Business of Charging Infrastructure for Electric Vehicle

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- Smart Grid
- Charging Infrastructure
- Battery Swapping Station
- Impact on Charging Infrastructure
- EV Market
- EV Charging Business Model
- Challenges and solutions to India’s EV charging infrastructure
- Viability of xEVs in India: A Public Opinion Survey
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Introduction

1. The swiftly growing structure of urbanization and industrialization;
   - Facilitating the transportation era at peak; 25% GHG
   - Exponentially increasing energy demand; 33.3T kWh by 2030

2. The salient impacts of the use of fossil fuels for power generation;
   - Significant ecological degradation,
   - Fuel supply shortage,
   - Energy security crises,
   - Economic growth limitations.

3. The conventional T&D systems causes;
   - Significant amounts of energy losses,
   - Do not provide the hoped reliability & security levels,
   - Limited control and high costs of FACTS devices.

Smart Grid

Zero-Carbon future through intelligent integration of electric vehicles, electricity, free renewable energy and market opportunities.
Structure of Smart Grid

- Generation
- Transmission & Distribution
- Energy Management Centre
- Residential
- Commercial & Industrial
- Renewable Energy Sources
- Conventional Energy
- Cross-Border Power Transfer
- Smart Meters
- Demand Response
- Smart Appliances
- Energy Storage
- Residential EV Charging
- EV Charging Station
- Distributed Generation
- Smart Substation
- Grid/Distribution Automation
- Remote Control/Condition Monitoring
- Smart Switches
- Distributed Energy Management
- Energy Storage
- Smart Building
- Data Analytics
- Tariff Mechanism
- Asset Management
- Ancillary Services
- Isolated Microgrid Outage Management
- Disturbance in grid
### Power & Automation for ... Overview Benefits

<table>
<thead>
<tr>
<th>Solution Area</th>
<th>Overview</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Automation</td>
<td>§ New levels of monitoring, protection and control deeper into the distribution grid</td>
<td>§ Improved capacity, efficiency, reliability, sustainability</td>
</tr>
<tr>
<td>Demand Response</td>
<td>§ Incent customers with supply side signals to change demand or feed in generation</td>
<td>§ Reduced need to build new generation or grid capacity</td>
</tr>
<tr>
<td>Renewables Integration</td>
<td>§ Cope with renewables using voltage regulation as well as distribution grid automation</td>
<td>§ Improved reliability of supply</td>
</tr>
<tr>
<td>Energy Storage</td>
<td>§ Utilize batteries in the network to address capacity constraints and improve power quality</td>
<td>§ Improved network stability, power quality and efficiency</td>
</tr>
</tbody>
</table>
# Solution Area: Transport

**Infrastructure to effectively electrify transportation**

<table>
<thead>
<tr>
<th>Power &amp; Automation for ...</th>
<th>Overview</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Vehicle Charging</td>
<td>§ Charging infrastructure for 15-30 minute charges and longer</td>
<td>§ Foster electric vehicle uptake &lt;br&gt;§ Cut emissions in the city &lt;br&gt;§ Help integrate renewables</td>
</tr>
<tr>
<td>Electric Buses</td>
<td>§ Ultra-fast charging for battery powered electric buses</td>
<td>§ Clean, quiet public buses &lt;br&gt;§ No overhead cables</td>
</tr>
<tr>
<td>Electric Rail</td>
<td>§ Recuperate braking energy in metro trains and trams</td>
<td>§ Reduce energy costs by up to 30% &lt;br&gt;§ Potentially sell services to grid</td>
</tr>
<tr>
<td>Shore-to-Ship</td>
<td>§ Infrastructure to power ships with electricity from the shore when berthed</td>
<td>§ Eliminate 98% of emissions and all noise and vibration &lt;br&gt;§ Improve quality of life near port</td>
</tr>
</tbody>
</table>
Path to Transportation Electrification

The EV value chain

- Raw Material Suppliers
- Traditional Component Suppliers
- Battery Suppliers
- OEMS
- Utilities / Infrastructure
**EV Charging Infrastructure Deployment Timeline**

**1994-2000:** GM inductive MagneCharge for home charging

**2009:** Inductive charging standard SAE-J1772

**2010:**
- The CHAdeMO standard developed in Japan.
- SAE-J1772 adopted by GM, Chrysler, Ford, Toyota, Honda, Nissan and Tesla

