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**BSES**  
BSES Rajdhani Power Limited

## UTILITY LED ELECTRIC VEHICLE CHARGING PROGRAMS

Consumer Focused and Segmented Electric  
Vehicle Charging Programs for Delhi

India E-Mobility Finance Facility

### About This Study



India E Mobility  
Finance Facility  
(IEMF)

**BSES**  
BSES Rajdhani Power Limited

BSES Rajdhani  
Power Limited

The “BSES Consumer Centric Electric Vehicle Charging Program Study” has been conducted for BSES Rajdhani Power Limited (BRPL) one of Delhi's electricity utilities, by the India E-Mobility Finance Facility (IEMF) which is a not for profit initiative for accelerating Electric Vehicle (EV) adoption in India. This study has been completed in 2 parts. The first part was a consumer survey to understand consumer requirements. This report covers the second part which is to make recommendations on possible business models and programs that BRPL can focus on.

This study has been completed by a joint team of BRPL and IEMF

India E-mobility Finance Facility is a not for profit Project Preparatory Facility (PPF) for catalyzing flow of finance into electric mobility projects. Our beneficiaries include utilities, financing institutions, private and public companies working towards bringing innovative electric mobility services for public good. IEMF supports projects through all stages of development. IEMF selects projects for support through an interactive platform. It then develops these projects, bringing together the right skills to create implementable projects, garner financial support, and identify and partner with the right partners to create a winning ecosystem of public good. Finally it also supports public awareness building programs for EVs.

BSES Rajdhani is Delhi's largest electricity Distribution Company (DISCOMs). BRPL distributes power to an area spread over 750 sq. km with a customer density of ~3100 per sq km. It's over ~2.4 million customers are spread in 21 districts across South and West areas including Alaknanda, Dwarka, Hauz Khas, Jaffarpur, Janak Puri, Khanpur, Mundka, Najafgarh, Nangloi, Nehru Place, Nizamuddin, Palam, Punjabi Bagh, R.K. Puram, Saket, Sarita Vihar, Tagore Garden, Vasant Kunj, Vikas Puri, Uttam Nagar & Mohan Garden. BRPL is among the most successful electricity utilities in the country and has launched a number of highly beneficial programs for reducing its climate change impacts including promotion of energy efficiency appliances, promotion of residential solar rooftop installations etc. BRPL is known to be a highly consumer focused DISCOM, always striving to improve its services for its customers.





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## Acronyms

2WH	2-Wheelers, vehicles like bikes, scooters etc.
3WH	3-Wheelers, vehicles like autos, rickshaws, e-rickshaws
4WH	4-Wheelers, vehicles like cars, vans etc.
AC	Alternating current
Avg.	Average
BMS	Battery management system
BRPL	BSES Rajdhani power limited, a Delhi DISCOM
C	Demand response (or Demand side management- DSM) controller (local)
CAPEX	Capital expenditure
CCS	Combined charging systems
CEA	Central electricity authority of India
CHAdemo	A global DC fast charging protocol
CI	Charging infrastructure
CNI	Charging network installers
CNP	Charging network providers
DC	Direct current
DCFC	DC fast charging facilities
DERC	Delhi electricity regulatory commission
DISCOM	Electricity distribution companies, electric utilities
DMRC	Delhi metro rail corporation
DR	Demand response

e-3WH	Electric 3-Wheelers, like autos, rickshaws, e-rickshaws
e-4WH	Electric 4 Wheelers, like cars, vans etc.
EV	Electric vehicles
FAME	Faster adoption & manufacturing of (Hybrid &) Electric Vehicles Scheme
HCV	Heavy commercial vehicles
hrs	hours
ICE	Internal combustion engine vehicles
IEMF	India E-Mobility Finance Facility
INR/Rs	Indian rupees
km	kilometers
kW	kilowatt, unit for load/power
O&M	Operation and maintenance
OEMs	Original Equipment Manufacturers
OLEV	Office for low emission vehicles, United Kingdom
PCS	Public charging stations
PG&E	Pacific gas & electric utility, California
RWAs	Residential welfare associations
SCE	Southern California Edison, electric utility California
SDG&E	San Diego gas and electric (SDG& E), California
V2G	Vehicle to grid services

### Definitions:

Kerb-side Charging	EV Charger is installed by the roadside for charging the vehicle, not in a private garage
Poleside Charging	EV Charger is installed along existing electricity poles on roads, without a strictly private or strictly public mode of usage
Swapping Stations	A place where an EV user can replace/swap out his discharged battery with a charged battery, this is model for battery ownership as well as charging

## 1. Executive summary

Globally, Electric Vehicles (EVs) are poised for a take-off. In India too EVs are gaining consumer mind-space, driven by rapidly improving Total Cost Of Ownership (TCO), environmental benefits and energy security considerations. The government has expressed a clear intent to accelerate adoption of EVs. Under the nationwide Faster Adoption and Manufacturing of Electric Vehicles (FAME) Scheme, INR 10,000 cr. capital support has been announced for to EVs and EV charging infrastructure. Simultaneously many states have announced aggressive policies for encouraging EV demand (additional capital subsidies, waivers of registration costs, easements on licensing tax and road-tax, preferential access and parking rules; preferential tariffs for EV charging etc.)

Public mobility solutions- commercial vehicles (taxis, leasing, local logistics operations, corporate employee transportation etc.), and public buses, have doubled down on EV adoption and are making rapid progress. In India, 3 wheelers serve as a last mile connectivity solutions (in large metros), and as a public transport substitute for buses (in smaller cities). This segment is making big leaps on EV transition. Across segments, we see charging infrastructure availability as a big bottle-neck for rapid EV adoption in India. These trends are confirmed by the 'consumer behavior study' we ran in Delhi<sup>4</sup>.

Customers differ in their charging behavior- and need a 'bouquet' of charging options to satisfactorily meet their operational needs. Our consumer assessment shows that *customers are open to DISCOMs playing some role in facilitating access to different charging modes.*

DISCOMs have been at the forefront of setting up EV charging infrastructure in developed regions such as US, Europe, China, Middle East etc. Our report has profiled many such programs.

DISCOMs have become 'facilitator(s)', 'managers', 'aggregators', or 'charging service providers'. DISCOMs *facilitate* in identifying charging sites and tie up with landowners, act as coordinators for *engaging regulators and permitting entities*, or *distribute subsidies and incentives*. As 'managers' DISCOMs become fully engaged in managing operations of the charging infrastructure. They may schedule and control EV loads, and may also use EVs for V2G (Vehicle to Grid) /G2V (Grid to Vehicle) integration for better grid management. As 'aggregators' they help aggregate customer demand for charging infrastructure so that better pricing may be discovered for the charging infrastructure. As a 'charging service provider' DISCOM may install and operate EV chargers. They charge customers for charging services.

These different roles can be fulfilled under different utility anchored charging infrastructure programs.

### Home charging (3-15 KW AC chargers)

- Dedicated (to an individual owner)
- Shared (across a vehicle owners, in a condominium managed by an RWA etc.)



### Kerb-side (7-15 KW AC Chargers)

- For individuals without dedicated parking. They currently park on streets<sup>1</sup>
- For 3-wheelers, fleet independent (3 WH) owners, chargers may be set up around their normal stands (Mohalla corners, DMRC stations, bus stations etc.)

### Commercial Space Parking (15-22 KW AC Chargers)

Commercial establishments such as offices, shops, malls, hotels, hospitals, educational institutes, RWAs etc. *can be creatively used by commercial vehicle owners/fleets during off peak hours or at night.*

### Group Charging

Owned and operated by commercial entities such as fleet operators to charge their own vehicle fleets- 2/3/4 WH vehicles.

### Off-street public parking lots - 15-22 KW AC Chargers

- Used by shop-owners or residents in congested areas
- Delhi parking policy puts emphasis on developing off-street parking lots
- May serve those without self-owned parking spaces

### Swap Stations

- Likely to be used by 3 WH and 2WH Fleets

### Public Fast Charging Stations (PFCS: 15-350 KW DC)

These provide fast charging solutions. Parking is not the primary need for users of these facilities. PFCS may be located within city (e.g. around petrol pumps), edge of the city (to cater to intra city traffic or suburban traffic), or along highways.

Figure 1 Segmented map of likely usage patterns based on the consumer survey

		Charging Facility type									
		Home		Commercial Charging					Public Fast Charging		
		Dedicated	Shared	Kerb-side	Commercial spaces	Off Street Parking lots	Group Charging	Swap	In City	Edge of Town/Hub	Highways
Customer Segment/Use case	Personal Vehicles										
	2WH	>75% usage									
	4WH	>10-25% usage									
	Fleet Operators, Logistics Companies										
	2WH	>75% usage									
	3WH										
	4WH										
	Individual Drivers										
	3WH										
		<10% usage									

<sup>1</sup> This is expected to be a big requirement in mega cities like Delhi. Delhi Maintenance and Management of Parking Rules (23 Sep 2019) aim to address this burning issue. Spaces for night parking of commercial e-vehicles finds a special mention; city urban body will find such spots on priority. E-rickshaws will also get priority for on-street parking.



Using scenario estimations of vehicle stock growth in Delhi and expected EV penetration levels, we estimated the likely % distribution of electricity usage in various charging station types.

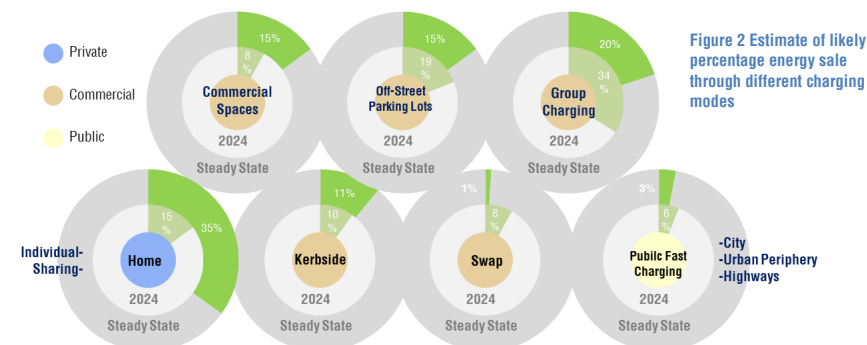


Figure 2 Estimate of likely percentage energy sale through different charging modes

This analysis, coupled with an assessment of 'ease of implementation'<sup>2</sup> of different charging station types, led us to an ordered preference list of charging modes for utility engagement:

Figure 3 Order of preference for DISCOM led programs



1. Home Charging
2. Kerb-side Charging
3. Charging in Commercial spaces
4. Charging in Off Street Parking Lots
5. Group Charging

*We find that viable charging access, a concern for all potential users, will not be addressed by actions for only PCSs. Our study outlines potential DISCOM roles, likely business models, and the value proposition for DISCOM anchoring for different EV charging models.*

DISCOMs can play a very important role in establishing an eco-system of charging infrastructure. They are equipped to play this role as:

- **They have existing customer-connect**
  - Customers know them, have dealt with them before. If services are managed efficiently, customers can trust them more than third party vendors
  - They have existing processes of metering, billing, payments etc.
- **DISCOMs can offer customers single point program management, which no other institution can offer**

<sup>2</sup> Consumer Insights for Electric Vehicle Charging Programs for Delhi. India E-Mobility Finance Facility & BSES Rajdhani. May 20

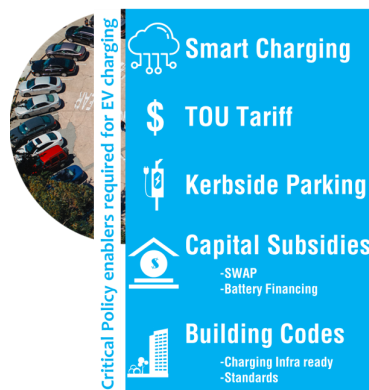
Ease of implementation assessment takes into account, openness of customer to DISCOM participation, complexity of roles and partnerships that need to be established for implementation, and the alternative strategies that a customer can pursue.

- DISCOMs have a the geographical and technical reach to set up, operate or manage a variety of charging infrastructure. Since EV customers need different types of charging infrastructure at different points of time, dealing with a single supplier will be easier for them
- DISCOMs must necessarily manage EV loads, along with other electric loads (peak load management, need for infrastructure upgrade, potential V2G services in future etc.)
- DISCOMs can bring in significant benefits of *aggregation* (customer demand aggregation, aggregation of services from CNI/CNP, payment assurance to various parties involved, collections efficiency from different segments, engagement with regulators, distribution of subsidies etc.).

