

xEV: POLICIES & IMPLEMENTATION STATUS IN INDIA

Shrikant R. Marathe

Director

Automotive Research Association of India (ARAI), Pune, India

2nd AAI – Summit , Electric Vehicle Session
Denpasar, Bali, Indonesia
26th November 2013

Presentation by
Neelkanth V. Marathe

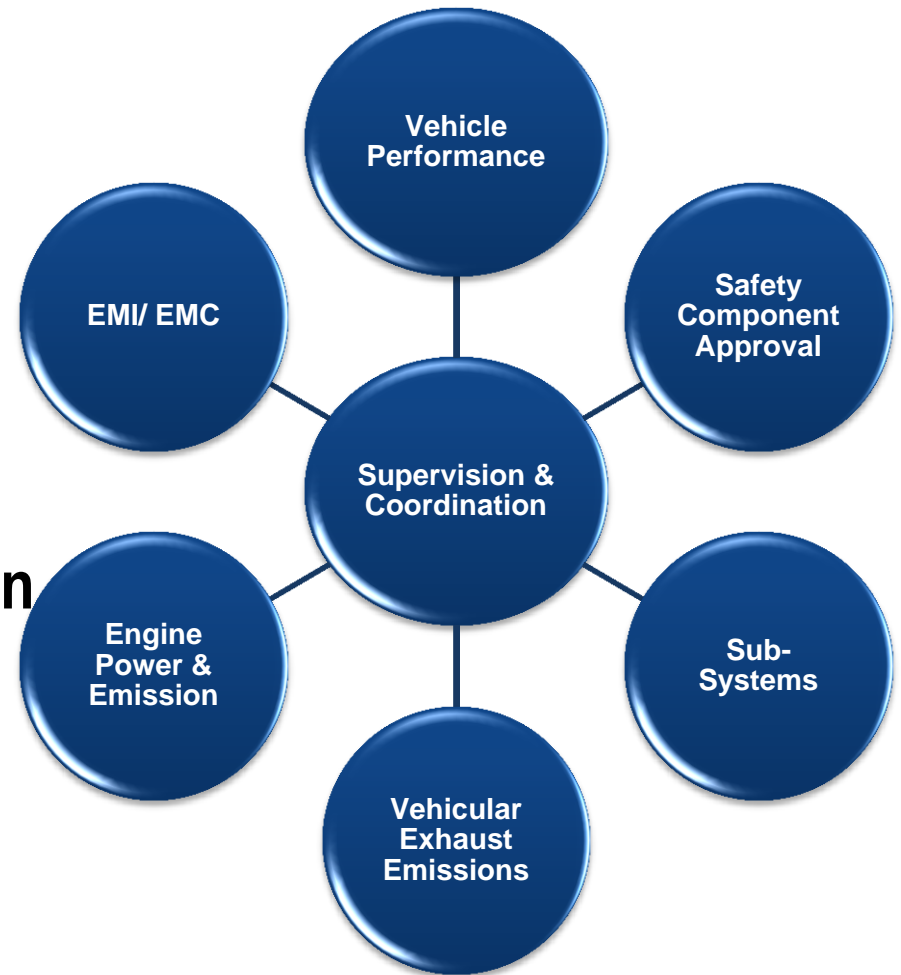


About ARAI



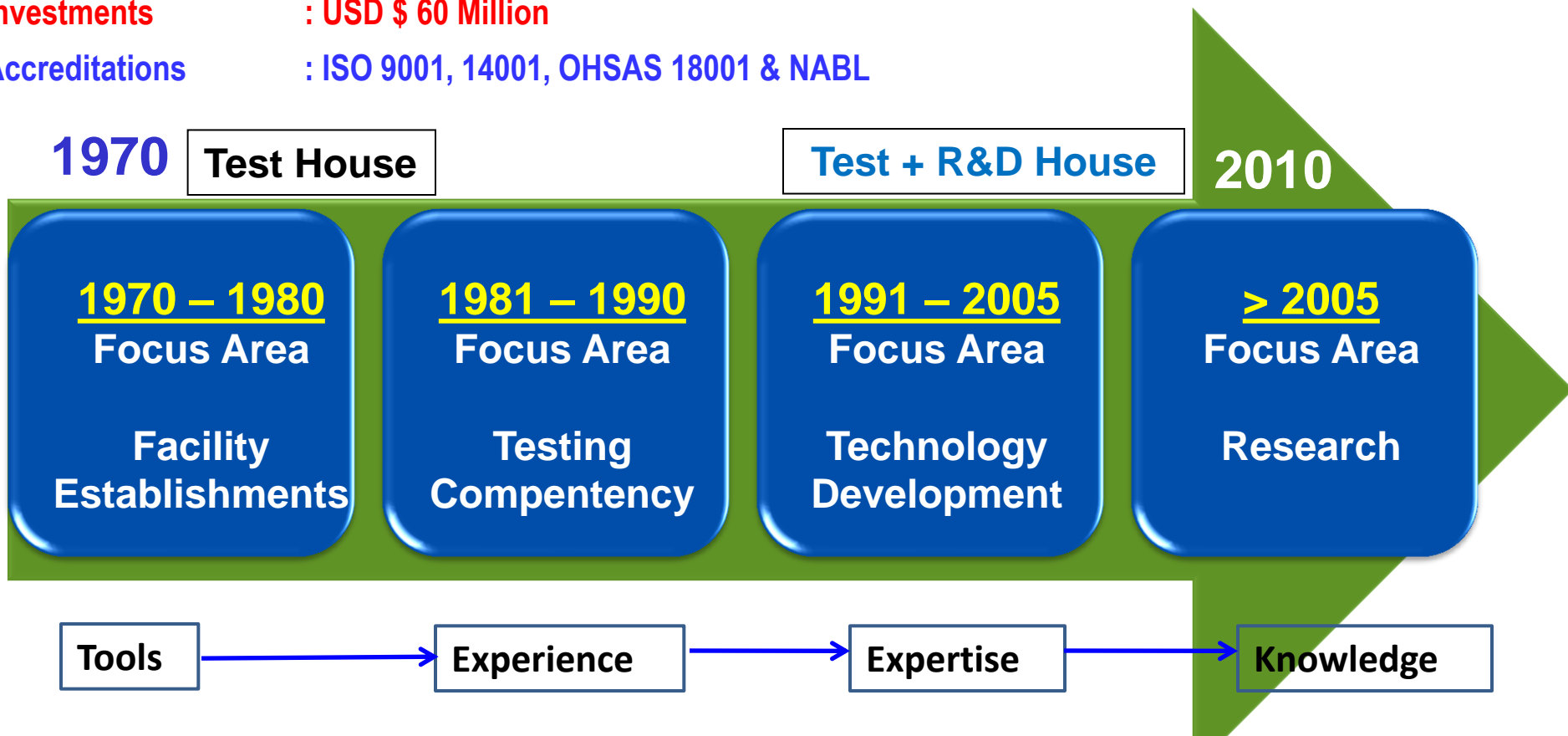
Activities

- Automotive R and D work
- Certification testing / Homologation
- Assist Government in formulation of regulatory standards and harmonization of regulations
- Education and Training
- Consulting Services




ARAI Overview

- Establishment** : 1966
- Location** : Pune, INDIA (150 km from Mumbai)
- Manpower** : 600+
- 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 Within India-Chennai
- Investments** : USD \$ 60 Million
- Accreditations** : ISO 9001, 14001, OHSAS 18001 & NABL



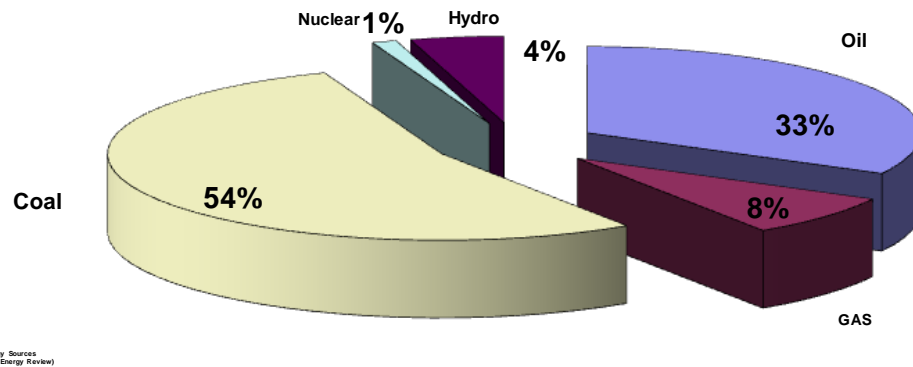
Contents

- 
- India – Mobility scenario**
 - EV Status in the world**
 - India Initiatives**
 - Challenges for establishing EV mobility in India**
 - NEMMP 2020**
 - Summary and Way Ahead**

INDIA Mobility Scenario – Automotive industry at a glance



Indian Automotive Industry



- **India- World's 4th largest consumer of oil. Total oil consumption is approx 170 MMT**
- **Imports 70% of total oil demand**
- **90% of total consumption is utilized by transport sector**

