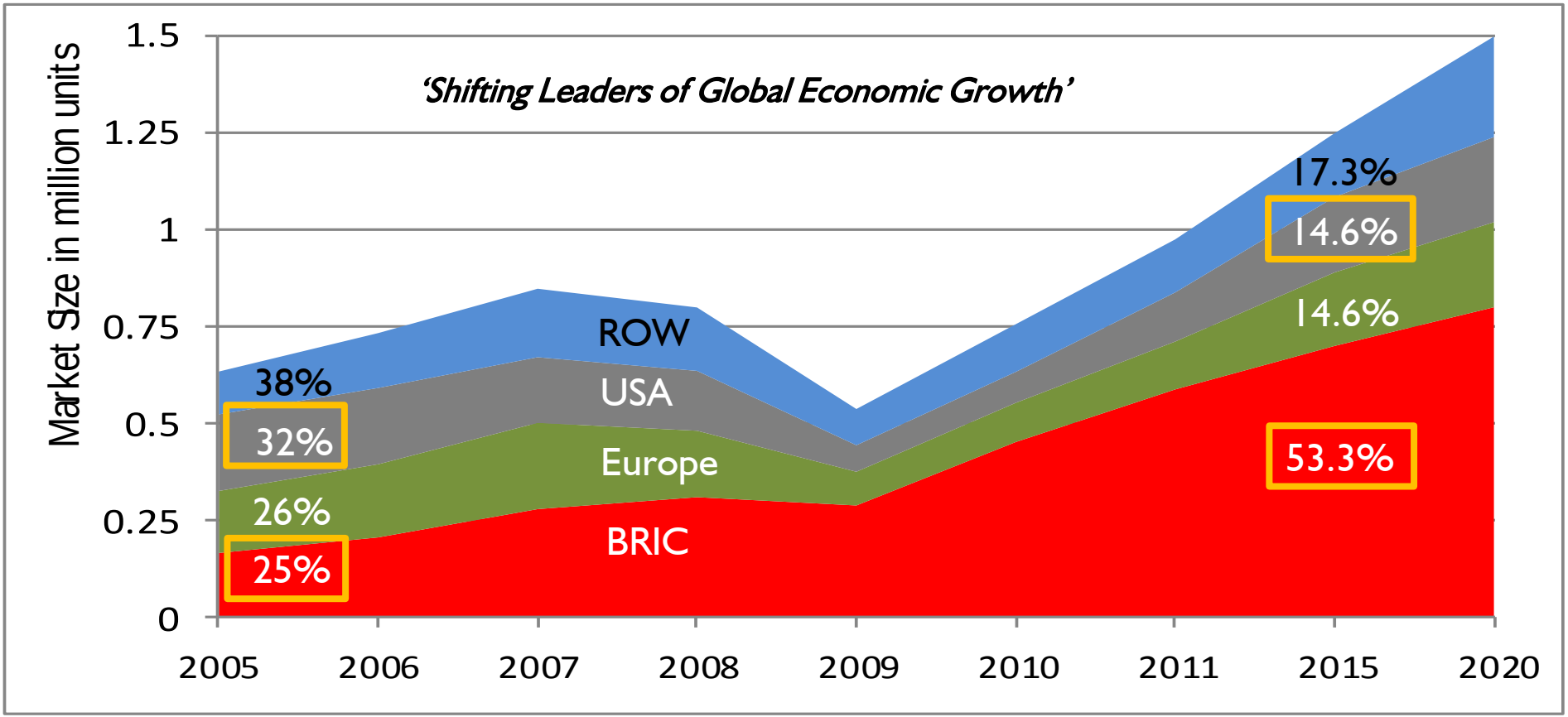
LEADING BY INNOVATION

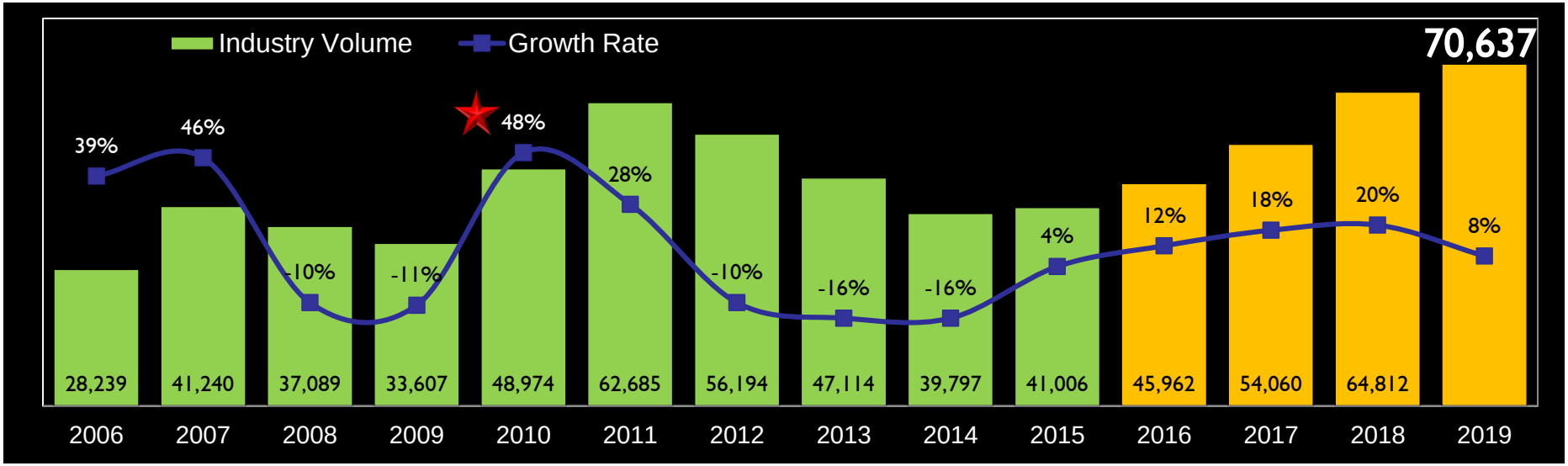

Off-highway Machinery Landscape
Earthmoving Equipment
Construction Vehicles
Material Handlers
Construction Equipment
Tractors/Agri-equipments

World CE Market



Source : World Market Analysis

India CE Market



Strong Long Term Potential

Vehicular Emissions Challenge

