India EV Story
Emerging Opportunities
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</table>
Executive Summary

This report is developed by Innovation Norway, to map the fast growing ‘Electric Vehicles’ sector in India. Here, we delve into the details of the Indian EV sector nuances and present to you an analysis on how you can ride the EV boom in the country. After interacting with various Norwegian companies and different stakeholders in the Indian EV space, we have put together for you a list of opportunities that can be explored in this high growth market.

We hope this will bring you a step closer in realising your India ambition.

The Indian Automobile Industry is currently ranked 5th largest in the world and is set to be the 3rd largest by 2030. The requirement of mobility in India is set to change dramatically in the near future to cater to the requirement of 1.30 billion+ population. The past modes of transport and infrastructure will not suffice in coming years. Recognising this aspect, the Government of India, is working towards developing a mobility option which is ‘Shared, Connected and Electric’. There is an increased need to prepare for a green future for Indian mobility and reduce dependence on imported crude oil.

The Government of India is working towards an EV policy which is expected to be released in 2018 Q1. There are strong indicators from various policy makers in India to keep focus on EVs and to look at other low carbon options such as Methanol, CNG etc. The Government plans to work towards creating a demand for EVs by buying in bulk, which could provide for large orders for automakers. A recent tender for 10,000 cars is already issued and now a major tender for electric buses in 11 cities is likely to be released soon.

The Indian EV Industry is in its nascent stages with only 2 electric car manufacturers, about 10+ players in 2 Wheelers and 3-4 OEM’s in Electric buses. Most other auto OEM’s are now looking at introducing EV models in India.

While there is a vision for 100% electric vehicles by 2030, most industry experts indicate that around 40-45% EV conversion by 2030 is a realistic expectation. A major push towards EVs will be led by the public transportation requirements in India – Fleet cars, E-Buses, 3 wheelers and 2 wheelers. Personal vehicle options for EVs will still be a relatively smaller element in the whole pie.

India offers huge opportunities for Norwegian companies in every aspect of the EV ecosystem. This is a market in developmental stages and Norwegian firms could identify and position themselves to cater to this growing market in the long run. We have identified certain key areas for Norwegian firms to focus on.
Indian Automobile Industry
An Overview
Current status of the Indian Auto Industry

Indian Automobile industry is currently the 5th largest in the world and is set to take over as the 3rd largest automobile industry by 2030. There are a range of players operating in India as shown below:

<table>
<thead>
<tr>
<th>Passenger Vehicles</th>
<th>2 Wheelers</th>
<th>3 Wheelers</th>
<th>Commercial Vehicles</th>
<th>Tractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of OEMs</td>
<td>15</td>
<td>13</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>No. of Manufacturing units</td>
<td>29</td>
<td>22</td>
<td>7</td>
<td>34</td>
</tr>
</tbody>
</table>

- Maruti Suzuki
- Hyundai
- Tata Motors
- Fiat
- Ford
- Honda
- General Motors
- Mahindra
- Nissan
- Toyota
- Volkswagen Group
- Renault
- Premier Auto
- Mercedes Benz
- BMW
- Hero Moto Corp
- Honda Motors
- Bajaj
- TVS
- Suzuki Motorcycles
- Yamaha
- Mahindra
- Royal-Enfield
- Piaggio Vehicles
- LML
- Harley Davidson
- Triumph
- Kawasaki
- TVS
- Bajaj
- Piaggio
- Atul Auto
- Scooters India
- Mahindra
- Force Motors
- Tata Motors
- Ashok Leyland
- Force Motors
- Hindustan Motors
- Isuzu Motors
- Mahindra
- AMW Motors
- Piaggio Vehicles
- SML Isuzu Ltd
- Eicher
- Volvo
- Man Force
- Mahindra
- Escorts
- TAFE
- John Deere
- New Holland Tractors
- International Tractors
- Force Motors
- Indofarm Tractors
- SAS Motors
- HMT Tractors
- CNH Industrial
- ACE
- Preet Tractors
- SAME DEUTZ – FAHR INDIA
- Standard Tractors
- Captain Tractors
- Trishul Tractors
Indian Automobile Industry: Past Trend

Vehicle Production Trend (Volume in Mn)

- Production of automobile increased at a CAGR of around 4% over FY 12 & FY 17. Commercial Vehicle & 3 Wheeler production witnessed negative growth.
- The industry accounts for 7.1% of the country's Gross Domestic Product (GDP).
- India is also a prominent auto exporter and has strong export growth expectations for the near future.
- Around 40 OEMs are present in India, operating either through a manufacturing unit or assembly set up; large OEMs include:
  - PV: Maruti Suzuki, Hyundai, Honda, Tata Motors
  - 2W: Hero Motocorp, Honda, Baja Auto, TVS
  - 3W: Bajaj Auto, Piaggio
  - CV: Tata Motors, Ashok Leyland, Eicher Motors

Source: SIAM data and Feedback Analysis
Indian Automobile Industry: Future Outlook

Vehicle Production Trend (Volume in Mn)

- Production growth for the industry is estimated at ~7% over the next 4 - 5 years
- The outlook for 2018
  - Passenger cars to see a higher increase in new model launches compared to utility vehicles
  - Production capacity will also be added at car makers to reduce waiting periods and to boost demand. (Passenger vehicle segment growing between 7-9%)
  - In the two-wheeler segment, motorcycles are expected to grow moderately while scooters will continue to grow in double digits with two-wheelers growing between 9-11% in FY’18
  - Industry moving towards a March 2020 launch of BS-6 and most OEM/Auto component firms have made investments to meet this deadline.

Source: SIAM data and Feedback Analysis
## TWO WHEELERS

### Geographical presence of 2-Wheeler OEMs in India

<table>
<thead>
<tr>
<th>Brand</th>
<th>FY 2016-17</th>
<th>YoY Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bajaj Auto Ltd</td>
<td>3,209,395</td>
<td>-4.06</td>
</tr>
<tr>
<td>H-D Motor Company India Pvt Ltd</td>
<td>10,093</td>
<td>-14.48</td>
</tr>
<tr>
<td>Hero MotoCorp Ltd</td>
<td>6,645,745</td>
<td>0.49</td>
</tr>
<tr>
<td>Honda Motorcycle &amp; Scooter India (Pvt) Ltd</td>
<td>5,044,518</td>
<td>13.23</td>
</tr>
<tr>
<td>India Kawasaki Motors Private Ltd</td>
<td>688</td>
<td>-19.53</td>
</tr>
<tr>
<td>India Yamaha Motor Pvt Ltd</td>
<td>970,902</td>
<td>23.4</td>
</tr>
<tr>
<td>Mahindra Two Wheelers Ltd</td>
<td>57,065</td>
<td>-65.93</td>
</tr>
<tr>
<td>Piaggio Vehicles Pvt Ltd</td>
<td>49,583</td>
<td>76.57</td>
</tr>
<tr>
<td>Royal Enfield (Unit of Eicher Ltd)</td>
<td>666,822</td>
<td>30.34</td>
</tr>
<tr>
<td>Suzuki Motorcycle India Pvt Ltd</td>
<td>421,346</td>
<td>11.86</td>
</tr>
<tr>
<td>Triumph Motorcycles (India) Pvt Ltd</td>
<td>278</td>
<td>-63.42</td>
</tr>
<tr>
<td>TVS Motor Company Ltd</td>
<td>2,853,050</td>
<td>12.66</td>
</tr>
<tr>
<td><strong>Total Two wheelers</strong></td>
<td><strong>19,929,485</strong></td>
<td><strong>5.84</strong></td>
</tr>
</tbody>
</table>

