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Confederation of Indian Industry

Fleet Electrification in India

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We are Statiq. We are here to fast-track EV adoption in India by providing a one stop solution for the EV ecosystem across the nation. With our innovative software and locally manufactured state of the art EV Chargers we want the world to transition towards e-mobility.

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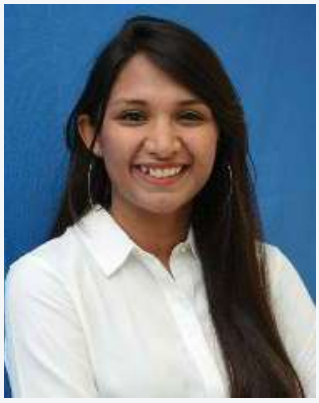

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List of Abbreviations

Abbreviation	Definition
2W	2-wheelers
3W	3-wheelers
4W	4-wheelers
ACC	Advanced Chemistry Cells
ARAI	Automotive Research Association of India
BaaS	Battery as a Service
BCS	Battery Charging Station
BEE	Bureau of Energy Efficiency
BP	British Petroleum
BWM	Battery Waste Management
CESL	Convergence Energy Services Limited
ChaaS	Charging as a Service
CNA	Central Nodal Agency
CPO	Charge Point Operator
EV's	Electric Vehicles
EVI	Electric Vehicle Initiative
FAME	Faster Adoption & Manufacturing of Electric Vehicles
FDI	Foreign Direct Investment
GHG	Greenhouse Gases
ICE	Internal Combustion Engines
kW	Kilowatt
LCV's	Light Commercial Vehicles
MHI	Ministry of Heavy Industries
MNRE	Ministry of New & Renewable Energy
MoHUA	Ministry of Housing and Urban Affairs
MoP	Ministry of Power
MoRTH	Ministry of Road Transport & Highways
MoST	Ministry of Science & Technology
NEMMP	National Electric Mobility Mission Plan
NHAI	National Highway Authority of India
NHEV	National Highway for Electric Vehicles
NMEM	National Mission on Electric Mobility
OCPI	Open Charging Point Interface
OEM	Original Equipment Manufacturer
PCS	Public Charging Station
PISC	Project Implementation and Sanctioning Committee
PLI	Production Linked Incentive
RaaS	Ride as a service
SERC	State Electricity Regulatory Commissions
SIRO	Scientific and Industrial Research Organisation
SNA	State Nodal Agency
TCO	Total Cost of Ownership
VaaS	Vehicle as a service
VRE	Variable Renewable Energy

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Summary for Decision Makers

The focus of this report is the electrification of vehicular fleets deployed or engaged by public and private agencies in India to meet their transportation needs. The primary motivation for fleet electrification is the mitigation of tailpipe emissions from the Business-As-Usual technologies which are detrimental to the public health and the health of the planet owing to their associated ambient air and global climate footprints respectively. Fleet electrification is crucial as it provides businesses with a practical option to reduce the carbon footprint associated with the movement of goods and people thereby helping in meeting their net-zero commitments. Also, contributions of high-mileage commercial vehicles to on-road traffic emissions are proportionately higher as spend more time on the road on average compared to private vehicles owned by individuals. The current energy mix is rather to be seen as an ongoing opportunity to closely align the mobility and energy transitions and we strongly believe that fleet electrification can lead way for better integration of energy system within the transportation system. Electrification of fleet can in fact be the most effective strategy for balancing the grid impacts of variable renewable as opposed to a scenario where EVs and accompanying energy supply infrastructure which is rather seen as a burden on the grid.

Electric vehicles have a higher upfront cost compared to traditional fuel vehicles, which is a major obstacle to their mass adoption in price-sensitive markets like India. However, the total operational cost of an electric vehicle over a period of 3-5 years makes it a cost-effective proposition, especially for the fleet operators and other agencies handling large transport fleets.

The per kilometre cost of driving an electric vehicle is significantly lower than that of a petrol or diesel vehicle, which translates into substantial savings in the long-term or over the full life of the vehicle. Electric vehicles have fewer moving parts, require less maintenance, and suffer from less wear and tear over time, leading to significant savings for fleet operators. A comparative analysis of Total Cost of Ownership (TCO)[1] from existing databases shows that electric vehicles are a more cost-effective option in a long run. EVs may take more time to become economically more appealing to individual consumers at large as their capital cost is still roughly by 1.5-2 times in the electric 2-4 wheelers in passenger vehicles segment. Nonetheless, their TCO, as analysed from multiple secondary databases, is already comparable to ICE counterparts. As a result, fleet electrification is an active opportunity for agencies to deploy new business models and financial solutions to electrify their fleets. The B2B partnerships can be leveraged for fleet electrification to make the transition cost-effective and win-win for all concerned agencies such as- e-commerce businesses, fleet operators, CPOs etc. TCO for all passenger segments and light cargo segments is already lower for EVs when compared to BAU ICE technologies- 12-48% lower for passenger vehicles and 27% lower for light electric cargo. Medium-to-heavy cargo vehicles TCO is found to be 37-39% higher when compared to BAU ICE technologies requiring technology indigenisation and significant cost reductions in future.

[1] The "total cost of ownership" (TCO), which considers all costs involved in the purchase, operation, and maintenance of a given asset during its lifetime, is a more accurate assessment of the economic efficiency of electric vehicles.

Box I. Business Case: Fleet Electrification in Ride-Hailing Platforms & Employee Transportation

Employee transportation demand is on the rise in India due to safety concerns and a lack of reliable public transportation. Also, shared mobility and ride-hailing services in India are rapidly evolving, further expanding in Tier 2/3 cities and including 2-3W segments now. Electrification of ride-hailing services and employee transportation is advantageous due to high utilisation rates and well-defined routes, leading to economic value and business viability. The estimated market size for corporate transportation is estimated to be USD 3.5 Billion in India. The app-based ride-hailing industry is an active opportunity for fleet electrification.

eee - Taxi

- Started operations in 2016 and present in Delhi NCR, Hyderabad, and Bangalore (targeting expansion in Pune and Mumbai)
- Total fleet strength of 150 EVs (eVerito & TATA Tigor)
- B2B model with corporates and governments
- Looking at creating hubs for captive charging and in partnership with CPOs. Top-ups usually happens through public charging infrastructure

SMARTe™

- Started operations in 2015 and present in Delhi NCR, Lucknow, Kanpur, Sitapur, Prayagraj, Varanasi, Jaipur with total fleet strength of 1500-plus EVs (Electric 3Ws)
- Currently aggregating 150-200 vehicles per month
- Currently operates 20+ charging hubs: charging and swapping stations
- Shifted from self-owned fleets model to aggregated fleet of passenger vehicles

Source: CII-Invest India-Statiq (2023) analysis

The report provides details of the latest trends in the country and elsewhere that are shaping the fleet electrification agenda. Boxes I and II summarise case studies with actual business cases captured in this report. Electric vehicles are revolutionising the way fleets operate, offering a cleaner, more efficient and sustainable transportation solution. With their zero tailpipe emissions, fuel cost savings, government incentives and rapid technological advancements, electric vehicles are rapidly becoming the preferred choice for fleet operators worldwide. The transition not only aligns with environmental goals but also provides economic advantages, positioning fleets owners, managers, and operators as leaders in sustainability. Many big companies have announced targets to shift to electric mobility as part of their sustainability goals to eliminate reliance on traditional fuels and ensure operations are not adversely affected by volatile fuel prices seen globally. The transformation to electric and clean fuel vehicles calls for a viable business model for fleet operators to sustain new mobility technologies.

Box II. Business Case: Fleet Electrification in Urban Freight & Last-mile Deliveries

Last-mile delivery is becoming increasingly important due to its significant impact on the environment and workforce. Electrifying the delivery system can help reduce emissions, lower costs, and increase efficiency. Electric two and three-wheelers have the least cost disparity (35-48% lower TCO compared to BAU ICE counterparts) and are the most deployed vehicles for last-mile delivery. Fixed charging hubs and battery-swapping facilities, especially for E2-3W, can make electric vehicles more convenient to operate. Different models of ownership, including platform-owned, service contracts, and driver-owned, can be used for different types of deliveries such as e-commerce, traditional commerce, and food delivery.

DUNZO

- Dunzo started operations in 2014 and is present across 8 cities
- Depend on public charging infrastructure and contemplating setting up charging stations (conventional AC/DC charge or battery swapping) at warehouses
- Two business models followed:
  a. Delivery partners to join at their own capacity while they use their own vehicle
  b. Partner with companies that provide solutions for both delivery partners and vehicle.

EVAGE

- The company is scheduled to commence operations in the second quarter of 2023 and is currently situated in Mohali, Punjab. They have plans to expand their presence in the Northern Region, including Chandigarh, Haryana, Delhi, and Himachal Pradesh. Their fleet consists of N1 Light Commercial Vehicles with a capacity of 1 ton, which can be customised according to client requirements.
- The company intends to expand its fleet to include heavy and medium-duty trucks.
- Currently, they are in the process of installing chargers at client hubs and their focus is on public charging.
- The business model followed by the company includes both selling and leasing options.

Source: CII-Invest India-Statiq (2023) analysis

As part of this fleet electrification study, closed-door consultations were held with various industry stakeholders from subsectors including- the ride-hailing/sharing & last-mile delivery platforms, e-commerce companies, urban freight operators, vehicle manufacturers or OEMs, infrastructure companies and charge point operators to gain practical insights into their business models and understand key challenges being on the ground. As a culmination of these consultative processes, Fleet Electrification Workshop was organised in February 2023 with the aim to gather final inputs for this study from the above-mentioned industry stakeholders including the key government officials from the Ministry of Heavy Industry, Government of India and Delhi Electric Vehicle Cell at Transport Department, Government of NCT Delhi. Box III provides a summary of stakeholders' perspectives which were gathered as part of this study.

Box. III. Stakeholders' Perspectives Captured at the Fleet Electrification Workshop

Fleet Operators

Challenges

- High capex: EVs & EV Batteries
- Slow profitability, even with the Opex model
- OEMs' reluctance to separate the battery & assets
- Ascertaining the residual value (RV) of EVs
- Varying electricity tariffs across DISCOMs
- Limited availability of highway charging
- Range anxiety for inter-city travel (drivers and users)
- Navigating current regulations and policies

Solutions

- Battery technology R&D and localization
- Battery swapping or Battery-as-a-Service(BaaS) business models
- Vehicle-battery standardisation for interoperability
- Expansion of EV hubs
- Standardisation across hubs for interoperability between hubs
- Implementation of SOPs in greenfield EV hubs
- Collaboration among stakeholders across the e-mobility ecosystem
- Simplifying regulation for setting up public/private infrastructure
- Digital platform with proper tagging & access to drivers/users

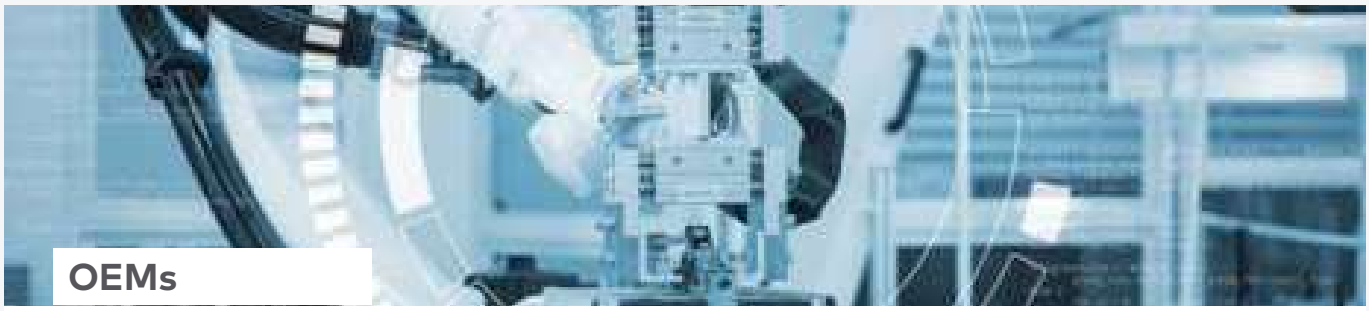
Charge Point Operators (CPOs)

Challenges

- Limited fast chargers (FCs) with significant investment cost
- Asset safety as major financing risk for CPOs
- Power availability & reliability
- Land acquisition
- Variations across State EV policies
- Long process for connections from DISCOMs

Solutions

- Financial support & favourable interest rates
- Robust FC networks to reduce range anxiety
- Uniform State EV policies
- Standardized insurance products for CPOs
- Reliable 24x7 Power
- Standardised template from States Nodal Agencies
- Single-window clearance & digital dashboard to track applications



OEMs

Challenges

- Reducing EV upfront cost
- Availability of electric infrastructure
- Six months' approval process to avail FAME subsidies
- User's challenge in locating chargers at one platform
- Lack of standardisation across OEMs
- Standardisation of E2W chargers
- Lack of secondary market for EVs
- Higher interest rates for E3Ws

Solutions

- Cost reductions in EV batteries
- Improving infrastructure availability & trackability
- Standardisation or interoperability amongst OEMs
- Standardisation of E2W chargers
- Developing a secondary market for EVs
- Robust battery recycling framework
- Better collaboration between OEMs & financing companies
- Streamlined approval processes under FAME

Charge Point Operators (CPOs)

Challenges

- High acquisition costs of EVs
- Inadequate charging infrastructure
- Longer charging times
- Limited EV range for hyper-local deliveries
- Limited supply of high-performing EV models from OEMs
- Lack of proper information on EV availability/supply
- Lack of standardised EV identification system
- Need for stakeholder's directory
- Portal for mapping battery swapping locations
- Risk of products becoming obsolete quickly

Solutions

- Accessible charging infrastructure
- Interest-free or low-interest vehicle loans for delivery partners
- OEMs integrating Battery-as-a-service (BaaS) model
- Improved EV 2-3W range for hyper-local deliveries
- Availability of a greater number of high-performing EV models
- Better information on EVs availability/supply
- Standardised EV identification system
- Stakeholders' directory including OEMS, CPOs etc.
- Portal for mapping battery swapping locations
- Alternative funding mechanisms and incentive structures

Source: CII-Invest India-Statiq (2023) Analysis

Recommended Measures for Scaling Fleet Electrification

By analysing stakeholders' inputs and existing policy landscape, key actionable measures are being suggested in this report to increase adoption of EVs across transportation fleets. As evident from Box III, stakeholders' challenges and their proposed solutions reflect the Indian market where fleet electrification is at a nascent stage and the adoption of EVs needs to be supported in transportation fleets with dedicated demand-side and supply-side measures while building domestic R&D and manufacturing capabilities of electric vehicles required in different segments. The table 12 in our report summarises the key recommended measures as discussed in subsequent text.

Table I. Total Cost of Ownership/TCO for vehicle segments in India

S.N.	Vehicle Segment	Vehicle Categories	Models Incentivised under FAME (as of 24 March 2023)	Capex	TCO
				[times BAU-ICE]	[percent difference with respect to BAU-ICE]
1.	Two-wheelers	L1, L2	67, 20	1.87	-48%
2.	Three-wheelers	E-rickshaw, L5M, E-cart, L5N	43, 17, 28, 54	1.37	-35%
3.	Passenger four-wheelers	M1	22 α	1.50	-12%
4.	Buses	M2, M3	_ _ _ β	1.19	-38%
5.	Light commercial cargo four-wheelers	N1	2	1.21	-27%
6.	Medium commercial cargo four-wheelers	N2	Not applicable	2.04	39%
7.	Heavy commercial cargo four-wheelers	N3	Not applicable	2.56	37%

Note-

α Only applicable to commercial car or taxi models incentivised under FAME
β No data on number of OEM models but 38% of total 6,365 sanctioned e-buses had been deployed by March 2023

Source: CII-Invest India-Statiq (2023) Analysis

The FAME (Faster Adoption and Manufacturing of Electric Vehicles) is the key demand-side policy instrument in India for promoting localisation of EVs. With the ongoing phase (phase II) of the FAME scheme set to expire in March 2024, clear policy signal is required for the extension of phase two or initiation of phase three for all eligible categories included under FAME-II. This will be crucial for business viability across EV segments. Further, the inclusion of medium-heavy (N2 and N3) commercial cargo and long-haul trucks is suggested under the FAME Scheme which will be crucial for their market growth in the near future. As summarised in Table I on TCO across EV segments, the upfront cost for vehicle categories N2 and N3 is found to be 2-2.6 times the BAU-ICE technologies while the Total Cost of Ownership (TCO) of EVs in these categories is on average 38% higher than the BAU-ICE technologies[2]. Regarding the allied infrastructure, the FAME-II subsidies currently focus solely on EVSE or EV chargers, whereas upstream electrical infrastructure can contribute 30-40% of charging station investment costs depending on the location. It is therefore crucial to consider full cost of setting up a Public Charging Station, as opposed to EVSE alone, for any demand-side incentives under FAME-II and to really support business viability for EV charging or Charging-as-a-service (ChaaS).

[2] Cf. capex and TCO for all other segments applicable under FAME-II which is the range of 1.2-1.9 times BAU-ICE and 12-48% lower than BAU ICE

The recent Production-Led incentives (PLIs) Schemes for both Auto and Auto Components (AAC) and Advanced Chemistry Cells (ACC) have attracted significant investments into new technologies- INR 67,069 Crore and INR 18,100 Crore respectively. The momentum can be sustained by further expanding the scope of these **supply-side policy interventions** to key identified areas-

1. Advanced fuel technologies for long-haul transportation including maritime and shipping e.g. battery/ hybrid EVs, hydrogen fuel cell, hydrogen ICE etc.
2. Energy supply infrastructure for long-haul freight transportation: green hydrogen production, transportation, storage, and distribution
3. Prioritisation or segmentation within the existing AAC PLI Scheme for vehicle segments with high penetration of EVs and yet high import dependence for primary cells, that is- E2Ws and E3Ws.

For the benefit of all stakeholders, two key National-level guidelines for setting up public charging infrastructure from the concerned Ministries of the Government of India (GoI) are mapped in detail in our report. As voiced by different stakeholders, these guidelines are not fully adopted across States yet. Their adoption needs to be enhanced on the ground in favour of policy harmonisation and business viability of EV charging across States. While the 'Electric Vehicle Charging Infrastructure (EVCI) Guidelines' from the Ministry of Power (GoI 2022) provide a comprehensive guide with respect to all requirements for a private entity or a CPO to set up a public charging station; the 'Model Building Byelaws Respective Model Building Bye Laws (MBBLs) for EVCI' from the Ministry of Housing and Urban Affairs (GoI 2019) provide needed benchmarks for city-level building bye-laws for accordingly planning the urban land-use for electric vehicles and allied infrastructure.

States need to come up with their own and state-specific mandates, templates, and incentive structures on the top of Central Government's FAME Scheme and additional measures as part of their State EV Policy instruments. These specific recommended measures include-

1. State-specific template or model agreement form revenue sharing model with the LOA[3]
2. State-specific incentives which include tax breaks and land use concessions.
3. Strict enforcement of timelines for new connections, open access, electric equipment safety clearance, and fire preparedness (primarily by the concerned SERC and DISCOM/DISCOMs).
4. State or State Nodal Agency guidelines for EV tariffs and service charge caps as suggested by GoI
5. Clear guidelines for public-private partnerships between state governments and private companies to finance, build and operate Public Charging Stations (PCSs).

The application process for public charging infrastructure differs significantly for public and private players. Government entities can directly submit the EOI to set up a Public Charging Station or PCS to MHI. Private entities, however, have to first approach the ULBs, then it is escalated to the nodal agency and then to MHI. The application process to set up a public charging station is cumbersome and time taking for a private entity. It is strongly recommended in this report that The National Single Window System (NSWS) portal[4] is leveraged and used to incorporate all the necessary clearances related to setting up a Public Charging Station (PCS).

Specific policies and guidelines for open access and net metering or bi-directional metering at EV Charging Station (EVCSs) will be crucial to enable higher penetration of green power into EVs and making a better business case for ChaaS by taking advantage of two inherent opportunities-

(1) renewable energy integration with EVCS and

(2) vehicle-to-grid integration.

[3] LOA stands for Land-Owning Agency
[4] National Single Window System portal: https://www.nsws.gov.in/

A dedicated policy instrument with clear policy directions and adequate incentives for integrating renewable power at public/private EVCSs is therefore recommended, which may include the following components to begin with-

1. Provision for net-metering at EVCS including public and private changing stations.
2. Integration of existing provision for 'open access' covered in the EVCI Guidelines 2022.
3. Provisions such as blockchains-based peer-to-peer energy trading or green energy certificates for those who are not eligible to participate in the 'open access renewable energy market' or cannot afford to set up their own generation capacities due to the unavailability of land space or financial resources.
4. State Governments or State Nodal Agencies to subsequently formulate state-specific guidelines and regulations using such proposed Central Government Policy from the MoP, GoI.

Further, as per global evidence and experiences from matured EV markets, large EV fleets of tomorrow can strengthen the integration of variable renewable power rather than becoming a challenge for grid stability. Specific evidence highlighted in this report includes-

a. With noticeable EV load & low flexibility demand, which is currently the scenario in India, passive measures such as ToD tariffs can significantly help to shift the EV grid load and they are relatively easier to implement compared to active or smart charging measures. California experience shows that 15-20% of EV users shifted out from any given hour and 20-30% shifted into a given hour depending on the mix of incentives and price signals under ToD regime.

b. Active measures will become important with significant EV load in India in the future and necessitate smart charging, that is- unidirectional charging active control (V1G) and active control with bidirectional charging to the grid (V2G) in a phased manner[5]. V1G measures currently free up to 9-20% of the total weekly peak load demand in France. Evidence from Denmark shows net savings of EUR 2,304 per EV per year from V2G compared to a net cost of EUR 955 per EV per year[6].

The VGI or smart charging can support the electricity grid's balancing needs while helping to integrate the variable renewable electricity to support the green power ambitions at the same time. The standardised grid-EVSE-EV communication protocols are the first and foremost need for 'digitally connected and managed charging stations' that can act and respond to price signals, grid load, frequency etc. The following measures are accordingly suggested at this point to prepare capacities for grid integration of EVs and smart charging in the future-

1. It is recommended that a dedicated and futuristic policy instrument for 'digitally connected and managed charging stations' or EV-grid integration is formulated by MoP to guide and promote investment in smart infrastructure from both DISCOMs as well as infrastructure companies so that large EV fleets of tomorrow can strengthen the integration of variable renewable power rather than becoming a challenge for grid stability.
2. It is recommended that State Nodal Agencies (SNAs) or DISCOMs undertake (periodic) hosting capacity analyses[7] and consider publishing hosting capacity maps with- feasible kW range, existing demographics, EV registration data and relevant land-use information on Geographical Information System/GIS for use by infrastructure companies and CPOs. Information from SNAs may further be consolidated by Central Nodal Agency at the national level and used accordingly by SNAs to rationalise user tariffs or EV user charges which may vary with specific locations and as per the results of hosting capacity analysis.

[5] V2G active control further enables EVs to discharge energy to the grid, providing frequency response to the grid and an opportunity for EVs to participate in the electricity market by providing ancillary services.

