Urban EV Charging Infrastructure:

A Paper on Strategy and Planning for Urban Charging

July 2026

Executive Summary

India's urban EV charging infrastructure has expanded rapidly. Delhi now has approximately 9,000 public charging points but their average utilisation remains below 10%. This gap is not a failure of effort; it reflects an evolving understanding of who actually needs public charging. Private passenger EV owners, who make up the majority of current EV users, predominantly charge overnight at home and use public chargers only for longer trips or emergencies.(1) As the EV market matures, the infrastructure strategy must evolve with it.

The next phase of urban charging demand will be led by electric three-wheelers (L5N) and small commercial vehicles (N1 SCVs). These are the vehicles that move kirana, e-commerce, cold chain, and FMCG goods across Indian cities. TERI project that this segment will make up 76% of total SCV stock by 2030.(2) Both vehicle types operate from fixed logistics nodes of of warehouses, mandis, fulfillment centres. Thus, both require reliable charging infrastructure at those locations. Without it, operators are resorting to informal charging at dhabas, paying ₹14–15/kWh on unmetered, uncertified sockets — a safety risk that, if left unaddressed, could undermine confidence in urban freight electrification more broadly.

The proposed solution is a Cluster-First, Hub-and-Spoke model. Build charging at the logistics nodes where freight vehicles already concentrate. Since L5N (Type 6/7 connector) and N1 (CCS2) vehicles operate from the same hubs, each hub should co-locate both charging standards alongside battery swapping for high-turnover operators. Sub-zone access points at petrol pumps, DTC depots, and DISCOM substations serve the owner-operators who park near their residences. This two-tier network is organised around where freight vehicles actually operate.

Three targeted interventions from the Centre would enable this model:

1. Leveraging PM E-DRIVE Category C upstream infrastructure subsidy for upstream infrastructure to support charging stations for logistics-adjacent sites warehouses, mandis, and fulfillment centres with a time bound priority focus. (3)
2. Fast-track 33 kV grid connections for identified logistics and industrial charging clusters, with a deemed-approved backstop to ensure reliable power supply to meet peak demand.
3. Establish inter-agency coordination protocols for hub site approvals, so that positive decisions are seamlessly aggregated.

By prioritizing the deployment of Category C subsidies for charging stations, the government can unlock private investment poised to foster predictable and reliable infrastructure utilisation. The questions of exactly where to site hubs, what the grid looks like at those locations, and what financial model makes the CPO investment viable are critical to answer to ensure the success of these interventions

The Utilisation Problem: Why Public Urban Charging Is Underperforming

Demand realignment needed for ensuring high utilisation for Public EV Charging

Delhi has a little under 9,000 public charging points against an estimated requirement of around 36,000, and the state action plan targets roughly 16,000 public charging points by 2026.(4) Yet on-the-ground utilisation is below 10% on average, across most public charging locations. The gap points less to a supply shortfall than to a demand alignment challenge.(5)

The core issue is that urban public charging infrastructure has largely been planned around private passenger EV users, even though most private EV charging in India continues to take place at home. FAME I and FAME II policies for EVs focused on subsidising prices for the 2W, 3W, and 4W market segments. This led to more private vehicle owners, but they need not use public charging, as unlike petrol vehicles, they can charge at home.

Why Private EV Owners Rarely Use Public Charging

- Typical urban private EV usage in India is on the order of 20–60 km per day, which is easily covered by overnight home charging.
- Home charging typically costs around ₹4–6/kWh under dedicated EV or higher domestic slabs, while public AC and DC fast charging is more commonly priced in the ₹12–20+ per kWh range.
- The private owner's charging event is a parking event, not a detour where plugging in overnight costs zero additional time or effort.
- For today's early-majority EV owners, public charging is a backup (long trips, emergencies), not a routine.

This means that as private passenger EV penetration grows in cities, public charging utilisation per point may not grow proportionately. This can be attributed to the fact the growth in private EVs is accompanied by a growth in home chargers installed in housing societies/ allocated house parking.

Commercial Operators: The Segment with the Strongest Need for Public Charging

There is a large, growing, and commercially motivated EV user population for whom home charging is structurally impossible. In our fieldwork/interviews, we see:

- Three-wheeler auto and delivery drivers living in shared accommodation, not societies with parking
- N1/N2 SCV fleet drivers who park near warehouses, not at private homes
- Fleet operators whose vehicles operate across city zones, returning to a logistics hub

For these users, public or semi-public charging at fixed, reliable, accessible locations is the primary charging strategy. This is also the segment where current public charging infrastructure has the most limited reach.