*Source: SIAM data and Feedback Analysis*
TWO WHEELERS
Geographical presence of 2-Wheeler OEMs in India

[Map showing geographical presence of 2-Wheeler OEMs in India]
## PASSENGER VEHICLES

**Geographical presence of passenger vehicle OEMs in India**

<table>
<thead>
<tr>
<th>Brand</th>
<th>FY 2016-17</th>
<th>YoY Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIAT India</td>
<td>4,700</td>
<td>-47%</td>
</tr>
<tr>
<td>Force Motors Ltd</td>
<td>2,636</td>
<td>-22%</td>
</tr>
<tr>
<td>Ford India Pvt Ltd</td>
<td>252,959</td>
<td>28%</td>
</tr>
<tr>
<td>General Motors India Pvt Ltd</td>
<td>83,368</td>
<td>16%</td>
</tr>
<tr>
<td>Hindustan Motors Ltd</td>
<td>705</td>
<td>-61%</td>
</tr>
<tr>
<td>Honda Cars India Ltd</td>
<td>158,370</td>
<td>-21%</td>
</tr>
<tr>
<td>Hyundai Motor India Ltd</td>
<td>670,451</td>
<td>3%</td>
</tr>
<tr>
<td>Isuzu Motors India Pvt Ltd</td>
<td>1,621</td>
<td>369%</td>
</tr>
<tr>
<td>Mahindra &amp; Mahindra Ltd</td>
<td>242,721</td>
<td>-2%</td>
</tr>
<tr>
<td>Maruti Suzuki India Ltd</td>
<td>1,581,329</td>
<td>11%</td>
</tr>
<tr>
<td>Nissan Motor India Pvt Ltd</td>
<td>169,206</td>
<td>11%</td>
</tr>
<tr>
<td>Renault India Pvt Ltd</td>
<td>147,359</td>
<td>98%</td>
</tr>
<tr>
<td>SkodaAuto India Pvt Ltd</td>
<td>14,556</td>
<td>-10%</td>
</tr>
<tr>
<td>Tata Motors Ltd</td>
<td>169,599</td>
<td>10%</td>
</tr>
<tr>
<td>Toyota Kirloskar Motor Pvt Ltd</td>
<td>153,778</td>
<td>5%</td>
</tr>
<tr>
<td>Volkswagen India Pvt Ltd</td>
<td>138,182</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Total PVs</strong></td>
<td><strong>3,791,540</strong></td>
<td><strong>9%</strong></td>
</tr>
</tbody>
</table>

*Source: SIAM data and Feedback Analysis*

*Model wise details in annexure*
PASSENGER VEHICLES

Geographical presence of Passenger vehicle OEMs in India

Maruti Suzuki
Honda Cars India
General Motors India
TATA Motors
General Motors India
TATA Motors
Force Motors
Fiat India
Mahindra & Mahindra
Mercedes Benz India
Premier Automobiles
Audi India
Skoda Auto India Pvt. Ltd.
Volkswagen India Pvt. Ltd.
Mahindra REVA Electric Vehicles
Toyota Kirloskar Motor

Key Clusters

International Cars & Motors Ltd.
Honda Siel Cars India
Mahindra & Mahindra
BMW India
Ford India Pvt. Ltd.
Hyundai Motor
Mitsubishi
Renault Nissan India
Force Motors
India has 3 key Strategic Imperatives to look at EVs

**Higher Carbon Emissions**

One of India’s major development goals is the urgent need to reduce our carbon emissions and meet our climate obligations. **EVs could reduce our CO2 emissions by 37%**.

**Lower Power Demand**

Demand for power has not risen in sync with power generation capacities, leading to non-viability of the sector. Rise in EVs could help grid stability going forward.  

*A new source of power demand in the form of Electric Vehicles will be beneficial for the power sector and may lead to stable demand and a ‘paying customer segment’*

**Fuel Security Risks**

India currently depends on large scale imports of crude to meet most of its mobility fuel needs. **India can save 64% of passenger mobility-related energy demand in 2030 by pursuing a shared, electric & connected solution.**

*This could result in a reduction of 156 Mtoe (~US $ 60 Bn.) in diesel & petrol consumption for that year.*

Source: NitiAyog/RMI Report on Transformative Mobility Solutions for All
Electric Vehicles
Policy Structure
Overview of Political structure involved in EV Policy planning

*NIIT Ayog – National Institution for Transformative Initiatives*
## Key milestones in the EV Policies in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td><strong>01 First Automotive Mission</strong> Plan 2006-2016 Launched</td>
</tr>
<tr>
<td>2010</td>
<td><strong>02 MNRE INCENTIVE SCHEME FOR EV</strong></td>
</tr>
<tr>
<td>2012</td>
<td><strong>03 NEMMP 2020</strong> National Electric Mobility Mission 2020 Launched</td>
</tr>
<tr>
<td>2015 April</td>
<td><strong>04 FAME Policy</strong> launched in April 2015 – Faster Adoption and</td>
</tr>
<tr>
<td></td>
<td>Manufacturing of (Hybrid &amp;) Electric Vehicles</td>
</tr>
<tr>
<td>2015 September</td>
<td><strong>05 Second Automotive Mission Plan 2016-26 launched</strong></td>
</tr>
<tr>
<td>2017</td>
<td><strong>06 NITI AYOG ROADMAP Transformative Mobility Solutions For All</strong></td>
</tr>
</tbody>
</table>

- **01 First Automotive Mission Plan**: Huge push towards making India the global hub for small cars and quality auto components.
- **02 MNRE INCENTIVE SCHEME FOR EV**: Was withdrawn in March 2012 to be introduced as NEMMP 2012 but no incentives were given till FAME was introduced.
- **04 FAME Policy**: National Electric Mobility Mission 2020 Launched.
- **05 Second Automotive Mission Plan 2016-26 launched**.
- **06 NITI AYOG ROADMAP Transformative Mobility Solutions For All**.
Introduction to NEMMP 2020 (National Electric Mobility Mission Plan)

- Under this mission, the Government would use the following mechanisms/policies to increase the usage of electric vehicles in India
- National Electric Mobility Plan (NEMMP) 2020 targets to deploy 5 to 7 million electric vehicles in the country by 2020

NEMMP also targets 400,000 passenger battery electric cars (BEVs) by 2020 avoiding 120 million barrels of oil and 4 million tons of CO2. Total investment required for this will be Rs. 20,000 – 23,000 Crores (approx. 3 billion USD)

- Permissive legislations: Legislations to allow usage of electric vehicles in various areas, if not already allowed
- Operational regulations: Use of legislation framework and regulations aimed at setting safety regulations, emission regulations, vehicle performance standards, charging infrastructure standards, etc.
- Fiscal policy measures: Trade related policies for shaping the market, imports and exports
- Manufacturing policies aimed at encouraging investments
- Specific policies aimed at incentivizing manufacturing and early adoption of electric vehicles through demand creation initiatives
- Schemes and pilot projects for facilitating infrastructure creation
- Policy for facilitating research & development

Apart from launching this plan and conducting few pilot projects, nothing much was done on ground in terms of implementation of this policy till 2015 when the new government launched the FAME program
**FAME**

**Faster Adoption and Manufacturing of Hybrid and Electric vehicles was launched in April 2015 to fast track the goals of NEMMP 2020 plan**

- In order to promote the sale of electric vehicles in the Indian market, the government launched FAME scheme (Faster Adoption and Manufacturing of Hybrid and Electric vehicles) in India, as a part of the National Electric Mobility Mission Plan 2020, under which, the government would provide certain incentives to lower the purchasing cost of electric vehicles.

