In India, there is growing interest among policymakers to encourage EV-based mobility in cities and phase out fossil fuel consuming Internal Combustion Engine (ICE) driven vehicles in view of three major imperatives.

- To reduce petroleum imports and thus secure the country’s energy supply
  Import of crude oil accounts about 85% of India’s petroleum supply. Reduction of oil import will also help decrease the Current Account Deficit (CAD) of the economy.

- To reduce the carbon footprint of the economy by leveraging higher efficiency of EV over ICE vehicle and through effective off-take of renewable energy
  EVs are almost 5 times more efficient than similar ICE vehicles. The total CO$_2$ emission reductions from 2-wheeler and 4-wheeler electric vehicles (EVs) is estimated to be 7114 tCO$_2$/km. On the other hand, India’s renewable energy generation capacity (including hydro) has reached more than 119 GW which thus constitutes about 34% of the total power generation capacity. Further RE capacity addition would reduce emission factor of the grid. Not to ignore EVs’ potential use for energy storage.

- To reduce vehicular emissions of particulate matter, different polluting gases and GHGs
  14 of the 20 most polluted cities (in terms of PM2.5 conc.) are reportedly in India. Pollution levels in tier 2 and tier 3 cities are increasing at alarming rates.
GOVERNMENT ACTION

NEMM 2020 - In January 2013, the Government of India (GoI) launched the National Electric Mobility Mission (NEMM) 2020 which aims at gradually realizing a vehicle population of about 6-7 million electric/hybrid vehicles in the country.

FAME - In the 2015-16 Union Budget, GoI introduced the scheme Faster Adoption and Manufacturing of (Hybrid & Electric Vehicles (FAME) to support hybrid/electric vehicles market development and manufacturing eco-system. Phase-I of the scheme is effective till 31st March 2019 and the GoI has already notified Phase-II which will run for next 3 years from 1st April 2019, where the budgetary allocation is increased from INR 8950 million to INR 100 billion.

Recently, the GoI has expressed an intent to achieve 100% electric mobility by 2030. A few states such as Andhra Pradesh, Delhi (draft), Karnataka, Maharashtra, Telangana, Uttar Pradesh and Uttar Pradesh have developed dedicated state policies for creating an ecosystem for EV.

EV IMPLEMENTATION - A MULTI-STAKEHOLDER CHALLENGE

EV implementation would involve at least five central ministries (namely, MoRTH, MoP, MNRE, MHI, MST), multiple central public agencies (such as Niti Aayog, NAB, BIS, BEE), and state electricity regulators, transport and urban departments.

Key Concerns

The road to realizing such a major paradigm shift is not without challenges. The Society of Indian Automobile Manufacturers (SIAM), the association for automobile companies in India, has expressed apprehensions about the feasibility of fully replacing the conventional ICE vehicles in all new passenger vehicle sales by 2030. Some experts have also shared their concerns regarding the impact of complete electrification of the vehicle fleet in India. The major concerns are:

- **The high upfront cost of EVs**: Although the cost of batteries has declined appreciably, the price of an EV is still much higher (about double) than that of a comparable conventional ICE vehicle. This raises a doubt whether the EV market will find enough acceptance among Indian consumers at least in the short-term, which may impact the economics of EV related investments.

- **Constraints in battery manufacturing**: In the present ICE-dominated vehicle manufacturing landscape in India, domestic manufacturing of car batteries (pegged at about INR 300 billion) has been completely based on lead acid technology. Electrification of vehicle fleet which would be primarily based on Li-ion battery technology would render the existing battery manufacturing base obsolete and this warrants a big shift for local manufacturers towards new battery technologies suited for EVs.

Currently, the manufacturing base in India for Li-ion battery is limited and mostly based on the assembly of battery modules and packs. Hence, setting up Li-ion battery manufacturing facilities in the country would be required. However, the manufacturers face the typical “chicken or the egg” conundrum – should they invest now to support EV adoption or wait for a sizeable market for such batteries to develop first? The fact that India reportedly does not have substantial natural reserves for the raw materials required for manufacturing Li-ion battery which account almost half of the EV cost is also a matter of concern. This raises the question of whether India’s import dependence will merely shift from Gulf-oil to Chinese batteries.

