Concept Paper on Regulatory Framework for Promoting Electric Vehicles and their Impact on the Grid

JUNE 2020


Delicensed Activity
Priority Connection
Open Access
Concessional Tariff
Fast Charging
Battery Swapping
Solar Charging
Vehicle to Grid
Infrastructure recovery

Table of Contents

List of Abbreviations

CO_2	Carbon Di Oxide
CSS	Cross Subsidy Surcharge
DL	Distribution Licensee
DISCOM	Distribution Companies
EV	Electric Vehicle
EA	Electricity Act
GST	Goods and Services Tax
ICE	Internal Combustion Engine
JNNSM	Jawaharlal Nehru National Solar Mission
FAME	Faster Adoption and Manufacture of Electric Vehicles
FOR	Forum of Regulators
MOP	Ministry of Power
MoU	Memorandum of Understanding
NITI	National Institution for Transforming India
NEMPP	National Electric Mobility Mission Plan
NO_2	Nitrogen Oxide
ToD	Time of Day
SERC	State Electricity Regulatory Commission
RERC	Rajasthan Electricity Regulatory Commission
RE	Renewable Energy
RPO	Renewable Purchase Obligation
R&D	Research and Development

List of Figures

1 Introduction

1.1 Current Scenario of Power Sector in Rajasthan

1.1.1 Power Surplus Situation

The power sector in Rajasthan received impetus with the formation of Rajasthan State Electricity Board (RSEB). Thereafter, a planned growth in installed capacity, transmission network and rural electrification took place. In 2000, the RSEB, a vertically integrated entity, was restructured by forming one Generation Company, one Transmission Company, and three Distribution Companies, as shown below, to encourage functional specialisation, efficiency, productivity, autonomy and accountability in decision making.

Generation Company	• Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RVUNL)
Transmission Company	• Rajasthan Rajya Vidyut Prasaran Nigam Ltd. (RVPNL)
Distribution Company	• Jaipur Vidyut Vitran Nigam Ltd. (JVVNL) • Ajmer Vidyut Vitran Nigam Ltd. (AVVNL) • Jodhpur Vidyut Vitran Nigam Ltd. (JdVVNL)

The total installed generation capacity in the State is around 19,135 MW as per Rajasthan State Load Despatch Centre. Around 45% of the power is generated by State Generating Stations (SGS) and the remaining energy is produced by Renewable Energy Sources, Independent Power Producers (IPPs), and Captive Power Plants (CPPs). The total available capacity in the State is around 13,000 MW while requirement is around 11,000 MW resulting into a surplus of around 2,000 MW as per latest LGBR Report of FY 2018-19.

The power sector in the State of Rajasthan has witnessed many changes during the last five years. The State is moving towards power surplus scenario from power deficit scenario, with the commissioning of new generating stations of RVUN during the year.

1.1.2 Stranded Capacity

In Rajasthan, conventional generation capacity, even though having Power Purchase Agreements (PPAs) with the DISCOMs, are stranded due to demand increase being lower than that envisaged.

Secondly, due to shifting of consumers having load more than 1 MW towards Open Access to buy power from cheaper sources, the generators are forced to back down.

As per the Additional Surcharge Order dated 24th August 2016 in Petition No. RERC-548/15 the average back down capacity (per time block) due to Open Access is around 656 MW and the total energy backed down during FY 2015-16 was around 2,852 MU. It was estimated that the total surplus power available after meeting the demand for FY 2018-19 is 12,865 MU as per Tariff Order dated 28 May 2018 and surplus power for FY 2019-20 as per order dt. 06.02.2020 was assessed as 6,732 MU.

1.1.3 Why are Electric Vehicles required?

India is gradually moving towards the regime of Electric Vehicles (EV), with the intention of complete phasing out of Internal Combustion Engines (ICE) vehicles. The Indian Government has set a vision of achieving 100% Electric Vehicles (EV) by 2030 as per the latest report of National Institution for Transforming India (NITI) Aayog and is working on Policies for making EVs economically viable. The Ministry of Heavy Industry and Public Enterprise has also launched a Policy named Faster Adoption and Manufacture of Electric Vehicles (FAME) Scheme Phase 1 and 2 under the National Electric Mobility Mission Plan 2020 (NEMPP 2020) to promote faster transformation from ICEs to EVs. There are multiple factors that drive EV requirement, however, the primary factors for shifting towards EVs are as follows:

1. **Vehicular Pollution** - Indian cities are one of the world's most polluted cities. ICEs are one of the largest contributors towards air pollution. Further, India

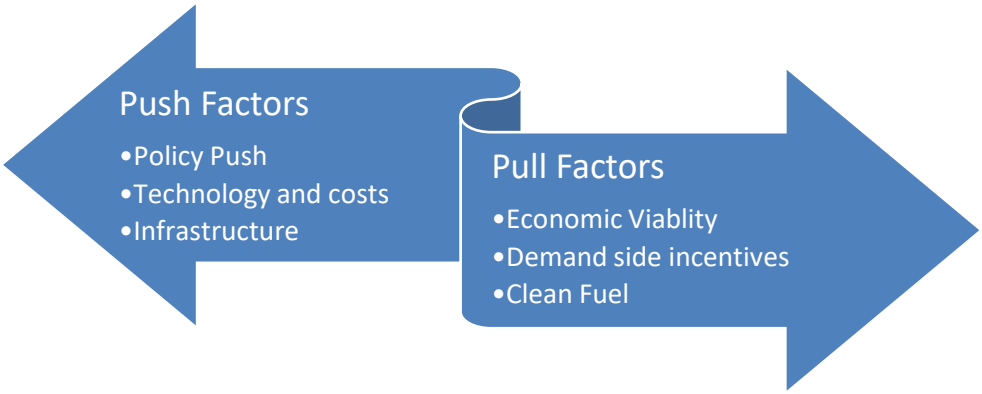
accounts for one of the highest numbers of premature deaths in the world due to air pollution. EVs are much cleaner technology as compared to ICEs.

2. **Energy Security** - India is one of largest importers of oil. This directly impacts the balance of payment as well. Nearly 70 to 99% of the sales of petrol/diesel occurs in the transport sector. Transformation towards EVs will ease out the balance of payments and improve the energy security of India.
3. **Utilisation of Renewable Energy** - India has set up a target of 100 GW solar power and 60 GW of Wind power by 2022 as per Ministry of New and Renewable Energy (MNRE). All this power has to be utilised. Higher penetration of EVs will help to improve the utilisation of the electricity generated by Renewable Energy sources.

1.1.4 Push and Pull Factors for EV

The following are the push and pull factors introduced for promotion of EV's:

Figure 1: Push and Pull Factors for EV



Push factors:

(i) **Policy Push** - India is providing incentives and tax benefits for manufacturing of EVs. The Government of India approved the National Mission on Electric Mobility in 2011 and subsequently National Electric Mobility Mission Plan 2020 was unveiled (in 2013). The overall scheme was

proposed to be implemented over a period of 6 years, till 2020, wherein it was intended to support the hybrid / electric vehicles market development and its manufacturing eco-system to achieve self-sustenance at the end of the stipulated period. The Salient features of NEMPP 2020 are as follows:

- Target of deploying 5 to 7 million electric vehicles in the country by 2020
- Emphasizes importance of government incentives and coordination between industry and academia
- Target of 400,000 passenger battery electric cars (BEVs) by 2020 ~ avoiding 120 million barrels of oil and 4 million tons of CO_2
- Lowering of vehicular emissions by 1.3 percent by 2020
- Total investment required – INR 20,000 – 23,000 Crore (Approx. 3 billion USD)

(ii) **Technology and Cost** - Battery costs are single largest driver of Total Cost of Ownership for EVs. NMC Graphite battery cells are most commonly used in EV battery today and provide specific energy of 200 Wh/kg and cost around $150 to $200 per kWh as per NITI Aayog report on 'Zero Emission Vehicles (ZEVs) Towards a Policy Framework' published in September 2018. The battery costs have seen enormous technological advancement in recent years, both in terms of improving performance and reducing cost. There is huge scope for improvement in technology of battery which includes 'solid state batteries' that promise storage of 1000 Wh/kg and 80% charge in 10 min. There are other breakthrough technologies with possibilities in R&D to find alternatives to batteries such as ultra-capacitors. The various factors that affect the range the vehicle can travel before recharging or swapping are battery size, cooling requirements, weight of the vehicle, and energy efficiency of the vehicle.

(iii) **Charging Infrastructure** - The availability of battery charging infrastructure is another important factor for pushing more EVs on road. Easy access to fast charging infrastructure to reduce downtime for EV consumers across

highways, residences, office/ work places will make it more convenient. At present, the charging infrastructure is scarce across India, since development of EV charging infrastructure is at nascent stage. The Ministry of Power notified guidelines for charging infrastructure on **14 December 2018 and subsequently on 1 October 2019.** Further, various States through individual policies have provided incentives for setting up fast charging infrastructure. Further, the Government of India has clarified that setting up of public charging infrastructure for supply of electricity is a delicensed activity. States are also providing benefits and incentives for setting up of charging infrastructure through individual policies. For e.g.; Andhra Pradesh has allowed socialising of charging infrastructure costs set up by DISCOMs through the Aggregate Revenue Requirement (ARR).

Pull Factors

(i) **Economic Viability** - Indian consumers are highly price conscious. Over the past few years, the cost of petrol and diesel have seen a significant rise and the battery prices have been falling, however, there is still more way to go before achieving the breakeven point in upfront cost. EVs are attractive due to lower running costs. Thus, there is huge potential to reduce the monthly spending in case of shift from petrol or diesel-based vehicle to EV. More savings can be achieved with shared mobility as an alternative. For e.g. OLA launched a fleet of 200 EVs in Nagpur in collaboration with solar power developer ACME.

(ii) **Demand Side Incentives** - In 2015, the FAME scheme under NEMPP was launched with an objective to 'support hybrid / electric vehicles market development and manufacturing ecosystem. The scheme envisaged providing subsidy to buyers of hybrid and electric vehicles. The subsidy for vehicles were given based on their fuel saving potential. As per FAME India website (*At present, the subsidy for two-wheelers range from INR 7,500 to 22,000; for three-wheelers from INR 25,000 to 61,000; and for four wheelers from INR*

70,000 to 6,10,000). The budget outlay for the scheme was Rs. 895 Crore as per FAME I policy notification. In 2017, the implementation of NEMPP and FAME was allocated to NITI Aayog. In 2017, Karnataka became the first State in the country to introduce a Policy dedicated to EVs, followed by many other States. In 2019, the Government of India launched FAME II Policy, which is discussed in detail in subsequent sections.

(iii) **Clean Fuel -** EVs and hybrids are cleaner technology as compared to Internal Combustion Engine (ICE). EVs do not emit particulate matter, nitrogen oxide (NO_2) and carbon-di-oxide (CO_2) unlike conventional vehicles. As per FAME India website, as on date, EVs have helped India to reduce up to 1,20,130 Tonnes of CO_2 emission.

1.2 Policy Initiatives (FAME I and II) & MOP Guidelines for Charging Infrastructure

1.2.1 Brief of FAME Policy

The following is a summary of FAME Policy I introduced in 2015 and FAME Policy II introduced in 2019.

