



Fundamentals of Electric Vehicle Charging Technology And it's Grid Integration

"Sustainable Motoring with zero-emission - I am confident that with our collective efforts, we can enable a green and smarter tomorrow for India"



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FOREWORD :

With the second-largest road network in the world, India's road transport contributes towards nearly 64% of the country's overall goods movement and caters to around 90% of India's total passenger traffic. This provides a huge opportunity to carbonize the transport sector but there are also challenges. Government of India has taken proactive measures towards fostering a clean, connected, shared and cutting-edge transportation system by providing policy and regulatory support.

To support deployment of EV charging infrastructure in the country, the Government of India has allocated a total fund of INR 1000 Crore under the FAME II scheme. Under public procurement, Department of Heavy Industry (DHI) has sanctioned 2,636 EV Charging Stations, in 62 cities across 24 States/UTs and 1,544 such stations on highways under FAME II scheme. EV charging is a Delicensed activity in India and the Ministry of Power (MoP) has published revised guidelines for charging infrastructure for Electric Vehicles during Jan-2022 to facilitate the deployment of charging infrastructure.

Apart from this, several states have announced targets for EV deployment including special EV tariff to incentivize EV charging in India. For the uptake of EV adoption in India, a major challenge of integrating the charging infrastructure with the electrical network needs to be tackled. The continued development of EV charging infrastructure and its integration will depend, among other things, on Policy and Regulatory Environment, which must also account for grid stability.

Abstract:

This Article focuses on the Key Terminologies in the EV Ecosystem, Stakeholders in EV Ecosystem, EV charging Infrastructure Classification, GoI Initiatives towards EV Mission, Battery Swapping, India's Panchamrit at COP-26, Karnataka is Becoming the Centre piece of India's Electric Vehicle Revolution, Guidelines & Standards for Charging Infrastructure for Electric Vehicles, Karnataka Electric Vehicle & Energy Storage Policy 2017 and Conclusion.

Key Terminologies used in the EV Ecosystem.

- Electric Vehicle (EV): Any vehicle which has an electric motor and can be powered by battery storage, fuel cell, photovoltaic array, or any other source of electric current
- Battery Electric Vehicle (BEV): A Battery electric vehicle is only powered by a battery storage and cannot be



powered by any other type of fuel.

- Hybrid Electric Vehicle (HEV): An HEV combines an internal combustion engine powered by conventional fuels with a battery-powered electric motor.
- Charging Point/ Electric Vehicle Supply Equipment (EVSE): A charging point or an EVSE is the actual point of connection of the EV with the electrical network.
- Charging Station/ Electric vehicle Charging Station (EVCS): A charging station or EVCS is the physical station with one or more charging points.
- Connector: A Connector is a physical interface between the EVSE and the EV.
- Charge Point Operator (CPO): The charge point operator is responsible for the management, maintenance, and operation of the charging stations.

Stakeholders in EV Ecosystem

The EV ecosystem includes a variety of stakeholders as shown in Fig(1) between whom proper coordination and communication is necessary for the growth of the EV market. These stakeholders include,

- Original Equipment Manufacturers (OEM): OEMs includes charger manufacturer, vehicle and its components manufacturer etc.
- Charge Point Operator (CPO): The charge point operator is responsible for the smooth operation of the charging station.
- Electric Mobility Service Providers (eMSP): The eMSP offers EV charging services to the EV users by providing access to the charge points within the eMSP network.
- Energy Distributor/retailer: They provide the energy to the CPOs for the charging needs.
- DISCOM/DSO: The Electrical connection to the charging station is provided by the DISCOM and so the CPO needs to coordinate with the DSO regarding connection requirements as well have communication layers in place to control the charging load based on the network condition.
- Public Authority: The public authorities are responsible for framing policies to increase the growth of the EV market as well as frame regulations for grid integration of EV.
- IT & Communication: They provide communication services between the different associated stakeholders and provide cyber security services.