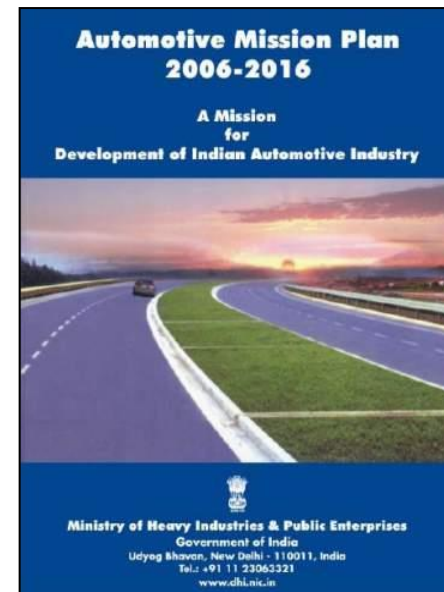
Indian Automotive Industry



- 2nd Largest Two-Wheeler Manufacturer in the World
- World's largest Motorcycle Manufacturer is in India
- 2nd Largest Tractor Manufacturer in the World
- 5th Largest Commercial Vehicle Manufacturer in the World
- 4th Largest Car Market in Asia – 1,545,000 Vehicles

Source :SIAM

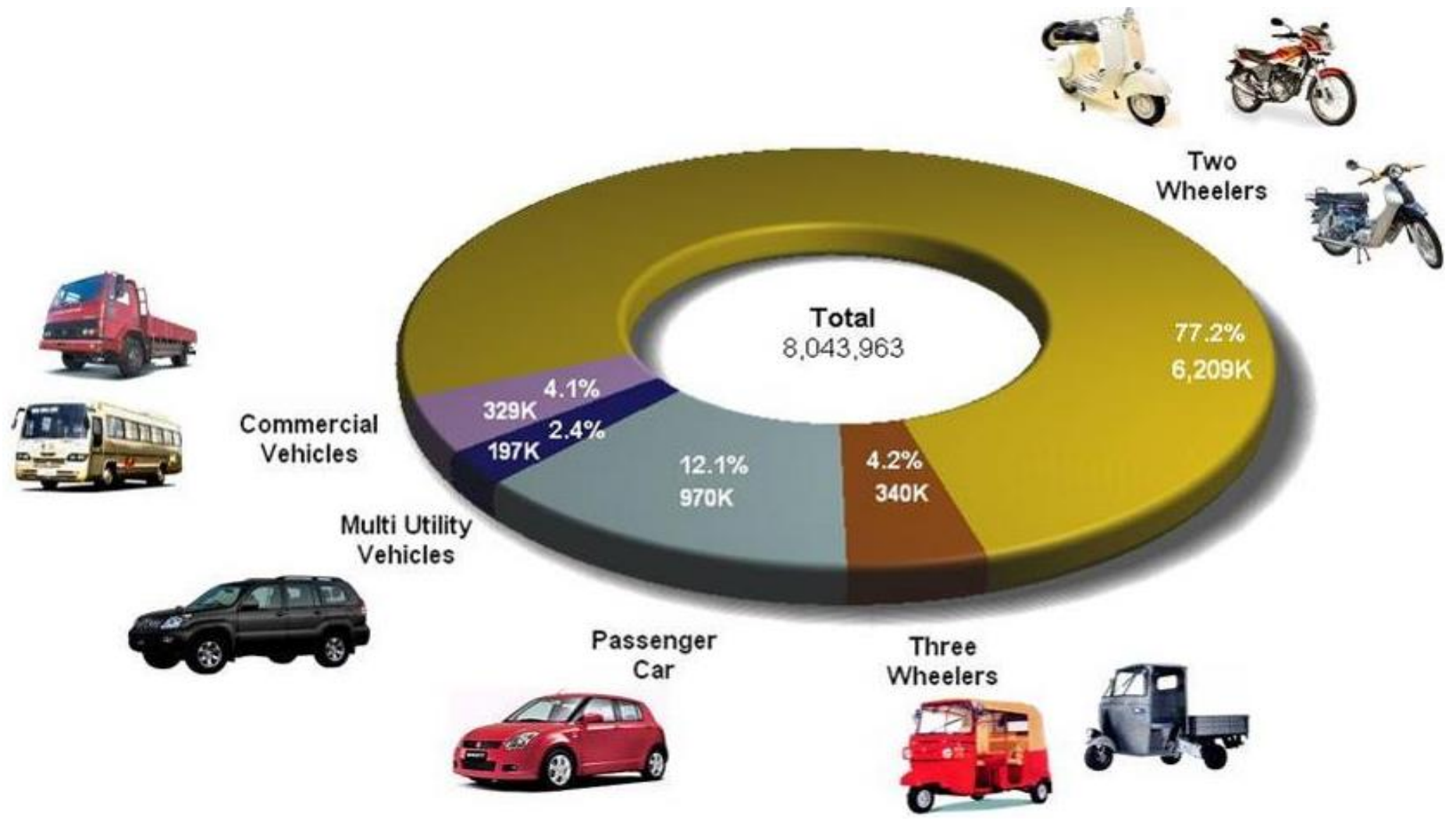
Total Registered Vehicles ~140 Mn



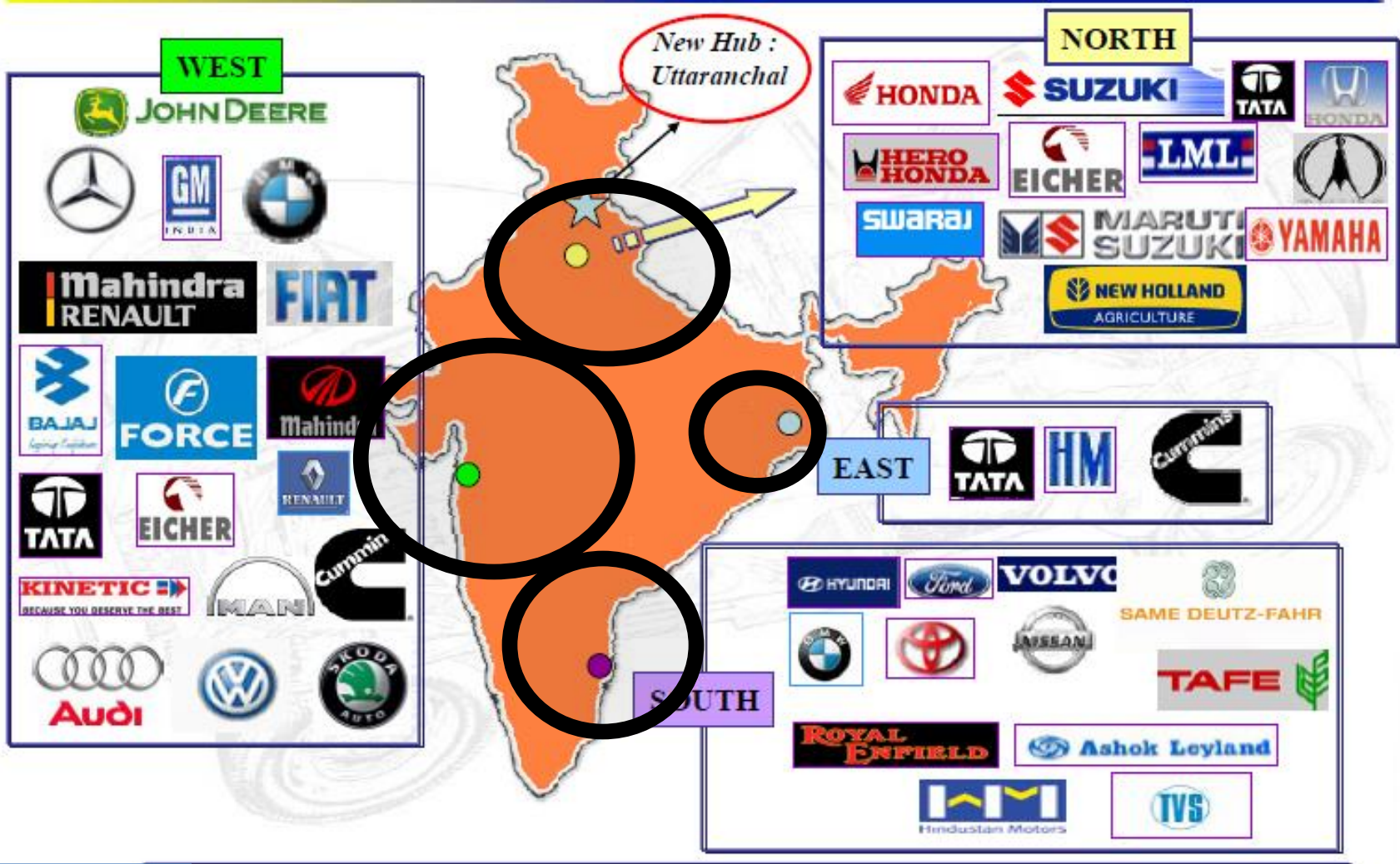
**Turnover from
35 to 145 bn
USD**

**Exports from
4.1 to 35 bn
USD**

Distribution of Automobile Industry in India



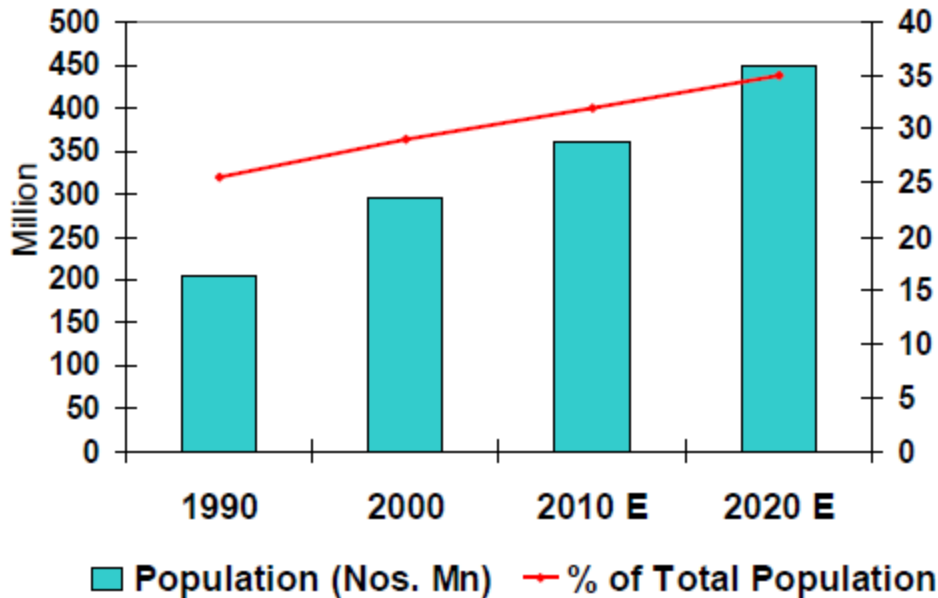
Spread of Indian Auto Industry



Source : SIAM

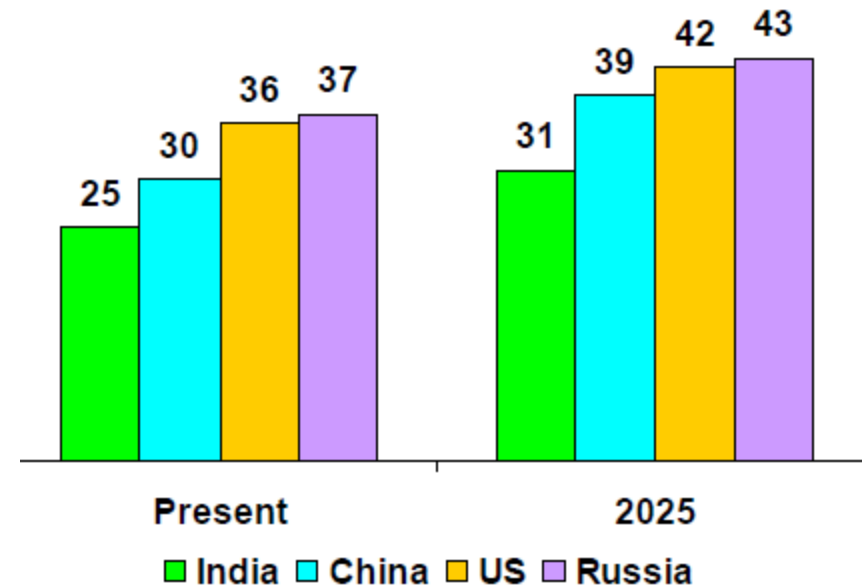
Factors Affecting Vehicle Growth in India

Growth in Urban Population - India



Source : SIAM

Median Age (Years)



India figures as a country of YOUNGER people

Increasing young population with rising disposable income with annual growth rate of 10 % is fuelling the demand for new vehicles

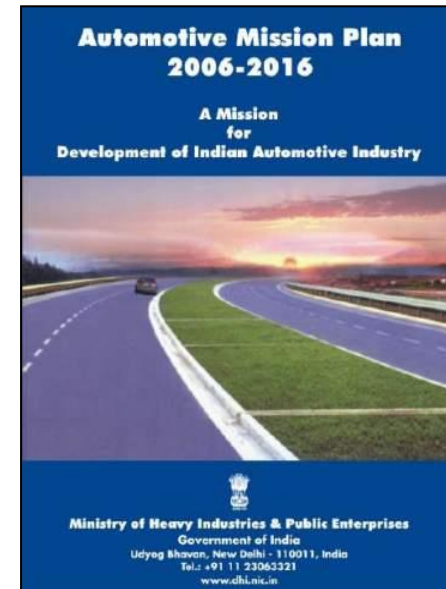
Unique Indian Market

- **140 million registered vehicles in India.**
- **75% 2Wheeler vehicle ; 5 times of car segment.**