Environment – Vital Stats

- Global CO_2 emissions expected to increase by **1.9%** annually between 2001 & 2025 that may result in more than **5°C** temperature rise.

- Developing countries' emissions are expected to grow **above the world average at 2.7%**

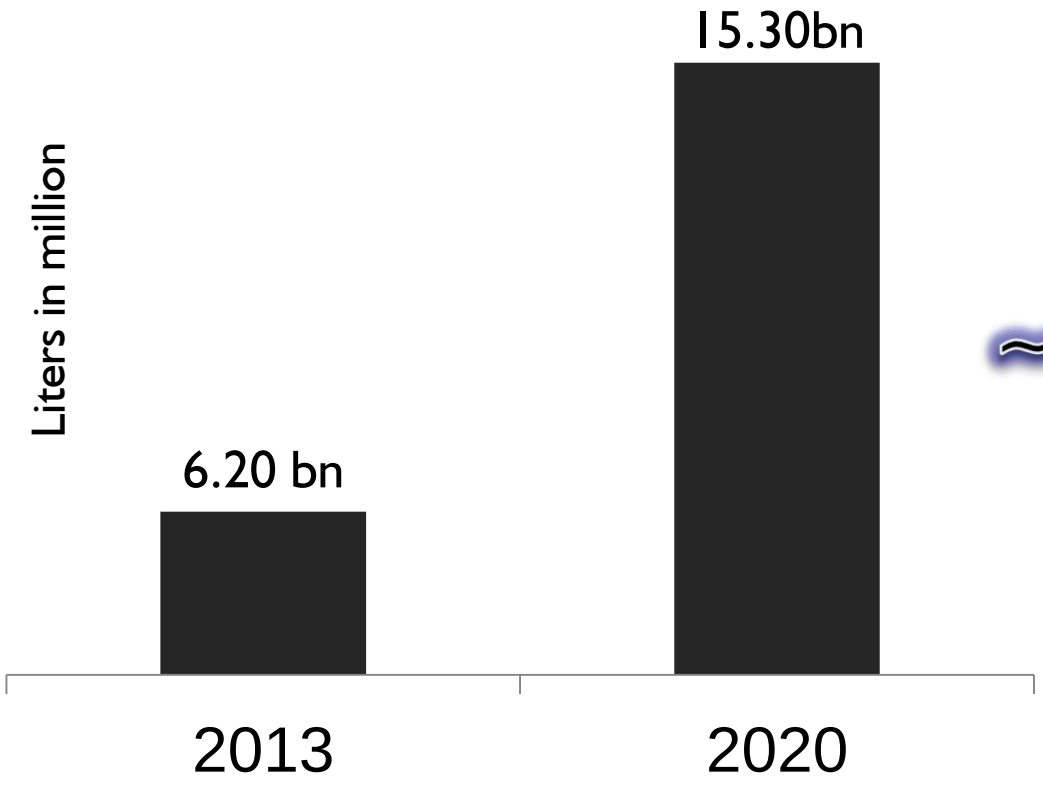
- 31% of petroleum oils consumed by CEV & tractors and second to Transport sector.