- The scheme has 4 focus areas i.e. Technology Development, Demand Creation, Pilot Projects and Charging Infrastructure.

- Overall, the government is expected to spend around Rs. 14,000 Crores for this scheme, which includes incentives to the customers for purchasing electric vehicles, incentives to the manufacturers for research and development besides developing the charging infrastructure.

- During the financial Year 2015-16, an amount of Rs. 75 Crores was allocated for this scheme, which was almost fully utilised. In the last financial year (2016-17), Rs. 91 Crores (approx.) has been utilised out of the budget allocation of Rs. 122.90 Crores.

- Under phase 1 of this scheme, support was extended to buyers during the fiscal years 2015-16 (Rs. 260 Crores) and 2016-17 (Rs. Rs 535 Crores). Further incentives would be provided depending upon the success of phase 1.

- Incentives of about Rs. 33 to 66 Lakhs are planned for each electric bus which typically costs around Rs. 1-2 Crores (imported buses) and around Rs. 50-80 Lakhs (domestically manufactured).

- Under the JNNURM (Jawaharlal Nehru National Urban Renewal Mission), NEMMP (National Electric Mobility Mission Plan) and Smart city plans launched by the government, various state and local transport bodies are expected to purchase electric buses over the next 5 years.

*Source: Desk research, Primary interviews*
In 2017, the Government of India through extensive ministerial discussions came out with a major policy document in terms of “Transformative Mobility For All”

- The NEMMP 2020 was extensively handled by Department of Heavy Industries till 2016. In 2017, a major inter-ministerial discussion on this took place which included the Prime Minister’s Office, NitiAyog (Planning Body), Department of Heavy Industries, Power Ministry, Ministry of Surface Transport & Roads, Urban Development Ministry, Petroleum and the Finance Ministry. From this emerged, a need to look at transforming the mobility in the country and reduce the dependence on fossil fuels and reduce imports obligations. One of the key pillars of this transformative mobility is the emergence of EVs and the EV infrastructure that is likely to be needed. Post this discussion, the NitiAyog has come out with a report on the plans for the Government on Transformative Mobility Solutions for All.

- Under the GST regime, EVs were kept at the 12% tax levels, while hybrids fell at the 43% levels (luxury products) - this has led to a lot of heartburn in the auto industry as major players have been focusing on hybrids. There are now representations to give more weightage to Hybrids as well and reduce GST on Hybrids.
## NitiAyog Plan

### Planned approach to mobility transformation

<table>
<thead>
<tr>
<th>Elements of India’s mobility transformation</th>
<th>OPPORTUNITY AREAS</th>
<th>NEW MOBILITY PARADIGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>System integration</td>
<td>Assembling the pieces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Mobility as a service</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Interoperable transport data</td>
<td></td>
</tr>
<tr>
<td>Shared infrastructure development</td>
<td>Building the ecosystem</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Mobility-oriented development</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Vehicle-grid integration</td>
<td></td>
</tr>
<tr>
<td>Scaled manufacturing</td>
<td>Creating the supply</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Product manufacturing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Electric vehicle deployment</td>
<td></td>
</tr>
</tbody>
</table>

- **Systems integration**: Enabling wide-scale adoption of mobility solutions through ubiquitous availability and sharing of interoperable transport data (ITD).

- **Scaled manufacturing**: Facilitating market creation through policies and mechanisms that enable manufacturing of electric vehicles (EVs) and necessary components in successive segments based on their market readiness.

- **Shared infrastructure development**: Better urban design, where a larger fraction of mobility demand is met by nonmotorized transit and public transit, and access to vehicle-charging infrastructure enables higher penetration of EVs.
Push towards EV inevitable in India
even though no formal policy is out yet

The current Government in India is firmly disposed towards bringing in a low / reduced carbon footprint in India’s mobility scenario by 2030 – and EVs seem to be pivotal to these plans.

Even though there are multiple voices within the Government stakeholders towards the route of implementing this, Various Government bodies / Ministers are discussing the push towards EV, Alternate Fuels and a move towards a ‘Shared Mobility’ era.

As of now, there is no formal Policy announcement / notification on EVs but the NitiAyog is mandated to come out with an EV policy now and it will be implemented by multiple Ministries.
Public Transport (Bus & Fleet cars) and 2/3W seem to be first movers towards EV in India

- In India, the focus will be on getting the public transport fleet onto the electrification journey before focusing on private vehicles. Priority will be given in the order of electric buses, 3 wheelers, fleet cars, 2 wheelers and then private cars.

- To push this philosophy into action, the Central Government has started some key initiatives such as:
  - DHI has come out with a scheme to assist all 1Mn+ populated cities to buy Electric Buses with an subsidy support of INR 1.05 billion per city and INR 150 million for Charging infrastructure)
  - [http://dhi.nic.in/writereaddata/UploadFile/inclusion%20of%20bus%20in%20fame%20india%20scheme_1.PDF](http://dhi.nic.in/writereaddata/UploadFile/inclusion%20of%20bus%20in%20fame%20india%20scheme_1.PDF)
  - EESL, a Power Ministry PSU, having expertise in large aggregated procurements, has come out with a tender of 10,000 electric cars and about 4000 chargers and is on the verge of getting the first 500 e-cars delivered – these cars will be used by Government PSU’s & ministries to meet their fleet cabs requirement
  - FAME scheme for 2W’s is a huge boost for the industry. Nearly 15-16 Indian firms operate in the 2W electric scooters and bikes segment– this is bound to move up faster
Karnataka is the only state to have its EV policy notified recently – other states like Telengana and Andhra Pradesh are also actively working on releasing their policies

- Karnataka has notified a very comprehensive state policy for Electric Vehicles
- This policy sets the State’s vision and intention to take a leadership position in the EV business in India
- This is a policy which covers all elements of the EV business – EV manufacturing, EV Charging business and EV sales & consumption in the state
- There are specific policies to boost consumer demand with incentives and other soft policies such as parking preference and lane preferences for EVs
- There are specific policy statements for EV Charging infrastructure business as well
- Availability of charging infrastructure is a prerequisite for electric mobility. Government of Karnataka will develop charging infrastructure as a commercially viable business venture that attracts private investment.
- It is proposed to adopt BIS standards for charging equipment, mandating charging infrastructure in public buildings, amending building bylaws for provision of charging outlets, regular electricity supply etc.
- Other states like AP, Telengana, Maharashtra, Tamil Nadu, Kerala are likely to adapt similar policies

POLICY LINK DOCUMENT

Towards EV Mission 2030
Currently electric car market is at a very nascent stage with only 1 serious player

- About 7100 cars on road since introduction of the first Electric Car in 2001 by REVA (Mahindra)
- Limited support from the government in the car market

- Currently the market largely limited to 2 cities in India
- Mahindra’s manufacturing plant is located in Bangalore & a new one is being planned at Nashik

Installed base of Electric Cars in India

Source: Feedback Analysis
Current Market

**No. of EVs & Hybrids sold under FAME**

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of Vehicles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Wheelers</td>
<td>52,622</td>
<td>33.63%</td>
</tr>
<tr>
<td>3 Wheelers</td>
<td>145</td>
<td>0.09%</td>
</tr>
<tr>
<td>4 Wheelers</td>
<td>103,685</td>
<td>66.26%</td>
</tr>
<tr>
<td>Buses</td>
<td>23</td>
<td>0.01%</td>
</tr>
</tbody>
</table>

*Source: Feedback Analysis*

*Under the 4 Wheelers segment – nearly ~99,000 are Hybrid SUV’s and only about 4000 are EV Passenger cars*
The sales of Electric cars have been stagnant at 2000 units / yr since the last 2 years.