- **In car segment, 75% smaller cars i.e. <1.2 l petrol or <1.4 l diesel**
- **Affordability is a major deciding factor for a buyer.**

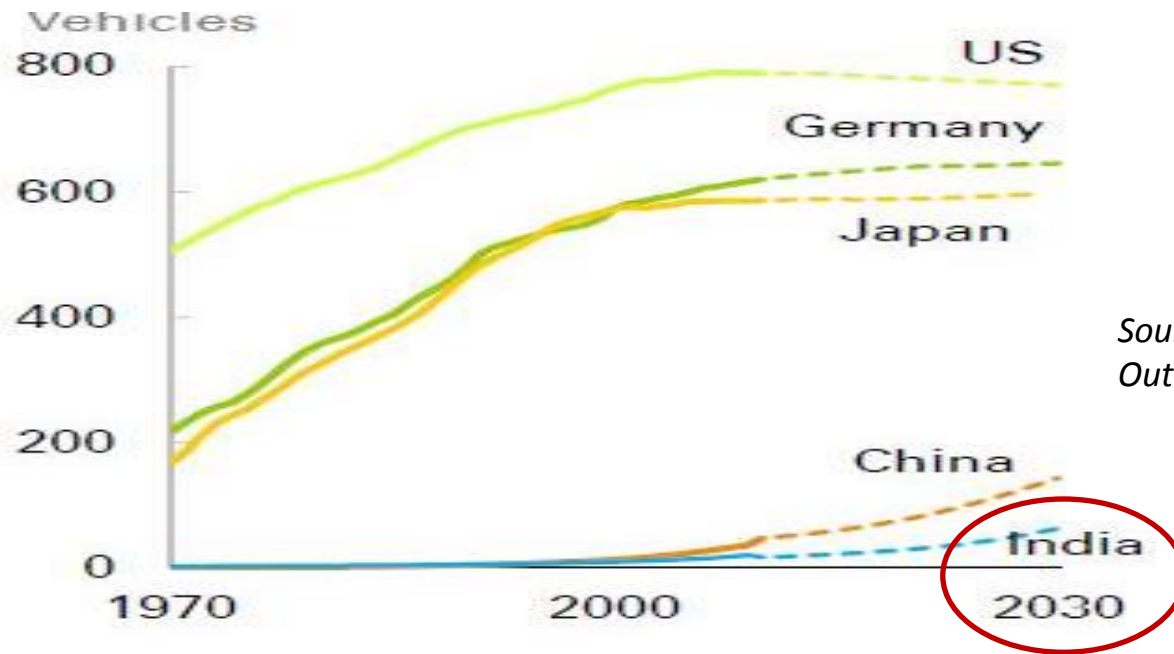
Source: SIAM and ACMA Presentations

Unique Indian Market

- Present vehicle production is 20 million units & India ranked 6th highest vehicle producer worldwide.
- The Automotive Mission Plan 2006-2016
 - Targeted output of Indian Automobile Sector - **\$145 Billion**
 - Doubling contribution in **national GDP (5% to 10%)**
 - Additional **employment opportunities for 25 Million people** in the entire Value Chain
- Automobile production to double by 2020-21



Unique Indian Market



Source: BP Energy
Outlook 2030, Jan 2012

- **Vehicle density per 1000 population in India expected to grow to 65 by 2030**
- **Survey shows that Indian Vehicle population has increased by 183 folds in the past decade**

Source: Estimation of Automobile emissions and control strategies –
K. S. Nesamani, University of California, 2009

EV Status In The World

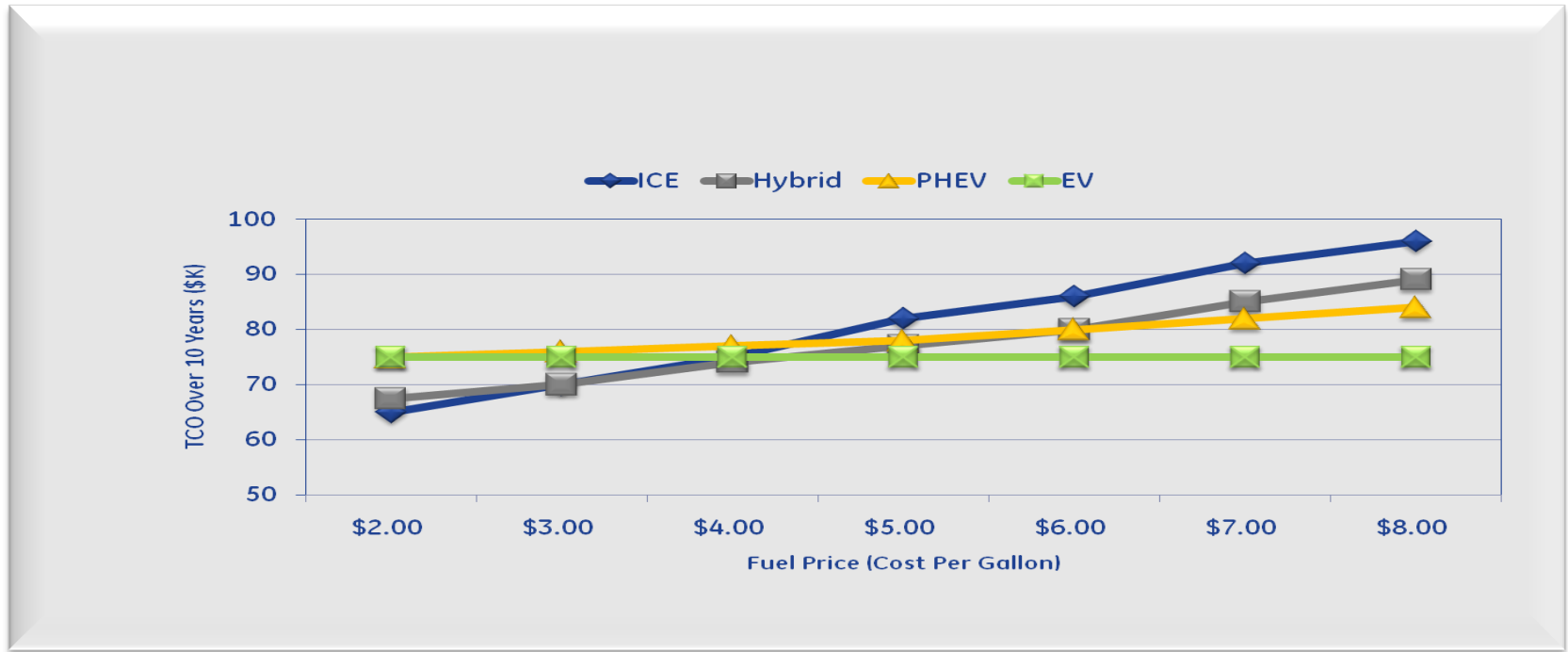


- **More than 100 years after the invention of the I C engine, we are facing significantly growing concerns and challenges.**