Table 1: FAME Policy I & II

	FAME I Policy	FAME II Policy
Budget	Rs. 795 Crore enhanced to Rs. 895 Crore	Rs. 10,000 Crore
Implementation period	2 years extended to 3 years	3 years
Scheme Focus Areas	1) Technology Development 2) Demand Creation 3) Pilot projects 4) Charging Infrastructure	1) Demand Incentives 2) Charging Infrastructure 3) Administration
Nodal Department	Department of Heavy Industries (DHI)	Department of Heavy Industries (DHI)
Categories of Vehicles	Two Wheelers (Category L1 and L2 as per CMVR, Max. power not exceeding 250W), Three Wheelers (Category L5), Passenger Cars (Category M1), Light Commercial Vehicles (Category N1), Buses	Buses (only Electric Vehicle technology), Four-Wheeler (Electric (EV), Plug in Hybrid (PHEV) and Strong

	FAME I Policy	FAME II Policy
	(Category M3) and Retro fitment (Category M1, M2 and N1)	Hybrid (SHEV), Three-wheeler (Electric) including Registered E-Rickshaws and Two Wheelers (Electric)
Technology	Mild Hybrid, Strong Hybrid, Plug-in Hybrid and Pure Electric technologies	Strong Hybrid, Plug-in Hybrid and Pure Electric technologies
Demand Incentives	Level 1 incentive and Level 2 incentives (120% rounded off of the Level 1 incentive). The principle of having two incentive slabs was to promote development of technologies and vehicles with higher fuel saving potential.	Rs. 10,000/- per kWh of battery size for all vehicles; Rs. 20,000/- per kWh of battery size for Buses and trucks.
Others		Non-Fiscal incentives like waiver/ concessional road tax, parking fees, toll tax, registration charges exemption from permit

1.2.2 MOP Revised Guidelines for Charging Infrastructure

The Ministry of Power (MoP) notified revised guidelines for Charging Infrastructure for Electric Vehicles on 1st October 2019. The revised guidelines have tried to address the concerns of EV owners regarding Charging Infrastructure for faster adoption of EV in India.

The summary of MOP Revised Guidelines for Charging Infrastructure are as under:

1) Any Charging Station/Chain of Charging Stations may obtain electricity from any generation company through open access.

2) Private Charging

- At residences/offices shall be permitted. Distribution Companies shall facilitate the same.
- Minimum infrastructure requirements as per these Guidelines do not apply to Private Charging Points meant for self-use of individual EV owners (non-commercial basis)
- Captive charging infrastructure for 100% internal use for a company's own/leased fleet will not be required to install all type of chargers and to have Network Service Providers (NSP) tie ups
- The tariff applicable for domestic consumption will be applicable for domestic charging.

3) Public Charging Stations (PCS)

- De-licensed activity; any individual/entity is free to set up PCS provided, such stations meet the technical, safety as well as performance standards and protocols laid down as well as further norms/standards/specifications laid down by Ministry of Power and Central Electricity Authority (CEA) from time to time.
- Connectivity on priority basis for PCS by the Distribution Company
- Electric Vehicle Supply Equipment (EVSE) shall be type tested by an agency/lab accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) from time to time.
- Location of PCS - at least one charging station in a grid of 3 km x 3 km
- One charging station to be set up at every 25 km on both sides of highways/ roads
- Density/Distance requirement shall be used by the concerned State/UT's Governments for purpose of land use planning for public charging stations as well as for priority installation of distribution

network including transformers/feeders etc. This shall be done in all cases including where no Central/State subsidy is provided

- Appropriate Governments (Central/State/UT's) may also prioritise existing retail outlets of Oil Marketing Companies for installation of Public EV Charging Stations (in compliance with safety norms) to meet the requirements as laid down in the guidelines.

- Fast Charging Stations (FCS) shall be installed for long range EVs and heavy duty EVs like buses/trucks, etc., at every 100 Km on each side of the highway/road located preferably within/alongside the Public Charging Station with the following requirement

    - At least two chargers of minimum 100 kW (200-750 V or higher) each of different specifications (CCS/CHAdeMO or any fast charger as approved by DST/BIS for above capacity) with single connector gun each.

    - Appropriate Liquid Cooled Cables for high speed charging as above, for onboard charging of Fluid Cooled Batteries (currently available in some long range EV's), if required.

- Within cities, FCS may be located within Transport Nagars, Bus Depots.

- Such Fast Charging Stations (FCS), which are meant only for 100% in-house/captive utilization. For e.g. buses of a company. The Company would be free to decide the charging specifications as per its requirement for its in-house company EV's.

- Additional PCS/FCS can be installed even if there exist a PCS/FCS in the required grid or distance

- Charging stations may also be installed by Housing Societies, Malls, Office Complexes, Restaurants, Hotels, etc. with a provision to allow

charging of visitor's vehicles which are permitted to come in its premises.

4) Public Charging Infrastructure Requirements

- Exclusive Transformer with all the related Sub-station equipment including safety appliance if required.
- 33/11 KV lines/cables with associated equipment including line termination etc, if required
- Appropriate Civil works
- Appropriate Cabling and Electrical Works ensuring safety
- Adequate space for Charging and entry/exit of vehicles
- Shall have one or more chargers or any combination of chargers in one or more electric kiosk/boards:
- Charging station for e-two/three wheelers shall be free to install any charger other than the specified ones subject to compliance of technical and safety standards laid down by CEA
- Tie up with at least one online NSP to enable advance remote/online booking of charging slots by EV owners. Such information shall include location types and number of Chargers available at Charging Stations.
- Share charging stations data with appropriate Distribution Company and adhere to the protocols as prescribed by CEA. CEA, Central Nodal Agency (CNA) and State Nodal Agency (SNA) shall have access to this database.

5) Standards of PCS

Charger Type	Charger Connectors*	Rated Voltage (V)	No. of connector guns (CG)	Charging Vehicle Type (W=wheeler)
Fast	Combined Charging System (CCS) (min 50 kW)	200-750 or higher	1 CG	4W
	CHArge de MOve CHAdeMO (min 50 kW)	200-500 or higher	1 CG	4W
	Type 2 AC (min 22 kW)	380-415	1 CG	4W, 3W, 2W
Slow/Moderate	Bharat DC-001 (15 kW)	48	1CG	4W, 3W, 2W
	Bharat DC-001 (15 kW)	72 or higher	1 CG	4W
	Bharat AC-001 (10 KW)	230	3 CG of 3.3 kW each	4W, 3W, 2W

**In addition, any other fast/slow/moderate charger as per approved DST/BIS standards whenever notified.*
Note: Type – 2 AC (min 22 kW) is capable of charging e-2W/3W with the provision of an adapter

6) Priority for Rollout of EV Public Charging Infrastructures:

- Phase I (1-3 Years) - It is envisaged that all Mega Cities with population of more than 4 million as per 2011 census, all existing expressways connected to these Mega Cities & important Highways connected with each of these Mega Cities may be taken up for coverage

- Phase II (3-5 Years) – Big cities like State Capitals, UT headquarters may also be covered for distributive and demonstrative effect. Important highways connecting to these Mega Cities may be taken up for coverage

7) Other Aspects

Particulars	Details
Tariff	✓ Tariff for supply to EV Public Charging Stations shall be determined by Appropriate Commission in accordance with the Tariff Policy. ✓ Tariff applicable for domestic consumption shall be applicable for domestic charging ✓ Separate metering arrangement shall be made for PCS so that consumption may be recorded and billed as per applicable tariff for EV Charging Stations

Particulars	Details
	✓ State Nodal Agency/State Government/Appropriate Commission shall fix the ceiling of the service charges levied by the PCS/FCS for those installed with Govt. Incentives
Implementation Mechanism for Rollout	✓ Bureau of energy Efficiency (BEE) shall be the Central Nodal Agency for rollout of EV Public charging Infrastructure. All relevant agencies including CEA shall provide necessary support to Central Nodal agency ✓ State government shall nominate Nodal Agency for that state for setting up Charging Infrastructure. The State DISCOM shall generally be the Nodal Agency for such purposes. State Governments are however free to select Central/State Public Sector Undertaking (PSU) including Urban Local Bodies (ULBs), Urban/Area Development Authorities etc. as its Nodal Agency
Implementation agency for Rollout	✓ Central Nodal Agency shall finalize the cities and expressways/highways to be finally taken up in priority in consultation with the respective State Governments. ✓ An Implementation Agency may be selected by the respective State Nodal Agency (SNA), which will be entrusted with responsibility of installation, operation and maintenance of PCS/FCS for designated period as per parameters laid down in this Policy ✓ Implementation Agency may be an Aggregator as mutually decided between Central and State Nodal Agencies. However, they may also decide to choose different PCS providers for bundled packages or for individual locations as mutually decided. Further whenever bundled packages are carved for bidding, such packages may include at least one identified expressway/highway or part thereof to prepare a cohesive regional package; selected identified cities may be divided into one or more parts as necessary for such purposes. ✓ Appropriate Agency shall have the option of giving subsidy such as bidding for lower service charges or bidding for quantum of subsidy for fixed service charges etc.
Database of Public EV Charging Station	✓ CEA shall create and maintain national online database of all the PCS through DISCOMs ✓ Appropriate protocols shall be notified by DISCOMs for this purpose which shall be mandatorily complied by the PCS

Particulars	Details
	✓ This database shall have access as finalized by CEA and Ministry of Power

1.2.3 EV Charging as De-Licensed Activity

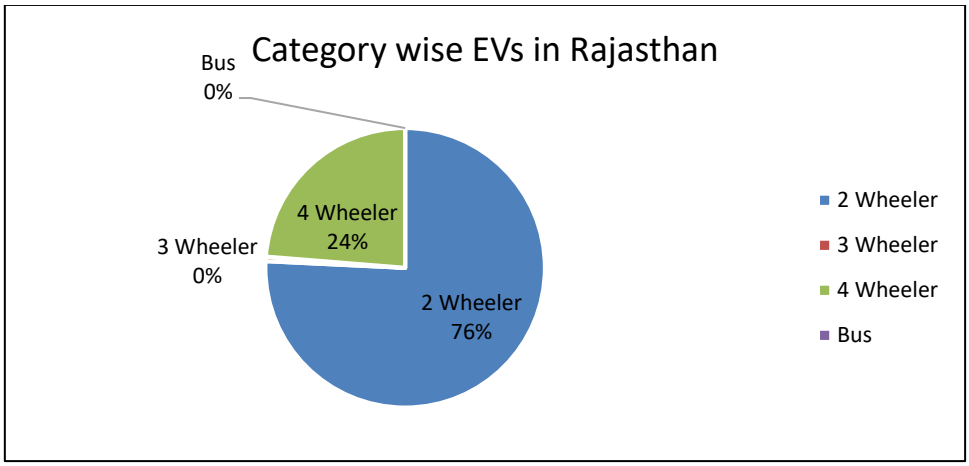
The Ministry of Power (MoP) vide notification dated April 13, 2018 clarified that the activity of charging of battery of electric vehicle through charging station does not require any licence as per the provisions of EA 2003. The clarification is as follows:

> "Section 2 of the Act provides definitions for "consumer" for electricity, and "trading" of electricity. As per definition, consumer means any person who is supplied with electricity for his own use and includes any persons whose premises are for the time being connected for the purpose of receiving electricity whereas trading is defined as procurement of electricity for resale thereof.
>
> The charging of battery essentially involves utilization of electrical energy for its conversion to chemical energy, which gets stored in the battery. Thus, the charging of battery of an electric vehicle by a charging station involves a service requiring consumption of electricity by the charging station and earning revenue for this purpose from the owner of the vehicle. The activity does not in any way include sale of electricity to any person as the electricity is consumed within the premises owned by the charging station, which may be connected to the distribution system or otherwise for receiving electricity. By the same logic, the activity does not involve further distribution or transmission of electricity.