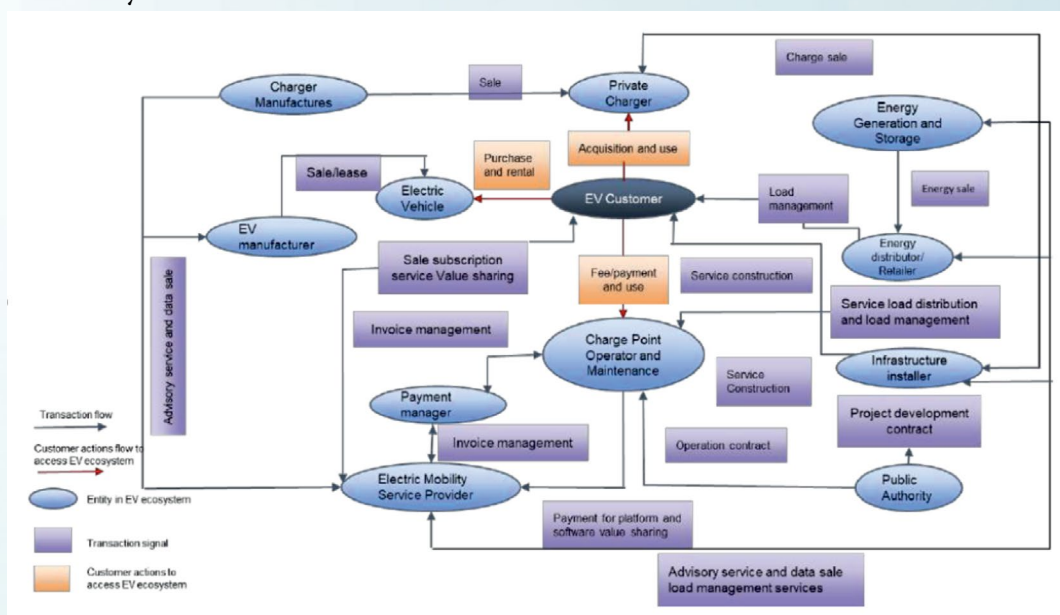


Fig 1: Diagrammatic representation of EV ecosystem.

EV charging Infrastructure Classification :

The Charging Infrastructure can be distinguished in Terms of speed of charging, standardization of chargers, ownership, process of charging and power flow directionality, as shown in Fig(2).