- **The reliance on the I C engine as the principal automobile powertrain technology has**
 - **raised environmental concerns,**
 - **created dependence among industrialized and developing nations on crude oil import and**
 - **exposed consumers to volatile fuel prices.**

- In addition, investments made by incumbent automobile manufacturers in manufacturing and technology related to the internal combustion engines have to date inhibited rapid innovation in alternative fuel powertrain technologies.
- these challenges offer an historic opportunity for companies with innovative electric powertrain technologies
- Soon we are going to witness the new technological era of the automotive industry.

Economics will favor Electrification



- Electric vehicles emit zero tailpipe emissions at the point of use. The carbon footprint of electric vehicles is approximately 30% better than that of conventional vehicles, even when the electricity used is produced by a coal-fired power station.
- Total Cost of Ownership (TCO) will become increasingly favorable as the price of fuel rises in the future.
- Current global economic conditions will drive how quickly fuel prices begin to appreciably rise and influence the TCO of various models (ICE, Hybrid, PHEV, EV)..

Governments encouraging adoption of EVs

Governments have introduced consumer EV purchase subsidies and tax exemptions, public/commercial EV fleet subsidies, home charging station subsidies, R&D / manufacturing incentives, free parking and public charging / battery swap infrastructure projects.



- \$ 7,500; \$ 25B Loans
- \$ 2.4B stimulus funds

- € 5,000, 20% Incentive
- Free Parking, \$ 2.2B Charging Network

- 20%, 30% (business) eco-bonus
- 75% (government) eco-bonus

- € 5,000 Congestion/ Excise/ Road-Tax Exemptions

- Import Tax 30% Exemption

Survey of Global Initiatives

Americas

United States

Offers up to \$7,500 for qualified vehicles (Chevrolet Volt, Nissan Leaf, Coda sedan, Tesla Roadster). \$2.8 billion overall budget allocated.

Canada

Plans to have 1 in 20 vehicles driven in Ontario to be electrically powered by 2020. Quebec offers up to \$8,000.

Mexico

Mexico City signed an agreement with Nissan to deliver recharging infrastructure for EVs in 2011.

Brazil

Plans to develop electric vehicles and build solar-powered charging stations in near future.

Europe

United Kingdom

Offers £ 5,000 max or 25% of retail. Plans to have more than 1,000 electric vehicles for its fleet and 25,000 charging points by 2015 to support running of a target 100,000 electric vehicles.

France

Offers €5000 or 20% of retail, valid up to 2012. Offers up to 1,000 charging stations. €400 million budget allocated for incentives, technology, and infrastructure.

Germany

€3,000 to 5,000 for the first 100,000 vehicles. €500 million budget allocated for EV incentives, technology, and infrastructure.

Asia

China

Offers up to USD \$8,800 in subsidies. Plans to invest USD \$15 billion to help domestic automakers put 20 million fuel-efficient vehicles on China's roads by 2020.

India

Offers \$2,200 or 20% of retail for electric vehicles, plus other smaller subsidies for electric 2-wheelers which is majority of the market.

Japan

Enforces periodic vehicle inspection, testing, and taxation based on engine size to drive adoption. By 2020, 1 in 5 will be an EV vehicle. ¥106 billion budget allocated.

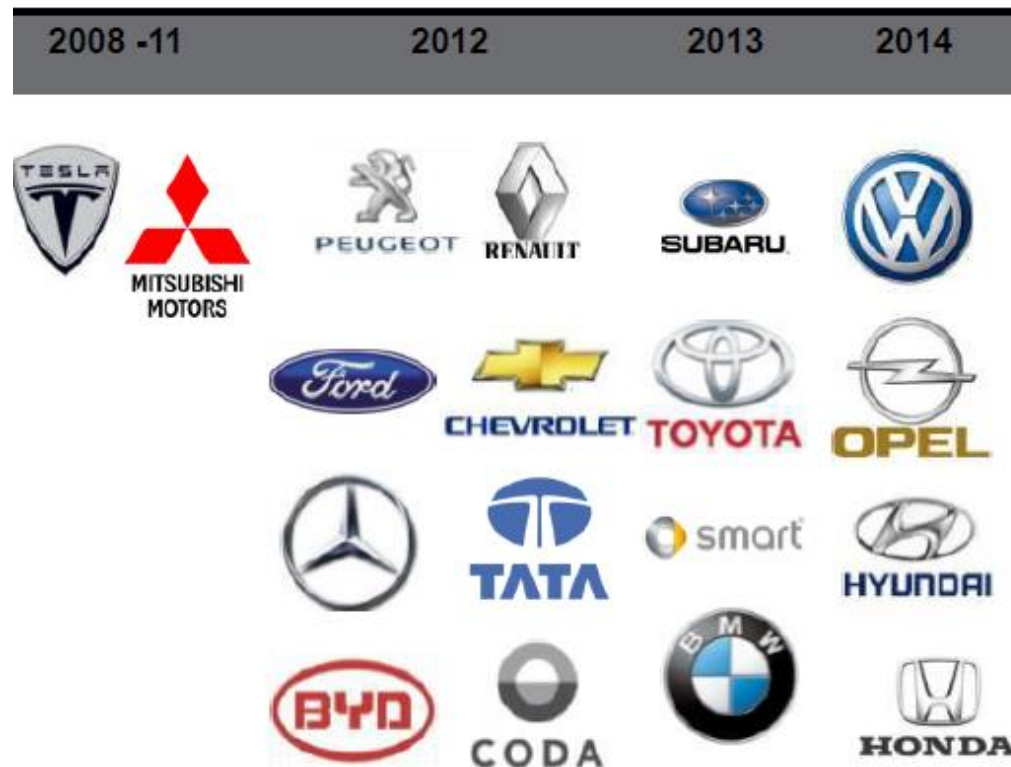
Electric Mobility Gaining Critical Mass

- As of December 2010, Reva i was a mass-produced global EV
- In 2011, Nissan, Chevrolet, and Mitsubishi sold **44,000 Evs**
- **In August 2012, 3.6% of all cars sold in Norway were EVs from 0.1% 1.5 yrs ago**
- In China over 100 million 2 wheeler EVs exist & **20 million were made last year**
- Nearly 40 new production EV models launching by 2013
- Nissan/Renault - \$6 billion EV investment, 7 new EVs, **1.5 million** fleet by 2016
- GM - \$1 billion investment in EV mfg, boosting Volt capacity to 60,000 by 2012
- Mitsubishi – targeting 50% of sales as EV/PHEV by 2020
- BYD - Built team of 10,000 auto, battery engineers for EV R&D
- BMW - New sub-brand, i, for EVs – tagline “Born Electric”
- **Startups** - Tesla (f. 2003, now \$3.5B mkt cap), Fisker (f. 2007, \$500M funding)



Source: Mahindra Reva

Large Investments by OEMs and Supply Chain



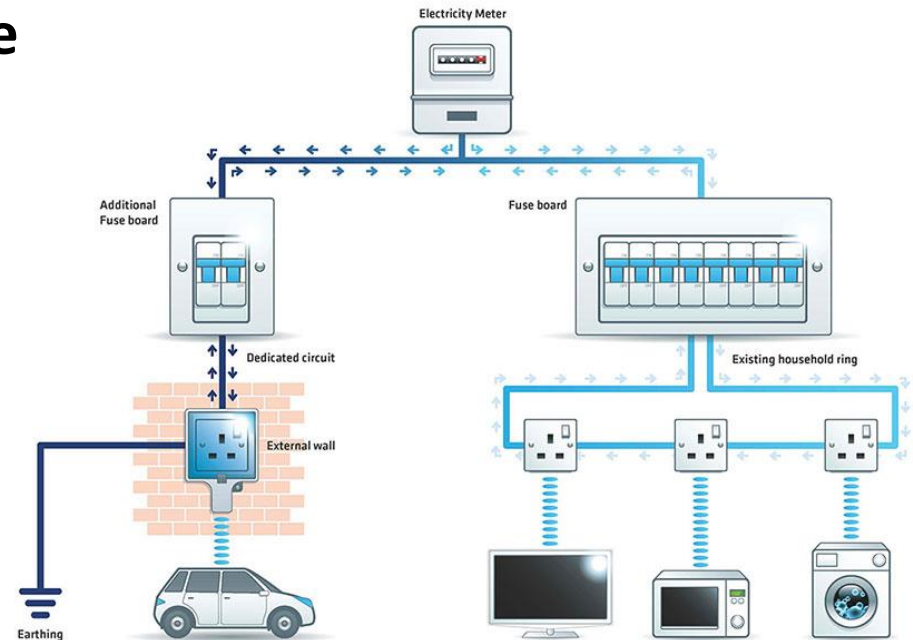
Courtesy: **Mahindra REVA**

- Substantial investment in manufacturing capacity build-out funded by private, public investment; growing economies of scale for key components
- 30 new advanced battery factories in US alone from 2010-2012
- Large Investments in Electric Battery research & development
- Implementation of EVs in corporate vehicle fleet to deal with rising oil prices