**2011:**
- SAE Combined Charging System (Combo Coupler) introduced

**2017:**
- Audi, BMW, Daimler, Ford, General Motors, Porsche and Volkswagen agreed to introduce Combo Coupler/BSS
E-mobility models: Comparison of selected countries

<table>
<thead>
<tr>
<th>Lever</th>
<th>US</th>
<th>China</th>
<th>Japan</th>
<th>France</th>
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<tbody>
<tr>
<td>R&amp;D</td>
<td>✔✔✔✔</td>
<td>✔✔✔✔</td>
<td>✔✔</td>
<td>✔✔✔✔</td>
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<tr>
<td>Supply Side</td>
<td>✔✔</td>
<td>✔✔✔✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Demand side incentives</td>
<td>✔✔✔✔</td>
<td>✔✔</td>
<td>✔✔✔✔</td>
<td>✔✔✔✔</td>
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<tr>
<td>Infrastructure</td>
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<td>✔✔✔✔</td>
<td>✔✔</td>
<td>✔✔</td>
</tr>
<tr>
<td>Proposed Investment</td>
<td>&gt;$5 B</td>
<td>&gt;$20 B</td>
<td>&gt;$1.7 B</td>
<td>&gt;$3.5 B</td>
</tr>
</tbody>
</table>
Typical layout of EV charging system
# EV Charging Levels

<table>
<thead>
<tr>
<th>Charging type</th>
<th>Level 1</th>
<th>Level 2</th>
<th>DC Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charging Time (h)</strong></td>
<td>20-22</td>
<td>6-8</td>
<td>0.2-0.5</td>
</tr>
<tr>
<td><strong>Charger location</strong></td>
<td>On-board (1-phase)</td>
<td>On-board (1 or 3-phase)</td>
<td>Off-board (3-phase)</td>
</tr>
<tr>
<td><strong>Voltage supply (V)</strong></td>
<td>120</td>
<td>240</td>
<td>208-600</td>
</tr>
<tr>
<td><strong>Power level (kW)</strong></td>
<td>1.3 to 1.9</td>
<td>Up to 19.2</td>
<td>50 to 150</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>2-5 miles per hour of charging</td>
<td>10-20 miles per hour of charging</td>
<td>60-80 miles in &lt; 30 minutes</td>
</tr>
<tr>
<td><strong>Primary Use</strong></td>
<td>Residential charging</td>
<td>Residential and public charging</td>
<td>Public charging</td>
</tr>
</tbody>
</table>
## EV Charging Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE-J1772</td>
<td>EV Coupler for conductive Charging</td>
</tr>
<tr>
<td>SAE-J1773</td>
<td>EV Inductively Coupled Charging</td>
</tr>
<tr>
<td>SAE-J1797</td>
<td>Recommended Practice for EV Battery Modules Packaging</td>
</tr>
<tr>
<td>SAE-J2288</td>
<td>Life Cycle Testing of Battery Modules for EV</td>
</tr>
<tr>
<td>SAE-J2464</td>
<td>EV/HEV Rechargeable Energy Storage System (RESS) Safety &amp; Abuse Testing</td>
</tr>
<tr>
<td>SAE-J2836 Part 1</td>
<td>Use Cases for Communications between PEVs and Utility Grid</td>
</tr>
<tr>
<td>SAE-J2836 Part 2</td>
<td>Use Cases for Communications between PEVs and Supply Equipment (EVSE)</td>
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<tr>
<td>SAE-J2836 part 3</td>
<td>Communications between Plug-In Vehicles and the Utility grid for Reverse Flow</td>
</tr>
<tr>
<td>SAE-J2894</td>
<td>Power Quality Requirements for Plug-In Vehicle Chargers- Requirements</td>
</tr>
<tr>
<td>IEC-69/156/CD:2008</td>
<td>Electric vehicle conductive charging system</td>
</tr>
<tr>
<td>IEC-23H/222/CD:2010</td>
<td>Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of EVs</td>
</tr>
<tr>
<td>JEVS-C601:2000</td>
<td>Plugs and receptacles for EV charging</td>
</tr>
<tr>
<td>AIS-138(Draft)</td>
<td>Electric Vehicle Conductive AC charging system-ARAI</td>
</tr>
</tbody>
</table>
Main type of charging facilities

Bus

Charging station

Taxi

Charging station

Environmental sanitation vehicles

Charging station
Estimated Cost of Charging Infrastructure

Total investment cost required for the establishment of charging infrastructure for EVs includes:

- The cost of equipment to be used,
- Installation costs,
- Operation and maintenance costs.

