Present Ecosystem of BEV manufacturing: Challenges and Opportunities

Presented by: CRISIL Limited
CRISIL is India’s foremost provider of ratings, data, research, analytics and solutions

- Advisory at various stages of infrastructure development cycle
  - Infrastructure Advisory

- Grading of over 95000 SMEs
  - SME Ratings

- Ratings
  - Ratings of over 30000+ companies

- High-end research and analytics
  - Global Research

- Global Analytics
  - Financial Products for long-term operational strategy

- Risk Solutions
  - Mitigating a comprehensive range of risks

**India Research**
Providing rich insights and perspectives on Indian markets

**How we add value**
- Manage and mitigate risks
- Take pricing and valuation decisions
- Reduce time to market
- Enhance revenue & returns
- Catalyze economic growth by helping shape public policy on infrastructure
India’s largest independent research house providing comprehensive, integrated and cross-sectoral coverage

90% of India’s banking industry by asset base served

Global and Indian clients exceeding 1,200+

86 industries and sub-sectors tracked on regular basis since two decades

KEY INDUSTRIES COVERED

Research

Industry Research
Take strategic decisions with our comprehensive views & opinions across 86 sectors

Funds & Fixed Income Research
Provide security level valuations to AMCs and insurance firms

Customised Research
Tailored solutions to help you steer through markets and seize opportunity

Economy Research
Gain valuable insights on emerging Indian macroeconomic trends

Funds & Fixed Income Research
Provide security level valuations to AMCs and insurance firms

Customised Research
Tailored solutions to help you steer through markets and seize opportunity

KEY INDUSTRIES COVERED

Pharma
Coal
Steel
Agriculture
Banking
Retail
Paper
Capital Goods
Housing

Retail
Healthcare
Food Beverages

Transportation
Textile
Telecom
Technology
Automobiles
Travel

Energy
Natural Gas
Power
Construction

Fertilizers
Petrochemicals
Chemicals
Aluminum

Cement
Power
Construction

Packaging
Packaging
Packaging
Packaging
Packaging
Customised research offerings

### Business Planning
- **Identification of attractive sectors/sub-segments**
  - Demand-supply dynamics, profitability and opportunity
  - Sector/Company financial health
  - Policy and regulatory view
- **Opportunity mapping for planning**
  - Market dynamics, capacity utilization, economics
  - Policies and regulations
- **Demand dashboards across locations and sectors**
- **Commodity price tracking**
  - Short term/long term, regional markets, brand-wise assessments

### Fund raising & valuations
- Feasibility/Viability studies/Credit Assessment
- Valuations including structured instrument valuation
- Exit diligence

### Strategic initiatives
- **Pre-investment commercial due-diligence**
  - Market assessment
  - Channel feedback
  - Financial assessment
  - Management assessment
- **Post investment monitoring**
  - Market feedback, end-user and growth outlook
  - Exit strategy
- **Assessment of partners and tie-ups**
- **Market entry strategy**

### Competitor Benchmarking
- Competitor strategy – expansion, value addition, supply chain assessment, channel feedback, market intelligence
- Cost Benchmarking
Major Pillars for enabling BEV manufacturing in a country

Readiness status of industry
- Manufacture and stakeholder willingness to enter EV business
- End-use EV market and potential demand growth

Access to global supply chains
- Availability of raw materials
- Competitiveness in the EV manufacturing space

Key policy and regulatory stance towards EV manufacturing in the country
- Steps taken to encourage PPP
- Ease of funding opportunities in the segment
- Indigenous skill development to promote domestic manufacturing of components
Stakeholders of a BEV manufacturing ecosystem

I. EV manufacturing

- Battery Cell manufacturers
- Component manufacturers
- Battery pack assemblers
- EV manufacturers
- Dealership

R&D

Raw Material Mining

Digital technology providers
- Telematics components
- Telematics service providers

II. After Sales services

- Battery Swap operators
- Maintenance service providers
- Battery and vehicle second life
- Aftermarket components
Pillar 1: Readiness Status of industry

Global EV Market

- As of end-2018, the global stock of EVs surpassed 5 million, an increase of 63% (3.14 million in 2017) from the previous year (IEA estimates). China led the deployment, accounting for ~45% of the electric car fleet, followed by Europe (24%) and the US (22%)
- The biggest EV penetration (in terms of volume and sales) occurred in China. The nation outperformed all other countries on both the market side as well as the industry side (component manufacturing).