1.3 Growth in EV after introduction of FAME Policy in Rajasthan

The number of EVs sold in Rajasthan is 6.21% of the total EVs sold in India and stands at around 17,405, as per FAME India website. The share of 2 wheelers is more than 75% as shown in the category wise distribution of EVs sold in Rajasthan below:

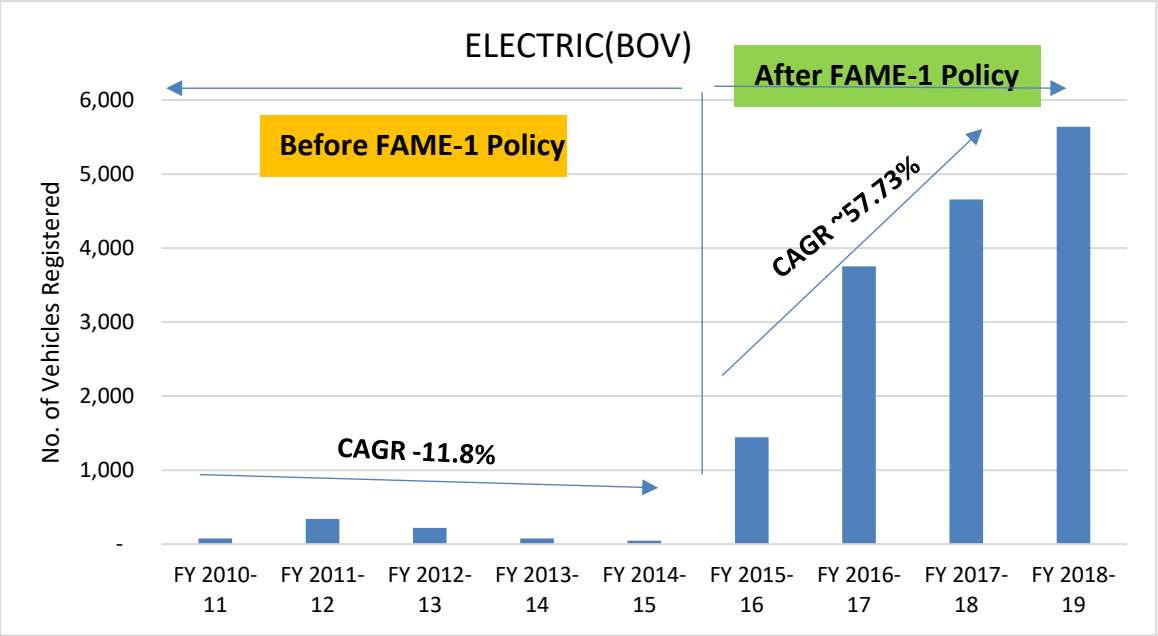
Figure 2: Category wise EVs sold in Rajasthan



Source: FAME India Website

Further, the growth of EVs registered in Rajasthan is predominantly higher after the FAME-1 policy as compared to before FAME-1 policy, as seen in the Figure below:

Figure 3: EV growth in Rajasthan



Source *– Ministry of Road Transport &Highways and Rajasthan Parivahan website*

1.4 FOR Study on Impact of EV on Grid

The Forum of Regulators published a study report on 'Impact of Electric Vehicles on the Grid' in September 2017. The study highlighted international experiences of EV's, technical impact on grid through simulation techniques, legal aspects, business models, and possible tariff impact of investments. The study made the following recommendations:

1. Pass through of Investments for EV Charging Infrastructure in tariffs
2. Franchisee Agreements for setting up public charging infrastructure
3. Creation of new Tariff Category for EV's by allowing recovery of incremental cost of infrastructure through wheeling charges over and above the average cost of service

4. Special ToD tariff structure for EV charging
5. Open Access for EV Charging without Cross-Subsidy Surcharge
6. Banking of RE generation to promote reduced tariffs
7. Incentive mechanism for use of Renewable Energy to cater to demand of EV

1.5 Union Budget Highlights for EV

The Central Government introduced the Union Budget for FY 2019-20 on 5th July 2019, wherein some major announcements were made for promotion of EV's. The Indian Auto sector did not witness any dramatic changes in tax norms, however, the Government announced reduction in the GST rates for EVs from 12% to 5%. In addition, there will be an income tax deduction of Rs. 1.5 Lakh on the interest paid on the loan taken to purchase the EV.

The Union Budget for FY 2019-20 had also included the proposal for exemption of customs duty on import of spare parts of EVs. The new proposal will be in addition to Rs. 10,000 Crore allocated for EV's under FAME II Scheme.

1.6 Inter-State Comparison of EV Charging Station Tariff

The following table shows the inter-State comparison of EV Charging station tariff

Table 2: State-wise Comparison of Tariff for EV Charging Stations

State	Category of consumers	Tariff			Comments
		Fixed/Demand Charge/Customer Charge (Rs/kVA/ month)	Energy Charge/ Total Variable charge (Rs/kWh/ kVAh)	Time of Day/ Surcharge/ Rebate	
Rajasthan (*Tariff Order dated 06.02.2020*)	LT – 8 Public Charging Stations	40/HP/Month of sanctioned connected load	6.00	11 pm to 6 am **–Rebate 15%**	Separate category created for Public Charging with concessional tariff. Other consumers can charge EV at the respective premises with applicable tariff
	HT – 6 Public Charging Stations	Rs. 135 / kVA/ month	6.00	11 pm to 6 am **–Rebate 15%**	

State	Category of consumers	Tariff			Comments
		Fixed/Demand Charge/Customer Charge (Rs/kVA/ month)	Energy Charge/ Total Variable charge (Rs/kWh/ kVAh)	Time of Day/ Surcharge/ Rebate	
Andhra Pradesh (*Tariff Order dated 10.02.2020*)	LT II Commercial and Others (Electric Vehicle/ Charging Station)	NIL	6.70	NA	No demand charge proposed to Electric Vehicle /Charging Station with a view to promote Electric Vehicles
	HT II Commercial and Others (Electric Vehicle/ Charging Station)	NIL	6.70	NA	
Delhi (*Tariff Order dated 31.07.2019*)	LT Charging Station	NIL	4.50	**May-September Peak Hours**: 1400 Hrs – 1700 Hrs & 2200 Hrs – 0100 Hrs **Surcharge-20% Off Peak Hours:** 0400 Hrs – 1000 Hrs **Rebate-20%**	Tariff for Charging Station reduced from previous Tariff Order. Other category consumers can charge EV from their metered connections with prevailing tariff of that category
	HT Charging Station	NIL	4.00		
Gujarat (*Tariff Order dated 31.03.2020*)	LT Electric Vehicle Charging Station	Rs. 25 per installation	4.10		Other consumers - RGP, RGP (Rural), GLP, LTMD, Non-RGP Night, LTMD Night can use regular supply

State	Category of consumers	Tariff			Comments
		Fixed/Demand Charge/Customer Charge (Rs/kVA/ month)	Energy Charge/ Total Variable charge (Rs/kWh/ kVAh)	Time of Day/ Surcharge/ Rebate	
					under their regular category
	HT Electric Vehicle Charging Station	Rs. 25 per kVA per month up to contract demand Rs. 50 per kVA per month in excess of contract demand	4.00		Other consumers like HTP-I, II, III, IV, V, Railway Traction can use regular supply under same regular category
Karnataka (*Tariff Order dated 30.05.2019)*	LT Electric Vehicle Charging Station	Rs. 60/ kW/month	5.00	NA	
	HT Electric Vehicle Charging Station	Rs. 190 /kVA/ month			
Maharashtra (*Tariff Order dated 30.03.2020)*	LT Electric Vehicle Charging Station	Rs. 70/kVA/ month	5.50	NA	Consumers are allowed to charge their own EV at their premises with the Tariff applicable to such premises falling under the respective consumer category.
	HT Electric Vehicle Charging Station				
Uttar Pradesh (Suo moto *Case no. 18SM of 2019 dated 03.09.2019)*	Multi-storey Buildings	NIL	LT-6.20		Consumers of other categories will be charged as per tariff applicable for their respective category
		NIL	HT-5.90		
	Public charging stations	NIL	LT-7.70	**April-Sep** 05:00 to 11:00 Hrs- **(-) 15%** 17:00 to 23:00 Hrs**-(+)15%** **Oct to March** 17:00 to 23:00 Hrs**-(+) 15%**	
		NIL	HT-7.30		

State	Category of consumers	Tariff			Comments
		Fixed/Demand Charge/Customer Charge (Rs/kVA/ month)	Energy Charge/ Total Variable charge (Rs/kWh/ kVAh)	Time of Day/ Surcharge/ Rebate	
				23:00 to 05:00 Hrs-**(-) 15%**	
Chhattisgarh ***(Tariff Order dated 02.03.2019)***	LT-Non-Domestic HT-Other Industrial and General-Purpose Load	NIL	5.00	6:00 PM to 11:00 PM – 120% of normal tariff 11:00 PM to 5:AM – 75% of normal tariff	
Punjab (*Tariff Order dated 27.05.2019)*	Non-Residential Supply	NIL	6.00	April to May 10:00 PM to 06:00 AM – Normal Tariff – Rs. 1.25/kVAh June to Sept 06:00 PM to 10:00 PM- Rs. Normal Tariff +Rs. 2.00/kVAh Oct to Mar 10:00 PM to 06:00 AM – Normal Tariff – Rs. 1.25/kVAh	

State	Category of consumers	Tariff			Comments
		Fixed/Demand Charge/Customer Charge (Rs/kVA/ month)	Energy Charge/ Total Variable charge (Rs/kWh/ kVAh)	Time of Day/ Surcharge/ Rebate	
Assam (*Tariff Order dated 07.03.2020*)	LT-X Electric Vehicle Charging Station	Rs. 130 per kW/month	5.25	N/A	Consumers can charge their own Electric Vehicles at their respective premises, paying the charge applicable to the consumer category.
	HT-XII Electric Vehicle Charging Station	Rs. 160 per kW/month	6.75		

1.7 Purpose of the Concept Paper

EVs are likely to impact the distribution grid, as it is not a stationary load for which the grid up-gradation can be made at any location. Investments may be required to setup charging stations city-wide as well as to upgrade the capacity of transformers and cables to accommodate the new loads from EVs. The Commission through this Concept Paper intends to provide an overview of Regulatory Framework including Connectivity, Grid Impact, and Business Models for Charging Infrastructure in order to invite the comments of various stakeholders on Regulatory Framework to be adopted for Charging Stations for EVs in the State of Rajasthan. The Commission along with this Concept Paper is issuing Suo Moto Draft Order on *"Charging Infrastructure, Tariff and other regulatory issues for Electric Vehicles"* for inviting comments from the stakeholders on Draft Order. Based on the comments received on Draft order, the Commission will issue the final Order to facilitate the promotion of Electric Vehicles in the State of Rajasthan.

