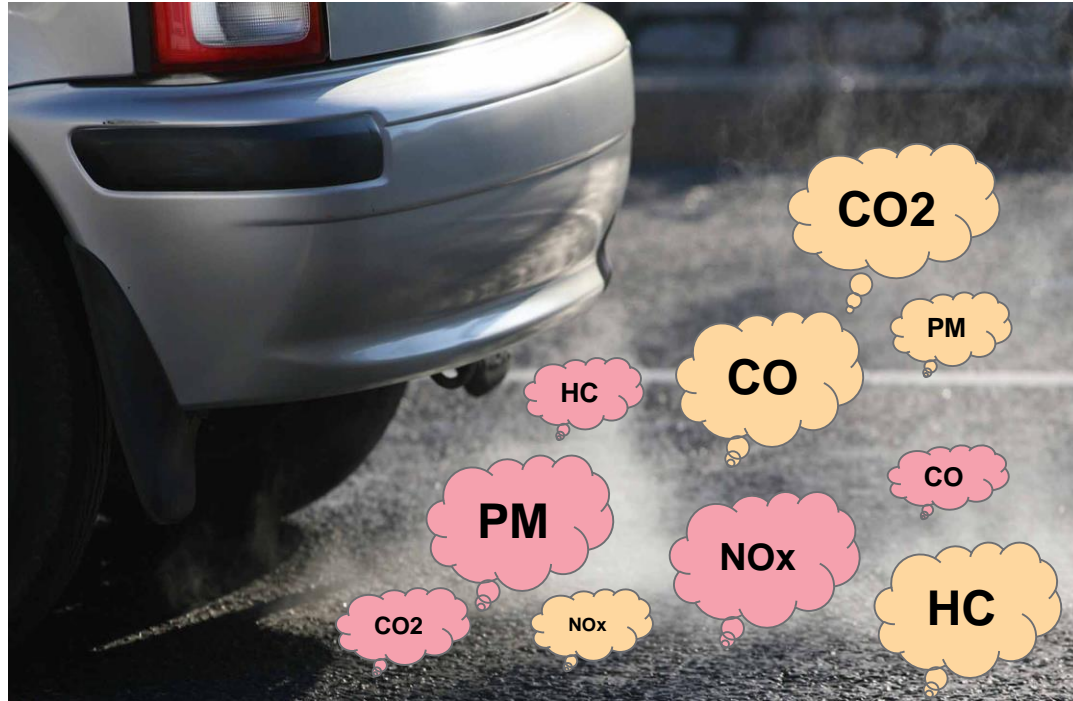
Demystifying BS VI



- **Pollutants & Legislation**
- **Technologies & Electronics**
- **Fuel upgrade**
- **Advanced Engine Management**