To support DISCOM anchored programs, the following policies would need further work

- Policies for smart-charging and time-of-use-tariffs
- Policy for Kerb-side charging
- Policy for subsidy for EV users using SWAP stations for charging or using battery financing
- Building codes for installation of charging infrastructure.

These ideas need proof-of-concept pilots before scale-up. In order to facilitate local pilots, our report outlines profiles of similar pilots that have been implemented in other countries which are ahead of the curve in scaling up EVs. This report also outlines designs for India-centric pilots that Indian utilities can test to launch larger programs which are based on consumer insights gained through discussions with potential customers.



## 2. Introduction

EVs are becoming attractive vis-à-vis ICEVs and rapid adoption is expected.

Supportive government policies and technological innovations have made EVs attractive. Increasingly *Total Cost of Ownership (TCO)* advantage vis-a-vis Internal Combustion Engine Vehicles (ICEVs), along with significant environmental benefits and improving availability and visibility of EVs is driving rapid adoption. *In all responses we found that availability of charging infrastructure has been a key driver for rapid adoption in every segment we approached.*

Several market studies now confirm the openness of customers to EVs, and also the criticality of charging infrastructure for EV scale up.

More recent consumer behavior studies from developed markets show that top three drivers for EV adoption include improvements in *driving experience*, *monetary subsidies* and benefits, and *TCO advantage*<sup>3</sup>. Market response and consumer requirements are rapidly changing with changing technology trends and government regulations.

In our market assessment in Delhi<sup>4</sup>, which covered individual personal use drivers, resident welfare associations (RWAs), fleet aggregators, 3wheeler drivers, commercial spaces, charging infrastructure providers and Original

Equipment Manufacturers (OEMs), we identified key drivers and barriers for each segment of potential EV users. Our key findings from this small consumer survey are:

- The survey confirms that fleet aggregators, local delivery operators, and 3 wheelers (autos, rickshaws) will quickly transition to EVs. Very high awareness and need for EV transition was assessed in these segments. More than 50% 3-wheeler drivers are positive about EVs. A key challenge for them is *availability of charging infrastructure*
- Individual EV users are beginning to evaluate EVs seriously (10% interested in EV purchase) and rank *environmental benefits* and *low TCO* as top drivers
- *Positive customer perception* is the main driver for commercial space owners. They are open to creating EV charging points in a few of their parking spots
- Customers seem generally open to *DISCOM facilitation* or DISCOM anchored EV Programs (37% -88% in different segments). 3 wheelers drivers would also welcome a DISCOM anchored program, as it would allow them fair access to charging infrastructure, closer to their normal parking space compared to what is available currently
- *Customers acknowledge that TOU tariffs*, high off peak discount or high peak pricing, will likely better guide their charging behaviors. Peak time restriction is less preferred among customers, although it may be due to lack of understanding of increased demand charges. Big penalties are imposed in case peak consumption increases beyond sanctioned load for a meter

Distribution Companies (DISCOMS) can play a very critical role in creating the charging infrastructure and support of EV scale up.

Our survey results show the following:

- Customer perceive that a critical role can be played by the DISCOM in promoting EVs and setting up EV charging infrastructure
- Customers are open to anchoring/facilitation role from a DISCOM
- The DISCOM will need to devise customer segment specific strategy to support EV scale up
- DISCOM will need to partner and work with parking space owners, and develop specific business models to be able to accelerate access to the charging infrastructure

From a DISCOM perspective, this is a great insight. They are uniquely placed to improve the charging infrastructure to aid both current users and future users and create an ecosystem geared towards promoting and rewarding adopters.

Large incentives for EVs have been announced in India (at both central and state levels) to support EV scale up.

There is also significant government push for EVs, with subsidies being available under central schemes such as Faster Adoption and Manufacturing of Electric Vehicles (FAMEI and FAME II) and also state schemes, coupled with lower registration costs, and easements on licensing and taxation on EVs along with other regulatory easements. Many states are also supporting local EV manufacturing with additional incentives.

FAME II was announced in 2019 as an extension to the 2015 scheme of capital subsidies for Electric vehicles as a means to alleviate some of the high upfront cost hurdles faced in EV adoption. Under FAMEII capital subsidies are available to vehicles engaged in public transport, including 4 wheeler (4WH) taxis, 3 wheelers (WH), buses, and also private 2 wheelers (2 WH) and charging infrastructure. The total size of capital support is ~ INR 10,000 Cr (~USD 1.4 Bn), of which, charging infrastructure may seek support of up to INR 1000 Cr (~ USD 140 Mn).

In 2019, the ministry of road transport and highways had issued a draft notification for exemption of battery-operated vehicles from payment of registration fee.

Delhi government has recently (December 2019) approved its EV policy for promoting adoption of EVs.<sup>5</sup> Recognized as one of the more strategic and strong policies among states, its key provisions are:

<sup>3</sup> Road ahead for e-mobility, McKinsey & Company, 2020.

<sup>4</sup> 'Study of customer perceptions relating to EVs, Charging Infrastructure and the role of the Distribution Companies', March 2020, IEMF. The study was carried out during Oct 2019 to Jan 2020 in Delhi.

<sup>5</sup> More details about the policy available in Annexure II

- It targets to increase electric vehicle sale penetration to 25% and have 500,000 EVs on road by 2024.
- Apart from subsidies to early adopters, special benefits have been announced for commercial electric vehicles (e.g. taxis, last mile transport, e-commerce delivery and logistics). The subsidies offered are in addition to central subsidies.
- The policy mandates that new home and workplace parking should reserve 20% parking for EVs. In addition, a capital subsidy up to INR 6000/installation has been announced for the first 30,000 charging points across the city.
- All battery operated vehicles will enjoy a full road tax and registration waiver in the city.
- An interest subsidy of 5%/annum is also available for commercial 3WH EVs.

With such a great bouquet of benefits, it is expected that EV adoption should rapidly increase in the city.

In this scenario, BSES Rajdhani Pvt Ltd (BRPL), the largest DISCOM in Delhi, is keen on developing programs and business models to create charging facilities for all segments of their consumers and supporting the e-transition of mobility within its jurisdiction.

### 3. Process of this study

This research report reviews global examples of utilities developing charging infrastructure programs.

While, many of these programs are at pilot scale, and are continuously evolving, a lot can be learned from

- The rationale behind these programs, the objectives and goals
- The institutional structure, policies, regulatory mechanisms and processes used
- The challenges faced
- The results achieved

Not all the details about these programs are available publicly. However, the key ideas are discernible from public sources. No subsequent validation with the program anchors has been carried out.

We also considered the consumer responses we received in our survey in Delhi:

- Customers' openness to EVs, perceived drivers and barriers.
- Customers' openness to DISCOMs- their anchoring a charging infrastructure program, TOU Tariffs, Demand Response (DR) to control peak time charging etc.
- Different types of charging infrastructure needed by different customer segments

Based on customer needs, global models, and discussions with Charging Infrastructure Providers (CNPS), Charging Infrastructure Installers (CNIs), Original Equipment Manufacturers (OEMs, manufacturing EVs) and DISCOM, we have proposed *Business Models and Program Ideas* for charging infrastructure in the city along with some key *Policy interventions* that are needed to facilitate these solutions.



## 4. Globally, DISCOMs play important roles in promoting EVs

Globally, DISCOMs have played a major role in promoting EVs along with the charging infrastructure required for EVs. DISCOMs have taken on different roles in the charging infrastructure or charging services supply chain. They act as 'facilitator(s)' in the short term and evolve into more engaged functions as capacities increase including acting as 'manager', 'aggregators', or 'charging service providers'. DISCOMs may facilitate in identifying charging sites and tie up with landowners, act as coordinators for *engaging regulators and permitting entities*, or *distribute subsidies and incentives*. As managers DISCOMs become fully engaged in managing charging operations, scheduling and controlling EV loads, and using EVs for Vehicle to Grid (V2G)/Grid to Vehicle (G2V) ancillary services for better grid management. As aggregators they help aggregate demand for charging infrastructure and work with charging network providers or charging network implementers in getting appropriate charging infrastructure in place for their customers. As charging service providers, utilities install EV chargers, operate them and charge customers for charging services.

Many DISCOM led charging infrastructure programs are now under implementation globally. They may be designed for a specific customer segment or cut across many segments.

Some of the common features adopted by the DISCOMs for charging programs include the following:

- **Online processes** for empaneling customers, vendors, partners
  - *Pre-validating vendors* for EV charging installations, operation and management
  - *Voluntary enrolment of customers*. Customer initiated requests for chargers which are reviewed and approved under a well-defined process
  - *Time-bound processes* for sanction and implementation
  - Programs are *focused on a few customer segments* (e.g. individual residences, apartment complexes, commercial, industrial, malls, fleets etc.)
    - Many programs focus on multi-unit dwellings, workplace charging
    - Public Fast Chargers were also set up under some programs
- Many programs for **kerb-side charging** have been launched, as cities try to meet the needs of customers with no owned parking space. These programs have been anchored by utilities as well as city councils.
- Utilities have **channeled subsidies for chargers** and associated infrastructure, to set up initial capacities
  - Capped, phased reduction, of subsidies for charging infrastructure
  - Distributing tax exemptions or subsidies
  - Public (restricted or complete) access rights to subsidized chargers
- DISCOM participates in the **development of technical specifications**, quality assurance and operational monitoring of the charging infrastructure. They also carry out **upgradation of the distribution system** to support the large loads of EVs.
- The programs we explore in this report define a mode of operation, billing, and payment mechanism to be used while the chargers are operated
  - Choice of ownership by customers: could be individuals, DISCOM, or the charging service provider.
  - DEWA has also introduced Charge Cards as a means of payment for its charging facilities
- **Tariff schemes** to attract customers and reduce peak time charging
  - TOU and DR to shift demand to off peak periods
  - Some utilities like Dubai Electricity and Water Authority (DEWA) offer free charging for a limited period to encourage ownership
  - Special tariff plans have been deployed by a few to support V2G, G2V support to accelerate use of renewable energy, grid ancillary services, surplus power during off peak periods etc.
- The charging data is monitored and reviewed at the control centers of the DISCOM
- Some programs identify a governance process to select the sites and beneficiaries and monitor results



A few of these programs are briefly summarized in Annexure I:

## 5. Types of charging stations- an analysis for Delhi

Results of our consumer interactions show that the following types of charging stations may be needed in Delhi.

### Home charging (3-15 KW AC chargers)

- Dedicated (to an individual owner)
- Shared (across a few vehicle owners; for example, in a condominium managed by an RWA)

### Kerb-side (7-15 KW AC Chargers)

- For people who don't have dedicated parking. They park on streets<sup>6</sup>.
- For 3 WH owners who are not part of fleets and must fend their own solutions. Around their normal stands (Mohalla corners, DMRC stations, bus stations etc.)

### Commercial Space Parking (15-22 KW AC Chargers)

- Commercial establishments such as offices, shops, malls, hotels, hospitals, educational institutes, RWAs etc.
- Can be creatively used by commercial vehicle owners/fleets during off peak hours such as night.

### Group Charging

Owned and operated by commercial entities such as Fleet Operators to charge their 2/3/4 WH vehicles

### Off-street public parking lots - 15-22 KW AC Chargers

- Used for shop-owners, residents in congested areas
- Delhi parking policy puts emphasis on developing off-street parking lots
- Can meet the needs of those who don't own their own parking

### Swap Stations

Likely to be used by 3 WH Fleets. In some limited cases 2 WH Fleets.

### Public Fast Charging Stations (PFCS: 15-350 KW DC)

- These provide fast charging; parking is not the primary need in these cases
- Can be located within city (e.g. around petrol pumps), edge of the city (to cater to intra city traffic or suburban traffic, and highways).



<sup>6</sup> This is expected to be a big requirement in mega cities like Delhi. Delhi Maintenance and Management of Parking Rules (23 Sep 2019) aim to address this burning issue. Spaces for night parking of commercial e vehicles finds a special mention; city urban body will find such spots on priority. E-rickshaws will also get priority for on-street parking.



We used a Consumer-Charging Infrastructure Matching Matrix to analyze the findings and make recommendations (Figure 1)

The special EV charging tariffs would apply to Kerb-side, Off Street Parking Lots and Public Fast Charging Stations (PFCS). Rest of them would have some restrictions in being open to general public and therefore may not attract special EV tariff.