Investments in EV manufacturing

- China $135.7 billion
- Germany $71.7 billion
- USA $34 billion
- South Korea $20 billion
- Japan $18.9 billion
- France $10.4 billion
- Others $9.4 billion

- Global automakers are planning an unprecedented level of spending to develop and procure batteries and electric vehicles over the next five to 10 years, with a significant portion of their budgets targeted at China
- Global auto makers like Volkswagen, Daimler, Ford, Fiat, Toyota, Nissan and Renault have begun investing in EVs (vehicles as well as batteries)

Note: Includes investments which have been publicized and does not reflect planned investments; Data as on April 2019
Source: IEA EV Outlook
### Pillar 2: Access to global supply chains

#### China’s grip on battery metals supply chain

**Stage 1: Mining**

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>EU</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>8%</td>
<td>0%</td>
<td>31%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>Graphite</td>
<td>1%</td>
<td>0%</td>
<td>65%</td>
</tr>
<tr>
<td>Lithium</td>
<td>0%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Manganese</td>
<td>0%</td>
<td>0%</td>
<td>6%</td>
</tr>
</tbody>
</table>

**Stage 2: Chemical Processing**

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>EU</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>13%</td>
<td>1%</td>
<td>65%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>17%</td>
<td>0%</td>
<td>82%</td>
</tr>
<tr>
<td>Graphite</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Lithium</td>
<td>0%</td>
<td>4%</td>
<td>59%</td>
</tr>
<tr>
<td>Manganese</td>
<td>7%</td>
<td>0%</td>
<td>93%</td>
</tr>
</tbody>
</table>

### China’s dominance in battery raw materials can most clearly be seen in the market for graphite, which produces 65 per cent of the world’s graphite.

### Producing countries supply Lithium majorly from brines of Argentina, Chile and Bolivia and hard rock from Australia.

### Cobalt mine supplies is monopolistic: more than 70% of cobalt mined originates from DRC, followed by Russia, Cuba, Australia and Canada.

### China’s dominance in battery raw materials encompasses across all major chemicals.

### The USA has build up some supply chain in Nickel and cobalt.

### The EU continues to lag behind, with no major share in chemical processing space.
## Pillar 2: Access to global supply chains (contd.)

### China’s grip on battery metals supply chain

#### Stage 3: Cathode and Anode Production

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>EU</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode</td>
<td>0%</td>
<td>0%</td>
<td>61%</td>
</tr>
<tr>
<td>Anode</td>
<td>0%</td>
<td>0%</td>
<td>83%</td>
</tr>
</tbody>
</table>

- 61% for cathodes are produced in China
- 83 per cent of the world’s anodes for lithium-ion batteries are produced in China, owing to dominance in graphite usage

*Source: Benchmark Mineral Intelligence*

#### Stage 4: Li-ion Battery Manufacturing

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>EU</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cells</td>
<td>6%</td>
<td>10%</td>
<td>73%</td>
</tr>
</tbody>
</table>

- The rise of battery mega factories has predominantly been taking place in mainland China, which has contributed to ~73% of output in 2019
- Of the 136 lithium-ion battery plants in the pipeline to 2029, 101 are based in China

*Source: Benchmark Mineral Intelligence*
China’s dominance in chemical production of battery-grade raw materials stand at ~80% of total global production.

Monopolistic advantage in capacity ownership can lead to global supply chain issues and pricing power by China.

Both USA and EU are still missing the chemical links in the supply chain.