[6] Moreover, global evidence shows that battery degradation costs from V2G represent approximately 1% of total costs for domestic electricity prices and 3-8% for commercial/industrial electricity prices. OEMs will need to consider virtual miles from V2G in mileage warranties, as per global regulations from the UN.

[7] For more detail on hosting capacity analysis, refer-
IREC (2017) Report. Optimizing the Grid: Regulator's Guide to Hosting Capacity Analyses.
Link: https://irecusa.org/resources/optimizing-the-grid-regulators-guide-to-hosting-capacity-analyses/

6. Price signals are introduced to utilise the flexibility of EVs, especially for the FCSs (with more than one fast charger/FC) that deal with large power volumes. Dynamic pricing regimes such as Time-of-the-day (ToD) tariffs and incentives/discounts for charging during solar hours are good starting point for a dynamic electricity pricing regime that reflects demand and incentivises charging during off-peak hours. Such passive measures will be extremely relevant to exploit the flexibility of EVs, before capabilities for real-time tariffs and smart charging are built at public-cum-private charging stations (as recommended under below points).

3. Globally available standards, such as OCPP (Open Charge Point Protocol) and Open Charge Point Interface (OCPI), are used as default standards for interconnected charging stations while tendering Public Charging Stations/PCSs.

4. Tax deductions or benefits to publicly accessible charging stations if they can be digitally connected and managed by a standard protocol such as OCPP.

5. Guidelines by the competent authority, such as the Central Nodal Agency, for smart functionalities in phases with priority to PCSs with a minimum of one fast charger or so-called FCSs.

6. Guidelines from the competent authority, say MoRTH, for minimum standards for EVs and charging points. This may include use of ''open vehicle-grid integration platforms' such as OpenADR by OEMs so that the flexibility of electric vehicles is valued for grid stability.

EV roaming will be crucial to overcome range anxiety concerns in India. EV roaming will significantly enhance ease of use and accessibility of public infrastructure for drivers or EV users. Aggregation, interoperability, and harmonisation across public charging stations is first step in the direction of EV roaming to enable users to charge their vehicles at any station, state or road/highway using a single mobile application. Open Charging Point Interface (OCPI) functional in matured EV markets support connectivity between e-Mobility Service Providers who have EV drivers as partners and CPOs who manage charge stations. OCPI and similar interface is required at the national level in India for easy access to drivers to charge their vehicles anywhere. Recommended actions for EV roaming include-

1. Initiate a National-level digital aggregation platform for EV roaming needs-
    1. Create a national-level digital platform (with consolidated CPO information[8]) of all EV charging stations including- location, types of available chargers and charging price. As suggested under VGI measures, existing OCPI interface can be utilised for this platform.
    2. Develop a mobile app (user interface from CPO) that provides real-time information on charging stations/points availability, prices and waiting times.
    3. Ensure accuracy and reliability of information on national database via automatic verifications and real time updates.

2. Design an Open Charging Point Interface that can cater to CPOs across states-
    I. Create standardised data formats for collecting and sharing information on charging stations/points. As suggested earlier, existing OCPP can be contextualised for India's needs.
    II. To make aggregation and interoperability a success, the above mentioned OCPP needs to be followed by every CPO. Once the OCPI layer is developed, it is followed by steps for testing and integration which ensures a seamless sharing of network between different CPOs. To ensure proper utilisation of the integrated network, the operators/CPOs need to enter into a service level agreement with central agency developing/managing OCPI.
    III. A dedicated (central) agency is needed for- (a) harmonising practices across CPOs to achieve interoperability, (b) encouraging policy to bring all the CPOs together on a single platform and share their data, and (c) forming a technical user community to address the queries of all the OCPI users, and regarding the installations and OCPI-based agreements.

[8] MoP (2022) EVCI Guidelines' existing provision require CPOs to share data/information with the Central Nodal Agency via their Network Service Providers

Scaling R&D efforts is required to domestically produce various EV components such as motor, controllers, primary cell and BMS. It is crucial to leverage the innovation in the vibrant start-up ecosystem. Testing and certification costs hinder innovation as smaller players lack resources to test/certify products. Therefore, to support technology indigenisation for EV powertrain or battery technologies, differentiated pricing for EV component testing and certification are recommended for the startups. It is preferable to set up common testing facilities in cluster so that the start-ups can test their product cost effectively, before going to the certification body such as ARAI or ICAT for final test and type approval. This is important from the perspective that existing testing facilities are limited in number and are already burdened. Newly proposed testing facilities can be facilitated by the government and potentially operated or maintained by a non-profit organisation or a business entity. Finally, tax rebates are proposed to businesses against R&D efforts and investment in certain priority areas (such as brushless DC motors, BMS or power controllers & energy storage) to promote innovation and technology indigenisation.

Scaling battery reuse and recycling efforts is going to be crucial in near future for a thriving E-mobility ecosystem. Latest Battery Waste Management (BWM) Rules provide a solid regulatory framework for battery waste management in EVs to begin with. As noted in the report, there is, however, significant scope for waste reduction or minimisation as follows-

a. Design strategies and design for Environment (DfE) to improve refurbishment & repurposing of existing batteries. By designing EVs with second-life applications in mind, automakers can encourage good practices in battery standardisation and safety across the industry so that battery packs can easily be repurposed for use in other applications and without risking injury to workers or damage to the environment.

b. Improvements in recycling technologies through dedicated R&D support. Direct recovery is found to be least polluting of all available methods, but it requires further developments to achieve similar material recovery levels as the pyrometallurgical and hydrometallurgical methods[9] which have significant environmental footprint on ambient air and water respectively. One of the key impediments in India for direct recovery of metals and critical minerals is again the lack of harmonisation of practices across OEMS and battery manufacturers as far as the DfE or material recovery are concerned.

c. Improved design strategies can lead to higher recovery potential, lower cost of recycling and recovery, and reduce the complexity involved in such operations. It is highly such desirable DfE strategies are considered by OEMs and battery manufactures well before new manufacturing units of advanced chemistry cells (batteries) are commissioned.

Basis the above rationale and understanding of e-mobility landscape, following actionable steps are recommended for scaling up battery reuse and recycling in the country and supporting implementation of the latest BWM Rules-

1. Formulate DfE Guidelines for OEMs and Battery Manufacturers: Pilot interventions and studies with collaboration across OEMs, battery manufacturers, recycling companies and other relevant technology players are need of the hour. DfE Guidelines for OEMs need to be drawn for Indian context based on learnings from these pilots as well global best practices and best available technologies. DfE considerations may consider harmonising practices for specific vehicle types or EV battery 'types and size classes' as much as possible in order to- simplify refurbishing processes for transition to second life of battery, increase recycling/recovery potentials or costs and reduce requirement of critical minerals and metals.

2. Enhance battery traceability: Tracking batteries and its usage profile can help all the players in the value chain of EV batteries. EV batteries have highest energy densities across battery storage application

[9] Proven technologies for battery recycling are briefly assessed and compared in the report for their advantages, disadvantages, specific energy consumption and maximum recovery percentage.

and a typical EV battery would still hold 80% of its original capacity at end of its first life in an electric vehicle. Batteries therefore need to be tracked though a uniformly followed standard/guideline. An EV battery goes through number of players in the value chain including- cell producers, module producers, battery producers, automotive OEMs, battery service, refurbishing, and repurposing companies. Following information would therefore be helpful to access the economic and technical feasibility of batteries at any given point of their life and specific guidelines to these two sub-points on battery traceability can be integrated into the existing BWM Rules 2022 via an amendment by the MoEFCC.

a. A unique identification number along with all technical information of battery from the OEM.
b. Historic information on usage and charging cycles as accessible information which is stored on battery BMS.

Finally, as noted in the report, there is need to raise public and consumer awareness on benefits of EVs and good charging practices to boost their confidence and increase adoption of EVs with specific target audiences such as- citizens/workforce in cities, taxi drivers, delivery partners and bus drivers etc.

1.Introduction

Fleets, Fleet Electrification and Fleet Charging

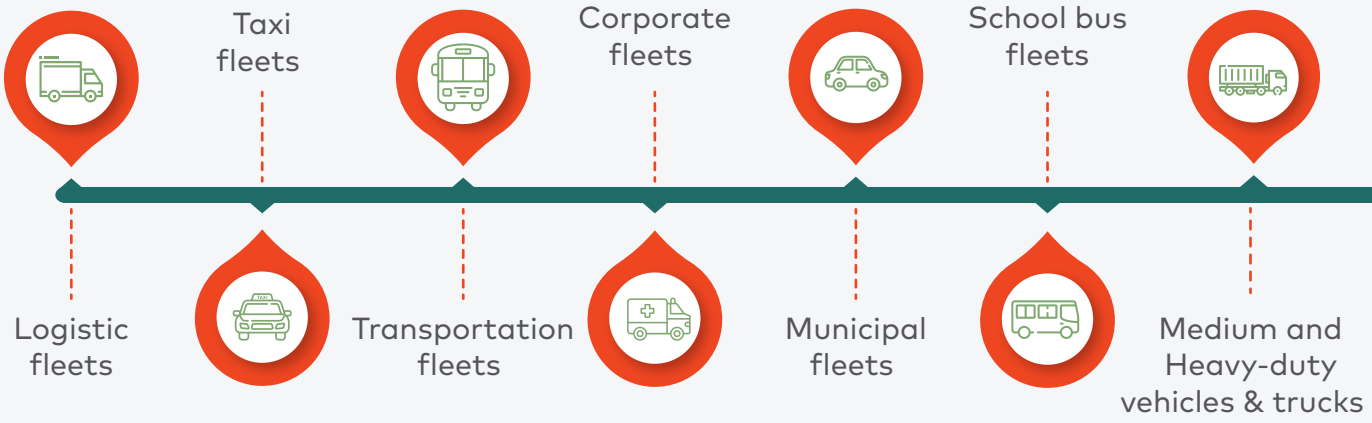
To achieve the aggressive goal of a net zero economy by 2070, there is a need to increase the adoption of EVs among both private and commercial use, with electrification of fleets playing an important role. According to a primary survey conducted by British Petroleum (BP) focusing on fleet decision makers, it was found that 52% already have electric vehicles in their fleet and among those who don't, 54% of decision makers revealed they will start switching to EVs in the coming 5 years (BP, 2021). Surveys like these display the positive trajectory of the industry.

In this section we will give a brief introduction about fleets and will understand the concept of fleet electrification and fleet charging.

1.1 Understanding Fleets & Fleet Electrification

Fleets lie at the centre of transportation industry and comprise of all the transport vehicles that are either owned or leased by a business, government agency or any other organisation rather than by an individual or family. Fleet vehicles cater to all our needs and move everything starting from the food we eat to our commute to the workplace.

Figure 1- Different types of fleets



Source- CII-Invest India- Statiq (2023)

Cities, corporates across the world are shifting towards electric fleets. This transition of fleet vehicles from current internal combustion engines (ICE) to zero emission electric vehicles is called fleet electrification.

Fleet electrification will not only help in reducing carbon footprint and energy consumption but will help in meeting the bigger goal of sustainability and net zero. Few factors that are playing an important role in uptake of fleet electrification include impact on environment, availability of supportive infrastructure, demonstration of Corporate Social Responsibility, cost benefits associated with electric fleet and availability of options.

Additionally, to achieve these bigger goals various countries and big corporates have taken steps towards fleet electrification among which Global giant IKEA has announced its target of becoming climate positive by 2030 and has also set a goal of 100% zero emission home deliveries by 2025; Walmart has committed to 100% zero emission trucks by 2040; British Gas aims to electrify its 12000 strong operational fleet by 2025; San Francisco has committed to electrify its light-duty passenger vehicle fleet and cities like Hangzhou and Shenzhen are committed towards taxi electrification. To add, Indian food delivery giant Zomato and e-commerce leader Flipkart are also a part of the EV100 initiative and have committed to transition their fleet to electric by 2030.

To add, Clean Energy Ministerial introduced the Electric Vehicle Initiative (EVI) which is a multi-governmental policy initiative dedicated towards accelerating the adoption of EVs worldwide. Various governments that have been active in the EVI include Canada, Chile, China, France, Germany, India, Japan, Norway, United Kingdom, United States and others. Additionally, various campaigns have been launched globally that focus on EV deployment, some of these campaigns include EV30@30 Campaign, Drive to Zero Campaign, GEF-7 Global Programme on Electromobility, EVI Global EV Pilot City Programme and others.

These initiatives and programmes are not only supported by various national governments across the world, but also by various leading state, provincial, regional governments and agencies, companies, and organisations.

1.2 Driving Successful Fleet Electrification

From the examples above we can see that the drive towards successful fleet electrification is no longer a future vision but is a reality. As governments and organisations are moving towards acquiring electric fleet, various factors will play an important role in this transition including factors like power, charging infrastructure and providing services that support the charging of EVs.

Powering EVs require a huge amount of investment in charging infrastructure. In this section we are talking about fleet charging, its scope, and few successful examples.

According to a report by IDTechEX (2022), the electric fleet charging represents less than 10% of the total charging infrastructure in volume but amounts to 15% of the total market value. With the growing interest in fleet electrification, fleet charging is expected to grow at a high rate.

1.3 Understanding Fleet Charging

Since organisations and fleet operators are making a shift towards electric vehicle fleets, there is a growing need for EV charging infrastructure to meet the charging requirements of a mixed fleet. To add, electric vehicle fleets of buses and trucks require very different charging infrastructure solutions in comparison to that of passenger cars. Hence, for any company adopting electric vehicle in its fleet must plan for charging solutions. While planning for fleet charging, various factors need to be considered including- growth in EV fleet, requirement for charging stations, type of charging stations, location, peak demand, vehicle models, availability of off-site public charging stations.

In today's time, the majority of EV owners charge at home, but for the complete electrification of the vehicle fleet, the availability and convenience of public chargers will play a crucial role. Hence, EV charging will play a large part in the future of the EV industry and will

make EVs more convenient. Proper public EV charging will lead to increase in utilisation and revenues, while increasing available charging option to EV owners.

In this section we showcase two examples for accelerating fleet electrification.

A. Delhi, India:
The Delhi Government launched a very progressive and holistic EV policy with the ambitious target of achieving 25% new vehicle registrations as EVs by 2024. Since the notification of this policy in 2020, there have been various efforts to encourage fleet operators and on-demand mobility service providers to switch to EVs. The policy provides purchase incentives, tax exemptions and has introduced scrapping and retrofitting policy for old vehicles. To add, Delhi will aim to install ~18,000 public and semi-public EV charging points by 2024.

B. The United States of America:
According to a report by McKinsey, commercial and passenger fleets in the USA could amount to 8 million EVs by 2030 which will be around 10 to 15 percent of all fleet vehicles. These EVs would require a great deal of investment and infrastructure. As per McKinsey, USA will require 13 million chargers by 2030 with an investment amounting to around USD 11 billion. To add, the market for fleet charging services could be worth USD 15 billion per year by 2030.

These examples not only showcase the future of fleet electrification and fleet charging, but also show how different countries/ states are committed and moving towards fleet electrification.

The upcoming sections of the report focus on various reasons why fleets are shifting towards EVs, discuss various existing business models in the industry. The report is also focussing on various government initiatives and FDI opportunities in the sector and lastly deep dives into various challenges and learnings from stakeholder meetings conducted.

2.Why fleets across the world are shifting to Electric Vehicles

The transport sector in India accounts for ~14 % of total CO_2 emissions in the country (ICCT, 2022) out of which freight vehicles (HCV and LCV) contribute 38% and the intermediate para transit vehicles contribute 15% (Singh et al, 2021). In 2022 alone, around 716,566 of commercial vehicles were sold in India (SIAM, 2022) making it critical for businesses to convert their fleets to zero emission electric vehicles. Nations across the world have come up with various strategies to ensure a smooth transition to E-mobility. Europe for example came up with policy mandates such as stricter emission targets for OEMs and generous subsidies for consumers whereas the United States introduced regulatory target of an EV share of at least 50% by 2030. All these mandates and subsidies shifted the consumer mindset towards sustainable mobility and accelerated the adoption of electric vehicles worldwide.

Corporates now a days pay a lot of attention towards environmental, social and governance issues and focus a lot on their sustainability targets. Sustainability in business has come a long way, it has evolved into a strategic concern driven by the market forces. Today, businesses do develop sustainability strategies, market sustainable products and publish sustainability reports for consumers, investors, activists and general public. Therefore, a lot of big companies have announced targets to completely shift to electric mobility as a part of their sustainability goals. PepsiCo, the American multinational beverage corporation has a target to convert its existing fleet of 27,000 trucks and vans to electric by 2040. Amazon, the global e-commerce giant aims to become 100% carbon neutral by 2040 and is actively advancing towards the goal. Also, there are a lot of global initiatives like EV100, Drive to zero, EV30 which brings together forward-looking companies and countries committed to accelerating the transition to electric mobility.

As the automotive, transportation and mobility markets are undergoing a social, technological and economic transformation that is fundamentally going to change how people and goods were moved. The use of electric and alternate fuel vehicles is likely to replace the old internal combustion vehicles. This transformation calls for proper strategy, cost projection and a viable business model for fleet operators to sustain. Also, operating cost is very crucial for a fleet operator to maximise profits and to optimise fleet efficiency. Budgets for fleets have historically been tight, with cost savings always being a top priority for operators. Since, fuel prices are extremely volatile due to various factors such as political conflicts, natural -

disasters, and plant closures it continues to be a costly and unpredictable variable cost for fleet operators, but it is still required for them to operate. Electric vehicle fleets, on the other hand, eliminate the need for these traditional fuels and ensure that operations are not adversely affected by any rapid rise in fuel prices.

As organisations today are competing in a sustainability-conscious marketplace, electric vehicles help demonstrate a commitment to operate with greener products and services, while at the same time conserving energy and reducing operating costs. There are several other benefits which electric mobility brings with it; these benefits include:

A Impact on Environment

Electric vehicles can lead to the reduction in the emission of carbon dioxide as when an electric car runs, it emits zero tailpipe (also known as direct) emissions. Since electric vehicles does not consist of any engine and operates only with an electric motor which is relatively less noisy when compared to the exhaust systems of the ICE cars, thus producing less noise pollution. Producing a light-weight and functional EV is a major obstacle. Many EV manufacturers are now a days focusing on producing lighter electric vehicles as lighter the vehicle, lower is its carbon footprint. In order to achieve this, manufacturers use recycled and organic material, which is eco-friendly, strong and durable.

B Maintenance

Maintenance of an electric vehicle is easier as well as cheaper. Electric vehicles are inherently more reliable than ICE vehicles and have fewer mechanical parts prone to failure and often provide better data to enable more pro-active

maintenance thus are less prone to breakdown.

C Safety

Since EVs go through various safety certifications in addition to the established safety testing and standards requirements, they are expected to be safer. In EVs, the battery packs are distributed along the bottom of the vehicle, resulting in a lower centre of gravity. This makes them less likely to roll over in the event of a collision. Furthermore, battery electric vehicles lack an engine and related components. This adds more space to act as a crumple zone, protecting the occupants from absorbing the majority of the energy in the event of a collision. Thus, making these vehicles structurally safe (Feil, 2022).

D Source of Value

By installing an electric vehicle charging station, consumer facing businesses (particularly retailers and leisure companies) can monetise their facilities to create a new income stream. On-site charging is also likely to encourage customers to stay longer in the store, resulting in higher per-customer spending. Businesses that install local generation and storage infrastructure to support EV charging can also earn money through energy-saving programmes.

E Enhances Organisation's Reputation

Transitioning to EV can help you avoid falling foul of increasingly stringent government regulations, thereby protecting your reputation. Consumers and employees are concerned about the environmental impact of the organisations they buy from and work for. Entities that transition to electric vehicles can improve their brand reputation by demonstrating green leadership and stronger sustainability credentials.

F Increasing Employee Satisfaction

An electric vehicle setup isn't just for the business, but also benefits the employee. Enhanced experience for fleet drivers with better route planning to reduce driving time lowers commute costs, reduces risk of breakdowns, and manages range anxiety. EVs break down less frequently than internal combustion engine vehicles because they have fewer component parts, allowing drivers to stay on the road for longer. Also improved health and safety through better local air quality and less exposure to harmful NOx is also a benefit for the employees.

The higher cost of electric vehicles when compared to traditional fuel vehicles is a major barrier to mass adoption in a price sensitive market like India. Today the upfront cost of electric cars is 25-30% higher than petrol/diesel car. However, the math changes once you consider the total operational cost of an electric vehicle over a period of 3-5 years. For fleet operators the running cost of their vehicles is of utmost importance to them. The running cost of the vehicle is inversely proportionate to the profits of the fleet operator i.e., higher the running cost of the vehicle, lower is the profit and vice versa. The per kilometre cost of driving a petrol vehicle is INR 7-8 whereas it comes down to INR 1.2-1.4 for an electric vehicle. This major difference in the per kilometre cost ends up saving a very substantial amount in long term, even more than the difference in the upfront cost of buying an electric vehicle. Thus, a more accurate assessment of the economic efficiency of electric vehicles is the 'total cost of ownership' that is the sum of all costs involved in the purchase, operation and maintenance of a given asset during its lifetime. Since electric vehicles have fewer moving parts therefore it requires less maintenance as well as suffer from less wear and tear over time. Also, the cost of servicing of an electric car is one third when compared to that of a petrol/ diesel car. All these factors lead to a significant amount of savings for a fleet operator.

In order to get a sense of practicability and to get an idea of actual capital and running costs in the Indian context, a TCO (Total Cost of Ownership) case study for both, an electric vehicle and an ICE vehicle is given and a comparative analysis is shown to find out the savings made by an electric vehicle in long term.

Case Study 1 - Total Cost of Ownership of a 4-wheeler

Objective

To derive the Total Cost of Ownership (TCO) over a period of 5 years of an Electric and CNG car. Also, to compare the TCO's of different fuel types and find out the most efficient fuel type for 4-wheelers in the fleet sector.