DISCOM can play varying roles in setting up each type of charging stations, depending on customer connect, level of electricity sale, openness of the customer for DISCOM involvement, and feasible business models.

A model based on current vehicle population in Delhi, expected EV penetration rates, vehicle stock growth trajectory and indicated choice of charging infrastructure across 2 WH, 3 WH and 4WH segments shows that

- In the initial period, due to faster take off in vehicle fleets and aggregator segments, Group Charging will be important and may enjoy a share up to ~34%<sup>7</sup> of electricity consumed by EVs. In steady state, when the individual owner segment also takes off, Group Charging will still constitute ~ 20% share
- Home charging will be very important. It will increase from an initial share of 15% to 35% in steady state. It will also be very important from the perspective of peak load management, Vehicle to Grid (V2G) services etc. Hence home charging is an important segment for a DISCOM.
- Other important segments would be Kerb-side charging (10%), Commercial Space charging (8%) and charging in Parking Lots (19%). Apart from Home Charging segment, a DISCOM in large cities should focus on these segments.
- Public Fast Chargers may provide 3-6% of charging needs, although they would be crucial in convincing people to adopt EVs. Such chargers therefore can be established using government subsidies, financed using carbon tax or equivalent measures. Being expensive due to high power ratings, they would be most difficult to justify using private capital.

## 6. Potential DISCOM anchored charging programs

All the above types of charging stations can be anchored and set up by a DISCOM. DISCOMs can play some key roles such as:



In this report, based on relative rankings, we recommend a few programs for implementation by BSES.

### 6.1. Home charging program

Home charging is the most likely mode for charging by owners of personal vehicles, who have access to their own parking space. In such cases 80%+ charging needs may be met at home.

For 2 WHs, since the charging load is small (~ <3 KW), a normal 15 amp socket is enough to charge. Apart from ensuring safety aspects of such charger, DISCOM may not need to play much of a role. Hence the analysis presented here applies to 4 WH EVs.

<sup>7</sup> These number of indicative and only show relative importance of various types of charging infra

As per our customer survey, personal vehicle owners (~45%) are open to DISCOM involvement in setting up the charging facilities. Those who are not open to DISCOM involvement, feel that EV OEMs may require them to use the specific chargers, due to warranty reasons. Currently cost of chargers is bundled in the EV price.

However, OEMs have expressed openness to DISCOM involvement in setting up home charging.

DISCOMs can play some useful roles which are currently unfulfilled:

- DISCOMs can assess the overall load profile and set up a charging protocol such that an EV doesn't add to additional peak demand infrastructure requirement, wherever feasible. This means EVs could be charged within the existing sanctioned loads, ensuring charging during off peak hours when load is less than the sanctioned load.
- If needed, DISCOMs can provide additional infrastructure upgrade<sup>8</sup>.

The involvement of the DISCOM may prove even more useful when the charging station is set up under a *shared sanction load* e.g. for an apartment block where the DISCOM bills the RWA and RWA in turn bills its various residents.

According to our research, EV OEMs installing home chargers are unable to take care of these issues. If sufficient load is not available, they may not set up the charger or even deny sale of EV to such customers.

In this section, we describe two modes of home charging:

- Dedicated Home Charger (for the EV owner's personal use)
- Shared Home Charger (shared across 2 or more residents).

### 6.1.1. DEDICATED HOME CHARGERS

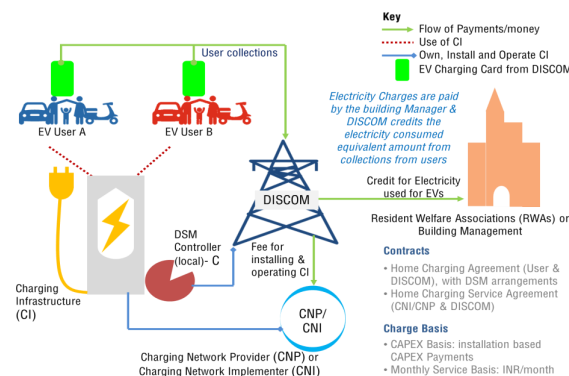
In this case the EV owner owns the space. The charger may be installed and maintained by a Charging Network Provider (CNP) or Charging Network Installer (CNI)

The EV Owner may pay for the charger as follows:

- As CAPEX – paid separately (to CNI) or as part of vehicle cost (OEM)
- As rental – paid to CNP (INR/month)

<sup>8</sup> As per current policy the infrastructure upgrade cost is to be borne by the EV Owner.

Figure 4 Home charging business model



### 6.1.2. SHARED HOME CHARGERS

In this case charger is shared across two or more residents. The charger may be installed in a common area or in a dedicated parking slot but with shared cables for connecting neighboring vehicles.

The charger may be installed by a CNP based on monthly rentals (INR/month), which may be shared between users as subscribers to the charging point.

### 6.1.3. ROLES THAT A DISCOM MAY PLAY IN SETTING UP HOME CHARGING PROGRAMS

#### Aggregation

DISCOMs can aggregate demand from customers. They may launch an online process for registering requirements of an individual EV owner for support in setting up home charging infrastructure. DISCOM may carry out assessments and grant permissions for setting up the charging facilities. The process could be made time bound for increasing efficiency.

Through bids, DISCOMs may empanel high quality CNIs or CNPs, to set up the charging infrastructure. EV Owners may be free to choose from amongst the empaneled vendors. This process is very similar to the one used for installing solar roof tops.

DISCOMs may also set standard supply and O&M contracts between the supplier and the owner.

#### Permissions

The DISCOM can facilitate load assessments and grant necessary permissions for the charging station.

Depending on the mode of charging (dedicated or shared) and the business model (CAPEX, rental), a simple user agreement can be set up between the EV user and the DISCOM. The user agreement may cover issues such as demand side management rights for the DISCOM to restrict charging to within the sanctioned load, off-peak charging etc.

#### Implementation

Based on already established contracts with vendors, DISCOMs can ensure that chargers are set up and are functional as per approved specifications, and within time.

#### Operation

DISCOMs can pay vendors upfront or through rentals, and collect charges from EV users under back to back contracts, with a small processing fee.

DISCOMs can issue an EV charge-card to users. This EV charge-card may be used for charging at home as well as other charging stations in the city. The EV charge-card may be integrated on a mobile application hosted by the DISCOM. Such mobile applications may display availability of charging stations that are closeby, enumerate access restrictions (access times or type of visitors who can access the charging station), facilitate booking of a charging station, and provide information on the overall costs of charging (INR/kwh, parking costs etc.). Through this app dynamic tariffs may also be implemented.

From the collected revenues, DISCOMs may recover cost of electricity, and pay the cost of charging provided by charging network providers (- CNPs, public or private) and parking fee (wherever applicable). It may also provide corresponding electricity charge credit in the electricity bills of the CNPs.

The advantages of this system would be:

- Confidence to users about availability of charging not only at home but in other parts of the city.
- Ease of billing and payment for customers.
- Assurance to charging and parking service providers about recovery of money from customers (especially when payments are rental or monthly subscription based).



- The system may also facilitate running promotion campaigns specially while charging in commercial spaces. For example, a particular shop owner, based on customer purchases in the shop, may provide waivers on charging costs.

#### 6.1.4. SHARING OF HOME CHARGERS

Interestingly even home chargers are being conceptualized as part public chargers in many countries. In China, a number of apps permit users to make private charging points available for sharing<sup>9</sup> with others. For example, In January 2018, public officials in Hebei province noted the difficulty of providing EV charging in rural areas and recommended that rural residents be encouraged to publicly rent or share household chargers. StarCharge, one of the largest private charging networks, stated that 11% of the privately owned chargers it installed, are capable of sharing with the public. EVMatch enables EV charger owners to offer their plugs for a fee through an app and website, evmatch.com.

### 6.2. Kerb-side charging

Globally, large cities have a significant proportion of residents with no access to parking inside their homes. The normal parking options in such cases are:

- Outside the residence, on streets
- Off-side parking lots (subscribed by residents)

Commercial vehicles (taxis, 3 WHs, 2 WHs) also face parking hurdles.

- The drivers often don't own residences where parking is possible
- In addition to night time parking and charging facilities they also need to charge their vehicles frequently while on the move

A solution for such needs is kerb-side charging stations, which are typically 7-15 kW stations. They are set up on the side of streets, often around streetlights, and may be available with parking restrictions. As per EV policies in India, kerb-side charging stations would be classified as Public Charging Stations and will enjoy special EV tariffs. The likely payment model would be INR/kWh.

#### 6.2.1. KERB-SIDE CHARGING PROGRAM FEATURES

Most kerb-side programs are anchored by municipal bodies or utilities, some examples are provided in

Table 1 Delhi has rules and guidelines which can be used to facilitate kerb-side charging:

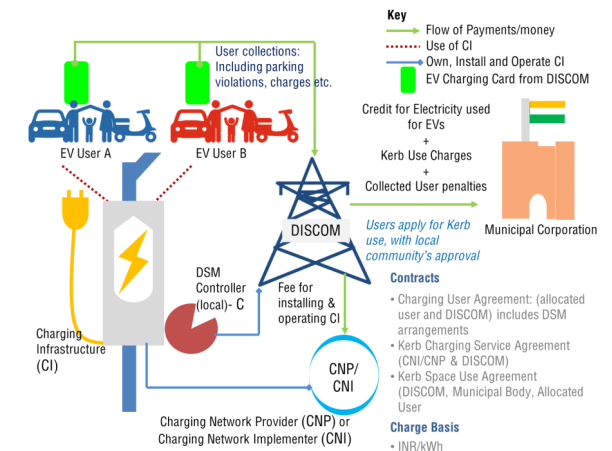


- Delhi maintenance and management of parking places rules (Sep 2019), place an emphasis on formal kerb-side parking permission based on payments. Taxis and autos are to be given priority for kerb-side parking. Residents will be allowed to park in their locality, based on availability of parking slots, time and recommendations from the community. E-vehicles will have priority.
- 'Protection of Livelihood and Regulation of Street Vending Rules, Delhi' (2016) permit street vendor to use streets for commercial purposes. These can be used to set up kerb-side charging posts.

A process of approval for kerb-side charging stations can be based on applications from individuals, endorsement from local community, and evaluation and sanction by a civic body. Such processes are not available presently and therefore such stations are not implemented as yet.

#### 6.2.2. ROLES THAT A DISCOM MAY PLAY IN SETTING UP KERB-SIDE CHARGING

Figure 5 Kerb-side charging business model



#### Aggregation

4 WH EV users, with no parking at home, may apply for kerb-side charging stations, with local community endorsement. DISCOM aggregates such demands. 3 WH drivers have shown high interest in buying EVs, if an organization like a DISCOM supports them in getting charging facilities around normal parking places such as metro stations, market places, Mohalla parking etc.

For helping them transition to EVs, the DISCOM may need to run a promotion campaign, to make the vehicle users aware of the benefits of EVs, help them assess EV purchasing options and assure them of charger availability by setting up kerb-side and nighttime parking-cum-charging stations.

DISCOMs can empanel Charging Network Providers (CNPs) who will invest in the kerb-side charging infra.

Charging infrastructure can become a branded service by the DISCOM.

#### Permissions

The DISCOM receives applications from EV users, endorsed by local community, for setting up kerb-side charging and facilitates approvals from the civic body.

The DISCOM also selects sites and gets load assessments and if necessary, carries out infrastructure upgrade, to support kerb-side charging.

#### Implementation

The DISCOM ensures kerb-side charging stations are built up quickly and comply with agreed specifications. To be successful and to meet customer requirements, entire process from receiving the application to building the kerb-side station may need to be completed in 7-10 days, as it is critical for EV purchase. The DISCOM may also ensure that before the station is built, the potential EV user has purchased the EV.

#### Operation

Kerb-side charging stations, being open to public, may work as DISCOM branded (or co-branded) stations. Users use an EV charge-card issued by the DISCOM for payments. The charges would be collected by the DISCOM who in turn pays the CNP to set up the charging infra.

### 6.3. Commercial space charging

Commercial spaces include malls, markets, educational institutes, hospitals, hotels, RWAs etc. Almost 80% of commercial space owners that we contacted were open to trying out EV charging stations for a few parking slots owned by them. However, many of them wanted to restrict the usage to their own customers, residents, employees or visitors and not allow open access to general public. Still a significant proportion (~50%+ in different segments) were open to the idea of unrestricted public use.

