

2nd Edition

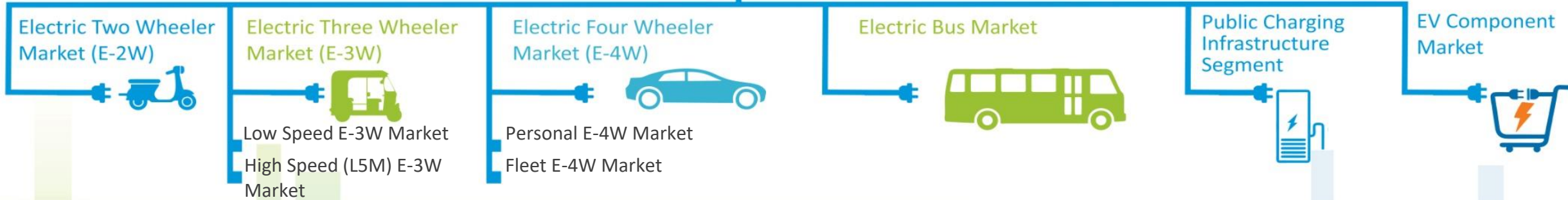
India Electric Vehicle Market Overview Report

2020-2027



SCOPE OF REPORT

Electric Vehicle Market Overview Report



In this report, we have estimated each of these markets in terms of unit sales and MWh projection for India, with 2019 as a base year and projections for 2020-2027. With respect to EV Ancillary Market, this report covers market overview & developments happening on ground wrt to localization of key EV components such as Motor, Controller, BMS, Onboard chargers, Convertors etc.

Exclusions: In this report, we have not covered commercial electric vehicles such as trucks, tractors, LCVs etc. in market forecast as there is no clarity on the timeline of launch of such vehicles in market.