For better analysis, few things have been assumed constant for this case study -

i. The car is purchased by making an **upfront payment** and not via EMI.

ii. The car runs **100 Km** daily.

iii. Car being considered for analysis is **Tata Tigor.**

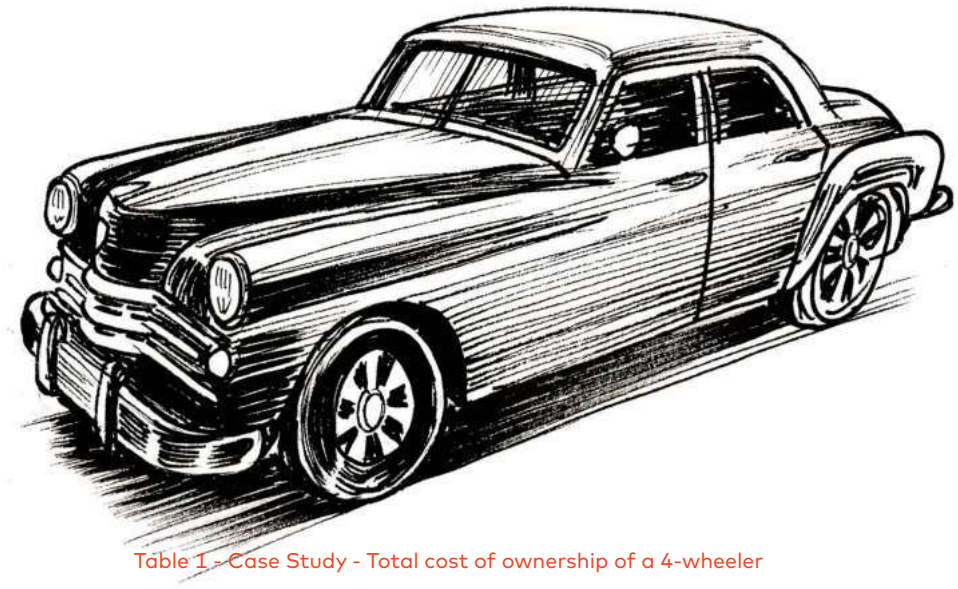


Table 1 - Case Study - Total cost of ownership of a 4-wheeler

	CAR TYPE	
VARIABLES	ELECTRIC	CNG
Cost of the vehicle	INR 13,66,404.00	INR 8,49,313.00
Energy cost per month *(Electricity, CNG)	INR 3,391.30	INR 18,436.50
Maintenance cost per month	INR 200.00	INR 350.00
Insurance (remaining 4 years)	INR 51,023.00	INR 30,951.00
Total cost of ownership in 5 years	INR 16,32,905.26	INR 20,07,454.00

Source - Tata Motors (2023)

Savings EV make in 5 years compared to a CNG vehicle

INR 3,74,548.74

Workings

1. Energy cost per month of electric vehicle is derived using the battery size and the range specified by Tata Motors. Kilometers that can be driven using 1 kW of energy is derived using the total range of the vehicle divided by the total capacity of the battery (In kWh). The cost of the required energy is then attained using the prevailing energy prices.

   Whereas for petrol and CNG vehicle the cost is derived using the range and current price of the petrol/CNG.

2. Maintenance cost of the vehicle is the average cost a person will incur in getting the vehicle serviced over the tenure of 5 years. This data is derived using the past service records of the vehicle owners of the respective fuel type.

3. Insurance of first year is included in the cost of the vehicle itself. Whereas the insurance cost of the next 4 years is derived assuming a fixed depreciation rate of 10% in the premium price of every year for every fuel type.

To add, Clean Energy Ministerial introduced the Electric Vehicle Initiative (EVI) which is a multi-governmental policy initiative dedicated towards accelerating the adoption of EVs worldwide. Various governments that have been active in the EVI include Canada, Chile, China, France, Germany, India, Japan, Norway, United Kingdom, United States and others. Additionally, various campaigns have been launched globally that focus on EV deployment, some of these campaigns include EV30@30 Campaign, Drive to Zero Campaign, GEF-7 Global Programme on Electromobility, EVI Global EV Pilot City Programme and others.

Case Study 2 - Total cost of ownership of a 2-wheeler

Objective

To derive the total cost of ownership of an electric and a petrol 2-wheeler. Also, to compare the TCO's of different fuel types and find out the most efficient fuel type for 2-wheelers in the fleet sector.

1.	2.	3.	4.
The 2-wheeler is purchased by making **upfront payment** and not via EMI	The vehicle has a daily run of **80 Km**	Vehicle considered is **Bajaj Platina** as it is one of the most common vehicles used by the fleets and is also one of the most fuel efficient 2-wheeler available.	Electric 2-wheeler being considered for this analysis is Hero **NYX CX ER**.

Table 2 - Case Study - Total cost of ownership of a 2-wheeler

	VEHICLE TYPE	
VARIABLES	ELECTRIC	PETROL
Cost of the vehicle	INR 1,02,690.00	INR 76,920.00
Energy Cost per Month*(Petrol, Electricity)	INR 576.00	INR 3,317.49
Maintenance Cost (Per Month)	INR 80.00	INR 140.00
Total Cost in 3 years	INR 1,24,506.00	INR 1,99,229.49

Source - Bajaj Auto, Hero Electric (2023)

Savings EV make in 3 years compared to a petrol vehicle

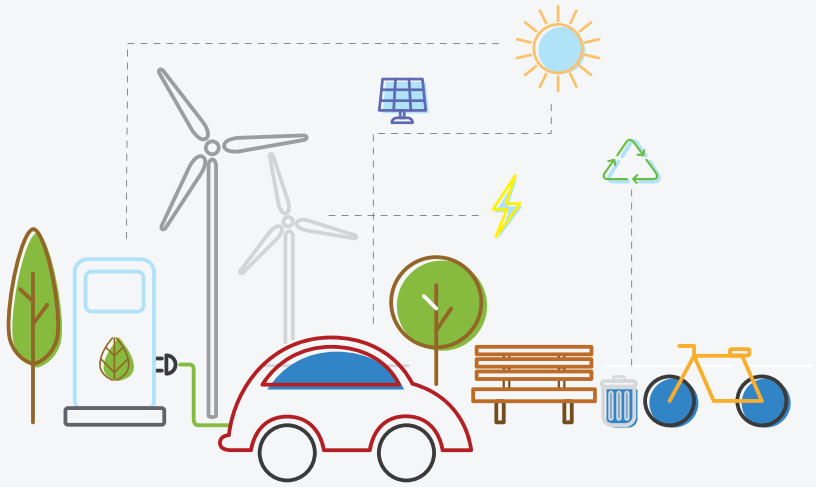
INR 75,083

Workings

1. Energy cost per month of electric vehicle is derived using the battery size and the range specified by Hero electric. Kilometers that can be driven using 1 kW of energy is derived using the total range of the vehicle divided by the total capacity of the battery (In kWh). The cost of the required energy is then attained using the prevailing energy prices. Whereas for the petrol 2-wheeler the cost is derived using the range and current price of the petrol.

2. Maintenance cost of the vehicle is the average cost a person will incur in getting the vehicle serviced over the tenure of 3 years. This data is derived using the past service records of the vehicle owners of the respective fuel type.

Hero electric's NYX CX ER is 33% (INR 25,770) expensive than the Bajaj Platina. However due to a major difference in the operating cost of both the fuel types, a person using electric 2-wheeler will not only recover the difference in the cost but will also end up saving a significant amount over and above. A person driving electric 2-wheeler will end up saving INR 74,723.49 in a short span of 3 years. This difference in the total cost of ownership occurs because per km cost of driving an electric 2-wheeler comes out to be INR 0.20-0.25, whereas for a petrol vehicle the cost per km rises to INR 1.40-1.50.



Case Study 3 - Total cost of ownership of a 3-wheeler

Objective

To derive the total cost of ownership of a 3-wheeler across all fuel types. Also, to compare the TCO's of different available fuel types and find out the most efficient fuel type for 3-wheelers in the fleet sector.

For better analysis, few things have been assumed constant for this case study -

1.

The vehicle is purchased by making upfront constant and not via **EMI.**

2.

The vehicle has a daily run of **100 Km.**

3.

The 3-wheeler being considered here for the analysis is **Piaggio Ape Xtra LDX**

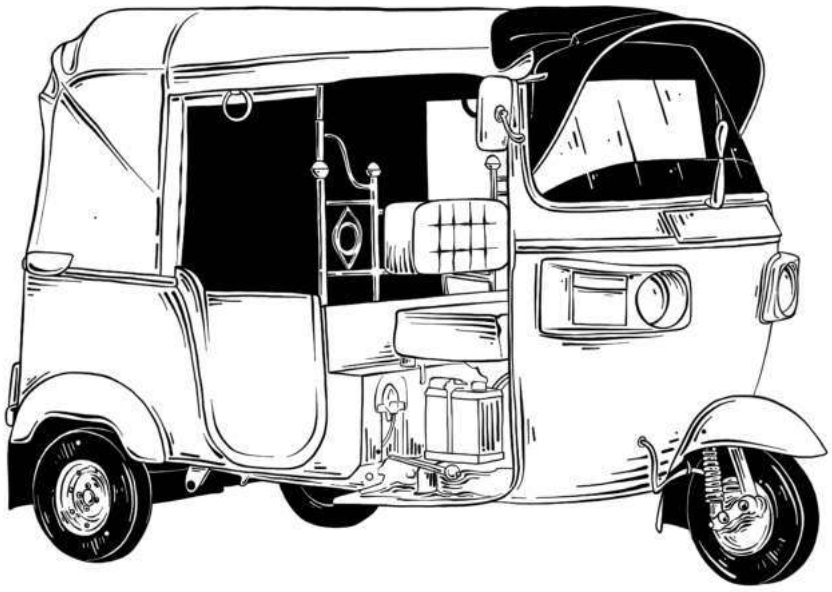


Table 3 - Case study - Total cost of ownership of a 3-wheeler

	VEHICLE TYPE		
VARIABLES	ELECTRIC	DIESEL	CNG
Cost of the vehicle	INR 3,36,000.00	INR 3,20,500.00	INR 3,20,000.00
Energy cost per month* (CNG, Diesel, Electricity)	INR 1,066.67	INR 10,759.20	INR 7,023.43
Maintenance Cost (Per Month)	INR 100.00	INR 150.00	INR 120.00
Total Expense in 3 years	INR 3,78,000.00	INR 7,13,231.20	INR 5,77,163.43

Source - Piaggio vehicles Pvt Ltd (2023)

Savings EV make in 3 years compared to a CNG vehicle

INR 1,99,163

Savings EV make in 3 years compared to a Diesel vehicle

INR 3,35,231.20

Workings

1. Energy cost per month of electric vehicle is derived using the battery size and the range specified by Piaggio vehicles Pvt Ltd. Kilometers that can be driven using 1 kW of energy is derived using the total range of the vehicle divided by the total capacity of the battery (In kWh). The cost of the required energy is then attained using the prevailing energy

prices. Whereas for the diesel and CNG variants the cost is derived using the range and current prevailing prices of diesel and CNG.

2. Maintenance cost of the vehicle is the average cost a person will incur in getting the vehicle serviced over the tenure of 3 years. This data is derived using the past service records of the vehicle owners of the respective fuel type.

There is a very little difference in the upfront cost of the three variants however in a span of 3 years, a person driving electric 3-wheeler will save INR 3,35,231 when compared to the diesel variant and INR 1,99,163 when compared to the CNG variant. This difference is due to the economical operating cost of an electric vehicle, cost of driving 1 km via an electric vehicle comes out between INR 0.4-0.5 , whereas it goes to INR 2.4-2.5 in a CNG vehicle and INR 3.5-3.6 for the diesel variant.

Along with the huge difference in the total cost of ownership, there is one more major and considerable factor making it important to make a shift towards e-mobility, that is the difference in the CO_2 emissions. While driving, electric vehicles emit no direct or tailpipe emissions, which significantly improves air quality and reduces air pollution. According to (EDF, 2018), just one electric car on the road can save up to 1.5 million grams of carbon dioxide despite the fact that manufacturing batteries for electric vehicles and using electricity generated by fossil fuels result in some indirect CO_2 emissions. However, with the improvement in technology, today's EV batteries have a carbon trace that is 2-3 times lower than two years ago, also charging stations powered by renewable sources of energy are under development and few of them have already been installed in some parts of the nation. The levels of CO_2 emissions produced by various vehicle types and electric versions are compared in Table 4 below. The amount of CO_2 emissions reduced by choosing electric over ICE is also shown in the table.

Table 4 - CO_2 Emissions savings in a period of 5 years by opting Electric 4-wheeler over an ICE vehicle

Vehicle type	**Annual CO_2 emission** (In tonnes, 100km's per day)	**Annual CO_2 emission** (In tonnes) **of the electric variant of the vehicle.** (100 km's	CO_2 (In tonnes) **savings done by opting EV ina period of 5 years**
4 - Wheeler (Diesel)	**6.34**	**4.96**	**6.90**
4 - Wheeler (Petrol)	**6.57**	**4.96**	**8.05**
3 - Wheeler (Diesel)	**4.83**	**2.52**	**11.55**
3 - Wheeler (Petrol)	**4.14**	**2.52**	**8.10**
2 - Wheeler (Petrol)	**1.42**	**0.98**	**2.20**

Source - GoI, 2023a

In a time of volatile fuel prices and growing environmental concerns, electric vehicles offer a way to reduce operating cost and demonstrate your environmental responsibility. According to a recent survey, 83% of large company fleet operators believe that the environmental benefits are the primary reason for electrifying their fleets, while 64% believe that the lower total cost of ownership is the motivator (PG&E, 2019). Organisations all over the world are assessing their requirements to determine where electrification can fit into their operations, and as new technologies and infrastructure improvements become available, more and more fleet operators will embrace electrification.

3.Business Models

Large scale adoption of electric vehicles requires various system wide changes which includes customer acceptance, availability of vehicle types & most importantly it requires supporting business models and policies.

Early adoption by government, businesses & fleets can provide the scale to create micro-systems, which can grow and eventually combine to form larger ones. In a country like India, three high priority use-cases for business EV adoption have been identified by WBCSD:

Figure 2- Key use cases identified

Source- WBCSD, 2019

These are the use-cases with the greatest potential for early adoption. Higher utilisation will result in EV ownership cost parity with ICE counterparts in each of these use-cases, making the transition easier and more viable.

3.1 Employee & Customer Transport

As Indian cities become more densely populated, a lack of dependable public transit, along with passenger safety concerns, has given rise to a developing corporate employee transportation system. Employee transportation is a better option in comparison to public transportation, such as the metro, because of factors like convenience, late-night availability, safety, and comfort.

Why electrify employee transport?

A. Higher utilisation rates and defined routes make EV adoption easier: At high utilisation rates, EVs may compete with traditional cars. This positions businesses and employees to gain economic benefit. Furthermore, because the staff transportation segment has well -defined and fixed routes, it is easy to ensure utilisation by planning and putting up charging stations, resulting in financial viability.

B. Market Size: As of 2017, corporate or ETS accounts for 23% of the total taxi business in India, which is projected to be worth USD 3.5 billion.

C. Unidirectional flow of traffic contributing to the heat island effects: The problem has emerged in Indian cities, where regions near corporate buildings can be up to 3-5 degrees Celsius warmer than the surrounding area.

There are three popular ownership models in corporate employee transport: company owned, mobility-as-a-service and employee-owned

A. Company-owned vehicles: Under this model the company owns and operates a fleet of vehicles and chargers. The company itself bears the cost to train staff, set up infrastructure and operate the fleet.

B. Mobility-as-a-Service: Under this model the companies rely on third party vendors to provide EVs to help employees commute to workplace and back home. The vehicle is also used for office operations.

C. Employee-owned vehicles: In this model the company or the employee creates and operates workplace infrastructure facilities (Charging infrastructure and dedicated EV parking spaces). Additionally, the company also incentivises employees to purchase and use EVs.

3.2 Platform based Ride Hailing

Ride-hailing and shared mobility services make it easy to obtain economical and convenient rides in two, three, and four-wheeler vehicles. App-based ride hailing services have risen fast in the recent five to seven years. The bulk of app-based ride-hailing services in India began with four-wheelers, but formalised two and three-wheeler ride-hailing has recently increased.

Why Electrify Ride Hailing?

A. Higher utilisation rates: It has been observed that the average coverage of a ride-hailing vehicle is higher in comparison to any other use cases (150-400 kms/day). Additionally these electric vehicles with high driving miles have shorter payback periods.

B. Preferred form of commute: The app based ride hailing market has grown significantly in the last three years and is expected to reach USD 10 billion by 2023. As per an EY analysis ride hailing services forms 13% of the Indian taxi market, making it a preferable choice for consumers.

C. Expansion of ride hailing services in tier 2/3 cities at lower costs: As the ride hailing services expand to Tier 3 cities and transportation costs decrease, demand for smaller form factor vehicles (bikes/autos) on ride-hailing platforms is projected to rise. Additionally, when compared to four-wheelers, two and three wheelers have a better economic viability for shorter journeys and commutes.

Variations In Use Case

A. Ride-as-a-service (RaaS)

Investor-owned

In this approach, investors place vehicles in platform fleets. Investor-owned models are anticipated to promote adoption in the short to medium term, at least until the purchase prices of ICEs exceed those of EVs. Platforms will need to provide investors/partners positive KPIs such as better visibility, higher utilisation, and operational savings.

Platform-owned

This model usually involves platforms leasing vehicles to drivers. Platform-owned models are feasible for platform-based aggregators as their operations guarantee high vehicle utilisation. Also, the decreased operating costs will allow for a faster cost recovery across all vehicle categories.

Driver-owned

This fleet ownership model is governed by the present cost differential. Due to a minor difference in the cost of electric two and three-wheelers compared to their ICE equivalents, driver-owned models can be considered in the two and three-wheeler categories.

B. Vehicle-as-a-service (VaaS)

Investor-owned

In the present use case, it has a larger adoption potential since it minimises upfront costs for platforms by having investors place vehicles in fleets.

 Platform-owned	VaaS may not provide the same number of daily miles as fleet aggregators, resulting in a lesser adoption potential.
 Driver-owned	Under the driver-owned model there is a lower adoption potential, owing to the high upfront costs.

3.3 Last mile urban freight & deliveries

Last-mile commodities distribution is becoming increasingly vital in modern metropolitan living. Globally, urban freight traffic accounts for 10-15% of total miles travelled and around 6% of overall GHG emissions from transportation. It employs between 2% and 5% of the overall urban workforce. The advent of e-commerce, food and grocery delivery is driving up demand for last-mile delivery services.

Why electrify the delivery system?

A. Vehicle segment cost competitiveness: Electric two and three-wheelers have a small upfront cost differential when compared to their ICE equivalents. Currently, electric two-wheelers have the most vehicle options. To add, electric bicycles along with other electric micromobility solutions can be utilised for food delivery as they offer a decreased TCO.

B. Consistent growth in markets and fleets: The delivery sector has expanded significantly since giants like Swiggy and Zomato joined and became aggregators of two-wheelers for food deliveries. Also, big names like Walmart, Flipkart and Amazon have begun using two-wheelers and vans for last-mile e-commerce delivery.

C. Ease of operation: Popular markets and food and beverage pick-up locations are great charging / swapping places for keeping an EV or fleet ready for both last-mile products and food delivery. To add, swapping at hubs is another possibility which is being explored to

reduce charging time.

D. High utilisation rates: According to statistics, last-mile deliveries in cities account for ~40% of all e-commerce logistics and two-wheelers deliver nearly 88 million orders a month.

Variations In Use Cases

A. E-commerce delivery

Platform-owned	These ownership models are possible since electric two-wheelers are nearly at parity with ICE versions (at 100 km per day). LCVs, on the other hand, do not offer a higher adoption potential, owing to both a huge cost differential and a lack of vehicle alternatives on the market.
Service contracts	To keep platforms asset-light, service contracts with strategic partners (for EV deployment and charging infrastructure) have a high potential for implementation.
Driver-owned	Since two-wheelers are the most common means of transportation in India, a driver-owned model has potential when compared to other vehicle sectors, notably LCVs.

B. Traditional commerce delivery (groceries, furniture and electronics)

 **Platform-owned**	Electric three-wheelers and LCVs can be purchased by furniture and electronics retailers for local delivery. This approach is only sustainable if shop sales allow for consistent and high fleet utilisation.
 **Service contracts**	Vendors working with retailers would need to plan fleet deployment through pilots and research. This approach is the most appealing to business owners since they do not have to pay for the EVs up front.
 **Driver-owned**	This model is most viable for grocery stores and platforms if the demand from customers and drivers is high enough.

C. Food delivery

 **Platform-owned**	Platforms and restaurants in this model would own a fleet of electric two- wheelers and the supporting infrastructure.

Service contracts

Instead of a captive fleet of electric two-wheelers, this approach might involve partnerships with third-party and vendors for delivery service and operations. This concept lowers the expenses of owning and managing a fleet. Also, this strategy would be very appealing to the market's existing online and asset-light platforms.

Driver-owned

Electric bicycles for food delivery might be an appealing way to test a driver-owned business since this model in two-wheeler sectors have a lower cost difference than other segments, their adoption potential remains substantially lower than leasing.

Although the electrification of fleet has gained momentum in India but the scale of financing required in the EV business remains a major impediment. Electric vehicle adoption in India is presently spearheaded by the B2B segment with many start-ups reaping benefits of higher utilisation of EV fleet followed by the B2C or private segment. Therefore, large scale EV adoption would not only require financial incentives but will also require innovative business models to deal with higher purchase costs of electric vehicles.

On the basis of our conversation with various fleet operators across different categories, below mentioned are some of the business models that are most commonly used in the industry.

Figure 3- Commonly used business models

Asset Light Model

The vehicle that runs on the platform are owned by asset investors and operated by fleet operator.

Asset Owned Model

The vehicles are owned, managed and operated by the fleet operator

Individual Aggregation Model

The fleet operators allow drivers to connect their vehicles (2W, 3W or 4W) and work as a DCO (Driver cum Operator). The fleet platform oversees the operations and assigns jobs to drivers.

Battery Leasing

Fleet operators lease batteries from OEMs or other battery solution providers on a subscription basis to reduce the capital expenditure.

Source- CII-Invest India-Statiq (2023)

In order to get a deeper understanding of the business models being practiced in the industry, CII along with Invest India and Statiq had closed door conversations with various stakeholders across the industry. These stakeholders were divided into 4 different categories including:

Figure 4- Categories of the stakeholders involved

Source- CII-Invest India-Statiq (2023)

The conversations with the industry stakeholders gave us an insight on the current and potential business models that are being explored in the ecosystem. The section below covers some of the case studies for your understanding.

3.4 Case Studies

Shared mobility and ride-hailing services make it simple to find affordable and convenient trips in two, three, and four-wheel vehicles. Over the last five to seven years, app-based ride hailing services have grown rapidly. The majority of app-based ride-hailing services in India began with four-wheelers, but there has recently been an increase in formalised two and three-wheeler ride-hailing.

A. ZUNZO

Launch date	2014
Presence (Cities / States)	8 cities
Charging Infrastructure required for current fleet	1. Contemplating if charging stations can be set up at warehouses in the city, these are places where the pickup of good happen and that becomes a source of charging (conventional AC charge/ DC charge or battery swapping). 2. Primarily want to depend on public charging infrastructure going forward for market place operations for various origin and destination players in the city. Also, battery swapping technology can be used for top ups by riders.
Business Models	In the present scenario there are two models that are followed: 1. Delivery partner is allowed to join in their own capacity, while they use their own vehicle or arrange a vehicle for their activity. 2. Also partnered with companies that provide solutions for having both delivery partner and vehicle.

B. EVAGE

Launch date	Vehicle is out for testing, should be launched by second quarter 2023
Presence (Cities / States)	Currently located in Mohali, Punjab. Also, looking at expanding in Northern Region – Chandigarh, Haryana, Gurgaon, Delhi and HP
Type of EV vehicles in your fleet	N1 Light Commercial Vehicle 1 ton. The product is exoskeleton in structure and can be modified as per client requirements. Going forward plans to get into heavy & medium duty trucks.
Number of charging stations (both AC and DC)	Focusing on setting up chargers at client hubs. Going forward will focus on semi-public charging.
Business Models	Currently Evage is looking at only selling and leasing as their strategy.