2 International Experiences & EV Policies

2.1 Detailed framework of EV initiatives taken in different Countries

2.1.1 Introduction

The global electric car fleet exceeded 5.1 million in 2018, up by 2 million since 2017 as per Global EV Outlook 2019. As India is poised for adapting EVs in the mainstream of the transportation system, regulatory support and guidelines will create a smoother transition. The comparison of Policy Initiatives in countries is given below:

Table 3: Policy Initiatives of Different Countries

		Canada	China	European Union	India	Japan	United States
Regulations (vehicles)	ZEV mandate	✓*	✓				✓*
	Fuel economy standards	✓	✓	✓	✓	✓	✓
Incentives (vehicles)	Fiscal incentives	✓	✓	✓	✓		✓
Targets (vehicles)		✓	✓	✓	✓	✓	✓*
Industrial policies	Subsidy	✓	✓			✓	
Regulations (chargers)	Hardware standards**	✓	✓	✓	✓	✓	✓
	Building regulations	✓*	✓*	✓	✓		✓*
Incentives (chargers)	Fiscal incentives	✓	✓	✓		✓	✓*

		Canada	China	European Union	India	Japan	United States
Targets (chargers)		✓	✓	✓	✓	✓	✓*

Source: Global EV Outlook 2019

Notes:

** Indicates that the policy is only implemented at a state/province/local level.*

*** Standards for chargers are a fundamental prerequisite for the development of EV supply equipment. All regions listed here have developed standards for chargers. Some (China, European Union, India) are mandating specific standards as a minimum requirement; others (Canada, Japan, United States) are not.*

ZEV = zero-emissions vehicle.

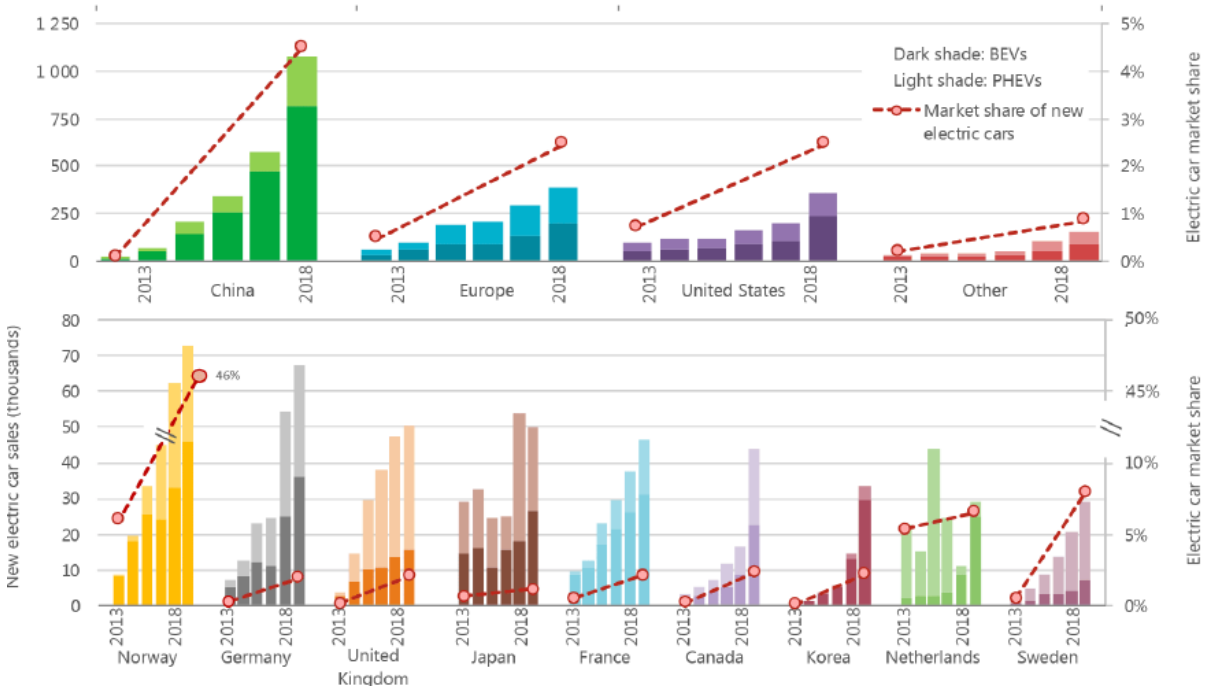
Check mark indicates that the policy is set at national level.

Building regulations refer to an obligation to install chargers (or conduits to facilitate their future installation) in new and renovated buildings.

Incentives for chargers include direct investment and purchase incentives for both public and private charging

The corresponding growth in EV's in these countries after initiation of Policies is shown in the following figure:

Figure 4: Growth in EV in various Countries



Source: Global EV Outlook 2019

2.1.2 Key Policy Developments in 2018/19

- In the European Union, several significant policy instruments were approved. They include fuel economy standards for cars and trucks and the Clean Vehicles Directive, which provides for public procurement of electric buses. The Energy Performance Buildings Directive sets minimum requirements for charging infrastructure in new and renovated buildings. Incentives supporting the roll-out of EVs and chargers are common in many European countries.
- In China, policy developments include the restriction of investment in new ICE vehicle manufacturing plants and a proposal to tighten average fuel economy for the passenger light-duty vehicle (PLDV) fleet in 2025 (updating the 2015 limits), the use of differentiated incentives for vehicles based on their battery characteristics (e.g. zero-emissions vehicle credits and subsidies under the New Energy Vehicle mandate).
- Japan's automotive strategy through a co-operative approach across industrial stakeholders, aims to reduce 80% of greenhouse gas (GHG) emissions from vehicles produced by domestic automakers (90% for passenger vehicles) – including exported vehicles – to be achieved by 2050 with a combination of hybrid electric vehicles (HEVs), BEVs, PHEVs and fuel cell electric vehicles (FCEVs). Fuel economy standards for trucks were revised and an update of fuel economy standards for cars was announced.
- Canada outlined a vision for future EV uptake accompanied by very ambitious Policies in some provinces, such as the zero-emissions vehicles (ZEVs) mandate in Quebec (similar to the one in California). British Columbia announced legislation for the most stringent ZEV mandate worldwide: 30% ZEV sales by 2030 and 100% by 2040. This places Canada in a similar framework as the ten States in the United States that have implemented a ZEV mandate.
- India's announced the second phase of the FAME Scheme. It reduces the purchase price of hybrid and electric vehicles, with a focus on vehicles used for public or shared transportation (buses, rickshaws and taxis) and private two-wheelers.

- In Korea, the scope of national subsidies for all low-carbon vehicle purchases increased from 32,000 vehicles in 2018 to 57,000 in 2019, adding to other policy instruments including public procurement, subsidies and rebates on vehicle acquisition taxes, reduced highway tolls and public parking fees. An ambition to scale up overseas sales of low-emission vehicles produced in Korea was also announced in 2018. It is accompanied by a goal to boost production capacity to more than 10% of all vehicles by 2022, and the use of financial support and loan guarantees to major industrial players.
- In the European Union, the Strategic Action Plan for Batteries in Europe was adopted in May 2018. It brings together a set of measures to support national, regional and industrial efforts to build a battery value chain in Europe, embracing raw material extraction, sourcing and processing, battery materials, cell production, battery systems, as well as reuse and recycling. In combination with the leverage offered by its market size, it seeks to attract investment and establish Europe as a player in the battery industry.

Source: Global EV Outlook 2019

2.1.3 Government Initiatives across the Globe

Country	Timeline	Policy Details
Norway	1990 onwards	No purchase/import taxes on vehicles
	1996 onwards	No annual road tax
	1997-2017	No charges on toll roads or ferries
	1997-2017	Free municipal parking
	2000-2018	50 % reduced company car tax
	2001 onwards	Exemption from 25% VAT on purchase
	2005 onwards	Access to bus lanes
	2015	Exemption from 25% VAT on leasing
	2016	New rules allow local authorities to limit the access to only include EVs that carry one or more passengers
	2018	Fiscal compensation for the scrapping of fossil vans when converting to a zero-emission van
	2018 onwards	Company car tax reduction reduced to 40%
	2018 onwards	Parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full
	2018 onwards	Maximum 50% of the total amount on ferry fares for electric vehicles
	2019	Maximum 50% of the total amount on toll roads
	2019	Allowing holders of driver licence class B to drive electric vans class C1 (light lorries) up to 2450 kg
Iceland	2007 onwards	Free parking for limited period of time
	2011 onwards	Different tax slabs for different emission levels of vehicles

Country	Timeline	Policy Details
	2011 onwards	Different vehicle excise duty for different emission levels
	2012 onwards	Tariff similar to domestic tariff for charging of electric vehicles at home
	Up to 2013	Zero VAT for electric vehicles
	2015 onwards	Free charging
	2016-18	EVSE infrastructure funding for publicly accessible charging stations
China	2014 to 2020	No purchase tax
	2010 onward	Extra subsidy on purchase cost upto 60%, to be decreased by 20% in 2017-18 and 40% in 2019-20.
	2020	Phase out subsidy
	2014 onwards	Waiver of license plate fee in Shanghai
	By 2020	Incentives to local government (Upto $14 million) for building charging stations.
	By 2016	30% Electric vehicle fleet for government bodies
	2016	50% Electric vehicle fleet for government bodies
USA	2003 to 2005	USD $2000 tax deduction on buying EVs
	2006	Local manufacturers promoted through "phasing out" period of incentives
	2010	Tax credit for shifting to electric vehicles
	2010	Parking privilege

Source: *https://elbil.no/english/norwegian-ev-policy/*, *https://theicct.org/blog/staff/iceland-ev-market-201807* *https://www.bloomberg.com/opinion/articles/2019-03-27/china-s-closing-the-6-trillion-electric-car-gap* *https://www.eesi.org/articles/view/comparing-u.s.-and-chinese-electric-vehicle-policies*

2.2 State EV Policies

Eight Indian States have framed Policies for accelerating adoption of EVs, as detailed below:

- **Karnataka:** Karnataka was the first State in the country to introduce a policy dedicated to electric vehicles. The Karnataka Electric & Energy Storage Policy, 2017, operational for five years, is expected to give the necessary impetus to the electric mobility sector in the State and attract investments. The Government of Karnataka intends to make Bengaluru the Electrical Vehicle Capital of India.

Key Highlights:

  - Attract investments of Rs. 31,000 crore and create 55,000 jobs - both from supply and demand side.

- Create a conducive environment for transition to EVs from the Internal Combustion (IC) engines.
- Focus on developing R&D, and special initiatives for EV manufacturing such as making industrial land available to create EV manufacturing zones.
- Support for charging infrastructure, and research development and skill development incentives and concessions.
- A start up incubation centre for EVs, and start-ups will be encouraged to develop business models focused on EVs.
- A venture capital fund for research in EV mobility.
- All EVs, including e-rickshaws and e-carts, are already exempted from GoK taxes.
- Policy to provide incentive to shift auto rickshaws, cab aggregators, corporate fleets and public transport systems to EVs.

In the budget announcement for FY 2020-21 made in March 2020, the Hon'ble Chief Minister allocated Rs. 100 Million for establishment of electric vehicle and energy storage manufacturing cluster in the State. Also, a grant of Rs. 1 billion was announced for adding 500 ordinary electric busses to the fleet of Bengaluru Metropolitan Transport Corporation.

- **Delhi:** The city, which has the unwanted reputation of being one of the most-polluted cities in the world, is striving hard towards a cleaner environment. The EV Policy was introduced by the Delhi Government in 2019, and it seeks to drive rapid adoption of Battery Electric Vehicles (BEVs) so that they contribute to 25 percent of all new vehicle registrations by 2024.