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ABBREVIATIONS



EV/ EOV Electric Vehicle/ Electrically operated Vehicles

E-2W Electric Two-wheeler

E-3W Electric Three-wheeler

E-4W Electric Four-wheeler

ICE Internal Combustion Engine

NEMMP 2020 National Electric Mobility Mission Plan 2020

FAME The Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles

MoEFCC Ministry of Environment, Forest and Climate Change

MoP Ministry of Power

MoUD Ministry of Urban Development

MoRTH Ministry of Road Transport & Highways

DHI Department of Heavy Industries

PMP Phased Manufacturing Program

ARAI Automotive Research Association of India

ICAT International Centre for Automotive Technology

CEA Central Electricity Authority

BIS Bureau of Indian Standards

EESL Energy Efficiency Services Limited

BSS Battery Swapping Stations

MeitY Ministry of Electronics and Information Technology

PCS/PCI Public Charging Station/ Public Charging Infrastructure

MoHUA Ministry of Housing and Urban Affairs

ABBREVIATIONS



BMS

Battery Management Systems

BLDC

Brush-less Direct Current

HCV

Heavy Commercial Vehicles

PCB

Printed Circuit Board

SoC

State of Charge

L5M

Passenger carrier (Auto rickshaw) category

CAGR

Compound Annual Growth Rate

MOSFET

Metal–Oxide–Semiconductor Field-Effect transistor

PMSM

Permanent Magnet Synchronous Motor

