



## ***E-mobility – Indian Roadmap Perspective***

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The Automotive Research Association of India*

# ***Presentation Outline***

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# About ARAI



**Establishment** : 1966

**Location** : Pune, INDIA (150 km from Mumbai)

**Manpower** : 530+

**Facilities** : 11 Laboratories – Powertrain, Emissions, Safety & Homologation, Passive Safety, Vehicle Evaluation, Materials, Automotive Electronics, NVH, CAE, Structural Dynamics, Calibration, Post Graduate Academy, Forging Industry Division

**Our Offices** : China, Korea and Chennai

**Investments** : USD \$ 60 Million

**Accreditations** : ISO 9001, 14001, OHSAS 18001 & NABL

# About ARAI

## **R&D**

- Sponsored R&D work for the Automotive and Component industry
- Self funded R&D Projects in futuristic areas
- Government funded R&D Projects in areas of common interest to the Auto Industry

## ***Homologation for OEMs and component manufacturers***

- In India ~80% of homologation work is done by ARAI

## ***Standards formulation***

- Helps the Government in preparation of safety and emission road map and formulation standards in association with the automotive industry, BIS, Ministry of Industries, etc.
- WP29 India Secretariat (UNECE activities of World Harmonization of Regulations)

# ARAI's Journey

**1970**

Testing House

**2010**

Testing + R&D House

**1970 – 1980**

Focus Area

Facility  
Establishments

**1981 – 1990**

Focus Area

Testing  
Competency

**1991 – 2005**

Focus Area

Technology  
Development

**> 2005**

Focus Area

Research

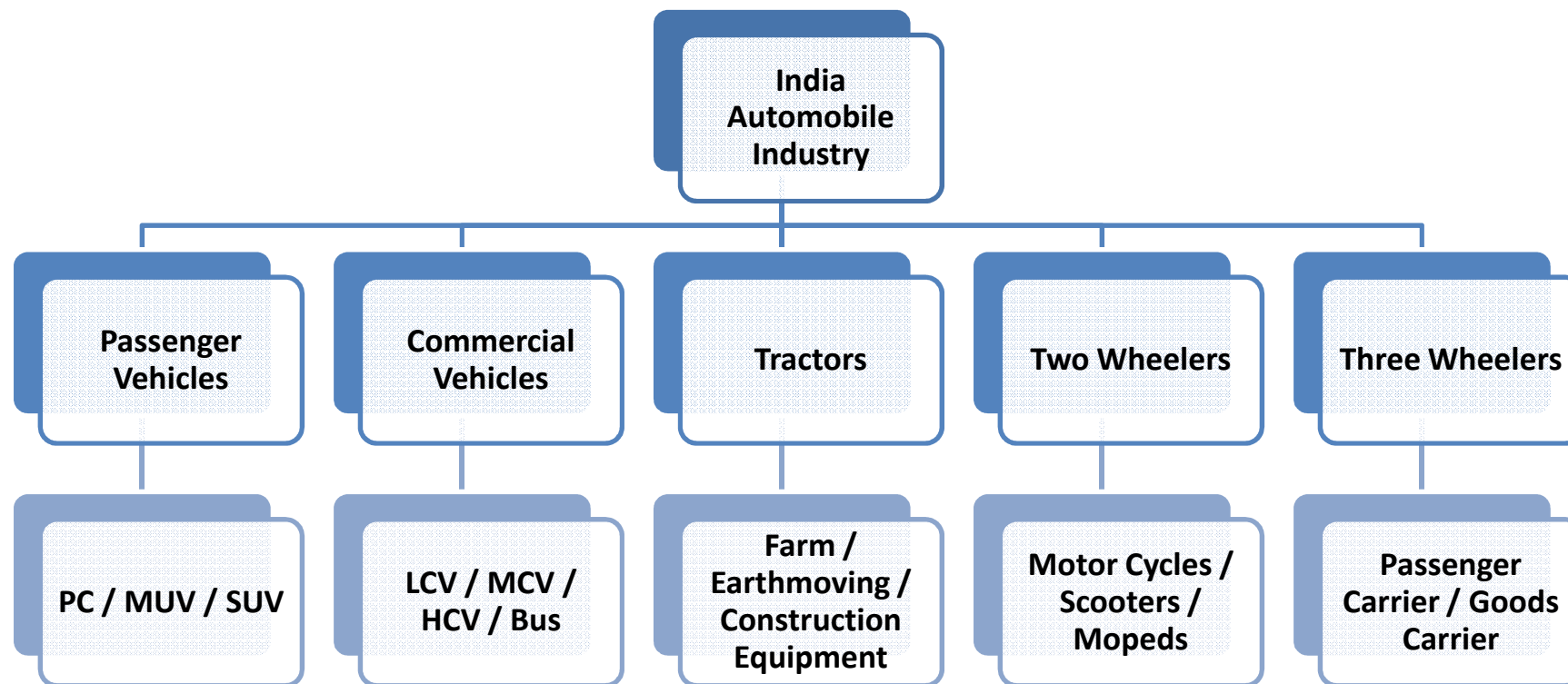
Tools

Experience

Expertise

Knowledge

# Indian Automotive Industry



# ***India As An Automotive Hub - Advantages***



# ***India As An Automotive Hub - Rankings***

***WORLDS SECOND LARGEST TWO  
WHEELER MARKET***

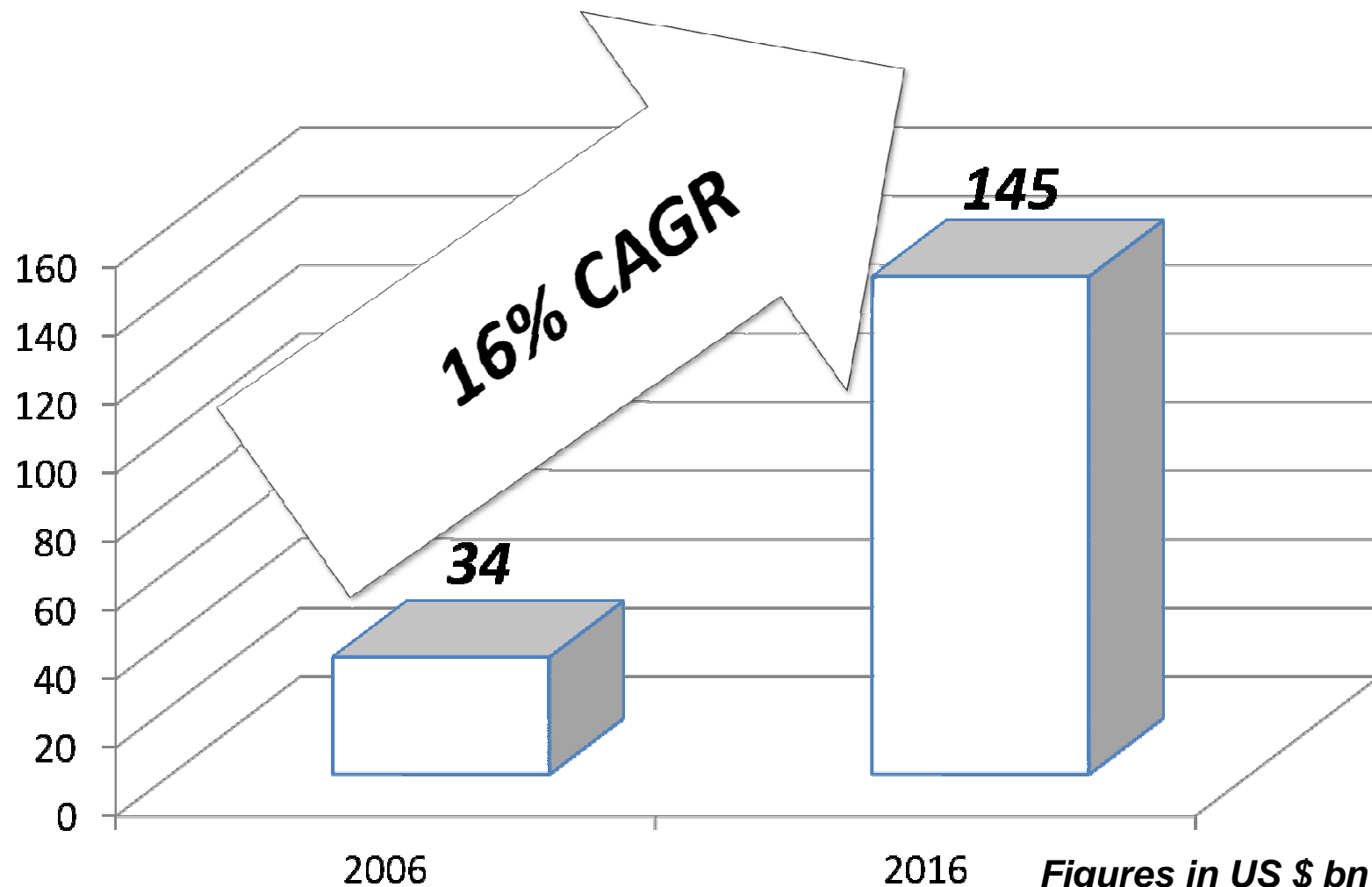
***ASIAS THIRD LARGEST PASSENGER  
VEHICLE MARKET***