C eee - Taxi

Launch date	2016
Presence (Cities / States)	Geographically present in Delhi NCR, Hyderabad and Bangalore
Type of EV vehicles in your fleet	eVerito & TATA Tigor
Fleet Strength of EVs	150 cars and are expanding
Number of charging stations (both AC and DC)	looking at creating hubs (both captive charging and partnering with CPOs). Also, top up usually happens through public charging infrastructure

Charging Infrastructure required for current fleet	In Delhi charging requirements are largely met. On the other hand, the charging needs in Bangalore and Hyderabad it is still a challenge due to range of the cars
Fleet Strength in 2030 or any future year (forecast numbers)	Expansion awaited due to better mass market cars in segment with long term warranty of battery. They are also focussing on expansion and targeting Pune and Mumbai as soon as possible
Business Models	1. EEE Taxi is following a B2B model and work with Corporates and Government 2. For employee transportation they are following a classic vanilla model 3. They have also come up with a very uberised kind of a model – PPP model 4. The organisation is also trying to develop the ecosystem and are leasing vehicles now. Going forward they want to be asset light

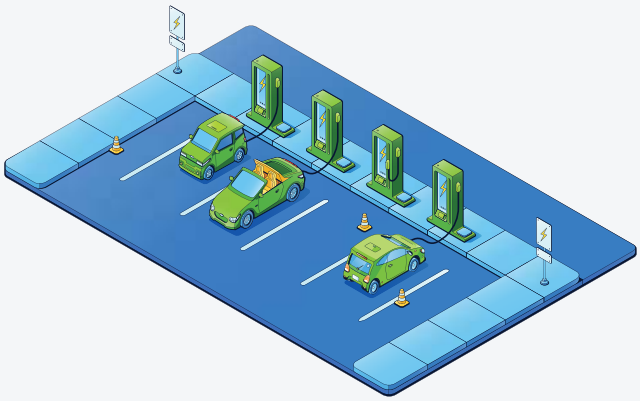
D. SMART E™

Launch date	2015
Presence (Cities / States)	Currently present in Delhi NCR, Lucknow, Kanpur, Sitapur, Prayagraj, Varanasi, Jaipur
Type of EV vehicles in your fleet	Electric three wheelers (L3 & L5)
Fleet Strength	1500+
Number of charging stations (both AC and DC)	Currently operate 20+ hubs (combination of both charging and swapping infrastructure)
Fleet Strength in 2030 or any future year (forecast numbers)	Aggregating 150-200 vehicles per month

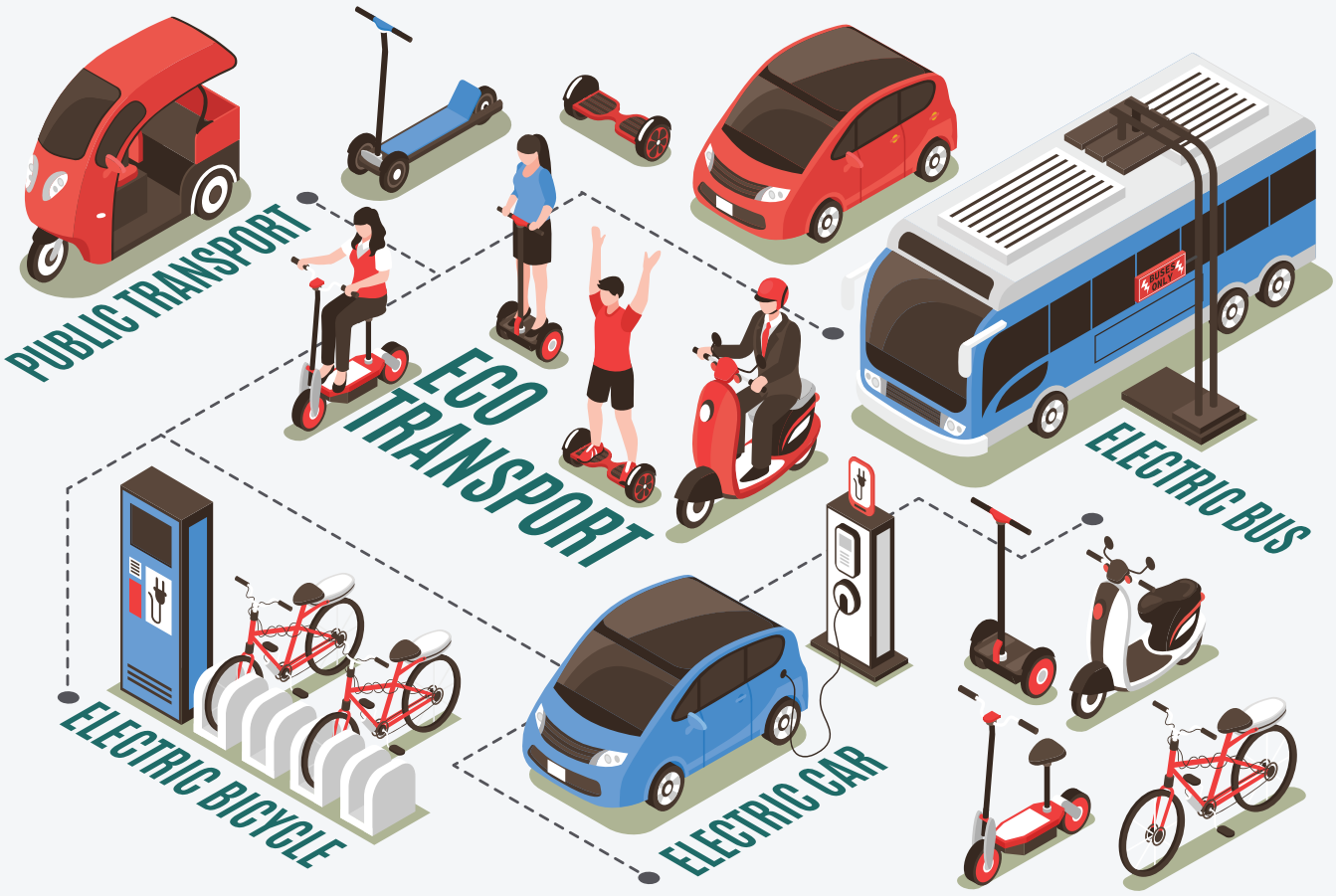
Business Models	SmartE has shifted from self-owned fleets model to aggregated fleet of passenger vehicles

4. Scope of Fleet Charging

Due to increased charging infrastructure and 100% FDI, the scope of fleet charging in India is expanding quickly. In India, there are three forms of EV charging infrastructure: the government-driven model, the private sector-driven model, and the public-private partnership model. To look into the possible advantages of charging, an analysis of the barriers and difficulties faced by electric vehicles in India was done. The government intends to introduce battery replacement in the three-wheeled vehicle and bus categories in order to decouple battery costs from vehicle costs and facilitate the use of electric cars in India. The Indian government has clarified that operating EV charging stations does not require a license and has issued a policy on charging infrastructure to enable faster adoption of EVs. The Department of Science and Technology has also launched a grand challenge for developing the Indian Standards for Electric Vehicle Charging Infrastructure Vehicles. India's EV market is expected to expand at a compounded annual growth rate (CAGR) of 49% between 2021-2030, with the segment's volumes set to cross annual sales of USD 43 billion by FY30. According to KPMG, the growth potential for the charging industry is 15-20% in the two-wheeler market. By FY30, India's total electric vehicle fleet is expected to reach five million units. The rapid expansion of the market is predominantly due to strong government support through policies such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicles.



The market's explosive growth can be largely attributed to strong government assistance through programs like Faster Adoption and Manufacture of Hybrid and Electric Vehicles (FAME) II. By offering incentives for electric vehicles, the policy seeks to promote clean transportation. Furthermore, a number of state governments have revealed their own plans to promote electric vehicles. Karnataka, for example, has introduced its Electric Vehicle & Energy Storage Policy 2021, which offers incentives for establishing EV manufacturing facilities.



5.Government Initiatives and FDI opportunities

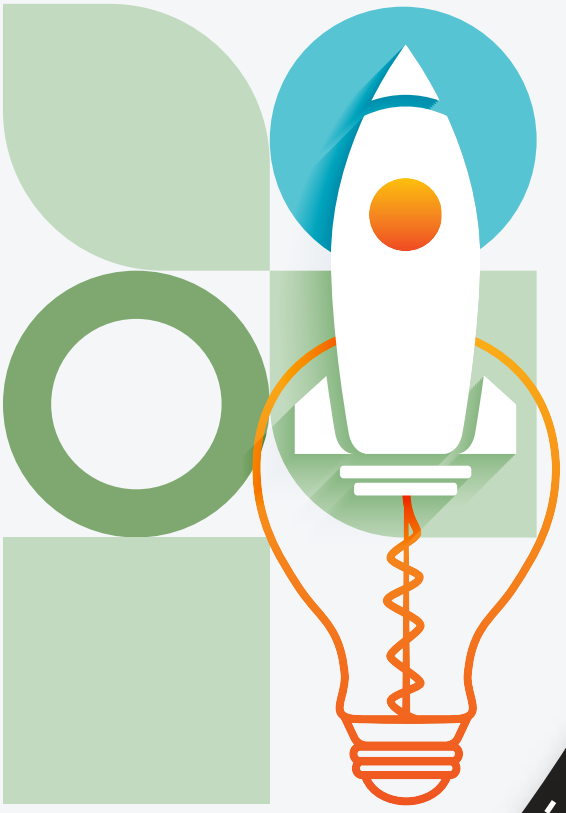
5.1 Policy Push:

Government support in Fleet electrification

The Indian government has been actively working towards promoting the adoption of electric vehicles (EVs) through policy measures. Starting with the National Electric Mobility Mission Plan (NEMMP) launched in 2013, which aimed to put 5-6 million electric and hybrid vehicles on Indian roads by 2020, the government has since announced its intention to make India a 100% electric vehicle nation for Three Wheelers and 80% for Two wheelers by 2030. To achieve this goal, the government has implemented a number of incentives for EV manufacturers and fleet operators, such as subsidies and tax exemptions on the purchase and maintenance of EVs, as well as plans to establish charging infrastructure across the country.

Policies will help play a major role for establishing charging infrastructure and providing incentives for the installation of EV charging stations. These policies will help to reduce the operational costs and improve the overall performance of EV fleets, making them more attractive to fleet operators. Various key policy measures being developed aim to address common barriers to EV adoption, such as range anxiety and lack of charging infrastructure, and make EVs a more attractive option for fleet operators.

The EV policy framework in India is constantly evolving to promote the adoption of electric vehicles and support fleet electrification in the country. The government's efforts to promote EV adoption will play a significant role for a smooth and successful transition of Fleets from ICE to EVs.



Evolution of EV policy framework

2005

First Automotive Mission Plan 2006-2016 With an investment of USD 35 million, a major effort was made to make India the world's centre for tiny automobiles and high-quality auto parts.

2010

MNRE Incentive scheme for EV In a major boost to the Indian electric vehicles industry, the ministry of new & renewable energy (MNRE) had announced a 20 per cent financial incentive on the ex- factory price of electric cars and scooters sold in the country.

2012

National Electric Mobility Mission 2020 Launched with an aim to achieve national fuel security by promoting hybrid and electric vehicle in the country. Major Policy improvements to help the EV Industry with the goal of putting 5-6 million electric and hybrid vehicles on Indian roads by 2020.

2015

FAME – Faster Adoption & Manufacturing of (Hybrid &) Electric vehicles (FAME) policy launched with an Outlay of INR 10,000 crore to provide financial incentives for the purchase of EVs and to establish charging infrastructure across the country.

2020

The Ministry of Power launches the **'Green Energy Corridors'** project to develop EV charging infrastructure across the country.

2019

FAME II: launch of the Phase II of the FAME India scheme to promote electric and hybrid vehicles. Revised incentives for EV's. E-2W sales grew by 5x

2018

Charging Infrastructure guidelines announced by Ministry of Power. **GoI targets 30% EV penetration by 2030.**

2017

Niti Aayog Roadmap Transformative Mobility Solutions for all plan 2016-2026 launched.

2020

Sale of Electric 3W and 2W without pre-fitted battery permitted by MoRTH. More demand side incentives such as road tax waive off announced by MoRTH.

2021

FAME II extention till 2024. Increased incentives for E2W. Introduced Production Linked Incentive (PLI) Scheme for Automobile and Auto Component Industry in India for enhancing India's Manufacturing Capabilities for Advanced Automotive Products (AAT) with a budgetary outlay of INR 25,938 crore. Production-Linked Incentive (PLI) scheme for the manufacturing of Advance Chemistry cells with an outlay of INR 18,100 Cr to cater to growing domestic demand of batteries & to enable India to leapfrog to environmentally cleaner, sustainable, advanced and more efficient Electric Vehicles (EV) based system.

2022

Draft battery swapping policy announced. Battery Waste Management guidelines announced. The Indian government has been actively promoting the adoption of electric vehicles through policy measures such as financial incentives, subsidies and tax exemptions, and the establishment of charging infrastructure. These policies have been continuously evolving to support the growth of the EV market in India.

5.2 Roles of various ministries in EV ecosystem

Ministry of Heavy Industries (MHI)

The Ministry of Heavy Industries is leading the execution of the policies and strategies to hasten the adoption of electric cars in India. To fulfil the goals of lower emissions, the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles in India (FAME) initiative was announced by MHI in March 2015. Its four main areas of concentration are as follows: Technology advancement Demand stimulation, Infrastructure charging pilot programmes. The programme offers financial subsidies and incentives to help accomplish the goals of the National Mission on Electric Mobility (NMEM). The scheme's initial budget of INR 765 crore was later increased to INR 895 crore. The FAME-II plan, with an enhanced layout of INR 10,000 crores and a spill over from FAME-I of INR 366 crore, was announced by the ministry in March 2019. The primary role of the ministry is to develop framework for implementation of FAME scheme.

National Automotive Board

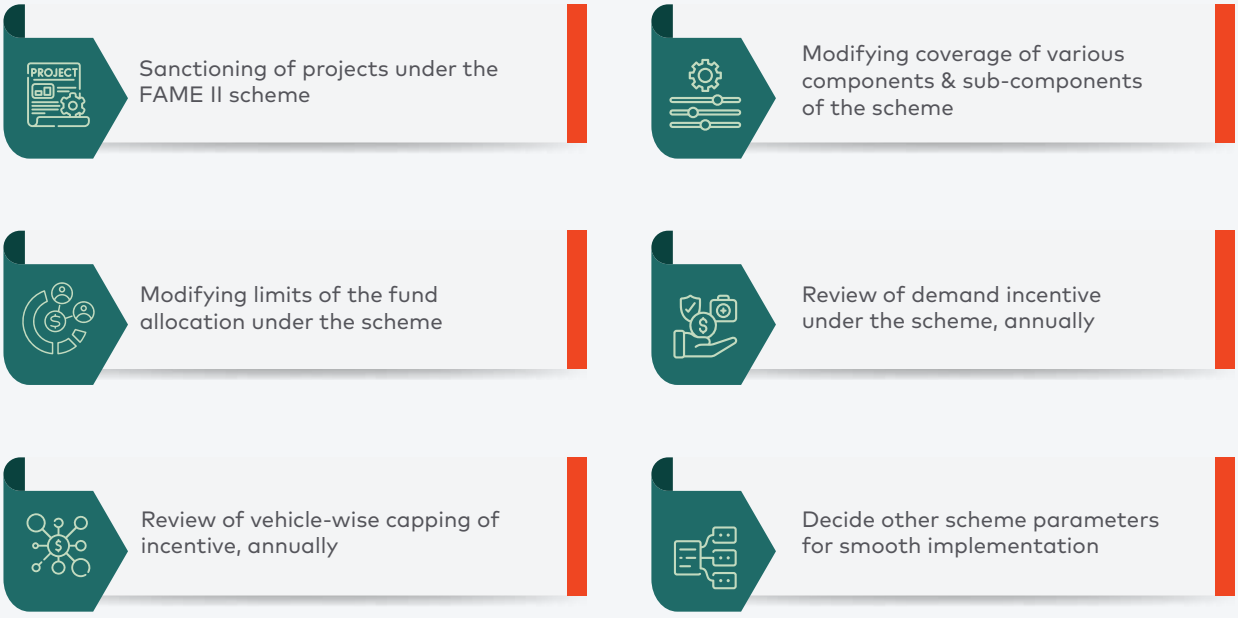
The National Automotive Board is an operational entity for the FAME India programmes under MHI. This organisation operates a web portal for the dissemination of scheme-related information and keeps track of state-by-state progress. A Project Implementation and Sanctioning Committee has also been established by the ministry to provide guidelines for the approval of projects under the FAME programme. The selection of the PCI project implementation agency is handled by this committee.

Project Implementation and Sanctioning Committee (PISC)

Project Implementation and Sanctioning Committee (PISC) is an MHI established Project Implementation and Sanctioning Committee (PISC), an inter-ministerial group, in March 2019 to oversee, approve, and carry out projects under the FAME-II initiative. The committee is presided over by the CEO of NITI Aayog, and its members include secretaries, financial advisors, and directors from various ministries and associations.

The following list summarises the main duties and tasks of the PISC:

Figure 5- Main duties & tasks of the PISC



Source- CII-Invest India-Statiq (2023)

1 Niti Aayog

In the context of India's electric vehicle (EV) ecosystem, NITI Aayog has played a significant role in shaping policy and regulatory frameworks to accelerate the adoption of EVs.

In 2018, NITI Aayog released a comprehensive policy proposal titled "Transformative Mobility Solutions for India," which laid out a roadmap for India's transition to electric mobility. The policy recommended a range of measures to support the adoption of EVs, including tax incentives, research and development funding, and infrastructure investments.

NITI Aayog has been facilitating cooperative federalism, extensive stakeholder and inter-ministerial consultations as well as implementation of an end-to-end policy framework for transforming the mobility landscape with particular focus on: Manufacturing, Specification & standards, Fiscal incentives, Overall demand creation and projections, Regulatory framework & Research & Development.

The multi-disciplinary National Mission on Transformative Mobility and Battery Storage, with an Inter-Ministerial Steering Committee, is chaired by CEO, NITI Aayog. The Steering Committee comprises Secretaries from the Ministry of Road Transport and Highways, the Ministry of Power, the Ministry of New and Renewable Energy, the Department of Science and Technology, the Ministry of Heavy Industry, the Department for Promotion of Industry and Internal Trade, and Director-General, Bureau of Industrial Standards.

2 Ministry of Road Transport and Highways (MoRTH)

The ministry is responsible for formulating policies and regulations pertaining to road transport. The Ministry also plays a key role in formulating non-financial incentives for promoting EVs by provisioning for parking infrastructure, priority lane access, etc.

Automotive Research Association of India (ARAI) is the leading automotive R&D organisation of the country set up by the Automotive Industry with the Government of India. ARAI is an autonomous body affiliated to the Ministry of Heavy Industries, Government of India. It has also been recognised as a Scientific and Industrial Research Organisation (SIRO). Further, ARAI is a prime Testing and Certification Agency notified by Government of India under Rule 126 of Central Motor Vehicle Rules, 1989. The creation of standards for automobiles and their parts is one of ARAI's duties. Standards AIS 138-Part 1 and Part 2 are notified by ARAI which specifies the charging requirements (AC and DC) for all electric vehicles (2/3/4) wheelers with the exception of trolley buses, rail vehicles and off-road industrial vehicles. The institute has so far released roughly 220 standards.

3 Ministry of Power

In terms of the development of the power sector, the ministry is in charge of long-term planning, policy creation, project processing for investment decisions, monitoring the execution of power projects, training and manpower development, administration, and adoption of laws. Electric charging stations are to be regarded as services rather than the distribution of power, according to the Ministry, which is creating laws for the industry and hinting that it is a delicensed business. The Bureau of Energy Efficiency (BEE) has been given the responsibility of serving as the Central Nodal Agency (CNA) under the Ministry's guidelines for the implementation of Charging Infrastructure.

25 State Nodal Agencies (SNAs) for different states have been notified by BEE. The role of SNAs for states is to facilitate the deployment of charging infrastructure in states and cities. These agencies include DISCOMs, nodal agencies for RE and EE, transport authorities, etc. The Ministry's Central Electricity Authority (CEA) is in charge of creating standards for EVSE safety. The committee on technical aspects of charging infrastructure has provided a report on the

standards and technical specifications to be followed for PCI.

The Electricity Act of 2003's requirements led to the creation of State Electricity Regulatory Commissions (SERCs). The notification of power rates relevant to the PCI is the responsibility of these regulatory authorities.

The SERCs also alleviate the problems associated with using numerous connections on a single premises because the PCIs may be deployed in already-existing areas (parking lots, malls, retail complexes, etc.).

4 Ministry of Housing and Urban Affairs (MoHUA)

MoHUA is playing a significant role in guiding the development of charging facilities in commercial and residential building complexes by changing building bye-laws. Residential and business buildings have been notified by MoHUA that they must reserve 20% of their parking spaces for electric car charging stations. The Urban and Regional Development Plans Formulation and Implementation Guidelines - 2014 have also been modified by MoHUA to incorporate the development of norms and standards for charging infrastructure in the design of city infrastructure.

Therefore, the prerequisite for this paradigm shift/phased migration to sustainable transportation is the Ministry of Housing and Urban Affairs (MoHUA) encouraging "Electric Vehicles" as a viable choice for short and long-distance travels with suitable "Charging Infrastructure".

5 Ministry of Finance

Ministry of Finance is one of the key ministries that has enormously helped in uptake of electric mobility in India. To boost Make in India, the Ministry of Finance rationalised the customs charge for all vehicle types, battery packs, and cells in 2019. Additionally, it announced an income tax credit of INR 1,50,000 on the purchase of electric vehicles and lowered the GST rates for such purchases from 12% to 5%.

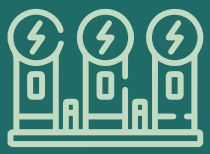
6 Ministry of Environment, Forest and Climate Change

Ministry of Environment, Forest and Climate Change is one of the main concerned union ministries in the "National Electric Mobility Mission Plan 2020" initiative. To improve the ecosystem for managing and disposing of batteries throughout India, the ministry recently notified draft of the Battery Waste Management Rules, 2020.

6 Ministry of Science and Technology

The MoST has formed a "Technology Platform for Electric Mobility (TPEM)", funded primarily by the MHI. Department of Science and Technology (DST) is playing a key role in forming electric mobility standardisation roadmap for India by working towards technological solutions through R&D efforts with industry and R&D laboratories to realise the electric dream of India by the year 2030.

The Program covers two important aspects:



Charging Infrastructure

Electric Vehicle R&D

5.3 State Level EV Policy efforts

To drive EV adoption, OEMs & the state & central government are working together towards an integrated policy, creating a conducive ecosystem for India's electric mobility vision. State-specific policies related to EVs could be a shot in the arm for the battery-powered mobility movement in India. 22+ states have come up with either their final or draft EV policies. State policies include incentives such as subsidies on capital investment that could be fixed asset as well as land. They also include several demand side incentives such as parking zones road tax exemption and incentives in relation to tax. States have also come up with special EV zones, establishment of venture capital and business incubation service to encourage EV start-ups.

