Institute for Energy Economics and Financial Analysis

Briefing Note

August 2024
Charith Konda || Energy Specialist, India Mobility and New Energy
Subham Shrivastava || Climate Finance Analyst

Upgrading India's Public EV Charging Experience

- *Accelerating the electrification of transportation is hindered by the poor reliability of public electric vehicle (EV) charging stations.*
- *The poor reliability of public EV charging stations is largely due to outdated technology, underutilisation, and inadequate incentives for operations and maintenance.*
- *To improve reliability, measures should focus on upgrading existing charging sites with the latest charging technology and introducing incentives that promote consistent uptime.*

Introduction

Public electric vehicle (EV) charging stations are a prerequisite for the uptake of electric vehicles. While the majority of EV charging happens at home globally, the increasing number of use cases of EVs is driving dependency on public charging. Public charging stations allow opportunity charging and allay range anxiety among EV users. However, in India, the proliferation of several albeit unreliable public electric charging stations has become a roadblock to the accelerated electrification of vehicles.

In this report, we analyse the reasons behind the current state of public EV charging stations and provide recommendations for improving their reliability.

Background

India's public charging station installations started with the implementation of the Faster Adoption and Manufacturing of (Hybrid &) Electric (FAME) Vehicles policy in 2015, under which 520 charging stations were set up across India. As per government data, India has 12,146 installed public charging stations as of February 2024. Among these, 1,886 charging stations are in the nation's capital – Delhi.

Initial government directives for setting up public charging stations required the installation of three fast charging connectors – Combined Charging System (CCS; European), CHAdeMO (Japanese), Type-2 AC – and two slow/moderate charging connectors – Bharat DC-001 (Chinese GB/T) and Bharat AC-001.[1] However, the government has refrained from standardising any connector type to promote innovation in EV charging, given that technology keeps evolving.

[1]Charging Infrastructure for Electric Vehicles – Guidelines and Standards, Ministry of Power, December 2018

While public charging station guidelines and standards have undergone several changes since since 2015, most of the chargers installed in the initial years were Bharat-001 (GB/T) chargers. The first-generation electric cars under FAME I used the Bharat-001 charging standard. However, over time, CCS2 has become the default industry standard for EV charging.

The rising adoption of CCS2-enabled EVs is rendering charging stations with alternative connectors, such as Bharat-001, increasingly obsolete. Low utilisation of these charging stations has led to poor maintenance with no power supply, missing connectors and broken display screens. However, these chargers continue to occupy prime land and hold valuable upstream electrical infrastructure.

Poor reliability of public EV charging stations is not just an India-specific problem. A 2022 study in California's Bay Area found that more than 25% of the public EV charging stations were non-functional. Another study indicated that EV users faced reliability issues with one-fifth of the available chargers in the US. Problems range from lack of compatibility between the charger and the vehicle, charging connector/cable faults, and lack of power supply (hardware problems) to failure to connect to the network for authentication, payment failures, and slow charging (software issues).

The poor reliability of public EV charging stations is so significant that, in a recent study, over 50% of Indian electric car users in major cities mentioned that given the opportunity, they would switch back to internal combustion engine (ICE) cars. In the same study, 88% of electric car users mentioned charging anxiety as a primary concern, followed by range anxiety.

To get a first-hand view of the current state of public EV charging stations, we conducted a sample study in Delhi, the city with the highest number of EV chargers in India.

Methodology of the Study

We employed a multistage probability-based cluster sampling method to assess the state of public EV charging stations in Delhi. Multistage probability-based cluster sampling is a well-established technique for situations where a natural grouping is visible and for studying geographically dispersed populations.

We identified/located the charging stations using the Delhi government website, which provides a comprehensive list of EV charging stations identified by the Delhi Transport Department, along with their locations. The website also categorises stations based on region (e.g., East Delhi, West Delhi). This inherent stratification within the data served as the first stage of our sampling strategy. From the eight regions listed on the website, we chose four – East Delhi, West Delhi, South Delhi and Central Delhi – using random sampling techniques.