Key Highlights:

- Policy aims to register at least 5 Lakh electric vehicles by 2024
- Focus is more on two-wheelers and commercial vehicles
- Target of 35,000 electric two, three and four wheelers and busses along with 1,000 electric vehicles for last mile deliveries
- Target of 250 public charging and battery swapping stations

- Waiver of road tax and registration fees for all battery electric vehicles for the next three years
- Purchase incentive of Rs. 5000/kWh of battery capacity
- Scrapping incentive of up to Rs. 5,000, subject to evidence of matching contribution from the manufacturer or dealer
- Service providers of last mile delivery companies like food delivery and e-commerce are expected to shift to 50 per cent of their fleet to electric by March 2023 and 100 per cent by March 2025
- E-rickshaws and carriers will get an incentive of Rs 30,000 per vehicle and interest subvention of 5 per cent on loans
- Electric four wheelers will get a purchase incentive of Rs 10,000 per kWh of battery capacity for first 1,000 cars subject to a cap of Rs 1,50,000 per vehicle
- New home and workplace parking should reserve 20 per cent parking to EVs
- 100 per cent subsidy for the purchase of charging equipment costing up to Rs 6,000 per unit for the first 30,000 charging points at homes and workplaces
- Formation of Electric vehicle board and an EV cell within transport department that will be responsible for implementing the policy

- **Maharashtra:** The State introduced its EV Policy in 2018 with the aim to make Maharashtra among the most-preferred EV investment destinations for global investors through promotional strategies, combined with developing a competitive and sustainable investment environment.

Key Highlights:

- Increase the number of registered EVs to five lakh.
- To generate investment of Rs 25,000 crore for EVs and EV infrastructure and create jobs for 1,00,000 people.

- Provide fiscal and non-fiscal incentives to increase viability of EVs.
- Promote creation of dedicated EV charging infrastructure through subsidised investment.
- Promotion of R&D and innovation.
- Petrol pumps will be allowed to set up charging stations freely, subject to Regulations.
- To promote EVs in public transport in six cities, i.e., Mumbai, Pune, Aurangabad, Thane, Nagpur, and Nashik.
- The first 1,000 private/public passenger electric bus buyers will be eligible for user subsidy for five years, and the first 100,000 EVs across categories will get end-user subsidy for five years.
- Exemption from road tax and registration fees.

- **Uttar Pradesh**: Lucknow, the capital of Uttar Pradesh, is one among the 10 cities identified for pilot project of Multi-Modal Electric Public Transport, under the FAME scheme. Keeping this in mind, the State Government came out with the Uttar Pradesh Electric Vehicles Manufacturing and Mobility Policy, 2019.

Key Highlights:

- To attract investment of over Rs. 40,000 crore in the next 5 years across electric mobility ecosystem with an employment potential of 50,000 people
- To launch 1000 electric buses and achieve 70 percent EV public transportation on identified green routes in identified 10 EV cities by 2030
- To phase out all conventional commercial fleets and logistics vehicles and achieve 50% EV mobility in goods transportation in identified 10 EV cities by 2024 and all cities by 2030
- To roll out nearly 10 lakh EVs combined across all segment of vehicles, by 2024
- To bring in manufacturing units of high-density power storage of at least 5 GWh capacity in the next 5 years for smooth electric mobility

- To set up nearly 2 lakh slow and fast charging, swapping stations by 2024
- 100 percent road tax exemption on two wheelers EVs and 75% exemption for other EVs.

- **Telangana**: The State of Telangana introduced its draft EV Policy in 2018 to showcase a model of international standards for EV adoption across segments, supported by world-class infrastructure and ecosystem.

Key Highlights:

- To attract investments worth $3 billion and create employment for 50,000 people by 2022.
- Provide ecosystem and infrastructure to make Telangana the EV hub of India.
- Develop a proving ground for viable business models through accelerated demand for EVs.
- Promote innovation in EVs and other trends such as autonomous/connected mobility.
- Mandating use of EVs at an institutional level.
- Establishing a start-up ecosystem to nurture innovation in EV technology space.
- Road tax exemption for all electric vehicles till 2025.
- 100 percent electric buses by 2030 for intra-city, intercity, and interstate transport.
- A separate power tariff will be created for EV Charging, both public and private.
- An innovation fund will be created to offer financial support to EV OEMS, ancillaries, and start-ups for research and innovation in battery technologies.

- **Andhra Pradesh**: The Government of Andhra Pradesh has the ambitious plan of putting 10 lakh EVs on the road in the next five years, which will be aided by fiscal incentives to become one of the important hubs for this segment in the country. The state launched its Electric Mobility Policy in 2018.

Key Highlights:

  - To attract investments of Rs 30,000 crore by 2030.
  - Create employment for 60,000 people.
  - Battery manufacturing units in Amaravati.
  - Advanced battery manufacturing units of 10 GWh.
  - One lakh EV charging stations will be built by 2024.
  - All government buses and commercial vehicles will be made electric by 2024.
  - Stamp duty and GST reimbursements on purchase or lease of land for EV manufacturing in Amaravati, and no registration fee on electric vehicles.
  - Development of EV manufacturing hubs.

- **Kerala**: Kerala also came out with an EV Policy in 2018, which seeks to reduce the number of vehicles running on fossil fuels with the introduction of electric buses in public transport and e-autorickshaws. It is aiming for full electrification of all types of motor vehicles by 2030.

Key Highlights:

  - To have one million EVs in the State by 2022.
  - Pilot EV fleet of 200,000 two-wheelers, 50,000 three-wheelers, 1,000 goods carriers, 3,000 buses, and 100 ferry boats.
  - To attract investments in power electronics and battery pack assembly, which will also provide employment opportunities.
  - Targeting over 6,000 electric buses in public transport by 2025.
  - Creating common charging infrastructure that will be inter-operable with several models of EVs.

- Create awareness and promotion of shared mobility.
- Building human resources in the area of EV, which would also mean reskilling.

- **Uttarakhand**: The hilly State of Uttarakhand came out with its EV Policy in 2018. The State wants to create a conducive atmosphere to support manufacturers and reduce vehicular pollution. It is also looking to create jobs in the State.

Key Highlights:

- To waive off motor vehicle tax for the first 100,000 customers purchasing EVs for a period of five years.
- The first 100,000 customers purchasing commercial EVs or electric stage carriages will also be able to avail exemption from tax.
- Investors in the EV segment will be entitled to have 100 percent electricity duty exemption.

Source: https://yourstory.com/2019/03/india-government-electric-vehicles-policies-mvqiyx

3 Roadblocks in EV Implementation

3.1 Identification of issues in EV

3.1.1 Establishment of EV Charging Station

Charging Infrastructure connects EVs at different charging points to the Distribution Grid. Currently, there is no specific framework for installation of EV Charging Infrastructure, which leads to uncertainty among stakeholders/investors.

The major roadblock for successful implementation of EV in the State is the lack of Charging Infrastructure. It is observed that EV charging stations are limited to only a few numbers, which discourages the consumer to shift from conventional ICE to EV.

To boost the demand for installation of Charging Infrastructure, the FAME II Policy recently introduced fund allocations worth Rs. 1,000 Crore in a phased manner from FY 2019-20 to FY 2021-22.

MOP has also issued guidelines and standards for setting up Charging Infrastructure for EVs. MOP has also made setting up of Charging Infrastructure for EV as a delicensed activity so that private investors can also install Charging stations and may not require special permission from the Regulator/Licensee.

Owing to these initiatives, it is expected that the demand for setting up EV Charging Infrastructure may rise in the near future, giving a boost to the demand for EVs.

However, it is also the role of the Regulator to intervene in the matters related to setting up Charging Infrastructure and facilitate such initiatives so that it can be achieved at the ground level. The detailed role of the Regulator with respect to Charging Infrastructure is discussed in Chapter 5.

3.1.2 Impact of EV on the Grid

Currently, the penetration levels of EVs is very low in the State and most of the vehicles are privately owned. There are **total 17,405 vehicles** in the State, out of which around 76% are two wheelers and the rest are three and four wheelers. Considering a

load of 3 kW per vehicle for two wheelers and 15 kW for four wheelers, the total load of EVs can be assumed to be around ~101 MW currently sanctioned in the State. The demand of the State is around 11,000 MW. Therefore, the sanctioned load of EVs currently is hardly around 0.9% of the total demand in the State.

It can therefore, be concluded that presently the grid would hardly be affected by the demand of EV load in the State, considering the stranded capacity available in the State. With the increase in penetration of EVs over the years, the situation would have to be assessed again, to check the impact of EVs on the grid.

RERC, in its latest Tariff Order, has allowed consumers to charge EV at the same rate that is applicable to the consumer as per the Tariff Order. For e.g. a residential consumer can charge EV at residential rates, while a commercial consumer can charge EV at commercial rates, and so on.

Considering the above structure where consumers can charge their EVs in their respective premises, residential consumers may shift to higher slabs from their respective traditional slabs while commercial consumers may exceed their sanctioned load/contract demand. Though these consumers will be charged for higher consumption/load as per prevailing tariff order and relevant Regulations .However, this would affect the load management of the Licensee.

Therefore, it is necessary to have a push towards Public Charging where people are encouraged to charge their vehicles in public places such as malls, commercial complexes, parking areas, etc. The Distribution Licensee may be able to manage the load more efficiently in such cases, considering a fixed load of EV charging stations at such places and accordingly tie up for additional power purchase if required.

3.1.3 Tariff for EV Charging Infrastructure

As discussed in previous Sections, it is necessary to have EV charging stations at various public places as a long-term solution for EVs. Charging at own premises may

work as a short-term solution but in the long run may create problems for load management and grid stability.

The recent MOP Guidelines also focusses on development of charging infrastructure at various public places. However, there are still concerns among investors on how charging infrastructure will pan out in the near future. The various business models for setting up charging infrastructure as discussed in subsequent sections of this Paper will provide some clarity to the investor on the economics of the business of charging infrastructure.

The Regulator can play an important role by giving a boost to development of charging stations for EV by deciding the tariff that is to be charged for electricity supply to the Charging Infrastructure. Tariff plays a very important factor, which will help the investor decide whether to enter into the market of charging infrastructure or not. Therefore, tariffs should be such that, more and more investors are encouraged to jump into the business of charging infrastructure, which should remain a lucrative business at least for the initial years or till the time EVs become the norm and do not require any such support.

Most of the States including Rajasthan have determined separate tariff for EV charging stations set up at public places, detailed in Chapter 1. In States such as Maharashtra, the tariffs for charging stations is significantly lower than Average Cost of Supply, while in Punjab and Chhattisgarh, Charging Stations are included in Commercial category and have a single-part tariff.

The EV growth needs to pick up exponentially considering the targets given by NITI Aayog. It is planned to phase out all conventional ICE by 2030. To achieve such a growth in the near future, the major driving factor will be the growth of charging infrastructure, which will enable the end consumer to shift from ICE to EV. Charging Infrastructure will be setup in large volumes only if there is a push from the policy makers/Regulators/Government through incentives.

FAME Policy advocates that the tariffs for Charging Infrastructure should at most be 15% higher than the ACOS. In the immediate future, the Commission may consider creating a separate category for Charging Infrastructure and determine the tariffs for

this category either at ACOS or slightly below ACOS, in order to boost the growth of Charging Infrastructure. The growth in the sales to this category can be tracked, and once the sales in Million Units reaches the desired levels, the tariffs can be revisited.