***WORLDS FIFTH LARGEST BUS AND TRUCK  
MARKET (BY VOLUME)***

***WORLDS FOURTH LARGEST COMMERCIAL  
VEHICLE MARKET***

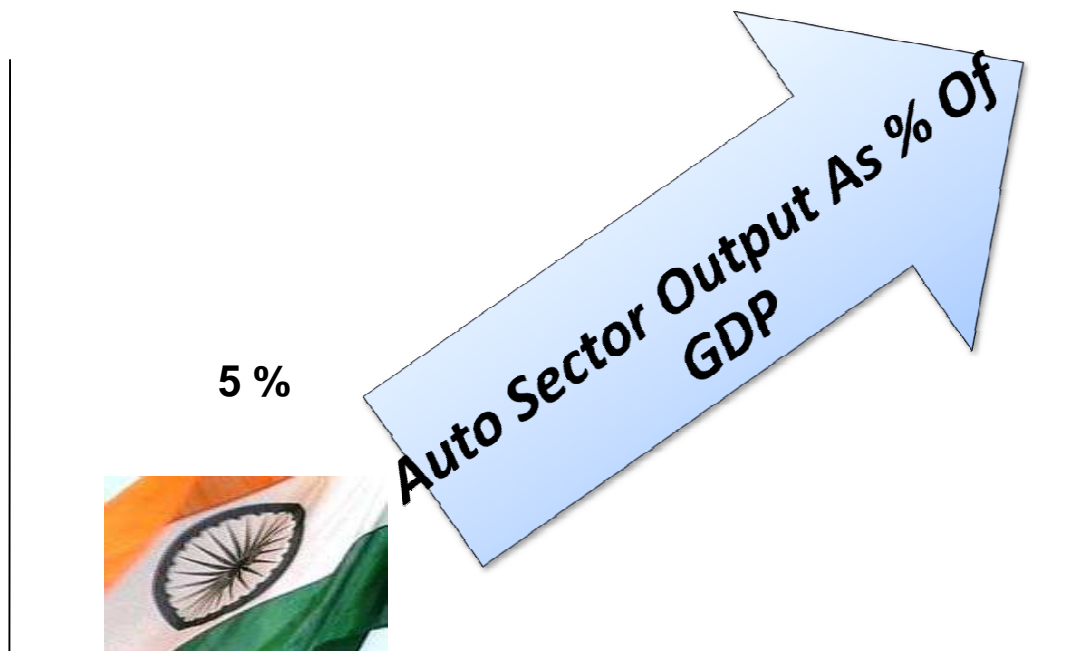


# Indian Automotive Industry – Turnover Forecast



Figures in US \$ bn  
Source: Automotive Mission Plan

# Indian Automotive Industry – Contribution To GDP



India

Source: Automotive Mission Plan

## BRIC – Projected GDP Growth Rate

Year	Brazil	Russia	<i>India</i>	China
2000 – 2005	207	5.9	<b>5.3</b>	8.0
2005 – 2010	4.2	4.8	<b>6.1</b>	7.2
2010 – 2015	4.1	3.8	<b>5.9</b>	5.9
2015 – 2020	3.8	3.4	<b>5.7</b>	5.0
2020 – 2025	3.7	3.4	<b>5.7</b>	4.6
2025 – 2030	3.8	3.5	<b>5.9</b>	4.1
2030 – 2035	3.9	3.1	<b>6.1</b>	3.9
2035 – 2040	3.8	2.6	<b>6.0</b>	3.9
2040 – 2045	3.6	2.2	<b>5.6</b>	3.5
2045 – 2050	3.4	1.9	<b>5.2</b>	2.9