World over, commercial spaces have been at the forefront of adoption of EV charging, driven by<sup>9</sup>:

- Research indicates that key motivations for installing EV charging infrastructure at shopping centers in China are to advertise green credentials and meet government mandates.

<sup>9</sup> Anders Hove and David Sandlow 'Electric Vehicle Charging in China and the United States, February 2019', Columbia Centre for Global Energy Policy.



Figure 6 Common features of kerb-side charging programs

- In the United States, chains such Best Buy, Safeway, Whole Foods, Kohl's, Home Depot, Ikea etc., offer EV charging services. Walgreens advertises that it has EV charging at over 400 locations on high-traffic road corridor around the country.
- Outlet malls, located in rural areas along highways, are active adopters of EV charging.
- In the United States, fueling station operators such as Sheetz, the mid-Atlantic chain Royal Farms and South Carolina-based Sphinx have partnered with charging network providers to offer charging services. However, in many areas fueling stations are unable to offer EV charging due to regulations that prevent resale of electricity.
- Commercial space owners are willing to offer promotion schemes to let EV users come to their shops and receive parking and charging free. EV users are likely to spend longer time in the shops and being early adopters, likely to be better spenders.

In our limited market assessment in Delhi too, the main driver for adoption in commercial spaces seems to be the environmental friendliness of EVs and the potential for marketing advantage, better brand image, better services for their customers and longer time spent by EV owners in their shops while EVs are getting charged.

Commercial space owners emphasized the need for presence of a single entity, like a DISCOM, to set up the charging stations with right specifications, take care of all permissions and management, and establish an appropriate business model.

#### 6.3.1. HOW THE CHARGING INFRASTRUCTURE MODEL MAY WORK FOR COMMERCIAL SPACES

For analysis purposes, we have divided the commercial spaces in three broad segments:

- Offices
- Markets and Service Providers
- RWAs and gated communities

RWAs are strictly not commercial spaces, but they behave in most cases like one, especially w.r.t the use of common spaces. Hence, their selection here.

#### Offices

Offices are often the second place of choice for regular charging, where parking is for longer hours, the first of course being at homes. Office charging may be carried out during daytime peaks, hence smart charging would be necessary.

Office owners would normally create a program for EV charging, based on requests from employees who plan to switch to EVs. Many corporates are active in promoting the use of EVs by their employees and are willing to provide assistance in purchase, leasing or financing. EV-100<sup>10</sup> program by The Climate Group (TCG) is a well know global program for encouraging adoption of EV's by corporates.

The possible drivers for offices to promote EVs are:

Lower environment footprint as the transport used by employees is part of Scope 1/3 emissions of a corporate. It is increasingly becoming a sustainability target for corporates.

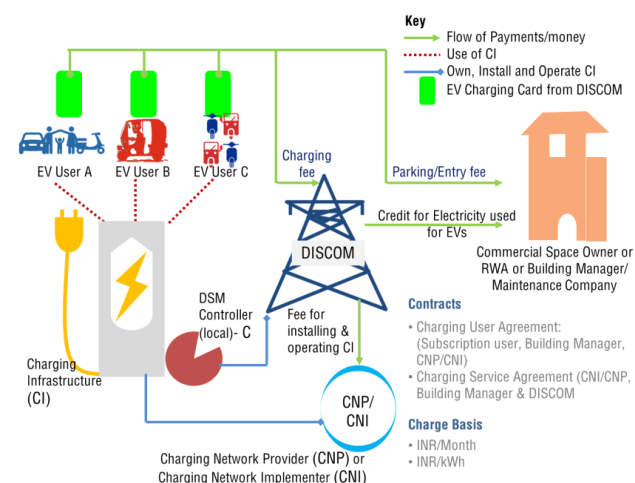
- Reduced costs as TCO for EVs is falling and is more competitive vis-à-vis ICEVs.
- Government mandates.

<sup>10</sup> More than 69 members in March 2020, many of them large corporations including fortune 500 companies

Normally, a CNP may invest in the charging infrastructure in the office parking, based on an office's request. A CNP may charge a monthly rental or charge in INR/kwh or INR/charge. The charges may be subsidized by the office owner or recovered from the user. Electricity charges are paid by the office owner or by the CNP to the building maintenance company.

Normally offices have day operations only and may provide the use of charging cum parking slots to their transportation service providers at night. This allows for building a viable business model for this charging infrastructure in non-use times.

In most cases office charging stations may not qualify as Public Charging Stations (PCSs) as they may not be open to general public, and as a result may not avail the special tariff



### Markets and service providers

This segment would include shopping malls, community markets, entertainment complexes, food courts, hospitals, educational institutions, hotels etc.

Many of these institutions are willing to invest in a few charging stations to attract customers or for branding purposes. The charging facilities would be built by a CNI, and the business model would be to recover the investment as payment on installation or in installments over a time period. The maintenance and availability assurance would be provided by the CNI. The owner of the charging stations would be the shops, mall maintenance companies or the institutions who may charge the user for service provided, along with the parking charges.

### RWAs and gated communities

Some RWAs, who we contacted during our survey, were willing to consider installing a few charging stations in their common areas, for use by visitors and vendors who visit the society. However, they were most likely to follow a CNP model, where CNP invests in the facility, and recovers it from user charges. RWAs also expected to receive rentals for the space used.

### 6.3.2. ROLES THAT A DISCOM MAY PLAY IN SETTING UP CHARGING STATIONS FOR COMMERCIAL SPACES

#### Aggregation

Commercial spaces seem positively inclined for the DISCOM to act as a single point agency for coordinating all activities for setting up the charging infra. Hence a DISCOM can run a promotion campaign for commercial space owners, explain the benefits and the process of setting the charging infra, and sign them up, for a chosen business model (payment of CAPEX, INR/month, or INR/kwh).

The charging infrastructure may be set up by the DISCOM empaneled CNIs or CNPs, ensuring the benefit of cost, quality and service through such aggregation.

#### Permissions

Permissions for sanction of load, demand side management etc. would be managed by the DISCOM.

#### Implementation

The DISCOM ensures construction of the charging stations as per agreed specifications, costs and delivery. The DISCOM also sets up local load management system to comply with demand side management agreement, control of loads within the sanctioned load etc.

Subsidies, if any available under state/central schemes could be routed through the DISCOMs.

#### Operation

The DISCOM delivers the charge cards to users and charges them as per agreement (INR/m, INR/kwh, INR/charge). The DISCOM also credits the building's electricity bills, for electricity charges collected via the charging stations. The DISCOM pays the CNP and if the contract demands, the RWA or Commercial Space Owners for the space used.

## 6.4. Group charging stations

A number of aggregators are operating in the taxi and e-commerce (e-com) delivery segments, are slated to shift rapidly to EVs, driven by compelling cost economics, ease of driving and buyer's preference for green transportation products and services. The vehicles could be 4WH (e.g. Blue Smart, Uber, Ola, Lithium, Shuttle, ZipGo), 3 WH (e.g. Smart-E, Ola), 2 WH (e.g. Moby, VOGO, Rapido) etc.

The aggregators are setting up the charging infra, on their own or in partnerships. The key requirement is to identify appropriate land and get permissions (such as electric connections, parking). If the partner brings in investments for charging infrastructure too, that is welcome, but it is not a necessary condition.

### 6.4.1. HOW THE CHARGING MODEL WORKS FOR GROUP CHARGING

The charging infrastructure may include a 'hub' where vehicles can be parked during the night and charged, as well as other well-located charging facilities to serve the daytime quick top-up for the aggregator's fleet.

It is estimated that initially, group charging stations in a city like Delhi could provide 50%+ of EV charging load, which could reduce over time to 25-30% as personal vehicles take off.

The investment, location and permissions are organized by the aggregator or its charging infrastructure partner. The users are charged based on INR/Kwh or INR/charge. The aggregators offer assurance of demand, hence are attractive partners for a charging infrastructure player.



#### 6.4.2. ROLES THAT A DISCOM MAY PLAY IN SETTING UP CHARGING STATIONS FOR AGGREGATORS (GROUP CHARGING)

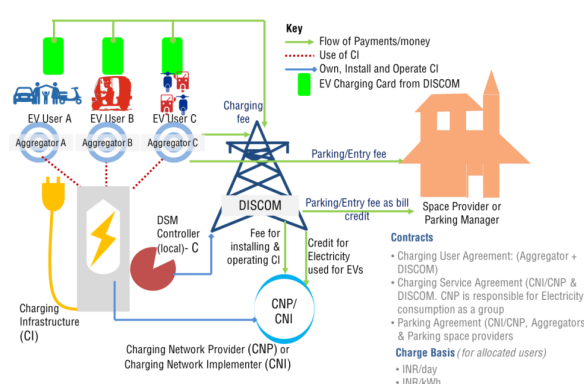


Figure 8 Likely business model for group charging

#### Aggregation

The DISCOM brings together multiple stakeholders:

- The DISCOM identifies aggregators who are open to partnering.
- The DISCOM identifies locations or parking lot owners who can collaborate in setting up night-time hubs.
- The DISCOM also identifies CNI's who can invest in the charging infrastructure based on capital cost recovery and operational costs.

There is a rationale for such a role for the DISCOM if it helps in the following ways:

- The DISCOM aggregates demands and attracts quality players (vehicle aggregators, parking owners/landowners, CNIs etc.)
- The DISCOM is able to select locations/ find partners in areas which are commercially attractive (e.g. near to major commercial districts, travel routes)
- The DISCOM is able to support the model by providing the chosen locations with right distribution infrastructure.
- An additional value can be provided by the DISCOM, by wheeling renewable electricity to the charging hub.
- The DISCOM provides the EV users with charge-cards, which are valid throughout the city at the DISCOM branded charging points. The charge-cards become attractive to the vehicle drivers, because it eases their operations and assures better availability of charging infrastructure compared to the individual aggregator.

Therefore, although the aggregators are carrying the charging infrastructure setting up work on their own at present, a DISCOM can provide tangible benefits by suitable aggregation efforts.

#### Permissions

Permissions for charging sites, sanction of load etc. would be handled by the DISCOM.

#### Implementation

The DISCOM ensures construction of the charging stations as per agreed specifications, costs and delivery. The DISCOM also sets up local load management system to comply with demand side management agreement, control of loads within the sanctioned load etc.

Subsidies, if any, available under state/central schemes could be routed through the DISCOMs.

#### Operation

The DISCOM delivers charge cards to users and charges them based on their agreement. The DISCOM credits the charging hub's electricity bills, for electricity charges collected via the charging stations. The DISCOM pays the CNP for the use of charging facilities and the parking lot owner for use of the space.

#### 6.5. Off-street public parking lots

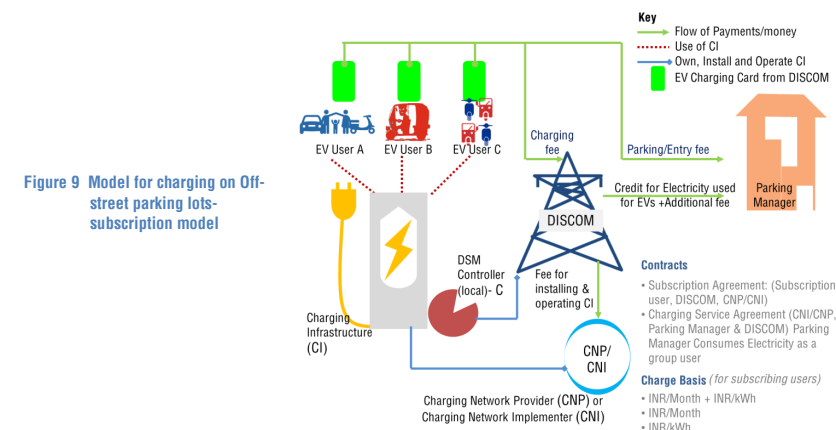


Figure 9 Model for charging on Off-street parking lots-subscription model

Independently standing public parking lots present a good opportunity to integrate charging facilities with parking. Depending on the parking needs, the segment can be analyzed further as follows:

- There are parking lots near markets, tourist places etc. where parking is frequently done for a short period (2-3 hours), except for owners of shops in the market who may need to park for longer time.
- Parking lots which provide nighttime parking for residents. They are located near residential colonies. There may be a subscription model for use of the parking by regular users.
- Parking lots which provide nighttime parking for commercial vehicles such as taxis, intra city delivery vehicles, autos etc.