The Commission may also consider allowing ToD tariffs coupled with smart charging for charging Infrastructure which would help the Licensee to use its stranded capacity during off-peak hours and reduce the fixed cost per unit borne by the Licensee for power that is backed down. The Commission may address the issue of peak demand by introducing dynamic ToD tariffs since going forward the load of EV's may increase owing to the push given to the EV industry by the Government.

Battery Swapping being a new concept may initially be introduced to 2 and 3-wheelers. Depending upon the response and market potential, it can be introduced to 4-wheelers and other heavy vehicles.

4 Models for EV Charging Infrastructure

4.1 Models for EV Charging Infrastructure

4.1.1 Distribution Licensee Model

The Distribution Licensee may set up Charging Infrastructure at different locations in the State, for charging the batteries of EVs.

4.1.2 Private Charging Model

Any person can setup the infrastructure for charging stations or battery swapping stations. Such person can get electricity supply from the Distribution Licensee at the tariff approved by the SERC or procure power from any other source through Open Access if they qualify for open access in accordance with applicable Regulations. The FAME Policy provides that the State Nodal Agency shall determine the Service Charges to be charged by such Service Provider, which would have to be sufficient to recover its fixed and variable costs.

4.2 Distribution Licensee Model

4.2.1 Framework

In this Model, the Distribution Licensee shall be responsible for setting up of charging infrastructure as well as to operate and maintain the assets.

4.2.2 Merits and De-Merits of Model

Merits	De-Merits
• A simple model with least number of participants • The DISCOMs can socialise the cost of charging infrastructure in ARR and hence, there is no risk to be borne by Distribution Licensee • O&M work can be outsourced, if required, by DISCOMs • Seperate tariff for EV charging stations • No connectivity related issue to consumers as supply is directly from Discoms	• The cost of setting up charging infrastructure are to be borne by Discoms. • The number of Charging Points that can be set up by the DISCOM will be limited, and can work primarily as a demonstration project rather than full-scale roll out of Charging Points

4.3 Private Charging Model

4.3.1 Framework

As clarified by MoP vide notification dated April 13, 2018, battery swapping or charging of battery of an EV by a charging station will not amount to resale of electricity as the electricity is consumed within the premises. Therefore, charging of batteries of EV through charging station does not require any licence under the provisions of EA 2003. Hence, any person can charge the batteries of EV by setting up public charging infrastructure. The tariff applicable for the Charging Infrastructure shall be determined by the Commission. Also, the person can avail supply from either the Distribution Licensee or from Open Access as per prevailing Open Access Regulations.

4.3.2 Merits of Model

Merits

- Risk of capital investment borne by the Private party
    - O&M cost borne by Private party
    - Private party has to comply with the standards
    - Lower administration cost to be borne by DISCOMs
    - Private party person can avail open access facilities as per prevailing Regulations
    - Easy accessability to charging points at Malls, parking spaces, office complex, etc.
    - The number of Charging Stations that may be set up would be much higher

Though, the Private charging model is favourable, the Service charges to be taken for charging the EVs shall not be regulated by the SERC. The FAME Policy provides that the State Nodal Agency shall determine the Service Charges to be charged by such Service Provider, which would have to be sufficient to recover its fixed and variable costs. There could be concerns regarding whether the Private agencies are charging within the limits or over-charging. At present, the Charging Stations in India are at very nascent stage in terms of technology as well as number of Charging Stations are very few. Once there is ample availability of Charging Stations, the consumers can choose the Charging Station which provides cheaper service. Thus, in the long-term, the rate of service for PCS will be determined by market forces.

A combination of all Models discussed above would have to be encouraged and adopted, as no single Model will help achieve the desired objective of deeper penetration of EVs in the State.

4.4 Solar Power for EV Charging

As usage of EV's grow, it is expected that charging infrastructure would come up at various public places in the Country and State. If EV's are charged through the grid of the Distribution Licensee, which is powered primarily by fossil fuel-based generation, then the use of EV's would not prove to be environmentally friendly. As

solar has a great potential to generate electricity from PV panel, charging of EV's from PV panel would be the right solution for sustainable environment.

Rajasthan is one of the States in the country having the highest solar irradiation of 6-7 kW/km2 and the State witnesses a maximum number of more than 325 sunny days in a year. MNRE has estimated the feasible potential of solar power in the State as 1,42,310 MW. At present, the State is harnessing merely 2.50 % of the potential with an installed capacity of solar generators in Rajasthan of around 3,551 MW as per MNRE.

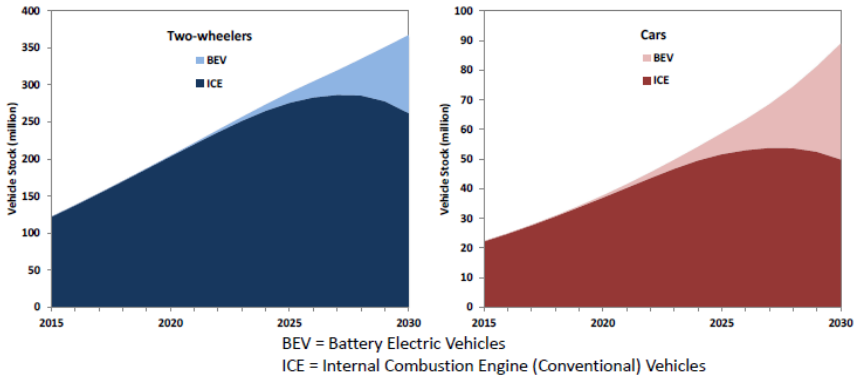
EV charging stations can therefore be designed with rooftop solar generation to minimize dependence on fossil fuels in entire supply chain hence shifting towards clean energy in accordance with relevant Regulations. The charging station can directly supply power during the day from the rooftop solar generation and use grid power during the night.

4.5 Growth in Demand for EVs in India

The number of EVs sold all over India as on May 2020 is 2,80,988 as per FAME India website. The total number of 19,355 vehicles were sold till date, after notification of FAME-2 policy in March 2019.

As per **'Techno-Economic Assessment of Deep Electrification of Passenger Vehicles in India'** by Berkeley Labs, if all vehicles sold in India are EVs by 2030, which is in line with the vision of Government of India, the sale of EVs would reach ~30 million 2 wheelers per year and ~10 million 4 wheelers per year by 2030.

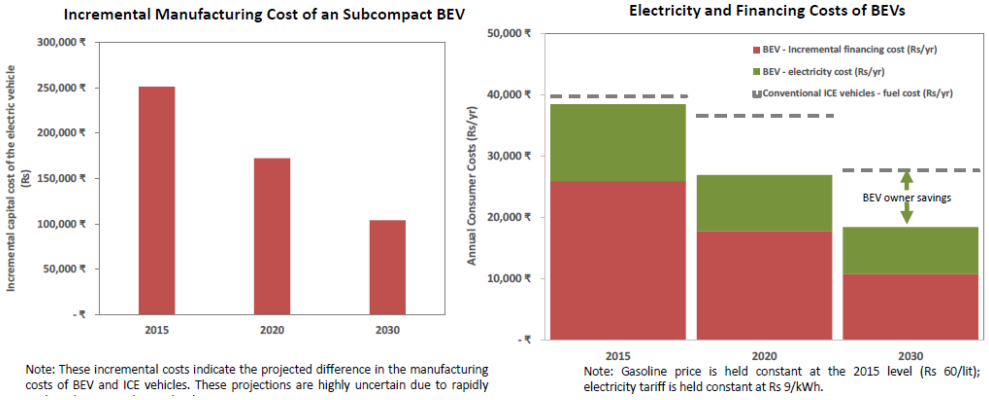
Figure 5: Growth of BEV and ICE by 2030 (in million)



Source *– 'Techno Economic Assessment of Deep Electrification of Passenger Vehicles in India' by Berkeley Labs*

It is expected that the cost difference between a BEV and an equivalent conventional sub-compact car is expected to drop by 65% between 2015 and 2030.

Figure 6: Incremental manufacturing cost, electricity and financing cost of BEVs



Source *– 'Techno Economic Assessment of Deep Electrification of Passenger Vehicles in India' by Berkeley Labs*

The incremental manufacturing cost of BEV will come down significantly. Considering the petrol price and electricity tariff to be constant at 2015 level, annual cost in terms of capital cost + running cost of EVs would be significantly lower than that of ICEs.

It is estimated that the annual energy demand by 2030 in the country shall be ~2,522 TWh with 402 GW peak load under Business as Usual scenario (by extrapolating National Electricity Plan (NEP) up to 2027). The impact of additional energy

requirement due to BEVs is estimated at 82 TWh/year, which is ~3.25% of the total electricity demand. The demand growth of other loads will also be higher at the same time and the additional peak demand due to EV charging is ~23 GW or 5.6% of the projected peak demand.

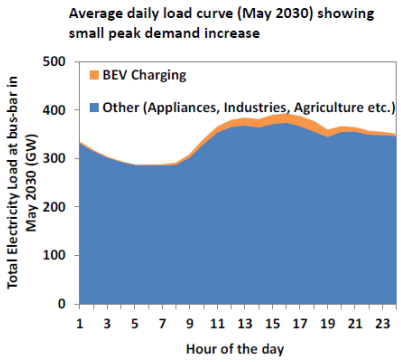
Figure 7: Additional energy demand due to BEVs

Additional energy demand from BEVs will be small

	Energy reqd per BEV in 2030 (kWh/yr)	Total BEVs in 2030 (millions)	Total Energy Reqd (bus-bar) TWh/yr*
Two-wheelers	291	105	36
Subcompact Hatchbacks	852	21	22
Compact Sedans	1030	9	11
Vans/MUVs	1381	8	14
Total		144	82

* Assuming T&D loss of 15%

Non-BEV electricity load in 2030 (bus-bar):
Energy = ~ 2522TWh/yr
Peak = ~ 402 GW



Source *– 'Techno Economic Assessment of Deep Electrification of Passenger Vehicles in India' by Berkeley Labs*

4.6 Growth in Demand for EVs in Rajasthan

As discussed above, significant growth of EVs is expected in the Country with increase in Renewable capacity and push from Central and State Government. The increase in demand will also be seen in the State of Rajasthan.

As discussed in the above section, the growth in EVs in the country is likely to reach 144 million by 2030 as per the report of Berkeley Labs. If the same demand growth is likely to be witnessed in Rajasthan, the total number of EVs in Rajasthan is expected to reach around 88.84 Lakh by 2030. Considering the same ratio of two wheelers and four wheelers that currently exist in the State, Rajasthan may have around 67.30 Lakh electric two wheelers and around 21.07 lakh electric four wheelers by 2030. This will increase the demand of Distribution Licensees with increased number of charging stations and it is expected that in a short term the surplus capacity available in the State of Rajasthan will be able to meet the increased load on account of EV charging.

4.7 Charging stations as separate business for Distribution Licensee

Distribution Licensees have a good opportunity to tap the potential of growth in EV's by having a separate business stream for setting up Charging Stations.

The Utilities may have to make smart investments to enhance the grid to support the growth of charging Infrastructure. Presently the impact on the grid is negligible but such provision may be made when the demand surges. Utilities may also look at opportunities and enter new EV related markets like providing services for installations, operating and maintaining of EV charging stations to private players.

Licensees such as Tata Power have signed an MoU up with Oil marketing Company, Hindustan Petroleum Corporation Limited (HPCL), for setting up commercial-scale EV charging stations at HPCL's retail outlets and other locations in the country. Through this MoU, both Parties have agreed to collaborate in planning, development and operation of charging infrastructure for EVs (e-cars, e-rickshaws, e-bikes, e-buses, etc).