Source : *Dreaming With BRICs: The Path to 2050* by Goldman Sachs

# ***Low Carbon Vehicles - Driving Forces***

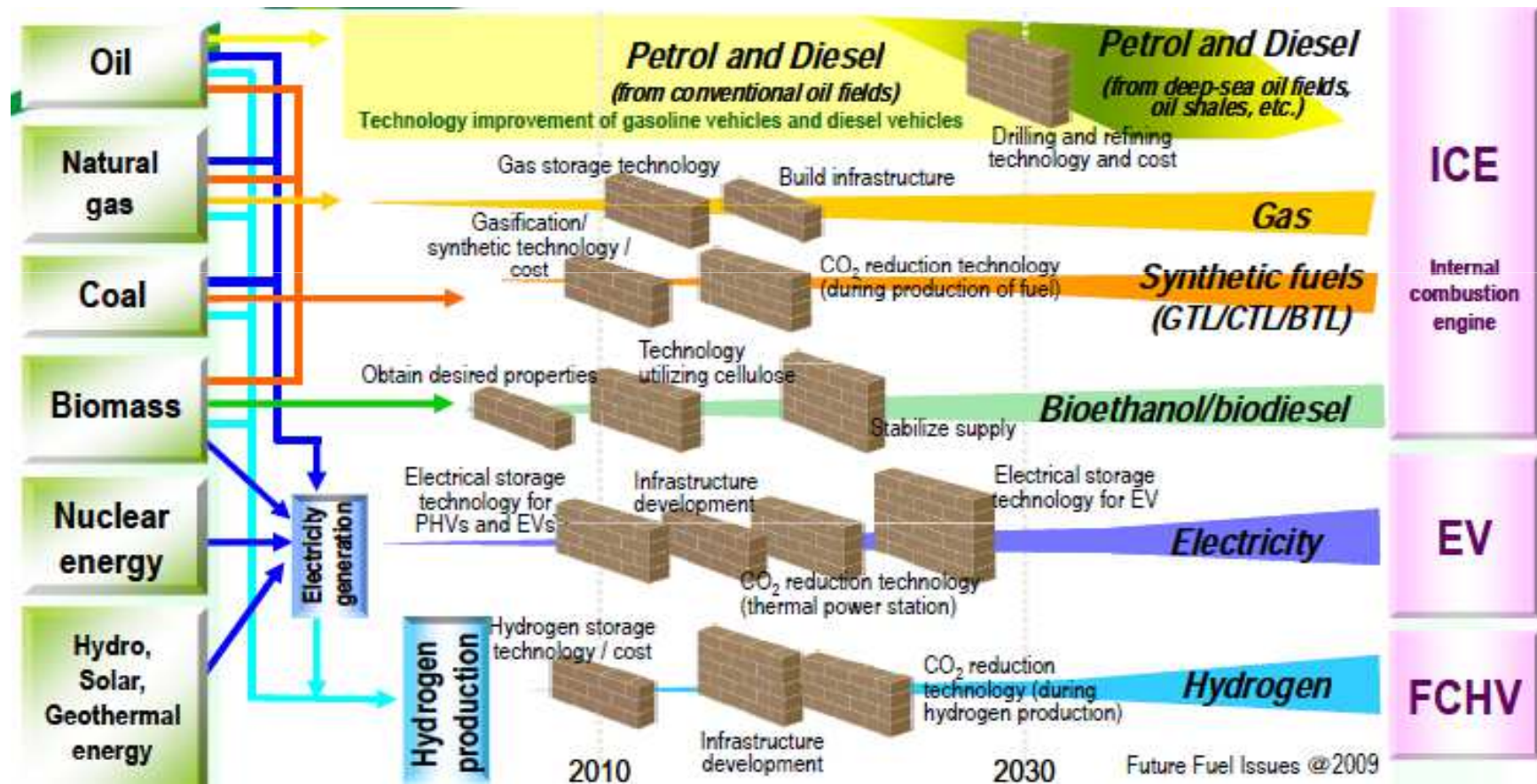
## ***High GHG Emissions***

- ***India 4<sup>th</sup> In CO2 Emissions***
- ***CO2 Emissions From Transport Sector Was 1853 Mt In Year 2005***
- ***CO2 Emissions From Fossil Fuels Was 1167 Mt (63%) In Year 2005***
- ***CO2 Emission From Road Transport Was 135 Mt (7%) In Year 2005***