Automotive Emissions

Key pollutants



DIESEL



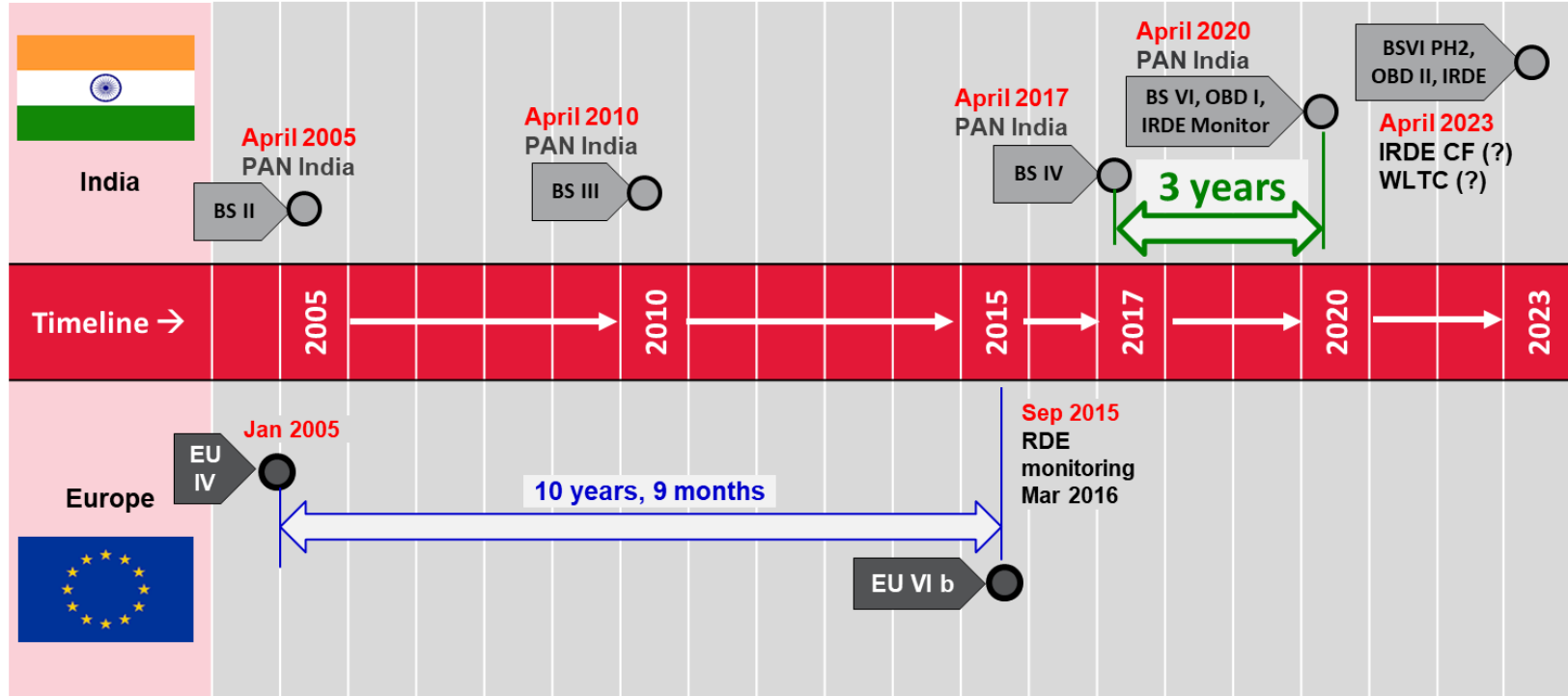
GASOLINE

Key Pollutants:-

- Diesel – PM & NOx
- Gasoline – CO , HC & CO2
- Gasoline emits 20-25% higher CO2 than Diesel

Legislation Overview

Legislation Roadmap : India & Europe



Stage 4 to Stage 6 Emission Migration, Europe in over 10 years and India in 3 Years

BS4 to BS6 : (Both PM and NOx reduction together)

First country to skip an emission standard (BS-V)

BS4 [mg/km]
NOx – 250
PM – 25

DIESEL

NOx – 68 %
PM – 82 %

BS6 [mg/km]
NOx – 80
PM – 4.5

BS4* [mg/km]
CO – 833
HC – 83

GASOLINE

CO – 20 %
HC – 8.5 %

BS6* [mg/km]
CO – 667
HC – 76

* thru Deterioration Factor

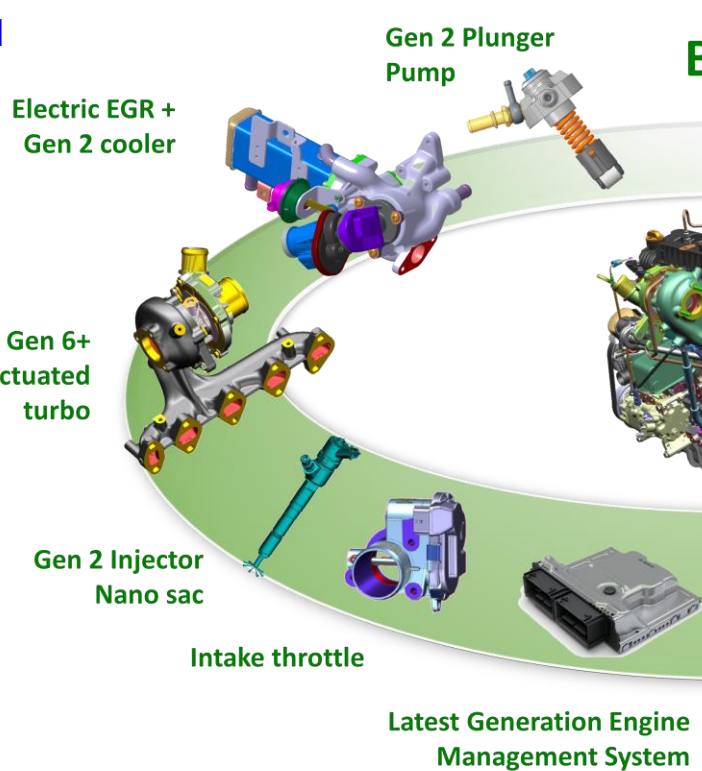
Outline

- About BS-VI
- **Technology Overview**
- Customer Perceptive
- Product Portfolio
- World-class Ecosystem
- Key Success Factor