The 2W Industry is now slowly coming out of its slump of 2015 where it had reached a sale of 20,000 units from a high of ~100,000 in 2011.

- The Indian government had first offered tangible support to the electric vehicle industry at the end of 2010, with the Ministry for New and Renewable Energy announcing a Rs 95-crore incentive scheme for manufacturers.
- The government subsequently slashed the import duty on batteries from 26 per cent to 4 per cent.
- Since 2012, there were no fiscal incentives available for EVs and sales slumped to 20,000 units. Now with FAME policy, sales have started to rise but most of the earlier EV 2-Wheeler firms have shut shop.
Approach to Future EV Market Estimation

1 OF 3

Auto Industry body, SIAM had predicted the 2026 sales of Vehicles in India based on the average GDP growth of 5.8%

The future projections for various types is given below:

<table>
<thead>
<tr>
<th>2016-17 revised classification as per Niti Ayog</th>
<th>2016-17 domestic sales</th>
<th>2026 SIAM Projections (Min.)</th>
<th>2026 SIAM Projections (Max.)</th>
<th>2026 SIAM Projections (median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Vehicles - Personal</td>
<td>2,132,709</td>
<td>5,170,000</td>
<td>7,370,000</td>
<td>6,270,000</td>
</tr>
<tr>
<td>Passenger Vehicles - Commercial / fleet</td>
<td>914,018</td>
<td>4,230,000</td>
<td>6,030,000</td>
<td>5,130,000</td>
</tr>
<tr>
<td>Commercial Vehicles - Goods</td>
<td>616,106</td>
<td>1,700,000</td>
<td>3,315,000</td>
<td>2,507,500</td>
</tr>
<tr>
<td>Commercial Vehicles - Passenger</td>
<td>98,126</td>
<td>300,000</td>
<td>585,000</td>
<td>442,500</td>
</tr>
<tr>
<td>Three Wheelers</td>
<td>511,658</td>
<td>1,200,000</td>
<td>1,500,000</td>
<td>1,350,000</td>
</tr>
<tr>
<td>Two Wheelers</td>
<td>17,589,511</td>
<td>50,600,000</td>
<td>55,600,000</td>
<td>53,100,000</td>
</tr>
<tr>
<td>Overall vehicles</td>
<td>21,862,128</td>
<td>63,200,000</td>
<td>74,400,000</td>
<td>68,800,000</td>
</tr>
</tbody>
</table>

Source: SIAM – Society of Indian Automobile Manufacturers
Approach to Future EV Market Estimation

2 OF 3

Estimates based on NITI Ayog's plan

To arrive at the 2026 penetration numbers of the EV, assumptions were considered on the 2030 penetration levels.

These assumptions were taken into consideration based on the Vehicle type and the current ground realities surrounding each of these assumptions as shown below.

<table>
<thead>
<tr>
<th>2016-17 revised classification as per NitiAyog</th>
<th>NitiAyog EV Plan 2030</th>
<th>Assumption on the NitiAyog plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2030 Business As usual (BAU)</td>
<td>2030 Transformative</td>
</tr>
<tr>
<td>Passenger Vehicles - Personal</td>
<td>1%</td>
<td>40%</td>
</tr>
<tr>
<td>Passenger Vehicles - Commercial / fleet</td>
<td>5%</td>
<td>100%</td>
</tr>
<tr>
<td>Commercial Vehicles - Goods</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Commercial Vehicles - Passenger</td>
<td>1%</td>
<td>100%</td>
</tr>
<tr>
<td>Three Wheelers</td>
<td>5%</td>
<td>100%</td>
</tr>
<tr>
<td>Two Wheelers</td>
<td>5%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Considering the above 2 factors the future for EVs in India by 2026 was projected.
## Approach to Future EV Market Estimation

### Likely future market for EVs in India

<table>
<thead>
<tr>
<th>2016-17 revised classification as per NitiAyog classification</th>
<th>SIAM Data</th>
<th>Feedback estimate</th>
<th>Feedback projection based on the explanation earlier</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-17 domestic sales (all Types)</td>
<td>2,132,709</td>
<td>2,000</td>
<td>31,350</td>
</tr>
<tr>
<td>2016-17 domestic sales (only EVs)</td>
<td></td>
<td></td>
<td>1,254,000</td>
</tr>
<tr>
<td>Passenger Vehicles - Personal</td>
<td>914,018</td>
<td></td>
<td>102,600</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3,078,000</td>
</tr>
<tr>
<td>Passenger Vehicles - Commercial / fleet</td>
<td>616,106</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Commercial Vehicles - Goods</td>
<td>98,126</td>
<td>20</td>
<td>2,213</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>265,500</td>
</tr>
<tr>
<td>Commercial Vehicles - Passenger</td>
<td>511,658</td>
<td>50</td>
<td>27,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>675,000</td>
</tr>
<tr>
<td>Three Wheelers</td>
<td>17,589,511</td>
<td>22,000</td>
<td>1,062,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10,620,000</td>
</tr>
<tr>
<td>Overall vehicles</td>
<td>21,862,128</td>
<td>24,070</td>
<td>1,225,163</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15,892,500</td>
</tr>
</tbody>
</table>

*Around 10-12 Million EVs by 2026 would be a safer projection to consider*
Mahindra Electric is the first major EV manufacturer in India.

Mahindra Electric Mobility Limited, formerly known as the Reva Electric Car Company, is an Indian company based in Bangalore, involved in designing and manufacturing of compact electric vehicles.

Mahindra Electric started their journey in to the EV space in 2001 by launching Mahindra Reva, India’s first electric car. They subsequently launched Mahindra E20, the current version on roads India.

Some key features of this firm are:

- The first and pioneer in the Electric Vehicles in India
- The company is selling around 180-200 units per month across India in all models.
- Recently, launched a new EV model, eVerito and expecting sales of 350-400 per month
- Mahindra has a dedicated R&D centre in Bengaluru where over 200 engineers are working on e-vehicle technology and refinements.
- Since 2010, Mahindra electric has 7000+ customers under EV segment and has completed over 50 million miles of Electric vehicle driving in India
- Mahindra Electric has partnered with a Corporate Fleet firm - Lithium and provides Electric Corporate fleet services in Bengaluru.
- Partnered with OLA to launch 300 EVs in Nagpur
- It has participated in the EESL and has supplied over 150 eVerito in the first EV tender in India
- Partnered with NTPC to launch charging stations in Noida and Delhi
- The company is boosting capacity at its Bengaluru facility to make battery packs from 500 per month to 800 -1000 per month in the next two to three months. (two facilities can assemble 5,000 battery packs per month)
- All the EVs have a battery packed by Mahindra, while importing cells from China – typically a battery of 48Volts (or 76 volts) will have about 16 cells and each cell would have 3 modules
- It has tied up with Zoom Car to sell 200 cars (e2o Plus)
- They are planning to increase the production capacity that can help them to sell over 5000 units per month over the next 2 years in all category vehicles
- Currently they are in discussion with all the fleet operators as most traction in future will come from commercial operators
India EV Story: Emerging Opportunities