“ US President Barack Obama has challenged automakers to put one million EVs on the US road by 2015”

Recent Technology Advancements

- Advances in Li-Ion batteries – 4X lighter, 3X increase in life and can be charged in an hour
- Advancements in electronics – increasing vehicle performance and lowering costs
- “Power Grid” to “Smart Grid”
- New EV technology now lets your EV power your house



Issues related to Electric vehicles

- Needs heavy duty power plug terminal (high current) everywhere: home, parking and street with metering device
- Electric energy infrastructure (generation, transmission and distribution) must be expanded to provide extra energy for this type of cars.
- Travels short distances, inner city
- Low speed
- Battery charging takes time
- Limited battery life
- Safety issues
- Need new regulatory standards and
- Need to build new electric code



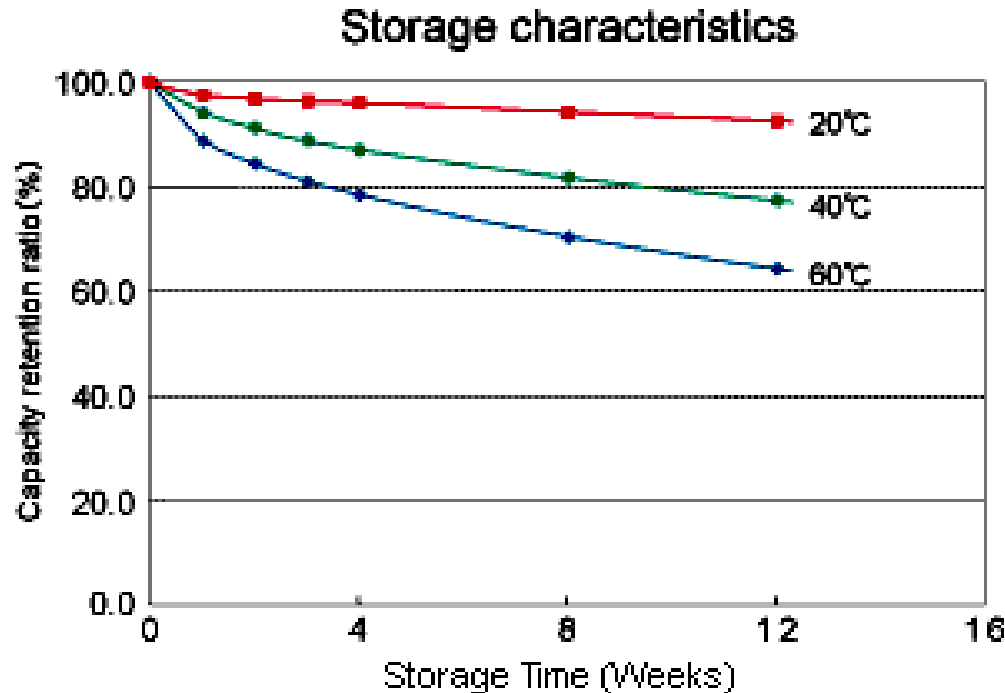
Favoring aspects of Electric vehicles

- Have comparable speed and power
- High overall fuel efficiency, thermal power plants can have up to 80% efficiency and lower emission
- No IC engine, no transmission, no engine oil, no gearbox fluid
- Lower maintenance
- Lower price
- Good for inner city short trips
- Simple and mature tech
- Low noise



Technology challenges and opportunities

- **Battery capacity reduces by time, even we do not use it.**
 - This will impact fuel economy



- **Fuel economy is dependent on battery capacity**

Technology challenges and opportunities

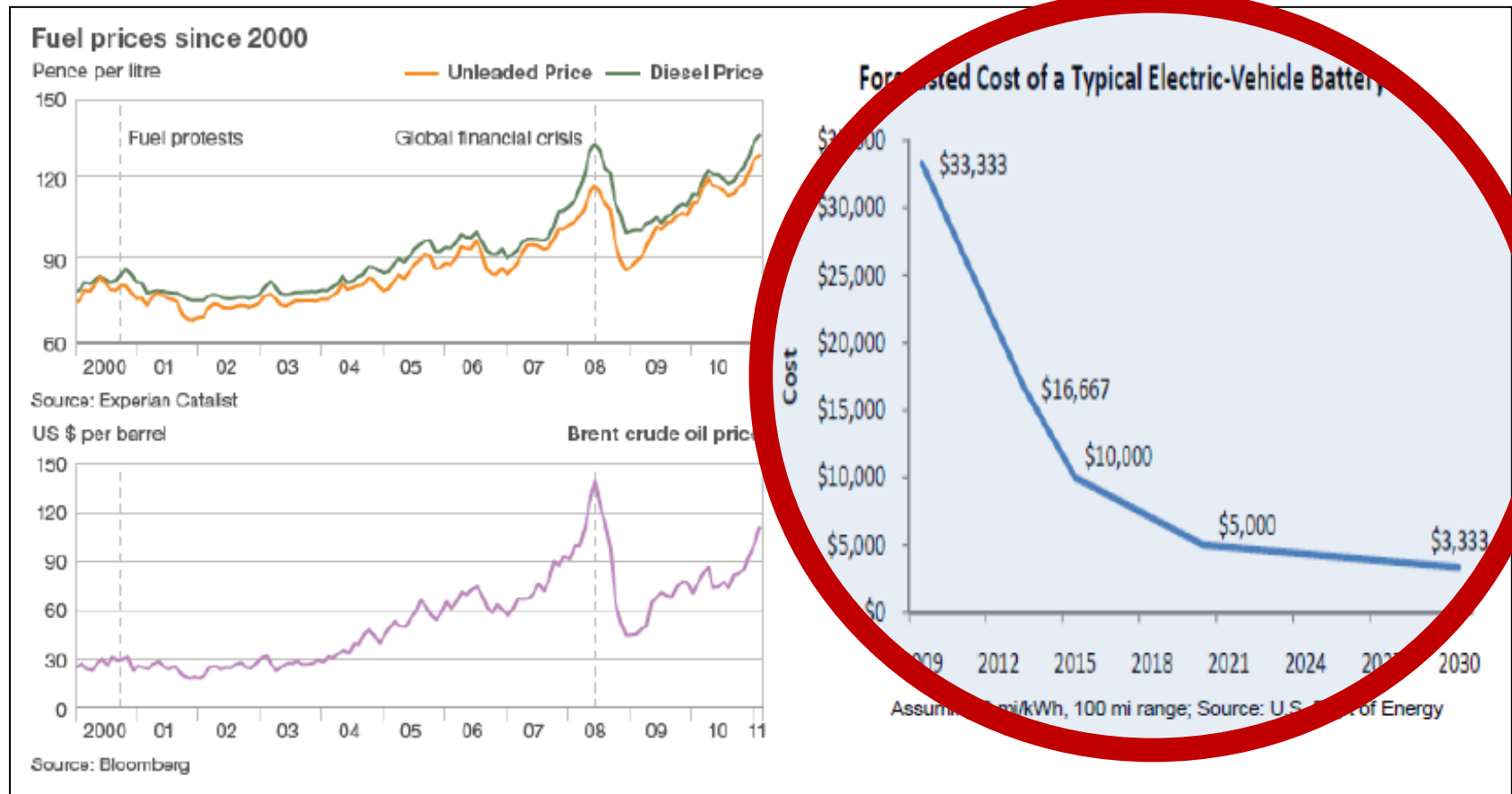
- Time of battery changing is long (plug in hybrid)
- Batteries are heavy
(100kg extra weight consumes 2L/100km more)
- Batteries are expensive
- Low performance in hot or cold temperatures also may damage the battery
- Very sensitive to overcharge/undercharge(Battery life reduces dramatically)
- Contain toxic heavy metals, disposal issue

Opportunity for researchers:

Advance research projects on batteries are supported by governments and industries