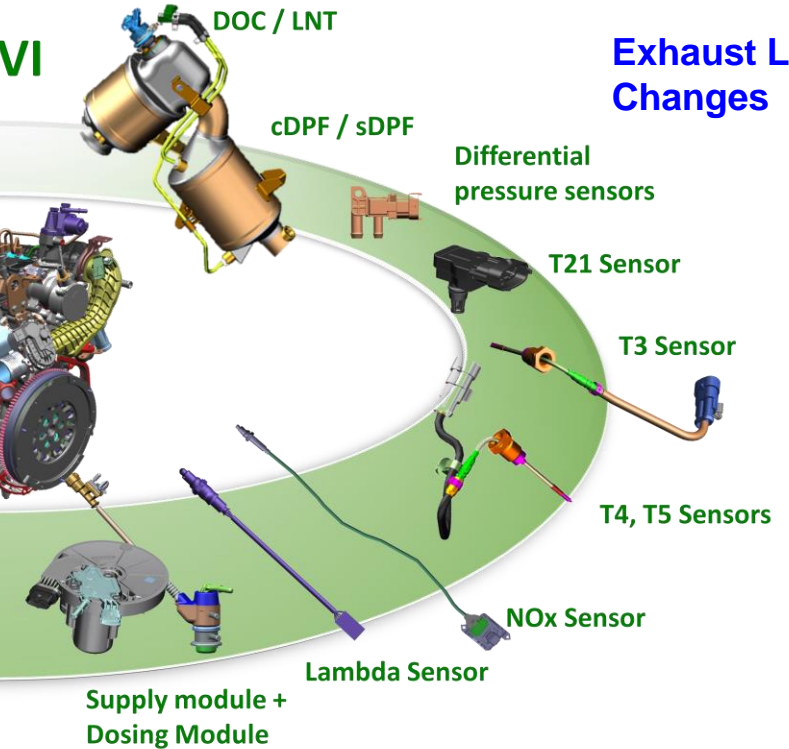
Technology Overview

BS4 to BS6 : Major Technology Migration (Engine & Exhaust level)

