

# EV Charging Infrastructure for Kerala: Approach Paper

## 1. Background

Kerala aims to be one of the front-runners in the adoption of Electric Mobility and has been among the earliest States in India to adopt an approved Electric Vehicles Policy. The vision of the Policy is *“to embrace electric mobility as a tool to promote shared mobility and clean transportation and ensure environmental sustainability, pollution reduction, energy efficiency and conservation, and to create an ecosystem for manufacturing EV components in Kerala.”* The Policy targets to have 1 million EVs on the road by 2022 including a Pilot Fleet of 200,000 two-wheelers, 50,000 three wheelers, 1,000 goods carriers, 3,000 buses and 100 ferry boats by 2020.

As part of the Policy, the Kerala State Electricity Board Ltd. (KSEB) has been appointed as the State Nodal Agency for establishing a charging infrastructure for electric vehicles (EVs).

As articulated in the Central and State policies, there is an urgent need to promote electric mobility although it may not have yet achieved cost parity with conventional vehicles, requiring various fiscal and non-fiscal promotional initiatives. A critical requirement for accelerating EV adoption is the development of an appropriate charging infrastructure for EVs. While such infrastructure is being cited as precondition for increasing vehicle sales, companies are reluctant to commit investments in infrastructure without assured demand. Given this scenario, KSEB with the support of the Government of Kerala, is committed to take a proactive stance in promoting both public and private investment in charging infrastructure in the State.

This document describes the approach which KSEB proposes to adopt to support the EV Policy both for providing power in its role as the state DISCOM as well as for establishing an adequate charging infrastructure as the State Nodal Agency.

## 2. Objective

To enable the State of Kerala to become the leader among Indian states in e-mobility through creation of electric vehicle charging infrastructure that achieves State level coverage.

## 3. Partnering with Industry

Being the State Nodal Agency for Kerala, KSEB shall facilitate organizations or entrepreneurs who desire to set up charging stations in Kerala on their own, as mentioned below.

1. Private charging at residences / offices will be permitted.
2. Any individual/entity is free to set up Public Charging Station (PCS), provided that such stations meet the technical and performance standards, norms, specifications, etc laid down by the competent authorities. Any person seeking to

set up a Public Charging Station may apply for connectivity, which shall be considered on priority to supply power in the area.

#### 4. Energy Availability and Grid Capability

KSEB asserts that it is well equipped to handle electrical energy demands for vehicle charging in the short to medium term, and will take necessary steps to make additional energy available foreseeing the future trends.

For example, the following table illustrates the projected daily energy need during 2020 if the Pilot Fleet target as per the Kerala EV Policy is achieved.

Vehicle Type	Battery Capacity (kWh)	Pilot Vehicle Target	Daily Energy Need (kWh)
2W	2	200000	400,000
3W	9	50000	450,000
Car	20	5000	100,000
Goods Carrier	15	1000	15000
Bus	150	3000	450,000
Ferry Boats	100	100	10000
<b>Total</b>		<b>259100</b>	<b>1425000</b>

(Assumption: All vehicles charge the battery from 0% to 100% daily.)

It can be seen that the projected approximate need of 1.43 Million Units (MU) per day is less than the current daily fluctuation in energy demand of KSEB (average daily energy demand is about 70 MU) and can easily be met.

KSEB is expecting that there is likely to be local stresses in the distribution grid to cater to the power requirements of EV charging, especially during peak hours. This will be adequately dealt with as described in the section "Grid Balancing".

KSEB has already initiated steps to enhance the transmission capacity for bringing more power from the national grid foreseeing future demand. Till recently Kerala has been depending solely on hydro-power for electricity, and on other fossil-fuel alternatives from outside the State. But now, to cater to ever-increasing demand of power on a long term basis, encouragement is being given to power generation from non-conventional Energy Sources, which are environment friendly. Steps are being taken to increase the Renewable Energy component in the energy Sector by efforts like expediting the Renewable Energy projects currently underway, thereby increasing the clean component of the State's energy basket.