SRM

Switched Reluctance Motor

OEM

Original Equipment Manufacturer

SCV

Small Commercial Vehicles

ACIM

Alternating Current Induction Motor

HVDC

High Voltage Direct Current

LVDC

Low Voltage Direct Current

IGBT

Insulated Gate Bipolar Transistor

PCS

Public Charging Station

CPO

Charge Point Operator

kW

Kilo Watts

GB/T

Guobiao Standards

CHAdeMO

Charge De Mode

ABBREVIATIONS



BPCL

Bharat Petroleum Corporation Ltd

NDMC

New Delhi Municipal Council

BHEL

Bharat Heavy Electricals Ltd

SDMC

South Delhi Municipal Corporation

EESL

Energy Efficiency Services Ltd

JVVNL

Jaipur Vidyut Vitran Nigam Ltd

JDA

Jaipur Development Authority

EPC

Engineering Procurement Construction

REIL

Rajasthan Electronics & Instruments Ltd

NTPC

National Thermal Power Corporation

NREDCAP

New & renewable Energy Corporation of AP

KSEB

Kerala State Electricity Board

BESSCOM

Bangalore Electricity Supply Company

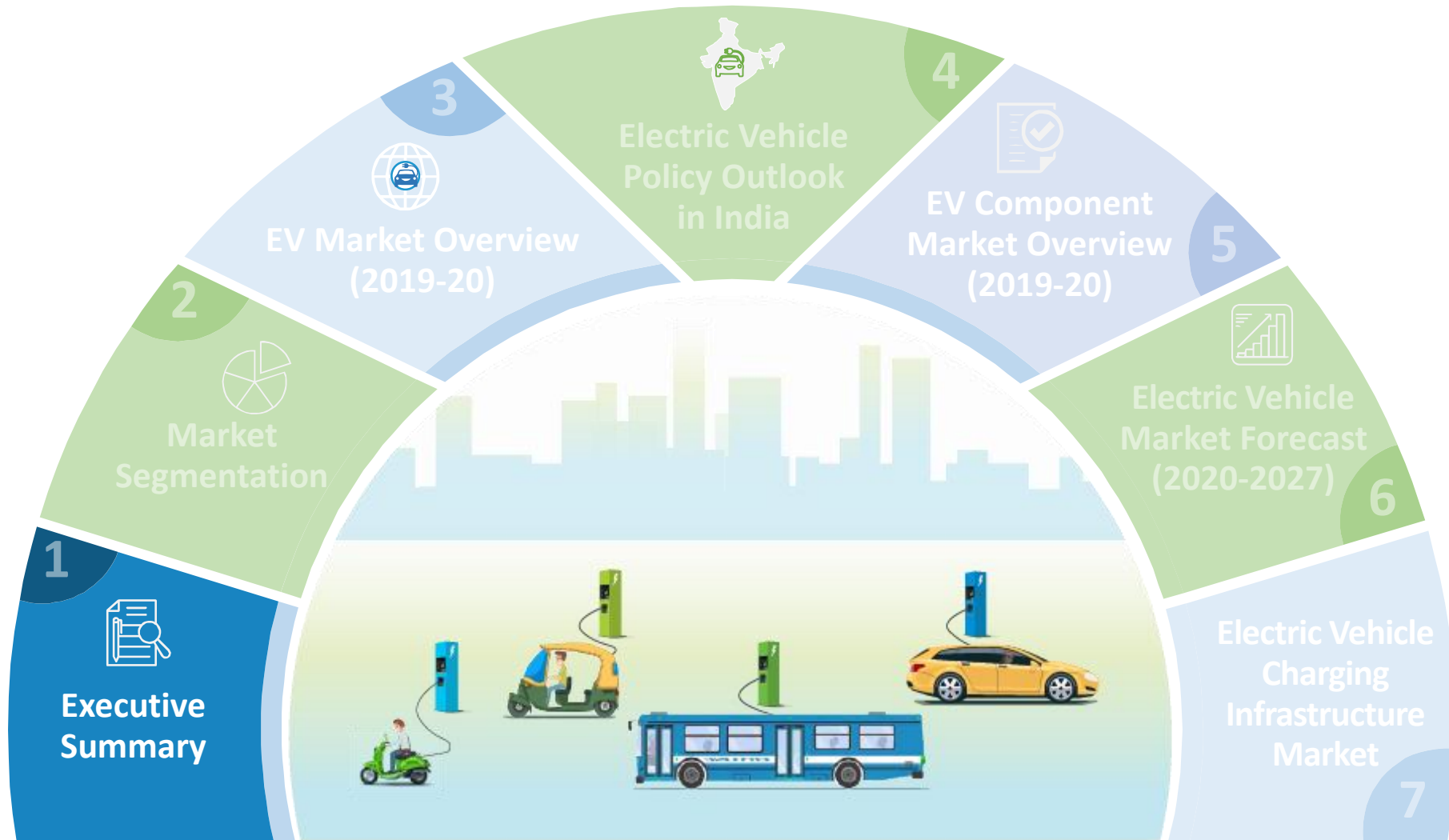
PSU

Public Service Undertaking

MOU

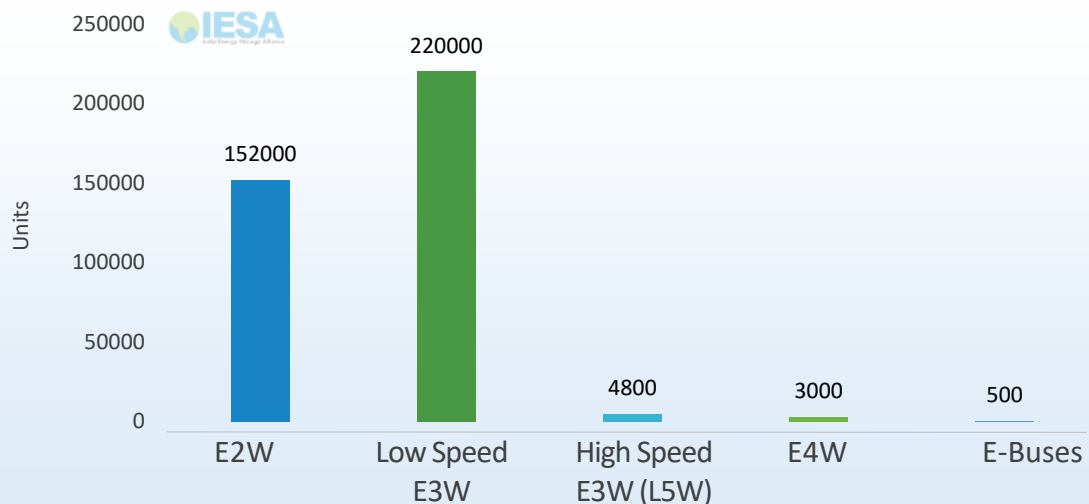
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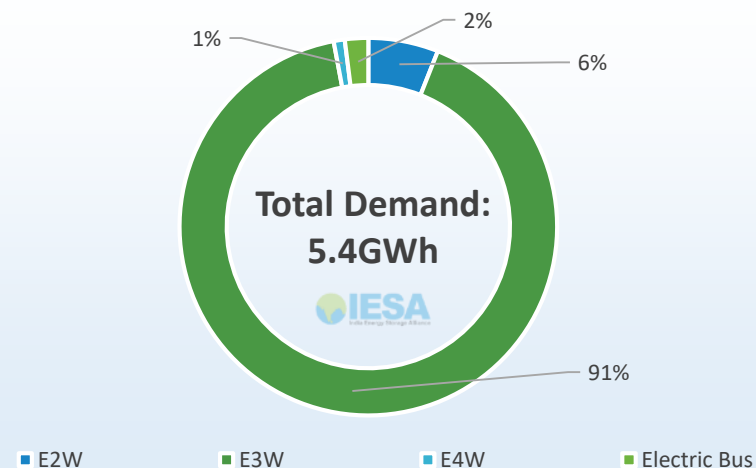


INDIA EV MARKET OUTLOOK, 2019-20

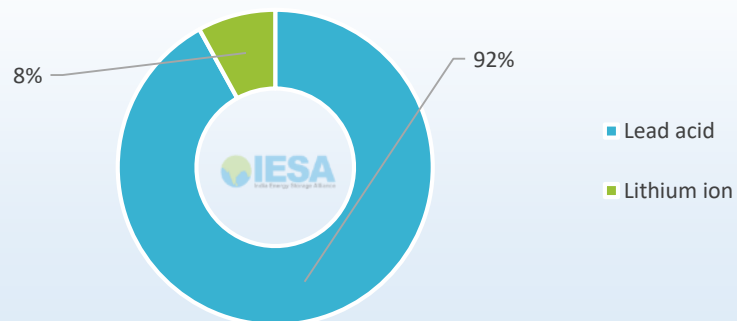
EV Sales in India, 2019-20, Total: 3.8 Lakhs



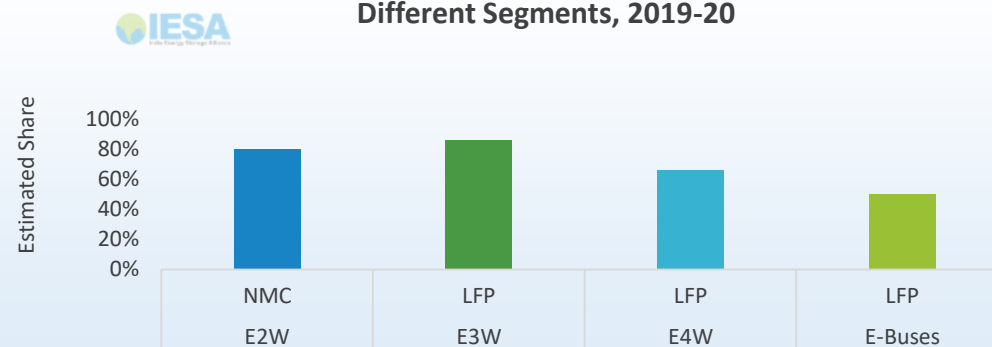
Battery Demand Split, EVs, 2019-20, India