Based on the request from regular users of such public parking lots, a CNI can set up EV charging stations. The parking lot can collect a fee over and above normal parking fee. The CNI can collect a charge based on INR/hr. and INR/kwh or INR/Charge

#### 6.5.1. ROLES THAT A DISCOM MAY PLAY IN SETTING UP CHARGING STATIONS IN PUBLIC PARKING LOTS

#### Aggregation

The DISCOM connects with multiple stakeholders:

- The DISCOM identifies locations or parking lot owners who can collaborate. Sets up commercial contracts
- The DISCOM also identifies CNI's who can invest in the charging infrastructure based on capital cost recovery and operational costs

- The DISCOM carries out surveys/connects with customers, and registers those wishing to shift to EVs if parking and charging solution can be provided. Special contact programs may be run to identify 3 WH drivers who wish to use EVs

Such registrations can indicate the required volume and location of the charging stations. This also gives confidence to users, who have not yet made up their mind to buy EVs, that there is an agency which can support in identifying the right charging solution for them.

Just like the case of group charging stations, additional value can be provided by the DISCOM, through its aggregation efforts:

- The DISCOM is able to support the model by connecting the chosen parking lots with right distribution infrastructure, including upgradation if needed
- Wheels renewable electricity to the parking lot if it is an intensive use of energy
- The DISCOM provides EV users with Charge Cards, which are valid throughout the city at DISCOM branded charging points. The Charge Cards become attractive to vehicle drivers, because it eases their operations and assures better availability of charging infrastructure compared to individual aggregator

DISCOM also benefits by such charging stations because most charging happens during the night, when electricity is surplus and costs are low.

#### Permissions

Permissions for charging sites, sanction of load etc. would be handled by the DISCOM.

#### Implementation

The DISCOM ensures construction of the charging stations as per agreed specifications, costs and delivery. The DISCOM also sets up local load management system to comply with demand side management agreement, control of loads within the sanctioned load etc.

Subsidies, if any, available under state/central schemes could be routed through the DISCOMs.

#### Operation

The DISCOM delivers charge cards to users and charges them as subscription Fee (INR/m or INR/charge) and INR/kwh for electricity used. The DISCOM credits the parking lot's electricity bills for electricity used in the charging stations. The DISCOM pays the CNP for the use of charging facilities and the parking lot owner for use of the space.

## 6.6. SWAP stations

SWAP stations have become popular for fleet operators (2 WH, 3 WH) as the swap system owner provides finance for batteries as well as sets up off street swap stations which can exchange empty batteries with fully charged batteries very quickly.

The significantly reduced time (a few minutes compared to 2-4 hours) to get the battery fully charged improves productivity of vehicles and their earning ability.

Individual EV owners, as discovered in our survey of 3 WH drivers, find swap services as difficult to access or risky:

- Swap service providers are unwilling to set up a charging service for a few individual subscribers
- There is a credit risk as the cost of battery is financed by the swap service provider and the borrower is an individual with small financial capability
- The individual drivers find it risky to buy a vehicle, where the heart, the battery, is owned by somebody else and there is a risk of non-performance (non-availability of battery when needed) which may directly impact their earnings. The risk of non-performance is higher, compared to an equivalent risk of fuel non-availability at a fuel retailer's station, as normally the swap batteries can't be charged at any other charging stations. The swap service provider recovers the cost of battery every time a swap is performed.

### 6.6.1. ROLES THAT A DISCOM MAY PLAY IN SETTING UP SWAP CHARGING STATIONS

The credibility of a swap service provider would be important. In our study we found that an efficient DISCOM, with

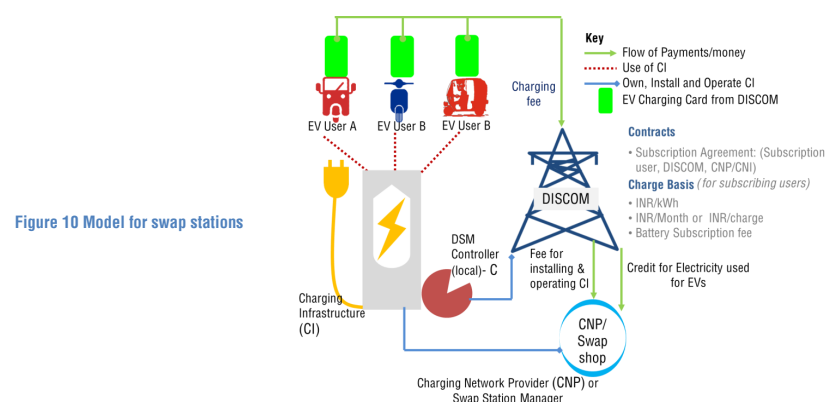


Figure 10 Model for swap stations

branded charging outlets available all around the city, will be perceived as more reliable. If it becomes possible to charge the battery across different formats of charging stations, including the swap stations, the risk perceived by the users would be further reduced significantly.

The existing business model of swap stations could be modified by the DISCOM as follows:

- Swap service provider (the DISCOM) charges a rental INR/day (for a defined time period say 5 years or a defined KM run, recovering the cost of battery and return on capital) and INR/kWh for electricity used for every charge.
- The user may be given the flexibility of charging at other direct charging stations managed/operated by the DISCOM.
- Swapping could have a higher charge for electricity, as it involves costs of extra inventory of battery kept in the swap stations. Charging at other DISCOM branded outlets or nighttime parking lots, could have a lower cost. Thus, swapping will be used only when urgent, day-time charge is needed.
- The DISCOM can still exercise control by ensuring that BMS (battery management system) lock opens to charge at only their managed/branded station.

The specific roles that DISCOM can play in implementation are outlined in the sub-sections below.

#### Aggregation

The DISCOM connects with multiple stakeholders:

- The DISCOM identifies willing customers (individuals and aggregators) and registers their interest. This will also identify routes and locations where swap stations would be most desired.
- The DISCOM also identifies CNP's who can invest in the Charging Infrastructure based on capital cost recovery and operational costs.
- The DISCOM identifies/empanels operators/locations where swap cum charging stations can be set up. The specs of a single swap stations (space, equipment, management etc.) can be standardized.

- The DISCOM identifies investors who are willing to provide finance for the batteries.
- The DISCOM then offers, a subscription-based charging service including swap, to individuals or aggregators.

Just like the case of group charging stations, additional value is provided by the DISCOM, through its aggregation efforts:

- Flexibility of charging across formats, using Charge Cards.
- Wheels renewable electricity to the charging stations.
- Scale advantage in terms of equipment costs.
- Assured customer access, hence lower risks.

#### Permissions

Permissions for charging infrastructure sites, sanction of load etc. would be handled by the DISCOM.

#### Implementation

The DISCOM ensures construction of the charging stations as per agreed specifications, costs and delivery.

At present, the swap models suffer from not being able to access subsidies as the EV buyer doesn't buy battery whereas the FAME subsidies are linked to battery capacity of the vehicles. This issue perhaps can be discussed with Niti Aayog and a solution found.

Subsidies, if any, available under state/central schemes, could be routed through the DISCOMs.

#### Operation

The DISCOM delivers the charge cards to users and charges them as subscription Fee INR/day and INR/kWh for electricity used. The DISCOM credits the charging lot's electricity bills for electricity used in the charging of EVs. The DISCOM pays the CNP for the use of charging infrastructure and the financier for the usage of batteries.

### 6.7. Public fast charge stations

These charge stations will be set up on most well used roads and will provide a fast charging (a few minutes to say, an hour) service. Within a city, this charging infrastructure will mostly be used just enough to reach home/office or other destinations, where a slower yet larger charging can take place.

The three types of locations where these chargers may be set up are:

#### In city chargers:

- Most cities are planning one charger at least in a 3 Km x 3 KM area. More can be set up as the usage scales up. These will be set up on most frequented roads.
- Such chargers are likely to be of 15-50 kW capacity, providing charge for a distance of 10-30 KM in 5-20 minutes.

#### Charging hubs, near the edge of the cities:

- These will serve large aggregators or vehicular movement between cities (entering or exiting a city)
- Most likely would be 50-350 kW catering of MCVs, Taxis, Cars or Buses.
- The hubs would also have other facilities such as restaurants, shops etc.



- The normal charging time could be 1-2 hours and the vehicle may charge for distances of 200-300 KM.

#### Highway charging stations

- These charging stations are planned on major highways to support inter-city traffic.
- These charging stations would also be 50-350 kW DC fast chargers
- The current plans are to set them up every 25/100 KM<sup>11</sup>

The government has started giving contracts to chosen PSUs and CNPs to implement these stations with FAME subsidies. Such charging stations, globally, have faced difficulty in developing a market-based model. In the final analysis, they may distribute ~5-8% of electricity consumed by EVs, unless Heavy Commercial Vehicles (HCVs) come into play. We don't assess a DISCOM would be able to play any meaningful role in such stations, being expensive and channeling a much smaller part of total electricity consumed.

## 7. Priority segments for DISCOMs

We have evaluated various Charging Infrastructure segments and suitability for anchoring by the DISCOM on the following dimensions:

- Potential size of the segment in terms of electricity consumption
- Customer connect for a DISCOM
- Openness of the segment to the participation by a DISCOM
- Ease of Program Management for a DISCOM

Ranking on each parameter has been done as High, Medium, Low and finally an overall ranking has been arrived.

Based on this analysis we recommend the following segments for focused efforts by a DISCOM<sup>12</sup>



Figure 11 Suitability ranking of charging infrastructure segments for a DISCOM anchored program

Charging Facility Type	Evaluation Parameter				
	Potential Size	Customer Connect	Openess to DISCOM Engagement	Ease of Program Management	Overall Ranking
Home Charging	High	High	High	High	High
Kerb-side Charging	Medium	Medium	Medium	Medium	Medium
Commercial Spaces	Medium	Medium	Medium	Medium	Medium
Group Charging	High	Low	Low	Low	Low
Parking Lots	Medium	Low	Medium	Medium	Medium
Swap Stations	Medium	Low	Medium	Low	Low
Public Fast Charging	Low	Low	Medium	Medium	Medium
Key Score	High	Medium	Low		

<sup>11</sup> MOP guideline Oct 2019

<sup>12</sup> This analysis is in the context of Delhi and BSes Rajdhani as the DISCOM. Ranking will differ based on cities and DISCOMs



## 8. Policy recommendations

Our analysis identifies the following areas where urgent policy action is needed to ensure fast take-off of Charging Infrastructure (and consequently EVs)

- Policy for kerb-side parking cum charging stations.
- Policy for smart charging within buildings and TOU tariffs
- Policy for subsidies to swap vehicles (equivalent to normal EVs)
- Charging infrastructure mandates for buildings, through building codes.

The following paragraphs provide detailed explanations

### 8.1. Policy for kerb-side parking cum charging stations

Delhi Maintenance and Management of Parking Places Rules (Sep 2019), place an emphasis on formal paid parking in the streets, the cost of which may be higher than the cost of parking in a commercial parking lot. Cost of parking may also be dynamic, dependent on time of use or filled up capacity of the parking lot. Certain areas completely prohibit street parking (e.g. near busy intersections) and parking rule violations are expensive and implemented strictly.

Other cities, such as Bengaluru, are also implementing similar policies.

A consequence of such policies would be:

- Scaling up of local parking lots for residents and shop keepers.
- Fee based parking on certain streets, allocated to individual users.
- Night-time parking on certain streets, where commercial vehicles can park when traffic flow is light (say 10 pm to 6.0 am)

When paid street parking becomes the norm, it may be possible to use certain streets for charging alongside the parking slots- based on request from the parking users. For slots not allocated by municipal corporations, local community may permit usage.

#### 8.1.1. KEY ELEMENTS FOR KERB- SIDE CHARGING POLICY

Hence the policy for kerb-side charging may have the following elements:

- Fee for parking- may be different for different areas; may change based on the 'time of use'.
- Charging infrastructure – Specifications for the charging infrastructure and parking at such as location. The charging infrastructure may be implemented as an underground station<sup>13</sup> which gets activated by charge card and comes up for connection. The policy may permit use of electricity from nearby streetlight poles or sharing the charging station by more than one vehicle through multiple cables.



- Charging infrastructure provider to pay electricity charge and parking fee to the municipal body. The Charging Infrastructure provider collects EV charging fee (inclusive of all costs and permitted margin) from EV users.