Engine Level Changes



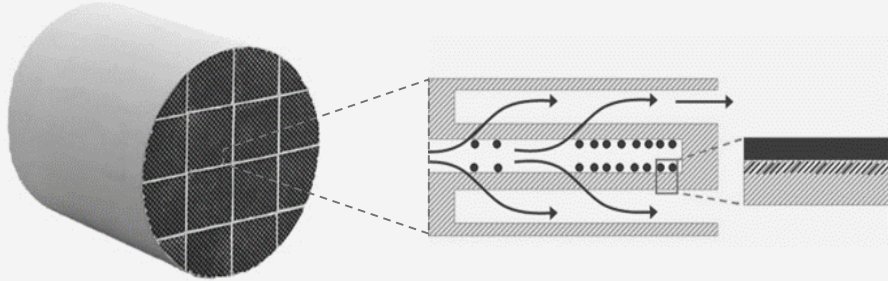
BS VI



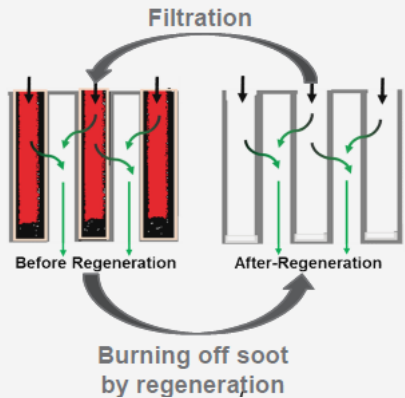
Exhaust Level Changes

Technology Overview

Diesel Particulate Filter : Particulate Matter / Soot reduction



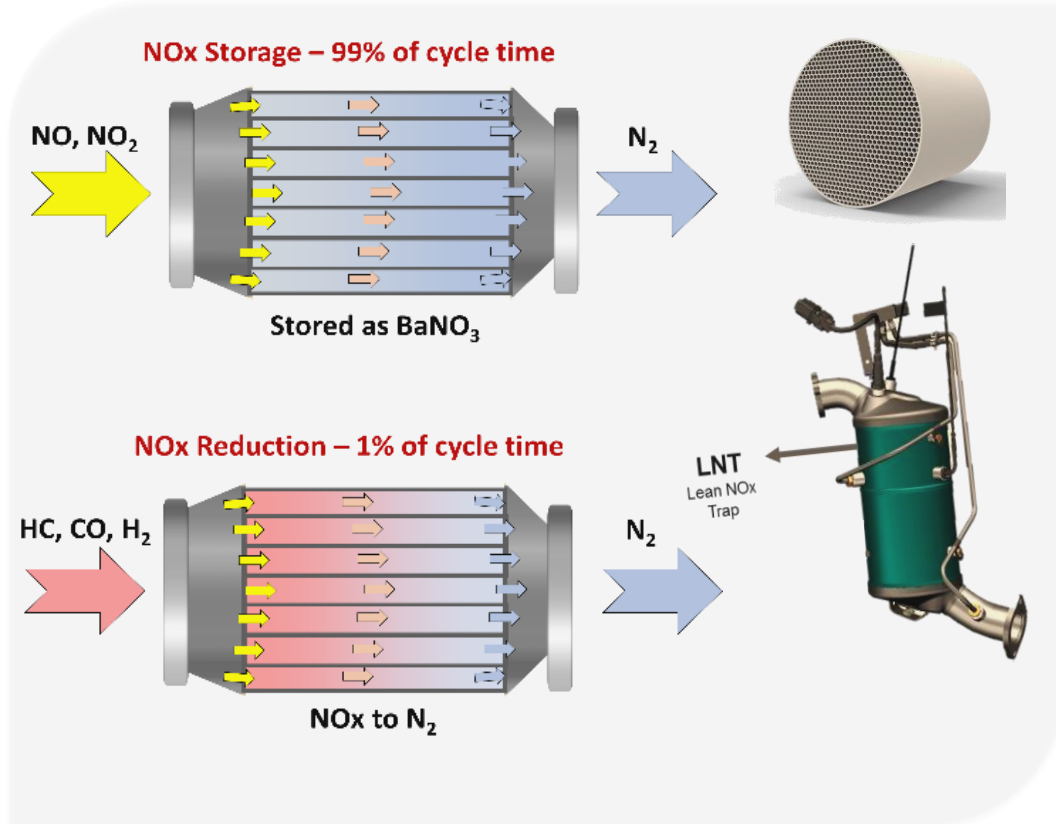
Regeneration Process



- Filtration of Particulate Matter (PM / Soot) from exhaust gas through porous walls.
- Soot accumulates and makes filter full
- Filter is regenerated by burning the soot
 - Active / Passive
- Managed by computer through calibration
- Complex development cycle

Technology Overview

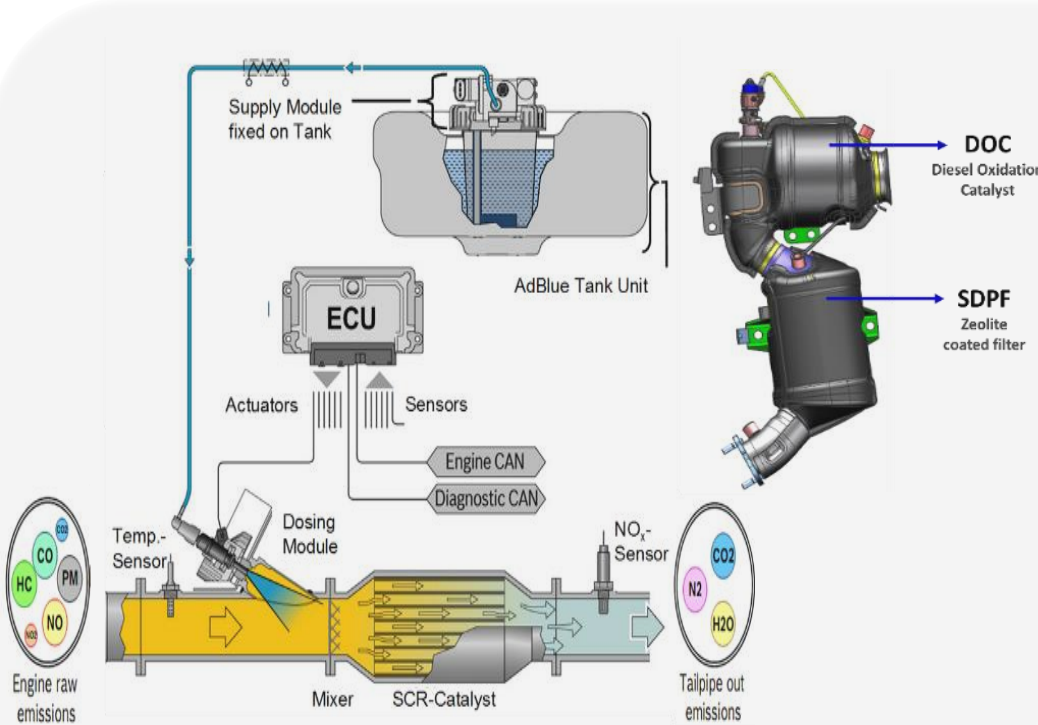
a. Lean NOx Trap (LNT) / NOx Storage Catalyst (NSC) : NOx Reduction