Table 5 - Key State EV policies

STATES	POLICY	FEATURES AND INCENTIVES
Key States Policies		
Gujarat	Gujarat State Electric Vehicle Policy 2019	The goal of the policy is to establish Gujarat as a market leader for EV adoption and to foster an environment that will support the growth of the EV sector. The policy calls for the establishment of charging stations in allocated parking spots, reserved EV parking/charging areas, charging stations for tourists and government workers in office parking areas, and facilitation of private charging infrastructure through DISCOMS.
Maharashtra	Electric Vehicle Policy 2018	The policy aims to (a) increase the number of electric vehicles (EVs) registered in Maharashtra to 5,00,000; (b) generate an investment of approximately USD 3277 million (INR 25,000 crores) in EV and in manufacturing of EVs, its components, batteries (including assembly enterprises), and charging infrastructure equipment in the state; and (c) generate employment for 100,000 people. The aforementioned goals will be achieved through promoting EV technology, providing financial & non-financial incentives, funding the construction of specialised charging infrastructure, establishing R&D centres around the state, and promoting R&D.
Kerela	Electric Vehicle Policy approved on 10 March 2019	The following objectives were the targets of the policy. By 2022, there should be one million electric vehicles on the road, and much earlier a pilot fleet of 200,000 two-wheelers, 50,000 three-wheelers, 1000 cargo carriers, 3000 buses, and 100 ferry boats will be in operation. Additionally, it seeked to attract investment possibilities in long-term EV manufacturing, centres of excellence in the EV value chains, and the production of EV components. The policy calls for controlling the electrical grid, modernising bus fleets, and other strategy measures such as bridging the visibility gap of EVs, developing charging infrastructure and EV production in the state, raising awareness through EV promotion, etc.

Madhya Pradesh	Madhya Pradesh Electric Vehicle Policy 2019 dated 01 November 2019	The policy's main goals are to support sustainable electric mobility and enhance the state's air quality by reducing emissions from the transportation sector. The goal is to implement the aforementioned by the rapid adoption of EVs in such a way that by 2026, 25% of all new registrations for public transportation vehicles may be EVs. By placing a focus on (a) encouraging EV adoption, (b) EV type incentive structure, (c) manufacture of EV and its components, (d) charging infrastructure, (e) recycling ecosystem - battery and EVs, (f) demand generation for EVs, and (g) R&D, the policy seeks to accomplish its objectives. Incentives are also offered under the policy for two-wheelers, shared e-rickshaws, electric autorickshaws, electric goods carriers (three-wheelers), electric automobiles, buses, and other vehicles.
Tamil Nadu	Tamil Nadu Electric Vehicle Policy 2019	The programme aims to attract INR 50,000 crore in investments for EV production, build a robust EV ecosystem in the state, and generate 1,50,000 new employments as a result of those investments. By offering financial incentives and setting up a charging infrastructure, EV adoption is being promoted. The policy suggests converting (a) all auto-rickshaws in the state's six major cities to EVs within a 10-year period, (b) all taxis and app-based transport operators and aggregators in the six major cities to EVs within a 10-year period, and (c) about 5% of the state's buses each year with the introduction of about 1000 EV buses. In addition, the policy offers demand-side incentives for two-wheelers, three-seater autorickshaws, transportation vehicles, light cargo vehicles, and private automobiles, as well as assistance and incentives for the infrastructure for EV charging.
Telangana	Telangana Electric Vehicle and Energy Storage Policy 2020-2030	The policy aims to, (a) lower total mobility costs by increasing the adoption of electric vehicles (EVs) in public transportation, two- and three-wheelers, four-wheelers, light commercial vehicles, and shared transportation, (b) attract investments worth USD 4.0 billion and generate 120,000 jobs by 2030 through EVs in shared mobility, charging infrastructure development, and EV and energy storage manufacturing activities, and (c) promote the development of EVs and energy storage technologies.
Uttar Pradesh	Uttar Pradesh EV Policy 2022	The programme outlines financial and non-financial incentives to draw capital to the state's push for electric transportation. The legislation encourages early EV adoption in the state and boosts demand for the product. For big, medium, small, and micro-EV manufacturing units alike, the state provides incentives like capital interest

		subsidy, infrastructure interest subsidy, industrial quality subsidy, exemption from stamp duty and electricity duty, SGST reimbursement, etc. Furthermore, the state government will assist service providers in establishing public charging network by leasing government property for ten years at a minimal profit- sharing structure of INR 1 per kWh. It also has a single window system in place for all approvals for EV and battery manufacturing units.

Key State Policies (Due for renewal in 2023)

Delhi	Delhi Electric Vehicles Policy, 2020 notified on 07 August 2020 Expiring in 2023	The policy's main goals are to accelerate EV adoption across all vehicle types, notably in the category of goods carriers, public/shared transportation vehicles, and two-wheelers, and to make Delhi the EV capital of India. By 2024, the programme wants battery electric vehicles (BEVs) to account for 25% of all new vehicles registered in the state. This is being done to reduce emissions from the transportation industry, which would help Delhi's ecology. Additionally, this would put policies in place to help Delhi create jobs. The policy calls for (a) financial incentives, such as rebates on loans taken out for EV purchases, (b) the elimination of road tax and registration fees, (c) the establishment of a vast network of charging stations and swappable battery stations and the creation of a publicly owned database of the same, (d) the establishment of a state electric vehicle board and a dedicated EV cell, and (e) the creation of a comprehensive awareness-raising campaign for the general public. (f) setting up of skill centres that will provide training related to jobs in the EV sector, (g) setting up of facilities for recycling of batteries of the EVs, (h) creation of 'State EV Fund', funded through levy of additional taxes, cess, fee etc., on inefficient or polluting vehicles.
Karnataka	Electric vehicle and Energy Storage policy 2017 Expiring in 2023	The objective of the plan is to establish Karnataka as the top location for the growth of electric mobility, to provide a supportive industrial environment, and to build up human resources to fulfil the demands of the sector. The goals include (a) a USD 406.4 million investment and the creation of 55,000 new jobs, (b) the advancement of R&D in electric mobility, and (c) the transition from ICE to EV. Along with other incentives and concessions, the strategy embraces unique measures for EV production, assistance for charging infrastructure, support for R&D, and support for skill development.

Source - CII-Invest India-Statiq (2023)

5.4 State level effort to promote Fleet Electrification

I. Case study of Delhi Government

The Delhi government has made significant efforts to promote fleet electrification in the state through its Electric Vehicle Policy launched in 2020, with the aim of increasing the number of electric vehicles in the state, creating an ecosystem for the widespread adoption of EVs, and reducing air pollution and dependence on fossil fuels.

The government has set priorities for public transport electrification as the top priority, followed by cabs and 3-wheelers, and last mile delivery companies. They are working with various aggregators such as ride-hailing companies, food delivery companies, and e-commerce companies to have their entire fleet operating in Delhi be EV by 2030. To support this, the government has also announced several incentives for EV buyers and commercial fleet operators while the government is also planning to establish over 18,000 charging points by 2025 and is offering subsidies for private charger installations. The government is also engaging with CESL to set up charging stations on public land parcels and has issued instructions to several Oil PSU's for establishing electricity charging stations in Delhi.

Source: Business Today

Electrification of Delhi Government Internal Fleets

The Delhi government plans to electrify their own internal fleet (owned & hired both) by 2030. They have already been floating bids for both individual and aggregate demand. Government fleets have certain norms for entitlement of vehicles for hiring based on the level of hierarchy of the government employees. These norms are partially tied around pricing of the vehicles. As the pricing of EV's are higher than that of ICE's, they have been facing an issue on allocation of EV's based on entitlement, to solve this, the Delhi government finance department is working on developing new mechanism for hiring such vehicles. A proposal has also been moved for higher entitlement to employees from an EV perspective. Along with that and in line with MoRTH advisory for vehicle scrappage of over 15-year-old government vehicles the Delhi government is first planning to electrify the fleets that are closer to 15 years or as and when they reach the age for scrappage.

Electrification of all other fleets

Working with aggregators such as ride hailing companies, food delivery companies, e-commerce companies is a huge area of priority for Delhi Government. As a broad goal, these aggregators have been given guidelines for induction of new

vehicles. By 2030, their entire fleet operating in Delhi should be EV. As a lot of these aggregators are not vehicle owners, this will entail in either restructuring of the overall business model or creation of new business model for some of the companies to achieve such an ambitious target. This has seen an increase in companies trying to tie up with fleet providers while also planning incentives for the riders/drivers to ensure conversion from ICE to EV's.

Interestingly, the Delhi government is also experimenting a few key new initiatives. One such initiative to increase the number of E3W (passenger vehicle) has resulted in the Delhi government issuing permits to Delhi metro authorities for ensuring last mile connectivity with an understanding that the authorities will engage with aggregators that provide electric mobility services.

Charger and Infrastructure Comprehensive plan

The Delhi Transport authorities have had a high-level consultation with the Chief secretary along with several Oil Psu's, CPO's and discoms to work on developing an action plan for the deployment of public charging infrastructure following which the government has set an ambitious target of establishing over 18000 charging points by 2025 up from the current network of 3500 public charging stations. These points will be a mix of both fast and slow chargers.

The Delhi government also has a model in place for single window clearance for private charger at office/shop/home where Delhi government is also giving a subsidy of INR 6000 up to the first 30,000 charger installations. This cost is almost close to 80% of the cost of chargers.

The government is also engaging with CESL to setup charging stations on public land parcels such as DTC Bus depots, cluster bus depot and so on. Apart from issuing instructions to several Oil PSU's for establishing electricity charging station even Indraprastha Gas Limited (that operates more than 750 gas station across NCR) has been mandated for developing EVCI.

Some key experiments to boost the charging infrastructure

In previous cases the model for establishing charging station network was being used as per MoP EVCI guidelines, where there was no regulation around the sale price of electricity and the CPO had to share revenue at INR 1 per unit of electricity consumed with the land-owning agency. But in Delhi, the government has successfully aggregated public land parcels and invited companies to bids for setting up charging stations. The Bidding parameter was kept as Sale price (selling price) and that resulted in certain companies submitting negative bids.

In another such initiative, the Delhi government has also created 12 teams in decentralised zones of Delhi, each team, headed by a district magistrate, have been asked to prepare micro zonation charging infrastructure plan based on the profile of EV owners in those zones, this data is derived from a geo-spatial framework through Mapmyindia. Through this data, the government plans to determine possible location for deployment of adequate charging infrastructure. Based on the analysis of the current data, they have also started identifying MCD parking lots for establishment of electric charging stations moving forward.

Some key experiments to boost the charging infrastructure

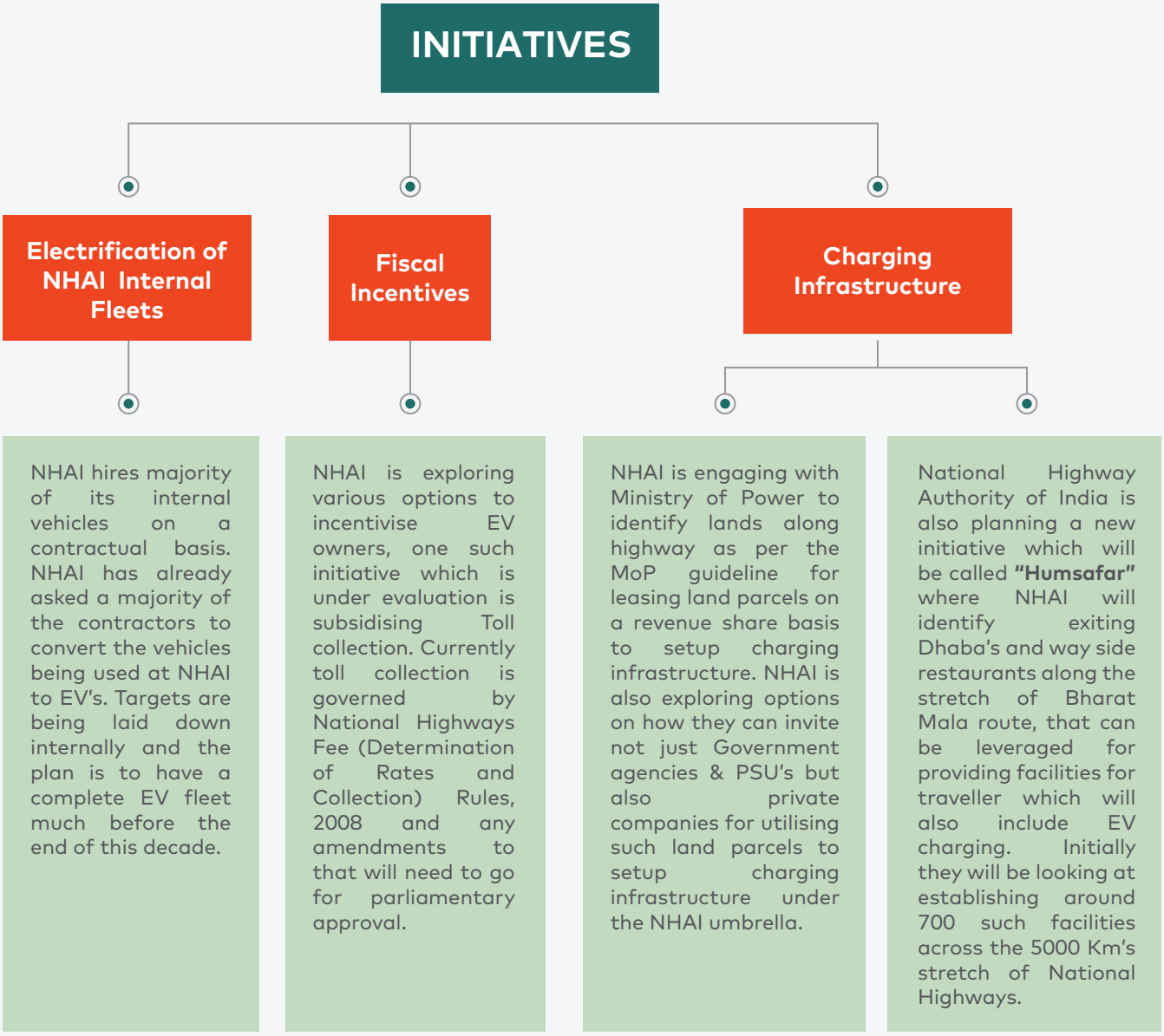
Delhi government is also planning to restart the subsidies for Taxi fleets. Previously they gave subsidies to the tune of INR 1.5 Lakh per vehicle which was handed out for about 1000 vehicles. But this time the government plans to give subsidies for about 5000 vehicles (including L5 Commercial vehicles and 4W taxi's) while also putting in place a cap on limit of subsidies that can be availed by any one particular company. With this subsidy, the government plans to help the commercial vehicles achieve cost parity.

For Auto rickshaws, the model so far is to give individual permits to people. In the case of individual permits, the incentive for auto owners is to maximise their vehicle run every day. And in the process, they go from one end of the town

to the other defeating the purpose of first and last mile connectivity. In order to change this landscape, the Delhi government In the case of Delhi Metro has allowed the registration of Auto/rickshaws in the name DMRC and aggregator. With this initiative the penetration of EV's being rented has increased. For example, analysis of a pilot in Dwarka, which was an underserved area, where over 150 permits have been allocated there are already 50 autos active and 50 more are being inducted. As a measure to ensure first and last mile connectivity, Geofencing has been done for the vehicle while the swapping range also restricts the vehicle from going anywhere else apart from the serviceable. Overall, across Delhi around 1250 such permits have been issued so far majorly for ETO and Sun Mobility fleets. Delhi government is inviting more players for taking part in such initiatives.

Electrification of all other fleets

Working with aggregators such as Ride hailing companies, food delivery companies, e-commerce companies is a huge area of priority for Delhi Government. As a broad goal, these aggregators have been given guidelines for induction of new



II. Case Study NHEV

(Takeaways from Tech Trial Run)

National Highway for Electric Vehicles is a private sector ease of doing business initiative for the E-mobility sector.

This initiative has been conducting technical and commercial trail runs on National Highways with an aim to bring maximum Ease of Doing business and create a platform to help EV value chain companies. Based on licensing reforms of the government, 2 out of 12 NH - marked by the Ministry of Power to be converted into E-Highways (Jaipur-Delhi -Agra). On the same note, #National Highway for EV pilots were conducted on Delhi-Agra and Delhi Jaipur highway routes. The four noteworthy features of National Highway for Electric Vehicles (NHEV) trail run included studying Electric Mobility as a service, new financing model for EVs, Charge Point Operations viability, E-highway technical feasibility.

Source: Outlook India

Through its study and the completion of the first Technical Trial Run between Delhi and Agra, the initiative claimed to achieve success over four pain areas of the industry.

- Technical backup under 30 minutes during vehicle breakdown
- More than 30% utilisation of charging stations
- 30% lesser EV prices for the fleet operators
- Breakeven of service providers within 36-40 months

What is really interesting in this trial run is the financing model that has been piloted successfully. For the first time, a new financing model for E-mobility in highway is introduced. NHEV has created a funding model called Annuity Hybrid E-Mobility (AHEM). This model is inspired by Hybrid Annuity Model (HAM) which was introduced by Ministry of Road, Trasport and Highway under Union Minister Shri Nitin Gadkari in 2015. The HAM model is an amalgamation of Toll-Operate-Transfer (TOT), Build-Operate-Transfer (BOT) and Engineering, Procurement, and Construction (EPC) models, which has gained great recognition and appreciation from renowned credit rating agencies and institutions such as CRISIL, Moody's, the IMF, and the World Bank. The introduction of HAM quadrupled the speed of road construction from 9 Kilometre per day to 38 kilometres per day.

NHEV wants to create a similar impact with the introduction of AHEM for converting highways into E-highways through an accelerated process and a significant reduction in cost and time. The model is a PPP where the land is to be allotted by the National Highways Authority of India (NHAI) and the priority to own capex, construction, and installation is given to power and petroleum PSUs followed by banks and NBFCs and finally the private players along with the model also providing the option for common people to own the charging infrastructure.

E-Logistics

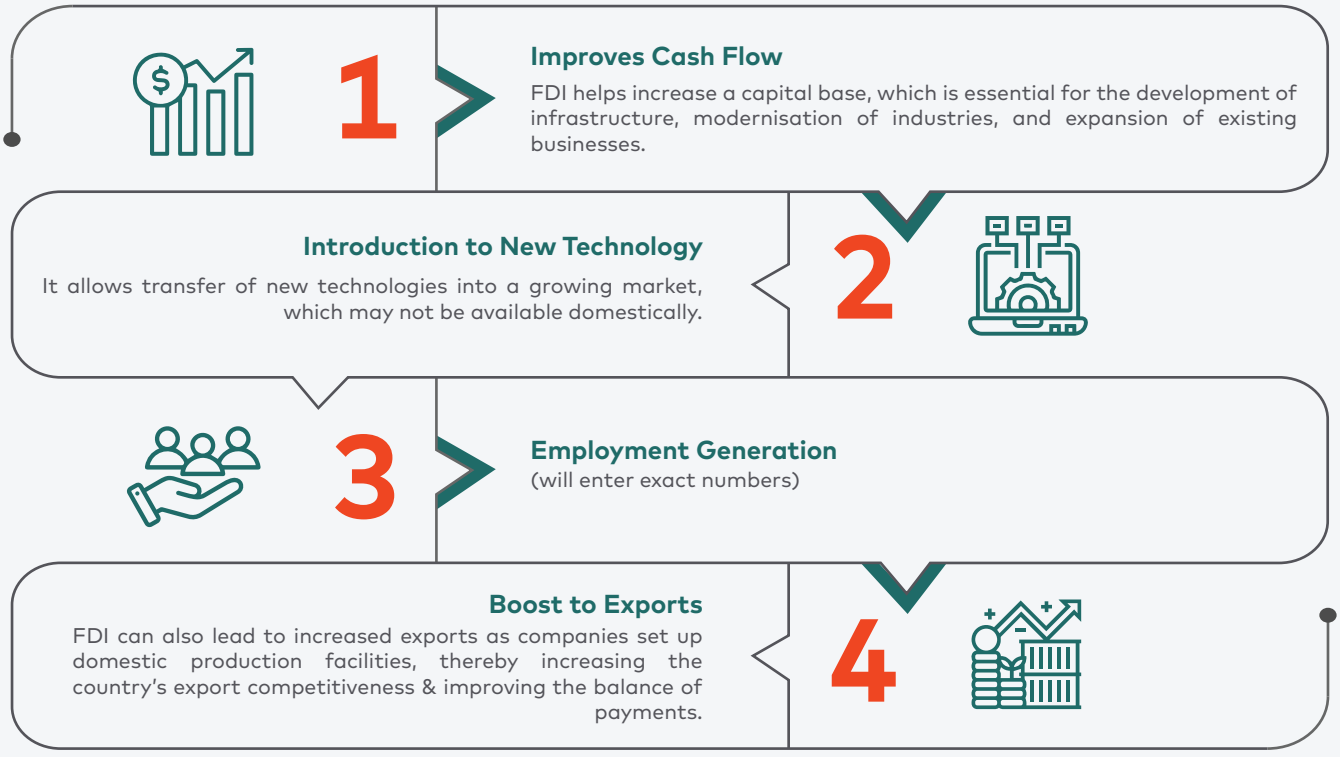
NHEV has proposed developing micro-cargo hubs at its pilot stations that will aim to increase E-Commerce coverage to remote areas in the station's radius, which were earlier deprived of such services. These hubs will also provide E-vehicles to the nearby village youth on a subscription basis which will enable them deliver goods within a 50 Km radius of the station. Cargo Hub will work in partnership with logistics and well as delivery companies.

5.5 FDI opportunities in Fleet Electrification

Foreign Direct Investments (FDI) for a developing economy like India is a key driver of growth. Since the liberalisation of the economy in the late 80 and 90's, FDI through both the direct and in-direct route has allowed inflow of capital and market entry for global players into the Indian market. Indian auto sector has cumulatively received ~ USD 25 Bn in FDI over the last two decades contributing to over 7% of India's total FDI. In terms of the EV industry, the sector received a record breaking USD 3.6 billion in funding in FY23, of which USD 2.5 billion came from just the previous two years.

Key advantages of FDI

Figure 6- Key advantages of FDI



Source- CII-Invest India-Statiq 2023

Transition to electric is an extremely CAPEX heavy process, requiring billions of dollars of investment in both technology and operations. Fleet operating companies investing heavily in upstream technology such as – Charging Infrastructure, Battery Manufacturing and Fleet Management services.

One of the biggest examples of this is Amazon's investment in Rivian. Rivian is an American automaker that specialises in electric adventure vehicles. In 2019, Amazon, one of the largest fleet operators in the world announced that it an investment of USD 700 million in Rivian, Amazon ordered 100,000 electric delivery vans from Rivian to be deployed in its delivery fleet by 2030. For Rivian, the investment from Amazon provides significant funding for its ambitious plans to produce a range of electric adventure vehicles, including an electric pickup truck and an SUV. The deal also gives Rivian access to Amazon's vast logistics network and expertise in supply chain management. For Amazon, the investment in Rivian is part of its broader effort to reduce its carbon footprint and become a more sustainable company. The 100,000 electric delivery vans ordered from Rivian will help Amazon achieve its goal of becoming carbon neutral by 2040.