The L5N and N1 SCV Case: Why This Segment Is the priority for Urban Charging

Understanding the vehicle segment that support freight movement in cities

L5N and N1 vehicles, both are already active, often operating side by side out of the same warehouses, mandis, and fulfillment centres. L5N three-wheelers (goods-carrying variants such as the Mahindra Treo Zor and Piaggio Ape Electric) and N1 four-wheeler SCVs (such as the Tata Ace EV, Euler HiLoad, and Mahindra Zeo) serve the same urban freight functions — kirana delivery, e-commerce fulfillment, cold chain, FMCG distribution. Fleet aggregators such as Porter, Amazon, Delhivery, and SafeExpress routinely deploy both in the same city, often from the same dispatch points.

Where the two segments compare closely:

- **Ownership patterns,** with a mix of owner-operators with 1–3 vehicles and consolidated fleets of 10–50+.
- **Trip distances,** typically 40–80 km per trip within a sub-zone.
- **The origin-destination pattern,** with vehicles returning to a warehouse or distribution hub at the end of the day.
- **The commercial motivation,** with thin margins and high sensitivity to operating cost.

Where the two segments differ diverge

- **Daily energy demand,** with 5–15 kWh for L5N versus 20–60 kWh for N1.
- **Connector standards,** with Type 6/Type 7 for L5N versus CCS2 for N1.
- **Vehicle acquisition cost**, where N1 trucks are priced higher than L5N vehicles.
- **Battery swapping** is a viable option for L5N and is readily available and in practice.

N1 vehicles make up approximately 60% of the commercial vehicle industry by volume in India. SIAM has formally requested the government to include N1 class EVs in PM e-DRIVE, arguing that their inclusion "will increase both the production and sales of e-light commercial vehicles" and "benefit small businesses and logistics sectors".(6)

The Charging Problem That is Blocking Adoption of e-freight

The operational pattern of urban freight drivers in both L5N and N1 is sub-zone fixed. A driver based out of Bamnoli warehouse (Southwest Delhi) travels 40–80 km per trip, completes 2 trips per day, and needs to charge within 2–3 km of their residential area in the same sub-zone. Charging for urban freight EVs must therefore be planned at the sub-zone level, not the city level. One hub can serve Dwarka's 18–20 sectors, but Janakpuri and Bamnoli each need their own hubs. This sub-zone constraint is what makes the hub-and-spoke architecture the correct spatial response.

Despite compelling economics, urban freight EV adoption faces three structural infrastructure gaps that are slowing scale-up:

Connector fragmentation at mixed-use sites

L5N three-wheelers use Type 6 or Type 7 connectors; N1 SCVs use CCS2. Fleet aggregators deploying both vehicle types face an immediate infrastructure dilemma: a charger optimised for one connector standard is unavailable to the other. A CPO building a public charging station must choose between connector types, or invest in both and with already low utilisation rates (below 10% at most public locations), splitting demand across two connector types makes the economics challenging.

Informal charging and safety risk

The infrastructure gap today is pushing both L5N and N1 operators toward unsafe informal charging. Operators visit dhaba outlets with unmetered sockets and workshop connections, and end up paying ₹14–15/kWh for charging with no earthing, certification, or fire safety. One serious incident at an informal charging point could cause major set backs.(8)

Grid connection delays at warehouses

CPOs attempting to add 200–300 kW of EV load report multi-month delays in load-extension approvals, during which vehicles sit underutilised. While official guidelines now seek to cap new EV connection approvals at 3–15 days, implementation on the ground has yet to fully catch up.(9)

Battery Swapping as a Freight Enabler: Cutting Downtime, Spreading Infrastructure Costs, and Democratizing EV Adoption

For urban freight operators, particularly those on thin margins where vehicle downtime directly reduces daily revenue, battery swapping offers a distinct set of advantages that conventional depot charging does not.

By separating the battery from the vehicle, swapping eliminates charging downtime entirely. The driver exchanges a depleted battery for a fully charged one in minutes rather than waiting at a charger for 1–4 hours. The drained battery is recharged at the swapping station while the vehicle is back on the road.