**e2oPlus**
The 4 door all-electric city car from Mahindra Electric.

**eVerito**
The electric sedan from Mahindra Electric.

**eSupro**
India's 1st all-electric cargo and passenger van by Mahindra Electric.

**eAlfa**
Mahindra's zero emission and all-new, electric rickshaw.

---

### Dealers
33 dealers across 9 states with ~60% dealers in Bangalore, Mumbai and Delhi

### Charging stations
80 locations across 10 cities with ~86% located in Delhi, Kolkata, Bangalore and Pune

### Service
Free charging service as of now and will cost around INR 60-66 per charge in future

### Locations
Public places include shopping malls and Mahindra showrooms as of now
Tata Motors has recently entered the EV market in passenger vehicles and Electric buses

Tata Motors Limited, a USD 42 billion organization, is a leading global automobile manufacturer of cars, utility vehicles, buses, trucks and defence vehicles. As India’s largest automobile company and part of the USD 100 billion Tata group, Tata Motors has operations in the UK, South Korea, Thailand, South Africa, and Indonesia through a strong global network of 76 subsidiary and associate companies, including Jaguar Land Rover in the UK and Tata Daewoo in South Korea. In India, Tata Motors has an industrial joint venture with Fiat. Engaged in engineering and automotive solutions, with a focus on future-readiness and a pipeline of tech-enabled products, Tata Motors is India’s market leader in commercial vehicles and among the top in passenger vehicles with 9 million vehicles on Indian roads. The company’s innovation efforts are focused on developing auto technologies that are sustainable as well as suited. With design and R&D centres located in India, the UK, Italy and Korea.

Tata Motors in collaboration with its subsidiary, the UK based Tata Motors European Technical Centre (TMETC), are looking to have a major play in the EVs market in India.

It plans to address both the Passenger Vehicles and Electric Buses market in India.

**Electric buses**

- It has already launched electric buses in the state of Himachal Pradesh
- Plans to deliver 25 hybrid buses to MMRDA in Mumbai
- 100 Buses tender floated for Pune city, 6 buses for BEST, in Mumbai and 6 Buses for Himachal Road Transportation
- Company in talks with Chandigarh Government to start a pilot project for Smart City
- Expect demand from State Transport Unions alone to be around 400,000 Electric buses in the long run.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tata Starbus Hybrid19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seats</td>
<td>32</td>
</tr>
<tr>
<td>Cost (INR)</td>
<td>1.2–1.4 crores</td>
</tr>
<tr>
<td>Fuel Efficiency</td>
<td>25 – 30% better</td>
</tr>
<tr>
<td>Range (KMS)</td>
<td>286–520</td>
</tr>
<tr>
<td>Max power</td>
<td>230 BHP engine</td>
</tr>
<tr>
<td>Battery type</td>
<td>Li-ion batteries</td>
</tr>
</tbody>
</table>
Passenger vehicles

Tata Motors launched their EV Passenger cars business by winning a major tender of 10,000 cars launched by EESL. They have launched a car – Tigor EV and have recently delivered their first set of cars to EESL from their Saanand Plant in Gujarat. The Tigor Electric will be able to do about 120-150 kilometers on a full battery charge.

The Tigor EV for EESL order will be delivered in three trim variants – Base, Premium and High and will be available in ‘Pearlescent White’ colour with blue decals. Over the basic requirements of the tender, the Tigor EV, across the variants, would have FATC (Fully Automatic AC) to provide maximum comfort to its occupants. Equipped with a single speed, automatic transmission, the Tigor EV will also allow the customers to enjoy the driving experience, maximized efficiency and seamless acceleration. The electric drive systems for the Tigor EV is developed and supplied by Electra EV – a company established to develop and supply electric drive systems for the automotive sector.

Tata Motors will commercially launch many electric cars in India. The automaker has already showcased an electric variant of the Tiago and has been testing the Nano Electric quite extensively. With the Tigor Electric already in production, Tata already has about 3 options to pick from.

The Nano EV could be the first electric car that the automaker launches in India, followed by the Tigor and Tiago electric vehicles. Electric car charging infrastructure is at its infancy in India, and the government is fast stepping up its efforts to roll out charging stations.

Tata Motors is setting up 400 charging stations in Delhi alone and has plans for more cities. They plan to develop their own vendor for chargers as well.
EV Chargers in India
EV Chargers

Industry Structure in India

Existing suppliers

- ~15 firms currently supplying EV Chargers in India
- Only 3 firms in 4W, AC Chargers so far in India
- 4 Wheelers – AC Chargers - RRT Electro Power, Chennai; Mass Tech Controls, Mumbai; Exicom, New Delhi
- These are mostly Power Electronics & Battery Charger manufacturers who have diversified into EV Chargers
- 10-12 firms in small 2W AC Chargers who supply along with their vehicles and a few OEMs for EV Chargers

Global EV Charger firms

- 5-6 key global firms eyeing the EV Chargers market closely
- Firms like ABB India, Delta India, Schneider India, Siemens India etc are looking at the Indian market closely
- These firms have their global designs and products and are studying the technical / specifications, business models and potential for their products
- All these firms are only looking at the 4 Wheelers' (Cars) EV Chargers

Likely Indian firms in EV chargers

- Huge interest in the Indian market for manufacturing EV Chargers
- Most Large & MSME firms in power electronics & battery rectifiers are looking at this market very closely
- Some names we could confirm, who have evinced interest in EV Chargers manufacturing are Raychem RPG India, Analogic India, Deltron, EOS Power, AdorPowertron, Kraft Power Con, Elind etc
- Most of these firms are currently getting their designs and products in place
# EV Chargers

## Overview of Key Players

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>4 Wheelers (Ecars)</th>
<th>4 Wheelers (Ecars)</th>
<th>2 Wheelers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Firms</td>
<td>Existing Indian suppliers</td>
<td>Existing Indian suppliers</td>
<td>Existing Indian Suppliers</td>
</tr>
<tr>
<td>Name</td>
<td>RRT Electro Power, Chennai</td>
<td>Mass-Tech Controls, Mumbai</td>
<td>Most bike manufacturers have their own in-house chargers manufacturing and few OEM’s like Axiom</td>
</tr>
<tr>
<td>Background</td>
<td>Power Electronic &amp; Battery Chargers</td>
<td>Power Electronic &amp; Battery Chargers</td>
<td>eBike manufacturing and Power Electronic firms</td>
</tr>
<tr>
<td>Their presence in EV Charging</td>
<td>They have been supplying to Mahindra for sometime now</td>
<td>They have been an OEM for various Power Electronics for Tata Power, they are now supplying EV Chargers for Tata Power Pilot projects in Mumbai</td>
<td>Most firms are into supplying Chargers for bikes for nearly a decade now.</td>
</tr>
</tbody>
</table>
EV Chargers

Market Characteristics and Business Models

Nascent Market

EV Chargers market is at a very nascent stage and is limited to pilot projects largely. Currently, few players are present in the market barring the small 2W Chargers.

Unorganised / small players dominating now

Due to its limited scale of business, this business in India is currently limited to small firms who are essentially power electronic firms making products like power panels, battery chargers, rectifiers etc and they have diversified into EV chargers.

The high technology, Indian and foreign players are now waking up to the potential of this business and are in the process of getting their products and designs ready for India.

Low on technology

Most of these chargers are AC chargers with about 90 minutes charging time and are claimed as Fast Chargers.

Business model dependent on Auto OEM’s and their plans for now

Due to its nascent status, business models are yet to be established and most players are in this business either with an alliance with 1-2 auto firms or a charging service provider.