Battery Technology Split by Capacity, Total: 5.4GWh, 2019-20



Leading Lithium-ion Battery Chemistry in Different Segments, 2019-20



EV MARKET DRIVERS



| Market Drivers by segment | Description | Driver Impact in Annual Unit sales , CAGR* (BAU Scenario) | |
|-------------------------------|--|---|-----------|
| | | 2020-2023 | 2024-2027 |
| Growth of E-2W Market | <p>The E-2W market in India is continuously growing since the implementation of FAME India scheme. Currently, low & medium speed E-2W (up to 40 kmph) with conventional lead acid batteries are dominating the market as they are already at par in terms of upfront cost with ICE vehicles.</p> <p>Secondly, high speed segment with lithium-ion batteries is also gaining momentum slowly. With more companies getting FAME-2 certification in 2020, sale of high speed E2W's is also expected to increase rapidly in next 2 years.</p> <p>Going forward, for the exponential growth of this segment, the market is demanding for the quality two wheelers, which can compete with ICE vehicles in terms of both cost & performance. Further, with continuous drop in the price of lithium-ion batteries, power electronics, & advancement in EV technologies, the high-speed segment is also expected to hit the parity by 2024-25 without the subsidy support from the government & that could be considered as a tipping point for the exponential growth of this segment in the country.</p> <p>In terms of battery technology for E-2W's, then as per industry inputs, lead acid technology will be completely out of the market in next 5 years.</p> | 79% | 54% |
| | | High | High |
| Growth of Electric Bus market | <p>The electric bus market in India is expected to be driven with subsidy support from the central government in phase-1 (2023-24) due to high upfront cost. Going forward, expansion is likely to happen based on viability & access to financing. So far, FAME-1 & FAME-2 schemes have been the key drivers of e-bus market in India. In 2019, DHI sanctioned 5595 e-buses to various STU's under FAME-2 scheme. Out of which, procurement process of 2500 buses is already completed & approved for subsidy by DHI & further contracting is still underway.</p> <p>Further, in terms of demand aggregation, then as per transport policy & Niti Aayog's estimation, there will be a requirement of 1,60,000 buses for STU's by 2030. Secondly, many state governments have already announced their targets of converting the existing fleet of buses into electric under their EV policies.</p> | 10% | 27% |
| | | Low | Medium |

| | | | | | | | |
|-----|---|-----|----------------|--------|-------------|------|------|
| Low | Depicts the impact of CAGR in the growth of market in base case scenario. Indicative of the rate of growth of the EV market segments. | Low | CAGR Up to 20% | Medium | >20% to 50% | High | >50% |
|-----|---|-----|----------------|--------|-------------|------|------|

EV MARKET DRIVERS



| Market Drivers by segment | Description | Driver Impact in Annual Unit sales CAGR* (BAU Scenario) | |
|---------------------------------------|--|---|-----------|
| | | 2020-2023 | 2024-2027 |
| Growth of Low-Speed E-3W Market | <p>The low-speed E-3W market in India has grown very rapidly in different parts of the country since 2013. As per ICAT, there are 600+ registered players available in the segment. Apart from the registered OEMs, the gray e-rickshaw market has also evolved rapidly in different parts of the country particularly in West Bengal, Bihar, & Delhi NCR. As per industry estimation, 60% of the erickshaw today on road came from the unorganized players. The growth of the gray erickshaw market has slowed down due to government's push for ICAT certified models from late 2018 & the share of organized players is increasing slowly.</p> <p>Going forward, industry believes that there is a huge potential for the growth of e-rickshaw market in the upcoming years as many new markets such as Raipur, Indore, Bhopal, Orissa etc. have opened last year. Moreover, the South and North East markets are also expected to open in the upcoming years.</p> <p>In terms of battery technology, lead acid is still dominating the market due to strong after sales service. However, OEMs have started shifting towards lithium-ion batteries. As per ICAT, 80% -90% of the newer models tested and certified are based on lithium-ion batteries.</p> | 7% | 7% |
| Growth of High-Speed E-3W Market (L5) | <p>The high-speed E-3W (L5) market is currently at a very nascent stage and has opened mainly at B2B or in cargo segment due to requirement of performance vehicles. Low-cost financing is a key constraint hindering the growth of this segment. Going forward, industry believes that the market will grow very rapidly in the upcoming years as many state governments are planning to convert the existing fleet of autos into electric under their EV policies. Apart from state governments, e-commerce companies are looking to increase their fleet size & have already announced their targets.</p> <p>Secondly, as per industry, battery swapping option could be a game changer for this segment & if included under Fame-2 scheme, then, it can disrupt the market.</p> | 92% | 39% |
| | | Low | Low |
| | | High | Medium |

| | | | | | | | |
|------------|---|------------|----------------|---------------|-------------|-------------|------|
| Low | Depicts the impact of CAGR in the growth of market in base case scenario. Indicative of the rate of growth of the EV market segments. | Low | CAGR Up to 20% | Medium | >20% to 50% | High | >50% |
|------------|---|------------|----------------|---------------|-------------|-------------|------|