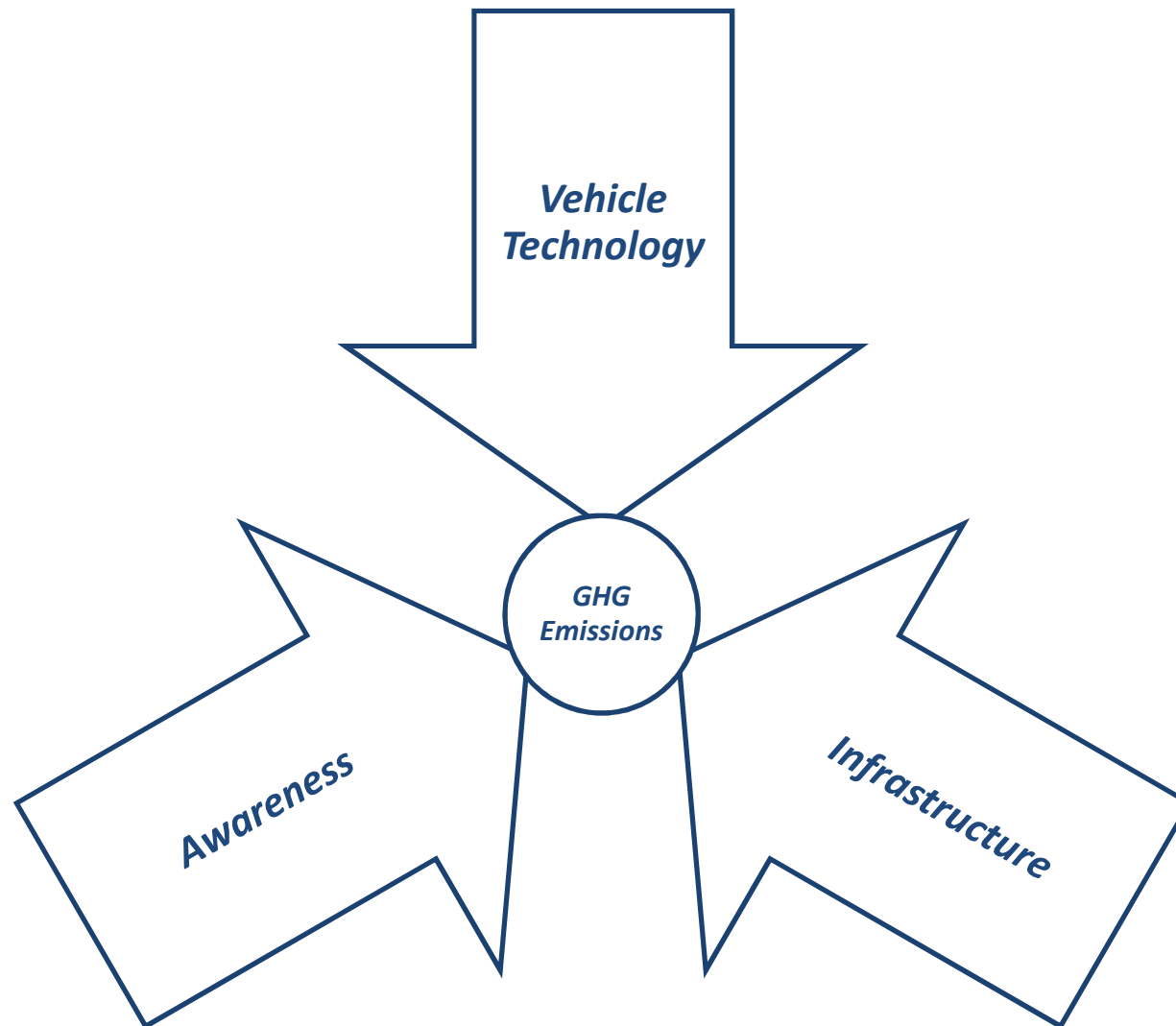
## ***Multiple Growth In Indian Automotive Industry***

- ***Reflection In Total CO2 Emissions***
- ***Urban Air Quality***
- ***Oil Dependency***
- ***Transportation Issues***

# Low Carbon Vehicle - Pathways



# Controlling GHG Emissions From Transport Sector



# ***Low Carbon Vehicles - Technology***

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**Engine Technology**

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**Efficient Alternator System**

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**Weight Reduction**

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**Aerodynamic Drag**

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**Hybrid Technology**

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**Tyre Technology**

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**Air Conditioning Systems**

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**Alternate Energy Vehicles**