As per guidelines of MoP, EV charging station is a de-licensed activity and it can be taken by any investor/private player. However, it is also necessary that the functioning/operations/safety standards etc. adopted by charging station operator needs to be monitored in order to avoid disturbances to the grid. The nodal agency may also indulge in such activities and set up a separate cell for monitoring of Charging stations installed by individuals/private players. The Licensee may charge a nominal fee as decided by the Commission for purpose of monitoring the functioning of entire network of EV charging station. Licensee may also consider such revenues on account of monitoring charges/fees in their business model.

5 Connectivity and Technical Issues

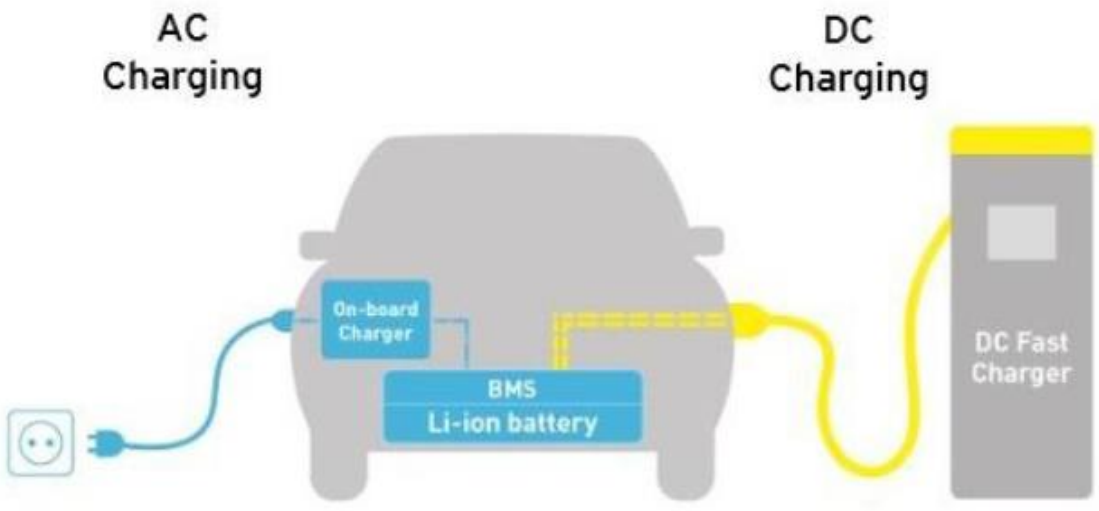
5.1 Chargers

Electric Vehicle Supply Equipment (EVSE) is an equipment or a combination of equipment providing dedicated functions to supply electric energy from a fixed electrical installation or supply network to EVs. There are different ways to classify an Electric Vehicle Supply Equipment (EVSE) depending upon power supply (Alternating Current or Direct Current), power rating levels, speed of charging and communication and connector type. An EV charging station, electric recharging point, charging point, ECS (electronic charging station), and EVSE (electric vehicle supply equipment), form the infrastructure that supplies electricity for the recharging of plug-in EVs—including electric cars and plug-in hybrids.

For charging at home or work, some EVs have on-board converters that can plug into a standard electrical outlet or a high-capacity appliance outlet. Others either require or can use a charging station that provides electrical conversion, monitoring, or safety functionality. These stations are also needed when traveling, and many support faster charging at higher voltages and currents than that possible from residential EVSEs. Public charging stations are typically on-street facilities provided by DISCOMs or located at Shopping Malls, restaurants and parking places, operated by Private players.

Charging stations provide a range of heavy duty or special connectors that conform to a variety of standards. For common rapid charging and DC, the Combined Charging System (CCS) is becoming the universal standard. Others are CHAdeMO, and the Type 2 connector.

The Commission shall promote charging station operators to install all types of connectors which are internationally accepted, depending on the demand of the market.



5.2 Type of Charging

5.2.1 Detailing

Charging can be classified into various types:

- By output: In case of AC EVSE, the vehicle has an on-board charger that converts AC into DC first. AC EVSE comes in different power ratings, ranging from 3.3 kW to 43 kW. DC EVSE can supply higher power rating ranging from 10 kW to 240+ kW.
- By power rating:

Level	AC Chargers	DC Chargers
Level 1	120V single phase AC up to 1.9 kW (up to 16A)	200-450V DC up to 36 kW (upto 80A)
Level 2	240V single phase AC up to 19.2 kW (up to 80A)	200-450V DC up to 90 kW (upto 200A)
Level 3	Greater than 20 kW	200-600 V DC up to 240 kW (upto 400A)

Source: Technical Study of Electric Vehicles and Charging Infrastructure, March 2019-EY and BEE report

- Charging speed: Different type of chargers takes different times to charge a vehicle's battery fully. If the charging time for a charger is four to eight hours, it is usually referred to as a slow charger. If the charging time is one hour, the

charger is usually referred to as a fast charger, and if charging time is less than 30 minutes, the charger is usually referred to as an ultra-fast/super-fast/rapid charger. The use of slow/fast/ultra-fast charger depends not only upon the availability of these chargers (along with power), but also on the size, thermal management of battery and type of battery used. For instance, a 10-kW charging for a vehicle with 100 kWh battery would be considered as slow charging, whereas for a vehicle with 12-kWh battery, the same charger would be considered fast.

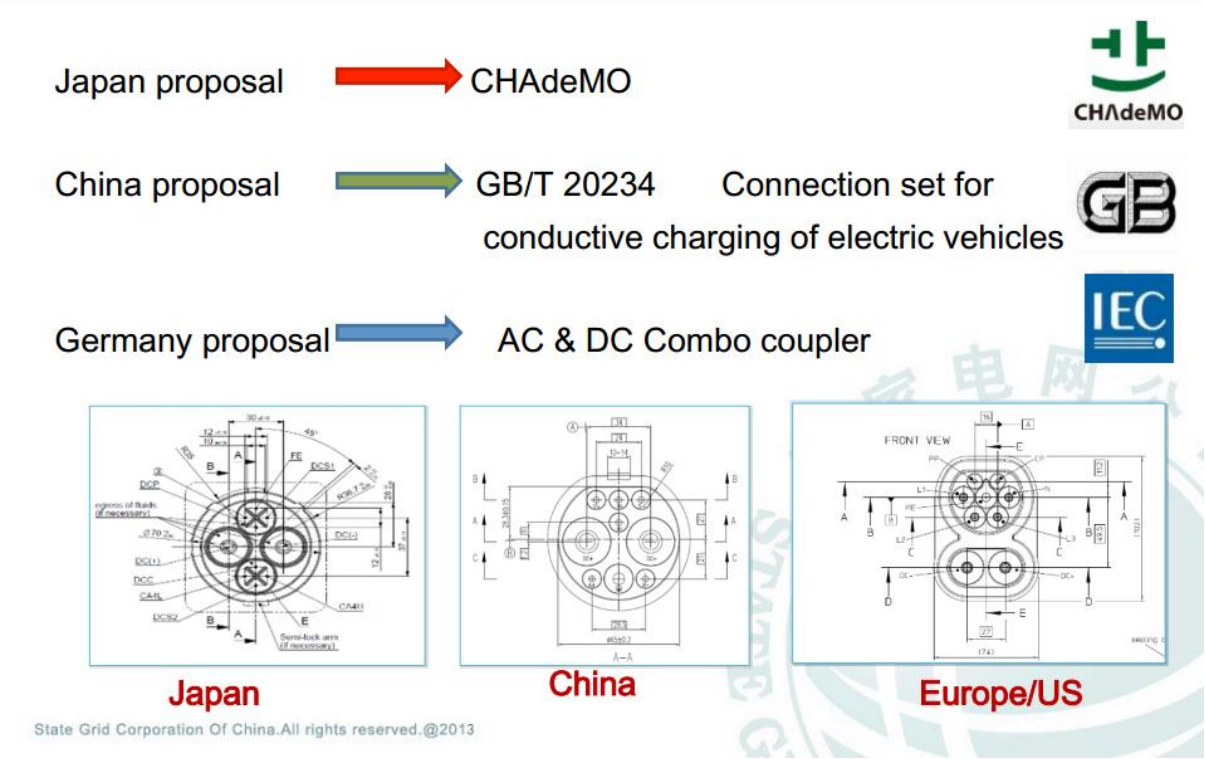
- By connector type: To charge lithium-ion batteries, constant current/constant voltage (CC/CV) is often adopted for high efficiency charging and sufficient protection. The battery (or the vehicle having the battery) and the charger need to communicate with each other continuously during charging. When the charger (EVSE) is external to the EV, a communication protocol is needed for the battery and the charger to communicate; this is referred to as EV-EVSE communication protocol. There are three standard EV-EVSE communication protocols, which are associated with three charging standards from three different countries/continents. The interoperability between the vehicles and the chargers made by multiple vendors is crucial for the success of the technology. At present, the EV and EVSE market is dominated by three technologies with different connectors and communication protocols, which raises concerns of interoperability. CHAdeMO, GB/T and CCS standards define both the connector type as well as the operation/communication system between charge point(s) and vehicle. The components and systems contained within the charge point are designed specifically for each system. This means that to change from one system to the other involves significant engineering work and hardware, well beyond swapping the plugs. However, producing multi-standard charge points resolves the issue and it is relatively cost effective to include both systems at the time of construction. Each of these protocols define the kind of connector to be used, maximum power and voltage for the

connection, the communication link to be used, and communication protocols. The Table below briefly discussed the various charging protocols:

Table 4: Charging Protocols

Particulars	CCS		GB/T	CHAdeMO
Country following the standards	Adopted worldwide		China	Adopted worldwide
Charging standard	SAE J1722		GB/T-20234	IEC 62196-4
Physical layer for EVSE-EV communication	PLCC		CAN	CAN
Type of charging	AC and DC		AC and DC	DC
Charging limits	1000 V, 350 A, 350 kW		750 V, 200 A, 150 kW	500 V, 125 A, 400 kW
AC Connector	Type 1 5 Pin Mechanical Lock 	Type 2 7 Pin Electronic Lock 	7 Pin Mechanical + optional electrical lock 	5 Pin Mechanical + electrical lock 
DC Connector	5 Pin Mechanical Lock 	7 Pin Electronic Lock 	9 Pin Mechanical + optional electrical lock 	4 Pin Mechanical + electrical lock 
AC+DC Combo Connector	7 Pin Mechanical Lock 	9 Pin Electronic Lock 	NA	NA
Advantages	• PLCC supports higher data rate than CAN • CCS communication protocol is richer than GB/T and CHAdeMO • CCS also support V2G • CCS comes in single connector for AC and DC		• GB/T communication protocol is richer than CHAdeMO	

Source: Technical Study of Electric Vehicles and Charging Infrastructure, March 2019 -EY and BEE report

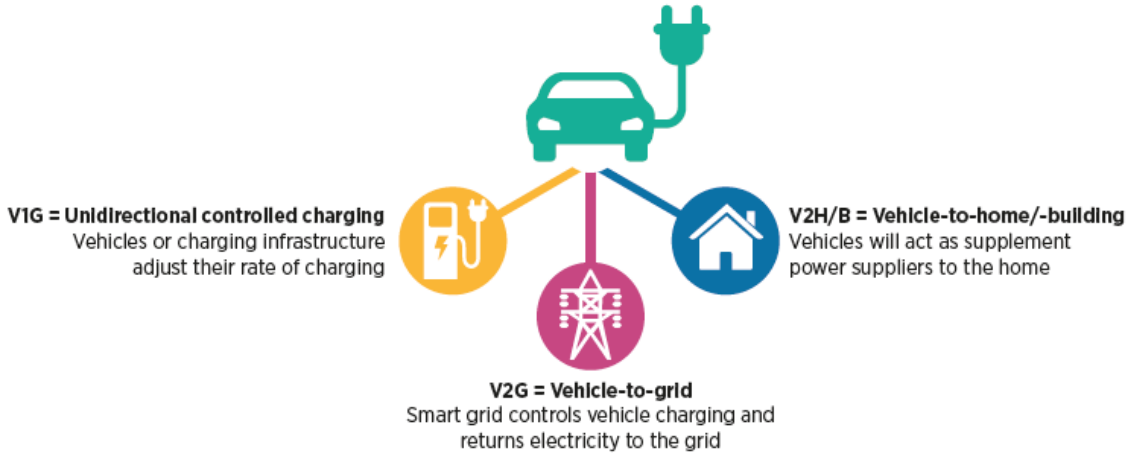


5.2.2 Smart Charging

Smart charging would mean adapting to the requirement of the conditions of the power system and the needs of the vehicle users. Smart charging allows certain level of control over charging process. The simplest form of smart charging is the incentive-based charging or introduction of ToD tariff, which encourages consumers to defer their charging from peak to off-peak period.