- NOx stored in the catalyst
- Once its full, it is regenerated through Rich Fuel Pulse in Engine
- Simple system and less expensive
- Used for Low power density vehicles

Technology Overview

b. Selective Catalytic Reduction : NOx reduction



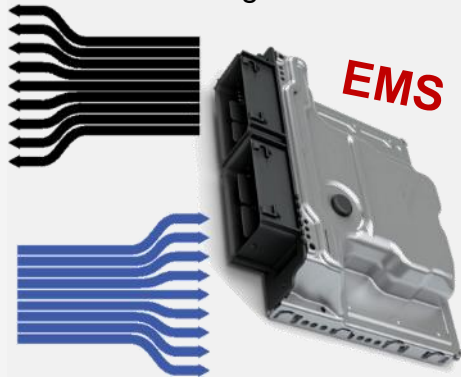
- NOx conversion by ammonia in catalyst through dosing Urea
- Complex system and more expensive
- More efficient, used for High power density vehicles

Technology Overview

Engine Management System(EMS) – Controls & Monitors

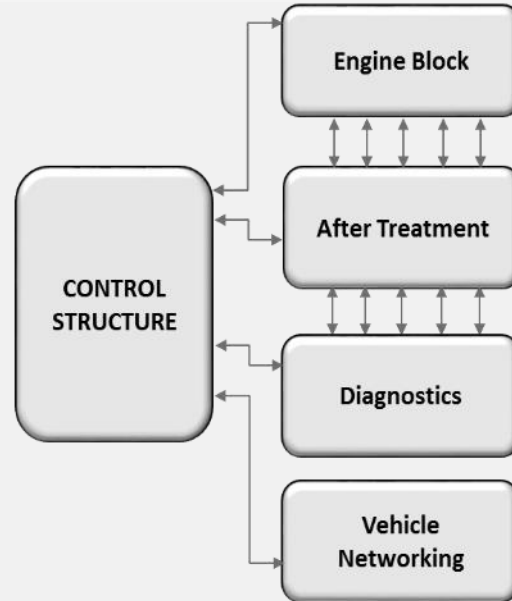
ACTUATORS

- Injector
- AdBlue dosing
- Turbocharger etc



18 SENSORS

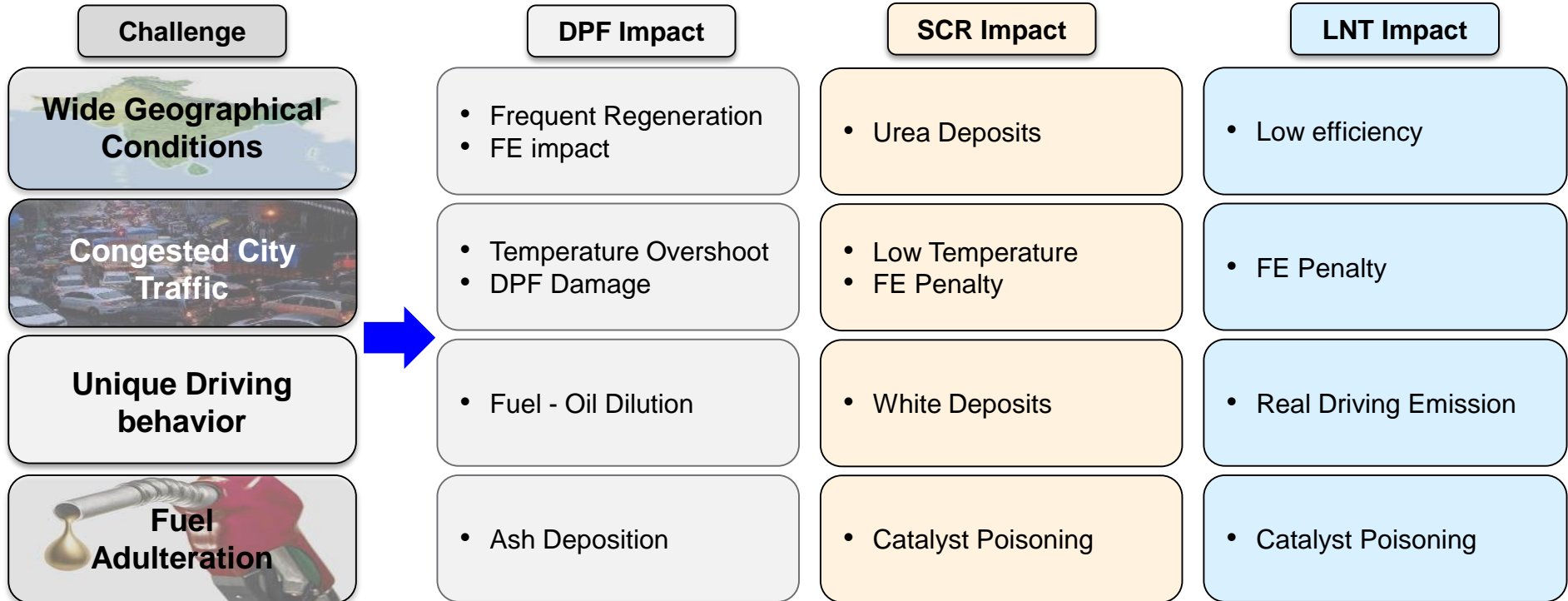
- Pressure
- Temperature
- Flow etc



- Control structure connects various functions such as
 - Engine
 - After treatment
 - Diagnostics
 - Vehicle Networkingand the output is given to actuators.
- Calibration : Complex , lengthy and fine programming for system to perform

Technology Overview

DPF, SCR, LNT : India specific key challenges