Within each chosen region, we identified sub-clusters of geographically proximate charging stations by utilising the website's map feature. We assigned unique codes to the sub-clusters for offline random selection. Finally, we randomly selected two sub-clusters from each of the four regions. The specific sub-clusters chosen were:

- **South Delhi:** Jor Bagh and Hauz Khas
- **Central Delhi:** Connaught Place and Patel Chowk
- **West Delhi:** Dwarka (Matiala) and Janakpuri (East)
- **East Delhi:** Mayur Vihar Phase 1 and Patparganj

This multistage probability-based approach ensures randomisation at various levels, mitigating selection bias and promoting a representative sample. Employing a probability-based random sampling technique at the regional level and further randomising sub-cluster selection within each region aims to capture the functionality of EV charging stations across diverse geographical areas of New Delhi. This method, although limited in scope, aims at mitigating any bias in EV

chargers selection and to an extent strengthens the generalisability of the findings to the wider population of EV charging stations in the city.

Findings

Based on this methodology, we found that nearly 84% of EV chargers examined in a representative sample of South, Central, West, and Eastern Delhi regions were not functional (Table 1).[2] The reasons for this were:

- Theft of charging equipment like guns, copper wires/cables, etc.[3]
- No maintenance of the charging equipment, leading to no power supply and non-functional display screens.

Other observations include:

- The designated EV charging parking spaces were occupied by ICE vehicles.
- There was often a mismatch between online information and actual on-the-ground status. "Working" chargers online were not functional.
- In some instances, there was a discrepancy in the charging station's location details displayed on the Delhi government EV website, Switch Delhi, and on the ground.[4]
- Switch Delhi did not accurately display the charger status (whether functioning or not). No real-time information was available on the website/app.
- Most of the charging stations were in prime areas with good traffic flow.

Table 1: Status of Public EV Charging Stations Observed in Delhi, June 2024

Cluster	Sub-cluster	Chargers examined[5]	Connector type	Station operator	Non-functional chargers[6]	Non-functional chargers as a % of total chargers observed	Accessible[7]
South	Jor Bagh	7	Bharat DC-001	Energy Efficiency Services Limited (EESL)[8]	5	71.4%	Not accessible - ICE vehicles parked in EV-designated space
South	Hauz Khas	6	Bharat DC-001	EESL and NSEFI	5	83.3%	50% of the chargers were inaccessible as they were blocked by ICE cars
Central	Connaught Place	10	Bharat DC-001	EESL	10	100%	ICE vehicle parking at some places
Central	Patel Chowk	7	Bharat DC-001 & CHAdeMO	EESL	7	100%	All chargers were accessible
West	Vishwas Park Road, Matiala (Dwarka)	3	Multiple	Bolt.Earth and Kazam	2	66.7%	Some chargers listed on the website were missing
East	Mayur Vihar Phase 1	3	Bharat DC-001	Switch Delhi	1	33.3%	Not accessible - reserved car parking for EVs was occupied by ICE cars. And one charger was missing.
East	Patparganj	1	CCS2	Plug & Go	1	100%	Not accessible - locked in a residential community
Total		37			31	83.7%	

Source: IEEFA, Switch Delhi

[2]This percentage reflects the condition of a representative sample of chargers, not all the EV chargers in Delhi.
[3]Substantiated by local parking attendants.
[4]Switch Delhi is an open, dynamic database offering real time information on EV charging and battery swapping stations in the national capital territory of Delhi. It is maintained by the Delhi government.
[5]Charging connector/gun = A charging connector is a plug on the power cord that connects the charger (supply device) to the charging inlets of the electric vehicle. There are different types of connectors, such as Bharat 001, CCS2, etc. Usually, there are one or two connectors for each charger.
Charger = A standalone electricity supply device with one or two connectors.
Charging station = A common site with one or more chargers with common upstream (e.g., transformer) electrical infrastructure.
[6]We have defined chargers as non-functional where some charging equipment is missing and the display is dead.
[7]We have defined accessible chargers as those that are physically accessible without any blockade.
[8]A joint venture of power sector public enterprises under the Ministry of Power, Government of India

In the annexure, we provide pictures of some of the chargers we sampled.