EV MARKET DRIVERS



| Market Drivers by segment | Description | Driver Impact in Annual Unit sales CAGR* (BAU Scenario) | |
|------------------------------------|--|---|-----------|
| | | 2020-2023 | 2024-2027 |
| Growth of E-4W Fleet Car Market | <p>The E-4W market in India has mainly opened at B2B and B2C level. 10+ companies have already launched a fleet of cars on pilot basis & operating their cars daily over 225km's to 300 km's to make the TCO attractive. The market is expected to grow rapidly as many companies have already announced their targets to expand the fleet size rapidly in next couple of years.</p> <p>Secondly, many government departments have already started converting their existing fleet of cars into electric through EESL. EESL is aiming to convert a fleet of 0.5 million existing cars in various government departments to electric in next 5 to 7 years.</p> <p>Going forward, as the electric cars will approach towards cost parity with ICE vehicles, due to drop in battery prices & economies of scale, adoption of e-cars is set to increase rapidly in upcoming years. Also, policy such as mandate of 40% of fleet to be electric for ride hailing companies like OLA & Uber from 2026 will provide additional boost to the sales of commercial electric cars in the country.</p> | High | High |
| Growth of E-4W Personal Car Market | <p>As far as personal E-4W car market in India is concerned, the market is currently at a very nascent stage. Industry witnessed an increase in traction from the customers with the launch of Tata Nexon, MG ZS, and Hyundai Kona electric cars in the market in 2019-20. Going forward, increasing consumer awareness due to improved air quality during COVID period, entry of more players in market, stringent emission norms etc. are likely to drive the market in the upcoming years.</p> <p>High upfront cost and "lack of availability of quality affordable cars" in the market are still hindering the rapid growth of this segment, and as per the analysis done by CES, the market could witness rapid growth in sales after 2026-27 as the electric cars are expected to meet cost parity with conventional cars without subsidy support from the government due to drop in battery prices, economies of scale and local manufacturing.</p> | High | High |

| | | | | | | | |
|------------|---|------------|----------------|---------------|-------------|-------------|------|
| Low | Depicts the impact of CAGR in the growth of market in base case scenario. Indicative of the rate of growth of the EV market segments. | Low | CAGR Up to 20% | Medium | >20% to 50% | High | >50% |
|------------|---|------------|----------------|---------------|-------------|-------------|------|

KEY OPPORTUNITIES IN THE EV ECOSYSTEM



FAME-2 scheme will provide subsidy support for 10 Lakh 2-wheelers, 5 lakh 3-wheelers, 55,000 cars, and 7090 e-buses till 2021-22 that will provide the volumes to kick start the industry.

Secondly, through Phased Manufacturing Program (PMP) for EV's & its components, Government has made it very clear to the industry to invest & develop the supply chain in India & defined a clear timeline for the localization of all the components. Parallely, government has also made it very clear that they are not interested in subsidizing the imports & from 2020, custom duty will be increased rapidly. Ministry of Finance (MoF) has already increased the BCD on electric vehicles in budget 2020.



To accelerate research, development, and demonstration of technologies, Department of Science & Technology (DST) is working on the EV R&D mission under which three separate technology hubs will be created: 1) EV Energy Storage, 2) EV Drive trains, and 3) EV Power electronic components. The technology hubs setup will be self managed & partially supported with government hubs. The entire responsibility of running the technology program will be that of the technology hubs.



To address the challenge associated with the local manufacturing of advanced lithium-ion battery cells, Niti Aayog is working on a proposal to setup Giga factories in India under which cash subsidy will be given to manufacturers through a performance link incentive scheme. The overall idea is to enable local supply chain with 60%-80% value addition in the country. Government has already recognized advanced battery cell manufacturing as champion sector as part of self-reliant India.



Apart from central government, many state governments are also offering incentives on manufacturing of EVs and components under their EV policies. So far, 12 states have already announced their EV policies.

KEY CHALLENGES IN THE EV ECOSYSTEM



Lack of supporting supply chain, manufacturing and infrastructure ecosystem is the key constraint that deters the pace of adoption. OEMs are heavily dependent on imports.

Lack of availability of low-cost financing for a longer tenure is a key challenge across segments hindering the growth of electric vehicle market in India.

With respect to charging infrastructure, lack of availability of commercially viable business model is the major roadblock for the private players as the capex requirement is very high and rate of utilization of chargers is very low. Secondly, industry is demanding clarity on standards required for battery swapping stations.