In fact, the European Union have already sounded alarm with the European Commission warning that over-reliance on imports of critical raw materials can undermine EV industry. The commission has added Lithium into the critical supplies list.
## Pillar 3: Regulatory and Policy Incentives for BEV manufacturing

### Examples from USA

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Technology Vehicle Manufacturing (ATVM) loan program</td>
<td>Loan support for PEVs and PEV components, as well as associated engineering integration costs. Three loans of more than $3 billion have been distributed to major firms including Nissan and Tesla, for PEV manufacturing.</td>
</tr>
<tr>
<td>Advanced Stimulus-funded grants for advanced battery manufacturers program</td>
<td>Direct loans to manufacturers of up to 30% of the cost to re-equip, expand, or establish manufacturing facilities; more than ~$5 billion grant program have been provided by the end by 2018.</td>
</tr>
<tr>
<td>PEV-related research and development (R&amp;D)</td>
<td>Direct grants for high-risk/reward research on next-generation battery systems. DOE expended ~$2 billion till date towards innovation in batteries and electric drive technology, vehicle and systems simulation and testing.</td>
</tr>
<tr>
<td>Federal PEV tax credits</td>
<td>$2500 per vehicle with a 4 kWh battery, up to $7,500 per vehicle for 16 kWh batteries. A phase-out period for a manufacturer’s vehicles kicks in after the given manufacturer has sold 200,000 qualified PEVs.</td>
</tr>
</tbody>
</table>
Pillar 3: Regulatory and Policy Incentives for BEV manufacturing (contd.)

Examples from European Union

<table>
<thead>
<tr>
<th>Strong policy overview to push EV sales</th>
<th>By 2025, the EU has sharpened the EV target to 20% of total sales while Norway has banned sales of gasoline and diesel cars. By 2040, France, Italy and UK (earlier part of EU) plan to target 100% zero-emission vehicle sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidies on EVs</td>
<td>Countries have set out tax benefits (registration tax, ownership tax), EV parking benefits, subsidies and sops for EV sales</td>
</tr>
</tbody>
</table>
| Public funds-backed investments and research | • Governments, universities, EU institutions and scores of businesses, including the leading carmakers, have been pooling funds and working on a new industrial policy to improve EU's technological independence in EV manufacturing  
• The EU is focusing on building open, competitive markets for EV manufacturing with strict controls on public subsidies |
Pillar 3: Regulatory and Policy Incentives for BEV manufacturing (contd.)

### Examples from China

*Only 5,000 EVs were sold in China in 2011; 1.2 million EVs were sold in 2019*

<table>
<thead>
<tr>
<th>Incentive Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dual Credit system</strong></td>
<td>Allows auto manufacturers, regardless of country of origin, to sell surplus EV credits to other firms to earn additional revenue and has prompted foreign manufacturers like Volkswagen and General Motors to seriously consider manufacturing more EVs in China</td>
</tr>
<tr>
<td><strong>Subsidies on EVs</strong></td>
<td>Central subsidies covering electric buses, public vehicles (including taxi fleets), local governments roll out additional subsidies in the form of grants and loans</td>
</tr>
</tbody>
</table>
| **Federal support for manufacturing EVs** | • Federal support for industry and academia to push manufacturers beyond niche vehicles and bolster largescale PEV commercialization.  
• This includes grants and loans to industry, basic research and development support to academia and national labs, vehicle demonstration funds, support for charging infrastructure, market and other applied research,  
• Grants are provided for training and education, including emergency response, technician training, and other supporting roles |

Research
### Long term outlook for EVs: Electric Vehicle penetration to be driven by 3Ws and 2Ws