- Each gallon of fuel CEV burns adds 20 pounds of CO_2 in the environment

- This means we are adding ~4 Tonnes of CO_2/vehicle/year

**Source: Petrofed and Indian Oil corp. Limited*

2020 Estimated Fuel Demand



Emission

~40 bn Tons of CO_2

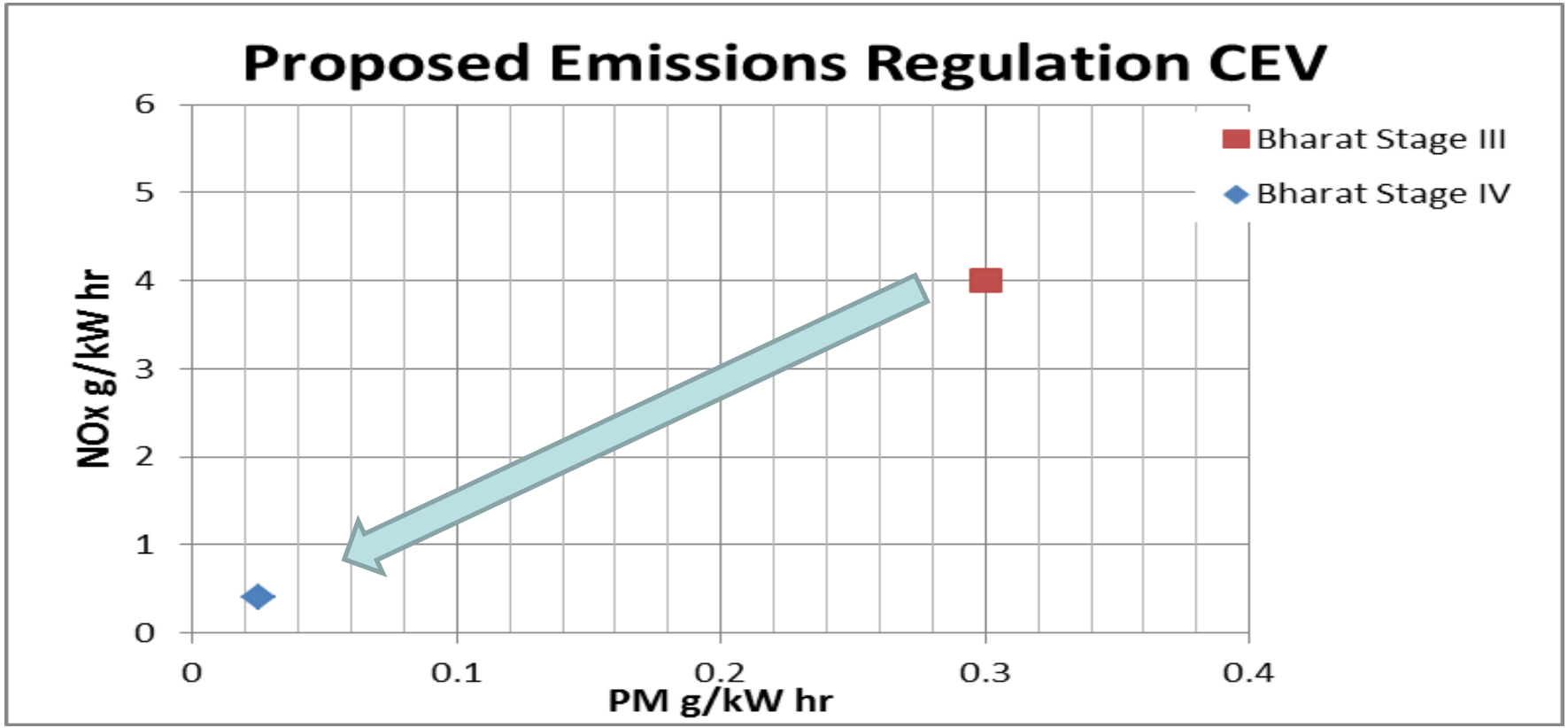
Fuel Efficiency as an Opportunity

30% Fuel Efficiency gain by 2020 would translate :

- ~ 5.0 billion Litres of Fuel Saved / Year
- 11.5 bn tonnes of CO2
- Savings on the subsidy

There is a case to therefore incentivize the Innovations driving fuel efficiency programs in industry