The infrastructure economics also work differently. Existing battery swapping stations already serving L5N three-wheelers and two-wheelers can be extended to serve N1 SCVs where battery standards are compatible, amortising infrastructure costs across a larger asset base and potentially reducing the energy cost per kWh for all users. For a logistics hub serving both L5N and N1 vehicles, a co-located swapping station for three-wheelers alongside depot charging for four-wheelers may be a more practical configuration than attempting to build a single charging network for both connector types.

From a financing perspective, the Battery-as-a-Service (BaaS) model converts what would otherwise be a large upfront vehicle acquisition cost into a predictable monthly operating expense. Thus, making EV adoption more accessible for small owner-operators who manage assets based on monthly cash flow rather than multi-year Total Cost of Ownership (TCO) calculations.

The Economic Case for Urban Freight Electrification

The electrification case for SCVs is economically compelling. A June 2025 report by Praxis Global Alliance finds that EVs offer a 15–20% lower TCO than diesel in three-wheeler and small four-wheeler logistics fleets, with diesel 4W SCVs typically costing ₹9.5–10.5/km to operate and comparable EV fleets at ₹7.5–9/km.(7) At 100 km/day, the per-km differential ranges from ₹0.5/km at the narrow end to ₹3/km at the wide end. This translates to annual savings of roughly ₹18,000 to over ₹1 lakh per vehicle depending on charging tariffs, duty cycles, and daily utilisation.

At higher daily utilisation (150+ km/day), which is common among consolidated fleet operators in urban logistics, the savings widen and the EV premium can be recovered within 3–4 years. For small owner-operators managing 1–3 vehicles on thin margins, the choice to transition to EV is highly dependent on their ability to pay the asset loan based on their monthly cash flow. Even at the conservative end of the savings range, a reduction of ₹1,500–8,000 per month per vehicle is meaningful against typical EMI differentials between diesel and electric financing. The battery-as-a-service model, where applicable, compresses the upfront cost differential further, making the month-one economics more favourable than a fixed-battery EV purchase.

The Cluster-First Hub-and-Spoke Strategy

Moving from Random Distribution to Demand-Anchored Location

Public charging rollout has typically followed available land The emerging consensus among infrastructure planners and fleet operators is a Cluster-First strategy: build charging infrastructure at origin/destination hubs first, because these locations already have demand concentration, grid capacity, and operator relationships.

Origin/Destination hubs for urban SCV logistics in Delhi:

Warehousing and logistics parks (Bhiwandi, Kundli Industrial Area, Greater Noida Logistics Park, etc.)

Mandis and wholesale markets (Azadpur Mandi, Ghazipur Mandi, Okhla Industrial Area)

E-commerce fulfillment centres (Amazon, Flipkart, Meesho dark store clusters)

Cold chain aggregation points (Mother Dairy, Safal distribution hubs)

FMCG distribution depots (HUL, ITC, Nestle C&F agent hubs)

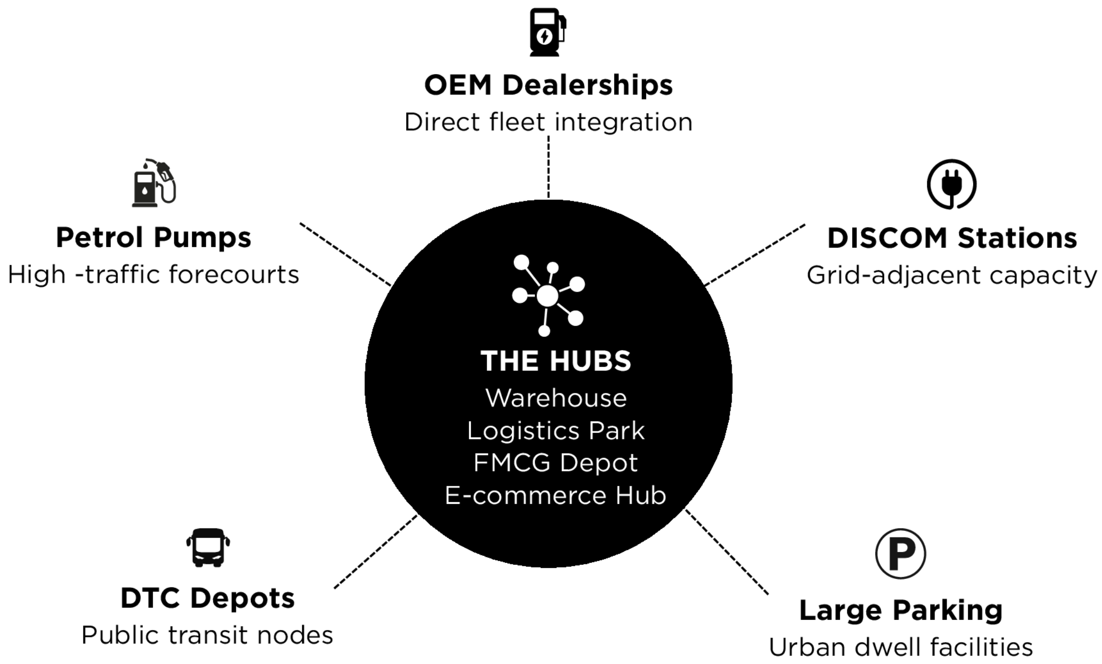
These locations share three characteristics:

1. Reliable daily demand (vehicles return here)
2. Existing electrical infrastructure (operational loads already present), and
3. A single operator relationship (one company controls the premises and can commit to charging use).

Not all five hub typologies are equally ready for deployment, however. A warehouse logistics park and a mandi operate on entirely different land ownership models, grid situations, and decision-maker relationships. The pathway from intent to operational charger looks very different across these categories.

The Two-Tier Urban Charging Architecture

A coherent urban SCV charging strategy requires two complementary tiers:



Tier 1: Hub Charging (Captive/Semi-Captive)

- **Location:** Warehouse, logistics park, FMCG depot, e-commerce fulfillment centre
- **Charger type:** Co-located — CCS2 fast (60 kW DC) and slow (7.4 kW AC) for N1 SCVs; Type 6/Type 7 AC for L5N three-wheelers; battery swapping station where volumes justify
- **Ownership:** Fleet operator captive or DISCOM/CPO tripartite model
- **Grid requirement:** Potentially 33 kV upstream connection, 250–500 kW allocated load
- **Land model:** Industrial land already controlled by fleet operator or logistics park developer or bus depot in a 500m - 1km radius
- **Resilience:** Solar-plus-storage integration for high-utilisation sites to maintain reliability during peak summer load stress and grid outages.

Tier 2: Sub-Zone Access Points (Public/Semi-Public)

- **Location:** OEM dealerships, petrol pump forecourts, DISCOM substations, DTC depots, large parking facilities within 2–3 km of residential clusters of drivers
- **Charger type:** Primarily slow (7.4–22 kW AC) with earthing and safety certification
- **Ownership:** DISCOM-led tripartite (land + connection from DISCOM/public agency, operation from CPO)
- **Grid requirement:** Potentially standard LT connection from existing pole/transformer; no augmentation needed for AC slow chargers
- **Utilisation driver:** Fleet operators within sub-zone operational radius

Critical Questions for Supply-Side Implementation

The two-tier architecture above describes what needs to be built. What remains to be established is whether and where it can be built and who will build it. Four questions, must be answered for the hub-and-spoke model can be successful.

Location and land

1. Where do freight vehicles already park?

The hub model's viability depends on whether sufficient land exists at sub-zone level to aggregate 20–30 commercial vehicles for charging. The right starting point is not finding new land but understanding where diesel L5N and N1 operators park today as they already solve the parking problem somewhere. Those locations are the natural candidates for charging infrastructure.

- Where do diesel SCV and L5N operators actually park in specific sub-zones — at warehouses, at informal aggregation points near mandis, or dispersed near driver residences?
- Is there a single land parcel in each sub-zone with enough footprint to aggregate viable charging demand?
- Who controls that land — a logistics park developer, a mandi authority, a municipal body — and what is the access model?
- For sub-zones where no single aggregation point exists, what is the minimum viable alternative?

Grid infrastructure

2. What does the grid look like at those locations?

A Tier 1 hub needing 500 kW of EV charging typically requires a dedicated 33 kV feeder or substation upgrade, cable and metering infrastructure, and power factor correction for a mixed slow/fast charger load. Whether any of this is achievable at candidate locations depends on site-specific grid conditions that are not yet known.

- How far is the nearest substation from the parking locations identified above?
- What is the existing load and available headroom?
- Does a given site require a full 33 kV feeder, a substation upgrade, or can it be served off existing LT infrastructure with load augmentation?
- What is the realistic cost and timeline for each option?