Long term energy needs for electric mobility would be determined by the pace of conversion to electric as well as the projected vehicle population. These in turn depend on a variety of factors including technology, battery cost, government policy, penetration of public transportation, change in consumer preferences, economic

growth, etc. Thus accurate assessment of energy requirement for the long term is challenging. However, the calculations in the following table are a useful illustration of the magnitude of the problem to be solved. It shows the projected energy need for a scenario where the current vehicle population of Kerala is 100% electric.

Vehicle Type	Battery Capacity (kWh)	Vehicle population	Daily Energy Need (kWh)
2W	2	6,472,000	12,944,000
3W	9	610,000	5,490,000
Car	20	2,178,000	43,560,000
Goods Carrier 3W	15	419,000	6,285,000
Bus	150	21,000	3,150,000
Ferry Boats	100	200	20,000
<b>Total</b>		9,700,200	71,449,000

As can be seen, full electrification of the current fleet will almost double the electrical energy demand. While KSEB will continue to watch the trends in vehicle electrification and energy need and make plans for the same, the large share of the projected energy consumed by cars point to the need for promotion of public transportation options.

## 5. Grid Balancing

Smart grid technologies can enhance flexible operation of the grid, improve utilization of existing infrastructure, improve cost effectiveness of grid operations, and defray large-scale investments. While seeking the promotion of EV Charging Infrastructure, smart grid technology enables drawing and supplying of power to the grid based on requirement of the grid. Through these mechanisms, smart grid technologies help systems operators and policy makers to affordably attain renewable energy deployment goals and ensure reliable system operation.

The State while rolling out the EV Charging Infrastructure also needs to balance the demand during peak and off-peak hours. Time of the Day (ToD) tariff will be made applicable for all Public Charging Stations (PCS), Bulk Charging Stations (BCS) and all charging infrastructures having Connected Load / Contract Demand above a specific limit. Uncontrolled nature of charging facilities in a plug-in-mode could increase peak load and network congestion. Hence, although consumers are free to choose their preferred modes of EV charging technologies, two and three wheelers with swappable batteries, which can be charged at Bulk Charging Stations during off peak hours will have preferential treatment over conventional vehicles with built in batteries in the matter of State incentives, for permits and allocation of power.

Destination charging at offices and public places during the day, as well as home charging during night hours will be useful for generating additional demand during off-peak hours and thus reduce the peak to off-peak ratio.

KSEB will also take steps to closely monitor the capacity of its distribution transformers, transmission lines and other infrastructure, and will make adequate investments to cater to the emerging needs.

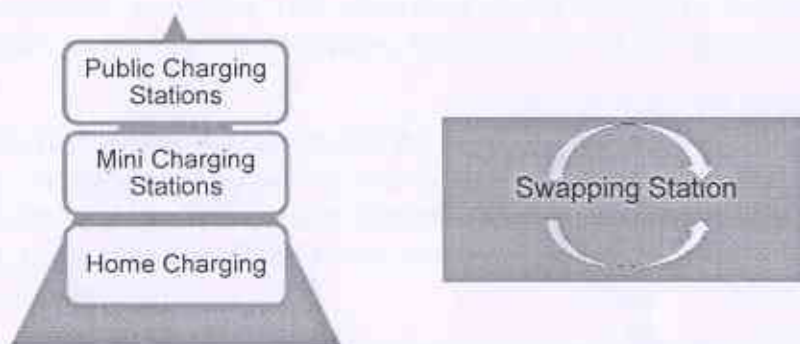
## 6. Tariff for EV Charging

Kerala has become one the few states to have approved special attractive tariff for electric vehicle charging. The Kerala State Electricity Regulatory Commission, vide its Tariff Order for the control period 2018-19 to 2021-22 (OA No. 15/2018 dated 8 July 2019), has fixed the tariff for EV charging stations as follows:

	LT-X	HT-VI
Monthly Demand Charge	Rs. 75 / kW	Rs. 250 /kVA
Energy Charge	Rs. 5 / kWh	Rs. 5 / kWh

(The existing ToD tariff applicable to HT consumers is also applicable to charging stations under category)

## 7. Charging Pyramid



EV Charging Ecosystem is often visualized in the form of a pyramid consisting of three layers- home charging, mini charging station and public charging station. Battery swapping is expected to be another type of complementary technology which is expected to gain traction in India.