- **EV charging infrastructure**: Establishing a charging infrastructure emerges to be another major challenge to India’s EV endeavour. While, the charging infrastructure has to support a sufficient range for EVs, charging time and inter-operability pose as critical factors in scaling up EV deployment. On the other hand, roll-out of charging stations and augmenting power distribution network capacity require high capital investments. This warrants the need to develop suitable standards, business models and tariff frameworks which will enable setting up and operating charging infrastructure as a commercially viable business venture.
INTERNATIONAL PRACTICES FOR PROMOTING ELECTRIC VEHICLES AND WHERE INDIA STANDS

<table>
<thead>
<tr>
<th>INTERVENTIONS</th>
<th>US - CALIFORNIA</th>
<th>NORWAY</th>
<th>FRANCE</th>
<th>CHINA</th>
<th>JAPAN</th>
<th>INDIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy support</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No official target</td>
</tr>
<tr>
<td>Targets for EVs</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No dedicated legislation</td>
</tr>
<tr>
<td>Legislation/ policy for EVs</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>National Electric Mobility Mission (NEMM) 2020</td>
</tr>
<tr>
<td><strong>Subsidies on EV purchase</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No interest on loan for leasing EVs</td>
</tr>
<tr>
<td>Upfront</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>FAME Phase I scheme - subsidies to OEMs.</td>
</tr>
<tr>
<td>Offered to leased vehicles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Lower GST rate (12%) for BEVs as compared to that for conventional cars (28%)</td>
</tr>
<tr>
<td>For company vehicles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Separate tariffs in some states for EV charging at charging stations</td>
</tr>
<tr>
<td><strong>Indirect incentives (road tax waiver, VAT waiver, access to reserved lanes, free parking)</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No separate ToD for EV charging</td>
</tr>
<tr>
<td><strong>Regulatory directives</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>No regulatory directive to transport agencies or utilities.</td>
</tr>
<tr>
<td>Approval of budget/ electrical tariff</td>
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</tr>
<tr>
<td>Time of use tariff</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td></td>
</tr>
<tr>
<td><strong>KEY QUESTIONS WE SHOULD ADDRESS</strong></td>
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</tbody>
</table>

**POLICY/ REGULATORY**

i. Should the government provide level playing field to alternative low emission/zero emission vehicular technologies such as hybrid technology (partial battery powered), hydrogen fuel cells, etc. apart from 100% BEV?

ii. Should Phase II of FAME scheme consider offering direct subsidies to low emission vehicle customers or OEMs to encourage the shift from conventional ICE vehicles?

iii. What regulations and standards should be adopted for batteries, vehicle systems, interface and charging infrastructure? Should an indigenous regime be developed, or the available international standards be followed? In the latter case, which international standard should be adopted?

iv. What are the key factors a model tariff regulation for EV charging should take into account while formulating the tariff framework?

**BUSINESS MODEL AND STRATEGY**

i. How could setting up and operating charging stations be made a commercially viable business venture within the ambit of India’s legislative framework?

ii. What should be the strategies of state transport departments/ agencies to convert existing public vehicle fleet to electric at least cost?

iii. What should be the strategy of the domestic OEMs for sourcing Li-ion batteries for EVs? Should they establish local manufacturing facilities for battery cells/ modules or directly import from international market?

**TECHNO-ECONOMIC**

i. What could be the right charging methods/ technologies for EVs – plugging in (AC, DCFC or AC Pulse Charger) or battery swapping or other modes considering their suitability for different vehicle fleets?

ii. What could be the major impacts from EV charging on power distribution network in a scenario witnessing EV roll-out at scale?

iii. How can EVs be utilized as a demand response resource and virtual power plants using V2G functionality?

iv. What should be the standards of performance for batteries and EVs to benchmark which will help weed away low quality makes?

v. How can EVs be effectively utilized for higher offtake of renewable energy, especially when the majority of the charging is expected to happen in the evening time?