There are more advanced forms of smart charging, which can be introduced in the system. Some of the approaches of advanced smart charging are as shown on the figure below:

Figure 8: Advanced forms of Smart Charging



V1G: Unidirectional Controlled Charging: With the consideration of V1G, the EV charging patterns could be controlled to flatten the peak demand and support real time balancing of the grid by adjusting their charging levels.

V2G: Vehicle to Grid: By injecting electricity back to the grid, EV's can provide ancillary services to the grid. It could also help in managing congestion. The introduction of ToD tariffs in such arrangements encourages consumers to charge in off-peak hours and supply power back to the grid during peak hours.

V2H/B: Vehicle to Home/Building: Such arrangement does not directly affect grid performance but are typically used as residential back-up power supply during periods of power outages or for increasing self-consumption.

There are about 2.8 Lakh EVs in the Country and to support this huge network, it is required to have smart charging in the system. Apart from public charging, focus should also be on developing stations at work places and parking towers. Smart chargers can help minimize peak load charging by cutting off vehicles once it reaches 70-80% and divert the power to other vehicles. Smart Charging can be introduced in common parking tower of small offices.

Though Smart Charging is an excellent feature in the field of EV charging, it is necessary that communication protocols between Vehicle and Grid integration are standardized before implementing such arrangements. Regulators and Policy makers need to play a vital role in implementation of smart charging in the State.

5.3 Battery Swapping

5.3.1 Detailing

Battery Swapping Infrastructure supports in providing swapping of discharged batteries with fully charged batteries in a vehicle. The prime advantage in battery swapping is the reduced amount of time for charging the EV's. Battery Swapping would take around 5-15 minutes as compared to six to eight hours required for charging a battery inside the vehicle, thereby saving considerable amount of time, and overcoming one of the drawbacks of owning EVs.

Battery swapping can also help in reducing the upfront cost of EV's as vehicles can be sold with battery available on lease.

Battery packs have been a major cost driver for EV's. The cost of battery in the recent years has decreased significantly due to technological advancements.

5.3.2 Issues relating to Battery Swapping

Though battery swapping provides considerable convenience to the EV user and savings in time during a journey, there are few issues for implementation of battery swapping infrastructure, as detailed below:

a. Cost of Battery: A battery swapping model will increase the battery pack requirement and add a 'multiple 'to the cost as raw material in the form of mineral reserves will continue to be imported. Cost of additional battery, swapping of battery, storage, asset under-utilization and profit by the

commercial entity involved will have to be absorbed by the vehicle owners using battery swapping model.

b. Absence of Standardization of Battery: EV Industry being at a very nascent stage, the standardization of battery remains an issue. Till the time there is homogeneity and consistency in operation procedures, it will be difficult to implement battery swapping models.

5.4 Impact on Grid

Charging station owner is required to provide a reliable protection system to detect various faults/abnormal conditions and provide an appropriate means to isolate the faulty equipment or system automatically. Charging station owner shall also ensure that fault in his equipment or system does not affect the grid adversely.

The Licensee shall carry out adequacy and stability study of the network before permitting connection with its electricity system.

The grid needs to be strengthened to handle increased loads due to EV charging and proper segregation of feeders needs to be done for HT consumers.

The Commission may impose the Grid discipline to be followed for charging stations connectivity to the grid. The existing applicable Regulations for Distribution Licensees regarding connectivity shall also be made applicable to charging station operators.

6 Regulatory Framework for EV

6.1 Licence Requirement

As discussed in Chapter 1, the MOP has clarified that setting up EV charging station is a delicenced activity, in its guidelines for Charging Stations. This would encourage investors to set up such Charging Infrastructure for making profits out of such business.

The SERC may issue a Order after stakeholder consultation process specifying the rules for setting up EV Charging Station, wherein such business may be considered as a de-licensed activity. This would encourage more investment in setting up Charging Infrastructure in the State.

6.2 Policy Initiatives

As discussed in Chapter 2, different countries have come up with various Policies to develop EV. The policy initiatives have been from the Government and/or the Regulator in the Country. Some of the major States already have an EV Policy in place, as discussed in Chapter 1.

The Rajasthan Government is also in the process to notify an EV Policy, which would show the political will and support of the Government to switch towards EV in the State. The Policy would also enable the manufacturers of EV and respective OEM's to have some amount of incentive in terms of land or input cost, etc., to encourage increase in manufacture of EVs. This would help the supply side to have the required platform for match with the existing ICE manufacturers.

The Demand side can also pick up by giving substantial subsidies, as provided in FAME II Policy, to the end user of the EV at the time of purchasing. Also, various initiatives such as waiver from toll tax, road tax, and parking charges may also be introduced by the Government for all EVs.

Though the above initiatives are to be taken up by Government, some of the initiatives can also be taken by the State Regulator which can be categorized under short-term initiatives and long-term initiatives.

In short term (1-3 years) the Commission may specify promotional tariff for EV charging stations and ToD Tariff may be introduced for public charging stations. The cost of development of network/ infrastructure may be considered as a part of Investment plan ..

In the long term (4-10 years), ToD Tariff may be introduced for all consumers including residential category and capital cost may be allowed to Distribution licensee to create a robust network to cater to EV loads.

6.3 Short-Term Initiatives

6.3.1 Promotional Tariff for EV Charging Stations

As discussed in previous Chapters, setting up EV Charging Stations plays a vital role in promotion of EV. The intention is to shift the consumer from conventional ICE to EV in the near future. To achieve such a goal, price economics for the end consumer is very important, not just at the time of purchase of EV but also in the long run during the operational years.

The fuel efficiency should be feasible for the end consumer to go for an EV instead of conventional ICE's in the market. This can happen only if the end consumer incurs lesser cost for one full charge of EV as compared to one full tank refill of ICE's considering the distance travelled in both the cases is the same. In other words, the cost of running per km should be lower. It is therefore necessary that the tariffs charged to the EV Charging Stations and by them to the end consumer should be such that it encourages the consumer to go for Electric Vehicles.

6.3.2 Cost of Infrastructure upgradation to cater to EV charging load

The Regulators currently approve the Capital Investment Plan of the DISCOMs for the development of distribution infrastructure. DISCOMs in their investment plan shall also factor in growth envisaged in EV and propose a suitable investment for augmentation of network for this purpose.

DISCOMs shall chalk to the network requirement for setting up such infrastructure only after rigorous discussion with proposed investor/stakeholders/private players who are planning to set up Charging Stations in the License area of the DISCOM.

DISCOMs shall also propose the Capital Investment Plan for setting up necessary infrastructure to reach out to the individual Charging Stations. The purpose of this capex would be to facilitate the smooth functioning of energy flow to Charging Stations without any interruptions/network congestions/overloading problems. Connections to Charging Stations shall be released at priority on payment of charges as per prevailing orders/ Regulations.

6.3.3 ToD Tariff for Public Charging Stations

To further incentivize the adoption of EVs, ToD tariffs has been introduced whereby lower charges during off peak hours can be provided. This would encourage the consumer to go for off-peak charging and the Distribution Licensee may be able to smoothen its load curve.

6.3.4 Issuance of Order for EV Charging Stations

Considering the push that is given by the Central Government schemes for promotion of EVs, there would be substantial growth in the number of EVs and the corresponding EV Charing Infrastructure in the State. The Regulator may issue an order on the regulatory issues for EV Charging Stations in line with the guidelines of MOP.

6.4 Long-Term Initiatives

6.4.1 Introduction of ToD Tariff for all consumers including Residential

RERC, in its prevailing Tariff Order, has stated that individual consumers may charge EVs in their respective premises and the tariff for such charging will be the same as that applicable for that consumer whose premises are used for EV charging. Therefore, a residential consumer may charge his EV at residential Tariff and a commercial consumer may charge EV in its commercial premises at commercial tariff and so on so forth for each respective category. There is no ToD tariff being charged to residential or commercial consumer in most of the States, as these consumers are not able to shift their load during off-peak hours.

However, with the growth in EVs in the near future, even residential, commercial and other category consumers can charge their EV during the night and avail the benefit of ToD tariff.

Moreover, the Distribution Licensee will also be able to manage their load by shifting of EV charging during off-peak hours. In case there is no ToD tariff, the residential and commercial consumers may charge their EV at any point of time during the day, which may also be during peak hours and considering the growth of EVs in the near future, the load on account of charging EVs during peak hours may result in the tripping of Distribution Transformers in the respective areas. Also, if the residential or commercial consumer does not get his Sanctioned Load revised and still charges the EV during peak hours, it will pose a threat to the Grid.

6.4.2 Allowance of Capital cost of Distribution Infrastructure to cater EV loads

The Distribution Licensee may require significant capital expenditure to cater to huge demand of EVs in future. The capital expenditure may be relating to setting up additional Distribution Transformers and/or Substations in the network of the Distribution Licensee. The may have to consider such additional cost of DT's and substations as a part of Capital cost and accordingly approve tariffs.

7 Way Forward

To summarize, it is necessary to have a push towards Public Charging where people are encouraged to charge their vehicles in public places such as malls, commercial complexes, parking areas, etc. The Distribution Licensee may be able to manage the load more efficiently in such cases, considering a fixed load of EV charging stations at such places and accordingly tie up for additional power purchase if required.

The tariffs should be determined by the Regulator such that, more and more investors are encouraged to enter into the business of charging infrastructure, which should remain a lucrative business at least for the initial years or till the time EVs become the norm and do not require any such support.

In the immediate future, the Commission may consider to continue incentivising setting up of EV charging infrastructure, in order to boost its growth. The growth in the sales to this category can be tracked, and once the sales reaches the desired levels, the tariffs can be revisited.

The Commission along with this Concept Paper is issuing Suo Moto Draft Order on *"Charging Infrastructure, Tariff and other regulatory issues for Electric Vehicles"* for inviting comments from the stakeholders on Draft Order. Based on the comments received on Draft order, the Commission will issue the final Order to facilitate the promotion of Electric Vehicles in the State of Rajasthan.