**i) Home Charging:** Experience of countries with high adoption of EVs show that the vast majority of energy consumed in EV charging will be delivered through charging which takes place in the owners' homes. This is typically delivered over slow AC chargers and happen overnight. Consumers returning from their daily commute would plug in the car into an appropriate home socket or wall mounted equipment, and will accumulate enough charge overnight to fully replenish the battery for a few days' worth of use. In fact, the advantage of not having to visit a fuel station is cited by new EV owners as one of the biggest conveniences compared to petrol and diesel vehicles.

The scenario in Kerala is such that large percentage of owners are likely to park their EVs at home. Therefore, home charging is expected to be the predominant mode of charging for auto-rickshaws as well as private two- and four-wheelers; KSEB will ensure that energy and distribution infrastructure is available to cater to this need. KSEB

customers have the freedom to charge their EVs at home and will be charged at the prevailing tariffs, although they are advised to enhance their connected load.

**ii) Mini Charging Stations:** Dependence on interim charging arises when a user has to travel beyond the range offered by the vehicle battery, does not have access to home charging, or in case of exceptions like unplanned trips or forgetting to charge. Even in such cases, it is seen that slow AC charging is sufficient for most situations. For example, a user who goes to a nearby city for work can plug the vehicle to an AC charging point and find his vehicle fully charged by the time he needs to return, or a traveler can charge his vehicle overnight at the hotel he is staying.

In the national scenario too, Slow Charging is expected to play a major role in public charging considering the vehicle mix which is likely to be predominated by two- and three-wheelers which do not usually feature fast charging technologies.

One of the fastest growing segments in charging stations is expected to be the Mini charging stations with simple slow Bharat AC 001 chargers of 10kW(3.3 kW x 3). Entrepreneurs who wish to utilize this emerging opportunity are welcome to make applications at their respective KSEB offices, complying with the prevailing standards and regulations.

**iii) Public Charging Stations:** EV batteries need DC power for charging and EVs usually feature an onboard charger which converts the AC power into DC. However, the capacity of the built-in charger is usually limited. Therefore, fast charging of batteries require electricity to be first converted to DC outside the vehicle and contributes to the high cost of fast chargers.

Public DC fast chargers enable users to quickly charge their vehicles and resume their journey. These are required on the side of highways where people stop for quickly recharging their battery, mid-way through a long trip. In cities also, these allow customers to quickly top up or fully charge their vehicles and resume their trip. Establishments like government offices, malls, hotels etc also install fast chargers for the convenience of visitors or to attract customers.

KSEB will partner with the Government of Kerala, PSUs and other private investors to create an adequate network of fast charging stations in Kerala, in the following categories.

<b>Category A</b>	At public places for commercial purpose Available to any individual without any restrictions (e.g., EV Charging station established in at Municipal Parking Lots, Petrol Stations, Streets, Malls, and Market Complexes etc.)
<b>Category B</b>	Within the premises of a state or central government office complex, Government Hospitals/clinics/Dispensaries, Government educational Institutions or any other Public office for non-commercial use. (e.g., EV Charging station established in Udyog

	<i>Bhawan, Shram Shakti Bhawan, PSU office Complex etc.)</i>
<b>Category C</b>	<p>Within the semi-restricted premises for commercial or non-commercial purpose .</p> <p>Available to any individual for charging of Evs without any restrictions.</p> <p><i>(e.g., EV Charging stations established for Taxi Aggregators for charging of Taxies, Co-operative housing societies)</i></p>

**iv) Battery Swapping:** The biggest drawback of EVs is the short range and high recharge time of currently available batteries. Many companies in the country are working on swappable batteries as a solution to this problem. These are expected to be suitable for two- and three-wheelers, although some leading companies are also working on swapping for cars and buses too. Swappable batteries on a pay-as-you-go model also eliminates the need to pay upfront for the battery, thus potentially making EVs cheaper than conventional vehicles.

From KSEB's perspective, swappable batteries also have the potential to contribute towards grid balancing as they can be charged during off-peak hours. Various consumer and industry groups have shown interest in the technology and KSEB will work with them to promote its use.