Charging Services firms emerging now

No existing charging services firms yet. However, there is a huge interest in this business post the push from NITI Ayog plan.
The NITI Ayog plan will act as a key driver for the EV chargers business going forward

Based on the NITI Ayog plan, the Ministry of Power has already undertaken several leads in pushing the EV Infrastructure initiatives though its various PSU companies, such as

- National Thermal Power Corporation (NTPC) – plans for setting up 100,000 EV charging stations in India
- Bharat Heavy Electricals Ltd (power equipment PSU) plans to make batteries in India using the Lithium technology developed by ISRO
- Energy Efficiency Services Ltd (EESL – a national ESCO company, experienced in large tendering process) has already issued tenders to source 10,000 EV and about 4,000 EV chargers in India
- Rajasthan Electronics (I) Ltd, (REIL) – plans to set up 200 charging stations in Delhi, Jaipur and Chandigarh

Each of these initiatives will help set the basic infrastructure and bring in interest from the private players as well, already many announcements have been made by various private players

- Tata Power has a set up a pilot project of EV charging and is likely to install more in future
- Mahindra along with Ola has been setting up EV charging stations so far and will continue to be aggressive about this
- Fortum India, Finland’s Utility firm, plans to enter and set up nationwide EV Charging stations
- Lithium Urban, an EV feet firm has plans to set up 60 charging stations

Each of these initiatives will be key drivers for the EV charging business going forward
NTPC will be a key player in setting up EV chargers infra in India

Present Status of EV Charging Stations

- National Thermal Power Corporation (NTPC) ventured into EV-Charging business and has installed first charging stations at its offices in Delhi and Noida.
- At present, they are looking for a country-wide licensing. If that happens than they will be able to set up the charging stations very quickly.
- The main objective in setting up EV charging points is to be part of promoting clean energy transportation.
- In NTPC, the charging station installed as of now is specific to Mahindra vehicles.
- NTPC has applied for National Distribution License to roll out this at a national level.
Bharat Heavy Electricals Ltd (BHEL)

- MOU has been signed between BHEL and ISRO for making Electric Vehicles battery. ISRO is providing R&D technology to BHEL for making efficient and low cost lithium-ion battery.
- For batteries, BHEL is in conversation with ISRO. A foreign agency is also involved with the company for technology tie-up.
- BHEL has started manufacturing electric motors for Ashok Leyland and Tata Motors for their electric vehicles.
- BHEL has formed an internal committee to understand the market and demand for batteries.
- According to BHEL there should be a generic standard for batteries in India.
- Presently, Mahindra Reva is using Chinese battery for its EVs.
The Ministry of Power has called for sourcing 4,000 EV chargers through an open tender from one of its PSU’s - EESL

TENDER NAME
Location Survey, Planning, Engineering, Manufacturing, Supply and Erection & Commissioning and 5-year comprehensive on-site warranty of 3,000 AC Slow Chargers and 1,000 DC fast Chargers compatible with Bharat AC-001 & DC-001 charger specification

Objective of this tender

- Ministry of Power has initiated a program to source 10,000 electric cars in India, through EESL.
- The goal of this initiative is to provide an impetus for Indian Vehicle manufacturers, charging infra firms, fleet operators, services providers etc to gain efficiencies of scale and drive down costs
- Create local manufacturing facilities
- Grow technical competence for the long-term growth of EV industry in India
- To enable Indian EV manufacturers to emerge as major global players
- EESL shall be supporting the new Electric Mobility Mission to scale EVs in India through bulk aggregating of demands of EV charging infrastructure, procuring best quality products & services at lowest prices

Structure of the order

- EESL plans to procure 1,000 EVs immediately in the Phase 1 of the exercise and 9,000 EVs later in the Phase 2 of this tender
- The Phase 1 for 1000 EVs are being procured for use in various Central Government Ministries in India
- Phase 2 exercise for sourcing 9,000 EVs is aimed at leasing the vehicles to various fleet operators
Some key points on the EV Chargers

- The charging equipment must be CE Certified
- The charging equipment must come with a comprehensive extended on-site warranty and AMC package for 5 years from the date of commissioning and must have a design life of 10 years
- The charging equipment before delivery, should be type tested as per AIS 138 at ARAI (Automotive Research Association of India) and IIT Madras
Tata Power

Tata Power is a private power distribution company that plans to invest in EV charging infrastructure

- Tata Power recently has installed its first electric vehicle charging facility at Vikhroli in Mumbai. It has set up 2 more stations in North & Central Mumbai.
- Tata Power plans to roll out nearly 50 EV charging stations in Mumbai and New Delhi.
- The chargers can also monitor the car battery charging status and units consumed while charging a car.
Ola

Ola has gone one step ahead in implementing Charging stations

Electric Vehicles

- Launched 200+ Ola cars that are charged by the company as of now in Nagpur pilot project
- Has 50+ charging stations at 4 strategic locations in Nagpur
- Ola electric vehicles are from Mahindra Electric (E20 model)
- The payment system is provided to third party vendor and can be paid via electronic or cash mode
- These cabs run around 200Kms per day

Limitations/ hurdles

- Setting up charging stations in Tier I city is operationally not feasible
- Drivers come back to charging station to charge, covering 7-8 trips
- Navigation and other apps are draining the battery, and in some instances, they have covered only 75-80 km over an anticipated mileage of 100km

Charging Stations

- DC fast charging that takes around 75 min to charge
- The ACME group has supplied the charging station
- Company has invested INR 50 Cr in the entire EV project
- The Ola cars are charged by the company under a subsidy

Future Plans

- Planning to launch the same in 2 Tier-I and 3 Tier-III cities in coming years
- Looking at Hyderabad, Lucknow and Kochi in the pilot phase
- Plans to invest $2 billion in Evs in all cities of India and run one million electricity-powered vehicles on the Ola platform by 2020
- Looking to tie up with OEM’s like TATA and Bajaj in future
- Ola is in talks with Government for PPP for pilot projects on EV segment
EV Charging business currently falls under the regulated environment (needing a License) but may be amended to allow more private sector participation

- For the EV charging business, there are no specific rules as such which is set out – due to the lack of the EV Policy overall
- Under the existing rules, EV charging business is classified as Electricity Sales and falls under the Electricity Act 2003 (EA 2003) and under the domain of the regulated sectors, needing a distribution license
- However, the EV chargers/charging stations used for maintaining own vehicles does not fall under the regulated environment and is allowed - considered as captive consumption
- Our discussions with various states like Karnataka, Telangana and Andhra Pradesh has also indicated that they could use some provisions for private sector participation in the EV charging business and need not be under the regulated domain
Indian Government has recently notified the standards for EV Chargers to be adapted in India

- The Government of India has recently notified the Protocol for Adaption of standards for Bharat Chargers (AC-001 & DC-001)

- The process of adapting these standards included the following steps:
  - Under the FAME Policy in 2015, the Department of Heavy Industries (DHI) had authorized the Automotive Research Association of India (ARAI) to come up with Draft Standards for EV Chargers in India
  - ARAI had published these standards in 2016 and the DHI invited Industry response to the same
  - DHI along with NitiAayog has proposed standards for EV Chargers in India

- The details of these standards could be found in the link
  http://dhi.nic.in/writereaddata/UploadFile/REPORT%20OF%20COMMITTEE.pdf
Current installed base of EV Chargers in India is about 270 units

- The EV chargers business in India is in nascent stages with only one major car manufacturer
- Home chargers are not included in these estimations; only public EV charging stations are considered
- Post FAME and the NitiAyog Plan announcement, we have seen an increased thrust on setting up EV chargers in the last 3-4 months in India