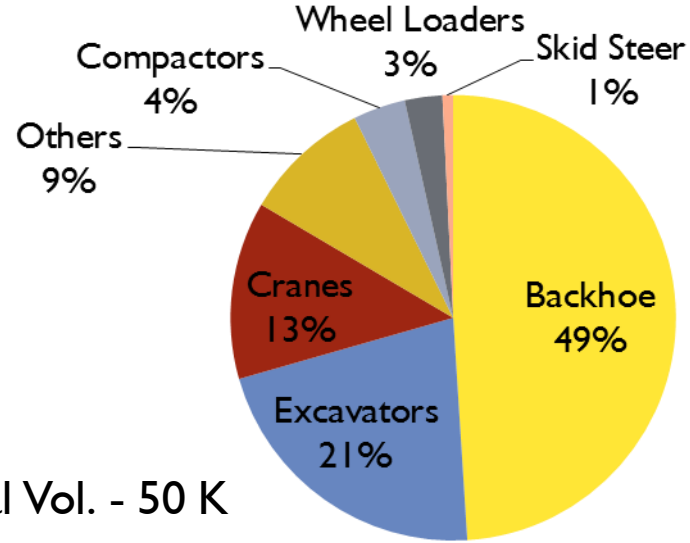
Emissions – CEV Market



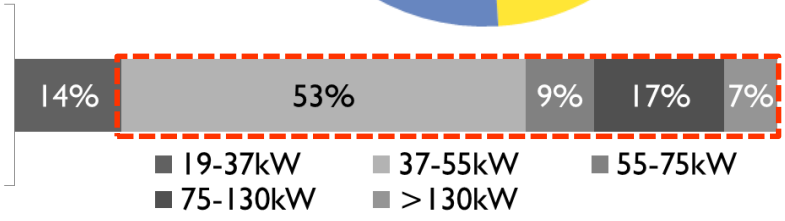
Power bands

Volume share

CEV

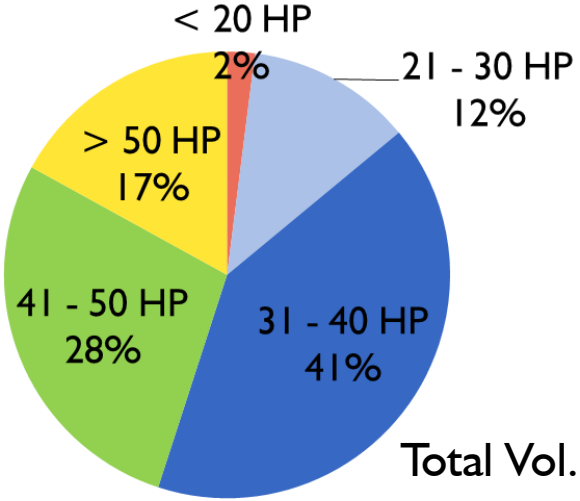


Total Vol. - 50 K

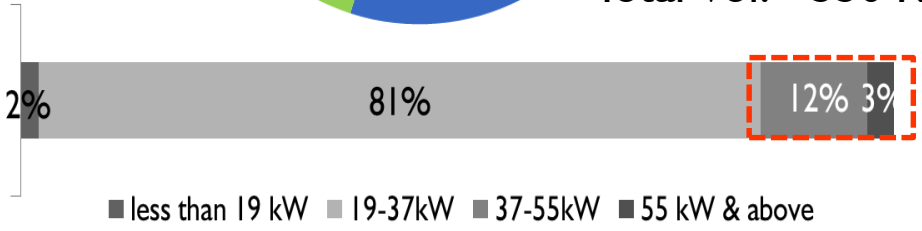


Only Wheeled Application

Tractors



Total Vol. - 550 K



BS IV : Implications

- Step changes needed on engine platforms.

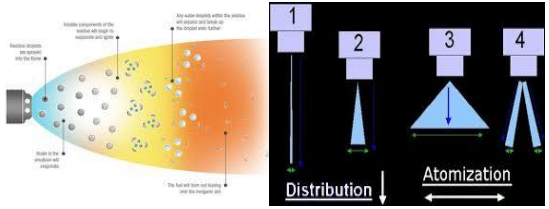
- Significant investments and lead times :
  - OEM Readiness
  - FIE Manufacturing capacity readiness
  - After Treatment technology viability / footprint

- Customer Impact : Initial Price and After-market , equipment serviceability and maintenance.