**v) Public Transportation and Shared Mobility:** Electrification of public charging infrastructure is one of the priorities of the Kerala EV Policy with targets for electric buses and boats. These initiatives will need to be planned as integrated projects which includes plans for the infrastructure as well as vehicles. KSEB will support the respective agencies for these projects with required technical inputs as well as adequate power to be made available at the depots or wherever it is needed. Other mobility initiatives like bike sharing, fleet taxis, etc will also be supported by KSEB based on need.

## 8. Stages of Charging Infrastructure Development

The development of a charging ecosystem can be divided into three stages- Pilot,



Coverage and Scaling- with distinct objectives, quantum of investment, risk and role of various stakeholders.

**i) Pilot Stage:** During the Pilot stage, the first few charging stations are set up in a city or region. At this stage, the objectives are clearly to demonstrate the new technology, develop skill and knowledge as well as to create awareness. These charging stations will generate interest and curiosity and thus help gather public support for the idea of

electric mobility, while supporting the early adopters. The chargers are unlikely to be meaningfully utilized for the initial period and will generate minimal revenue.

**ii) Coverage Stage:** Any customer looking to buy an EV is likely to seek 1 hour comfort from a network of charging stations which will be there to back him up in case he run out of charge mid-way. These stations will have to be available at reasonable intervals on all the routes the person is likely to travel along. This is similar to a mobile phone service provider who cannot start operations with only one tower in the city centre.

KSEB, with the support of Government of India and Government of Kerala, will take steps to provide adequate support to companies who plan to invest in establishing a state-wide coverage for its charging station network.

KSEB is also taking an active stance and is willing to partner with potential investors through various business models including but not limited to:

- Investor sets up charging stations in own land
- Investor sets up charging stations in KSEB / Govt land on Revenue Sharing Model
- Investor sets up charging stations in Govt. / KSEB land under a lease agreement
- Implementing Agency sets up & manage EVCS on behalf of KSEB (funding by KSEB)

Each of the above models differ in how resources are raised and risks and revenues shared. KSEB is also open to consider other models which investors might want to propose.

KSEB seeks to partner with the central and state governments, PSUs and private investors to make Kerala the first state in India to create an EV charging infrastructure offering full coverage of the state. Unique factors which will work to Kerala's advantage in achieving this are the low urban-rural divide with uniformly high vehicle concentration even outside cities, and the long and narrow geography of the state with almost no place being more than 50-100 km from a National Highway.

KSEB envisages two components to its plan for achieving this objective.

1. **Mini Charging Stations:** Two- and three- wheelers are expected to be the two segments which will see high adoption in the initial stages, both of which need AC charging only. In particular, three wheelers are going to be dependent on access to public charging as the range offered by currently available models is not sufficient for the typical distances these vehicles need to ply daily. Two wheelers and even cars can use the same network if the need arises.

KSEB is already receiving queries from entrepreneurs and small business owners who desire to set up such charging stations. KSEB will take an active promotional role in encouraging such individuals to set up Mini Charging Stations in population centres across Kerala, targeting to achieve 100% coverage of all Panchayats and Municipalities. KSEB will also encourage larger investors who

wish to set up a chain of charging points. In addition, KSEB will work with Local Self Government Institutions to identify suitable locations for installation of charging kiosks including public places, parking spaces and auto-rickshaw stands in addition to shopping centers, malls and similar buildings.

2. **Public Charging Stations:** Kerala is one of the top car markets in the country with the highest number of cars being sold per 1000, except Delhi. As manufacturers begin to introduce new models of electric cars in the country, Kerala is expected be one of the leading state. Off-take of electric cars will require an adequate Public charging network. KSEB is targeting a Public charging station in the categories mentioned below, at every 25 km interval along the entire National Highway network passing through the state, and in every 5km x 5km grid in cities. These suggested densities will be reviewed based on utilization figures which will be monitored.

