Future of Electric Vehicles in Road Passenger Mobility of India

Dhar, Subash

Publication date: 2014

Citation (APA):
Future of Electric Vehicles in Road Passenger Mobility of India

Subash Dhar
Priyadarshi R Shukla

66th IEA ETSAP Workshop
UN City, Copenhagen
November 17-19
Presentation Agenda

1. Low Carbon National Transport Modeling Assessment
   • Model System
   • Scenarios Architecture

2. National Passenger Transport Demand

3. Electric Vehicle (EV) Scenarios

4. Conclusions
Soft-Linked Integrated Model System (SLIM)

Databases
- Socio-Economic
- Technologies
- Energy Resources
- Environment

Models
- AIM CGE/GCAM-IIM
- ANSWER-MARKAL Model
- AIM ExSS

Database
- Scenario Database
- Sustainable Transport Indicators Database

Transport Models
- Transport Demand Model
- Transport Database
Transport Scenarios Architecture

**Base (BAU)**
- GDP – 8% CAGR
- CO₂ – 3.6 deg C

**Conventional Low Carbon Scenario**
- GDP ~ 8% CAGR
- CO₂ – 2 deg C

**Sustainable Low Carbon Scenario**
- GDP - Pegged to 8% CAGR
- CO₂ – 2 deg C

Changes due to targeted strategies + a carbon budget equivalent to conventional scenario

**Sustainable Mobility**
- i. Public Transport
- ii. NMT
- iii. Urban Design
- iv. High speed rail

**Sustainable Technologies**
- i. Electric Vehicles
- ii. Fuel Economy
- iii. ICT - Navigation

**Sustainable Fuels**
- i. Bio-fuels
- ii. CNG
- iii. Clean Electricity

**Sustainable Logistics**
- i. Dedicated Rail Corridors
- ii. Coal by wire
- iii. Regional Pipelines

Changes due to price of carbon
National Passenger Transport Demand in Scenarios
Passenger Demand Estimation

\[ TD_{urban} = \sum_{i=1}^{4} TR_i \times TL_i \times Pop_i \times 365 \]

\[ TD_{overall} = Population \times \text{Per Capita Mobility} \]
Passenger Transport Demand

Passenger Transport Demand - Urban
BAU (Bpkm)

Passenger Transport Demand - Inter-city
BAU (Bpkm)
Mode Share of Passenger Transport

Modal Share: Urban Transport
BAU Scenario

Modal Share: Inter City Transport
BAU Scenario
Electric Vehicle Scenarios
Electric Vehicles (EV) Scenarios

- Business-as-Usual (BAU)
  - Future socio-economic development along the conventional path: mirrors resource-intensive path of developed countries

- National EV Policies (EV)
  - Governments recognize multiple co-benefits of EVs (urban air quality; energy security etc.) and push their penetration

- EV plus 2°C Target (EV_LCS)
  - Global 2°C climate stabilization target leads to high carbon price; this lowers carbon content of generated electricity
Scenarios Description: EV & EV_LCS

Electric Vehicle Scenario (EV): Assumptions

- **Domestic policy supports**: Direct capital subsidy, improved charging infrastructure, dedicated lanes, incentives for R&D in power train, batteries and smart grid technologies, quotas for EVs in urban public & goods transport
- **Battery costs** comes down to half of current costs in next 10-15 years: driven by advancements in battery technologies, improvements in battery capacities, declining component costs, and economies of scale in production
- Improved batteries with higher energy density will also help reduce weight of batteries: further pushing down EVs costs
- Limited range per charge put constraints on penetration of cheaper EVs for urban transportation

Electric Vehicle plus 2°C Scenario (EV_LCS): Assumptions

- Global 450 ppmv CO₂ equivalent concentration stabilization target
- Carbon Price rise: from US$ 14/tonne CO₂ in 2020 to US$ 200/tonne CO₂ in 2045 (based on outputs from Lucas et. al., 2013)
EV Share in Personal Motorised Transport

**Share of EV & Hybrid 2 Wheelers**

- **2010**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2015**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2020**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2025**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2030**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2035**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%

**Share of EV, Hybrid and Fuel Cells: 4 Wheelers**

- **2010**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2015**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2020**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2025**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2030**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
- **2035**
  - BAU: 0%
  - EV Scenario: 0%
  - EV + 2 deg C: 0%
Electricity Demand and Supply

Electricity Demand (Mtoe)

Electricity Output 2035 (Twh)
Energy Demand: Transport

[Bar charts showing energy demand for transport from 2010 to 2035 for different energy sources: Oil, Gas, Electricity, Biofuels, and Hydrogen. The charts compare Business As Usual (BAU) and different scenarios including EV (Electric Vehicles) and EV + 2 deg C.]
PM 2.5 Emissions
CO$_2$ Emissions

![CO2 Emissions Graph](image)
Conclusions

- Early penetration of EV in India would come through 2-wheelers; this would create infrastructures that would facilitate larger vehicles.
- Low carbon transport transition shall deliver *Air Quality* and *Energy Security* co-benefits
- Electric Vehicles (EV) by themselves do not contribute to CO$_2$ mitigation; they may even increase emissions
- Under global 2°C stabilization policy, in India, EV contribute sizable mitigation however emissions would be much higher than in 2010
Thank You

Low Carbon Transport Project Website:

www.unep.org/transport/lowcarbon