**OTHER FACTORS OF NATIONAL IMPORTANCE**

i. What could be the possible international trade dynamics evolving around the EV industry and how it might impact India’s EV market?

ii. Is there a need for re-skilling existing local human resource in automobile and power sectors? What are the kinds of learning and un-learning the human force here would require?

iii. What could be the possible implications of electrification of vehicle fleet on India’s effort to achieve its NDC goals?
AEEE - THE “GO-TO” PARTNER

AEEE is a policy advocacy and clean energy market enabler with a not-for-profit motive. A typical AEEE intervention stands on the following four key pillars.

**INDUSTRY PLATFORM**
Create a credible platform to advocate business-enabling policies and develop a collaborative ecosystem

**THINK TANK**
Develop thought leadership position by nurturing innovative technologies and business models

**POLICY ENABLEMENT**
Advocate futuristic, holistic and data-driven policies that foster innovation and entrepreneurship

**MARKET ENABLEMENT**
Work with public and private sectors to create and enable widely adopted business value propositions

### AEEE ADVANTAGES

AEEE offers three clear advantages:

- **Network**: AEEE has an enviable reach to the full spectrum of stakeholders in India’s energy ecosystem – policymakers and implementing agencies, technology suppliers, power utilities, startups, financial institutions, multilateral agencies, and associations.

- **Dedicated research and credibility**: AEEE stands out for its focus in its research in the energy sector and has developed its competence to work across the spectrum of energy issues which has been highly recognized nationally and globally. It has a dedicated team which has extensive experience in addressing India’s power utility and urban infrastructure challenges.

- **Strategic international collaborations**: AEEE leverages its partnerships with major international thinktanks to address complex emerging challenges in the energy sector. Some of these strategic partners include the International Energy Agency (IEA), Lawrence Berkeley National Laboratory (LBNL), Rocky Mountain Institute (RMI), Electric Power Research Institute (EPRI) – US, International Council on Clean Transportation (ICCT) - US, and the American Council for an Energy-Efficient Economy (ACEEE).

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Sangeeta works on Energy Efficiency Data Indicators, State Initiatives and Urban Infrastructure. She is leading a team in developing India’s first ever State Energy Efficiency Index to evaluate States on their energy efficiency efforts and achievements across all demand sectors and electric utilities. She also publishes AEEE’s DSM newsletter to disseminate technology developments & best practices in DSM and DR to utilities. She was part of the team that developed a commercial building energy performance data framework for India. Sangeeta has conducted policy research to advance the adoption of sustainable space cooling, market assessment of India’s Standards and Labelling program for energy efficient appliances, and has contributed towards the development of an M&V application guide for energy-efficient street lighting. Prior to joining AEEE, Sangeeta worked in Information and Communications Technology for 20 years, during which she developed network products and operational support systems, and performed data analytics to improve efficiency in network repair and customer support. Sangeeta holds a B.E. in Electronics and Communication from Manipal Institute of Technology and an M.S. in Computer Science from University of California, Santa Barbara.

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Shyamasis has over 8 years of research and advisory experience in Power Distribution, Energy Management, and Policy & Regulation. He has served International Development Organizations, Governments, Public Agencies, Utilities, Project Developers, Industry Houses, and NGOs. He is credited with executing several important projects with high-profile clients including the World Bank, IEA, GGGI, DFID, KfW, GIZ, Govt. of India, BEE, EESL, UP Power Corporation Limited, Tata Power-DDL, BSES, BESCOM, India Smart Grid Forum (Ministry of Power) and major multi-national companies. In his present role, he is managing the power utility and urban infrastructure portfolio of AEEE and his research interest concerns the critical aspects of electric mobility, especially the inter-linkages of EV and power distribution. Shyamasis holds an International Master’s in Energy Management from Ecole des Mines de Nantes, France.

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