DEMystifying BS VI
Agenda

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

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Demystifying BS VI

- Pollutants & Legislation
- Technologies & Electronics
- Fuel upgrade
- Advanced Engine Management
Automotive Emissions

Key pollutants

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)

**DIESEL**

BS4 [mg/km]
NOx – 250
PM – 25

NOx – 68 %
PM – 82 %

BS6 [mg/km]
NOx – 80
PM – 4.5

**GASOLINE**

BS4* [mg/km]
CO – 833
HC – 83

CO – 20 %
HC – 8.5 %

BS6* [mg/km]
CO – 667
HC – 76

* thru Deterioration Factor
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Technology Overview

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

Engine Level Changes
- Electric EGR + Gen 2 cooler
- Gen 6+ e-Actuated turbo
- Gen 2 Injector Nano sac
- Intake throttle
- Latest Generation Engine Management System

Exhaust Level Changes
- DOC / LNT
- cDPF / sDPF
- Differential pressure sensors
- T21 Sensor
- T3 Sensor
- T4, T5 Sensors
- NOx Sensor
- Supply module + Dosing Module
- Lambda Sensor
Technology Overview

Diesel Particulate Filter: Particulate Matter / Soot reduction

- 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

- Control structure connects various functions such as:
  - Engine
  - After treatment
  - Diagnostics
  - Vehicle Networking
  and the output is given to actuators.

- Calibration: Complex, lengthy and fine programming for system to perform

ACTUATORS
- Injector
- AdBlue dosing
- Turbocharger etc

18 SENSORS
- Pressure
- Temperature
- Flow etc
Technology Overview

DPF, SCR, LNT: India specific key challenges

- Frequent Regeneration
- FE impact
- Temperature Overshoot
- DPF Damage
- Fuel - Oil Dilution
- Ash Deposition

- Urea Deposits
- Low Temperature
- FE Penalty
- White Deposits
- Catalyst Poisoning

- Low efficiency
- FE Penalty
- Real Driving Emission
- Catalyst Poisoning

Proven European technologies becomes sub optimal | Needs India specific development
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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

EGR System
85% efficiency & modular concept

- Improved & efficient fuel injection system
- More efficient EGR system
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
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BS VI Portfolio – Diesel

Engine and Vehicle Platforms

- **8 Engines**
  - DO6
  - DO9 NA & TC
  - 3 D15
  - 4 D15 DELPHI
  - 4 D15 BOSCH
  - D25
  - Eagle I
  - Future

- **16 Platforms**

- **38 Variants**

Globally unique
Many platforms | Shortest time
BS VI Portfolio – Gasoline

Engine and Vehicle Platforms

- G06
- GI2 NA
- GI2 TCMPFI / TGDI
- GI5

8 ENGINES
8 PLATFORMS
12 VARIANTS

Complete range
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Delivering World-class Experience

Mahindra Research Valley

Power train Infrastructure

Performance T/B (22)
Engine Preparation
NH3 Analyzer

Functional Test
Durability T/B
PEMS

Chassis Dyno
Transmission Rig
Index Rig

MRV - PDC

About BS-VI | Technology | Customer | Portfolio | Eco-system | Team
Delivering World-class Experience
Technology Partners - Perennial Source of Latest Technology

### Consultants
- **BOSCH**
  - Invented for life
- **AVL**
  - Innovation for the Real World

### Key Suppliers

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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
Thank You

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