A similar partnership is seen between Gogoro and Zomato in India. Gogoro, a Taiwan-based electric scooter company, has partnered with Zomato, an Indian online food delivery platform, to offer eco--friendly food delivery options in India. As part of the partnership, Gogoro will provide its electric scooters to Zomato delivery partners in Delhi-NCR, which will enable them to deliver food orders in a more sustainable and environmentally friendly manner. The partnership is part of Zomato's ongoing efforts to reduce its carbon footprint and promote sustainable food delivery practices. Gogoro's electric scooters are known for their innovative battery-swapping technology, which allows riders to quickly swap out depleted batteries for fully charged ones, making them a popular choice for eco-conscious consumers. Enabled by this pilot, Gogoro recently announced an investment of USD 1 billion in India, further solidifying their presence in the world's 2nd largest 2-wheeler market.

Source: workshop on fleet electrification in India organised by CII-Invest India-Statiq









Source: workshop on fleet electrification in India organised by CII-Invest India-Statiq

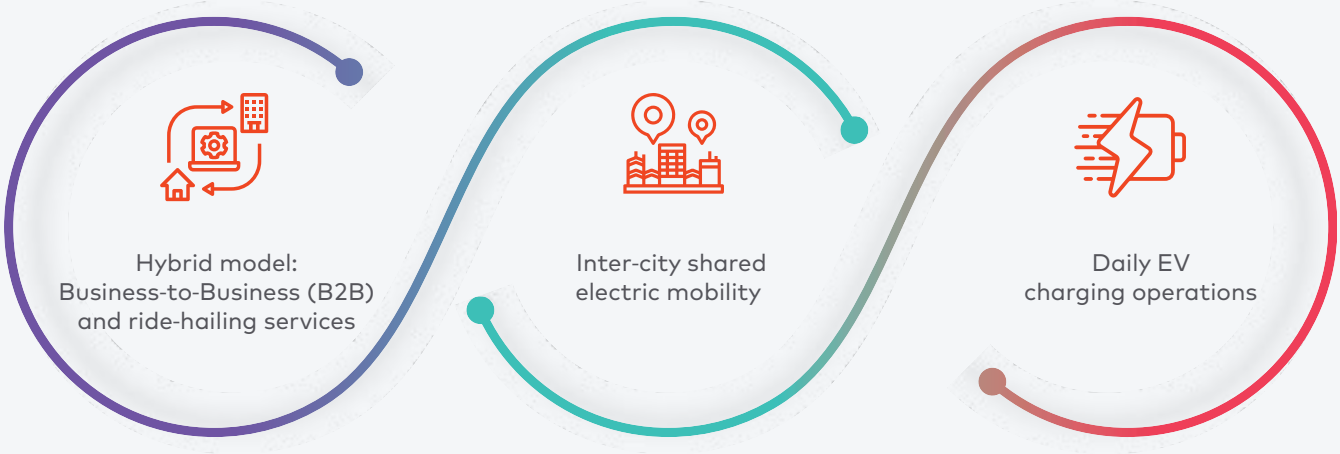
6.Challenges and Possible Solutions from Stakeholders' Perspective

Key inputs from industry stakeholders on bottlenecks and possible solutions for fleet electrification were collected at the workshop on 7 February 2023 organised in New Delhi by CII, Invest India and Statiq. This workshop was attended by 34 primary stakeholders which included OEMs, fleet operators, CPOs, last mile deliveries, e-commerce companies and government officials. All the stakeholders were divided into different groups and were asked to organise their challenges and possible solutions under specific use cases as much as possible.

6.1 Fleet Operators

The challenges and solutions as highlighted by fleet operators, specific to their use cases, are described in this section.

Fleet operators listed these under three use cases-



1 B2B and Ride-hailing Services

1) High capex of electric vehicles[1] including high capital expenditure on batteries.

2) Slow profitability, even with the opex model.

3) Difficulty in ascertaining the residual value (RV) of an electric vehicle.

4) Electricity tariff for charging differs even within States and one standard charging rate within a state is preferable to enable ease of doing business.

2 Inter-city Shared Electric Mobility

1) Limited availability of charging infrastructure for intercity travel.

2) The current driving range provided by EVs is insufficient for non-stop intercity travel. Range anxiety is a challenge as drivers fear running out of charge before reaching the destination.

3) OEMs' reluctance to separate the battery and assets presents a challenge for the adoption of battery-swapping technology that could potentially address the range anxiety issue.

4) Battery as a service (BaaS)[2] models could be an effective way to promote the adoption of electric intercity fleet specific to light commercial vehicle segment. Going forward, the battery swapping technology needs to be explored in the other segments of vehicle.

5) As battery technology itself evolves and improves, the use of BaaS could become more effective. Battery R&D and subsequently localisation to reduce cost and increase range and efficiency etc. will therefore be crucial for a higher uptake of EVs.

6) Substantial environmental gains and cost savings for drivers to be considered to drive the adoption of electric vehicles for inter-city travel.

3 Regular EV Charging Operations

1) Limited availability of charging infrastructure makes it difficult to keep vehicles charged on the road. Also, the time required for charging can impact fleet utilisation and overall profitability.

2) Expansion of EV hubs[3] is crucial for promoting the adoption of electric vehicles and would require collaboration and innovation pan EV ecosystem.

3) Implementing Standard Operating Procedure (SOP) for the greenfield EV hubs.

4) Standardisation across EV hubs for interoperability between hubs and ease of use for drivers.

5) Strong need for collaboration and coordination across the government agencies, private sector, and other stakeholders in the wider EV ecosystem, to ensure alignment of policies and guidelines with the needs of relevant stakeholders and promote the widespread adoption of EVs.

[1] Market price is 40% higher than their equivalent category car in ICE.
[2] Battery as a Service (baaS) involves separating the battery from the asset and offering it as a service to customers. Rather than having to pay the full cost of the battery upfront, customers could pay a subscription fee for the use of the battery, which could be maintained and replaced as needed by the service provider. Customers could have more affordable upfront costs, and greater flexibility in replacing and maintaining the battery over time. This could be especially important for intercity coaches which require long-range capabilities.
[3] Public stations solely dedicated to EV charging.

6) Proper tagging of a station for specifications of available charging points is important to ensure easy and quick access to the drivers.

7) Charge Points Operators (CPOs) to plan charging infrastructure and design use cases for fleet electrification as per needs of fleet operators and other commercial users.

6.2 Charge Point Operators (CPOs)

The inputs from the perspective of CPOs are captured below with key challenges and solutions under specific use cases including -

1 Last-mile deliveries and intra-city transportation

1) Dedicated financial support for deploying a robust fast-charging network. It is highlighted that developing fast-charging infrastructure requires significant investments in equipment, technology, and installation. An increase in the number of fast chargers can ultimately help to reduce range anxiety and accelerate the adoption of electric vehicles.

2) Government and private sector stakeholders need to work in tandem to ensure that the charging infrastructure is sufficient and accessible for all.

2 Highway for inter-city connectivity of EVs

1) A roadmap prioritising fast chargers along highways can facilitate commercial EVs, especially heavy-duty trucks, which require multiple charging stops. This will boost the confidence of commercial EV owners in their ability to complete journeys without experiencing delays in charging. A special fund will be helpful to enable CPOs to roll out EV chargers quickly.

2) Variation in State EV policies, in terms of EV tariffs and security deposit requirements, is a major bottleneck for CPOs to function smoothly across the States. A uniform policy on EV power connection, implemented under the guidance of a central scheme, will be preferable to industries.

3) Insurance is another major concern and policies must cover damage, failures, and vandalism. Low-rate insurance policies need to be developed.

4) High-interest funding (at approximately 15-16% interest rate) to CPOs makes it difficult to finance the deployment of EV charging infrastructure.

5) A common digital platform is needed to track charging points available to a driver in the vicinity of his/her EV.

3 Charging-as-a-Service (Chaas)

1) Power availability and reliability at all EV charging stations is an ongoing challenge.

2) Land acquisition for setting up new charging stations poses a significant challenge for the widespread adoption of EVs. As part of State EV Policies, state governments may provide land from their own land banks or through a dedicated policy mechanism.

3) DISCOMs' support is required to reduce the time taken in providing power connections for EV chargers and energising them. This may need the backing of a dedicated policy framework from competent authorities such as CERC or SERCs.

4) Financing of CPOs is difficult as the asset safety is the major concern. A standard insurance policy for CPOs would be beneficial to address these concerns.

5) A dashboard to track all the pending connections of the CPOs is required. If the connection gets delayed the entire business gets affected. The dashboard would help to easily engage with DISCOMs for connection.

6.3 Original Equipment Manufacturers (OEMs)

Across OEMs, participants voiced the need for more charging points to support the growing number of electric vehicles on the road. As listed below, there are key financial challenges specifics to EVs that are crucial to be addressed for wide-spread adoption of EV. Specific inputs are captured below.

1) One of the major challenges is the high cost of the EV as compared to the ICE vehicle which needs to be considered in order to make them affordable for the masses and increasing their penetration. Reducing battery costs can drastically bring down the cost of EVs.

2) There is lack of availability of electrical infrastructure. Besides, from user perspective, it is difficult to find a location for these chargers at one common place/platform.

3) It was highlighted that standardisation of two-wheeler (2W) charger is not present, and it may need certification from international agencies.

4) There is no secondary market in place for EVs, making it difficult for buyers to resell their electric vehicles. Since the risk associated with these vehicles is high, the interest rate is also high.

5) OEMs mentioned that the rate of interest is very high (18-24%) on three-wheelers (3W). Therefore, incentivising E3Ws or lowering this interest rate is seen as low hanging fruit for increasing EV penetration in India.

6) More support is required from DISCOMs and State Governments for providing space for electrical infrastructure. Operators (charging) need to be allowed to use state infrastructure for public services (public chargers) and this needs to cover inter-state operations as well.

7) Standardisation or inter-operability is another area that requires focus, as it is important for all OEMs to be on the same page.

8) The approval process for FAME needs to be fast-tracked to accelerate the growth of the electric vehicle market as some of the OEMs highlighted that it takes approximately 6 months for the approval.

9) Charging infrastructure need be made accessible to all user types including the public as much as possible

10) Faster process for getting upstream connection is required for EV charging to ensure efficient and reliable charging.

11) There is a disconnect between OEMs and financing companies. OEM partners do not have a defined service level agreement with the financial companies There needs to be a clear standardised service level engagement, where OEMs agree on certain parameters with respect to uptime of vehicles.

12) MoEFCC came out with multiple comprehensive frameworks on e-wastes and battery wastes but permitting and bringing in a robust vibrant framework for battery recycling is important. Enabling standard for battery recycling is crucial to bring down the TCO.

6.4 E-commerce Businesses

This sub-section lists the issues, challenges and desirable solutions, as highlighted by the e-commerce businesses. Electric vehicles are well-suited for last-mile and middle-mile movements of goods as they help to reduce emissions and improve efficiency in the logistics and transportation sector. The adoption of electric vehicles (EVs) in last-mile delivery and middle-mile movements of goods faces the following issues as per inputs from e-commerce companies at our workshop.

1) Acquisition cost of EVs is high, making it prohibitive or infeasible for many customers.

2) Inadequate charging infrastructure limits the EV range making it difficult to operate for longer distances.

3) The current range of EVs is insufficient for hyper-local deliveries which limit their usage. Currently 50-80 km range exists with e-2W, where desired range is 100-150 km[4].

4) Limited supply of high-performing EV models from OEMs.

5) Need for a proper battery-swapping ecosystem that provides a quick and efficient way to recharge EV without having to wait for charging. OEMs need to integrate battery-as-a-service (BaaS).

6) There is a lack of information on the supply of EVs with fleet operators, which makes it difficult to quantify and validate the number of EVs associated with them.

7) The absence of a standardised identification system for electric vehicles (EVs) poses a challenge for platforms to effectively consolidate information on battery swapping stations and facilitate seamless coordination with delivery partners.

8) There is a need to create a directory of different stakeholders such as banks, NBFCs, fleet operator related companies, and OEMs with their contact details.

9) Essential to explore and establish alternative funding mechanisms, with the aim of enhancing the effectiveness of financing efforts to address the challenge of insufficient development financing.

10) A portal mapping all battery swapping locations need to be created with easy access for e-commerce platforms.

11) Incentive structures need to be organised to encourage e-commerce platforms to adopt EV fleets. It was highlighted that interest-free or low interest vehicle loans can be provided to delivery partners to become EV owners for a more sustainable solution.

[4] Based on primary stakeholder inputs.

6.5 Other Businesses

The inputs from corporates, from categories other than those covered in previous subsections (CPOs, fleet operators, OEMs, and e-commerce companies), were also captured at our workshop to understand specific challenges/solutions that other businesses are facing to scale EVs in their fleets. The following issues were highlighted by these corporates.

1) The cost of infrastructure which is a significant barrier to entry for many individuals and businesses needs to be addressed.

2) EVs are still a relatively new technology and there are inherent risks of products becoming obsolete or outdated quickly.

3) Lack of appropriate data available to accurately assess the risks associated with EVs.

4) Insurance is challenging due to high cost of repair and replacement of EV components.

5) Low-cost funds needed to enable financing of charging infrastructure projects at a reasonable rate and making it easier for private sector to invest.

6) Structure the entire EV related information flow as there is a disconnect between different players. A robust digital platform would help in bridging this gap.

7) Engage constantly with multiple states and other countries to adopt the good practices from them to create a pathway for operators and investors.

7.Recommended Measures for Scaling Fleet Electrification in India

7.1 Demand-side Incentive to Support New Vehicle Technologies[1]

Faster Adoption and Manufacturing of (Hybrid &) Electric vehicles (FAME) is key demand-side policy instrument promoting localisation of EVs in India[2]. Demand incentive is linked to battery capacity i.e., INR 20,000/kWh for e-Buses and INR 10,000/kWh for all other eligible vehicles[3] and is subject to capping at certain percentage of cost of eligible vehicles- 40% for e-Bus and at 20% for all other categories of eligible vehicles. Demand incentive is extended to only those vehicles having ex-factory prices less than the threshold value and scope is limited to public transportation and commercial vehicles with exception of 4W in the privately owned vehicles as a mass segment.

Total Cost of Ownership (TCO) of a vehicle is a key tool to understand price parity between technologies over standard life of vehicle. As summarised in Table 06, it is found that TCO of all other vehicle categories (including- E2W, E3W, E4W, E-buses and light commercial vehicles) except electric medium and heavy commercial vehicle segment is comparable to their ICE (Internal Combustion Engine) counterparts.

With the FAME-II set to expire in March 2024, a clear policy signal is therefore required from the GoI, well in advance, to boost confidence of industries. GoI may extend the timeline for demand-side incentives as price parity between EVs and ICE vehicles is yet to be achieved. While up-front cost across vehicles categories is still significantly higher for EVs in general, the TCO in medium and heavy-duty trucks

[1] Mainly, purely electric/hybrid and hydrogen-based vehicular technologies

[2] The second and ongoing phase of FAME is being implemented for a period from April 2019 to March 2024 with a total budgetary support of INR 10,000 Crore, 86% of which is allocated towards demand incentives to EVs.

[3] INR 15,000 for E2W effective from 11th June 2021 with a cap of 40% cost of vehicles

remains significantly below BAU-ICE technologies. These two decisive parameters for EVs and BAU-ICE technologies[4] summarised in table 06.

TCO for each vehicle segment

Table 06: Total Cost of Ownership (TCO) for all vehicle segment

S.N.	Vehicle Type		Units	Analysis		Capex (EV/BAU -ICE)	TCO wrt reference %
				Electric	BAU-ICE		
1	Passenger 2W	Capital Cost	La INR	1.74	0.93	1.87	
		Average TCO by model at year 10	INR/Km	1.39	2.67		-48%
2	Passenger 3W	Capital Cost	La INR	4.03	2.94	1.37	
		Average TCO by model at year 10	INR/Km	2.95	4.56		-35%
3	Passenger 4W	Capital Cost	La INR	16.18	10.81	1.50	
		Average TCO by model at year 10	INR/Km	6.87	7.78		-12%
4	Heavy commercial cargo 4W	Capital Cost	INR	139.26	54.35	2.56	
		Average TCO by model at year 10	INR/Km	48.09	35.19		37%
5	Medium Commercial cargo 4W	Capital Cost	La INR	72.53	35.63	2.04	
		Average TCO by model at year 10	INR/Km	37.99	27.28		39%
6	Light Commercial cargo 4W	Capital Cost	La INR	9.24	7.64	1.21	
		Average TCO by model at year 10	INR/Km	8.54	11.76		-27%

[4] Petrol/diesel as applicable to different vehicles segments

6	Bus	Capital Cost	La INR	184.09	154.45	1.19	
		Average TCO by model at year 10	INR/Km	38.39	62.08		-38%

Source: CII-Invest India-Statiq (2023) analysis based on (WRI, 2020), (IEA, 2022a) and (GoI, 2023b)

Note:

1. TCO calculated for all the vehicle segment considering maintenance cost, operation cost, battery replacement, insurance, and financial incentive.
2. 100% home charging-based calculation is assumed for passenger 2W, 3W and 4W vehicles.
3. Electricity charges and petrol/diesel rates are calculated according to the Delhi tariff.
4. TCO analysis considered petrol as the reference fuel option for 2W, 3W, and 4W passenger vehicles. For commercial vehicles and buses, diesel is considered as the preferred fuel type for TCO calculations.
5. Total capital cost calculated for all the vehicles as per the Indian OEM model except for the commercial vehicles.

The light commercial cargo as well as long haul trucks have limited or no options available in the market currently. It is recommended that medium (N2) to heavy (N3) freight vehicles or trucks, which are not covered under the ongoing FAME-II scheme as shown in table 07, are considered under the scope of ongoing FAME-II or FAME-III expected after March 2024. Demand incentives for the N1, N2 and N3 vehicle categories will be crucial for new and significant market options to emerge in this segment. Proposed demand-side incentives for medium-heavy commercial freight vehicle categories may need separate provisions or incentive structures for BEVs and hydrogen-based vehicles.

Table 07: Vehicle sub-categories covered under demand incentives under the ongoing FAME-II scheme

S.N.	Vehicle Type	CMVR sub-category	Sub-category details	Models incentivised under FAME-II	EVs sold or deployed
Units				Numbers	Numbers
1	E2W	L1	Passenger 2W, max speed ≤ 45 Km/hr, motor power <0.5 kW	67	8,71,925
2		L2	Passenger 2W, max speed > 45 Km/hr, motor power >0.5kW	20	
3	E3W	E-rickshaw	3W for last mile passenger transport, max speed ≤ 25 Km/hr, motor power <2kW	43	87,620
4		E-cart	3W for last mile cargo transport, max speed ≤ 25 Km/hr, motor power <2kW	28	
5		L5N	3W Cargo, max speed > 25 Km/hr, motor power >250 Watts	54	
6		L5M	3W passenger, max speed > 25 Km/hr, motor power >250 Watts	17	

7	E4W	M1	Commercial passenger 4W, passenger seats ≤ 8 numbers	22	8,193
8		M2	Bus with GVW ≤ 5 tonne	Total 2,435 deployed, out of 6,365 sanctioned	
9		M3	Bus with GVW: 5-7.5 tonne		
10		N1	Light commercial cargo vehicle with GVW ≤ 3.5 tonne	2	
11		N2	Medium commercial cargo vehicle (truck) with GVW: 3.5-12 tonne	N.A.	Not applicable under FAME-II
12		N3	Heavy commercial cargo vehicle (truck) with GVW > 12 tonne	N.A.	

Source: CII-Invest India-Statiq 2023 analysis

Note:

1. Number of EV models incentivised under FAME II as of 25 March 2023
2. Total 9,71,730 EVs have been sold under the scheme by 27 March 2023

7.2 Supply-side Incentives to Support New Vehicular Technologies

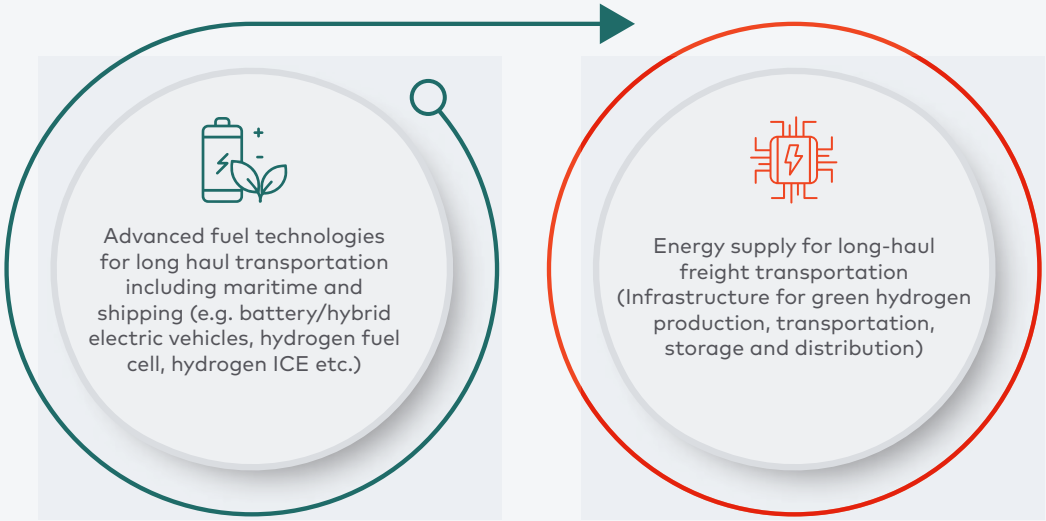
i. Auto and Auto Components: With budgetary outlay of INR 29,550 crore, Auto and Auto Components PLI has been successful in attracting proposed investment of INR 67,069 crore. Total 85 applicants have been approved under "Component Champion Incentive Scheme" and "Champion OEM Incentive Scheme". As per GoI, incentives (up to 18%) will be applicable under the scheme for determined sales of Advanced Automotive Technology (AAT) products (vehicles & components) manufactured in India from 1st April 2022 onwards for a period of 5 consecutive years (GoI, 2022b).

ii. Advanced Chemistry Cells (ACC) PLI: ACC PLI scheme with budgetary outlay of INR 18,100 crore is poised to further boost localisation of battery manufacturing in India. Total 10 bids were received by MHI on ACC PLI from companies with manufacturing capacity of 128 GWh. Successful industry bidders under PLI ACC are required to have total minimum net worth of INR 1,500 Crore (GoI, 2022b).

It is observed that while current scheme aims to establish giga-factories which is very much the need of hour; it benefits the big players due to inherent design and leaves out smaller players who are willing to participate in the technology development. (Stakeholder Consultation, 2022). Therefore, a segmentation within existing PLI or new dedicated PLI is recommended for smaller EV batteries (for instance, for e-rickshaw, e-cycles, E2W, E3W etc.) where lot of production volumes exist but industries

are still largely dependent on imported primary cells and battery management systems.