<table>
<thead>
<tr>
<th></th>
<th>Installed base 2016-17</th>
<th>Additions in the last 4 months</th>
<th>Total installed base as of August 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV Charging stations</td>
<td>100</td>
<td>30</td>
<td>130</td>
</tr>
<tr>
<td>Average Norms of EV Chargers</td>
<td>1.5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total EV Chargers installed</td>
<td>150</td>
<td>120</td>
<td>270</td>
</tr>
<tr>
<td>% of AC Slow chargers</td>
<td>100%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>% of DC Fast Chargers</td>
<td>0%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>No of AC Slow chargers installed</td>
<td>150</td>
<td>96</td>
<td>246</td>
</tr>
<tr>
<td>No of DC Fast Chargers installed</td>
<td>0</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>
Approach for likely future market estimation

The approach to the likely future market for EV Chargers is set out below:

- For the context of this exercise, only the Public Charging Infrastructure required for passenger cars is being considered as the market potential for the Client (2/3W are likely to shift to Battery swapping in a large way and will rely on home chargers; Buses are also likely to move to the Battery Swapping model in India)

- Currently, there is low visibility on how things are likely to pan out in EVs and EV Chargers segment in India, so there is a need to make certain assumptions - we have spoken to the Industry stakeholders and validated some of these assumptions

- These assumptions could be relooked in the future and the future estimation of the market could be adjusted accordingly as per new inputs in future

1. The base estimation of likely passenger car additions by 2026 considered:
   i) As explained earlier, we expect anywhere from 130,000 to 4,300,000 nos of Electric Cars to be added by 2026 based on the 2 scenarios set out by NITI Ayog in India
   ii) ASSUMPTION: Feedback has reckoned a conservative number of 2,000,000 Electric cars by 2026 in India, assuming the NITI Ayog’s plan to be very ambitious; the market likely to grow given the spate of new entrants and the push by the Government and the likely fall in prices going forward

2. Next, the norms of No. of EV Charging stations required for the EVs on road considered, as per industry estimate, this could be in the range for 1 EV Charging station per 4-6 vehicles, so a norm of 5 vehicles considered

3. Dividing the no of EVs likely with this norm, gives us no of charging stations required
   i) To reach a milestone of meeting the charging requirement of 2,000,000 Electric Cars, around 400,000 nos of Charging stations are required by 2026
   ii) This estimation is also validated from our interviews with NTPC, when asked them about why 100,000 nos of EV charging stations are being planned by them – they had mentioned that they would like to kick start the EV revolution in India by installing the initial 20-30% of EV Chargers required for India – then the private sector could chip in and take this industry ahead
4. Next, we used the norm of no of EV Chargers used per EV Charging Station
   i) We expect the average no of EV Chargers per station from an average of 4 / station to
go up to 6 / station by 2026

5. Next the norms of the type of Chargers (AC/DC and Slow / Fast ) was considered
   i) This is an area which will depend on the pace of technology developments and the
prices of EV Chargers going forward
   ii) We have considered the industry view that the AC Chargers (Slow) will dominate for
some years now and DC Fast Charging could be the future
   iii) Accordingly, we have used the norm of DC Chargers to be about 60% of the business
by 2026
Likely future market for EV Chargers in India

<table>
<thead>
<tr>
<th></th>
<th>2017-18</th>
<th>2018-19</th>
<th>2019-21</th>
<th>2021-25</th>
<th>Cumulative potential upto 2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of EV Charging stations likely to be set up</td>
<td>1,000</td>
<td>5,000</td>
<td>50,000</td>
<td>350,000</td>
<td>406,000</td>
</tr>
<tr>
<td>Norms of EV Chargers likely to be installed</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Total EV Chargers likely to be installed</td>
<td>4,000</td>
<td>20,000</td>
<td>300,000</td>
<td>2,100,000</td>
<td>2,424,000</td>
</tr>
<tr>
<td>% of AC Slow chargers likely</td>
<td>90%</td>
<td>80%</td>
<td>80%</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>% of DC Fast Chargers likely</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>No of AC Slow chargers likely to be installed</td>
<td>3,600</td>
<td>16,000</td>
<td>240,000</td>
<td>1,470,000</td>
<td>1,729,600</td>
</tr>
<tr>
<td>No of DC Fast Chargers likely to be installed</td>
<td>400</td>
<td>4,000</td>
<td>60,000</td>
<td>630,000</td>
<td>694,400</td>
</tr>
</tbody>
</table>
Overview on
EV Battery Segment
Battery Market in India - An Introduction

The battery market is characterized by the unorganized sector which accounts for 40% of the market in volume terms. This market is currently ruled only by the Lead Acid batteries in India. Most Lithium Battery requirements are imported and now we see some lithium battery packaging happening in India since the last 1 year.

There are close to 2,500 odd players making Batteries in India in the Lead Acid market. There could be close to another 10,000 odd small and unorganized players in the battery market.

The market is dominated by 2 key large players – Exide Industries and Amara Raja Industries. The battery market is a INR 177 billion industry and around 80.5 million units.

Automotive is a key large market dominating the end use application segments accounting for 60% of the market in India and the rest industrial and commercial applications accounting for the balance.

In terms of the types of batteries, Enhanced Maintenance Free (EMF) batteries account for 67% of the market, VRLA are now gaining in prominence and is about 31% of the market. Low maintenance batteries account for 2% of the market.

Automotive sector accounts for 60% of the 80.5 mn battery unit market

Source: Feedback Analysis
India is a virgin market for Lithium Ion or other advanced batteries market

- A mature market of Lead acid battery manufacturing eco-system established in the country
- Lithium Ion Battery manufacturing is just starting out and is currently almost non-existent
  - As of last year, most Lithium batteries were being imported from China, South Korea, Vietnam, Singapore and Japan predominantly
  - Last one year saw some major activities in Lithium Ion Batteries packaging in India
  - India may reach a capacity of 1GWH of Battery packaging by 2018
- Major announcements being made by global private and public sector units to look at Lithium Ion Battery production in India
Lithium Ion battery packaging started seriously in India in the last 1 year

**Current Lithium Ion battery packaging capacity in India ~500MWh**

- Lithium Ion battery for the telecom segment was the first major segment to be consumed in India
- For long we relied on importing these batteries from China and other countries
- Coslight & Exicom were the 2 serious players catering to this segment
- Many more battery packaging plants are likely to come up in this year
- The capacity is likely to reach 1GWH by 2018 end
- We foresee this to reach 5-6 GWH over the next 2-3 years depending on how the EVs take off in India
- Lithium Ion Cell manufacturing is still not on the radar even though the Government is seriously contemplating this and attracting investors

*Source: Feedback Analysis*
Major announcements being done in the last 6 months in India in Lithium Ion Battery manufacturing