Proven European technologies becomes sub optimal | Needs India specific development

Outline

- About BS-VI
- Technology overview
- **Customer Perceptive**
- Product Portfolio
- World-class Ecosystem
- Key Success Factor

BS VI : Impact to Customer

Key Challenges

**Performance
Driveability**



- Heavy exhaust system & Drivability deterioration

NVH



- Increased fuel pressure & fuel injection in favor of emission

Fuel Economy



- High exhaust pressure drop & after treatment tuning

Price



- High initial cost and cost of ownership due to technology

BS VI : Impact to Customer

Converting BS VI challenges to opportunity

**Performance &
Drivability**

NVH

Fuel Economy

Cost



**Innovation in
Turbocharger**

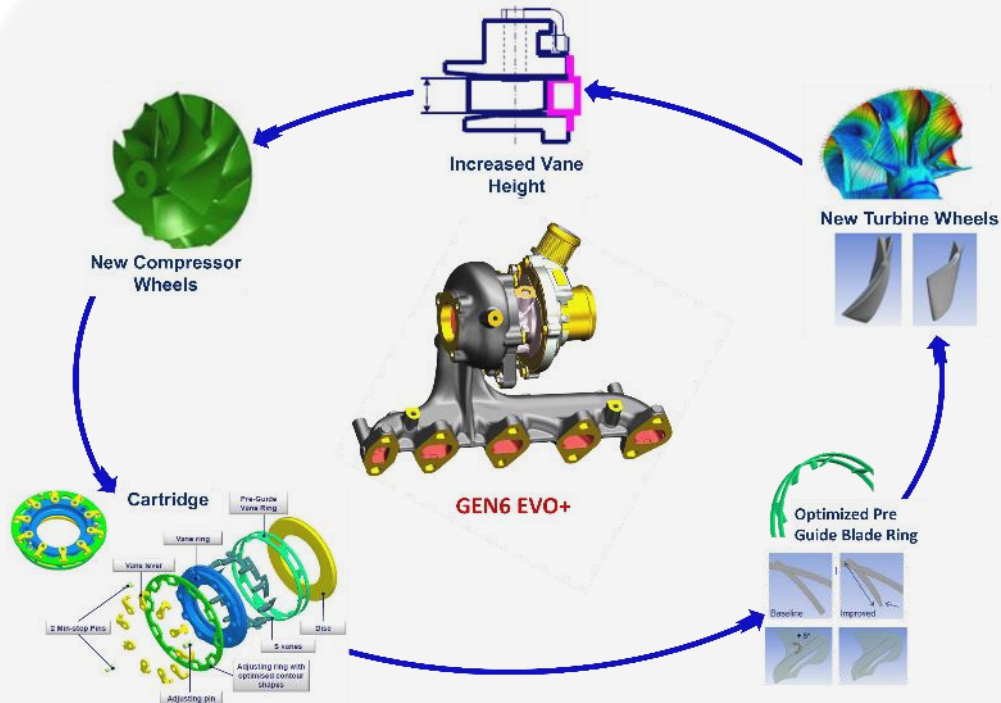
**Fuel Systems & EGR
Module**

**Friction Reduction
Technology**

**New Generation
Engines**

Customer Perspective

Innovation in Turbocharger – Benefit in Performance and FE



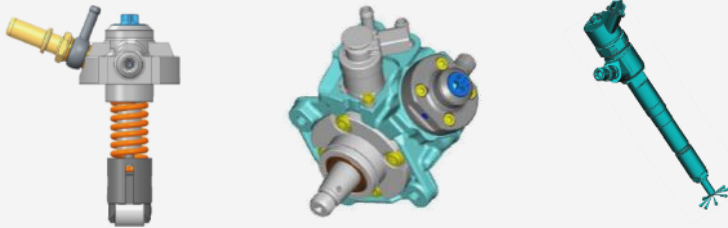
- Integrated Exhaust Manifold
- Electric Actuator for Wastegate / VGT
- Gen VI EVO+ Technology