Technology challenges and opportunities

Ever Rising Fuel Prices & Falling Battery Prices



INDIA Initiatives

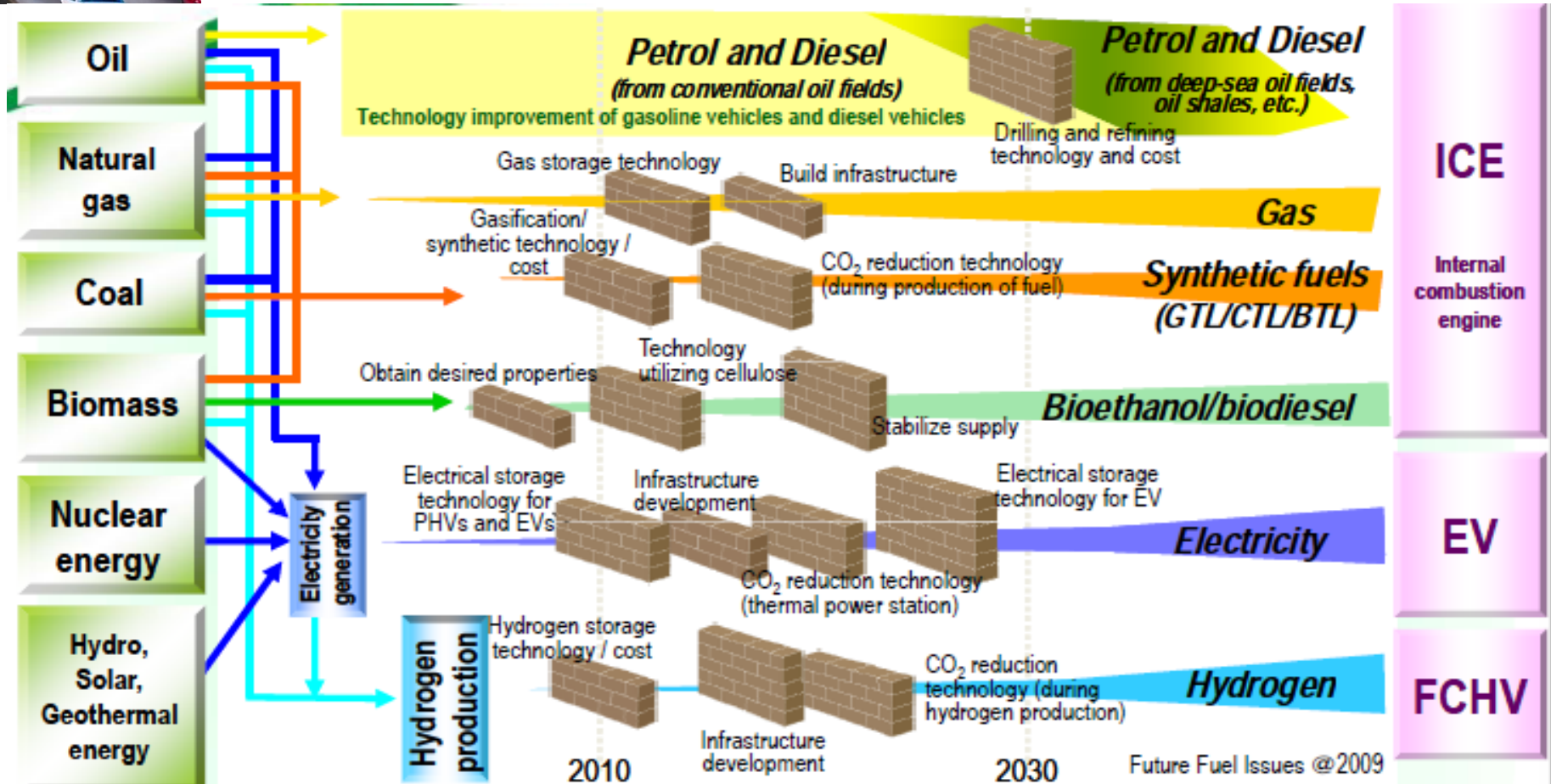
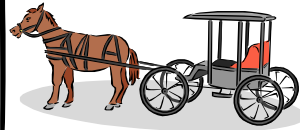
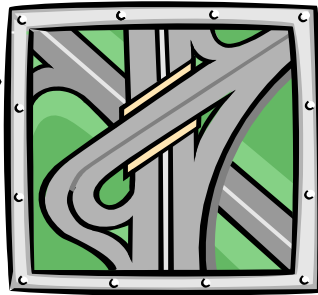
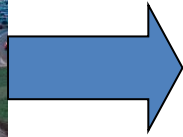
- Cleaner Fuels
- Status of xEV



Cleaner Fuels



Options for A Clean City

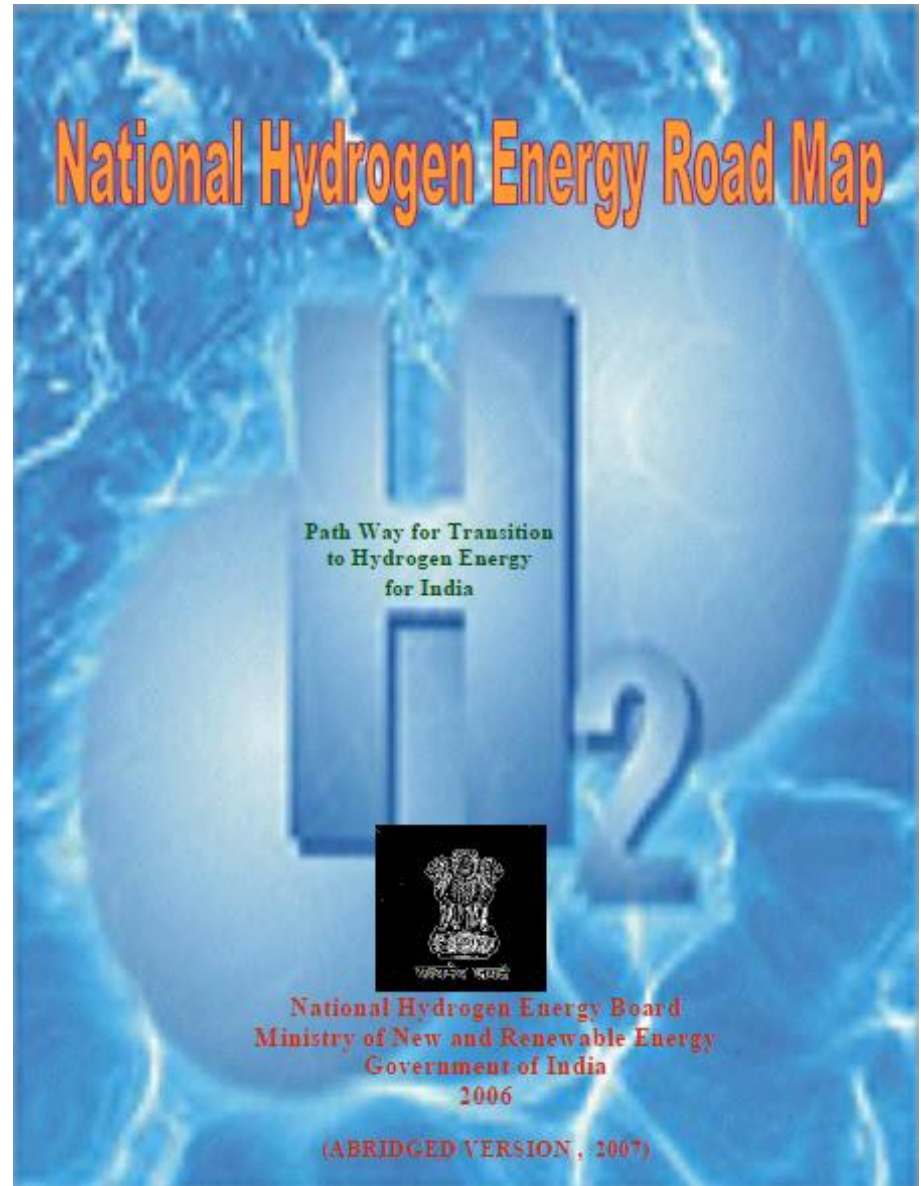


Using Cleaner Fuel...

**CNG operated
commercial fleet
successfully functional in
Delhi since a decade**



Hydrogen Energy...



Solar Energy...

Building Solar India



Jawaharlal Nehru National Solar Mission

JNNSM



Solar Energy...

- Solar system installed at home / over the garage for example
- just charge the electric vehicle before taking it out for a ride
- This potentially would be a very or one of the most clean type of vehicle we can run.
- Solar panels could also be installed on petrol pumps that would become electric charging stations.



Wait and observe if Indian entrepreneurs get into the concept of electric vehicles based on solar charging making it a reality.

xEV Market in India

MARKET

- Electric vehicle market in India is at a nascent stage and is expected to grow at 45% over 2008-09 and 2009-10
- Presently largely comprises of electric cars, 3-wheelers and 2-wheelers
- Electric 2-wheelers dominate the market

xEV Market in India

DRIVERS

- Increases crude oil prices
- Dependence on crude oil – import cost
- Government initiatives
- Lower operating cost
- Lower maintenance cost
- Increasing demand of environment-friendly green vehicles
- Attractive incentives by manufacturers

CHALLENGES

- Low vehicle performance
- Price constraint – high price
- Lack of supply of spare parts
- Battery performance
- Power storage
- Lack of infrastructure

xEV Market in India

TRENDS

- Growing number of players are entering the market
- Increase in number of joint ventures, mergers and acquisitions
- EV players are seeking carbon credit
- Growing competition – most of the players in 2W, only one in car segment

xEV Market in India

GOVERNMENT INITIATIVES

- Demand generation
- Research and development
- Manufacturing incentives
- Infrastructure development

ALTERNATE FUELS FOR SURFACE TRANSPORTATION PROGRAMMES (AFSTP)

NATIONAL ELECTRIC MOBILITY MISSION PLAN 2013 (NEMPP 2013)

xEV Market in India

DRIVERS & CHALLENGES - quantification

<i>Drivers</i>	
Government Initiatives	
Rise in Fuel Costs	
Low Operating and Maintenance Cost	
Foreign Dependence for Crude Oil	
Environment Friendly	

<i>Challenges</i>	
Low Vehicle Performance	
Inefficient Battery	
Price Constraint	
Power Shortage	
Lack of Infrastructure	

Electric Vehicles in India

- Tata had unveiled the eMO, a small concept car in 2012. However, the production on that seems to be dead.
- The famous Tata Nano is also being considered for an electric variant that would make it the cheapest electric vehicle on the road.
- Mahindra & Mahindra has different plans and launched electric variant of its popular care model, Reva, the E20. This indicates to some extent that Indian car manufacturers do seem to see a potential in the segment.