<table>
<thead>
<tr>
<th>Firm name</th>
<th>Key announcement detail</th>
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<tbody>
<tr>
<td>Reliance Industries Ltd</td>
<td>India’s large corporate body has announced plans to enter the Lithium Ion battery production business – media reports note that it was looking at a large factory that would produce Lithium-Ion (Li-Ion) batteries of 25 gigawatt-hours (GWh) capacity.</td>
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<td>Suzuki / Toshiba / Denso</td>
<td>Suzuki announced that it will invest Rs 1,150 crore (US $ 185 million) together with Japanese partners Toshiba and Denso Corp. to set up a Li-Ion battery facility in Gujarat. Suzuki will own 50%, Toshiba 40%, and Denso 10% of the joint venture that will make batteries and battery packs for Indian car maker Maruti Suzuki and export to Suzuki.</td>
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<td>Indian Oil Corporation Ltd</td>
<td>The nation’s biggest fuel supplier, is developing batteries and other technology for energy storage applications. According to Economic Times, while IOC is mainly focusing on lead-acid, it is also working on lithium-ion battery chemistries.</td>
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<td>Exicom Industries Ltd</td>
<td>Exicom, a telecom infrastructure provider that is part of the HFCL group, which has been in the Li-Ion battery business since 2013, is planning to increase its manufacturing capacity to 1 GWh.</td>
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<td>Other firms</td>
<td>Other major firms such as JSW Group, Adani, Mahindra, Hero Electric, Panasonic, Exide Batteries, Amara Raja and many others have evinced interest in getting into Lithium Ion Batteries.</td>
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EV Opportunities for Norway in India
India offers a massive potential for Norwegian firms in the EV Business

Opportunities in the Indian market

- World's 3rd largest car market by 2020 is now starting its EV journey – India could learn from the world largest EV market
- Norway could lead India’s EV journey in many dimensions – from helping in EV regulations & standards to being a technology provider for a Smart Mobility program
- EV business throws up multiple new business / technology challenges such as EV charging, Smart Charging, Batteries, Cloud based mobility etc which could be key areas where Norwegian technology can be introduced

Key challenges in the Indian market

- Policies are still in the making and due to multiple stakeholders, it may take a while before a clear horizon for EV emerges.
- Existing strong domestic auto industry & ecosystem could pose a challenge in terms of entry barriers. Local partnerships will be vital for Norwegian companies to enter the Indian market.
- Indian EV market will face initial hiccups and will require some time to stabilize. Norwegian companies need a longer view to succeed in India.
- ‘Value for money’ association is vital to succeed in any business in India – same applies for EV business as well.
Opportunity landscape in EV business in India by 2026

Unlike other countries, Indian EV opportunity lies in a variety of automobiles and not just passenger cars business, etc.

...many other opportunities like Ebike, Ecycles etc could emerge as we move ahead towards an electric future
Electric Vehicle Components presents a huge opportunity in India

Major EV subsystems and their interactions. Some of the subsystems are very closely related, while some others have moderated interactions.
Norwegian companies specifically in the electronics side of the business could tap India’s virgin EV market

<table>
<thead>
<tr>
<th>Module</th>
<th>Key Electronic Modules</th>
<th>Specifics</th>
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<tbody>
<tr>
<td>Electric Vehicles</td>
<td>Batteries</td>
<td>Main Battery - Lithium Ion battery / packaged under the front seats, 48V DC system, 200 AH; Aux Battery - 12V, 7Ah</td>
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<tr>
<td></td>
<td>Battery chargers</td>
<td>Electric vehicles in India do not have an on-board charger beyond 2.5kW or 3kW</td>
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<td></td>
<td>Electronic Controller</td>
<td>3 phase AC Motor Controller with hill hold &amp; restraint</td>
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<td></td>
<td>Power Converter</td>
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<td></td>
<td>Electric Motor</td>
<td>Three phase squirrel cage induction motor, 25.5 HP (19KW)@3750 RPM, 53 N-m @3500 RPM (±5%)</td>
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<td>Temperature Control</td>
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<td></td>
<td>Energy Management</td>
<td>Intelligent Energy Management System [IEMS] that controls energy flow from mains to battery power Pack through on board charger</td>
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<td>EV Chargers</td>
<td>Home Chargers</td>
<td>230V/15A single phase plug which can deliver a maximum of up to about 2.5kW of power; IEC 60309 Industrial connector to be used from both ends</td>
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<td></td>
<td>Public Chargers Slow</td>
<td>Type of each output: A.C., 230V (+6% and -10%) single phase as per IS 12360 and 15 A, 3.3kW Power</td>
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<td>Public Chargers Fast</td>
<td>10kW/15kW/30kW/50kW; 48V/72V for 2W, 3W, small and medium 4W; Up to 750V or even higher for medium to high end 4W / CV</td>
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Key opportunities for Norwegian firms lie in relatively unexplored businesses in India

1 OF 3 EV Charging spaces

- EV Chargers / Smart Chargers (equipment / technology)
- Charging Infrastructure Services
- Smart Charging networks
- Cloud based solutions for Charging

Apart from a few local firms in power electronics, EV Charging sector remains an unchartered territory for India. This offers excellent opportunities for Norwegian technology to be introduced.

2 OF 3 EV Mobility Services

- Cloud based mobility / fleet services
- Technology for such services
- Smart Networks

Ola and Uber are 2 national fleet operators, there is scope to introduce new solutions and enter this space of shared mobility in India.

3 OF 3 Vehicle to Grid / Storage / Battery

- Vehicle to Grid solutions
- RE integration with EV charging and Storage
- Lithium Battery Solutions and BMS

Currently, there is little awareness of the scope and extent of impact on the grid. Norwegian firms could bring in global experiences to India.
## Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>AP</td>
<td>Andhra Pradesh</td>
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<tr>
<td>BAU</td>
<td>Business As Usual</td>
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<td>BHEL</td>
<td>Bharat Heavy Electricals Ltd</td>
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<td>BMS</td>
<td>Battery Management Systems</td>
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<td>BS6</td>
<td>Bharat Standards</td>
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<td>CAGR</td>
<td>Compounded Annual Growth Rate</td>
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<td>CCC</td>
<td>Controlled current Charging</td>
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<td>CNG</td>
<td>Compressed Natural Gas</td>
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<td>CVC</td>
<td>Controlled Voltage Charging</td>
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<td>DHI</td>
<td>Department for Heavy Industries</td>
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<td>EESL</td>
<td>Energy Efficiency Services Ltd</td>
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<td>EV</td>
<td>Electric Vehicles</td>
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<td>FAME</td>
<td>Faster Adoption and Manufacturing of (Hybrid &amp;) Electric Vehicles</td>
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<td>FY</td>
<td>Financial year in India (April - March)</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GPS</td>
<td>Global Positioning Systems</td>
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<td>GST</td>
<td>Goods &amp; Services Tax</td>
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<td>ITD</td>
<td>Interoperable Transport Data</td>
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<td>JNNURM</td>
<td>Jawaharlal Nehru National Urban Renewal Mission</td>
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<tr>
<td>MNRE</td>
<td>Ministry of New &amp; Renewable Energy</td>
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<td>MSME</td>
<td>Medium, Small &amp; Micro Enterprises</td>
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<td>NEMMP</td>
<td>National Electric Mobility Mission Plan</td>
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<td>NITI Ayog</td>
<td>National Institution for Tranformative Initiatives Ayog (Planning Cell of PMO)</td>
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<td>NTPC</td>
<td>National Thermal Power Corporation Ltd</td>
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<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<td>PMAO</td>
<td>Public metered AC outlet</td>
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<td>PMO</td>
<td>Prime Ministers Office</td>
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<td>PSU</td>
<td>Public Sector Enterprise</td>
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<td>SIAM</td>
<td>Society for Indian Automobile Manufacturers Association</td>
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Feedback Business Consulting Services Pvt. Ltd.
Feedback Consulting is a 35+ years old research based consulting firm based in Bengaluru in India. Feedback Consulting helps firms to achieve their business goals in India in terms of Go To Market, Expanding offerings in India, Partner identification and many more. Feedback has worked with many firms in this space of EV & storage and was requested by Innovation Norway to assist them with this report.

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