Implementations of Hybrid Charging Stations for Electronics Vehicles

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Abstract: It is truly said that necessity is the mother of invention. On the same phenomenon the title is selected for the research paper. As we all know that Electronic and solar vehicles have transformed the complete transportation industry and it is not going to stop here. Since the demand of these electronics vehicles is increasing day by day including private and commercial purpose so I must say that in near future it will definitely going to be amazing revolution. It is completely switched the need of conventional fuel and now it relay on batteries. This is major issue for this revolution. So the article it based on the implications of hybrid charging stations for these vehicles. The main parameters which have been considered here are efficiency of the batteries, their working mode, their charging and discharging time duration and most important their cost. It is obtained that Power rating for light vehicles is varying from 7kW to 22kW for AC and DC current supply conditions whereas it is from 50kW to 200kW with DC current supply conditions for High segments vehicles. Similarly Battery capacity of light vehicles is 1.2-3.3kW while it is 3.-80kW for high capacity vehicles.

Keywords: Electronic vehicles, solar, batteries, charging stations, efficiency.

I. INTRODUCTION

The transition to electric mobility is a promising global strategy for de-carbonizing the transport sector. An accessible and robust network of electric vehicle (EV) charging infrastructure [1] is an essential pre-requisite to achieving this ambitious transition. Contextual approach is needed to ensure the efficient and timely implementation of EV charging infrastructure, such that it meets local requirements and is optimally integrated within the electricity supply and transportation networks. An overview of the technological and regulatory frameworks and governance structures needed to facilitate EV charging, along with a step-by-step approach to build out the implementation. Electric vehicles (EV) can be charged in a variety of ways, depending on location and requirement. Accordingly, charging infrastructure for EVs is of different types and designed for different applications. Specifications and standards for EV chargers, also known as electric vehicle supply equipment (EVSE) [2], vary from one country to another, based on available EV models in the market and the characteristics of the electricity grid.

Electric vehicle supply equipment (EVSE) is the basic unit of EV charging infrastructure. The EVSE accesses power from the local electricity supply and utilizes a control system and wired connection to safely charge EVs. An EVSE control system enables various functions such as user authentication, authorization for charging, information recording and exchange for network management, and data privacy and security. It is recommended to use EVSEs with at least basic control and management functions [3], for all charging purposes.

Conductive charging, or plug-in (wired) charging, is the mainstream charging technology in use. Requirements of EVSE for conductive charging depend on factors such as vehicle type, battery capacity, charging methods, and power ratings.

II. SPECIFICATIONS FOR CHARGING HUBS

In India, transport electrification over the next decade is expected to be driven by light electric vehicles (LEVs), comprising two-wheelers (scooters, motorcycles) and three-wheelers (passenger and cargo). Apart from these, cars and light commercial vehicles (LCVs) are the other key vehicle segments being electrified [4]. EV charging requirements depend on the specifications of EV batteries, as power must be supplied to the battery at the right voltage and current levels to permit charging. Typical capacity and voltage of EV batteries vary among the different EV segments [5].

The first generation of e-cars is also powered by low voltage batteries. However, these are likely to be phased out in the future, even if they continue in specific use cases such as taxis. The second generation of e-cars, as seen in the upcoming e-car models, is powered by high-voltage batteries [6]. Electric LCVs will comprise of both low-voltage and high-voltage vehicles, depending on their load-carrying capacity.

Table: 1 Battery Capacity for different vehicle segments

VEHICLE SEGMENT	BATTERY CAPACITY	BATTERY VOLTAGE
E-2W	1.2-3.3 kWh	48-72V
E-3W	3.6-8 kWh	48-60V
E-cars (First Generation)	21 kWh	72V
E-cars (Second Generation)	30-80 kWh	350-500V

III. CHARGING METHODS

EV charging involves supply of direct current (DC) to the battery pack [7]. As electricity distribution systems supply alternate current (AC) power, a converter is required to provide DC power to the battery. Conductive charging can be AC or DC. In the case of an AC EVSE, the AC power is delivered to the onboard charger of the EV, which converts it to DC. A DC EVSE converts the power externally and supplies DC power directly to the battery, bypassing the onboard charger [8]. AC and DC charging are further classified into four charging modes, with Modes 1-3 pertaining to AC charging and Mode 4 pertaining to DC charging.

E-2Ws and e-3Ws are powered by low-voltage batteries. The first generation of e-cars is also powered by low voltage batteries. However, these are likely to be phased out in the future, even if they continue in specific use cases such as taxis [9]. The second generation of e-cars, as seen in the upcoming e-car models, is powered by high-voltage batteries. Electric LCVs will comprise of both low-voltage and high-voltage vehicles, depending on their load-carrying capacity.