- Mass production level Micro-Hybrids (Start-Stop)
- Over 400,000 Micro hybrid SUVs on Indian Roads
- Commercial Micro-hybrid Pick-ups introduced

Hybrid Vehicles Demonstration – Commonwealth Games, India 2010



Mahindra Reva e20

Glimpse of xEVs progress in India



Challenges For Establishing EV Mobility In India

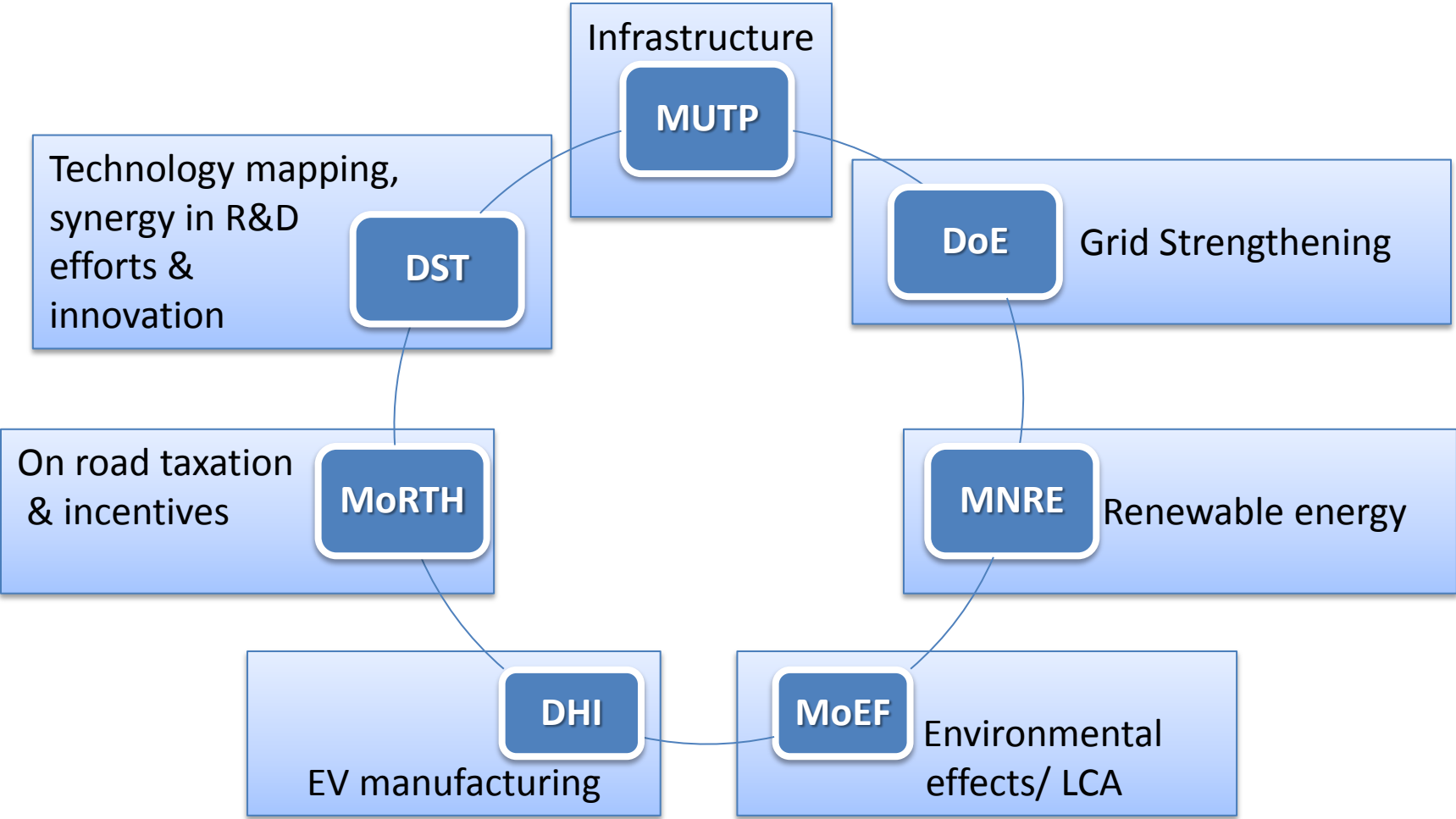


Can EVs be a solution for India?

Challenges

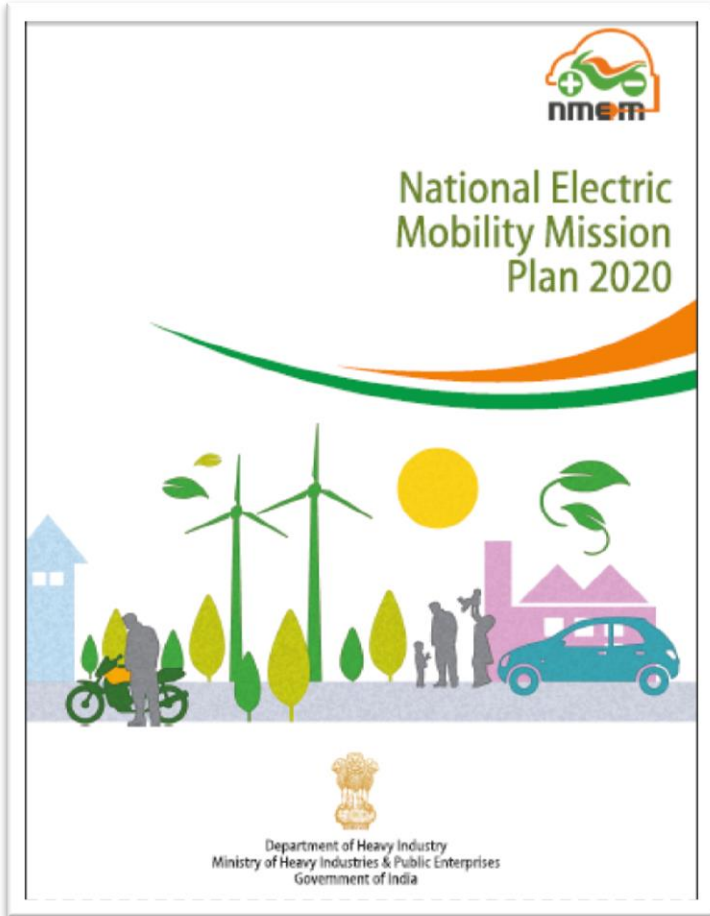
- Are we shifting pollution sources from urban to power plant?
- Infrastructure for support?
- Is EV affordable?
 - Initial cost
 - Life cycle cost
 - Need to have special promotional policies
- Is EV acceptable?
 - Does it meet consumer demands?
 - Features compared to ICE?
 - “Zero fuelling time”?
 - Cost sensitivity
- Adaptation
- Availability
- Indigenous solutions

Development of Cohesive 'eco-system' for xEV Implementation



National Electric Mobility Mission Plan (NEMMP) 2020

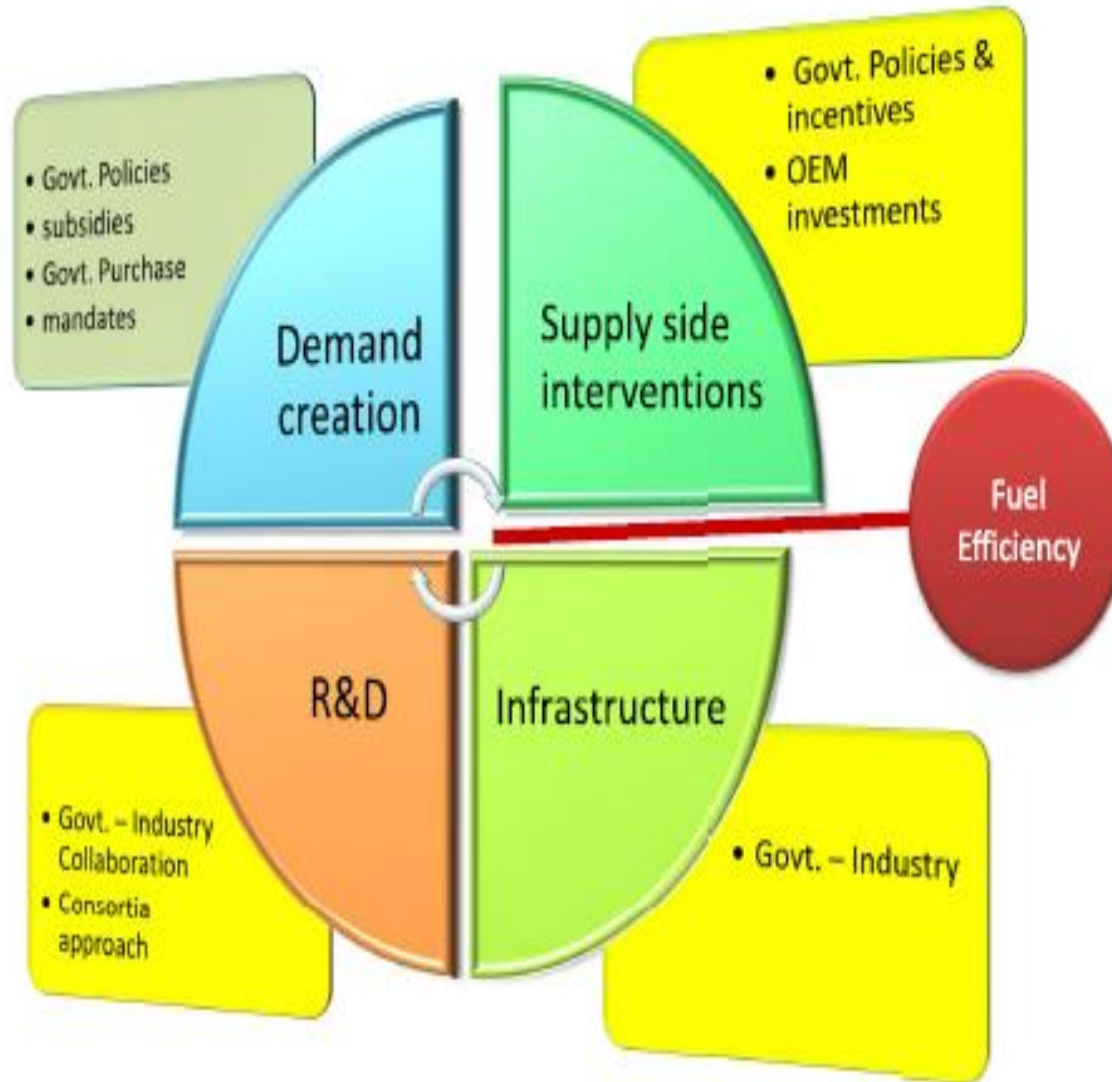
Unveiling of NEMMP at PM Residence – 9th January 2013