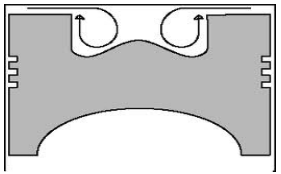
- Fuel quality, availability and infrastructure pan India.

Technology Shift (In Cylinder)

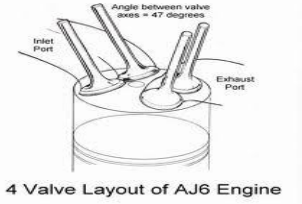
Combustion System



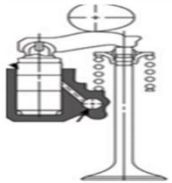
Optimized Nozzle Spray Pattern, Zero sac vol.



Re entrant Piston Bowl

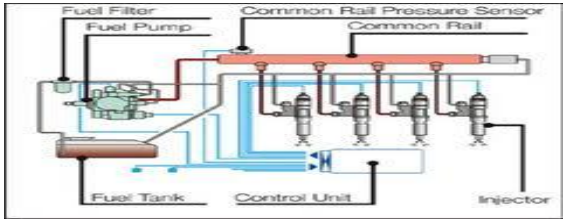


4 Valves per cylinder



Hydraulic Lash Adjuster

Better Swirl Ratio



Common Rail System
Third generation (2200 bar)

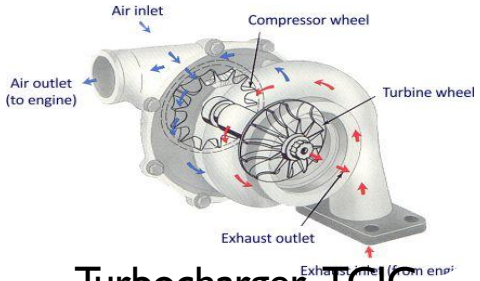
Rotary Pump

Inline Pump

Fuel Injection Equipment(FIE)