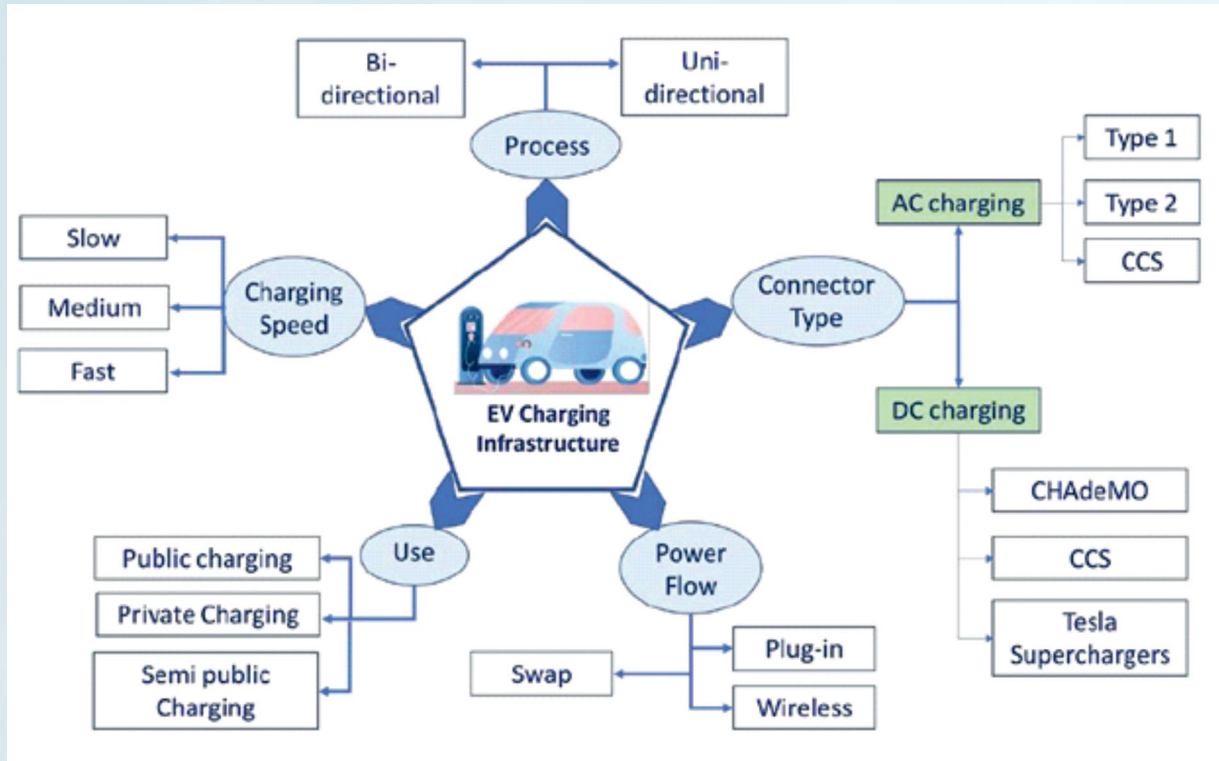


Fig 2 : EV Charging Infrastructure Classification

Battery Swapping:

Battery swapping is a straightforward and rapid process. It takes a few minutes to change the discharged battery with a fully charged one. However, depending on the vehicle model there are different Techniques of battery swapping methods.

The Two different types are,

- Chassis type battery swapping where the loading and unloading of battery is carried out from underneath the vehicle.
- The Battery packs are replaced from the side or rear of the vehicle.

India's Panchamrit at COP-26

The Government of India has articulated and put across the concerns of developing countries at the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom. Further, India presented the following five nectar elements (Panchamrit) of India's climate action:

- Reach 500GW Non-fossil energy capacity by 2030.
- 50 per cent of its energy requirements from renewable energy by 2030.
- Reduction of total projected carbon emissions by one billion tones from now to 2030.



KARNATAKA POWER ENGINEERS ACADEMY

- Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels.
- Achieving the target of net zero emissions by 2070.

Govt. Of India Initiatives towards EV Mission

During the Global Mobility Summit held in September 2018, Prime Minister of India had outlined a vision for the future of mobility in India based on the 7 C's: Common, Connected, Convenient, Congestion-free, Charged, Clean and Cutting-edge mobility.

Hence, there was a need felt to establish a dedicated multi-disciplinary mission that will facilitate cooperative federalism, extensive stakeholder and inter-ministerial consultations as well as implement an end-to-end policy framework for transforming the mobility landscape with particular focus on:

- Manufacturing
- Specification & standards
- Fiscal incentives
- Overall demand creation and projections
- Regulatory framework
- Research & Development

Sl. No.	Initiative	Date	Amount	Thrust Area	Impact
1	Setting up National Mission for Transformative Mobility and Battery Storage	7th March, 2019		Institutional	Improve air quality along with reducing India's oil import dependence and enhance the uptake of renewable energy and storage solutions.
2	Faster Adoption and Manufacturing of Electric (&Hybrid) Vehicles in India (FAME) Scheme, Phase-II	8th March, 2019	Rs 10,000 Cr (1.35 bn USD)	Fiscal Incentives	Support approximately 7000 e-Buses, 5 lakh e-3 Wheelers, 55000 e-4 Wheeler Passenger Cars and 10 lakh e-2 Wheelers
	Revised FAME-II scheme	11th June, 2021		Demand Aggregation	Increases upfront incentives for 2Ws, adopted 'Aggregation Model' for 3Ws and OPEX Model and 'Lighthouse Cities' approach for the Electric Buses. The validity of the flagship scheme is extended till 2024.
3	National Programme on Advanced Chemistry Cell (ACC) Battery Storage	9th June, 2021	Rs 18,100 Cr (2.48 bn USD)	Manufacturing	Implementation of giga-scale ACC manufacturing facilities in India
4	Production-linked incentive (PLI) scheme for the automotive sector	15th Sept, 2021	Rs 25,938 Cr (3.5 bn USD)	Manufacturing	Focus on electric and hydrogen fuel cell vehicles
5	State EV Policies	Since 2017		Regulatory	Inspired 25 states to come up with EV Policies (16 have already notified)
6	Skill Development Programs and Establishment of Dedicated Centers	Since 2019		R&D	9 IITs have started dedicated programs for EVs