Analysis

Obsolete technology, low or no utilisation, and lack of incentives for operations and maintenance are leading to poor reliability of public EV charging stations.

Our case study on the state of EV public charging stations in Delhi presents a snapshot of the ground situation. The findings are relevant across several other states in the country. For example, nearly 70% of the 246 DC fast charging connectors that the Kerala State Electricity Board is setting up across the state are either Bharat DC-001 (GB/T) or CHAdeMO connectors, making them unusable.

In this section, we highlight some reasons for dysfunctional public charging stations in Delhi and elsewhere in the country.

Obsolete technology: Bharat-001 (GB/T) charging connectors are first-generation chargers used in the initial EVs launched in India, such as the Mahindra e-Verito and previous variants of the Tata Tigor. Likewise, CHAdeMo is a Japanese fast-charging technology that major Japanese carmakers use in Japan and elsewhere, but not in EVs launched in India. In the last 4-5 years, CCS2 has emerged as the dominant charging standard for EVs launched in India due to its inherent advantage of featuring one connector for both AC (slow) and DC (fast) charging. Launching EVs with CCS2 technology also ensures interoperability across different brands of EVs and charging stations. The Bharat-001 (GB/T) and CHAdeMo charging standards have become obsolete, with CCS2 emerging as a default standard due to its rising popularity.

Low or no utilisation leading to no maintenance: As vehicles with Bharat-001 charging technology dwindled, the utilisation of these charging guns also faltered, affecting business viability. Further, low utilisation of EV chargers (across charging standards) has been a persistent problem since the introduction of EVs and could continue for 3-5 years until an adequate number of EVs ply on the roads.[9] The obsolescence of Bharat-001 and CHAdeMO charging standards and the low utilisation of public charging stations are leading to the poor maintenance of charging stations across Delhi and other states. Poor maintenance includes loss of and no replacement of charging equipment, no enforcement of EV reserved parking, and no electricity supply.

Lack of incentives for operations and maintenance (O&M): While the Government of India and several state governments are supporting the installation of charging stations in various ways (capex incentives), there are no incentives for government agencies and large public sector undertakings (PSUs) to operate and maintain public charging stations (O&M incentives). Capex incentives include reduced GST (5%) on EV charging equipment, a specified subsidy amount per charger (e.g., Delhi) or capital subsidy to a certain percentage of the cost of chargers (e.g., Maharashtra and Gujarat) and subsidies on the cost of land (e.g., Government of India and Tamil Nadu).

While the central government directed and incentivised its agencies like EESL and large PSUs to set up public charging stations, the lack of O&M incentives coupled with low utilisation of chargers is leading to the poor maintenance of public charging stations set up by these entities. Further, government agencies and PSUs have large core businesses that sideline charging station operations, especially when there are no O&M incentives. We noticed that private charge point operators (CPOs) run their charging stations more efficiently than government agencies and PSUs as they are more motivated to maximise profits and sustain their business.

[9] As mentioned by a few private operators of public charging stations during one-to-one conversations.

Recommendations

Measures to improve the reliability of public EV charging stations should include capitalising on the existing sites by upgrading them with the latest charging technology and incentives for uptime.

While the Bharat DC-001 and CHAdeMO charging connectors are outdated, these charge points still hold value for sites and the installed upstream electrical infrastructure. EESL established most of these charging connectors in Delhi on government-owned prime land belonging to the New Delhi Municipal Council, Municipal Corporation of Delhi or Delhi Transport Corporation. Hence, the best way forward is to upgrade these chargers to suit the current and future needs of the EV ecosystem.