Technology Shift Air Management

Air Management

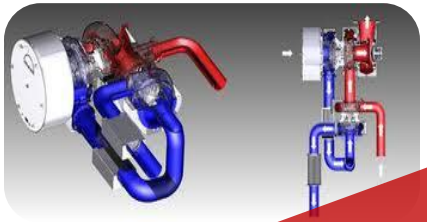


Turbocharger, TCIC, WG TC

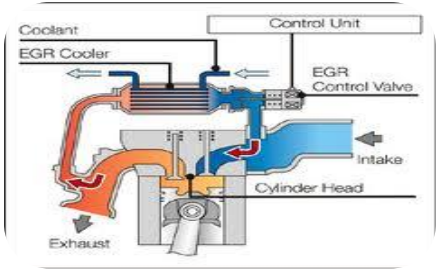
Variable Geometry Turbocharger

- Controls exhaust pressure to drive EGR flow
- Variable position vanes allow tailored performance
- Customer Value
  - Faster Response
  - More Torque
  - Improved Fuel Economy

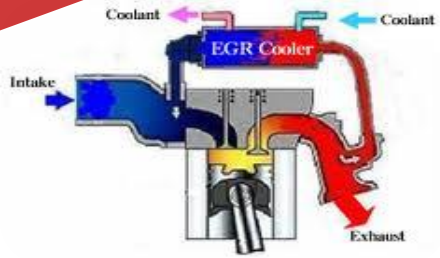
Variable Geometry TC



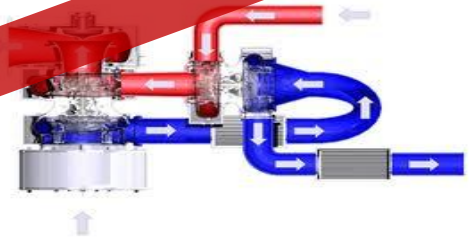
Two Stage TC



EGR with controller (Pneumatic/ Electrical) High Pressure /Low Pressure



Cooled EGR

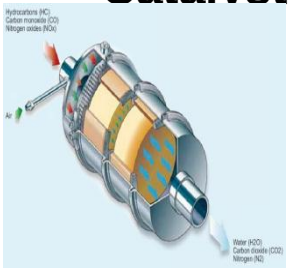


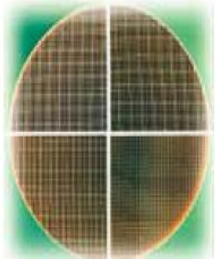
Basic EGR

Exhaust Gas Recirculation

JCB Aftertreatment Technology Strategy

Diesel Oxidation Catalyst (DOC)

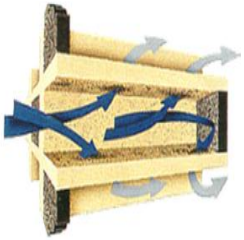


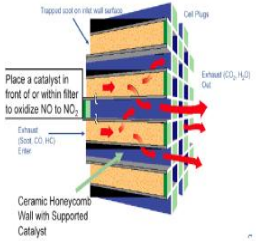


- Additional Transformation of No to NO2.
- PM reduction with SoF oxidation.
- Low Maintenance and cost

Challenges:
- Thermal & Chemical stability
- Formation of sulfuric acid

Diesel Particulate Filter (DPF)

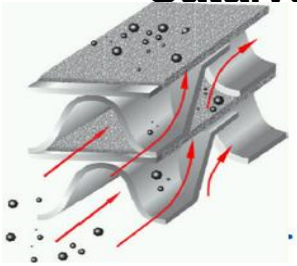


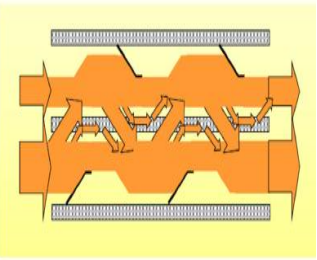


- Consists of particle collecting and the regeneration device
- Reduction of Ultra fine particle
- Filter Efficiency >99%

Challenges
- Regeneration
- Thermal failure

Particulate Oxidation Catalyst(POC)