<table>
<thead>
<tr>
<th>Vehicle Segment</th>
<th>EV Penetration (Sales)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FY19</td>
<td>FY24 P</td>
</tr>
<tr>
<td>Car</td>
<td>0.1% (~3,600)</td>
<td>3.5% (~1,76,000)</td>
</tr>
<tr>
<td>Two-Wheeler</td>
<td>0.6% (~126,000)</td>
<td>12-17% (~3,497,000)</td>
</tr>
<tr>
<td>Three-Wheeler</td>
<td>0.5% (~500)</td>
<td>2-4% (~4,500)</td>
</tr>
<tr>
<td>Bus</td>
<td>0% (~100)</td>
<td>3-5% (~24,000)</td>
</tr>
<tr>
<td>Light Commercial</td>
<td>0.01% (~700)</td>
<td>43-48% (~2,97,000)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Drivers for EV adoption for the period FY20-FY24</th>
<th>Drivers for EV adoption for the period FY25-FY230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Wheelers</td>
<td>E-Scooters to have better TCO than ICE scooters but weaker than ICE Motor cycles by FY24</td>
<td>Scooters to majorly shift to EV, motorcycles below 125 cc will begin conversion, majorly in the urban and semi urban regions</td>
</tr>
<tr>
<td>Three Wheelers</td>
<td>E- Auto to have favorable TCO and cost of acquisition (COA) as compared to a CNG powered three wheeler by FY24</td>
<td>Better cost economics, low running costs and rise in CNG prices to allure auto owners towards EV</td>
</tr>
<tr>
<td>PV and CV</td>
<td>Low annual running will hinder EV adoption in personal cars by FY24 while higher daily running to aid EV adoption in cab aggregators</td>
<td>CV segment expected to majorly convert to EV; PV segment will begin showing traction due to lowering cost and conducive economics</td>
</tr>
<tr>
<td>Bus</td>
<td>Subsidies will drive EV adoption for State Transport Undertakings (STUs)</td>
<td>Government push, lowering of battery prices to drive adoption</td>
</tr>
</tbody>
</table>
## India in Focus

### Regulatory and federal policies driving E-mobility

1. **National Electric Mobility Mission Plan**: The scheme intended to catalyse market development (demand generation, technology development, pilot projects and charging infrastructure) for creation of an EV ecosystem

2. **FAME II**: The FAME-II intends to support 10 lakh two-wheelers, 5 lakh three-wheelers, 55,000 four-wheelers, and 7,000 buses that operate on lithium-ion batteries or other electric power-trains. Under the scheme the government will offer incentives for electric buses, three-wheelers and four-wheelers to be used for commercial purposes.

3. **Subsidy support for setting up EV charging stations**: The Indian government plans to offer subsidy support to states for deployment of 5,000 EV charging stations in cities and highways.

4. **Focus on domestic manufacturing of EVs**: In order to encourage vehicle manufacturers to produce EVs in the country, the government plans to raise custom duties on EV parts and batteries in a phased manner. As part of the phased manufacturing program (PMP) of the Department of Heavy Industries, basic customs duties on completely built units of electric buses and trucks will be doubled from 25% to 50% from April 2020.
India in Focus

Stance taken by major states to promote EV manufacturing

With a target of 50 GWh, the NITI Aayog plan would support the establishment of anywhere between three to ten giga-factories of 20 GWh to 5 GWh capacity each in the country

1. Gujarat, which has already seen large-scale investments for Li-ion battery manufacturing, is offering additional support in the form of subsidized utilities under the state’s electronics policies.

2. Telangana has announced the availability of 200 acres of land plus power and water for the manufacturing unit at a concessional rate.

3. Andhra Pradesh, as early as 2017, announced the allocation of 200-400 acres for development of the electric mobility-focused industrial park. The state also plans to provide capital subsidies of 50 per cent of fixed capital investments in building and common infrastructure (up to a maximum of INR 20 cr [INR 200 mn = $2.8 mn]).

4. Maharashtra has set its intent in setting up India’s first five giga-factories. In addition to the capital subsidies on fixed capital investments, the state government shall be an equity partner up to nine per cent in large, mega, and ultra-mega projects, with FCI greater than INR 500 crores.