The installation cost includes:

- Cost of civil works,
- Transaction cost regarding distribution system operator permission and other related costs depending on factors like requirement of a new grid connection or upgrade of the existing connection.

With increase in penetration of EVs in the next few years, the number of EV chargers will increase and hence the equipment cost is expected to decrease.
Estimated Cost of Charging Infrastructure

- For semi-private/semi-public places where low or medium power level chargers are required, cost varies between 500 € (Rs 36,431) and 1200 € (Rs 87,435).

- For public places where high power level chargers are required, installation cost is relatively higher ranging between 2400 € (Rs 1, 74,871) to 3600 € (Rs 2, 62,306).

- For that operation and maintenance cost is to be added, which may be taken to be 10% of the total installation cost (including equipment cost).

Level 1 charger of 1.5kW, Level 2 charger of 6.6kW and DC fast charger of 50kW capacity.
Benefits of commercialized charging stations

- They will help in diverting the peak of charging load from the demand peak of the network.
- Unpredictable mobile load in the form of EVs would be transformed into a stationary load and it would be easier to predict.
- When in the form of bulk charging load, it would be simpler to enforce regulations on harmonics and power factor.
- Implementation of V2G concept would be easy as it would eliminate the need for integration of sophisticated devices for measurement, communication, and control, up to end consumer level.
In general, EV charging requires a long charging process. Thus far, due to policy and money constraints, the charging stations, charging piles and other charging infrastructure are not widely deployed.

The abovementioned reasons make it probable that EV users will be forced to stop and wait, which results in waiting anxiety.

In addition, EV users trade-off between the remaining battery energy, the location distribution of charging facilities and their travel plans, which easily results in range anxiety.

Therefore, more researchers and EV operators are turning their attention to battery swapping.

Battery swapping can provide a new fully charged battery, which does not require depleting the energy of the old battery.
Type of Battery Swapping Stations

Side-swapping: applicable to commercial electric vehicles such as buses and sanitation trucks which have battery packs installed in both sides of the vehicle body.

Rear-swapping: applicable to electric passenger vehicles such as private cars and taxis, with battery packs installed in the trunk of the vehicle body.

Bottom-swapping: applicable to electric passenger vehicles such as private cars and taxis, with battery packs installed in the chassis of the vehicle body.
Challenges of Battery Swapping Station

However, before the benefit of battery swapping becomes a reality, two problems need to be solved.

- One is the EV battery technology, which is fundamental for battery swapping.
- A standardized EV battery with the characteristic of high mileage, high energy density, high recycling ratio, high recovery ratio, environmentally friendly ability and security needs to be developed.
Complexity of EV/BSS Integration
Benefit of Battery Swapping Stations

Costumer Prospective

- In BSS scheme, the customers would lease the battery from the BSS and avoid a lump investment.
- The other aspects that concern potential EV owners are the long charging times, the costs of upgrading household installations to high power chargers, and the limited number of public charging stations.
- Another concern of the EV owners is the limited range due to the relative small capacity of the batteries. In order to ease this concern, the owners would need to have access to public charging stations, which are translated into requiring heavy infrastructure investments. These concerns could be eliminated if an EV owner has access to BSSs in the areas where they usually travel.
Benefit of Battery Swapping Stations

**Power System Operator Prospective**

- Sifting power demand form one duration to another
- Prediction of EV load demand is easy
- Furthermore, the BSS is an aggregator of batteries, and these stations could also be used to provide services to the system as a whole.
- The BSS can inject power back into the power system to smooth the net daily demand curve, if the BSS perceives a benefit in doing so.
- In addition to acting as a storage device, the BSS can also provide a share of the required ancillary services in different intervals, e.g., frequency regulation, load following, and voluntary reserve provisions.
Impact of charging on Power system

- Increases the difficulty of distribution network planning. New constraints in the form of electricity demand and the layout of charging stations need to be considered, which add to the complexity of network planning.