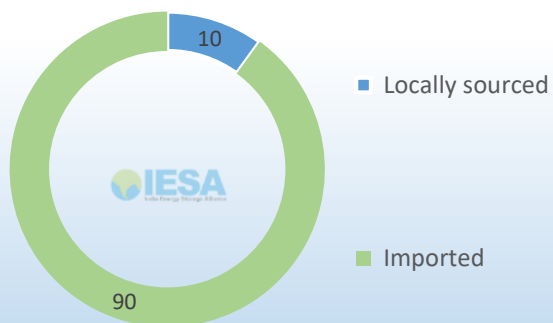
Industry readiness is another key challenge as many players today don't want to invest in EV technology as they have invested heavily in creating infrastructure for BS VI vehicles. Secondly, due to economic slowdown & COVID-19 crisis, many OEMs want to produce & sell BS-VI vehicles only to revive the demand. With respect to EV's, industry is demanding for a long-term roadmap from the government in terms of clear timelines to switch towards zero emission vehicles.

From Consumer perspective, high upfront cost of EVs, lack of availability of quality affordable products in the market, high interest rates, lack of resale market, range anxiety, lack of charging infra etc. are the major constraints.

BMS AND POWER COMPONENTS

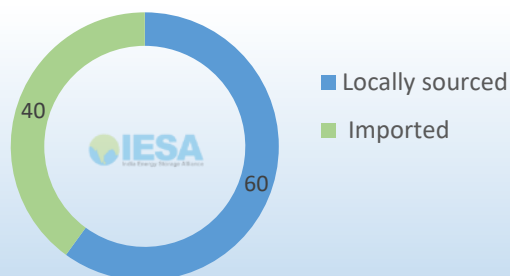


BMS Parts Localization* for 2Ws and 3Ws, India, 2019 (%)



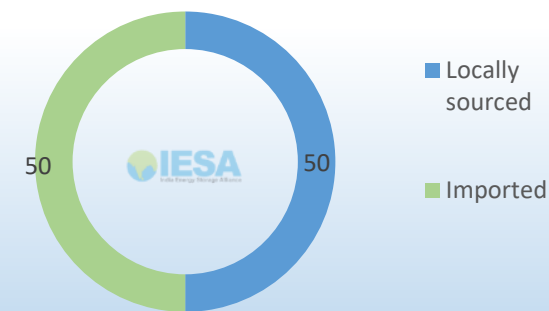
- BMS constitutes 15% of battery system cost
- Among BMS components available in India, primarily Printed Circuit Boards are sourced from India, with resistors and capacitors being sourced in some cases too
- BMS is assembled in India chiefly for e-2Ws and e-3Ws segment
- Key Players : Exicom, Amara Raja, Okaya, Ion Energy

BLDC Motor Parts Split, India, 2019 (%)



- e-2Ws and e-3Ws motor market are more active with their BLDC and PMSM motor offerings as compared to e-4Ws and other HCVs
- Motor casing or housing, wirings and harnesses, rotors, stators etc. can be locally sourced in India
- Localization is significant in e-2W and e-3W segments, as compared to e-4W and HCV
- Key Players : Tata, Mahle, Bosch, Bhorzwan, Cell Propulsion, Medha

Power Electronics Split, India, 2019 (%)

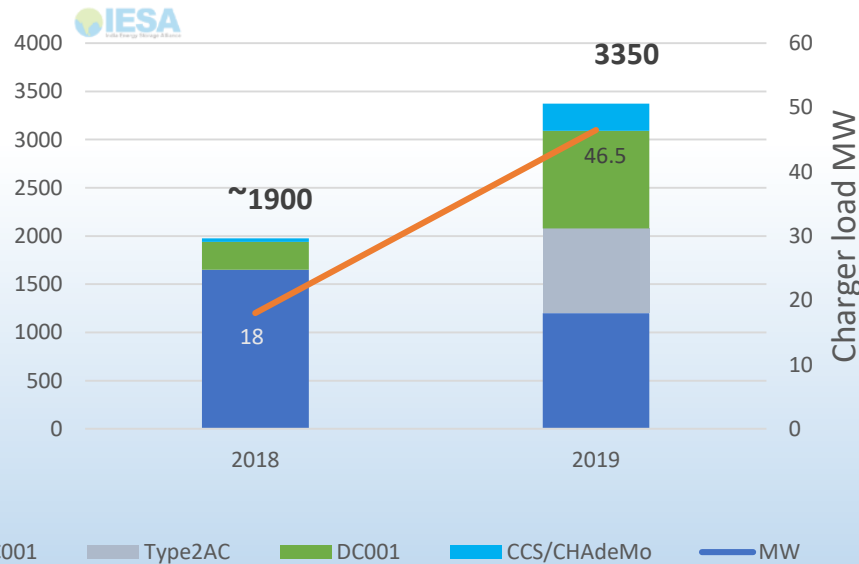


- Printed Circuit Boards (PCB), temperature sensors, wirings etc. can be locally sourced, whereas semiconductors (30-40 % of market) are imported
- Controllers and converters are locally available mostly for the electric two-wheeler and electric three wheelers
- Key Players : Cell Propulsion, Hella, Eaton, Napino