<b>Category A</b>	At public places for commercial purpose Available to any individual without any restrictions <i>(e.g., EV Charging station established in at Municipal Parking Lots, Petrol Stations, Streets, Malls, and Market Complexes etc.)</i>
<b>Category B</b>	Within the premises of a state or central government office complex, Government Hospitals/clinics/Dispensaries, Government educational Institutions or any other Public office for non-commercial use. <i>(e.g., EV Charging station established in Udyog Bhawan, Shram Shakti Bhawan, PSU office Complex etc.)</i>
<b>Category C</b>	Within the semi-restricted premises for commercial or non-commercial purpose . Available to any individual for charging of Evs without any restrictions. <i>(e.g., EV Charging stations established for Taxi Aggregators for charging of Taxies, Co-operative housing societies)</i>

**iii) Scaling Stage:** This stage is reached when a critical mass of vehicle adoption has been reached and the utilization of charging stations begin to increase. When this begins to happen, charging network operators will have to monitor the waiting time and utilization of chargers and accordingly add charging points or increase the network density. By the time this stage is reached, the infrastructure should have achieved self-sustainability and governments would start thinking of withdrawing from its active promotional role. Kerala is likely to take several years more to reach this stage.



## **9. Road Map for Roll-Out**

### **1. Pilot Projects**

KSEB is taking the following proactive steps towards establishing a pilot network of charging stations in the State. As a pioneer initiative, KSEB has already set up the first charging station at Kerala Government Secretariat, Trivandrum with multiple charging points of one Bharat DC 001 Charger 15kW and one DC Fast Charger 25kW with CCS & CHAdeMO standards of charging.

KSEB shall now proceed with the installation of Charging Stations in Board's own land along the National Highway in six Corporation areas viz. Thiruvananthapuram, Kollam, Kochi, Thrissur, Kozhikode & Kannur, as a Pilot Project. The work shall include setting up one charging station with multiple charging points of one Bharat DC 001 Charger 15kW and one DC Fast Charger 50kW with CCS & CHAdeMO standards of charging, along with the required canopy. Tender for the work will be floated by KSEB soon.

KSEB will also partner with PSUs and other investors to quickly put in place a pilot network of charging stations.

### **2. Supporting Government Fleet**

The Government of Kerala is gearing up to increase the adoption of EVs for its fleet of official vehicles. KSEB will work with the Government of Kerala to quickly set up charging stations in all district collectorates as well as other large government offices with more than 20 government vehicles. These AC slow chargers can also be utilized by the public. DC fast chargers can be installed based on need.

### **3. EOI for setting up charging infrastructure for achieving coverage**

KSEB is inviting an EOI under its initiative for shortlisting firms for setting up PCS in Kerala, based on which the detailed technical specification and business model could be finalized. Initially it is planned to set up 100 nos. of PCS across Trivandrum, Kochi and Kozhikode districts, which will later be rolled out to other Districts of Kerala as well. Slow charging kiosks as well as fast charging coverage are proposed along the National Highway.

### **4. Mobile APP**

EVSEs can be customized with added features like:

- Authentication
- Integrated payment gateways
- Software for remote monitoring.

The Mobile App required for the EVSE shall be developed by the Kerala State IT mission in co-ordination with the IT wing of KSEB. Few start-ups have also shown interest in developing the application.

#### 5. Utilization of FAME-II incentives

The Department of Heavy Industries, Government of India has invited applications for availing incentives for the deployment of charging infrastructure in the cities. With Kerala having seven cities coming under the category of cities with population above one million, this is a good opportunity for Kerala to seek support under the scheme for a few among these cities, where funds are being offered for setting up 25 charging stations having 6 chargers each under each city.

KSEB is taking the initiative to apply under this scheme, and has already started the process. This project will require active collaboration with the various government departments as well as the concerned Corporation, Municipality.

#### 6. Phasing out of existing KSEB vehicles

As a matter of policy, KSEB will scrap the own old vehicles plying in the Corporate offices and other field Offices and replace it with EVs in a phased manner. In future, petrol and diesel cars hired on contract for use of field officers will also be replaced with EVs, as far as possible. If required, the services of EESL/NTPC/Government /private agencies for possible leasing of EVs will also be explored.

#### **10. Conclusion**

KSEB is committed to support the rapid adoption of electric vehicles in Kerala. KSEB recognizes that Electric Mobility is still in its early stages with rapid changes in technologies, standards, Government policy and consumer preferences. KSEB will continue its efforts to understand the emerging needs and come up with proactive plans to satisfy the ambitions of the State in Electric Mobility and a clean future.