- Improved quality equipments with high ratings are required in the distribution network to facilitate interconnection of charging infrastructure.

- Requires distribution transformer with larger capacity and distribution line of larger cross section to avoid problems like overloading, voltage deviation etc.

- It may lead to a decrease in the economy of distribution system operation. As charging load exhibits large volatility, it is difficult to confine charging behavior to low load periods, leading to greater system peak difference. This would ultimately result in lower utilization efficiency of distribution network equipment.

- Power quality of the distribution network is affected. Charger uses several power electronic conversion devices in the form of converters which induce harmonics in the source side current.
Recommendations for EV charging/BSS

Most research in this area is focused on the following issues:

- Battery logistics strategy, battery swapping station planning and construction strategy,
- Battery charging strategy for the battery swapping stations

The abovementioned research intends to improve the coverage and service of a battery swapping system. However, these approaches do not realize the objective of “get energy replenishment anytime and anywhere.”

Switching from the existing passive battery swapping mode to the active battery swapping mode

Mobile Battery Swapping Stations
Electric Vehicle Infrastructure in India
Air Pollution in India

India now overshadowing China

Average PM2.5 concentration, micrograms per m²

- Delhi
- Lucknow
- Faridabad
- Ahmedabad
- Kanpur
- Varanasi
- Agra
- Pune
- Hyderabad
- Mumbai
- Chandrapur
- Chennai
- Bengaluru
- Beijing
- Guangzhou

Air Pollution from various sectors

Indian annual national standard
Annual urban standard
WHO annual guideline

INDIA

CHINA
Road Transport: CO₂ Emissions by Fuel type

- Buses/Cars/Taxi/3W (CNG+LPG): 55%
- 2W/3W (Petrol): 28%
- Car/Taxi/Jeep (Petrol+Diesel): 15%
- Commercial Vehicles: Trucks/Buses/LCV (Diesel): 2%

Graph Showing CO₂ Emissions:
- Water
- Freight rail
- Freight trucks
- Air
- Pass rail
- Buses
- 3-wheelers
- 2-wheelers
- Pass cars

Megatones CO₂: 2000 - 2050
Green Transport in India

1998
- India's first CNG bus launched
- Supreme Court orders to convert all city bus fleets, taxis and auto-rickshaws in Delhi to CNG
- CNG conversion of buses, taxis and auto-rickshaws introduced in Mumbai

2000
- First section of the Delhi Metro Rail—the red line-opened
- All buses in Delhi converted to CNG

2001
- Karnataka is the first state to utilize bio-fuels and ethanol-blended fuels in public buses in Bangalore

2002
- Reva exported to European markets and branded as G-wiz

2003
- India's first MUV-‘Omi Cargo’ launched by Maruti-Suzuki

2004
- India's first dual fuel (petrol + LNG) passenger car ‘Wagon R Duo’ launched by Maruti-Suzuki

2005
- Hero Electric launches electric two wheeler

2006
- 1,10,000 electric vehicles sold – 97.98% of which were two wheelers

2007
- GOI sets up the National Mission for Hybrid and Electric Vehicles

2008
- First hybrid car launched in India-Honda Civic Hybrid

2009
- Full exemption from central excise duty provided to Evs

2010
- Delhi is the first city in India to introduce a hybrid electric CNG public bus manufactured by Tata Motors

2011
- India's first MUV— 'Omi Cargo' launched by Maruti-Suzuki
- India’s first dual fuel (petrol + LNG) passenger car ‘Wagon R Duo’ launched by Maruti-Suzuki

Wednesday, May 2, 2018
The National Mission for Electric Mobility (NCEM) is a Government body made up of 18 members including 8 Cabinet Ministers. It has 25 members, comprising of secretaries of stakeholder Central Ministries and academia. The expert body to assist NCEM and NBEM is the National Board for Electric Mobility (NBEM). The National Automotive Board (NAB) is the expert body to assist NCEM and NBEM. The National Electric Mobility Mission Plan 2020 (NEMMP 2020) is the plan that aims to promote electric mobility in India.
## Total Investment Proposed under National Mission for Electric Mobility (Rs in Crores)