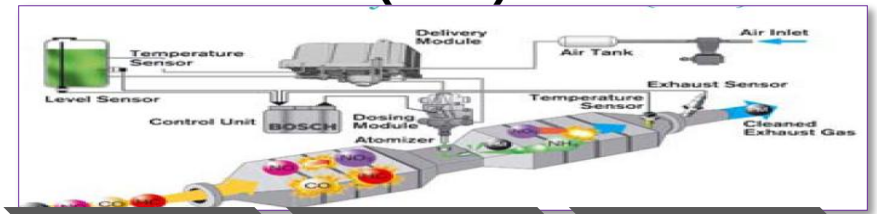


- Filter Efficiency of 60-80%(Less than DPF)
- Passive regeneration(Typically)
- Less sensitive to ash accumulation

Challenges:
- Low Sulfur Diesel

JCB Aftertreatment Technology Strategy

Selective Catalytic Reduction (SCR)



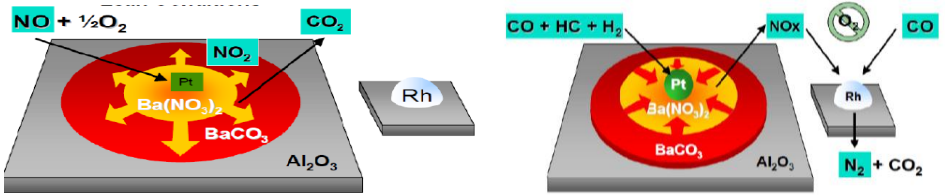
Urea Decomp-osition → SCR Reaction → Ammonia blocking

- Urea – Aqueous solution, Freezing at -11°C
- Catalyst
  - Urea injection and control system
  - Optimized for good fuel efficiency

Challenges

- Infrastructure & Cost
- Sulfur poisoning / desulfurization
- Low temperature range.

Nox absorber Catalyst (NAC) Lean NOx Trap (LNT)



Lean Mode
Nox Stored as nitrate

Rich Mode
Nitrate to NO2 ; NO2 to N2

- NOx conversion efficiency 10%-25%
- Option for retrofit/Easy to install and integrate

Challenges

- Sulfur poisoning / desulfurization
- Long-term stability / thermal aging
- Limited DeNOx regen operation area.

Key Challenges

T4f Compliance

2021/22

Challenges related to T4final development :

- ❑ **Packaging** and **sign-off** of **exhaust after-treatment** installation including
  - **SCR** (catalyst)
  - **DEF** (diesel exhaust fluid) injection system and
  - **On board diagnostic** to monitor and control the NOx content in the exhaust
- ❑ **Complex technology** for after market support & End user

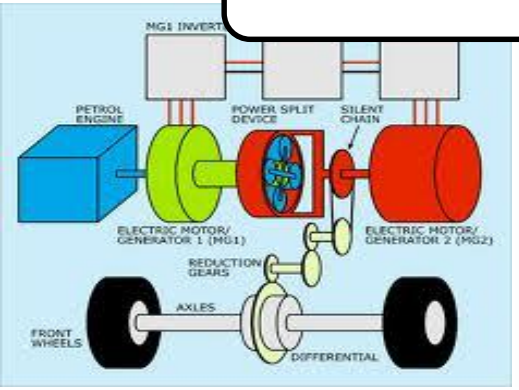
- ❑ Fuel Quality and Adulteration would pose challenge to system reliability.
- ❑ Cost to end Customer.