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**Life Cycle Assessment Of Vehicles**

# Low Carbon Vehicles - Technology

## Engine Technology

- Variable Valve Technology
- Cylinder Deactivation
- Dual Clutch Transmission
- Direct Injection

## Accessories Technology

- Efficient Alternator System
- Electric Power Steering
- Improved Oil And Water Pump

## Weight Reduction

- Every 10% Weight Reduction – FE Up By 7%

## Aerodynamic Drag

- Reduced Aerodynamic Drag – FE Up By 2%



# ***Low Carbon Vehicles - Technology***

## **Hybrid Technology**

- Mild Hybrid – FE Up By 10 To 15%
- Full Hybrid – FE Up By 30 To 40%

## **Tyre Technology**

- Reduced Tyre Rolling Resistance – FE Up By 2%

## **Air Conditioning Systems**

- Use Of Energy Efficient Compressors
- Use Of Low GWP Refrigerants
- Reduce Refrigerant Leakage

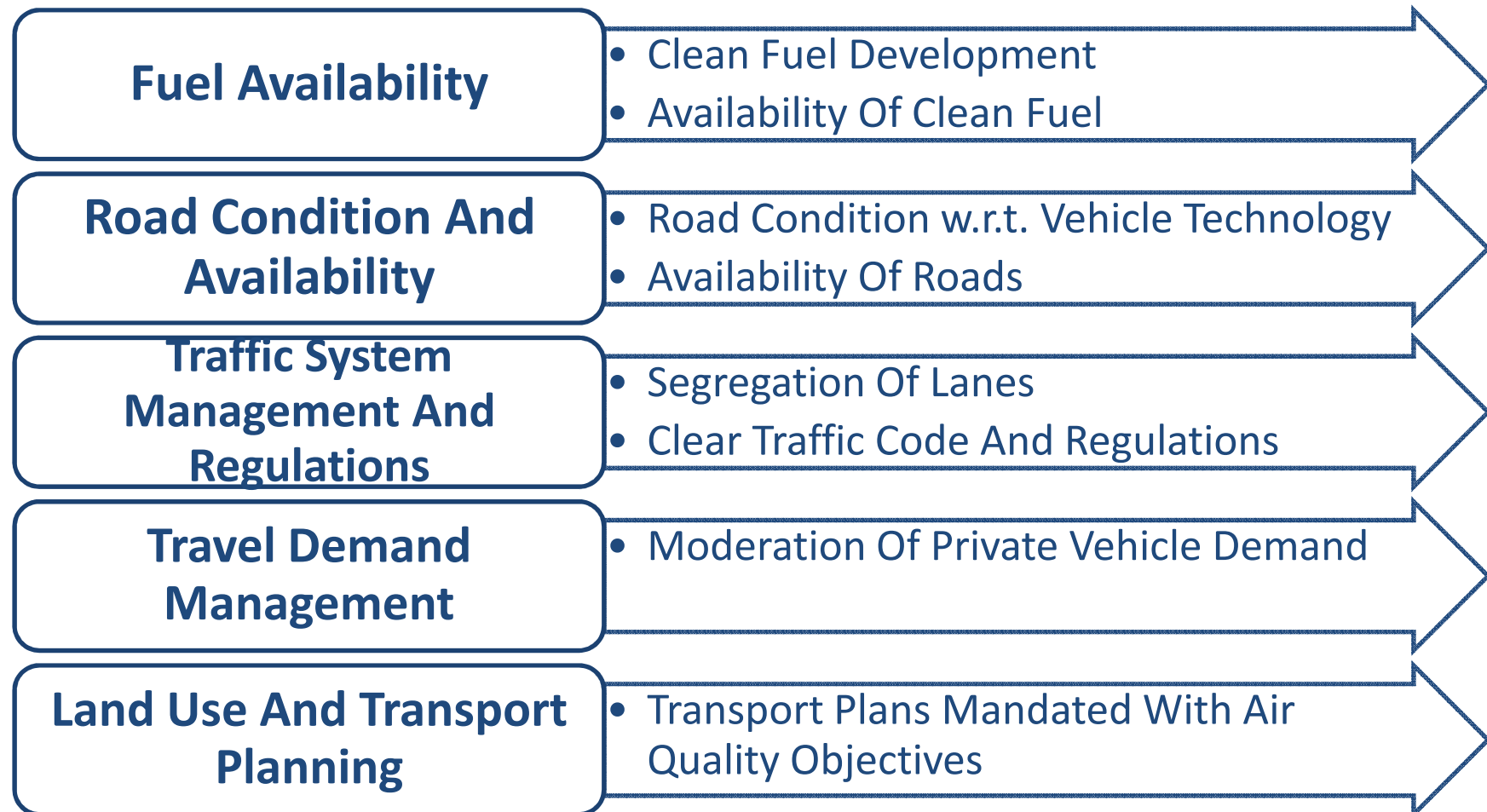
## **Alternate Energy Vehicles**

- Hybrid, EV, CNG, LPG, Biofuels, Solar, Hydrogen

## **Life Cycle Assessment Of Vehicles**

- Material Extraction And Processing
- Manufacturing
- Fuel Production
- Vehicle Use

# ***Low Carbon Vehicles - Infrastructure***



# ***Low Carbon Vehicles - Infrastructure***

## **Inspection And Maintenance Centers**

- Availability Of Service Centres
- Identification Of Gross Polluting Vehicles And Ensuring Their Repairs

## **Fleet Management And Sectoral Shift**

- Improvement And Promotion Of Public Transport
- Vehicle Scrapping Policy

## **Retrofitment**

- Up Grading In Use Vehicles To Meet New Norms
- Need To Have Network Of Authorised Retrofitment Agencies
- Cost Effective Option

## **Transport Information System**

- Transport Data Management
- Transport Network Overlays
- Fuel And Emission Data Management

# ***Low Carbon Vehicles - Awareness***

## **Eco Driving Habits**

- Accelerate Smoothly, Brake Gradually, Check Tyre Pressure
- Avoid Clutch Riding, Start Engine When You Are Fully Ready

## **Vehicle Maintenance**

- Regular Servicing Of Vehicle

## **Driving Planning**

- Plan Driving Route Based On Traffic Conditions

## **Good Product Choice**

- Procurement Of Green Product

# ***Low Carbon Vehicles - Awareness***

## **Timely Product Renewal**

- Scrap Old Vehicles

## **Tyre Replacement**

- Replace Old Tyres As Per Recommendations