The policy may include elements such as:

- Maximum time for which a vehicle may be permitted to use the charging station.
- Parking restrictions relating to times when no parking or charging may be allowed
- Penalties for parking vehicles without charging or violating parking norms.
- The charging infrastructure payment process may also be used to collect penalties from vehicles wrongly parked or parked beyond agreed times. The station may have a CCTV to monitor parking-cum charging as well as a theft prevention device. After deducting a management fee, the balance may be paid to the municipal body or traffic department.
- Consequences of defaults- for example towing of vehicles or addition to cumulative default record of the vehicles and consequent escalated penalties etc.
- Use of allotted kerb-side charging station. For example, will it be reserved only for the allocated user or will it be open for any user based on first-come-first-served principle? Some locations may be granted for exclusive use of an applicant and others may be open for public use.

#### 8.1.2. PROCESS FOR KERB-SIDE CHARGING

Processes may be laid out for installing the charging station

##### *Application and key terms for a kerb-side charging station*

- Definition of who can apply
- Local community approval
- Specifications of charging stations
- Site inspection and checks before grant of permission (DISCOM, Municipal Corporation, Traffic Department etc.)
- One-time processing fee
- Charging basis
- Services provided by the Charging Infrastructure provider.
- Obligations of the Charging Infrastructure user
- Validity – the time for which such parking may be allowed
- Termination (e.g. due to shift of residence/shop, inability to pay, change of municipal rules, traffic conditions etc.).
- Change of vehicles
- Transfer or sharing of parking-cum-charging permissions.

##### *Form with applicant details ( e.g. residence, type of vehicle purchased or to be purchased)*

This work will involve discussions with the municipal body, the transport department/traffic police and the DISCOM.

<sup>13</sup> Wireless charging also has been proposed for kerb-side charging stations.

## 8.2. Policy for smart charging within buildings and TOU tariffs

Buildings (residential, commercial or even industrial) have sanctioned load limits. Adding EVs may increase peak loads, and unless managed, will breach the sanctioned load limit. Normal DISCOM policy permits breaching the sanctioned load only on payment of demand charges linked to increased maxima and in case the breach continues for more than a defined period, consumers must apply for an increasing their sanctioned load.

In buildings, sanctioned load is always significantly higher than average load. It is therefore possible to use digital systems for controlling some flexible loads, to operate during the off-peak times, thus reducing the need for increasing the sanctioned load. This Demand Response (DR) method can be applied to EVs, as EV charging at homes, offices, long hour parking services etc. can be scheduled. Such controlled charging is termed as smart charging. A local controller, managed by the charging infrastructure provider, can schedule EV charging in a building or parking lot, to keep the overall load within the sanctioned load.

Most EV users seem open to the use of 'smart charging' and are willing to pay higher costs if they have to charge during peak times. *Smart charging combined with high TOU (Time of Use) rates may be a very useful strategy, when EVs scale up, to contain the rise in peak loads and reduce the distribution infrastructure stresses.* TOU tariff may incentivize the EV user to shift charging to off-peak times or be imposed with higher charges. The rates and peak times can be varied dynamically based on load conditions.

Many states and electricity regulatory commissions have defined tariffs for EV charging at public charging stations. This will need to be reviewed for implementing smart charging:

- Out of the 7 identified charging station types in our analysis, those in commercial complexes or residential complexes with restricted use may lie somewhere between private and public charging stations
- Regulators may permit use of public charging tariffs for private or semi/private chargers as long as they subscribe to smart charging

### 8.2.1. KEY ELEMENTS FOR SMART CHARGING POLICY

A policy may need to be laid out for smart-charging which may include the following elements

- DR responsibilities of the charging infrastructure provider and how the process will work. Will include prioritization and scheduling norms.
- Form to be filled by EV users opting for smart charging controls by DISCOM or the charging infrastructure provider/investor
  - Will involve both the EV user (s) as well as the building manager.



- If charging infrastructure is shared, all users will sign up.
- If TOU charges / TOU policy gets implemented. A rationale for applying TOU charges must be developed.

### 8.2.2. KEY ELEMENTS FOR THE PROCESS OF SMART CHARGING

Process description may include the following:

#### *What happens when sanctioned load limit is breached?*

- The process of kicking-in of automatic controls by the infrastructure manager/DISCOM.
- Permitted over-ride in certain cases with pre-agreed penalties for the forced breach.
- Providing TOU charge information to the EV user before any charging and getting user prior approval through the mobile charging application provided by the charging infrastructure manager.
- User charge will include additional TOU charges and penalties if any. After completion of each charging, the information on total charge-cost with break-up will be shared with the user.

## 8.3. Policy for subsidies for swap services and/or battery financing products

FAME subsidies for EVs have been linked to the battery capacity of the vehicle purchased. However, EVs working with swapping stations may be bought without batteries. The batteries are separately financed and provided by the swapping service provider.

The policy for EV subsidies may need to be revised therefore and provided to the user or financier based on the battery capacity financed.

All other conditions relating to EV subsidies (vehicle specifications, accreditations etc.) can remain the same as for normal EVs.

## 8.4. Building codes for minimal charging infrastructure and preparedness

Buildings (residential, commercial or industrial) and parking lots beyond a certain size, may need to provide a certain minimum number (or %) of parking slots as ready for EV charging. Readiness may be checked by third party verifiers. The actual charging infrastructure may be installed based on the user request.

The policy may include:

- Definition of buildings which qualify for these norms.
- Definition of readiness and how it will be checked and verified.
- Process for approval of the building as meeting the charging infrastructure norms.
- Consequences for defaults.

This policy is necessary, as EV users, especially in gated communities with utilities managed by the resident welfare association or building managers, find it difficult to navigate the acceptance/approval processes, as it leads to potential increase in the sanctioned load (the cost of which may have to be shared by all the residents).



## 9. Conclusions

IEMF market survey has brought to light some interesting insights on consumer perceptions and expectations from EVs for different vehicle segments. Each consumer segment will evaluate EV economics differently, look for products that meet their needs and then decide to transition or adopt EVs.

The survey establishes that viable charging access is a concern for all potential users and will not be covered simply by actions relating to PCSs.

DISCOMs can play a very important role in establishing an eco-system of charging infrastructure, facilitated by:

- Their customer-connect
  - Customers know them, have dealt with them, and if services are managed efficiently, can trust them more than third party vendors
  - Existing process of metering, billing, payments etc.
- DISCOMs can offer single point program management, which no other institution can offer
- DISCOMs can set up, operate or manage a variety of charging infrastructure. Since EV customers need different types of charging infrastructure at different points of time, dealing with a single supplier is critical for easy operations
- The necessity of DISCOM involvement in managing EV loads, along with other electric loads (peak load management, need for infrastructure upgrade, potential V2G services in future etc.)
- DISCOMs can bring in significant benefits of *aggregation* (customer demand aggregation, aggregation of services from CNI/CNP, payment assurance to various parties involved, collections efficiency from different segments, dealing with regulators, distribution of subsidies etc.)

In our study we have proposed business models and program designs for setting up DISCOM anchored charging infrastructure.

To support DISCOM anchored programs, the following policies would need further work:

- Policies for smart charging and time of use tariffs.
- Policy for kerb-side charging
- Policy for subsidy for EV users using SWAP stations for charging or using battery financing.
- Building codes to support installation of charging infrastructure.

These ideas must be piloted before scale up. Our report provides profiles of such pilots, implemented in other countries which are ahead of the curve in scaling up EVs.



## 10. Acknowledgements

This part of the study has benefited greatly from the vision of Abhishek Ranjan, VP BSES Rajdhani, who along with his team including Pradeep Aggarwal and Chetan Pathak has contributed significantly in designing and implementing this study. Subhash Jha from BRPL took the role of community manager and was instrumental in engaging BSES consumers for this study. IEMF Team was led by Vinod Kala, and included Snigdha Kala, Anirudh Narla and Shivani Singh. The team conducted desk research on global business models and utility roles. We then designed and explored suitable business models based on survey results and desk research. BRPL team was instrumental in defining charging program designs that DISCOMs can explore.

In this study, the team has also explored a large number of global charging programs to identify successful strategies. We are thankful for the public resources –reports and other articles that cover results of global pilots and new program structure solutions. Relevant sources are mentioned in the footnotes throughout the document



BSES Rajdhani Power Limited



India E Mobility Finance Facility (IEMF)



## Annexure I: Review of global EV charging programs

<b>Program Name</b>	<b>The EV Charge Network Program<sup>14</sup></b>
<b>Managing utility</b>	Pacific Gas & Electric (PG&E), California
<b>Customer Segments &amp; Program Highlights</b>	<ul style="list-style-type: none"> <li>- Utility got the approval in December 2016 to install up to 7500 Level-2 EV chargers at multi-unit dwellings, and workplaces</li> </ul>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Enrol customers online, review eligibility (site info, assessment of costs and technical feasibility)</li> <li>- Enrol charger vendors</li> <li>- Prepare site design layout and get participant's approval</li> <li>- Pay for, own, maintain and coordinate construction of the infrastructure from transformer to the parking space (~ 60-80% of the total project cost in US)</li> <li>- Activate and inspect chargers, monitor data post installation</li> <li>- Provide rebate on cost of charger</li> <li>- Maintain chargers for 10 years, customers pay AMC for self-owned chargers</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply online, if interested</li> <li>- Select the type of chargers to be installed from the Utility's vendor list</li> <li>- Select whether to own the chargers or have the Utility own the chargers</li> <li>- Pay for electricity.</li> <li>- In some cases pay for and own the chargers, selection based on participant requirement (vendors further restricted)</li> <li>- Define rights of access to the chargers: to employees, fleet vehicles or the public</li> </ul>
<b>Program Name</b>	<b>Charge Ready Program</b>
<b>Managing utility</b>	Southern California Edison (SCE), California <sup>15</sup>
<b>Customer Segment &amp; Program Highlights</b>	<p>Targeted to non-residential customers (work places, multi-unit dwellings, fleets, destination centres like malls). 1,280 charge port commitments at 79 sites by the end Q4 of 2018. An advisory board of customers, industry stakeholders, and representatives of disadvantaged communities was selected to advise during pilot implementation and execution</p>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Enrol interested customers, review eligibility</li> <li>- Evaluate site and existing utility infrastructure, develop the proposal (potential number of charging stations and proposed location deployment), seek participant acceptance</li> <li>- On-board charger vendors</li> <li>- Install, own, maintain, and pay all costs for readying the site for charger installation, including: <ul style="list-style-type: none"> <li>- Electricity distribution infrastructure (transformers, service lines, &amp; EV meters)</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>- Customer-side infrastructure (panels, step-down transformers, wiring, conduits, stub-outs)</li> <li>- Inspect final installation</li> <li>- Process and release funds towards cost of chargers and installation.</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Online application, minimum period of participation is set at 10 years<sup>16</sup></li> <li>- Own, lease, or operate a site with long dwell time parking</li> <li>- Provide an easement granted to the Utility by the property owner (to grant certain rights to Utility to secure the infrastructure it will deploy)</li> <li>- Responsible for procuring, installing, and maintaining qualified EVSE, including electrical energy and networking costs from approved vendors within 30 days of enrolment</li> <li>- Deliver proof of purchase of qualified charging equipment</li> <li>- Subscribe to a data management plan with an approved EV charging network service provider and Charging transactions data id shared with the utility</li> <li>- Compulsory participation in future Demand Response (DR) programs</li> <li>- Responsible for operating costs, including equipment repairs and maintenance, EV charging network subscription, and electricity costs</li> </ul>
<b>Program Name</b>	<b>Power Your Drive (PYD)</b>
<b>Managing utility</b>	San Diego Gas & Electric (SDG&E), California <sup>17</sup>
<b>Customer Segment &amp; Program Highlights</b>	<p>Caters to apartment buildings, condominium complexes, and workplace locations Chargers can be used by employees or residents of the respective workplaces or multi-unit dwellings. may not open to the general public</p> <ul style="list-style-type: none"> <li>- Started in 2017</li> <li>- Installed over 3000 charging stations at 255 locations</li> <li>- Caters to apartment buildings, condominium complexes, and workplace locations</li> <li>- Utility or Customer may own the charger</li> <li>- Third party vendor operates and maintains chargers, may offer additional services like managed parking, fleet EV management, or load management</li> <li>- Optional special rate structure called "Vehicle-Grid Integration" is available to users. This incentivizes charging when electricity supply and renewable energy production are high and, consequently, energy prices are low (<a href="https://www.sdge.com/pyd-map">https://www.sdge.com/pyd-map</a>).</li> <li>- Power Your Drive bill is separate from Utility bill</li> <li>- The pilot was fully subscribed within 2 years</li> <li>- Filed a proposal to bring 2000 more</li> </ul>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Enrol customers, review eligibility</li> <li>- On-board charger vendors (<a href="https://marketplace.sdge.com/ev-chargers/">https://marketplace.sdge.com/ev-chargers/</a>)</li> <li>- Prepare preliminary designs and secure participant's approval</li> <li>- Design, engineer and install chargers at low or no cost to property owners</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply for the program</li> <li>- Select the type of chargers to be installed from Utility's vendor list</li> <li>- Pay for electricity. Can bill drivers or offer charging for free</li> </ul>

<sup>14</sup> EV Charge Network Program, PG&E. 2018.