Regulatory pathway

3. What policy and process changes are needed to make connections happen?

Under PM E-DRIVE's EV PCS guidelines, Category C subsidies for logistics-adjacent commercial sites cover only upstream infrastructure (transformers, cables, civil works), not EVSE equipment limiting direct central support.(10)(11)

- Can a "deemed approved" model work for CPO power connection requests — where DISCOM non-response within a defined window (say, 15 days) constitutes automatic approval?
- Which states or utilities have attempted something similar, and what were the barriers?
- What would it take to formalise inter-agency coordination between municipal bodies, utilities, and transport authorities so that a site cleared by the DISCOM is not then stalled at municipal level?
- Is there a state-level precedent of a logistics hub that has successfully fast-tracked a 33 kV EV charging connection? Can learnings from that model be scaled?

Operator economics

4. Who builds it, and on what terms?

A Tier 1 hub needing 500 kW of EV charging typically requires a dedicated 33 kV feeder or substation upgrade, cable and metering infrastructure, and power factor correction for a mixed slow/fast charger load. Whether any of this is achievable at candidate locations depends on site-specific grid conditions that are not yet known.

- How far is the nearest substation from the parking locations identified above?
- What is the existing load and available headroom?
- Does a given site require a full 33 kV feeder, a substation upgrade, or can it be served off existing LT infrastructure with load augmentation?
- What is the realistic cost and timeline for each option?
-

Without credible answers to these four questions, the hub model remains a planning framework and we need to move towards an investment proposition.

References

1. Alliance for an Energy Efficient Economy (AEEE). Residential EV Charging in India: A Systems Perspective (New Delhi: AEEE, 2026); BAV, “Home EV Charging in India: Cost, Setup, Electricity Bill & What to Expect”, 18 Feb 2026.

2. WRI India. Accelerating Electrification of Small Commercial Freights in India (New Delhi: WRI India, 2022); IIT Delhi / TERI. Roadmap for Electrification of Urban Freight in India, Part I (New Delhi: TERI, 2021).

3. EV Charging Infrastructure under PM E-DRIVE scheme (05 DEC 2025, PIB Delhi)

4. Delhi EV Cell / Commission for Air Quality Management (CAQM). Delhi EV Charging Status & Targets, as reported in: Times of India, “Delhi Needs 36k EV Chargers, Has Just 9k”, 9 Feb 2026; Hindustan Times, “Delhi Set to Get 7,000 Public EV Charging Points in 2026”, 9 Feb 2026.

5.Vasudha Foundation. State-Level Insights into India’s EV Charging Landscape (New Delhi: Vasudha, 2025); utilisation statistics compiled by CPOs and industry analysts, e.g. LinkedIn post “CCS2 Charger Utilization in India Drops to 8.4%” (2025).

6. Society of Indian Automobile Manufacturers (SIAM). Representation to Government of India on Inclusion of N1 Category in PM E-DRIVE, 17 Aug 2025; summarised in Business Standard, CMV360 and TrucksBuses coverage.

7. Praxis / industry TCO analyses and e-FAST India, “Total Cost of Ownership (TCO) Tool for Electric Freight”, 2025; Economic Times Energy, “EVs Offer 15–20% Cost Advantage over Diesel in Logistics: Report”, 10 June 2025.

8. Mercom India, “Illegal Charging by E-Rickshaws in Delhi Leads to ₹1.5 Billion in Losses to DISCOMs”, 29 Jan 2019; New Indian Express, “E-Rickshaw Menace: Fires, Fraud & Faulty Power”, 12 June 2025; reports on EV charging-station fires and safety reviews in Delhi, Telangana, and Indore.

9. Economic Times, “Faster Nod for Power Connection to EV Charging Stations Proposed”, 18 May 2026; related MoP proposals to limit new EV power-connection approval times to 3–15 days, contrasted with industry reports of multi-month delays for logistics-park load extensions.

10. Ministry of Power & NITI Aayog. Electric Vehicle Charging Infrastructure and its Grid Integration in India (2023); PM E-DRIVE, “EV PCS Operational Guidelines” and FAQs (2025).

11. Ministry of Heavy Industries. “PM E-DRIVE Scheme: Driving Towards a Greener Future”, Press Information Bureau, 8 Oct 2024; EV PCS guidelines and FAQs describing Categories A–D subsidy structures.