Table 1: NITI Ayog Initiative on EV Mission



Karnataka is Becoming the Centre piece of India's Electric Vehicle Revolution:

Karnataka government outlined its plan to make the state the number one destination in India for manufacturing electric vehicles, releasing the landmark **Karnataka Electric Vehicles and Energy Storage Policy-2017**.

After extensive consultation with industry representatives and domain experts from India and around the world, the government came out with this document outlining how it plans to incentivize and reward EV (Electric Vehicle) production. Karnataka is the first state government to establish a full-fledged EV policy during 2017.

Pinnacle of Consolidated Guidelines & Standards for Charging Infrastructure for Electric Vehicles provided by the MoP

- Owners may charge their electric vehicles at their residences and offices using their existing electricity connections.
- Connection would be provided to public EV charging stations within 7 days in metro cities, 15 days in other municipal areas and 30 days in rural areas.
- The Ceiling of Service Charges to be charged by such charging stations would be fixed by the state governments.
- The Tariff for supply of electricity to public EV charging stations would be a single part tariff and would not exceed the "average cost of supply" till 31st March 2025.
- Through open access, public EV charging station or chain of EV charging stations may obtain electricity from any power generation company.
- Public EV charging stations would be required to tie up with at least one online Network Service Provider to enable advance remote/online booking of charging slots by EV owners.
- At least one EV charging station shall be available in a grid of 3 Km X 3 Km. Furthermore, one EV charging station shall be set up at every 25 Km on both sides of highways/roads.
- A Phase wise installation of EV Charging infrastructure for mega cities and big cities has been envisaged under the guidelines.
- The public charging stations shall have the feature of Prepaid Collection of service charges with the Time of the day rates and discount for solar hours.
- A Committee under Central Electricity Authority (CEA) to recommend to the State Government the ceiling limit of service charges to be levied.

Karnataka Electric Vehicle & Energy Storage Policy 2017

Targets of Karnataka EV Policy 2017

- To make Karnataka as a preferred destination for attracting investments in the manufacture of EVs.
 - To attract investments of Rs. 31,000 crores and create employment opportunities for 55,000 personas from both supply and demand side.
 - To provide opportunities for R&D in electric mobility.
 - To promote a conducive manufacturing ecosystem in collaboration with the industry.
- According to Karnataka Budget 2020-21, the state proposes to establish an "Electric Vehicles and Energy Storage Manufacturing Cluster" and a grant of Rs.10 crore is earmarked for this purpose.



Conclusion:

The Progress that the Electric Vehicle industry has seen in recent years is not only extremely welcomed, but highly necessary in light of the increasing global greenhouse gas levels. As demonstrated within the economic, social, and environmental analysis sections, the benefits of electric vehicles far surpass the costs. The biggest obstacle to the widespread adoption of electric-powered transportation is cost related, as gasoline and the vehicles that run on it are readily available, convenient, and less costly. As is demonstrated in our timeline, we hope that over the course of next decade technological advancements & policy changes will help ease the transition from traditional fuel-powered vehicles. Additionally, the realization and success of this industry relies heavily on the global population, and it is our hope that through mass marketing and environmental education programs people will feel incentivized and empowered to drive an electric-powered vehicle.

“Each person can make a difference, so go electric and help to make a difference!”