These two will be crucial to develop domestic manufacturing capabilities for advanced auto components required for pure electric and hydrogen-based technologies. Given multiple challenges around storage, transportation and distribution of green hydrogen as a fuel for long-haul transportation, a dedicated PLI scheme focussed on these two key areas –



7.3 Expand Scope of Demand-side Incentives for Public Charging Stations

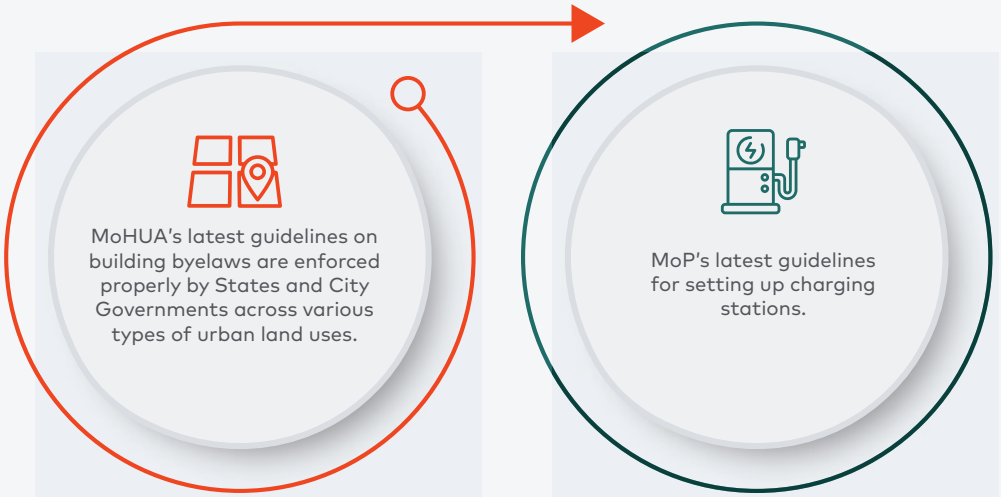
Public charging infrastructure needs to grow in tandem with the sales in EVs[5]. In addition to the EVs, domestic manufacturing capabilities are found to be missing for EV Supply Equipment (EVSE). It is therefore proposed that demand-side incentives are formulated for EVSE akin to EVs. As highlighted by the stakeholders, electrical infrastructure (upstream) which can be as high as 30-40% of overall cost of setting up a charging station[6]. It is therefore suggested that in the total cost of setting up the charging station, the upstream cost is considered for demand-side incentives towards public chargers under ongoing FAME-II scheme. This step is crucial for viable business cases on EV charging or Charging-as-a-service (ChaaS).

7.4 Promote Business Case on Public Charging while Reducing Non-Performing Assets

Two sets of national-level guidelines are enforced properly and harmonised across states as below-

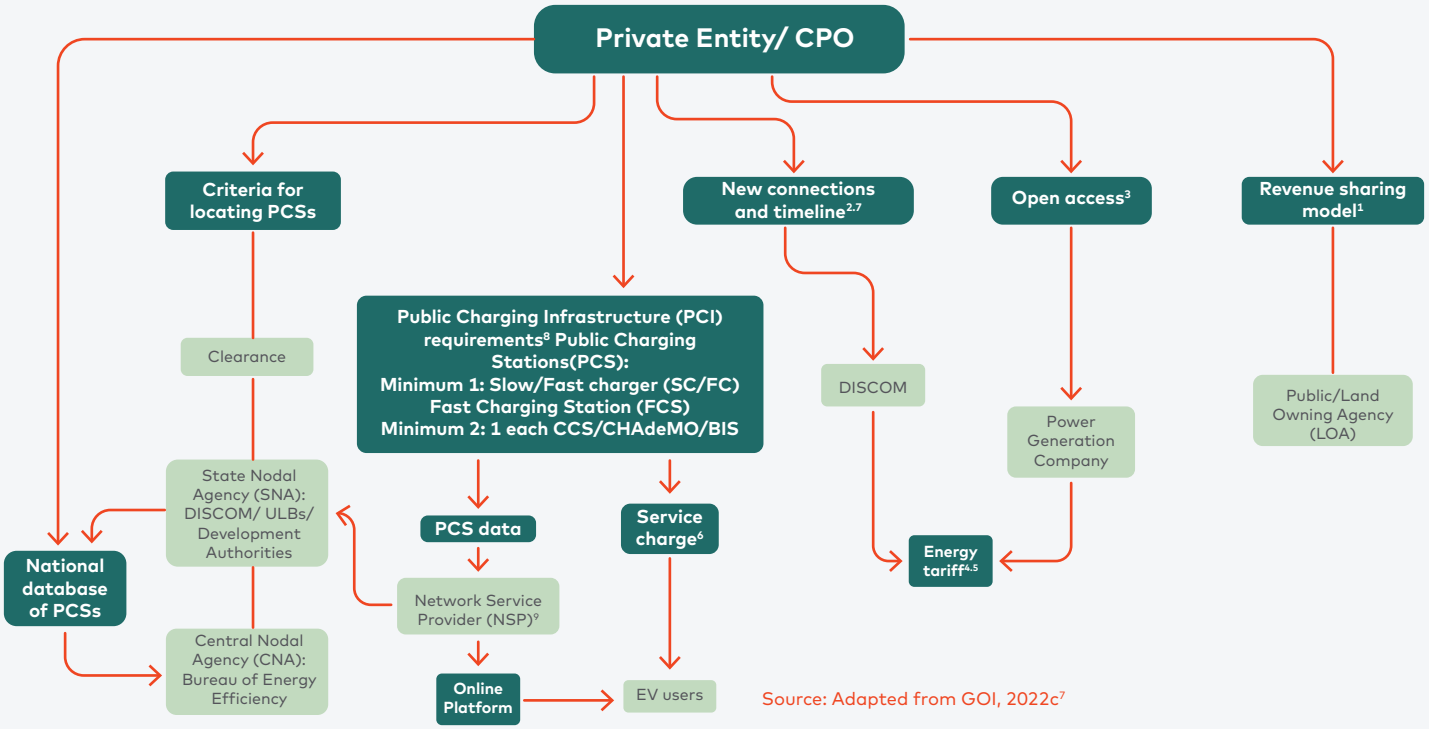
[5] total 1,576 EV charging stations at 16 Highways and 9 Expressways are sanctioned under FAME-II, 5% of these or a total of 83 EV Charging Stations have become operational as of 2022 (GoI 2022).

[6] Cost of setting up charging station varies due to inherent differences in available distribution infrastructure and accordingly the investment required in upstream electrical infrastructure.



It is also recommended that focus of public charging infrastructure is placed on the destination-based charging points (with fast chargers prioritised for highway-based locations) which are currently lacking in the system. Public agencies and large private companies above certain turnover which are operating such destinations or strategic locations can be mandated to set up EVCSs. Examples include- shopping malls (in cities and along highways), commercial complexes/office buildings, cinema halls, large public buildings, hotels, hospitals, clubs, large societies etc.

Figure 07. Nation-level policy guidelines for setting up public charging station in India



Source: Adapted from GOI, 2022c[7]

MoP's EVCI Guidelines:-

1. Suggested revenue model with INR 1 per kWh charging, payable every quarter for 10 years. For bidding by LOA/public agency, guidelines suggest a floor price of INR 1 per kWh
2. Timeline for a new connection: 7 days in metro cities, 15 days in other municipal areas, and 30 days in rural areas. Provision of separate metering arrangements for Public Charging Station (PCS).
3. Within 15 days of receipt of the duly completed application for open access with applicable surcharges
4. Single part tariff, for PCS/Battery Charging Station (BCS), not exceeding the 'average cost of supply' plus fifteen percent till 31st March, 2025.
5. ToD energy tariff & discount for charging during solar hours
6. A Committee under Central Electricity Authority to recommend to the State Government the ceiling limit of service charges to be levied at PCS and Fast charging stations (FCSs)
7. DISCOMs may leverage funding from the Revamped Distribution Sector Scheme (RDSS) for network augmentation
8. PCI requirements as per MoP's EVCI guideline include- exclusive transformer & related substation equipment with all civil-electrical works, fire & safety equipment, EVSE type-tested/lab accredited by NABL, EV charger requirements for PCS or FCS which also needs liquid cooled cables
9. Tie-up with Network Service Provider (NSP) are necessary for PCSs to provide online services to customers and share PCS data with NSA

[7] GoI 2022 Charging Infrastructure for EV - the revised consolidated Guidelines & Standards-regulations

In addition to aforementioned changes, better incentive structures are required for needed charging infrastructure, public-cum-private, to take off at required pace which can further be strengthened using State-level EV policies. At this point in time, various states are at different levels in their journey as State EV Policies are being formulated and evolved with actual learnings from the field. Awareness levels accordingly vary across states, especially DISCOMs and this is a major challenge faced by businesses at grassroot. As per industry feedback, the State Governments are requested to further ensure adequate clarity under respective State EV Policy Mechanisms and timely clearance with effective implementation of the Central Guidelines and Standardisation for Electric Vehicle Charging Infrastructure (EVCI), as outlined by the Ministry of Power in January 2022

- State specific incentives, for instance - tax breaks and land use concessions for private investment in charging infrastructure and promoting business case for EV charging.
- Revenue sharing model with the Land-Owning Agency(LOA) with a copy of state-specific model agreement form.
- Strict enforcement to meet stipulated timelines for all clearances- new connection, open access, electric equipment and safety, fire preparedness etc.
- State/SNA guidelines for EV tariffs and capping of services charges by CPO.
- Guidelines for public-private partnership between state governments and private companies to finance and operate PCSs.
- Time-of-Day tariffs, discounts for charging during solar hours. Implement dynamic electricity pricing that reflects the time of day and demand to incentivise charging during off-peak hours and reduce demand during peak periods.

Beyond above noted specific recommendations, clear policy signal and incentive structures will be required under GoI's EVCI Guidelines as well as respective EV Policies from the State

7.5 Renewable Energy Integration at EVCS

While renewable generation at EVCS (certain percentage of charging station requirement) can lower the requirement for grid electricity, it can also help CPOs reduce the Opex by taking advantage of renewable power. Specific policies and guidelines for open access and net metering or bi-directional metering at EVCSs will be crucial to enable higher penetration of green power into EVs and making a better business case of ChaaS by taking advantage below two inherent opportunities- renewable energy integration with EVCS and vehicle-to-grid integration (as discussed in subsequent recommendation). Players (CPOs) who are not eligible to participate in open access[8] or do not have resource to set up their own renewable generation capacities at EVCS, can be provided with alternatives such as peer-to-peer energy trading[9] or green energy certificates to ensure adequate green power for EVs. Proposed policy instrument can be a win-win for both CPOs as well as consumers/users including corporates with large vehicle fleets wanting to source green power for EVs to reduce their environmental health and climate footprint. (Ledger, 2021) (Tata Power-DDL, 2021)

A dedicated policy instrument for integrating green power, with clear policy directions and adequate incentives for integrating renewable power at public/private EVCSs, is therefore suggested to the Ministry of Power, Government of India. It is expected that States/State Nodal Agency will subsequently formulate state-specific guidelines and regulations using proposed central policy from MoP. Proposed policy instrument may consider following aspects

[8] Power demand lower than 1 MW

[9] P2P energy trading platforms open up possibilities for prosumers and consumers to trade green power. Open access regulations currently limit customer and prosumer involvement in trading to those with 1 MW or Two P2P energy trading pilot projects were recently undertaken in Delhi and Lucknow by ISGF

A. Provision for net-metering at EVCS.

B. Integration of existing provisions for 'open access' covered under MoP's EVCI Guidelines.

C. Additional provisions such as block-chains-based peer-to-peer energy trading or green energy certificates for those who are not eligible participate in open access renewable energy market or cannot afford to set up own generation capacities due to unavailability of land space or financial resources.

7.6 Digitally Connected and Managed Charging Stations

EVCSs including Public Charging Stations (PCSs) as well as private stations including- Captive Charging Stations (CCSs) or Battery Charging/Swapping Stations (BCSs) can contribute to grid balancing needs by leveraging EV batteries (as network of distributed energy storage systems) to provide ancillary services to the electricity grid. With demand for charging stations increasing in India, VGI opens up new possibilities for smart integration of energy and mobility systems.

It is recommended that a dedicated and futuristic policy instrument for Vehicle Grid Integration (VGI) is formulated by MoP to guide and promote investment in smart infrastructure from both DISCOMs as well as infrastructure companies so that large EV fleets of tomorrow can strengthen integration of variable renewable power rather than becoming challenge for grid stability. Policy may include guidance and support structures for setting up and operating smart grid infrastructure as required for VGI.

Based on experience of VGI measures, as summarised in Table 08, the global evidence suggests that-

i. Passive measures such as TOD tariffs can significantly help to shift the EV grid load and they are easier to implement. California experience shows that 15-20% of EV users shifted out from any given hour and 20-30% shifted into a given hour depending on the mix of incentives and price signals.

ii. Smart charging with unidirectional charging active control (V1G) is a direct control that can be exercised by electricity utility with express consent from EV user. In addition to peak-shaving, it can further support the grid by valley filling, and integrating variable renewable energy (VRE). It is estimated that V1G smart charging measures can free up to 9-20% of the total weekly peak load demand in France.

iii. Active control with bidirectional charging to the grid (V2G) can additionally discharge the EV battery providing the frequency response. This enables EV to participate in the electricity market by providing ancillary services to the grid. Evidence from Denmark shows net savings of EUR 2,304 per EV per year from V2G compared to net cost of EUR -955 per EV per year[10] (IEA 2022b) The battery degradation cost is nevertheless approx. 1% of the total costs when considering domestic electricity prices, and 3–8% when considering industrial prices (Calearo & Marinelli, 2020). As per the global regulation by the UN, the virtual miles from V2G need to be considered under mileage warranties by OEMs (UN, 2022b). So far, 25 countries have active V2G projects currently covering more than 6600 chargers (v2g hub, 2022).

It is recommended that all SNAs[11] or DISCOMs undertake (periodic) hosting capacity[12] analyses and consider publishing hosting capacity maps with feasible kW range and other relevant information (e.g., existing demographics, EV registration data, relevant land-use information) on GIS for the use by infrastructure companies and CPOs. To increase viability of CPOs' business case, it will be useful to ascertain the additional investment requirement for these proposed stations apart from core charging

[10] based on- (1) frequency regulation remuneration and (2) cost of a bidirectional charger.

[11] Central and State Nodal Agencies (CNA & SNAs) as per the institutional structure proposed in MoP's (2022) EVCI Guidelines.

[12] Hosting capacity refer to amount of new energy generation or consumption without compromising reliability or power quality.

infrastructure, that is- EVSE, chargers, safety equipment and station infrastructure. The availability of electricity connection, need for upgrades in distribution network and investment requirement for upstream electrical infrastructure (substations, transformers etc.) varies with actual location of proposed stations. Information from SNAs may further be consolidated by CNA at the national level and used accordingly by SNAs to rationalise user tariff or EV user charges which might vary with location.

Further, EVs need to be seen as flexible and distributed energy resources by DISCOMS rather than as a burden for grid stability. VGI or smart charging can support electricity grid's balancing needs, while helping to integrate the variable renewable electricity to support the renewable energy ambitions at the same time. Global experience shows us that unmanaged charging stations can be detrimental to the grid, whereas VGI or smart charging can provide the opportunity to turn this challenge into an opportunity for balancing and greening the grid (UN, 2022a). The standardised grid-EV-EVSE communication protocols are the first and foremost need for digitally connected and managed charging stations which can act and respond to price signals, grid load, frequency etc.

Incentive structures, akin to those existing in matured EV markets, can be considered for publicly accessible charging stations. Recommendations for action include-

1. Price signals are introduced to utilise flexibility of EVs especially at the FCSs (more than one FCs) that deal with large power volumes. Dynamic pricing regimes such as Time-of-the-day (ToD) tariffs will be useful at this point in time, before any real time tariff can be considered as they become feasible. Until then, ToD tariffs may include any critical-peak pricing as the second phase. Such passive measures would be extremely useful to exploit the flexibility of EVs and before capabilities for smart charging are built at public-cum-private charging stations and EVs as mentioned in subsequent points.
2. Tax deductions or benefits to publicly accessible charging stations if they can be digitally connected and managed by a standard protocol such as Open Charge Point Protocol (OCPP).
3. Globally available standards, such as OCPP and Open Charge Point Interface (OCPI), can be used as default standards for interconnected charging stations while tendering PCSs
4. Guidelines by competent authority, say CNA, for smart functionalities in phases with priority to PCSs with minimum one fast charger or so-called FCSs.
5. Guidelines from the competent authority, say MoRTH, for minimum standards for EVs and charging points. This may include use of "open vehicle-grid integration platforms' such as OpenADR by OEMs so that flexibility of electric vehicles is valued for the grid stability.

Table 08 - Global Good Practices for Vehicle-Grid Integration (VGI) with Market Evolution of EVs

		PHASE - 1	PHASE - 2	PHASE - 3	PHASE - 4
S.No	Type of measure	No noticeable grid impact	Noticeable EV load & low flexibility demand	Significant flexible EV load & high flexibility demand	Highly available flexible EV load & high flexibility demand
1.	Key VGI strategy	• Strategic charging infrastructure deployment	• Time-of-day (critical peak) tariffs & charging time delays	• Active control with unidirectional charging	• Active control with bidirectional charging
2.	Data	• EV registrations & charging points database	• Data exchange platforms for grid operators, fleet aggregators, EMSPs, OEMs, CPOs & EV users	• Forecasting of EV availability, electricity prices, VRE generation and grid constraints	• Battery state-of-health (BSoH) measure-ment

		• Data collection: travel (route patterns) & charging (dwelling times) patterns by vehicle types • Assessment of grid impacts	• Standardised communication protocols: EV-EVSE-Grid		
3.	Technology	• EV-EVSE interface standardisation & interoperability	• Separate metering (hourly/sub-hourly) for EVs or onboard charging measurement devices	• Real-time advanced metering and communications infrastructure	• Bidirectional charging protocols: ISO15118-20:2022, CHAdeMO • BSoH considerations for V2G cycling
4.	Policy, regulation & markets	• Frameworks to incentivise demand response	• Self-consumption policies • Time-of-use or critical peak tariffs	• Grid code definition for V1G • Real-time tariffs • Contracts & markets for flexibility • Market access for aggregators	• Grid code definition for V2G • Reducing/eliminating 2-way taxation for energy storage • Platforms for decentralised power trading

Source: Adapted from IEA 2022b

Note:

1. As noted against the serial number one, 1-a and 1-b are generally referred as passive VGI strategies, while 1-c and 1-d are called active VGI strategies.
2. 'Strategic charging infrastructure deployment' as noted in 1-a is enabled via coordinated planning for transport & energy (grid electricity).

7.7 Augment National Single Window System to consolidate procedures for setting up a Public Charging Station

The application process for public charging infrastructure differs significantly for public and private players. Government entities can directly submit the EOI to set up public charging station to MHI. Private entities, however, have to first approach the ULBs, then it is escalated to the nodal agency and then to MHI. The application process to set up a public charging station is cumbersome and time taking for a private entity. Based on primary inputs from stakeholders, it can take up to six months' time to get all required clearances in place. These clearances include- fire safety, electrical safety for transformer and substation equipment, and type-testing for EVSE to name a few. It is expected that a single window clearance system will simplify the process for CPOs to get required permissions and clearances

in place from various different departments including - Ministry of Heavy Industry (MHI), State Electricity Boards (SEBs), Urban Local bodies (ULBs), National Payments Corporation of India (NPCI), Bureau of Indian Standards (BIS), National Informatics Centre (NIC), State Transport Departments, and Ministry of New and Renewable Energy (MNRE).

To enhance efficiency and simplify the process, it is recommended that the National Single Window System (NSWS) Portal[13] is augmented to include the clearance system for setting up EV charging station. This integration will help to streamline and ease out all clearance-related tasks. Additionally, the status of the pending connections of the CPOs needs to be integrated in the NSWS portal.

7.8 Enhance Ease of Charging for EV Users

Aggregation, interoperability, and harmonisation across charging stations are a way forward to improve the user experience by enabling them to charge their vehicles at any station using a single mobile application. To achieve this, a common digital platform needs to be created where all the charge point operators (CPOs) share their network with the other operators.

One such good practice is the Open Charging Point Interface (OCPI) functional in EU and US which supports connectivity between e-Mobility Service Providers who have EV drivers as partners, and CPOs who manage charge stations. OCPI or similar interface is required at national level for easy access to the drivers to charge their vehicles anywhere.

The potential actionable points are mentioned below:

a. National-level digital aggregation platform for charging needs:
   i) Create a national-level digital platform of all EV charging stations, including location, types of available chargers and charging price.
   ii) Develop a mobile app (user interface from CPO) that provides real-time information on charging station availability, prices and waiting times.
   iii) Ensure accuracy and reliability of information on national database by regularly verifying and automatically updating the real time updates.

b. Open charging point interface that can cater to CPOs across states:
   i) Create standardised data formats for collecting and sharing information on charging stations.
   ii) To make aggregation and interoperability a success. Once the OCPI layer is developed, it is followed by the stages of testing and integration which ensures a seamless sharing of network between different charge point operators. To ensure proper utilisation of the integrated network, the operators/CPOs need to enter into a service level agreement with central agency developing/managing OCPI.
   iii) A dedicated (central) agency is needed for-
      a. harmonising practices across CPOs to achieve interoperability
      b. encouraging policy to bring all the CPOs together on a single platform and share their data, and
      c. forming a technical user community to address the queries of all the OCPI users, and regarding the installations and OCPI-based agreements.

7.9 Reduce Testing and Certification Cost for Smaller Industry Players

Currently EV components are tested at ARAI and ICAT labs. These testing are especially expensive for start-ups who have to undertake multiple

[13] Available at- www.nsws.gov.in

tests in the initial product development/designing phase before it can be certified for mobility application. Testing and certification cost hinders innovation in smaller industries who do not have their own resources to test products. Provided that a lot of R&D efforts are needed for domestically producing various EV components- motor, controllers, BMS etc. it is crucial to leverage the innovation in the vibrant start-up ecosystem as well. Therefore, it is recommended that a differentiated pricing or packages (certification) are introduced by ARAI/ICAT for start-ups. It would be preferable to separate common testing facilities where the start-ups can test their product before going to the certification body such as ARAI/ICAT. Latter is preferred as existing testing facilities are limited in number and are already burdened. Newly proposed testing facilities can be facilitated by government and potentially operated or maintained by a non-profit organisation.

Domestic research and development in the whole EV ecosystem need to be prioritised. A tax rebate to industry players spending on research and development activities relating to EVs and their components would encourage them to come up with innovative technologies.

7.10 Building Enabling Ecosystem for Battery Recycling and Reuse

The new Battery Waste Management (BWM) Rules 2022, released in August 2022, govern the battery waste from EVs[14] in India. BWM (2022) Rules prohibit the disposal of battery waste in landfills and incineration. Based upon the concept of Extended Producer Responsibility (EPR), BWM 2022 Rules require the producers[15] of the batteries or OEMs to make provisions for the collection, disposal, recycling and repurposing of the battery. Different targets and timelines[16] as proposed under the BWM Rules 2022 are summarised in the Table 09.

Table 09. Summary of different targets of EV batteries in the latest BWM Rules (2022)

S.No	EV segment	Base year for targets	First compliance year	Collection target in each consecutive compliance year[1]	Compliance period for 100% collection & refurbishment/recycling[1]	Recovery targets[3,4]	Remanufacturing targets[3,5]
1.	2W	22-23	26-27	70%	7 years	2024-25: 70% 2025-26: 80% 2026-2027 & onwards: 90%	5% by 2027-28, 10% by 2028-29, 15% by 2029-30, 20% by 2030-31
2.	3W	21-22	24-25	70%	7 years		
3.	4W	21-22	29-30	70%	14 years		

Source: Adapted from GoI 2022a

Note:

1. Collection target (for producers) framed as the minimum percentage of battery placed in market (dry battery weight).

[14] New rules replaced the Batteries (Management and Handling) Rules, 2001, which did not consider the mobile batteries.