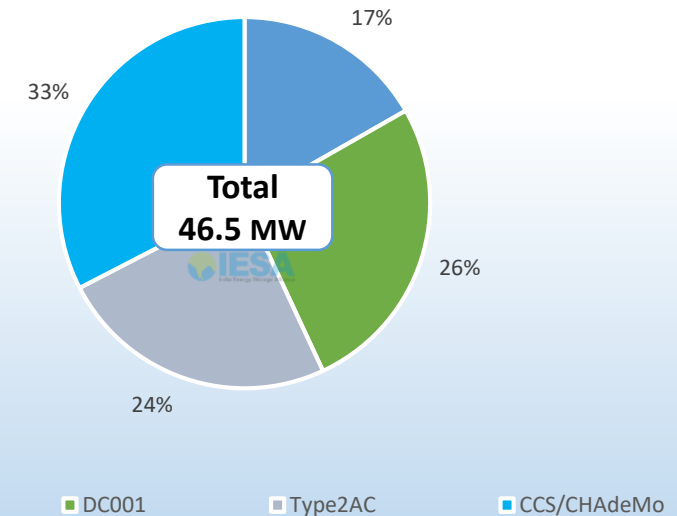
2019 EV CHARGER MARKET OVERVIEW



EV Charger*Unit Installation, 2018-20, India



Installed EV Charger Capacity MW, 2019-20



- During 2019, the total EV chargers supplied was around 3,350 units in India. This includes chargers supplied to EV OEMs to be sold along with EVs, procurement by PSUs for public or semi-public installations, by commercial fleet operators and bus operators and charging service providers.
- AC001 was ordered by EV OEMs for supplying with E4W and by PSUs for semi-public or public installations. Demand from commercial sector by CPOs or fleet operators were not significant during 2019-20. DC001, major ordered were from PSUs.
- The total installation of these chargers are for 46.5 MW. For private charging, both AC001 and Type2 AC chargers were used by four-wheelers. 2Ws and 3Ws mostly depended on 1kW chargers, that are excluded from this marker sizing.
- For public and semi-public charging AC001, DC001 and CCS/CHAdemo chargers were mainly used.

* Includes private and public chargers. Excludes <3.3kW chargers, such as those sold with 2W, 3W.

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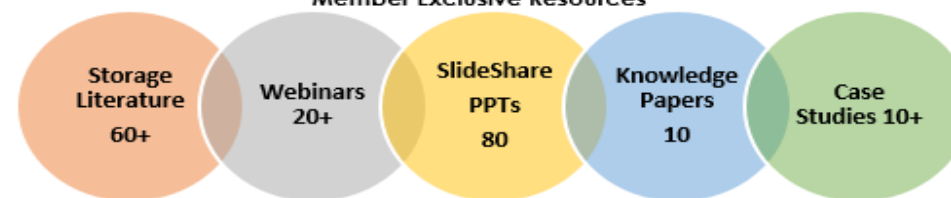
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Showcase products at events, online product catalogue and publications

Activities – 2019-20



Member Exclusive Resources



National and International Events

All year round, IESA organizes various regional and international events catering to every stakeholder of the energy storage and EV ecosystem. These conferences and workshops are a great place for learning, business networking and showcasing your company capabilities.

| | | | |
|------------------------------------|--------------------------------------|-----------------------------|---------------------------|
| India Energy Storage Week | IESA Industry Excellence Awards | ESS Meets for C&I Customers | India E-mobility Conclave |
| Manufacturing Masterclass for CXOs | Li Ion Cell Making Hands-on Workshop | ESS & EV Investment Summit | IESA Startup Competition |



ESS Meets & EV Roundtables

ESS meet & EV Roundtables provide an exclusive platform for members to reach out to commercial and industrial consumers and early adopters. Till date, IESA has successfully organized 10+ regional meets, held in the cities of Coimbatore, Pune, Bangalore, Delhi, Ranchi and Kanpur.



Storage IQ and Resource Bulletins

Storage IQ and Resource Bulletins give a detailed monthly update on activities and developments in the stationary energy storage and EV space in India. They covers tender updates, policy updates, draft policy recommendations, various meeting updates and information about upcoming meetings. Resource Bulletins serve are a one-stop-guide to all the important activities in the market over the month.

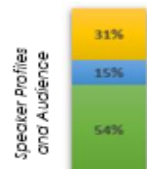


Annual Reports and White Papers

IESA releases two annual market overview reports covering stationary energy storage and e-mobility market. This year, IESA is releasing four Emerging Tech Reports. IESA also releases knowledge papers on a regular basis to help members stay on top of the latest industry trends.