Customer Perspective

Fuel Systems & EGR Module – Benefit in NVH and FE

Fuel Injection System

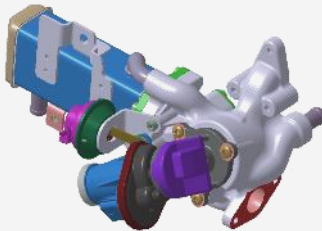
92% Hydraulic Efficiency



- Improved & efficient fuel injection system
- More efficient EGR system

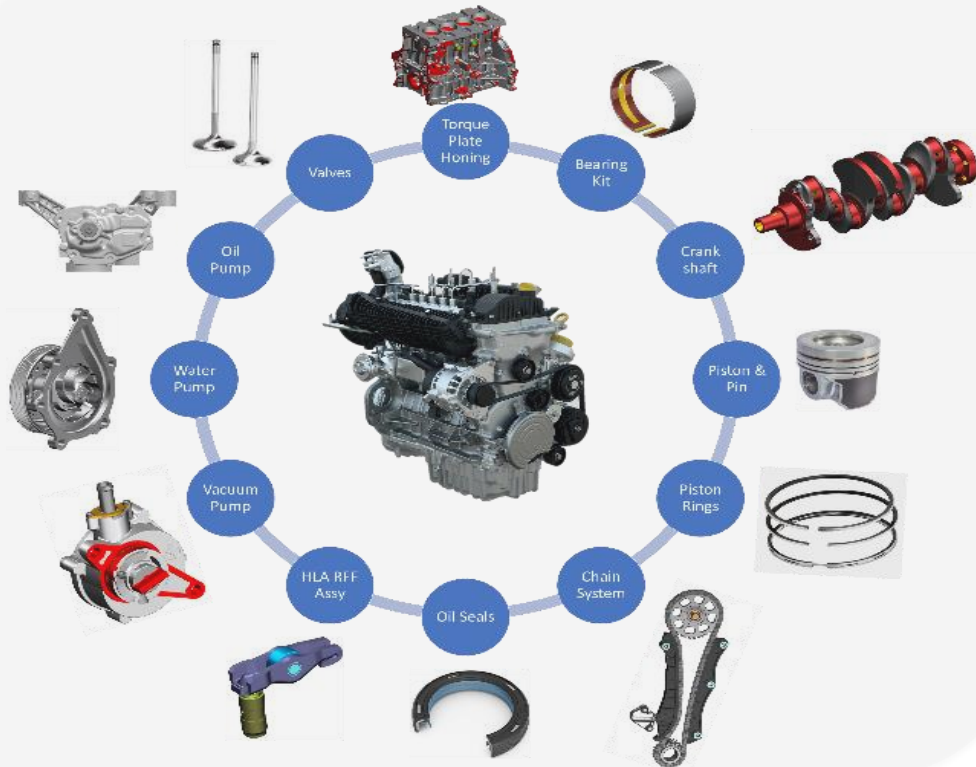
EGR System

85% efficiency & modular concept



Customer Perspective

Global Friction Reduction Technology – Benefit in FE



- All engines are upgraded to state-of-art friction technologies
- Key initiative over emission to retain customer benefit

BS VI : Challenges turned to Opportunities

Customer Values protected through Innovative Technologies

Performance Driveability



NVH



Fuel Economy



Price

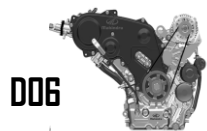


Outline

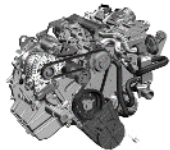
- About BS-VI
- Technology overview
- Customer Perceptive
- **Product Portfolio**
- World-class Ecosystem
- Key Success Factor