[15] As per the Rules, producers may involve the third party for collection and recycling of waste

[16] First compliance cycles as stipulated for different market segments are - E2Ws: 2026-27 to 2032-33; E3Ws: 2024-25 to 2030-31 & E4Ws: 2029-30 to 2042-43

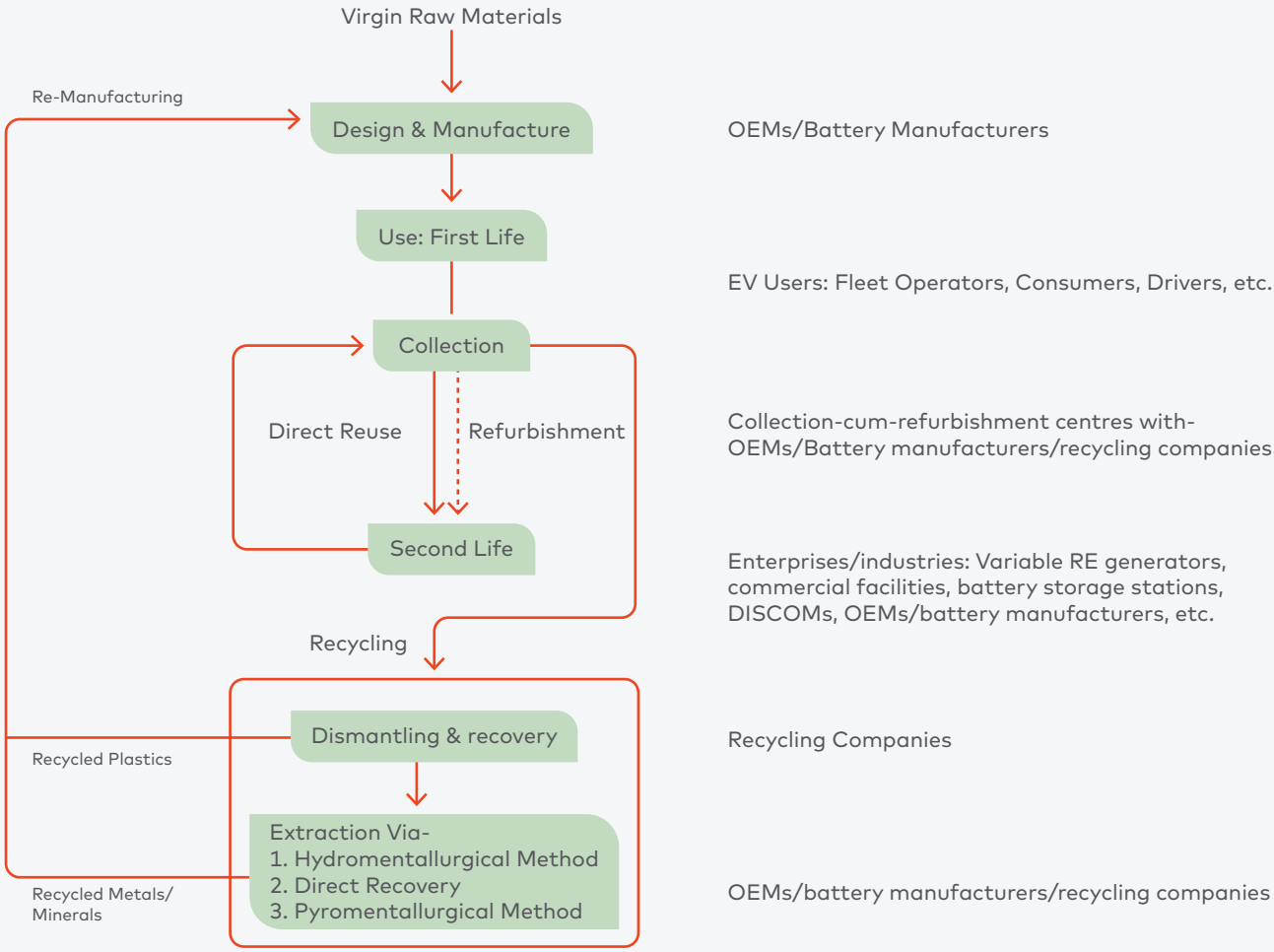
2. Rules also stipulate 60% carry forward (on average battery quantity placed in the market per year) from one compliance cycle (7 years for 2-3 EWs and 14 years E4Ws) to the next.
3. Recovery targets (for recyclers) and remanufacturing targets (for OEMs/battery manufacturers) are same across EV segments.
4. Minimum percentage for recovery of materials (by recyclers) from collected batteries.
5. Minimum use of the domestically recycled materials out of total dry weight of a battery from OEM/battery manufacturer.

To implement BMW Rules, a centralised online platform is being set up by CPCB for the exchange of EPR certificates among the producers and recyclers of e-waste. Environmental compensation would be levied by CPCB for not abiding by the rules, which will be further used for collection and repurposing or recycling of uncollected and non-recycled or non-repurposed batteries. Committee of Implementation[17] is constituted by CPCB to recommend effective measures to MoEFCC and provide guidance for the development of the online portal. All EV battery recyclers and refurbishers are required to have a certificate of registration from their respective State Pollution Control Boards (SPCBs).

Source: Reuters.com India

[17] comprises of representatives from Ministry of Electronics and Information Technology, Department of Promotion of Industry and Internal Trade, Ministry of Housing and Urban Affairs, Ministry of Micro, Small and Medium Enterprise, Ministry of New and Renewable Energy, Department of Chemicals and Petrochemicals, Organisations such as Central Pollution Control Board, State Pollution Control Boards, National Environmental Engineering Research Institute and stakeholders such as associations representing producers, recyclers and refurbishers, and any other stakeholder as invited by the chair of the Committee.

Figure 08. Process flow for Battery Waste Management



Source: CII-Invest India-Statiq (2023) Analysis

While above described BWM Rules provide a solid regulatory framework for battery waste management, there is significant scope for reduction or minimisation via design strategies (for examples- improving refurbishment & recyclability potential of existing battery technologies and improvement in battery technologies[18]) and further improvements in recycling technologies through dedicated R&D support. Design for Environment (DfE) strategies have huge potential to make refurbishment and repurposing batteries easier and cost effective for use in second-life applications if OEMs reduce the fragmentation and variability of battery designs available in the market. By designing EVs with second-life applications in mind, automakers can encourage good practices in battery standardisation and safety across the industry so that battery packs can easily be repurposed for use in other applications and without risking injury to workers or damage to the environment.

Proven and commercially available technologies for recycling EV batteries are summarised in the Table 10. As per the rapid assessment from global literature review, direct recovery is least polluting of all available methods, but it still requires further developments to achieve similar material recovery levels as the pyrometallurgical and hydrometallurgical methods which have significant associated environ-

[18] In existing and new emerging battery technologies for reducing demand for critical minerals and metals.

environmental pollution for air and water respectively. One of the key impediments in India for direct recovery of metals/minerals is lack of harmonisation of practices across OEMS and battery manufacturers as far as the DfE or material recovery are concerned.

Design strategies will be useful to enhance the recovery potentials, bringing down the cost of battery recycling/refurbishing, and to reduce the complexity of such operations. It is highly desirable that battery manufacturers and automotive OEMs work towards standardisation in the design of battery packs. Such DfE strategies or considerations need to be considered by OEMs and battery manufactures well before new manufacturing units of advanced chemistry cells (batteries) are commissioned. Common guidelines or standards, including global good practices, which can be referred across Indian industries will be of immense help.

Further similar guidelines and good practices need to be established in near future for reference of the recyclers/refurbishers of EV batteries. This is especially true due to involvement of MSMEs in these activities who would need a lot handholding and support for adoption good practices. Such guidelines or standards will be useful to organise the recycling and refurbishment EV Batteries in the country. Two key recommendations to build enabling ecosystem therefore include-

1 Design for Environment (DfE) Guidelines and Good Practices for OEMs and Battery Manufacturers

It is recommended that pilot interventions and studies are undertaken in collaboration across OEMs, battery manufacturers and other relevant technology players. Guidelines would subsequently need to be drawn for Indian context based on learnings from these pilots as well global best practices and best available technologies. DfE considerations may consider harmonising practices for specific vehicle types or EV battery 'types and size classes' as much as possible in order to -

a) Simplify refurbishing processes for easy transition to second life of battery (at the end of its first life).

b) Increase recycling volumes for spent batteries.

c) Reduce input of critical minerals and metals into advanced cell batteries for EVs.

2 Enhance EV battery traceability

Tracking batteries and its usage profile can help all the players in the value chain of EV batteries. EV batteries have highest energy densities across battery storage application and a typical EV battery would still hold 80% of its original capacity at end of its first life in an electric vehicle. Batteries can be tracked though a uniformly followed standards/guidelines. An EV battery goes through number of players in the value chain including- cell producers, module producers, battery producers, automotive OEMs, battery service, refurbishing, and repurposing companies.

Following information would therefore be helpful to access the economic and technical feasibility of batteries at any given point of their life-

a) A unique identification number along with all technical information of battery from the OEM.

b) Historic information on usage and charging cycles as accessible information which is stored on battery BMS.

Guidelines specific to these two sub-points, can be integrated in the BWM Rules 2022, as amendment to facilitate recycling and refurbishing EV batteries.

3 Guidelines, good practices and business cases for recycling and refurbishing of EV batteries

Battery OEMs and recycling companies need to come together to design these guidelines and good practices including occupational health and safety considerations which may again involve pilot studies and assessment of commercially proven technologies or best practices which fit India's context. Additionally, the business cases for recycling/refurbishment will be extremely useful if these can be made available for benefit of all stakeholders.

4 Promotion of R&D

Following specific measures are recommended to promote R&D activities in this space-

a) Tax rebates to OEMs, technology companies, battery manufacturers, chemical companies etc. against the R&D spending on-
   1. alternate and advanced battery chemistries with low requirement of critical minerals and metals,
   2. novel battery recycling technologies

b) Recycling challenge with involvement of OEMs, recycling companies and technology start-ups to promote commercially viable recycling processes with high recovery rates. Specific challenges or problem statements can be designed based on challenges faced by industries for higher recovery potential or low environment footprint of battery recycling.

There are three main technologies for battery recycling as summarised in the Table 10. Hydrometallurgy is the most accepted technology for battery recycling in India and globally as it consumes lesser energy as compared to the other form of recycling. The economic value and metal recovery efficiency depends on the recycling process adopted to recycle the battery waste. It also depends on the battery chemistry. In the Indian context, the battery chemistries that are popular are Lithium Iron Phosphate (LFP), Nickel Manganese Cobalt (NMC) and Lithium Cobalt (LCO) GoI, 2022d.

Table 10 - Comparison of proven battery recycling methods

S.No	Method	Description	Advantages	Disadvantages	Energy Consumption (kWh/kg-battery waste)	Estimated Maximum Recovery Percentage
1.	Pyromet-allurgical method	High-temperature treatment of batteries to separate and recover valuable metals	High metal recovery rates	Emissions of air pollutants and greenhouse gases, Generation of toxic slag and gases	100-150	Lithium (90%), Cobalt (95%), Nickel (80%)
2.	Hydrome-tallurgical method	Use of chemical solutions to extract valuable metals from the batteries	Lower energy consumption than pyromet-allurgy	Generation of large volumes of waste-water, Use of corrosive and hazardous chemi-cals, High capital and operating costs	10-20	Lithium (80%), Cobalt (90%), Nickel (70%)
3.	Direct Recycling	Mechanical separation of battery compo-nents followed by refining of metals	Low energy consumption and emissions	Limited recovery rates, Contamina-tion of recovered metals with impurities, Limited scalability for large-scale recycling plants	5-10	Lithium (70%), Cobalt (80%), Nickel (60%)

Source: CII-Invest India-Statiq (2023) Analysis based on (Dalini et al, 2020) and (Tawonezvi et al, 2023)

7.11 Raise General Public and Consumer Awareness

Educate consumers about the benefits of EVs and good charging practices to boost their confidence and increase adoption of EVs. Proposed awareness programmes may come up with targeted advertise-ments and social media campaigns as below. Potential collaborations between diverse players whether they are public and private sector agencies will be helpful to vastly scale this activity as needed in the coming years.

Table 11 - Target groups to be considered for awareness activity as per different vehicle usage scenarios

S.No	Target groups	VEHICLE TYPES AND USAGE SCENARIOS						
		2W- Passenger	2W Last mile deliveries	3W Passenger	3W Cargo	4W Passenger	4W Commercial heavy-duty: buses, trucks	
							Intra-city	Inter-city
1.	Citizens/workforce in metros-cities	✓				✓		
2.	Drivers: taxi and fleet aggregators	✓	✓	✓		✓		
3.	Delivery partners in e-commerce and gig economy		✓		✓		✓	✓
4.	Bus drivers						✓	✓

Source: CII-Invest India-Statiq (2023) Analysis

Citizens/workforce in metros-cities: This target group can be made aware of the benefits of using electric two-wheelers and cars through public awareness campaigns, social media posts, and advertisements. The focus can be on the cost savings, reduced emissions, and improved air quality that electric vehicles offer.

Taxi drivers: Taxi drivers including those working with fleet aggregator can be made aware of the benefits of using electric vehicles through driver training programs and incentives. For example, they can be provided with training on how to charge the vehicles and how to maximize their range. Incentives such as discounts on charging or insurance can also be provided to encourage drivers to switch to electric vehicles.

Delivery partners in e-commerce and gig economy: Delivery partners in the e-commerce and gig economy can be made aware of the benefits of using electric vehicles through incentives and partnerships. For example, e-commerce companies can offer discounts on their platforms for deliveries made using electric vehicles. Additionally, partnerships can be formed between electric vehicle manufacturers and e-commerce companies to provide affordable leasing options for electric vehicles.

Bus drivers: Bus drivers can be made aware of the benefits of using electric buses through training programs and incentives. Training can focus on the operation and maintenance of electric buses, as well as on how to handle emergency situations. Incentives such as tax breaks or subsidies can also be provided to encourage the purchase of electric buses.

Table 12 – Recommended measures for scaling fleet electrification in India

S.NO.	RECOMMENDATION	EXECUTING AGENCY	TIMELINE
	Demand Side Incentives for EV Adoption		
1	Clear policy signal for FAME scheme beyond 31st March 2024	Ministry of Heavy Industries (MHI)	Short Term
2	Demand incentives for medium-heavy freight vehicles or trucks under the scope of existing or new FAME scheme	MHI	Short Term
	Scale Domestic Manufacturing		
3	Dedicated PLI for: a. Advanced fuel technologies for long haul transportation including maritime and shipping (e.g., battery/hybrid electric vehicles, hydrogen fuel cell, hydrogen ICE etc.) b. Energy supply for long-haul freight transportation (Infrastructure for green hydrogen production, transportation, storage, and distribution) c. Small EV batteries (e-rickshaw, e-cycle, E2W and E3W)	MHI; MoP	Short Term
	Scale Public Charging Stations		
4	Integration of demand side incentives for the upstream electrical infrastructure under FAME II	MHI	Medium Term
5	Prioritise PCSs, with minimum one FC, for destination-based charging points to set up public charging infrastructure	BEE & State Nodal Agencies	Short Term
6	Clarity under State EV policy mechanisms for effective implementation of central guidelines on EVCI from MoP- a. State specific incentives (tax breaks or land use concession) for private investment in charging infrastructure b. Revenue sharing model with Land Owning Agency c. Strict enforcements to meet clearance deadlines for EVCS d. State/SNA guidelines for EV tariffs e. PPP guidelines for state government and private companies to finance and operate PCS f. Time of Day/ToD tariffs g. Discount for charging during solar hours	MoP, Ministry of Housing and Urban Affairs (MoHUA), State Governments	Short Term

Renewable Energy Integration at EVCS

7	Design dedicated Central and State policy with clear direction and incentives for integrating green power at EVCSs: a. Net metering provisions at EVCS b. Integration of existing provisions for open access covered under EVCI Guidelines c. Additional provisions such as blockchain based peer-to-peer energy trading or green energy certificates for those without land or financial resources	MoP, State Nodal Agency	Long Term

Digitally Connected and Managed Charging Stations

8	Design dedicated and futuristic policy instrument for 'digitally connected and managed charging stations' to guide and promote investment in small infrastructure from DISCOMs and infrastructure companies to strengthen integration of variable renewable power	MoP, State Nodal Agencies	Long Term
9	Conduct periodic hosting capacity analyses and publish hosting capacity maps on GIS for the use by infrastructure companies and rationalising user tariffs which may vary as per hosting capacity	State Nodal Agencies/DISCOMS	Long Term
10	Standardise grid EV-EVSE communication protocol	ARAI	Long Term
11	Propose dynamic electricity pricing regime e.g., ToD pricing and incentives during solar hours, especially for the Fast-Charging Stations/FCSs dealing with large power volumes	MoP, State Nodal Agencies/ DISCOMs	Medium Term
12	Tax deductions or benefits to publicly accessible PCSs if digitally connected and managed by standard protocol	State Nodal Agency	Medium Term
13	Prepare guidelines for smart functionalities in phases with priority to PCSs with a minimum of one fast charger	Central Nodal Agency	Medium Term
14	Prepare guidelines for minimum standards towards preparedness of EVs and charging points for use of "open vehicle-grid integration platforms' such as OpenADR by OEMs	MoRTH	MediumTerm

Augment National Single Window System (NSWS) for all PCS-related Clearances

15	Augment NSWS Portal to include all clearances needed to set up a PCS	Co-ordinated by DPIIT with concerned SNAs	Short Term

Ease of Charging for EV users

16	Develop national level digital aggregation platform for charging requirement	Central Nodal Agency	Medium Term
17	Develop Open Charging Point Interface (OCPI) for CPOs across states	State Nodal Agency	Short Term

Testing and Certification of EV Components

18	Differentiated pricing to startups for testing and certification of EV components	Automotive Research Association of India (ARAI) & International Centre for Automotive Technology (ICAT)	Short Term
19	R&D tax rebates to OEMs, technology companies, battery manufacturers, chemical companies etc. to promote technology indigenisation	MHI	Short Term

Scale Battery Reuse and Recycle

20	Prepare Guidelines for Design for Environment considerations to make recycling and refurbishing easier and cost-effective.	MoEFCC based on inputs from OEMs & recyclers	Long Term
21	Enhancing EV batteries traceability- • Unique identification number • Battery technical data • Historical usage and charging cycle information on BMS	MoEFCC by the way of amendment in the existing BMW Rules 2022	Long Term

Public and Consumer Awareness

22	Develop a dedicated awareness programmes for target audience	State Government, Private entities, OEMs	Short Term

Source - CII-Invest India-Statiq (2023) Analysis

1. Short term : Required within 0-4 years
2. Medium term : Required within 4-6 years
3. Long term : Required within 6-10 years

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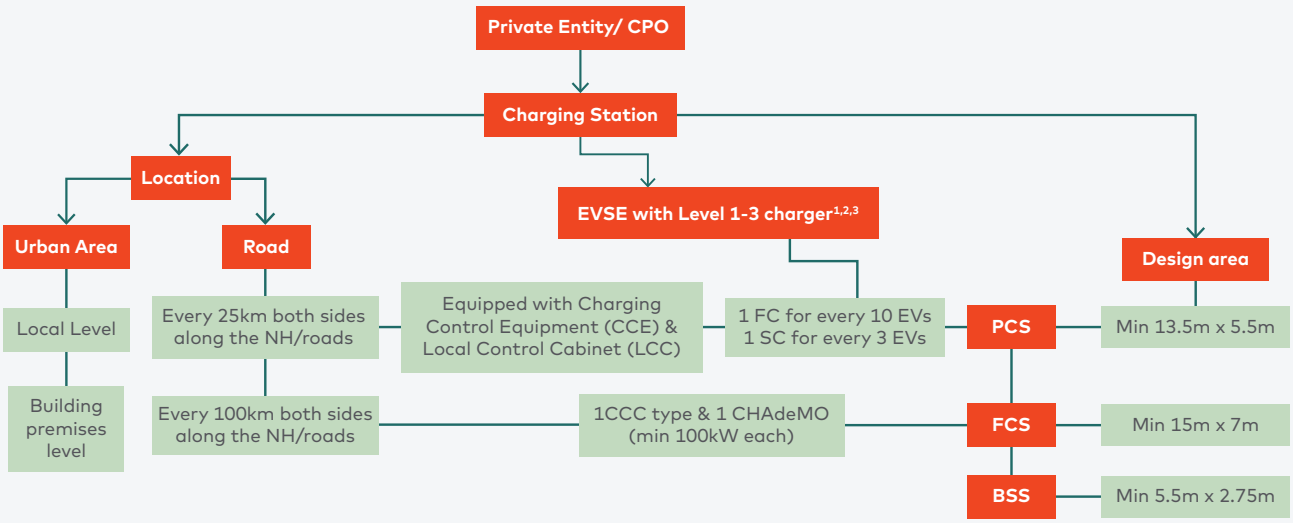
Annexure 1

Figure 09. Nation level policy guidelines on model building byelaws across various types of urban land uses



Source: Adapted from GoI 2019 - Model Building Bye-Laws (MBBL - 2016) for Electric Vehicle Charging Infrastructure

Note:

As per TCPO & URDPFI Guidelines:-

1. A small household outlet may charge as slowly as 1.2 kW, while the most advanced rapid charging stations can charge at up to 350 kW.
2. The home private chargers are generally used with 230V/15A single phase plug which can deliver a maximum of up to about 2.5KW of power.
3. DC current is sent to the electric car's battery directly via the charge port. FC chargers (usually 50 KW or more) can supply 100 or more kilometers of range per hour of charging.
4. At least 1 Public Charging Station is to be available within a grid of 3Km x 3Km.
5. Private charging infrastructure (non-commercial use) for individuals. For all commercial modes of charging EVs, at least 1 PCS, as per minimum specifications laid under MoP guidelines. Standalone Battery Swapping Stations may be added with the PCs.

*FC- Fast Charger, SC- Slow Charger, PCS – Public Charging Station

Annexure 2

Stakeholders Consulted

S.No	Category	Organisations
1.	Charging Infrastructure Providers	Bolt, Charge Zone, Statiq
2.	DISCOMs	TATA Power, Hitachi Energy
3.	OEMs	Ather Energy, Green Cell Mobility, Ashok Leyland, Volvo, Evage, Euler Motors
4.	Ride hailing and ride sharing platform	BluSmart, Ola, Uber, EEE Taxi, Everest Fleet, Lithium, MyEVPlus, Zingbus, SmartE
5.	Last mile Delivery platforms	Zomato, Swiggy, Amazon, Zepto, Dunzo, Ikea, Zypp Electric
6.	Corporates and Think Tanks	Bosch, ITC, Accenture, Pi Green Innovation, Hindustan Zinc, ICCT, Shakti Sustainable Energy Foundation
7.	Financiers	AMU Leasing

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