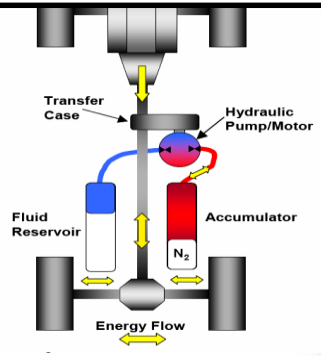
Huge Investment

Price Increase

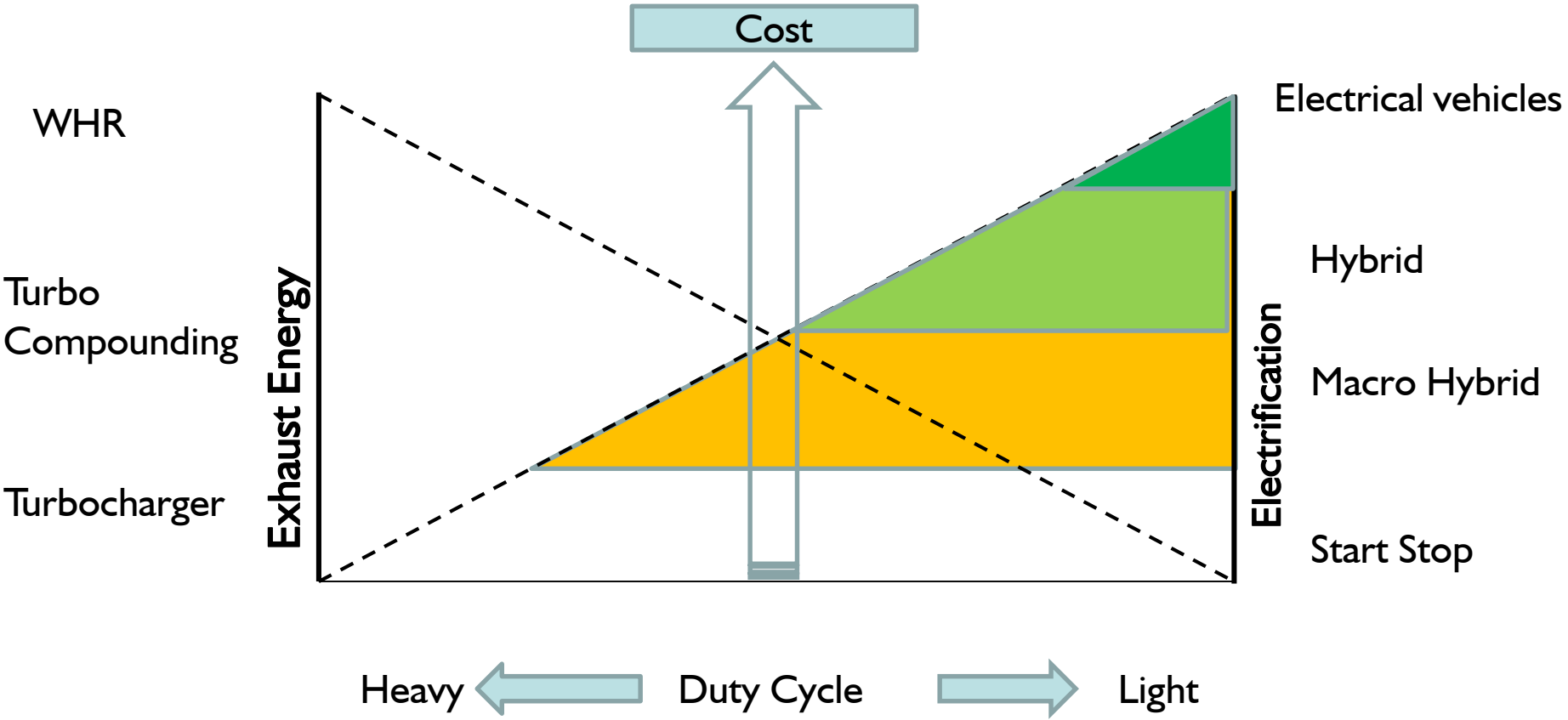
Alternate Energy

Fuel Efficiency up by 40%
Carbon footprints reduction by 30 %





Efficiency Improvement



Summary

- NRMM industry is on a cross road where it needs to preparing for next level of Challenges.
- BS IV significant impact on powertrain footprint (technology, manufacturing, FIE, supply chain, after-sales as well as the Customer).
- No. of Potential solutions for BS IV possible, but key lies in well Integrated Solution that meets end Customer requirement and Aftermarket support.
- Industry is ready with technology, however the lead times high to establish the footprint.

Summary

- NRMM Industry population would rise by 2020, pressure on fuel demand and environment impact esp. CO2 emissions.
- Fuel Efficiency is the big opportunity, need for Innovations to generate at least 30% reduction.
- Opportunity areas : Efficiency Innovations, Hybrid Technologies, Alternate Fuels, FE Labeling, Incentivization etc.

Thank You