### NMEM (Rs in Crores)

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<tr>
<th>Area</th>
<th>4W</th>
<th>2W</th>
<th>3W</th>
<th>Buses</th>
<th>LCV</th>
<th>Total</th>
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<tr>
<td>** HG/HEV/BEV **</td>
<td></td>
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<td></td>
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<tr>
<td>** Demand Incentives **</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>HG/HEV/BEV</td>
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<td>5600-5700</td>
<td>5200-5300</td>
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<td>700-750</td>
<td>500-550</td>
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<td>HG/HEV/BEV</td>
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<td>1200-1300</td>
<td>3300-3400</td>
<td>40-50</td>
<td>75-85</td>
<td>5-10</td>
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<tr>
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<td>950-1000</td>
<td>40-50</td>
<td>70-80</td>
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### India and global xEV demand projections for 2020 (Nos in Millions)

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<th>Vehicle seg./country</th>
<th>2W</th>
<th>4W Range</th>
<th>Buses</th>
<th>Total Range</th>
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<td>India xEV projections 2020</td>
<td>Numbers</td>
<td>4.8</td>
<td>1.6</td>
<td>1.7</td>
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<tr>
<td>penetration of xEV India</td>
<td>%</td>
<td>15.0%</td>
<td>17.8%</td>
<td>18.9%</td>
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<tr>
<td>Total vehicle Sales India</td>
<td>Numbers</td>
<td>32</td>
<td>9</td>
<td>9</td>
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<tr>
<td>Global xEV projections 2020</td>
<td>Numbers</td>
<td>27</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Global penetration of xEV</td>
<td>%</td>
<td>35.5%</td>
<td>7%</td>
<td>19%</td>
</tr>
<tr>
<td>Total vehicles 2020</td>
<td>Numbers</td>
<td>76</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>India Share as per above</td>
<td>%</td>
<td>17.8%</td>
<td>12.8%</td>
<td>-30%</td>
</tr>
</tbody>
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- 2.4 million EVs to be sold by 2020
- 6% displacement of global gasoline demand
- $100/Kwh battery pack costs in 10 years

- Expect the global EV fleet to rise from 2 million vehicles today to 125 million by 2035
How fast will EV market share grow: India

Forecasted India Passenger Car Electric Vehicle Market, Volume, 2017-2025

Source: ANS MarketProAnalytics
How fast will EV market share grow: India

Forecasted India Electric 2-Wheeler Market, Volume, 2017-2025

Forecasted India Electric 3-Wheeler Market, Volume, 2017-2025

Source: ANS MarketProAnalytics
The broad methodology for xEVs deployments

India HEV / EV Market and Challenges

- Consumer Acceptability
  - Detailed Consumer Research Insights

- Production Capability
  - Scale effects
  - Technologies considered

- Price-performance evolution
  - Battery price evolution
  - Performance evolution

- Infrastructure requirement
  - Power
  - Charging terminals

- Technology capability
  - Importance of technologies for India
  - India’s right to win

Recommended interventions

- Potential framework to unlock xEV potential
  - Demand incentives
  - Supply incentives
  - R&D
  - Infrastructure

- Cost benefit analysis and challenges
  - Net present value
  - Fuel savings
  - Investments

- Net benefit from xEVs
  - Fuel security
  - Carbon dioxide emissions
  - Job creations
Technology priority areas

- **Battery Cell**: Value 55-70%, Priority 1
- **Battery Management System**: Value 5-10%, Priority 2
- **Power Electronics**: Value 10-15%, Priority 3
- **Electric Motor**: Value 5-15%, Priority 4
- **Transmission System**: Value <5%, Priority 5
The broad methodology for xEVs deployments

- **Demand side incentives**
  - Promote initial sales

- **Manufacturing incentives**
  - Promote local manufacturing

- **R&D incentives**
  - Promote local battery and power train research

- **Infrastructure support**
  - Develop power generation and charging infrastructure

**Checking feasibility through TCO model**

**Studying global examples for implementation**

**Getting feedback from OEM and SIAM**

**Discussing proposed incentives with government bodies**

TCO: Total Cost of Ownership
SIAM: Society of Indian Automotive Manufacturing
Emerging Business Model for EV

Direct Vehicle Sales:
- Provide autonomy and flexibility to sell or trade the car whenever they consumers desire.
- Requires a high level of consumer education and awareness to effectively communicate the low operating cost of an EV when compared to conventional vehicles.