IESA Knowledge Webinars



IESA Academy conducts 'knowledge series' webinars which cater to global audience. The motto of the webinar is *by the members, for the members*. The webinars cover areas from technology, business models, to operations and recycling. IESA invites top thought leaders from the industry and attracts 100s of participants for these webinars.

■ SMEs ■ Academia & Research ■ Owners/ Decision Makers

| | | | |
|--------------------|-----------------------------|--------------------------|----------------------|
| Utilities | Battery Manufacturers | ESS Technology Providers | EV Manufacturers |
| EV Fleet Operators | Utilities and C&I Customers | Financial Institutes | RE Developers / IPPs |

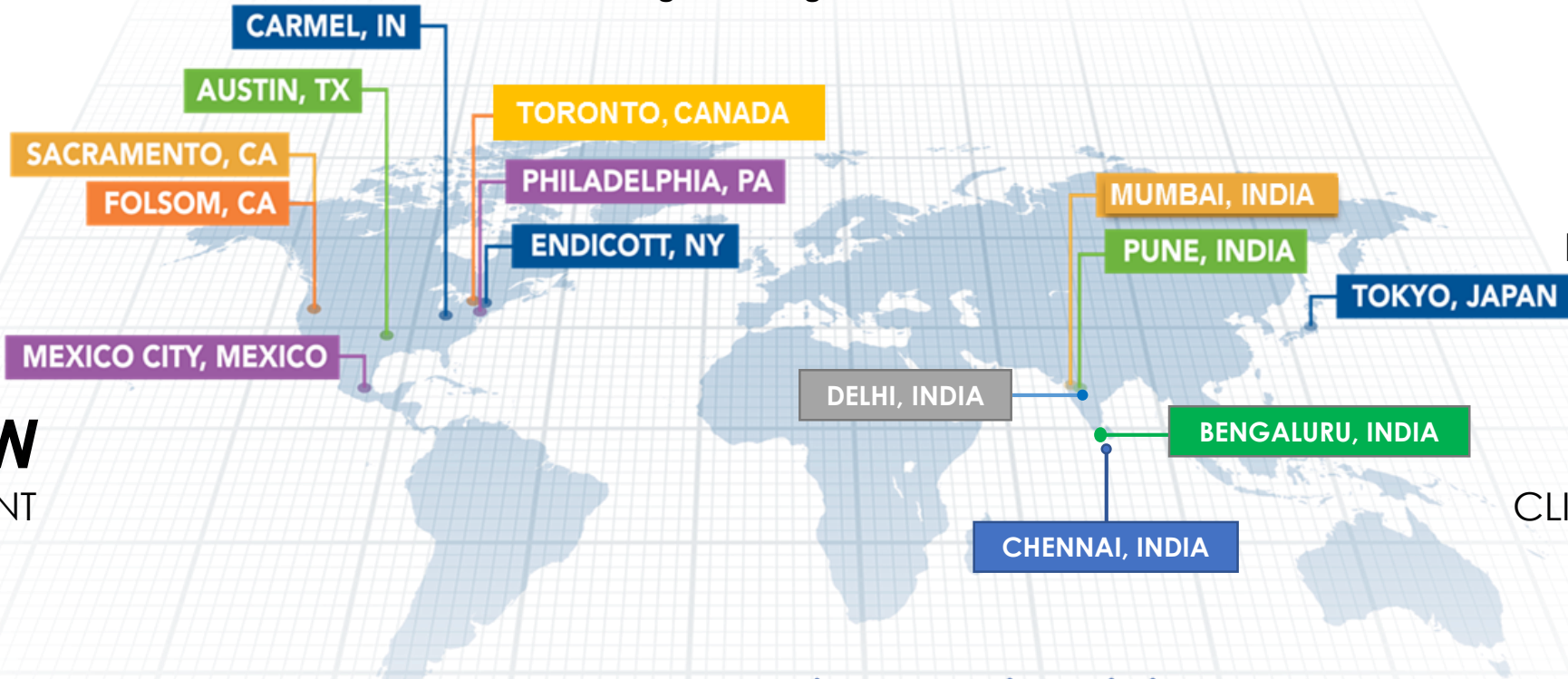
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PHILADELPHIA



1998

ESTABLISHMENT

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CLIENTS WORLDWIDE

10,000+ MW
ASSET MANAGEMENT

300+ MW

STORAGE ASSET
MANAGEMENT

Customized Across the Globe



2014 & 2016



11 TIMES HONOREE

Over 200+ Associates across United States, Canada, India, Japan & Mexico.