EVSEs have different power ratings or levels based on charging requirements, which in turn determine the input power requirements for charging infrastructure [10].

Table: 2 Power Rating of Electric vehicle supply equipments

	Power Rating	Current Flow	Compatible EV segment
Normal power charging	P≤7kW 7kW<P≤22kW	AC & DC AC & DC	E-2Ws, e-3Ws, e-cars, other LCVs (up to 1 ton)
High power charging	22kW<P≤50kW	DC	E-cars, LCVs and MCVs (1-6 tons)
	50kW<P≤200kW	DC	

IV. SETTING TARGETS FOR EV CHARGING INFRASTRUCTURE

Targets for EV charging provision vary from one place to another, given the levels of vehicle ownership and projected transport electrification trends. They will also vary over time as EV penetration increases [11].
The Ministry of Power (MoP) provides the following minimum requirements for the location of public charging stations:

• At least one charging station should be available in a grid of 3km x 3km.

• One charging station to be set up every 25km on both sides of highways/roads.

The Ministry of Housing and Urban Affairs (MoHUA) amended its Model Building Byelaws (MBBL) to include the provision of EV charging in buildings.
Charging infrastructure shall be provided for EVs at 20% of all 'vehicle holding capacity'/'parking capacity' at the premises.
The building premises will have to have an additional power load, equivalent to the power required for all charging points to be operated simultaneously [12-15], with a safety factor of 1.25.

ACCESS-BASED TARGETS aim to ensure minimal coverage across a city or region, and are typically measured in terms of "number of charging points/unit area." They are more appropriate in the early stages of EV adoption, due to low EV charging demand [16].

DEMAND-BASED TARGETS aim to provide sufficient public charging infrastructure for a growing number of EVs on the road. They are based on EV penetration rates and the number of electric kilometers driven. Demand-based targets are useful for a planned expansion of the public charging network, in line with projected EV growth [17].

V. CHARGE POINT OPERATORS INSTALLATION AND COMMISSIONING

Charge point operators (CPOs) and e-mobility service providers (e-MSPs) manage and enable day-to-day operations of EV charging infrastructure, for semipublic and public charging facilities. CPOs and e-MSPs are also responsible for setting up the framework architecture, protocols, and processes to enable centralized management [18] of charging facilities and their communication with the DISCOMs, and ensure efficient access to EV charging services for consumers.

• Procure EVSE hardware adhering to requisite specifications, depending on charging demand, charging patterns & required charging functionalities.

• Install a centralized system management software for backend network management, including user registration and permissions management, EV charger classification (by location and charger type), and remote monitoring.

Based on the projections of EV penetration within different vehicle segments, the charging demand, and the share of charging to be fulfilled by public charging stations, the number and type of public chargers required only in Bengaluru city for the horizon years 2025 and 2030 are calculated below [19].

Table: 3 EV Projections for Horizon Years, By Segment

VEHICLE SEGMENTS	Annual growth rate	EV penetration rate - 2025	Total number of EVs - 2025	EV penetration rate - 2030	Total number of EVs - 2030
E-2W	5.88%	10%	1,00,477	30%	6,12,353
E-3W (passenger/cargo)	5.57%	40%	30,376	70%	1,15,804
E-car (personal)	3%	3%	4,519	15%	42,561
E-car (commercial)	15.80%	10%	4,775	30%	41,992

Table: 4 Charging Demand by Vehicle Segment

VEHICLE SEGMENTS	Daily kms driven	Battery capacity in kWh	Driving range in km/full charge	Daily charging demand in kWh	Total daily charging demand in kWh - 2025	Total daily charging demand in kWh - 2030
E-2W	40	2.5	80	1.25	1,25,596	7,65,442
E-3W (passenger/cargo)	120	7	100	8.4	2,55,162	9,72,757
E-car (personal)	40	30..2	312	4	17,498	1,64,786
E-car (commercial)	100	21.2	181	12	55,931	4,91,838

EV charging requires space to set up an EVSE and to park the EV for the charging duration. For private and semipublic charging, this space is allocated in the parking areas of independent homes, apartment buildings, or of commercial and institutional establishments [20]. For public charging, however, it is necessary to plan for a network of chargers that are conveniently located and well-distributed across a city or region. The cost of public charging infrastructure primarily depends on three factors – the cost of EVSE, cost of land, and cost of power supply. All three can be significantly reduced by opting for a distributed charging network of normal power charging points that are less expensive and require less space and electricity at any given location.

Accessible, reliable, and affordable electricity is a prerequisite for adequate charging infrastructure provision. For a rapidly scalable EV charging network, the ubiquitous low-tension (LT) electricity distribution infrastructure should be leveraged wherever feasible to provide electricity connections for EV charging [21-23]. A distributed approach to charging infrastructure, comprising primarily of normal-power charging points, ensures that most charging points can be connected to the LT electricity network.