NEMMP - 2020 Vision

To encourage **reliable, affordable and efficient xEVs** that meet consumer performance and price expectations through **Government – Industry collaboration** for promotion and development of indigenous manufacturing capabilities, required infrastructure, consumer awareness and technology; thereby helping India to emerge as a leader in the xEV Two Wheeler and Four Wheeler market in the world by 2020, with total **xEV sales of 6-7 million units** thus enabling Indian Automotive Industry to achieve global xEV manufacturing leadership and contributing towards **National Fuel Security**.

Levers to support xEV Adoption



Govt. of India Policy Initiatives

National Electric Mobility Mission Plan (NEMMP) 2020

Working Group on R&D

- BMS & Battery
- Power Electronics & Motors
- Testing Infrastructure, Human Resources, Energy efficient Technologies

Working Group on Infrastructure

- Technology & Standards
- Infrastructure Rollout

Working Group on Demand & Supply

- Demand Incentive Scheme
- Incentive Delivery & Monitoring Mechanism
- Promotion of Hybrid Retro-fitment Kits

Summary And Way Ahead





National Electric Mobility Mission Plan 2020

GOVERNMENT OF INDIA IS DETERMINED TO PROMOTE CLEAN AND GREEN TRANSPORTATION



Department of Heavy Industry
Ministry of Heavy Industries & Public Enterprises
Government of India

Govt mulls hybrid vehicles for public transport

TIMES NEWS NETWORK

New Delhi: Delhi will host trials for hybrid three-wheelers, mini-buses and buses from August as the government explores the use of alternative fuel-based trans-



portation to help the government flesh out the national electric mobility mission announced by the PM earlier this year. The project involves electric vehicles — currently limited by the range such vehicles can run — and hybrids that use conventional fuel as well as a motor driven by a battery which captures energy usually lost during braking and decelerating.

Apart from foreign car makers like Toyota that see a future in hybrids, the Society of Indian Automobile Manufacturers has sought government support for alternative fuel technology through subsidies. "India has the potential to emerge as a global manufacturing hub for elec-

trical vehicles," a said. Initiatives including the development of a 10-seater e-rickshaw. In a scepticism to venture the prototype aircraft, intends to be at the said. The said is that its way to commercial needs to do the same in the next five to seven years or it may end up buying from its neighbour and remain a technological laggard.

The meeting decided that India should set a steel production target of 300 million tonnes for 2025. State firms are set to lead the way as they are expected to find it easier to obtain land, water and other clearances.

At present, India exports both sponge and coal and ends up as a major importer of steel. SPVs will also be formed to assemble land and approvals and will then be offered for takeover by investors through a bidding process.

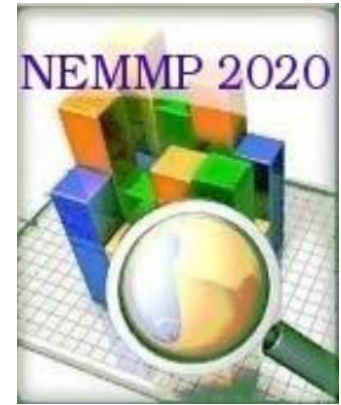
Government Initiatives – NEMPP 2020

From the larger perspective, this is amongst the most significant interventions of the Government for the people at large, that promises :

- transforming the automotive paradigm of the future by lessening the dependence on fossil fuels,
- increasing energy efficiency of vehicles
- providing smoke-free air to breathe, and
- noise-free commuting in the congested city roads and choking urban sky lines.

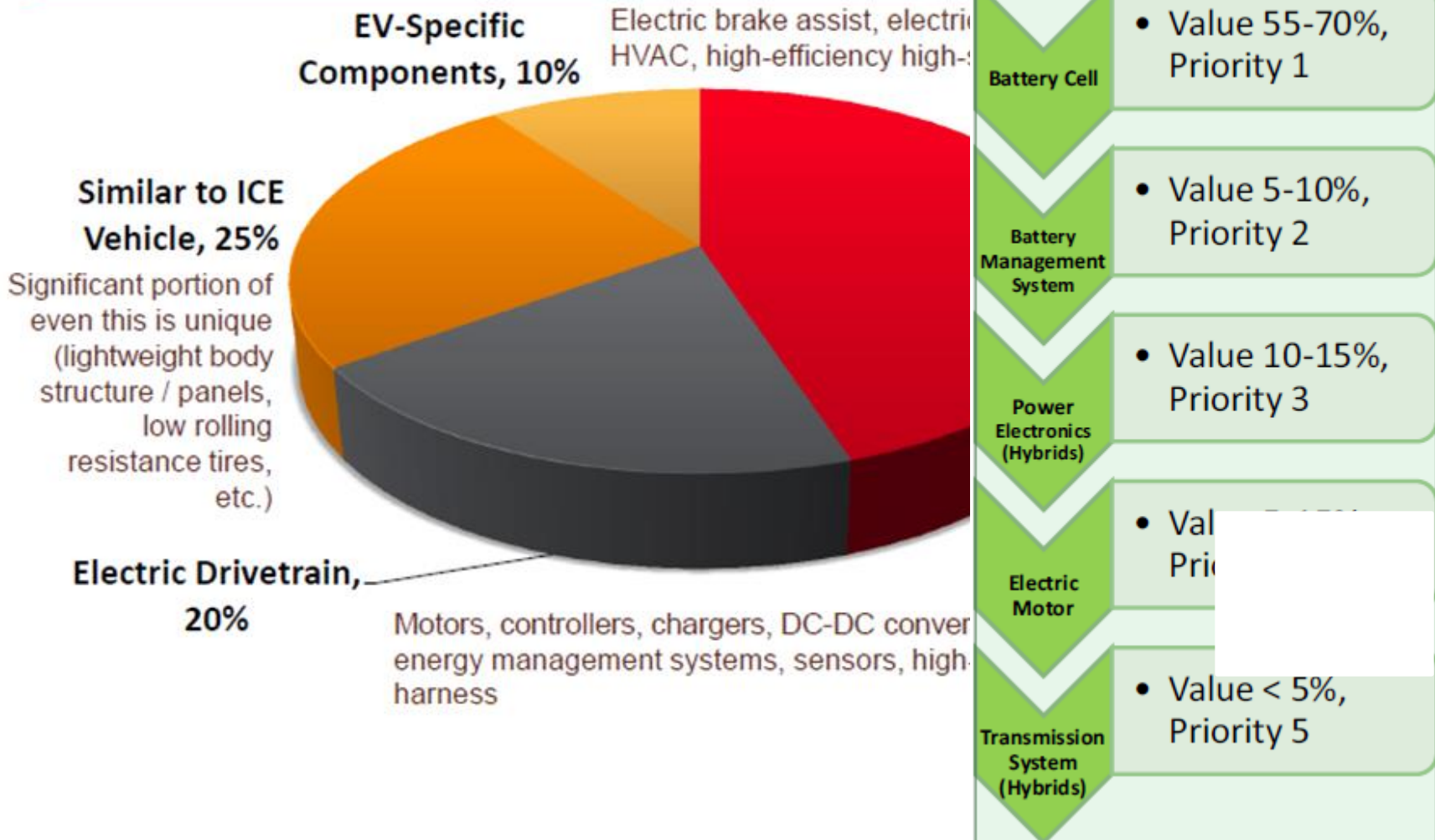
Highlights of NEMMP – 2020 ...

- Setting up of CoEs for technologies relating to
 - Motors
 - Batteries
 - Integration
 - Testing
- Demo City for xEV Implementation being discussed
- Incentive Policies for Manufacturers and Users being worked out



Technology Priority areas Identified under NEMMP

Compared to an ICE vehicle, 70% of the Bill of Materials (BOM) for an electric vehicle is unique*



- ❑ xEV has good future of mobility in India**
- ❑ India is gearing up with NEMMP 2020 PLAN and other initiatives**
- ❑ Key parameters for xEVs to succeed in India :**
 - Adaptation of technologies to Indian environment**
 - Innovation to meet local needs**
 - Localization of components and systems**
 - Effective use of renewable energy sources**
 - QCD aspects**



**Thank you
for your attention**