<sup>15</sup> Charge Ready Program Pilot. Southern California Edison Company, 2018.

<sup>16</sup> Charge Ready Program Factsheet. 2016 Southern California Edison Company, 2018.

<sup>17</sup> Installing and EV charging station for your apartment or condo complex. San Diego Gas and Electric. NA. Online.

<b>Program Name</b>	<b>Charging Forward</b>
<b>Managing utility</b>	DTE Electric, Michigan <sup>18</sup>
<b>Customer Segments &amp; Program Highlights</b>	<ul style="list-style-type: none"> <li>- Approved 150 charger port rebates since launch</li> <li>- \$20,000 rebate for DC Fast Chargers along highways (14 installations), further expansion plans</li> <li>- \$2,500 rebate for Level 2 chargers in public spaces, workplaces, and multi-unit dwellings (75 installations)</li> <li>- \$500 rebates for Level 2 chargers of residential users enrolled for year-round time-of-use electric rate (61 installations)</li> </ul>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Enrol customers, review eligibility</li> <li>- Fund, install, and maintain distribution system upgrades at no cost to the participant</li> <li>- Provide rebate to the Participant as follows: <ul style="list-style-type: none"> <li>- Lesser of: electrician cost or \$2,500 per Level 2 port, and</li> <li>- For DC fast chargers- commercial (\$20,000/charger), residential(\$500/per charger)</li> </ul> </li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>~ Apply to the program</li> <li>~ Demonstrate their right to install, own, operate, and maintain charging equipment on the site</li> <li>~ Agree to install, fund, own, operate, and maintain (for a min. of 5 years) new, charger with a corresponding qualified Network Provider</li> <li>~ Install at least four Level 2 ports or two DCFCs per Site (commercial)</li> <li>~ Enrol in future demand response programs, with an option to override the signal at a higher rate through an advanced notice if desired to do so (only residential)<sup>19</sup></li> <li>~ Incorporate Utility branding on chargers</li> <li>~ Share charging station utilization data with the Utility</li> <li>~ Establish required electric service orders for scheduling &amp; installation of EV Charger</li> <li>~ Identify and contract with a licensed electrician for required infrastructure upgrades</li> <li>~ Ensure visibility and access to chargers</li> <li>~ Pay the electricity costs</li> <li>~ Charge a transparent price to EV drivers for EV charging services</li> <li>~ Participate in Utility surveys: experience with the rebate, charging stations, EV drivers, etc.</li> <li>~ Agrees to properly remove and dispose of or recycle or de-energize the charger in accordance with all applicable laws and regulations at the customer's sole expense</li> </ul>
<b>Program Name</b>	<b>Workplace Charging Scheme<sup>20</sup> and the Electric Vehicle Homecharge Scheme</b>
<b>Managing utility</b>	Office for Low Emission Vehicles (OLEV), UK
<b>Customer Segments &amp; Program Highlights</b>	<ul style="list-style-type: none"> <li>- Grants 75% of the total cost of installation, capped at £500 per socket</li> </ul> <p>For Workplace</p> <ul style="list-style-type: none"> <li>- Open to registered business, charity, or public sector organisation (evidenced by a Companies</li> </ul>

	<p>House Reference Number/VAT Registration Number/HMRC Registration Letter</p> <ul style="list-style-type: none"> <li>- Max. limit of 20 charge points</li> </ul> <p>For Domestic</p> <ul style="list-style-type: none"> <li>- Eligible individuals, includes those who for at least six months:</li> <li>- Are assigned a company car</li> <li>- Lease an eligible vehicle</li> <li>- Have leased the vehicle as part of a salary-sacrifice scheme</li> <li>- Are named by their employer as the primary user of an eligible electric vehicle</li> <li>- Can prove that they have ordered an eligible electric vehicle</li> <li>- Grant limited to one charge point per household/electric vehicle</li> <li>- Date of installation must not be more than 4 months ahead of the date of delivery or start date of vehicle use</li> </ul>
<b>Utility function</b>	<p>For Workplace</p> <ul style="list-style-type: none"> <li>- Enrol customers, review eligibility, issue a unique voucher</li> <li>- Maintain a list of authorised vendors</li> </ul> <p>For Domestic</p> <ul style="list-style-type: none"> <li>- Enrol customers, review eligibility</li> <li>- Maintain a list of EVs eligible for the grant <sup>21</sup></li> <li>- Maintain a list authorised installers</li> </ul>
<b>Customer Function</b>	<p>For Workplace</p> <ul style="list-style-type: none"> <li>- Apply for the program<sup>22</sup></li> <li>- Complete the installation within 4 months of receiving the voucher</li> <li>- Install from authorised vendors only</li> <li>- Submit evidence of installation and claims grant before voucher expiry date</li> <li>- Reapply for a new voucher, if the installation is not complete within 4 months</li> </ul> <p>For Domestic</p> <ul style="list-style-type: none"> <li>- Should provide the evidence of ownership/lease of the space/EV;</li> <li>- Minimum retention period of 6 months; OLEV must be informed in case of early exit</li> </ul> <p>Provide registration information of the vehicle, except in the case of buying an EV</p>
<b>Program Name</b>	<b>Smart Charge Hawaii Program<sup>23</sup></b>
<b>Managing utility</b>	Hawaiian Electric Company
<b>Customer Segments &amp; Program Highlights</b>	<p>Hawaiian Electric has started a program with Elemental Excelsator (an impact accelerator) and Enel X (a private company funded by the Italian electric utility) for setting up smart charging stations for first 300 EV drivers and 50 businesses willing to participate in the program.</p> <p>Under this program, Hawaiian Electric will award a total of \$400,000 in rebased for EV charging</p>

<sup>21</sup> Grant Schemes for electric vehicle charging infrastructure. Gov.uk. Jan 2019.

<sup>22</sup> Work Place Charging Scheme application form. Gov.uk. Jul 2018.

<sup>23</sup> Smart Charge Hawai'i program to make EV Charging available to residents and businesses. Hawaiian electric. 2019.

<sup>18</sup>Charging Infrastructure Enablement Agreement. DTE Michigan. 2020.

<sup>19</sup>Residential Smart Charger Support Agreement. DTE Michigan. 2020.

<sup>20</sup>Workplace Charging Scheme-Guidance Document for applicants, Chargepoint installers and Manufacturers. Mar 2020.

	<p>stations, Rebates for</p> <ul style="list-style-type: none"> <li>-AC Level 2 multi-port charging stations with network connectivity –rebates of \$4,500 (new installation) and \$3,000 (retrofit)</li> <li>-For DC Fast-Charging stations with network connectivity – rebates of \$35,000 (new installation) and \$28,000 (retrofit).</li> </ul> <p>Chargers are free but installation cost must be borne by the user. Once deployment starts, load building and load shifting grid services will be managed by Enel x.</p> <p>It is open for existing consumers of Hawaii Electric, Maui electric, Hawaii Electric light.</p> <p>The platform will match charging patterns with real time input from utility to aggregate and manage charging demand to allow drivers to charge when electricity costs are lower, renewable energy is most available.</p>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Deploying the earmarked funds for EV charger deployment</li> <li>- Engage and support in the management of the program with partners</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply online</li> <li>- Pay bills on time</li> <li>- Share data with the platform</li> </ul>
<b>Program Name</b>	<b>DCFC (DC Fast charging ) Incentive Program<sup>24</sup></b>
<b>Managing utility</b>	New York Electricity Utilities
<b>Customer Segments &amp; Program Highlights</b>	<p>Phased incentive to be provided to DCFC installation per plug installed in public location (first 1074) above 75kW (for range: 50 -75kW-60%of incentive will be given). The incentive will be released annually, in a phased manner till 2025.</p> <p>Demand metered connections will be provided for the chargers (This takes away fixed demand charges, metering is done based on applicable tariff for the peak demand in 15 minute intervals. Public chargers are those for which no parking fee is applicable, those charging parking fees for the space will refund the charges for EVs in order to avail the incentive. To become eligible these fast chargers would have to have both CCS and CHaDeMO plug.</p>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Providing the special meters, and connectivity</li> <li>- Review and select eligible customers within 10 days from the last date defined for the year</li> <li>- After 12 months of commercial operation, issue the incentive to the customer</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply for participation</li> <li>- Pay charges for infrastructure upgrades as required by utilities and submit required documents within 180 days</li> <li>- Complete the installation within 1 year</li> <li>- Maintain the facility till 2025</li> <li>- Share data with the utilities</li> </ul>
<b>Program Name</b>	<b>Duke Energy electric transportation program in North Carolina</b>
<b>Managing utility</b>	Duke Energy, an electric utility in North Carolina
<b>Customer Segments &amp; Program Highlights</b>	<p>Duke energy proposes to invest 76 million USD in EV infrastructure in the state.</p> <ul style="list-style-type: none"> <li>- Residential EV charging: 1000 USD rebate for level II chargers for up to 800 residential</li> </ul>

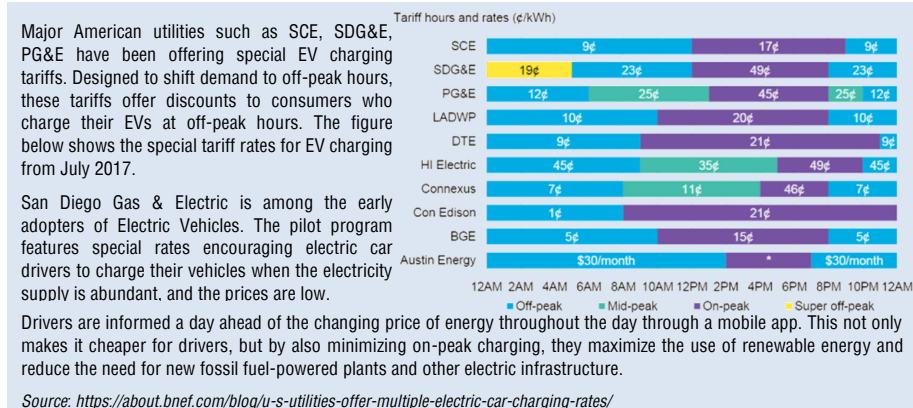
	<p>customers</p> <ul style="list-style-type: none"> <li>- Public charging: 800 public charging stations (DCFC, public level II, multifamily dwellings)</li> <li>- Fleet EV charging: 2500 USD rebate for 900 qualifying chargers</li> <li>- EV school bus: financial support for up to 85 electric school buses</li> <li>- EV transit bus charging station: more than 100 electric transit bus charging stations</li> </ul>
<b>Utility function</b>	- Identify eligible sites set up chargers
<b>Customer Function</b>	- Apply for participation
<b>Program Name</b>	<b>Park &amp; Plug in Florida- Duke Energy</b>
<b>Managing utility</b>	Duke Energy, an electric utility
<b>Customer Segments &amp; Program Highlights</b>	<p>Qualified site hosts serve as charging station locations, chargers are provided free of cost, program runs through December 2022.</p> <p>NovaCHARGE manages the installations of EV smart charging equipment for the park and plug pilot in Florida.</p> <p>Site host eligibility:</p> <ul style="list-style-type: none"> <li>- Must be a Duke Energy consumer in Florida</li> <li>- Site location must be safe well lit, paved, adequate access (ingress and egress), adequate power in close proximity</li> </ul>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Identify eligible sites set up chargers</li> <li>- Conduct feasibility assessment</li> <li>- Formalise agreement with host (owner of the site)</li> <li>- Install new meters at no cost</li> <li>- Support NovaCHARGE in installation of chargers</li> <li>- Own and operate the charging station network</li> <li>- Operate manage the services till 2022</li> </ul>
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply for participation</li> <li>- Commit to participate till 2022</li> <li>- Apply for separate connection and meter as required</li> <li>- Provide one parking space per charging port</li> <li>- Provide non-discriminatory access to EV charger</li> <li>- Pay for electricity</li> </ul>
<b>Program Name</b>	<b>It Pays to Plug- New Jersey</b>
<b>Managing utility</b>	New Jersey Department of Environmental Protection along with NJ Board of Public utilities.
<b>Customer Segments &amp; Program Highlights</b>	<p>Open to Multiunit dwellings, workplaces and educational institutions for level 1 and level2 DC fast charging stations, grant of a % of eligible costs up to \$750 for level 1 chargers, % 5000 for single port level 2 chargers and \$6000 for dual port level 2 chargers, the grant level depends on who own the property, is higher for government owned property when compared with private properties.</p> <p>The program has already allocated 4.2 million USD.</p>
<b>Utility function</b>	<ul style="list-style-type: none"> <li>- Review and Select participants</li> <li>- Evaluate project plans</li> </ul>

<sup>24</sup> Central Hudson DCFC Incentive Program Implementation Manual. Central Hudson. Oct 2019.