VI. FRAMEWORK FOR EV CHARGING

An EVSE with advanced smart charging capabilities has the following characteristics:

i It can be programmed to respond appropriately and autonomously to signals from DISCOMs (e.g.

electricity tariff), Central Management System (CMS), etc., to coordinate with ToD and ToU tariffs
ii It can be monitored and managed over an app
iii It is equipped with GPRS, 3G/4G or wired connection, and is connected to a cloud service
iv It shares a data connection with an EV and a charging network
v It is compatible with the back-end communication protocol

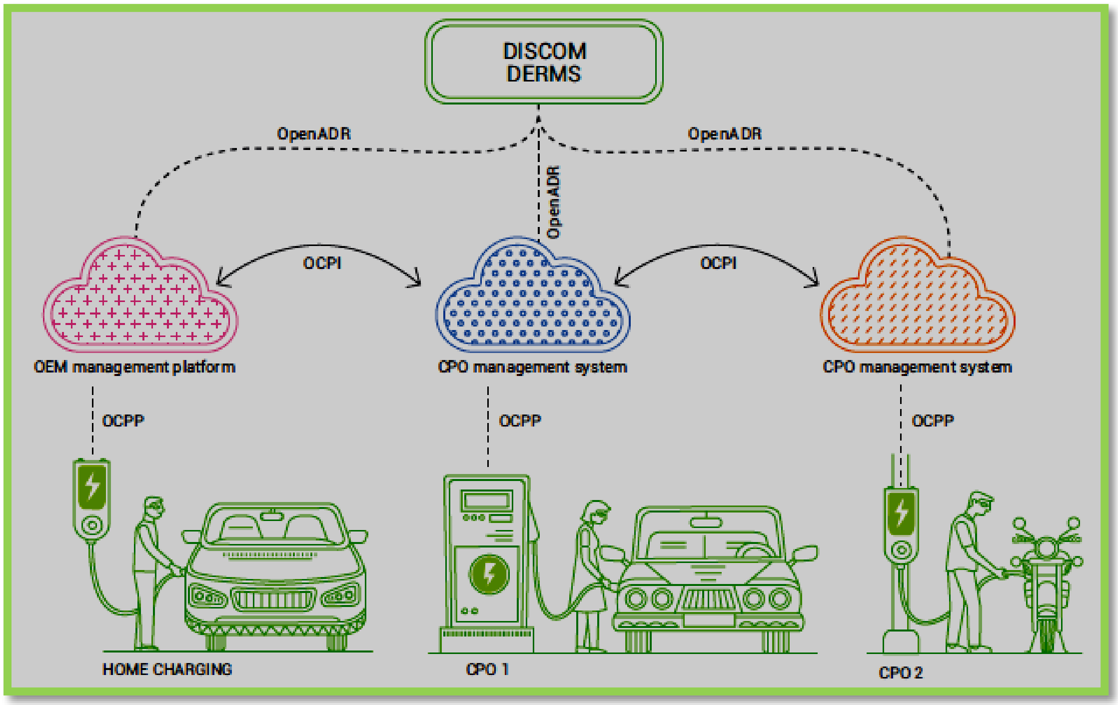

Figure: 1 Framework for EV charging stations

Conclusion

The total electricity demand for EVs, at 33% EV penetration rate by 2030, is projected to be 37 TWh. This constitutes less than 2% of the total electricity demand across the country by 2030. Therefore, meeting the overall energy demand for EVs is not expected to be a challenge in India.

However, high charging capacities of EVs and their spatial concentration may lead to significant volatility in their power demand. Combined with bottlenecks in distribution capacity at the local level, this can result in barriers to the seamless provision of EV charging connections, and can impact grid stability for all electricity consumers. A concentration of charging points at one location, especially of high-power chargers, increases the load requirement for EV charging. This, in turn, can necessitate infrastructure upgrades when the permissible utilization threshold for a feeder is exceeded. Hence, it is recommended that charging infrastructure is implemented in a distributed manner to limit the power demand for charging at any location.

The EV charging infrastructure market in India is young, with fewer than 2,000 charging stations established across the country as of March 2022. However, with the market expected to scale up rapidly in the next few years, companies from various sectors are entering at different points in the value chain. It is concluded that Power rating for light vehicles is varying from 7kW to 22kW for AC and DC current supply conditions whereas it is from 50kW to 200kW with DC current supply conditions for High segments vehicles. Similarly Battery capacity of light vehicles is 1.2-3.3kW while it is 3.-80kW for high capacity vehicles.

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