BS VI Portfolio – Diesel

Engine and Vehicle Platforms



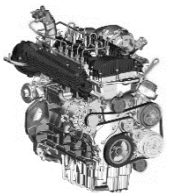
D06



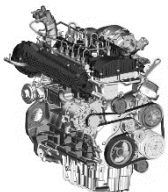
D09
NA & TC



3 D15



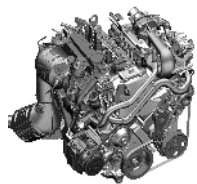
4 D15
DELPHI



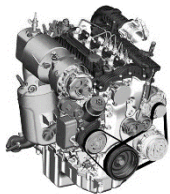
4 D15
BOSCH



D25



Eagle I



Future

8 ENGINES

16 PLATFORMS

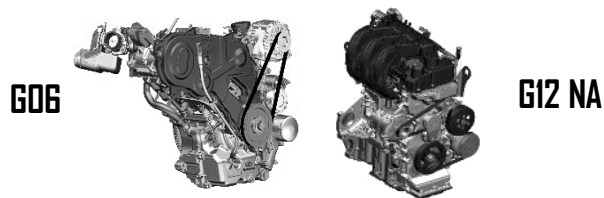
38 VARIANTS

Globally unique
Many platforms | Shortest time



BS VI Portfolio – Gasoline

Engine and Vehicle Platforms



8 ENGINES



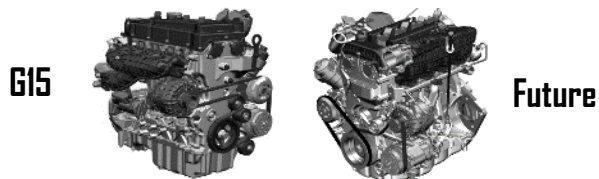
G12 TCMPFI / TGDI



8 PLATFORMS



12 VARIANTS



Complete range



Outline

- About BS-VI
- Technology overview
- Customer Perceptive
- Product Portfolio
- **World-class Ecosystem**
- Key Success Factor

Delivering World-class Experience

Mahindra Research Valley



MRV - PDC



Power train Infrastructure



Performance T/B (22)



Engine Preparation



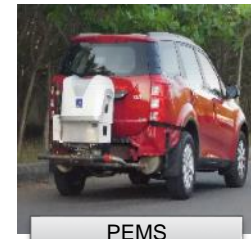
NH3 Analyzer



Functional Test



Durability T/B



PEMS



Chassis Dyno



Transmission Rig



Index Rig

Delivering World-class Experience

Technology Partners - Perennial Source of Latest Technology

Consultants



Key Suppliers

Outline

- About BS-VI
- Technology overview
- Customer Perceptive
- Product Portfolio
- World-class Ecosystem
- **Key Success Factor**

Key Success Factor – “*The Team*”

Current Development Status: Expedition

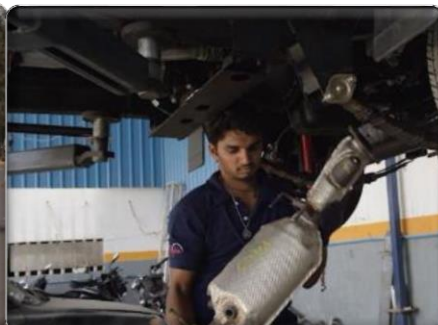
2 Summer and 2 Winter Expedition completed

- Coimbatore, Ooty, Chandigarh, Manali
- 64 vehicles
- 80 Engineers
- 20 Consultants
- Jury members

and still going on...

Key Success Factor – “*The Team*”

Start of On-time Fleet validation



Key Success Factor – “*The Team*”

Manufacturing Builds as per time line





... and miles to go before we sleep

Our Rise



AV

Thank You

Disclaimer

Mahindra & Mahindra herein referred to as M&M, and its subsidiary companies provide a wide array of presentations and reports, with the contributions of various professionals. These presentations and reports are for informational purposes and private circulation only and do not constitute an offer to buy or sell any securities mentioned therein. They do not purport to be a complete description of the markets conditions or developments referred to in the material. While utmost care has been taken in preparing the above, we claim no responsibility for their accuracy. We shall not be liable for any direct or indirect losses arising from the use thereof and the viewers are requested to use the information contained herein at their own risk. These presentations and reports should not be reproduced, re-circulated, published in any media, website or otherwise, in any form or manner, in part or as a whole, without the express consent in writing of M&M or its subsidiaries. Any unauthorized use, disclosure or public dissemination of information contained herein is prohibited. Unless specifically noted, M&M or any of its subsidiary companies is not responsible for the content of these presentations and/or the opinions of the presenters. Individual situations and local practices and standards may vary, so viewers and others utilizing information contained within a presentation are free to adopt differing standards and approaches as they see fit. You may not repackage or sell the presentation. Products and names mentioned in materials or presentations are the property of their respective owners and the mention of them does not constitute an endorsement by M&M or its subsidiary companies. Information contained in a presentation hosted or promoted by M&M is provided "as is" without warranty of any kind, either expressed or implied, including any warranty of merchantability or fitness for a particular purpose. M&M or its subsidiary companies assume no liability or responsibility for the contents of a presentation or the opinions expressed by the presenters. All expressions of opinion are subject to change without notice.



Mahindra
Rise.