The central government, through EESL, has already initiated the process of improving reliability and upgrading chargers by issuing a tender for the selection of a managed service partner for the operations, management, maintenance and security of CESL/EESL public EV charging stations across Delhi in March 2024. It should look at undertaking a similar initiative nationally to revive the public EV charging infrastructure set up. The following points are our suggestions for a national-level public EV charging infrastructure revival policy:

Infrastructure upgrade: Upgrade all Bharat DC-001 and CHAdeMO charge points to CCS2 chargers, as the latter has emerged as the default standard for EV charging. Official recognition of CCS2 as the charging standard of choice for public charging stations may be done through industry consultations. The policy should also include load enhancement provisions with state nodal agencies facilitating the discussion between power distribution companies and charging station operators. Upgrading charging connectors can increase charging station utilisation rates and ease charging anxiety in EV users.

Leasing to private CPOs: Goverment agencies should lease the charging stations they set up to private players (through auctions) as demarcation of sites, cabling and grid connection is already complete. As mentioned earlier, EESL is doing such an exercise in Delhi and the central government should replicate the same in other parts of the country. Leasing should be at nominal prices as public charging station utilisation rates are <10% and CPOs are not expecting to be profitable for another five years or so. Further, leasing contracts may include clauses for minimum uptime[10] and should include penalties for downtime.

Incentives for uptime: Incentives for EV charging infrastructure should include operations and maintenance clauses to ensure maximum uptime of charging stations. Currently, Indian incentives are tuned towards capital expenditure. There is a requirement for a recalibration to ensure uptime of charging stations along the lines of the rules specified under the National Electric Vehicle Infrastructure (NEVI) Program of the United States.

Further, regulations should allow charging station operators to undertake other commercial activities, like running a convenience store near the charging station, to make their business viable. Some private players (e.g., VOLTRAN) run a convenience outlet alongside EV charging stations, enabling them to earn additional revenue. This revenue helps them operate manned reliable charging stations.

Regulations for uptime: The central government should draft national-level regulations for the uptime of public charging stations, including norms for measuring uptime and the data required to substantiate uptime. There is an urgent need to drastically reduce information discrepancies that exist between online portals/apps (software-reported) and the real uptime

[10] In the case of Delhi, the EESL bid document specified a minimum uptime of 90% on an annual basis.

of charging stations. The government should enforce data accessibility and standardisation of communication protocols among charging station operators, EV users, and information aggregators to ensure interoperability. Similarly, a central agency should publish commonly defined protocols for monitoring and verification of the uptime of charging stations. Further measures should include capacity building of nodal agencies at the central and state levels so that they can monitor public charging stations, especially those that have been set up using government incentives.

Annexure

A few examples of the current situation:

1. Even though we found a few chargers operational in the Jor Bagh cluster, some of these were inaccessible as ICE cars were parked there, blocking the way (Photo 1).

Photo 1: EV chargers in the Jor Bagh cluster, Delhi

Source: IEEFA

2. Almost all the chargers we found in the Connaught Place sub-cluster were non-functional, with charger connectors missing and/or display units not working (Photo 2).

Photo 2: Non-functional EV chargers in Connaught Place, Delhi

Source: IEEFA

3. None of the chargers we found at Patel Chowk were functional as there was no power supply and connectors were missing. However, the parking spaces were free of obstructions (Photo 3).

Photo 3: Non-functional EV chargers at Patel Chowk, Delhi

Source: IEEFA

4. The chargers at Mayur Vihar were found to be working (with one exception), but we found that ICE cars were parked in EV-designated spots. A parking assistant claimed that he could get the ICE cars moved if needed (Photo 4).

Photo 4: Functional but inaccessible chargers at Mayur Vihar Phase 1 Metro Station

Source: IEEFA

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Author

Charith Konda

Charith is an Energy Specialist, India Mobility and New Energy at IEEFA. He works on issues related to clean mobility, newer clean energy technologies, and the overall energy transition challenges of the economy.

ckonda@ieefa.org

Subham Shrivastava

Subham Shrivastava is a Climate Finance Analyst at IEEFA, where he is dedicated to advancing the understanding of India's financial landscape and sustainable finance models in the context of Energy Transition initiatives. His role involves not only delving into policy impacts but also designing robust research methodologies to assess their effects.

subhams@ieefa.org