5. Tamil Nadu, would be offering SIPCOT land at a subsidized rate in addition to other incentives.
### India in Focus

#### Opportunities in EV manufacturing

- With a global growth rate of 60% in EVs, India has the opportunity to become a global player in the space.
- The market share of electric cars is around 2% in China while it is around 39% in Norway, whereas the Indian market share of electric cars is a meagre 0.06%.
- Global focus on making supply chains self-reliant provides an opportunity for domestic manufacturing of EVs.
- The government has raised tariffs on Li-ion batteries, providing domestic manufacturers a powerful incentive.
- Roughly 50% of Build of Materials (BOM) in an EV is different from that of an ICE vehicle, it will create a new opportunity for auto component manufacturers.

#### Challenges in EV manufacturing

- Lack of rare earth materials in the country.
- Sourcing challenges for elements like lithium, cobalt, nickel, most mines and capacities have already been leased out by global EV majors.
- Lack of a supporting supply chain, manufacturing and infrastructure ecosystem that deters the pace of adoption.
- Lack of dedicated focus on incubating new technologies pertaining to EVs, R&D spends are low.
- Lack of large-scale investments towards EVs by home-grown auto majors. This makes global investments sceptical.
Conclusion

- Presently, the global BEV manufacturing is tilted heavily towards China, however, USA and EU are investing in EV technologies.
- China has gained dominance by securing access to supply chains, other countries are playing catch up.
- Globally, EV growth is expected to remain strong; new innovation in battery technologies and scaling up of manufacturing capacities will help companies and countries achieve economies of scale, thereby reducing EV costs.
- India’s EV market is fledgling, however, it is poised to grow to ~80 million EVs by 2030.
- Domestic manufacturing ecosystem in India is small to non-existent, however, with the right policies and improved investments by auto makers to manufacture EVs, it can tip the balance from challenge to opportunity for India.
About CRISIL Limited
CRISIL is a leading, agile and innovative global analytics company driven by its mission of making markets function better. It is India’s foremost provider of ratings, data, research, analytics and solutions, with a strong track record of growth, culture of innovation and global footprint. It has delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers. It is majority owned by S&P Global Inc, a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide.

About CRISIL Research
CRISIL Research is India’s largest independent integrated research house. We provide insights, opinion and analysis on the Indian economy, industry, capital markets and companies. We also conduct training programs to financial sector professionals on a wide array of technical issues. We are India’s most credible provider of economy and industry research. Our industry research covers 86 sectors and is known for its rich insights and perspectives. Our analysis is supported by inputs from our large network sources, including industry experts, industry associations and trade channels. We play a key role in India’s fixed income markets. We are the largest provider of valuation of fixed income securities to the mutual fund, insurance and banking industries in the country. We are also the sole provider of debt and hybrid indices to India’s mutual fund and life insurance industries. We pioneered independent equity research in India, and are today the country’s largest independent equity research house. Our defining trait is the ability to convert information and data into expert judgments and forecasts with complete objectivity. We leverage our deep understanding of the macro-economy and our extensive sector coverage to provide unique insights on micro-macro and cross-sectoral linkages. Our talent pool comprises economists, sector experts, company analysts and information management specialists.

CRISIL Privacy
CRISIL respects your privacy. We may use your contact information, such as your name, address, and email id to fulfil your request and service your account and to provide you with additional information from CRISIL. For further information on CRISIL’s privacy policy please visit www.crisil.com

Disclaimer
CRISIL Research, a division of CRISIL Limited (CRISIL), will take due care and caution in preparing the Report based on the information obtained by CRISIL from sources which it considers reliable (Data). However, CRISIL does not guarantee the accuracy, adequacy or completeness of the Data / or any analysis based on the Data in the Report and will not be responsible for any inaccuracies resulting from the use of Data in the report. The Report will not be a recommendation to invest / disinvest in any company covered in the Report. CRISIL especially states that it has no financial liability whatsoever to the subscribers / users / transmitters / distributors of the Report. CRISIL Research operates independently of, and does not have access to information obtained by CRISIL’s Ratings Division / CRISIL Risk and Infrastructure Solutions Limited (CRIS), which may, in their regular operations, obtain information of a confidential nature. The views expressed in the Report will be that of CRISIL Research and not of CRISIL’s Ratings Division / CRIS