EV Leasing:
- Ownership of the vehicle primarily remains with OEM or authorized service providers that lease out the vehicle for a predetermined period of time.
- It reduces the upfront purchase price (which is prohibitive for a large proportion of consumers in India) by spreading it over the lease period.
Emerging Business Model for EV

Battery Leasing and Swap Schemes:

- It helps negate consumer concerns about battery durability and performance, while simultaneously reducing the initial/upfront EV purchase price.
- Service providers retain the ownership of batteries.
- This model puts the operational costs of an EV on par with conventional ICEs.
- It allows manufacturers to retain ownership of the battery for various 'second-life' applications that would provide additional value.
- At the end of the contracted subscription/rental period, the EVs would then return back to the franchised dealer network, giving them greater control over its assets.
- Manufacturers, battery suppliers and service operators can partner to collectively develop 'battery swap/switching stations.'
Emerging Business Model for EV Infrastructure Service Models

Public Infrastructure Model –
- Provides EV station at public parking spaces.
- Only EVs are allowed to park at these spots, they are likely to act as an incentive to consumers in urban cities.
- This model would have to be supported by local municipalities in partnership with infrastructure providers.
- It seeks to provide access to charging for those consumers that lack home charging.

Private Infrastructure Model –
- More preferable in the early stages of EV adoption as it responds to direct consumer demand.
- It involves installing charging points for EV adopters at their residence or at private sites such as malls, office parking etc.
- This ensures higher usage of charging points based on actual demand, as reflected by EV purchases, thus providing a greater return on investment.
Emerging Business Model for EV

End-to-End Solution –

- Involves close partnerships between OEMs, infrastructure facility providers, maintenance services providers and local Governments

- provide consumers with an integrated package of end-to-end value added services, *thereby minimizing the number of interfaces that the consumer has to manage*.

- **Evolve as a subscription service** where EV adopters pay a monthly/annual fee for an integrated services package that involves access to charging facilities, vehicle maintenance services and free parking at public pay-and-park lots, that are managed by local municipalities
Road Blocks for Charging Infrastructure in India

- EVs are to be taxed at 12%, hybrid vehicles are taxed at 28% plus a 15% cess.
- Consumers are more likely to try hybrid vehicles, but that sector is not being encouraged by the current tax structure.
- Most of the chargers being installed across the country, however, are AC chargers.
- Battery technology is yet another aspect that needs to be looked into.
- Yet another issue is that simply shifting the fleet to electric will not address the impact on the environment.
Viability of xEVs in India: A Public Opinion Survey
Survey methodology

The survey was conducted majorly at events:

- EV Boot Camp, AMU, Aligarh, 2016
- ISGF week 2016, New Delhi
- SIAT, ARAI, Pune, 2017
Survey Results

Fig: Demand for different xEVs type

Fig: Key characteristics of xEVs
Survey Results

- High initial cost: 30.4%
- Lack of charging infrastructure: 25.4%
- Range: 26.1%
- Safety: 4.3%
- Reliability: 13.8%

67.4% of respondents believe electric vehicles will completely replace internal combustion engine (ICE) vehicles.

23.9% believe they will be limited to research only.

8.7% believe they will be part of the transportation system but only next to ICE vehicles.
Potential solutions

- Advertising of vehicle manufacturer, internet resources etc. should be made available for consumers for decision making.
- Using media and social networks, public attitude can be influenced for non-financial advantages of adopting xEVs.
- Opportunities to develop local EV experience facility to offer essential test-drive prospects can be explored.
- By adding xEVs to public fleets and establishing charging infrastructure at various facilities, visibility and confidence of masses in GoI’s initiative can be improved.
- Other measures include bigger investments in xEV technology, infrastructure and battery swapping programs, strong warranties on the xEV batteries and tax waiver to reduce the cost of xEVs.
QUESTIONS for Workshop Participants

Barriers ?
Road Blocks??
Solutions……………………
CENTRE OF EXCELLENCE FOR CHARGING INFRASTRUCTURE

CENTRE OF ADVANCED RESEARCH IN ELECTRIFIED TRANSPORTATION
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EXPLORING ..........

- AVENUES FOR COLLABORATION
- CONSORTIUM PARTICIPATION
Any questions?
Thanks!