	- Release funds on completion
<b>Customer Function</b>	<ul style="list-style-type: none"> <li>- Apply for the participation, submit required proofs</li> <li>- Complete the installation work within 9 months of grant approval</li> </ul>
<b>Program Name</b>	<b>Norway's Charge and Drive Program<sup>25</sup></b>
<b>Managing utility</b>	
<b>Customer Segments &amp; Program Highlights</b>	<p>Norway has one of the most well developed charging programs in the world. It started with 100% subsidies for home chargers (2009-2010). Rapid technological advancements made these initial investments obsolete, and the program was upgraded for fast charging stations 2010-2014, many were operated by local utilities. From 2015 the state enterprise Enova, took over the fast charging program, to own and operate these public fast chargers.</p> <p>Enova's work has created a growing trend of adoption of fast chargers. Fast charging operators are now building faster chargers without public funding as the number of electric cars in Norway has become quite large.</p> <p>2 large operators dominate– Fortum and Grønn Kontakt, they have a pay/minute payment scheme for vehicles.</p> <p>Under the program a national database of chargers is maintained by Enova which allows relevant information to be available to users. For private charging Oslo municipality has a support scheme for housing cooperatives and associations with 20% of the total investment requirement.</p>
<b>Program Name</b>	<b>EV Green Charger Program<sup>26</sup></b>
<b>Managing utility</b>	Dubai Electricity and Water Authority (DEWA)
<b>Customer Segments &amp; Program Highlights</b>	<p>The chargers are installed at government offices, airports, petrol stations, shopping malls, commercial spaces, hospitals, residential complexes and establishments.</p> <p>The Program First launched in 2014, the second phase is under implementation since 2018. 100 chargers were installed in the first phase, and another 100 in second phase. Total number of chargers now stands at 240.</p>
<b>Utility function</b>	<p>DEWA coordinates with other government stakeholders (municipality, roads and transport authority (RTA) to ensure standards are met.</p> <p>The charging points are owned and managed by DEWA.</p> <p>It is issuing green charge cards for users to enable them to use services across facilities.</p> <p>It provided free charging for EV owners registered in the green charging initiatives till Dec 2019. This has now been extended for non-commercial users till Dec 2021. Commercial users pay a small fee.</p> <p>Bills are made monthly based on usage recorded per card.</p> <p>The RTA provides free assigned parking, exemption of registration fees and exemption from tag fee as well as special stickers for EVs.</p>
<b>Customer Function</b>	<p>Register in the green charging program.</p> <p>All public and private organisations must get approvals from DEWA for establishing, installing, operating and maintaining any electric vehicle charging station.</p>

	Use the available facilities and pay their dues on time.
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<sup>25</sup> Charging Infrastructure experiences in Norway- the world's most advanced EV market. E. Lorentzen, P. Haugneland, C. Bu, E. Hauge. Oct 2017.

<sup>26</sup> EV Green Charger Program. Dubai Electricity and Water Authority

Kerbside charging is a critical need in urban centers for mass adoption of EVs. Some examples of curbside charging programs are also summarized.

Table 1 Examples of international kerb-side programs

City	Agency	who applies	Location	Chargers
Sacramento, US	City Council	EvGo (Operator)	-Minimum site eligibility conditions set in bidding Sites verified by city council for selection	Three 50kW DC Fast Charger Three 150 kW DC Fast Chargers 15 charger program
Vancouver, Canada	City Council	Individuals	-For individuals who do not have dedicated parking at homes -Individual applies	15 stations - pilot to drive a neighborhood plan
New York, US	ConEdison (utility)	Operators	Selected by utility	60 level 2 chargers, 20 exclusive for fleets, rest public- AddEnergie curbside chargers
Berkeley, US	City Council	Individuals	-Minimum site eligibility conditions set in bidding -Sites verified by city council for selection -Only for applicants with no other charging options	25 Kerb-side charging pilot
Seattle, US	Seattle Dept. of Transportation (SDOT)	Individuals	-Minimum eligibility conditions set -City staff reviews site/proposal -Individuals apply for street use permit & electrical connection -SDOT sends applicant final approval -Applicant starts construction	2DC fast Charging Stations
Edmonton, Canada	ATCO (Utility)	Operators	Selected by utility	5 dual port kerb-side chargers-pilot
Amsterdam, Netherlands	Nuon (utility)	Operators	selected by utility	
London, UK	City Council	Operators	Individual communities nominate sites, selected by council/committee	>1000 lamp pole Chargers

Thus, it is evident that utilities in more developed markets are pushing public charging facilities very actively.

Some other notable examples include the

- Workplace Chargepoint grant program in the UK that covers upfront cost of purchase and installation costs (up to £500/socket) up to 20 points per applicant,
- The on-street residential charge point scheme which cost of installation is another popular program in the UK;
- Swedish Kimatklivet program, an investment incentive program covers charging infrastructure with a grant up to 50% of the investment in public and private charging stations.

Similar programs are available for charging installations across Europe as well. Nearly all studies demonstrate that home charging remains the primary means of charging for private vehicles.

## Annexure II: Main highlights of Delhi's EV policy (released 7<sup>th</sup> August 2020)

### Targets

- The EV Policy aims to drive the rapid adoption of Battery Electric Vehicles (BEVs) such that they contribute to 25% of all new vehicle registrations by 2024.
- The policy particularly focuses on electric two-wheelers, transport vehicles (e.g. three-wheelers, light goods carriers, taxis, buses) and goods carriers/freight vehicles, since they contribute to majority of the vehicular pollution.

### Subsidies for EVs

- Purchase incentive of Rs 5,000 per kWh of battery capacity. For an average e-two wheeler with 2kWh battery, applicable incentive would be Rs 10,000. A cap of Rs 30000 would be applicable. Scrapping incentive of up to Rs 5000 to be offered subject to evidence of matching contribution from the dealer or OEM.
- Ride hailing service providers will be allowed to operate electric two wheeler taxis, which will be a big boost to clean last-mile connectivity.
- All two-wheelers engaged in last-mile deliveries (e.g., food delivery, e-commerce logistics etc.) will be expected to transition 50% of their fleet to electric by March 2023, and 100% of their fleet by March 2025.
- Capital subsidy of Rs 30,000, a scrapping incentive of Rs 7,500 and an interest subvention of 5% (only for vehicles using high performance li-ion batteries) would be available for *e-autos*, *e rickshaws* and *light goods carriers* (L5N, N1). The vehicles wouldn't require license and would be subject to a cap if set by the Supreme Court. The subsidy for light goods carriers would be limited to first 10,000 vehicles.
- So, a loan of typically 12% interest from DFC will now be made available at 7% - the lowest anywhere in India for EVs.
- Purchase incentive of ₹10,000 per kWh of battery capacity for first 1000 cars subject to a cap of Rs 1,50,000 per vehicle

### Government Procurement

- All leased/hired cars used for commute of GNCTD officers will be transitioned to electric within a period of 12 months from the date of notification of this policy  
At least 50% of all new buses would be electric buses (including smaller buses for last mile connectivity).

### Permit, registration cost waivers

- Road tax and registration fees to be waived for all Battery Electric Vehicles during the period of this policy.
- For light goods carriers (EVs), no prohibitions and restrictions on plying on roads and idle parking would apply.
- Green number plates would be used for EVs for easier identification.

### Charging Infrastructure

- All new home and workplace parking will need to be 'EV ready' with 20% of all vehicle holding capacity/parking required to be EV ready.

- Delhi government to provide a 100% subsidy for the purchase of charging equipment up to ₹6,000 per charging point for the first 30,000 charging points at homes/workplaces. Subsidy to be routed through DISCOMs who will be in-charge of charger installations.
- *Customers of all DISCOMs operating in Delhi shall provide the facility to purchase a Private Charging Point online at a price net of the GNCTD grant, and request for charger installations at their premises.*
- *Charging points need to be engineered for safe charging of Electrical Vehicles, communicate with DISCOMs to enable load management, and offer metering that enables shared use and special tariffs to be offered for Electric Vehicle.*
- Providing accessible public charging/battery swapping facilities within 3 km travel from anywhere in Delhi is a key objective of this policy.
- a Working Group on Accelerated Rollout of Charging Infrastructure in Delhi ('Charging Infrastructure Working Group') has already been established by the Power Department, GNCTD with representative from all relevant government agencies, DISCOMs and Local Bodies vide order no. F11(50)2019/Power/1216 dated 29.04.2019.
- Concessional locations would be identified and Energy Operators (EOs) would be enrolled to set up Charging Infrastructure at such locations. Process for selection of EOs would be notified and Delhi Government would provide capital subsidies for such locations.
- *EOs would be required to offer charging using charge cards. An open, publicly owned database shall be developed by Transport Department, GNCTD offering historical and real time information on public charging infrastructure i.e., kWh, session length, vehicle type if available, number of events, location (latitude, longitude) of the charger, number of chargers at site, site classification, payment amount, pay structure (by hour, or by kWh, or by session), as well as payment rate.*

#### Charging Tariff

- The concessional charging tariff announced by DERC for EV charging at Public Charging would also be applied to 'captive charging' for fleet operators as well as Private Charging Points as long as they are compliant with BEVC-AC001, and as long as they are connected to the DISCOM's CMS.

#### Organization

- A dedicated EV cell shall be established within the Transport Department for effective day-to-day implementation of the Delhi State EV Policy.
- A State Electric Vehicle Board shall be constituted by the GNCTD as the apex body for effective implementation of Delhi Electric Vehicle Policy, 2020. It shall regularly review the performance of various measures under the policy.
- Funding for the above program would be organized by *Feebates- Pollution Cess* (on sale of fuels), *Additional Road Tax* and *Congestion Tax* on ICE Vehicles.

#### Comment:

The Delhi EV Policy is very forward looking and is designed to accelerate EV adoption in Delhi. From the Perspective of BRPL, it offers the following opportunities to support its EV programs:

- BRPL can act as an aggregator and support transition of 2 and 3 wheelers to EVs
  - Help interested buyers to acquire EVs (bids or special rates for aggregated buyers), get capital subsidies and scrapping incentives.
  - Achieve soft financing through DFC (3 wheelers).
  - Get appropriate charging infra, including *kerb* side, *group charging* facilities and charging infra at concessional locations.

- *The policy promotes the role of DISCOMs in organizing Private Charging Points (Home, Offices, Commercial Complexes) - exactly the premise we have used in the Business Models.*
- Provisions related to Private Charging being offered the same tariff as public charging as long as they interact with DISCOM to *enable load management* CMS, are *shared* is very forward looking and supports most of the business models that we have proposed in the report.
- BRPL could work with the Working Group on Charging Infra and identify concessional locations, as part of its EV programs, to support its customers interested in buying EVs. These could also be used as kerb-side and group charging facilities.
- BRPL can immediately start looking at the feasibility of BRPL charge card, usable over Private Charging Points as well as Public Charging Points.

#### Areas where further policy improvement is needed:

A major cost to the system can be saved if policy framework facilitates shift of charging during off peak hours. This will reduce peak loads, need for additional distribution capacity etc.

- Hence further work is needed on Time of Use (TOU) charging tariffs to discourage peak hour charging and incentivize off peak charging (post 1200 am in Delhi).
- Demand Response (DR) mechanism, specifically developed for EVs, where the DISCOM offers services to its consumers to auto-manage their charging during off peak periods, as well as allow the DISCOM to manage loads in case of system instabilities.