## **Incentives For Promotion Of Eco Driving**

- Monetary Incentives For Commercial Vehicle Drivers
- Reward Best Eco Drivers

## **Compliance With Traffic Discipline And Regulations**

- Awareness Campaign On Traffic Discipline And Regulations

# ***EVs As A Solution For India - Challenges***

- **Are we shifting pollution sources from urban to power plant?**

- $\eta$  of IC engine < 30% (well to wheel)

- $\eta$  of electric > 85% (socket to wheel)

- What about energy up to socket?

- Depends on power plant

- In India, dominating power source is Thermal

- If it is continued....

- **Is sufficient “electricity” available to support “electrification” of vehicles?**

- UK study shows peak power demand increase by 2% with 10% PHEVs & un-controlled charging

- What about India?

- More than 25% loss in grid.

- Energy crunch

- Robust grid

- Smart grid

- **Infrastructure for support?**

- Innovations in “Fuelling” options

- Use of renewable energy sources: solar/ wind/ tides/...

# ***EVs As A Solution For India - Challenges***

- **Is EV affordable?**
  - Initial cost
  - Life cycle cost
  - Need to have special promotional policies
- **Is EV acceptable?**
  - Does meet consumer demands?
  - Features compared to ICE?
  - "Zero fuelling time"?
  - Cost sensitivity
- **Can international solution be directly adopted?**
  - Cost
  - Consumer requirements of various segments
  - Climate
  - Drive patterns
  - Supply chain
- **Adaptation**
- **Availability**
- **Indigenous solutions**

## ***Still Want To Go EV Way....***

Have a vision for EVs in India: 2030 & Beyond

- Cohesive focused efforts of
  - OE, component
  - R&D wing
  - Government in terms of
    - Policies
    - Incentives
    - Infrastructure
- Based on vision, prepare a roadmap for
  - Technology
  - Policies
    - Role of various govt wings/ departments



# ***Policy Roadmap***

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- Everyone has a role to play
  - Infrastructure:
  - Grid Strengthening:
  - Renewable energy:
  - Environmental effects/ LCA:
  - EV manufacturing
  - On road taxation& incentives
  - Technology mapping, synergy in R&D efforts &innovation

***Let's Work Together For A Brighter Future...***

***Thank you!***

